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Status

Stormwater data included in this report references the revised PCSM Plan dated September 15, 2011 and prepared by Pennoni Associates, Inc. The revised PCSM Plan incorporates technical review comments issued by the Luzerne Conservation District in December 2010. Revisions were made to address those comments and to balance the site cut/fill to the greatest extent possible.

Hydrology and Hydraulics Analysis

PPL Bell Bend Nuclear Power Plant
Salem Township, Luzerne County, PA

1. Introduction and Purpose

This document is intended to meet the JPA requirement for a Hydrologic and Hydraulic Analysis of the activities involving obstructions or encroachments to jurisdictional waters associated with the proposed BBNPP. This report does not include any new work, but summarizes the analyses prepared in other reports related to this site. Specifically, the Floodplain Studies for Walker Run (LandStudies, 2011) and the Susquehanna River (LandStudies, 2011), as well as the Post Construction Stormwater Management Plan (Pennoni, 2011) are referenced. In addition, information requirements noted in Chapter 105 Subchapters C though G are discussed as they pertain to specific impacts. Finally, the need for an additional Risk Assessment is determined based on the potential for increased risk to life, property, or the environment as a result of the identified impacts.

2. Site History and Conditions

Two United States Geological Survey (USGS) gaging stations are located upstream and downstream of the BBNPP intake structure; Wilkes-Barre, PA (Station No. 01536500), and Danville, PA (Station No. 01540500. The Wilkes-Barre gaging station is located approximately 22 mi upstream from the proposed BBNPP intake structure. Streamflow records have been recorded at the Wilkes-Barre location since April 1899 (USGS, 2008b). The USGS gage at Danville, PA is located approximately 28 mi downstream from the BBNPP intake structure, and has been in continuous operation since April 1905 (USGS, 2008a).

Tropical Storm Agnes is the maximum flood on record on the NBSR. An average of 6-10 inches of rain fell over the Mid-Atlantic region from June 21-25, 1972 (NOAA, 2008). Rainfall was nearly continuous over this time period. These high rainfalls produced record flooding on the Susquehanna River, equaling or exceeding flood recurrence intervals of 100 years along portions of the Susquehanna River (NOAA, 2008). Tropical Storm Agnes generated peak stream flows of 345,000 cubic feet per second (cfs) and a flood level of 40.9 ft at Wilkes-Barre on June 24th (USGS, 2008b). The Danville gaging station peaked at 363,000

cfs and a flood level of 32.16 ft on June 25th (USGS, 2008a). On June 25, 1972, a river crest of 517.36 ft mean sea level (MSL) was observed near the SSES intake structure (Ecology III, 1986). BBNPP plant grade will be at elevation 674 ft MSL, approximately 157 ft above the recorded peak flood elevation of the 1972 flood near the present location of the SSES intake structure.

The mean daily streamflow data recorded for a 108-year period (1899-2000) is 13,641 cfs at the Wilkes-Barre gaging station (USGS, 2008b). The mean daily stream flow data recorded at Danville during the 102-year period (1905-2006) is 15,483 cfs (USGS, 2008a).

There is no gaging station within the Walker Run watershed.

No significant flooding problems are currently known to exist on the site. No existing structures, fill, or other influences result in adverse hydraulic conditions.

3. Hydrology

Existing Federal Emergency Management Agency (FEMA) Flood Insurance Studies were referenced to determine the 100-year peak discharge rates for the NBSR and Walker Run. The peak discharge rate for the unnamed tributary to Walker Run was calculated using the SCS TR-55 methodology. All peak discharge rates for the NBSR and for Walker Run and its tributary are discussed in the Flood Study Reports for the NBSR and Walker Run, as prepared by LandStudies, Inc. (LandStudies, 2011). Peak flow rates, calculation methodologies, and sources are summarized in Table 1.

Peak flow rates for the railroad culvert on the unnamed tributary to the NBSR were developed using the USGS StreamStats website, as presented in Appendix L of the Post Construction Stormwater Management (PCSM) Narrative (Pennoni 2011). StreamStats is a web-based application that uses spacial and statistical data to develop hydrologic estimates for a specified location. Peak flow rates for the proposed culvert connecting the "Teardrop Wetland" to the unnamed Tributary 1 to Walker Run were developed using the SCS TR-55 methodology by Pennoni Associates.

Peak discharge rates at all stormwater outfalls were developed using the SCS TR-55 methodology by Pennoni Associates and are summarized on Pages 10 and 11 of the PCSM Narrative (Pennoni, 2011). Eighteen points of interest (POI) have been identified for the purposes of comparing pre-development to post development peak runoff rates and volumes. These POI locations are discussed on pages 7-18 of the PCSM Narrative and identified on the drainage area maps in Appendix F of the PCSM Narrative. The values listed in Table 1, below, reflect the existing and proposed conditions peak rates.

The Watershed to the North Branch Canal was modeled using Autodesk's Hydraflow Hydrographs software using the TR-20 methodology. This analysis included the development of runoff Hydrographs from two subareas, the routing of one subarea through Lake Took-A-While, and the combination of the resultant hydrographs. A more detailed description of the watershed characteristics and complete model input and results can be found in the Design Report for the Riverlands Mitigation Site in Section R of this JPA.

Table 1. Summary of Proposed Peak Discharge Rates

Watercourse	Method	Source	Existing 100-year peak Discharge (cfs)	Proposed 100-year peak Discharge (cfs)
NBSR	Adjusted Gauge Data	Luzerne County FIS	260,000	260,000
Walker Run	Regional Regression	Luzerne County FIS	1,860	1,860
Unnamed Tributary To Walker Run	TR-55	Walker Run Flood Study	300	300
Trib. To NBSR	StreamStats	PCSM Narrative	N/A	49.2
Teardrop Wetland Outfall	TR-55	Pennoni Associates	N/A	12.7
Stormwater Point of Interest (POI) 1	TR-55	PCSM Narrative	1,955.30	2,036.39
POI 2	TR-55	PCSM Narrative	473.21	645.18
POI 3A	TR-55	PCSM Narrative	202.69	417.17
POI 3B	TR-55	PCSM Narrative	8.48	0.00
POI 3C	TR-55	PCSM Narrative	9.42	4.84
POI 4	TR-55	PCSM Narrative	157.24	235.34
POI 5	TR-55	PCSM Narrative	115.21	352.43
POI 6	TR-55	PCSM Narrative	484.85	484.50
POI 7	TR-55	PCSM Narrative	15.86	13.38
POI 8	TR-55	PCSM Narrative	381.57	370.33
POI 9	TR-55	PCSM Narrative	305.85	348.71
POI 10	TR-55	PCSM Narrative	787.31	783.79
POI I-1	TR-55	PCSM Narrative	0.00	3.70
POI I-2	TR-55	PCSM Narrative	0.0.	10.50
POI I-3	TR-55	PCSM Narrative	8.70	17.50
POI I-4	TR-55	PCSM Narrative	0.70	0.70
POI I-5	TR-55	PCSM Narrative	28.40	28.10
POI I-6	TR-55	PCSM Narrative	12.40	13.20
North Branch Canal	TR-20	Riverlands Mitigation Site Design Report	473.19	473.19

4. Hydraulic Analysis

4.1 Hydraulic Studies

Detailed Flood Studies have been completed for the NBSR and Walker Run, including unnamed tributary #1 to Walker Run (LandStudies 2011). Reports and Flood Maps detailing these studies are included in Section N (Floodplain Management Analysis) of this Joint Permit Application. Both studies used HEC-RAS models and were completed on reaches for which there was an existing FEMA Flood Insurance Study (FIS), although unnamed tributary #1 to Walker Run was not originally included in the detailed FIS. The existing FIS models were supplemented with newer and more detailed topographic data for the existing conditions. Geometric data of proposed conditions included all proposed grading, structures, and land cover changes. Proposed bridges 2 through 7, as well as the proposed channel and floodplain restoration on Walker Run are evaluated in the Walker Run Flood Study. The fill associated with the proposed intake structure on the NBSR was considered in the Susquehanna River Flood Study. No increases in the 100-year water surface elevations are projected along the NBSR. Minor (<1 ft), localized (on-site) increases are anticipated in some locations on Walker Run and unnamed tributary #1 due to hydraulic changes associated with the removal of existing culverts the construction of new bridges, and hydraulic transitions into the mitigation area on Walker Run. Base flood elevations are reduced significantly along much of Walker Run as a result of the stream and wetland mitigation activities.

The proposed railroad culvert over the unnamed tributary to the NBSR and the proposed culvert outfall for the Teardrop Wetland were sized by Pennoni Associates using the Federal Highway Administration HY-8 culvert analysis software. The railroad culvert has been designed as a 48" reinforced concrete pipe culvert and the Teardrop Wetland outfall was designed as a 36" reinforced concrete pipe culvert. HY-8 output for both structures is attached for reference.

All stormwater outfall locations are shown on the PCSM Plans. Outfall pipe sizes, configurations and outfall protection are detailed on Sheet CS6103. As stated in the PSCM Narrative, "Culvert and swale flows were calculated using the rational method for the 25

year design storm in PennDOT Region 5. Swales were designed using North American Green Software 4.31. Culverts were designed using HY-8 version 7.2"

A stop log structure is proposed at the inlet to the proposed culvert on the North Branch Canal. This structure was modeled, along with the 48" pipe culvert, using the TR-20 basin routing routine in the Hydraflow Hydrographs software by Autodesk in order to account for the storage in the canal. HY-8 was also used to more accurately predict the overtopping conditions. A discussion of the structure design and complete model input and results can be found in the Design Report for the Riverlands Mitigation Site in Section R of this JPA.

4.2 Bridges and Culverts (Chapter 105, Subchapter C)

Six bridges are proposed as part of this project. One bridge (#2/#6) will serve as both a vehicular access bridge as well as a pipe bridge. Three culverts are also proposed to provide rail and pedestrian access and to accommodate proposed grading, as noted below. A summary of the proposed bridges and culverts is provided in Table 2.

Table 2. Summary of Bridges and Culverts

Structure ID	Watercourse	Use	Type of Structure
Bridge #1	Wetland 19	Vehicular Access	Concrete Span w/ Piers
Bridge #2, #6	Trib. to Walker Run	Vehicular Access, Pipe Bridge	Concrete Span w/ Piers
Bridge #3	Trib. to Walker Run	Vehicular Access	Concrete Span w/ Piers
Bridge #4	Walker Run	Vehicular Access	Concrete Span w/ Piers
Bridge #5	Trib. to Walker Run	Rail Access	Concrete Span w/ Piers
Bridge #7	Trib. to Walker Run	Pipe Bridge	Prefabricated Metal Truss w/ Piers
Culvert	Trib. to NBSR	Rail Access	125 lf of 48" Reinforced Concrete Pipe
Culvert	Teardrop Wetland/ Tributary #2	Replace Ex. Pipe	428 lf of 36" Reinforced Concrete Pipe
Culvert	North Branch Canal	Pedestrian Access	40 lf of 48" Smooth Lined Corrugated Polyethylene Pipe

Hydraulic calculations for bridges and culverts were completed as described in the hydraulics section above. All structures are designed to safely convey the 100-year peak discharge. No increase in the 100-year water surface elevation of Walker Run is anticipated

as a result of Bridge #4. Small, local increases in the 100-yr water surface elevation may occur on the unnamed tributary due to changes in flow regime, although the overall conveyance area will be maintained or increased (Bridge 3), and the bridges will not cause any significant restriction of flood flows. Any increase in flood elevation will be contained on the project site. A detailed FEMA Flood Insurance Study exists for Walker Run, but the unnamed tributary was not included in that detailed study.

The railroad culvert on the unnamed tributary to the NBSR may result in a localized backwater, but any increase in flood elevation will be limited to the project site.

Wetland 11, commonly referred to as the "Teardrop Wetland," currently drains to an existing 6" PVC pipe, likely connected to a tile drain system under the adjacent fields, and discharges to the wetlands associated with the unnamed tributary to Walker Run. Storm flows overtop the pipe and are conveyed to the wetland via a grassed waterway though the fields. A 428-foot long, 36" diameter reinforced concrete pipe is proposed to replace the underdrain and grass swale system. This significantly larger pipe will reduce the backwater condition at the pipe entrance.

The proposed culvert on the North Branch Canal will have no affect on the 100-year water surface elevation, as the entire area is inundated by the flood waters of the NBSR.

All structures have been designed in a manner that will not cause increased erosion to the streambed or banks. The bridges on Walker Run and the unnamed tributary to Walker Run span the entire 100-year floodplain. The piers represent a relatively minor encroachment in the floodplain and accelerated erosion is not anticipated as a result. Riprap outfall protection is proposed to stabilize the outfall of the proposed railroad culvert. Stability calculations are provided in Appendix L of the PCSM Narrative. The proposed culvert on the North Branch Canal will be partially submerged on both the upstream and downstream ends. Due to the depth and low velocity of flow in the canal, accelerated erosion is not anticipated.

Based on this analysis, all requirements of 25 PA Code Chapter 105, Subchapter C are met.

4.3 Stream Enclosures (Chapter 105, Subchapter D)

Two stream enclosures are proposed as part of this project. The 428-foot long, 36" diameter reinforced concrete pipe proposed to replace the underdrain and grass swale system at the outfall of the teardrop wetland is considered a stream enclosure. This significantly larger pipe is designed to convey the 100-year peak runoff and will reduce the backwater condition at the pipe entrance. The culvert is necessary because the grading required to accommodate the facility infrastructure will not allow the flow to be daylighted. Calculations for this culvert were completed by Pennoni Associates and are attached for reference. A plan view of this structure is depicted on plan sheets CS 3105 and CS 3106 and a profile of the proposed culvert is provided in Figure 6E of plan sheet CS 3203. Plan sheets are located in Section F of the JPA.

The railroad culvert on the unnamed tributary to the NBSR is also considered a stream enclosure, as this structure will be 125 feet in length. This length is necessary to accommodate the fill needed to maintain an acceptable grade for the proposed rail siding. This culvert may result in localized backwater, but any increase in flood elevation will be limited to the project site. Calculations for this culvert were prepared by Pennoni Associates and are attached for reference. A plan view of the railroad culvert is shown on plan sheet CS 3110. A cross section view is provided in Figures 7B and 7C of plan sheet CS 3204.

Based on this analysis, all requirements of 25 PA Code Chapter 105, Subchapter D are met.

4.4 Channel Changes (Chapter 105, Subchapter E)

Two channel changes are proposed as part of this project. The floodplain of Walker Run will be restored, and the channel will be relocated to provide wetland mitigation, stream stability, and improved aquatic habitat as part of the stream and wetland mitigation being proposed for this project. The Stream and Wetland Mitigation Design Report for Walker Run and the associated mitigation plans are included in Section R of this JPA and provide the location and extent of the proposed change, longitudinal profiles, cross sections, an Erosion and Sediment Pollution Control Plan including disposal provisions, and a complete geomorphic analysis and design calculations. The proposed conditions of this channel change are modeled in the Walker Run Flood Study, as described above and included in Section N of the JPA.

The existing manmade outfall channel from the weir structure located on the North Branch Canal will be abandoned to accommodate the proposed water intake structure for the Bell Bend Nuclear Power Plant. The original alignment of the canal will be restored and the weir removed, eliminating the need for the current outfall channel. This change is described in detail in the Wetland Mitigation Design Report for the Riverlands Site. The associated Mitigation Plans for this site include the location and extent of the proposed change, longitudinal profiles, cross sections, and an Erosion and Sediment Pollution Control Plan including disposal provisions. The referenced Design Report and Plans are included in Section R of this JPA. The entire area affected by this change is currently within the 100-year floodplain of the NBSR, as modeled in the Susquehanna River Flood Study included in Section N of the JPA.

Based on this analysis, all requirements of 25 PA Code Chapter 105, Subchapter E are met.

4.5 Fills (Chapter 105, Subchapter F)

Three instances of filling waters of the commonwealth are proposed as part of this project. Wetland 5 is a 0.12 acre isolated wetland located within the area of fill required to construct the power block portion of the project. Structural fill will be used to elevate this area to create a level pad for the facility. A plan view of this impact is depicted on plan sheet CS 3102 and a cross section view is shown on plan sheet CS 3203, Figure 5F. All plan sheets are found in Section F of this JPA. As this is an isolated wetland that is located outside of the 100-year floodplain and is not associated with a watercourse, there are no issues related to flooding or backwater effects resulting from this fill.

A similar fill is proposed in Wetlands 49A and 49B, which are 0.02 and 0.04 acre in size, respectively. This fill is necessary to accommodate an expansion of the existing Susquehanna Steam Electric Station 500KV switchyard needed to accommodate the project. Structural fill will be used to elevate this area to create a level pad for the switchyard expansion. A plan view of this impact is depicted on plan sheet CS 3132. Cross sectional views are provided in Figures 6H through 6K located on plan sheet CS 3204. These wetlands are located outside of the 100-year floodplain and are not associated with a

watercourse, so there are no issues related to flooding or backwater effects resulting from this fill.

The proposed cooling water intake structure is to be located on the bank of the NBSR. The access road and pad associated with this facility will require the filling of 1.45 ac of wetland including Wetlands 43 and 44 and the Canal outfall channel. This is the largest single wetland impact associated with this project. A plan view of the proposed impact is depicted on plan sheet CS 3116. Cross section views are shown in Figures 8F through 8H on plan sheet CS 3205. The Flood Study for the Susquehanna River, provided in Section N of the JPA concludes that no increases in the 100-year water surface elevation will result from this fill and no substantial increases in velocity will occur.

Based on this analysis, all requirements of 25 PA Code Chapter 105, Subchapter F are met.

4.6 Stream Crossings, Outfalls, and Headwalls (Chapter 105, Subchapter G)

The proposed cooling water intake and blow down lines will cross under the North Branch Canal immediately downstream of the existing access drive crossing and over the unnamed tributary to Walker Run (Bridge #6), as shown on plan sheets CS 3116, CS 3130, and CS 3106, respectively. A cross section of the canal crossing is shown in Figure 8J on plan sheet CS 3205. A complete permitting plan set is provided in Section F of this JPA.

All stormwater outfalls are described in the PCSM Narrative and shown on the PCSM Plans. Refer to these documents in Section M of this JPA for pipe sizes, configurations and outfall protection,

An 18" pipe is proposed to maintain the hydrology of the wetland area behind the proposed intake structure fill. The headwall of this pipe is set 0.5 ft. above grade and the outfall is located on the bank of the NBSR. The pipe is intended to drain excess runoff from the area that would otherwise be impounded by the proposed fill. A more detailed description of this pipe is provided in Wetland Mitigation Design Report for the Riverlands Site, and a plan, profile and details of the pipe are provided in the associated Mitigation Plan set in Section R of this JPA (plan view is located on sheet CS 3116 and cross sectional view in Figure 8H on plan sheet CS 3205).

Based on this analysis, all requirements of 25 PA Code Chapter 105, Subchapter F are met.

5. Evaluation of Need for Risk Assessment

Based on the data summarized above none of the proposed impacts will result in an increase of peak runoff rates or result in a significant increase of base flood elevations. No adverse hydrologic or hydraulic affects are anticipated on any upstream or downstream properties as a result of this project. Therefore, no Risk Assessment is required, per 25 PA Code Chapter 105.13.(d)(1)(vii).

6. References

Conceptual Design of Stormwater Management, Bell Bend Nuclear Power Plant. UniStar Nuclear Energy. Report No. SL-009446, Revision 5, July 28, 2010

Flood Study Report for the Susquehanna River. LandStudies, Inc. Rev 3, August 2011.

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Middle Atlantic River Forecast Center, Hurricane Agnes. NOAA, 2008. Website: http://ahps.erh.noaa.gov/marfc/Flood/agnes.html, Date accessed: February 7, 2008.

Mitigation Design Report, Riverlands Site. LandStudies Inc. Rev 0, November 2010.

Peak Streamflow for Pennsylvania USGS 01540500 Susquehanna River at Danville, PA. USGS. 2008a. Website: http://nwis.waterdata.usgs.gov/pa/nwis/peak?site_no=01540500&agency_cd=USGS&format=html, Date accessed: January 25, 2008.

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Post Construction Stormwater Management Narrative. Pennoni Associates, Inc. September 15, 2011.

Post Construction Stormwater Management Plan. Pennoni Associates, Inc. September 15, 2011

Pre-Operational Studies of the Susquehanna River in the Vicinity of the Susquehanna Steam Electric Station, 1971-1982. Ecology III, Inc. December 1986.

Stream and Wetland Mitigation Design Report, Walker Run Site. LandStudies Inc. Rev 0, November 2010.

Attachment 1:

Teardrop Wetland Outfall Culvert Calculations

Pennoni Associates, Inc.

Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

Table 1 - Summary of Culvert Flows at Crossing: Teardrop Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
680.63	6.64	6.64	0.00	1
680.81	8.99	8.99	0.00	1
680.98	11.35	11.35	0.00	1
681.07	12.71	12.71	0.00	1
681.28	16.06	16.06	0.00	1
681.41	18.41	18.41	0.00	1
681.55	20.76	20.76	0.00	1
681.72	23.12	23.12	0.00	1
681.90	25.47	25.47	0.00	1
682.08	27.83	27.83	0.00	1
682.30	30.18	30.18	0.00	1
698.00	62.13	62.13	0.00	Overtopping

Rating Curve Plot for Crossing: Teardrop Culvert

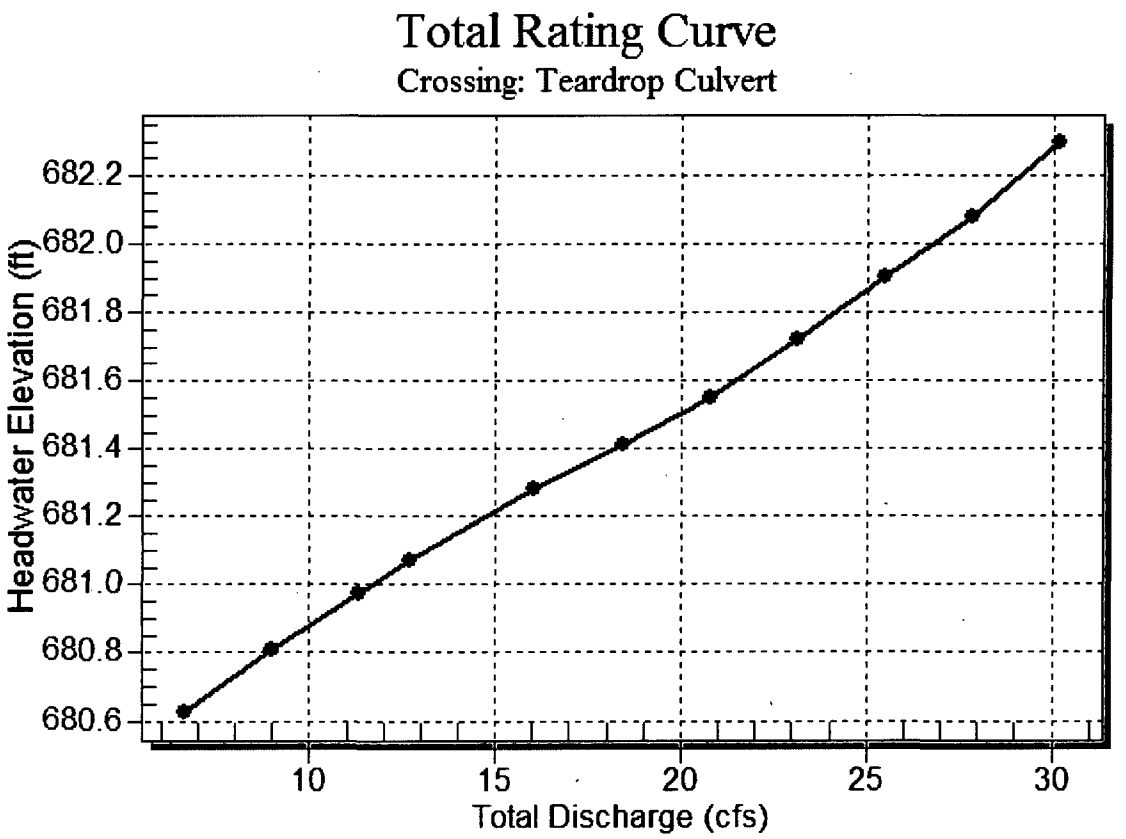

Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
6.64	6.64	680.63	0.817	0.0*	1-S2n	0.482	0.540	0.482	0.723	4.703	6.357
8.99	8.99	680.81	0.998	0.0*	1-S2n	0.585	0.660	0.585	0.810	5.228	6.858
11.35	11.35	680.98	1.165	0.0*	1-S2n	0.672	0.769	0.672	0.884	5.730	7.268
12.71	12.71	681.07	1.262	0.0*	1-S2n	0.722	0.828	0.722	0.922	5.977	7.477
16.06	16.06	681.28	1.471	0.0*	1-S2n	0.838	0.963	0.842	1.006	6.464	7.927
18.41	18.41	681.41	1.605	0.0*	1-S2n	0.915	1.050	0.915	1.059	6.847	8.203
20.76	20.76	681.55	1.739	0.0*	1-S2n	0.991	1.133	0.992	1.108	7.131	8.453
23.12	23.12	681.72	1.911	0.0*	1-S2n	1.064	1.214	1.064	1.154	7.431	8.683
25.47	25.47	681.90	2.092	0.0*	5-S2n	1.137	1.285	1.137	1.197	7.693	8.896
27.83	27.83	682.08	2.272	0.0*	5-S2n	1.211	1.357	1.212	1.237	7.916	9.095
30.18	30.18	682.30	2.486	0.0*	5-S2n	1.285	1.424	1.285	1.275	8.162	9.281

* theoretical depth is impractical. Depth reported is corrected.

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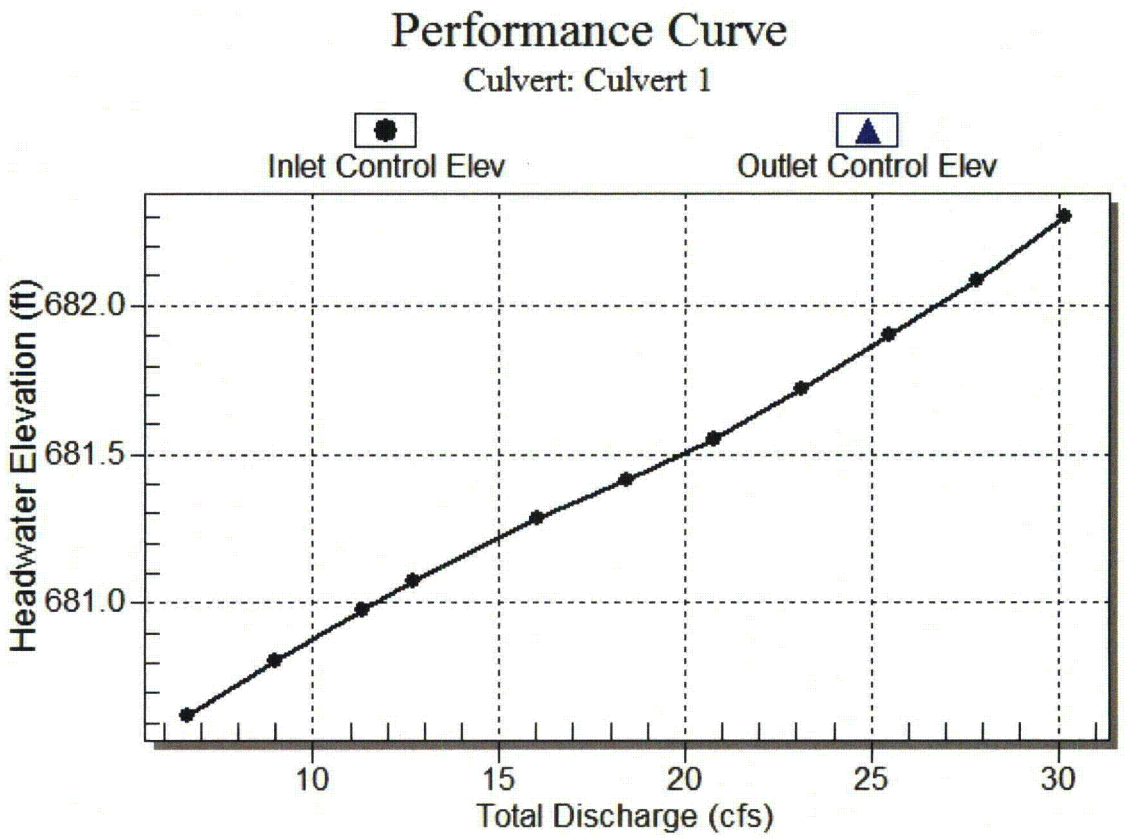
Inlet Elevation (invert): 679.81 ft, Outlet Elevation (invert): 666.00 ft

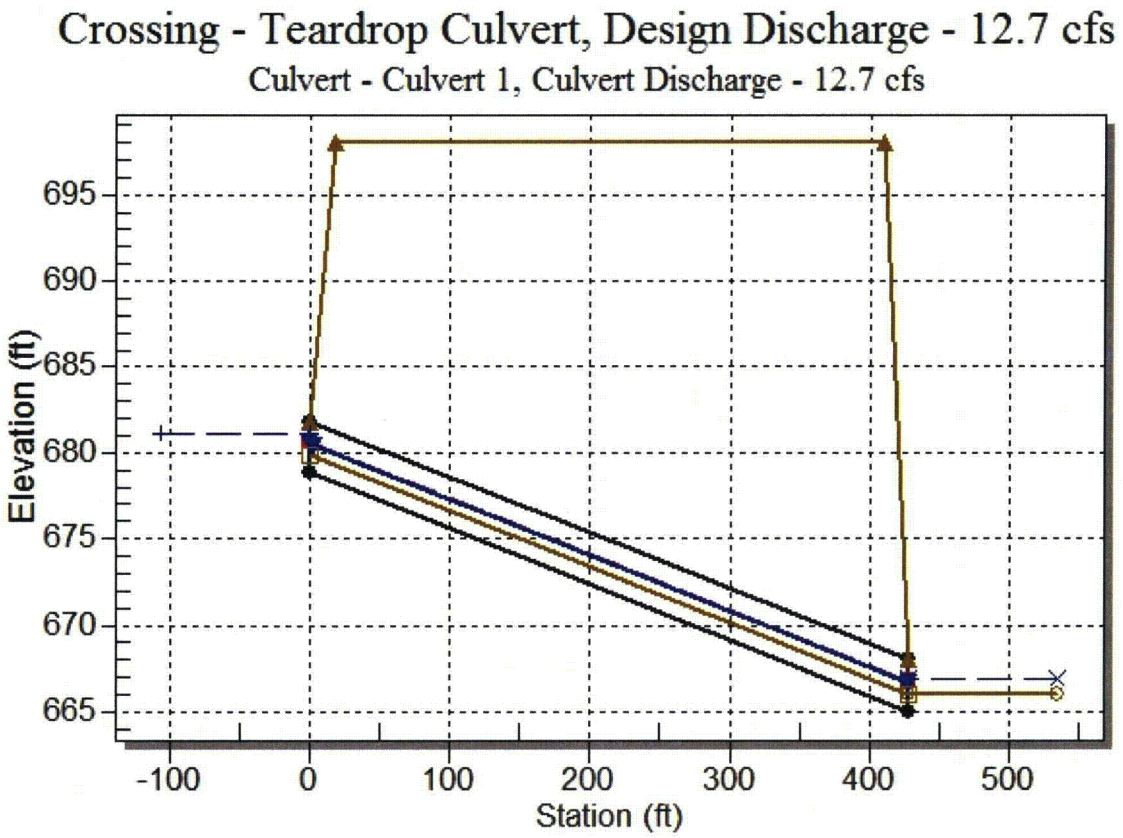
Culvert Length: 428.22 ft, Culvert Slope: 0.0323

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 678.81 ft

Outlet Station: 428.00 ft

Outlet Elevation: 665.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Concrete

Embedment: 12.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Inlet Type: Conventional

Inlet Edge Condition: Beveled Edge

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Teardrop Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
6.64	666.72	0.72	6.36	1.49	1.86
8.99	666.81	0.81	6.86	1.67	1.90
11.35	666.88	0.88	7.27	1.82	1.93
12.71	666.92	0.92	7.48	1.90	1.94
16.06	667.01	1.01	7.93	2.07	1.97
18.41	667.06	1.06	8.20	2.18	1.99
20.76	667.11	1.11	8.45	2.28	2.00
23.12	667.15	1.15	8.68	2.38	2.01
25.47	667.20	1.20	8.90	2.46	2.03
27.83	667.24	1.24	9.09	2.55	2.04
30.18	667.28	1.28	9.28	2.63	2.05

Tailwater Channel Data - Teardrop Culvert

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.00 (_:1)

Channel Slope: 0.0330

Channel Manning's n: 0.0200

Channel Invert Elevation: 666.00 ft

Roadway Data for Crossing: Teardrop Culvert

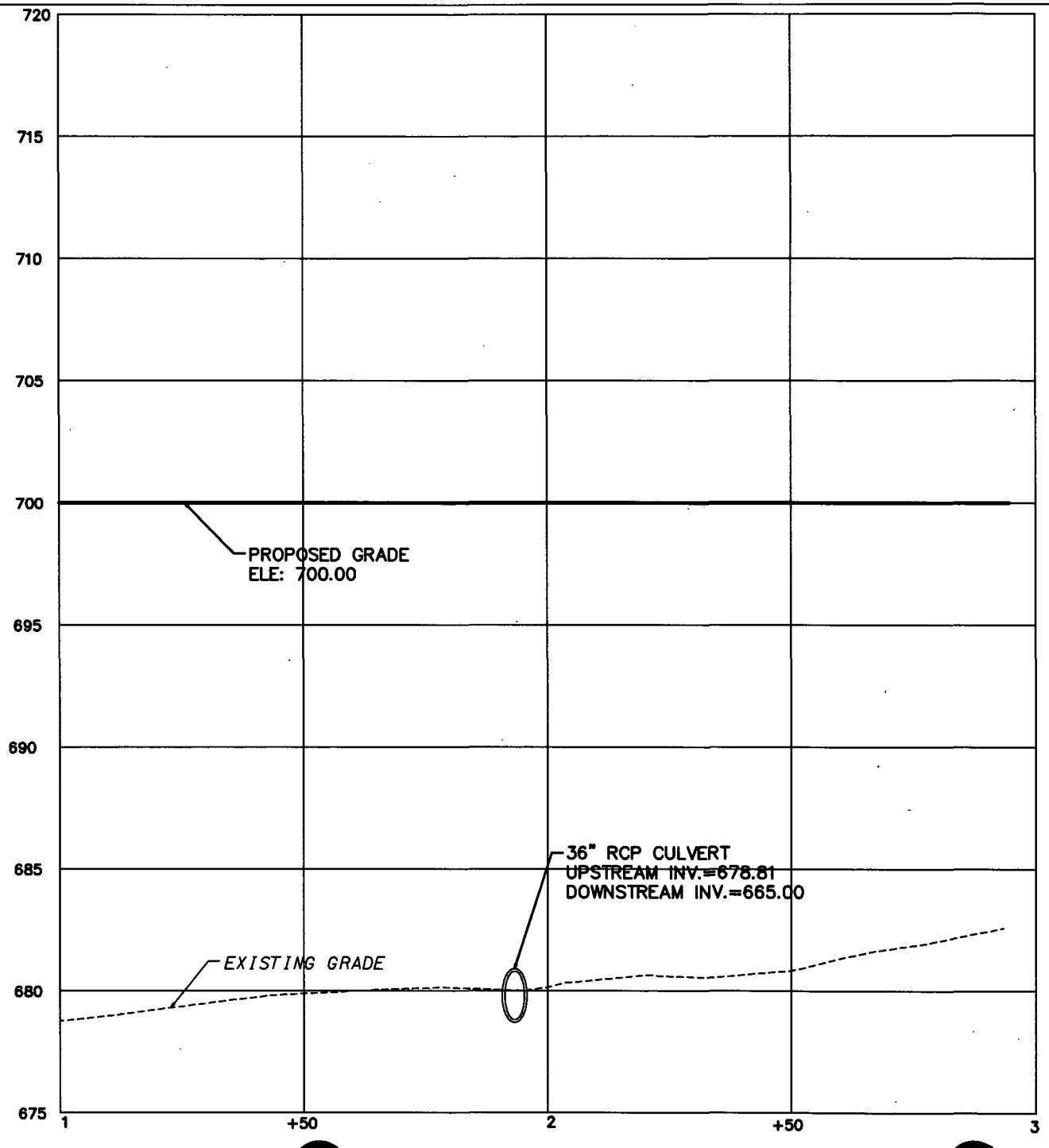
Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 1000.00 ft

Crest Elevation: 698.00 ft

Roadway Surface: Paved

Roadway Top Width: 392.00 ft



0 6

VERTICAL
SCALE: 1"=6'

0 30

HORIZONTAL
SCALE: 1"=30'

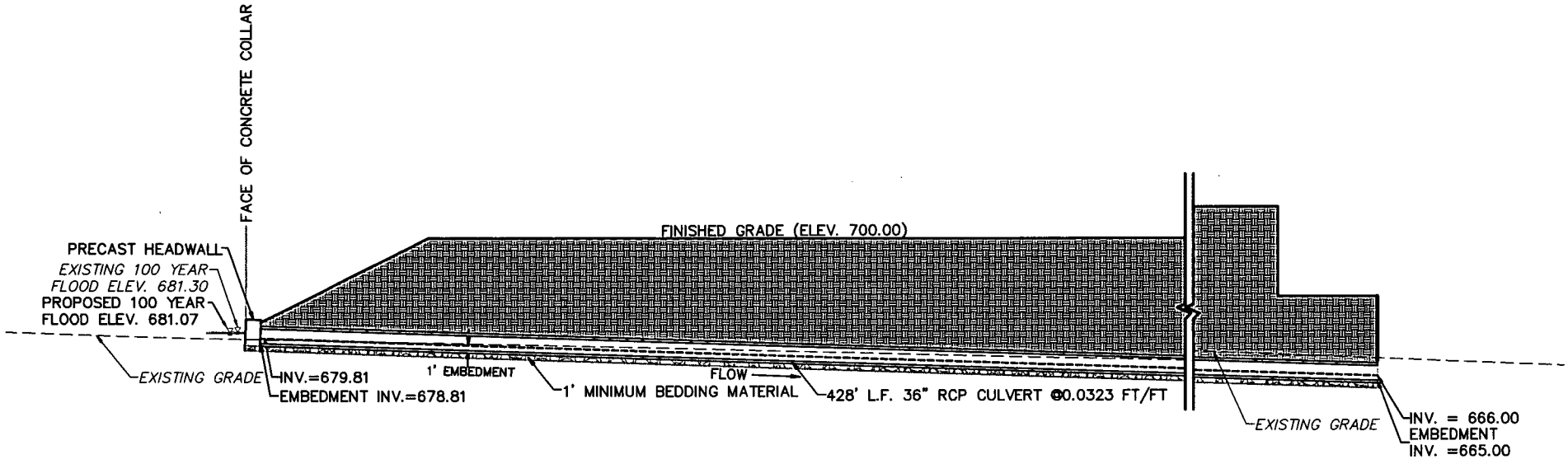
Pennoni

Pennoni Associates Inc.
100 N. Wilkes-Barre Blvd.
Wilkes-Barre, PA 18702

DRAWN BY: JMO
CHECKED BY: LGB
JOB No. PPLS0902
SCALE: AS SHOWN
DATE: 03/29/201
SKETCH No.

TEARDROP CULVERT - PROFILE

1 OF 2



PROFILE SECTION

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

Pennoni
Pennoni Associates Inc.
100 N. Wilkes-Barre Blvd.
Wilkes-Barre, PA 18702

DRAWN BY:	JMO
CHECKED BY:	LGB
JOB No.	PPLS0902
SCALE:	1":20'
DATE:	03/29/2011
SKETCH No.	2 OF 2

TEARDROP CULVERT CROSSING CROSS SECTION

Project Summary	
Title	PPL Bell Bend Nuclear Power Plant
Engineer	Lee G Borthwick
Company	Pennoni Associates, Inc
Date	11/29/2010

Notes

Table of Contents

Subsection: User Notifications

User Notifications?	No user notifications generated.

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
BY BASIN 11	BBNPP - Synthetic Curve, 100 yrs	100	0.861	12.017	12.71

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
POI-11	BBNPP - Synthetic Curve, 100 yrs	100	0.861	12.017	12.71

Subsection: Time-Depth Curve
Label: BBNPP

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

Time-Depth Curve: TypeII 24hr (7.0 in)	
Label	TypeII 24hr (7.0 in)
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.3	0.3
4.000	0.3	0.3	0.4	0.4	0.4
4.500	0.4	0.4	0.4	0.4	0.4
5.000	0.4	0.4	0.5	0.5	0.5
5.500	0.5	0.5	0.5	0.5	0.5
6.000	0.6	0.6	0.6	0.6	0.6
6.500	0.6	0.6	0.6	0.7	0.7
7.000	0.7	0.7	0.7	0.7	0.7
7.500	0.8	0.8	0.8	0.8	0.8
8.000	0.8	0.9	0.9	0.9	0.9
8.500	0.9	0.9	1.0	1.0	1.0
9.000	1.0	1.0	1.1	1.1	1.1
9.500	1.1	1.2	1.2	1.2	1.2
10.000	1.3	1.3	1.3	1.4	1.4
10.500	1.4	1.5	1.5	1.5	1.6
11.000	1.6	1.7	1.7	1.8	1.9
11.500	2.0	2.1	2.5	3.0	4.0
12.000	4.6	4.7	4.9	5.0	5.0
12.500	5.1	5.2	5.2	5.3	5.3
13.000	5.4	5.4	5.5	5.5	5.5
13.500	5.6	5.6	5.6	5.7	5.7
14.000	5.7	5.7	5.8	5.8	5.8
14.500	5.8	5.9	5.9	5.9	5.9
15.000	5.9	6.0	6.0	6.0	6.0
15.500	6.0	6.1	6.1	6.1	6.1
16.000	6.1	6.1	6.2	6.2	6.2
16.500	6.2	6.2	6.2	6.2	6.3
17.000	6.3	6.3	6.3	6.3	6.3

Subsection: Time-Depth Curve
Label: BBNPP

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.500	6.3	6.4	6.4	6.4	6.4
18.000	6.4	6.4	6.4	6.4	6.5
18.500	6.5	6.5	6.5	6.5	6.5
19.000	6.5	6.5	6.5	6.6	6.6
19.500	6.6	6.6	6.6	6.6	6.6
20.000	6.6	6.6	6.6	6.7	6.7
20.500	6.7	6.7	6.7	6.7	6.7
21.000	6.7	6.7	6.7	6.7	6.7
21.500	6.8	6.8	6.8	6.8	6.8
22.000	6.8	6.8	6.8	6.8	6.8
22.500	6.8	6.8	6.9	6.9	6.9
23.000	6.9	6.9	6.9	6.9	6.9
23.500	6.9	6.9	6.9	6.9	7.0
24.000	7.0	(N/A)	(N/A)	(N/A)	(N/A)

Subsection: Runoff CN-Area
Label: BY BASIN 11

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
IMPERVIOUS	98.000	0.680	0.0	0.0	98.000
CONST. LAYDOWN	91.000	0.710	0.0	0.0	91.000
Woods - fair - Soil A	36.000	5.510	0.0	0.0	36.000
MEADOW-A	30.000	4.550	0.0	0.0	30.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	11.450	(N/A)	(N/A)	40.708

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method (Computational Notes)
Definition of Terms

At	Total area (acres): At = Ai+Ap
Ai	Impervious area (acres)
Ap	Pervious area (acres)
CNi	Runoff curve number for impervious area
CNp	Runoff curve number for pervious area
fLoss	f loss constant infiltration (depth/time)
gKs	Saturated Hydraulic Conductivity (depth/time)
Md	Volumetric Moisture Deficit
Psi	Capillary Suction (length)
hK	Horton Infiltration Decay Rate (time^-1)
fo	Initial Infiltration Rate (depth/time)
fc	Ultimate(capacity)Infiltration Rate (depth/time)
Ia	Initial Abstraction (length)
dt	Computational increment (duration of unit excess rainfall) Default dt is smallest value of 0.1333Tc, rtm, and th (Smallest dt is then adjusted to match up with Tp)
UDdt	User specified override computational main time increment (only used if UDdt is => .1333Tc)
D(t)	Point on distribution curve (fraction of P) for time step t
K	2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks	Hydrograph shape factor = Unit Conversions * K: = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K Default Ks = 645.333 * 0.75 = 484
Lag	Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P	Total precipitation depth, inches
Pa(t)	Accumulated rainfall at time step t
Pi(t)	Incremental rainfall at time step t
qp	Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi. = (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t)	Unit hydrograph ordinate (cfs) at time step t
Q(t)	Final hydrograph ordinate (cfs) at time step t
Rai(t)	Accumulated runoff (inches) at time step t for impervious area
Rap(t)	Accumulated runoff (inches) at time step t for pervious area
Rii(t)	Incremental runoff (inches) at time step t for impervious area
Rip(t)	Incremental runoff (inches) at time step t for pervious area
R(t)	Incremental weighted total runoff (inches)
Rtm	Time increment for rainfall table
Si	S for impervious area: Si = (1000/CNi) - 10
Sp	S for pervious area: Sp = (1000/CNp) - 10
t	Time step (row) number
Tc	Time of concentration
Tb	Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp	Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr	Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method
Computational Notes
Precipitation

Column (1)	Time for time step t
Column (2)	D(t) = Point on distribution curve for time step t
Column (3)	Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4)	Pa(t) = D(t) x P: Col.(2) x P

Pervious Area Runoff (using SCS Runoff CN Method)

	Rap(t) = Accumulated pervious runoff for time step t
	If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
Column (5)	If (Pa(t) is > 0.2Sp) then use:
	Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)
	Rip(t) = Incremental pervious runoff for time step t
Column (6)	Rip(t) = Rap(t) - Rap(t-1)
	Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

Impervious Area Runoff

Column (7 & 8)...	Did not specify to use impervious areas.

Incremental Weighted Runoff

Column (9)	R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t)
	R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS Unit Hydrograph Method

Column (10)	Q(t) is computed with the SCS unit hydrograph method using R(t) and Qu(t).

Storm Event	TypeII 24hr (7.0 in)
Return Event	100 years
Duration	35.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	11.450 acres

Computational Time Increment	0.011 hours
Time to Peak (Computed)	12.017 hours
Flow (Peak, Computed)	12.72 ft^3/s
Output Increment	0.017 hours
Time to Flow (Peak Interpolated Output)	12.017 hours
Flow (Peak Interpolated Output)	12.71 ft^3/s

Drainage Area	
SCS CN (Composite)	41.000
Area (User Defined)	11.450 acres
Maximum Retention (Pervious)	14.4 in
Maximum Retention (Pervious, 20 percent)	2.9 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	0.9 in
Runoff Volume (Pervious)	0.861 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	0.861 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.083 hours
Computational Time Increment	0.011 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	155.74 ft^3/s

SCS Unit Hydrograph Parameters	
Unit peak time, Tp	0.056 hours
Unit receding limb, Tr	0.222 hours
Total unit time, Tb	0.278 hours

Storm Event	TypeII 24hr (7.0 in)
Return Event	100 years
Duration	35.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.083 hours
Area (User Defined)	11.450 acres

HYDROGRAPH ORDINATES (ft^3/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)
11.767	0.00	0.00	0.03	0.19	0.72
11.850	1.70	3.16	4.91	6.81	8.61
11.933	9.92	10.72	11.25	11.79	12.42
12.017	12.71	11.78	9.83	7.65	5.91
12.100	4.87	4.22	3.80	3.50	3.29
12.183	3.16	3.09	3.04	2.98	2.89
12.267	2.81	2.76	2.74	2.71	2.66
12.350	2.57	2.49	2.43	2.40	2.37
12.433	2.31	2.22	2.13	2.06	2.02
12.517	1.99	1.95	1.89	1.83	1.78
12.600	1.76	1.74	1.72	1.70	1.68
12.683	1.67	1.66	1.65	1.64	1.62
12.767	1.60	1.59	1.58	1.57	1.56
12.850	1.54	1.52	1.50	1.49	1.49
12.933	1.47	1.45	1.43	1.41	1.40
13.017	1.40	1.38	1.37	1.35	1.34
13.100	1.33	1.33	1.32	1.30	1.29
13.183	1.28	1.28	1.28	1.27	1.26
13.267	1.25	1.24	1.23	1.23	1.22
13.350	1.21	1.20	1.19	1.18	1.18
13.433	1.17	1.16	1.14	1.13	1.13
13.517	1.13	1.12	1.11	1.09	1.09
13.600	1.08	1.08	1.07	1.06	1.05
13.683	1.05	1.04	1.04	1.03	1.02
13.767	1.02	1.01	1.01	1.00	1.00
13.850	0.99	0.98	0.97	0.97	0.96
13.933	0.95	0.94	0.94	0.93	0.92
14.017	0.92	0.92	0.91	0.90	0.90
14.100	0.90	0.89	0.89	0.89	0.88
14.183	0.88	0.88	0.88	0.88	0.88
14.267	0.87	0.87	0.87	0.87	0.87
14.350	0.87	0.86	0.86	0.86	0.86
14.433	0.86	0.85	0.85	0.85	0.85
14.517	0.85	0.84	0.84	0.84	0.83

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
14.600	0.83	0.83	0.83	0.83	0.82
14.683	0.82	0.82	0.82	0.82	0.82
14.767	0.81	0.81	0.81	0.81	0.80
14.850	0.80	0.80	0.80	0.80	0.79
14.933	0.79	0.79	0.78	0.78	0.78
15.017	0.78	0.78	0.77	0.77	0.77
15.100	0.77	0.77	0.76	0.76	0.76
15.183	0.75	0.75	0.75	0.75	0.75
15.267	0.74	0.74	0.74	0.74	0.73
15.350	0.73	0.73	0.72	0.72	0.72
15.433	0.72	0.72	0.71	0.71	0.71
15.517	0.71	0.70	0.70	0.70	0.69
15.600	0.69	0.69	0.69	0.68	0.68
15.683	0.68	0.68	0.68	0.67	0.67
15.767	0.66	0.66	0.66	0.66	0.66
15.850	0.65	0.65	0.65	0.65	0.64
15.933	0.64	0.64	0.63	0.63	0.63
16.017	0.63	0.62	0.62	0.62	0.62
16.100	0.62	0.62	0.62	0.61	0.61
16.183	0.61	0.61	0.61	0.61	0.61
16.267	0.61	0.61	0.61	0.61	0.61
16.350	0.60	0.60	0.60	0.60	0.60
16.433	0.60	0.60	0.60	0.60	0.60
16.517	0.60	0.60	0.60	0.59	0.59
16.600	0.59	0.59	0.59	0.59	0.59
16.683	0.59	0.59	0.59	0.59	0.59
16.767	0.58	0.58	0.58	0.58	0.58
16.850	0.58	0.58	0.58	0.58	0.58
16.933	0.58	0.58	0.57	0.57	0.57
17.017	0.57	0.57	0.57	0.57	0.57
17.100	0.57	0.57	0.57	0.56	0.56
17.183	0.56	0.56	0.56	0.56	0.56
17.267	0.56	0.56	0.56	0.56	0.56
17.350	0.55	0.55	0.55	0.55	0.55
17.433	0.55	0.55	0.55	0.55	0.55
17.517	0.55	0.54	0.54	0.54	0.54
17.600	0.54	0.54	0.54	0.54	0.54
17.683	0.54	0.54	0.54	0.53	0.53
17.767	0.53	0.53	0.53	0.53	0.53
17.850	0.53	0.53	0.52	0.52	0.52
17.933	0.52	0.52	0.52	0.52	0.52
18.017	0.52	0.52	0.51	0.51	0.51
18.100	0.51	0.51	0.51	0.51	0.51
18.183	0.51	0.51	0.50	0.50	0.50

HYDROGRAPH ORDINATES (ft^3/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)
18.267	0.50	0.50	0.50	0.50	0.50
18.350	0.50	0.50	0.49	0.49	0.49
18.433	0.49	0.49	0.49	0.49	0.49
18.517	0.49	0.49	0.49	0.48	0.48
18.600	0.48	0.48	0.48	0.48	0.48
18.683	0.48	0.48	0.48	0.47	0.47
18.767	0.47	0.47	0.47	0.47	0.47
18.850	0.47	0.47	0.46	0.46	0.46
18.933	0.46	0.46	0.46	0.46	0.46
19.017	0.46	0.46	0.45	0.45	0.45
19.100	0.45	0.45	0.45	0.45	0.45
19.183	0.44	0.44	0.44	0.44	0.44
19.267	0.44	0.44	0.44	0.44	0.44
19.350	0.43	0.43	0.43	0.43	0.43
19.433	0.43	0.43	0.43	0.43	0.43
19.517	0.42	0.42	0.42	0.42	0.42
19.600	0.42	0.42	0.42	0.41	0.41
19.683	0.41	0.41	0.41	0.41	0.41
19.767	0.41	0.41	0.40	0.40	0.40
19.850	0.40	0.40	0.40	0.40	0.40
19.933	0.40	0.40	0.39	0.39	0.39
20.017	0.39	0.39	0.39	0.39	0.39
20.100	0.39	0.39	0.39	0.39	0.39
20.183	0.39	0.39	0.39	0.39	0.39
20.267	0.39	0.39	0.39	0.39	0.39
20.350	0.38	0.38	0.38	0.38	0.38
20.433	0.38	0.38	0.38	0.38	0.38
20.517	0.38	0.38	0.38	0.38	0.38
20.600	0.38	0.38	0.38	0.38	0.38
20.683	0.38	0.38	0.38	0.38	0.38
20.767	0.38	0.38	0.38	0.38	0.38
20.850	0.38	0.38	0.38	0.38	0.38
20.933	0.38	0.38	0.38	0.38	0.38
21.017	0.38	0.38	0.38	0.38	0.38
21.100	0.38	0.38	0.38	0.38	0.38
21.183	0.38	0.38	0.38	0.38	0.38
21.267	0.38	0.38	0.38	0.38	0.38
21.350	0.38	0.38	0.37	0.37	0.37
21.433	0.37	0.37	0.37	0.37	0.37
21.517	0.37	0.37	0.37	0.37	0.37
21.600	0.37	0.37	0.37	0.37	0.37
21.683	0.37	0.37	0.37	0.37	0.37
21.767	0.37	0.37	0.37	0.37	0.37
21.850	0.37	0.37	0.37	0.37	0.37

HYDROGRAPH ORDINATES (ft^3/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)	Flow (ft^3/s)
21.933	0.37	0.37	0.37	0.37	0.37
22.017	0.37	0.37	0.37	0.37	0.37
22.100	0.37	0.37	0.37	0.37	0.37
22.183	0.37	0.37	0.37	0.37	0.37
22.267	0.37	0.37	0.37	0.37	0.37
22.350	0.37	0.37	0.36	0.36	0.36
22.433	0.36	0.36	0.36	0.36	0.36
22.517	0.36	0.36	0.36	0.36	0.36
22.600	0.36	0.36	0.36	0.36	0.36
22.683	0.36	0.36	0.36	0.36	0.36
22.767	0.36	0.36	0.36	0.36	0.36
22.850	0.36	0.36	0.36	0.36	0.36
22.933	0.36	0.36	0.36	0.36	0.36
23.017	0.36	0.36	0.36	0.36	0.36
23.100	0.36	0.36	0.36	0.36	0.36
23.183	0.36	0.36	0.36	0.36	0.36
23.267	0.36	0.36	0.36	0.36	0.36
23.350	0.36	0.36	0.35	0.35	0.35
23.433	0.35	0.35	0.35	0.35	0.35
23.517	0.35	0.35	0.35	0.35	0.35
23.600	0.35	0.35	0.35	0.35	0.35
23.683	0.35	0.35	0.35	0.35	0.35
23.767	0.35	0.35	0.35	0.35	0.35
23.850	0.35	0.35	0.35	0.35	0.35
23.933	0.35	0.35	0.35	0.35	0.35
24.017	0.33	0.29	0.22	0.14	0.09
24.100	0.05	0.03	0.02	0.01	0.01
24.183	0.00	0.00	0.00	0.00	(N/A)

Summary for Hydrograph Addition at 'POI-11'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	BY BASIN 11

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	BY BASIN 11	0.861	12.017	12.71
Flow (In)	POI-11	0.861	12.017	12.71

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Project Summary	
Title	PPL Bell Bend Nuclear Power Plant
Engineer	Lee G Borthwick
Company	Pennoni Assiciates, Inc.
Date	11/29/2010

Notes

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Subsection: User Notifications

User Notifications?	No user notifications generated.

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
AREA 11	BBNPP - Synthetic Curve, 100 yrs	100	5.461	12.083	71.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
POI-11	BBNPP - Synthetic Curve, 100 yrs	100	5.461	12.083	71.66

Subsection: Time-Depth Curve
Label: BBNPP

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

Time-Depth Curve: TypeII 24hr (7.0 in)	
Label	TypeII 24hr (7.0 in)
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.1	0.1
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.2	0.2
3.000	0.2	0.2	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.3	0.3
4.000	0.3	0.3	0.4	0.4	0.4
4.500	0.4	0.4	0.4	0.4	0.4
5.000	0.4	0.4	0.5	0.5	0.5
5.500	0.5	0.5	0.5	0.5	0.5
6.000	0.6	0.6	0.6	0.6	0.6
6.500	0.6	0.6	0.6	0.7	0.7
7.000	0.7	0.7	0.7	0.7	0.7
7.500	0.8	0.8	0.8	0.8	0.8
8.000	0.8	0.9	0.9	0.9	0.9
8.500	0.9	0.9	1.0	1.0	1.0
9.000	1.0	1.0	1.1	1.1	1.1
9.500	1.1	1.2	1.2	1.2	1.2
10.000	1.3	1.3	1.3	1.4	1.4
10.500	1.4	1.5	1.5	1.5	1.6
11.000	1.6	1.7	1.7	1.8	1.9
11.500	2.0	2.1	2.5	3.0	4.0
12.000	4.6	4.7	4.9	5.0	5.0
12.500	5.1	5.2	5.2	5.3	5.3
13.000	5.4	5.4	5.5	5.5	5.5
13.500	5.6	5.6	5.6	5.7	5.7
14.000	5.7	5.7	5.8	5.8	5.8
14.500	5.8	5.9	5.9	5.9	5.9
15.000	5.9	6.0	6.0	6.0	6.0
15.500	6.0	6.1	6.1	6.1	6.1
16.000	6.1	6.1	6.2	6.2	6.2
16.500	6.2	6.2	6.2	6.2	6.3
17.000	6.3	6.3	6.3	6.3	6.3

Subsection: Time-Depth Curve
Label: BBNPP

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.500	6.3	6.4	6.4	6.4	6.4
18.000	6.4	6.4	6.4	6.4	6.5
18.500	6.5	6.5	6.5	6.5	6.5
19.000	6.5	6.5	6.5	6.6	6.6
19.500	6.6	6.6	6.6	6.6	6.6
20.000	6.6	6.6	6.6	6.7	6.7
20.500	6.7	6.7	6.7	6.7	6.7
21.000	6.7	6.7	6.7	6.7	6.7
21.500	6.8	6.8	6.8	6.8	6.8
22.000	6.8	6.8	6.8	6.8	6.8
22.500	6.8	6.8	6.9	6.9	6.9
23.000	6.9	6.9	6.9	6.9	6.9
23.500	6.9	6.9	6.9	6.9	7.0
24.000	7.0	(N/A)	(N/A)	(N/A)	(N/A)

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.400
Slope	0.100 ft/ft
2 Year 24 Hour Depth	2.9 in
Average Velocity	0.14 ft/s
Segment Time of Concentration	0.198 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	66.31 ft
Is Paved?	False
Slope	0.140 ft/ft
Average Velocity	6.04 ft/s
Segment Time of Concentration	0.003 hours

Segment #3: TR-55 Shallow Concentrated Flow	
Hydraulic Length	902.62 ft
Is Paved?	False
Slope	0.040 ft/ft
Average Velocity	3.23 ft/s
Segment Time of Concentration	0.078 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.279 hours

==== SCS Channel Flow

Tc =

R = Qa / Wp
V = (1.49 * (R**(2/3)) * (Sf**-0.5)) / n

(Lf / V) / 3600

Where:

R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Tc =

Unpaved surface:
V = 16.1345 * (Sf**0.5)

Paved Surface:
V = 20.3282 * (Sf**0.5)

(Lf / V) / 3600

Where:

V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Subsection: Runoff CN-Area
Label: AREA 11

Return Event: 100 years
Storm Event: TypeII 24hr (7.0 in)

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
IMPERVIOUS	98.000	0.360	0.0	0.0	98.000
Woods - fair - Soil A	36.000	11.140	0.0	0.0	36.000
Meadow - cont. grass (non grazed) - ---- - Soil A	30.000	4.440	0.0	0.0	30.000
Woods - fair - Soil C	73.000	5.180	0.0	0.0	73.000
Meadow - cont. grass (non grazed) - ---- - Soil C	71.000	3.130	0.0	0.0	71.000
WOODS-C\D	76.000	1.180	0.0	0.0	76.000
MEADOW-C\D	74.000	1.480	0.0	0.0	74.000
Cultivated Field A	78.000	2.120	0.0	0.0	78.000
Cultivated Field C	88.000	1.500	0.0	0.0	88.000
Cultivated Field C/D	89.000	0.700	0.0	0.0	89.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	31.230	(N/A)	(N/A)	55.355

Unit Hydrograph Method (Computational Notes)
Definition of Terms

At	Total area (acres): At = Ai+Ap
Ai	Impervious area (acres)
Ap	Pervious area (acres)
CNi	Runoff curve number for impervious area
CNp	Runoff curve number for pervious area
fLoss	f loss constant infiltration (depth/time)
gKs	Saturated Hydraulic Conductivity (depth/time)
Md	Volumetric Moisture Deficit
Psi	Capillary Suction (length)
hK	Horton Infiltration Decay Rate (time^-1)
fo	Initial Infiltration Rate (depth/time)
fc	Ultimate(capacity)Infiltration Rate (depth/time)
Ia	Initial Abstraction (length)
dt	Computational increment (duration of unit excess rainfall) Default dt is smallest value of 0.1333Tc, rtm, and th (Smallest dt is then adjusted to match up with Tp)
UDdt	User specified override computational main time increment (only used if UDdt is => .1333Tc)
D(t)	Point on distribution curve (fraction of P) for time step t
K	2 / (1 + (Tr/Tp)): default K = 0.75: (for Tr/Tp = 1.67)
Ks	Hydrograph shape factor = Unit Conversions * K: = ((1hr/3600sec) * (1ft/12in) * ((5280ft)**2/sq.mi)) * K Default Ks = 645.333 * 0.75 = 484
Lag	Lag time from center of excess runoff (dt) to Tp: Lag = 0.6Tc
P	Total precipitation depth, inches
Pa(t)	Accumulated rainfall at time step t
Pi(t)	Incremental rainfall at time step t
qp	Peak discharge (cfs) for 1in. runoff, for 1hr, for 1 sq.mi. = (Ks * A * Q) / Tp (where Q = 1in. runoff, A=sq.mi.)
Qu(t)	Unit hydrograph ordinate (cfs) at time step t
Q(t)	Final hydrograph ordinate (cfs) at time step t
Rai(t)	Accumulated runoff (inches) at time step t for impervious area
Rap(t)	Accumulated runoff (inches) at time step t for pervious area
Rii(t)	Incremental runoff (inches) at time step t for impervious area
Rip(t)	Incremental runoff (inches) at time step t for pervious area
R(t)	Incremental weighted total runoff (inches)
Rtm	Time increment for rainfall table
Si	S for impervious area: Si = (1000/CNi) - 10
Sp	S for pervious area: Sp = (1000/CNp) - 10
t	Time step (row) number
Tc	Time of concentration
Tb	Time (hrs) of entire unit hydrograph: Tb = Tp + Tr
Tp	Time (hrs) to peak of a unit hydrograph: Tp = (dt/2) + Lag
Tr	Time (hrs) of receding limb of unit hydrograph: Tr = ratio of Tp

Subsection: Unit Hydrograph Equations

Unit Hydrograph Method
Computational Notes
Precipitation

Column (1)	Time for time step t
Column (2)	D(t) = Point on distribution curve for time step t
Column (3)	Pi(t) = Pa(t) - Pa(t-1): Col.(4) - Preceding Col.(4)
Column (4)	Pa(t) = D(t) x P: Col.(2) x P

Pervious Area Runoff (using SCS Runoff CN Method)

Column (5)	Rap(t) = Accumulated pervious runoff for time step t
	If (Pa(t) is <= 0.2Sp) then use: Rap(t) = 0.0
	If (Pa(t) is > 0.2Sp) then use:
	
	Rap(t) = (Col.(4)-0.2Sp)**2 / (Col.(4)+0.8Sp)

Column (6)	Rip(t) = Incremental pervious runoff for time step t Rip(t) = Rap(t) - Rap(t-1) Rip(t) = Col.(5) for current row - Col.(5) for preceding row.

Impervious Area Runoff

Column (7 & 8)...	Did not specify to use impervious areas.

Incremental Weighted Runoff

Column (9)	R(t) = (Ap/At) x Rip(t) + (Ai/At) x Rii(t) R(t) = (Ap/At) x Col.(6) + (Ai/At) x Col.(8)

SCS Unit Hydrograph Method

Column (10)	Q(t) is computed with the SCS unit hydrograph method using R(t) and Qu(t).

Storm Event	TypeII 24hr (7.0 in)
Return Event	100 years
Duration	35.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.279 hours
Area (User Defined)	31.230 acres

Computational Time Increment	0.037 hours
Time to Peak (Computed)	12.087 hours
Flow (Peak, Computed)	71.77 ft³/s
Output Increment	0.017 hours
Time to Flow (Peak Interpolated Output)	12.083 hours
Flow (Peak Interpolated Output)	71.66 ft³/s

Drainage Area	
SCS CN (Composite)	55.000
Area (User Defined)	31.230 acres
Maximum Retention (Pervious)	8.2 in
Maximum Retention (Pervious, 20 percent)	1.6 in

Cumulative Runoff	
Cumulative Runoff Depth (Pervious)	2.1 in
Runoff Volume (Pervious)	5.461 ac-ft

Hydrograph Volume (Area under Hydrograph curve)	
Volume	5.461 ac-ft

SCS Unit Hydrograph Parameters	
Time of Concentration (Composite)	0.279 hours
Computational Time Increment	0.037 hours
Unit Hydrograph Shape Factor	483.432
K Factor	0.749
Receding/Rising, Tr/Tp	1.670
Unit peak, qp	126.86 ft³/s

SCS Unit Hydrograph Parameters	
Unit peak time, Tp	0.186 hours
Unit receding limb, Tr	0.744 hours
Total unit time, Tb	0.930 hours

Storm Event	TypeII 24hr (7.0 in)
Return Event	100 years
Duration	35.000 hours
Depth	7.0 in
Time of Concentration (Composite)	0.279 hours
Area (User Defined)	31.230 acres

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
11.033	0.00	0.00	0.00	0.00	0.01
11.117	0.01	0.02	0.03	0.05	0.06
11.200	0.08	0.10	0.13	0.16	0.19
11.283	0.22	0.26	0.30	0.35	0.39
11.367	0.44	0.49	0.54	0.60	0.66
11.450	0.72	0.79	0.85	0.93	1.01
11.533	1.10	1.22	1.34	1.53	1.71
11.617	1.98	2.28	2.67	3.14	3.68
11.700	4.40	5.16	6.21	7.27	8.68
11.783	10.14	12.00	14.09	16.55	19.52
11.867	22.71	26.85	31.00	36.04	41.14
11.950	46.39	51.71	56.61	61.07	65.10
12.033	67.88	70.59	71.13	71.66	70.25
12.117	68.34	65.52	61.98	58.31	54.35
12.200	50.42	46.67	42.91	39.68	36.53
12.283	33.89	31.54	29.43	27.68	26.01
12.367	24.65	23.29	22.17	21.07	20.12
12.450	19.23	18.41	17.66	16.94	16.30
12.533	15.66	15.10	14.54	14.04	13.56
12.617	13.10	12.68	12.28	11.92	11.57
12.700	11.27	10.97	10.71	10.46	10.23
12.783	10.03	9.84	9.67	9.50	9.36
12.867	9.22	9.09	8.97	8.85	8.74
12.950	8.64	8.54	8.43	8.33	8.23
13.033	8.14	8.04	7.95	7.86	7.77
13.117	7.68	7.60	7.52	7.44	7.37
13.200	7.29	7.23	7.16	7.09	7.03
13.283	6.97	6.91	6.85	6.80	6.74
13.367	6.69	6.63	6.58	6.53	6.48
13.450	6.42	6.37	6.32	6.27	6.22
13.533	6.17	6.12	6.07	6.02	5.97
13.617	5.93	5.88	5.83	5.78	5.74
13.700	5.70	5.65	5.61	5.57	5.53
13.783	5.49	5.45	5.41	5.37	5.33

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
13.867	5.29	5.26	5.22	5.18	5.14
13.950	5.10	5.07	5.03	4.99	4.96
14.033	4.92	4.88	4.85	4.81	4.78
14.117	4.75	4.71	4.68	4.66	4.63
14.200	4.60	4.58	4.56	4.53	4.51
14.283	4.49	4.48	4.46	4.44	4.43
14.367	4.41	4.40	4.38	4.37	4.35
14.450	4.34	4.33	4.31	4.30	4.29
14.533	4.28	4.26	4.25	4.24	4.22
14.617	4.21	4.20	4.19	4.17	4.16
14.700	4.15	4.14	4.12	4.11	4.10
14.783	4.09	4.07	4.06	4.05	4.04
14.867	4.02	4.01	4.00	3.99	3.97
14.950	3.96	3.95	3.94	3.92	3.91
15.033	3.90	3.88	3.87	3.86	3.85
15.117	3.83	3.82	3.81	3.79	3.78
15.200	3.77	3.76	3.74	3.73	3.72
15.283	3.70	3.69	3.68	3.66	3.65
15.367	3.64	3.62	3.61	3.60	3.58
15.450	3.57	3.56	3.54	3.53	3.52
15.533	3.50	3.49	3.48	3.46	3.45
15.617	3.44	3.42	3.41	3.40	3.38
15.700	3.37	3.36	3.34	3.33	3.32
15.783	3.30	3.29	3.27	3.26	3.25
15.867	3.23	3.22	3.21	3.19	3.18
15.950	3.16	3.15	3.14	3.12	3.11
16.033	3.10	3.08	3.07	3.06	3.04
16.117	3.03	3.02	3.01	3.00	2.99
16.200	2.98	2.97	2.96	2.95	2.95
16.283	2.94	2.93	2.93	2.92	2.91
16.367	2.91	2.90	2.90	2.89	2.89
16.450	2.88	2.88	2.87	2.87	2.86
16.533	2.86	2.85	2.85	2.84	2.84
16.617	2.83	2.83	2.82	2.82	2.81
16.700	2.81	2.80	2.80	2.80	2.79
16.783	2.79	2.78	2.78	2.77	2.77
16.867	2.76	2.76	2.75	2.75	2.74
16.950	2.74	2.73	2.73	2.73	2.72
17.033	2.72	2.71	2.71	2.70	2.70
17.117	2.69	2.69	2.68	2.68	2.67
17.200	2.67	2.66	2.66	2.66	2.65
17.283	2.65	2.64	2.64	2.63	2.63
17.367	2.62	2.62	2.61	2.61	2.60
17.450	2.60	2.59	2.59	2.58	2.58

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
17.533	2.57	2.57	2.56	2.56	2.55
17.617	2.55	2.54	2.54	2.53	2.53
17.700	2.53	2.52	2.52	2.51	2.51
17.783	2.50	2.50	2.49	2.49	2.48
17.867	2.48	2.47	2.47	2.46	2.46
17.950	2.45	2.45	2.44	2.44	2.43
18.033	2.43	2.42	2.42	2.41	2.41
18.117	2.40	2.40	2.39	2.39	2.38
18.200	2.38	2.37	2.37	2.36	2.36
18.283	2.35	2.35	2.34	2.34	2.33
18.367	2.33	2.32	2.32	2.31	2.31
18.450	2.30	2.30	2.29	2.29	2.28
18.533	2.28	2.27	2.27	2.26	2.26
18.617	2.25	2.25	2.24	2.24	2.23
18.700	2.23	2.22	2.22	2.21	2.21
18.783	2.20	2.20	2.19	2.19	2.18
18.867	2.18	2.17	2.17	2.16	2.16
18.950	2.15	2.15	2.14	2.13	2.13
19.033	2.12	2.12	2.11	2.11	2.10
19.117	2.10	2.09	2.09	2.08	2.08
19.200	2.07	2.07	2.06	2.06	2.05
19.283	2.05	2.04	2.04	2.03	2.03
19.367	2.02	2.02	2.01	2.01	2.00
19.450	1.99	1.99	1.98	1.98	1.97
19.533	1.97	1.96	1.96	1.95	1.95
19.617	1.94	1.94	1.93	1.93	1.92
19.700	1.92	1.91	1.91	1.90	1.90
19.783	1.89	1.88	1.88	1.87	1.87
19.867	1.86	1.86	1.85	1.85	1.84
19.950	1.84	1.83	1.83	1.82	1.82
20.033	1.81	1.81	1.80	1.80	1.79
20.117	1.79	1.78	1.78	1.77	1.77
20.200	1.77	1.76	1.76	1.76	1.76
20.283	1.75	1.75	1.75	1.75	1.75
20.367	1.75	1.74	1.74	1.74	1.74
20.450	1.74	1.74	1.74	1.74	1.73
20.533	1.73	1.73	1.73	1.73	1.73
20.617	1.73	1.73	1.73	1.73	1.73
20.700	1.72	1.72	1.72	1.72	1.72
20.783	1.72	1.72	1.72	1.72	1.72
20.867	1.72	1.72	1.71	1.71	1.71
20.950	1.71	1.71	1.71	1.71	1.71
21.033	1.71	1.71	1.70	1.70	1.70
21.117	1.70	1.70	1.70	1.70	1.70

HYDROGRAPH ORDINATES (ft³/s)
Output Time Increment = 0.017 hours
Time on left represents time for first value in each row.

Time (hours)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)	Flow (ft³/s)
21.200	1.70	1.70	1.70	1.70	1.69
21.283	1.69	1.69	1.69	1.69	1.69
21.367	1.69	1.69	1.69	1.69	1.68
21.450	1.68	1.68	1.68	1.68	1.68
21.533	1.68	1.68	1.68	1.68	1.68
21.617	1.68	1.67	1.67	1.67	1.67
21.700	1.67	1.67	1.67	1.67	1.67
21.783	1.67	1.67	1.66	1.66	1.66
21.867	1.66	1.66	1.66	1.66	1.66
21.950	1.66	1.66	1.65	1.65	1.65
22.033	1.65	1.65	1.65	1.65	1.65
22.117	1.65	1.65	1.65	1.64	1.64
22.200	1.64	1.64	1.64	1.64	1.64
22.283	1.64	1.64	1.64	1.64	1.63
22.367	1.63	1.63	1.63	1.63	1.63
22.450	1.63	1.63	1.63	1.63	1.62
22.533	1.62	1.62	1.62	1.62	1.62
22.617	1.62	1.62	1.62	1.62	1.62
22.700	1.61	1.61	1.61	1.61	1.61
22.783	1.61	1.61	1.61	1.61	1.61
22.867	1.60	1.60	1.60	1.60	1.60
22.950	1.60	1.60	1.60	1.60	1.60
23.033	1.60	1.59	1.59	1.59	1.59
23.117	1.59	1.59	1.59	1.59	1.59
23.200	1.59	1.59	1.58	1.58	1.58
23.283	1.58	1.58	1.58	1.58	1.58
23.367	1.58	1.58	1.57	1.57	1.57
23.450	1.57	1.57	1.57	1.57	1.57
23.533	1.57	1.57	1.56	1.56	1.56
23.617	1.56	1.56	1.56	1.56	1.56
23.700	1.56	1.56	1.55	1.55	1.55
23.783	1.55	1.55	1.55	1.55	1.55
23.867	1.55	1.55	1.55	1.54	1.54
23.950	1.54	1.54	1.54	1.53	1.53
24.033	1.51	1.48	1.45	1.39	1.33
24.117	1.25	1.16	1.06	0.96	0.86
24.200	0.76	0.67	0.58	0.50	0.44
24.283	0.37	0.32	0.28	0.24	0.21
24.367	0.18	0.15	0.13	0.12	0.10
24.450	0.09	0.07	0.06	0.05	0.05
24.533	0.04	0.03	0.03	0.02	0.02
24.617	0.02	0.02	0.01	0.01	0.01
24.700	0.01	0.01	0.01	0.00	0.00
24.783	0.00	0.00	0.00	0.00	(N/A)

Summary for Hydrograph Addition at 'POI-11'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	AREA 11

Node Inflows

Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	AREA 11	5.461	12.083	71.66
Flow (In)	POI-11	5.461	12.083	71.66

Index

Trapezoidal Channel Analysis - Open Channel Flow (w/ Manning's Eq)

Client/Subject: **PPL, BELL BEND NUCLEAR POWER PLANT**
Description: **Teardrop/Unnamed Walker Run Tributary Connection**
Prepared by: **LGB**
Date: **25 Aug 11**

Print Date: 25 Aug 11 9:48 PM
Project #: PPLS0902

Checked by: CML

Objective:

Using Manning's equation, this spreadsheet will calculate the amount of flow through a trapezoidal or triangular (b=0) channel. By inputting the channel characteristics, the flow depth will be calculated. Other flow characteristics are also computed, including the critical slope and required freeboard based on E&S manual guidelines. The last line calculates the maximum allowable velocity as indicated by the PA E&S manual.

Method: See PA Erosion and Sedimentation Control Manual for reference.

Manning's Equation: $$Q = \frac{1.486}{n} * A * \left(\frac{A}{P}\right)^{2/3} * \sqrt{S}$$

Given Input Data: Swale Calculation

Discharge, Q=	71.66	cfs
Left Side Slope =	3.0	H:1V
Right Side Slope =	3.0	H:1V
Base width of Channel, b=		feet
Bed slope, s=	0.0330	ft/ft
Available depth of channel:	2.00	feet
(OPTIONAL) Input Manning's 'n':	0.0200	
Lining Type:	**Bare**	

Calculate Flow Depth:

Flow depth, d=	**1.49**	**feet**

Calculated Results:

	Design Acceptable?	
	V too high	
Freeboard, f=	0.51	feet
Calculated Velocity, V=	10.73	fps
Flow Top Width, T=	8.95	feet
Flow Area, A=	6.68	sq ft
Wetted Perimeter, P=	9.44	feet
Hydraulic Radius, R=	0.71	feet
Shear stress on channel bottom, τ =	3.07	lbs/sf
Critical Slope, S_c=	0.0069	ft/ft
Flow stable? (no if $.7S_c < s < 1.3S_c$)=	yes	
Required Freeboard=	0.5	feet
Allowable Velocity for Lining Material=	2.5	fps

Conclusions

R-3 riprap is needed for velocity.

Pennoni Associates Inc.

100 N. Wilkes-Barre Blvd, Suite 409, Wilkes-Barre, PA 18702
TEL: 570-824-2200 FAX: 570-824-0800

Engineers • Surveyors • Planners • Landscape Architects

MAP 1

BELL BEND NUCLEAR POWER PLAN UNISTAR NUCLEAR
PENNSYLVANIA

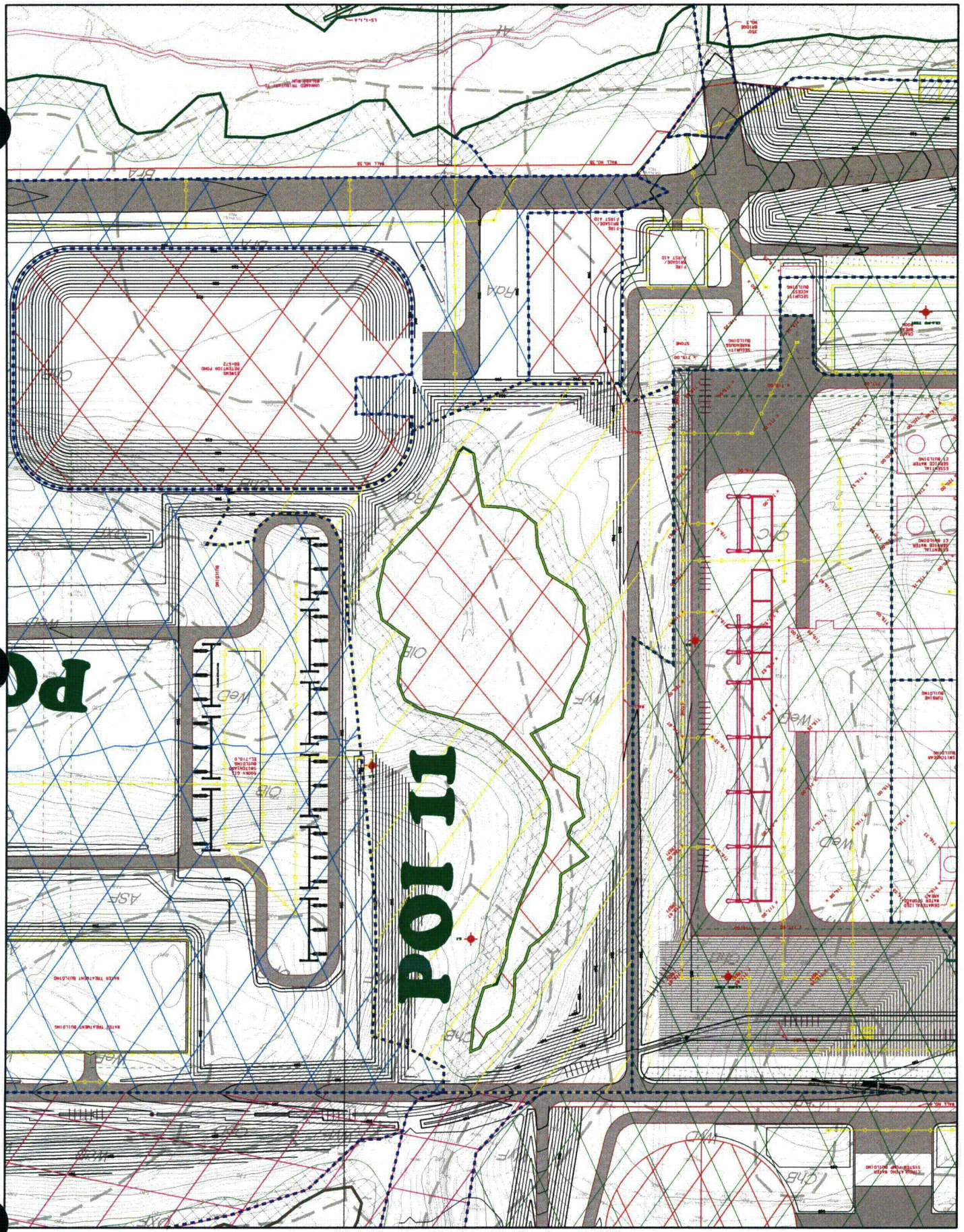
PRE-DEVELOPMENT DRAINAGE AREA

MAP 1
PPL BELL BEND, LLC
38 BOMBOY LANE
SUITE 2
BERWICK, PA 18603

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR AND OWNER MUST BE NOTIFIED OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK.

DATE	NO.	REVISIONS	BY
08/20/2010	0	XXXXXXX XXXXXXXXX	XXX

PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS



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BELL BEND NUCLEAR POWER PLAN UNISTAR NUCLEAR
PENNSYLVANIA

POST-DEVELOPMENT TEARDROP AREA

MAP 2

PPL BELL BEND, LLC
38 BOWBOY LANE
SUITE 2
BERWICK, PA 18603

MAP 2

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR AND OWNER MUST BE NOTIFIED OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK.

DESIGN	0	XXXXXXXX XXXXXXXXXX
DATE	NO.	REVISIONS

Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

Attachment 2:

Railroad Culvert Calculations

Pennoni Associates, Inc.

Pennoni
PENNONI ASSOCIATES INC.
CONSULTING ENGINEERS

Table 1 - Summary of Culvert Flows at Crossing: Rail Road Culvert

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
632.75	40.30	40.30	0.00	1
632.89	43.66	43.66	0.00	1
633.00	47.02	47.02	0.00	1
633.07	49.20	49.20	0.00	1
633.21	53.74	53.74	0.00	1
633.32	57.10	57.10	0.00	1
633.43	60.46	60.46	0.00	1
633.54	63.82	63.82	0.00	1
633.67	67.18	67.18	0.00	1
633.82	70.54	70.54	0.00	1
633.96	73.90	73.90	0.00	1
670.00	390.48	390.48	0.00	Overtopping

Rating Curve Plot for Crossing: Rail Road Culvert

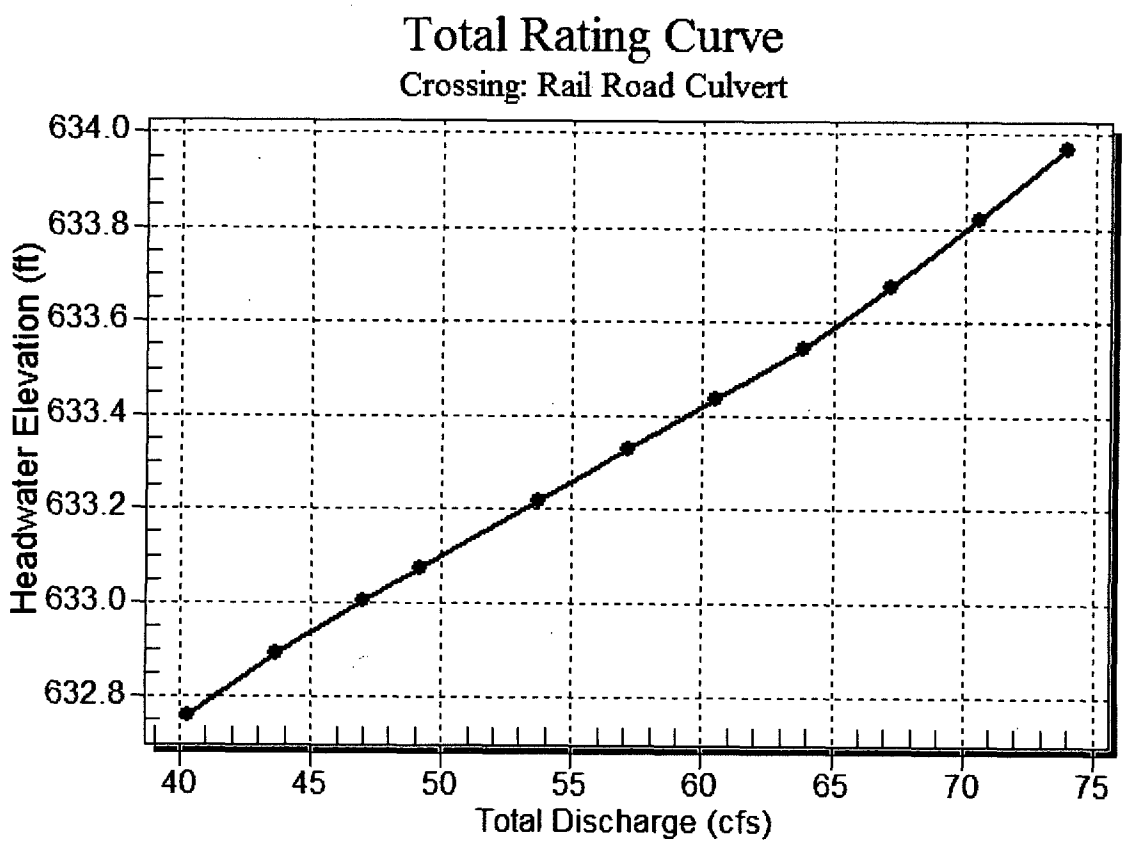


Table 2 - Culvert Summary Table: Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
40.30	40.30	632.75	2.254	0.0*	1-S2n	0.763	1.620	0.772	1.761	15.997	5.197
43.66	43.66	632.89	2.388	0.0*	1-S2n	0.799	1.702	0.844	1.815	15.633	5.302
47.02	47.02	633.00	2.496	0.0*	1-S2n	0.835	1.780	0.840	1.866	16.941	5.402
49.20	49.20	633.07	2.567	0.0*	1-S2n	0.859	1.825	0.865	1.898	17.124	5.463
53.74	53.74	633.21	2.713	0.0*	1-S2n	0.908	1.921	0.970	1.962	16.445	5.585
57.10	57.10	633.32	2.821	0.0*	1-S2n	0.944	1.991	1.011	2.007	16.671	5.670
60.46	60.46	633.43	2.930	0.0*	1-S2n	0.980	2.062	0.982	2.050	18.244	5.752
63.82	63.82	633.54	3.038	0.0*	1-S2n	1.016	2.128	1.093	2.093	17.093	5.830
67.18	67.18	633.67	3.169	0.0*	1-S2n	1.051	2.188	1.131	2.133	17.256	5.905
70.54	70.54	633.82	3.316	0.0*	1-S2n	1.082	2.249	1.170	2.173	17.437	5.978
73.90	73.90	633.96	3.462	0.0*	1-S2n	1.112	2.310	1.122	2.211	19.161	6.048

* theoretical depth is impractical. Depth reported is corrected.

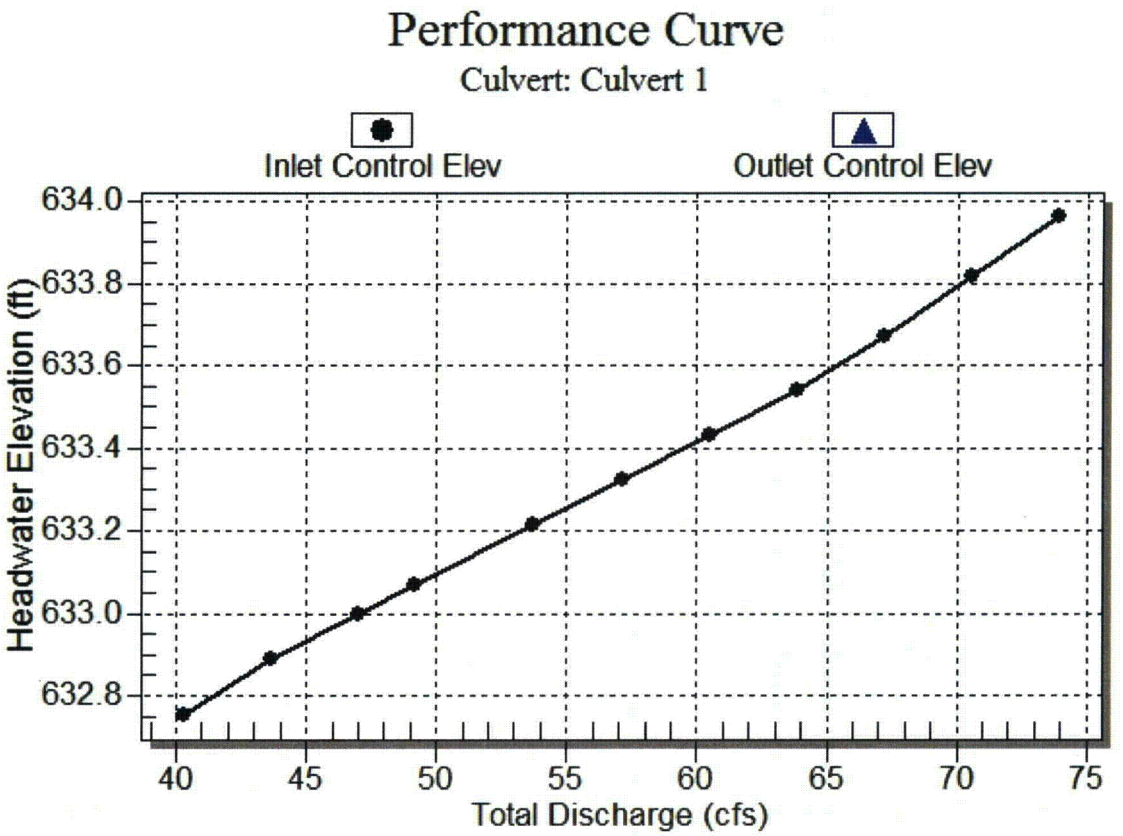
****

Inlet Elevation (invert): 630.50 ft, Outlet Elevation (invert): 625.10 ft

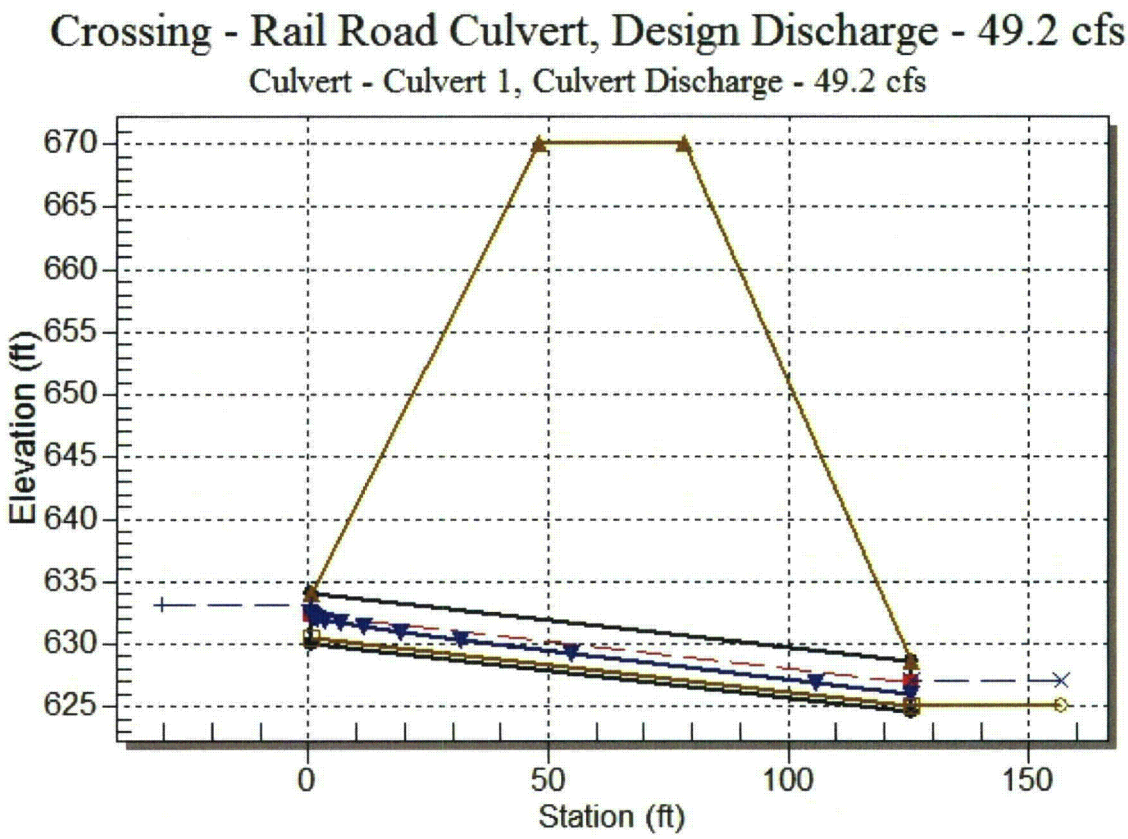
Culvert Length: 125.12 ft, Culvert Slope: 0.0432

****

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 630.00 ft

Outlet Station: 125.00 ft

Outlet Elevation: 624.60 ft

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 4.00 ft

Barrel Material: Concrete

Embedment: 6.00 in

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0130 (bottom)

Inlet Type: Conventional

Inlet Edge Condition: Beveled Edge

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: Rail Road Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
40.30	626.86	1.76	5.20	4.40	0.98
43.66	626.91	1.81	5.30	4.53	0.98
47.02	626.97	1.87	5.40	4.66	0.99
49.20	627.00	1.90	5.46	4.74	0.99
53.74	627.06	1.96	5.58	4.90	0.99
57.10	627.11	2.01	5.67	5.01	1.00
60.46	627.15	2.05	5.75	5.12	1.00
63.82	627.19	2.09	5.83	5.22	1.00
67.18	627.23	2.13	5.91	5.32	1.01
70.54	627.27	2.17	5.98	5.42	1.01
73.90	627.31	2.21	6.05	5.52	1.01

Tailwater Channel Data - Rail Road Culvert

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.50 (_:1)

Channel Slope: 0.0400

Channel Manning's n: 0.0500

Channel Invert Elevation: 625.10 ft

Roadway Data for Crossing: Rail Road Culvert

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 300.00 ft

Crest Elevation: 670.00 ft

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

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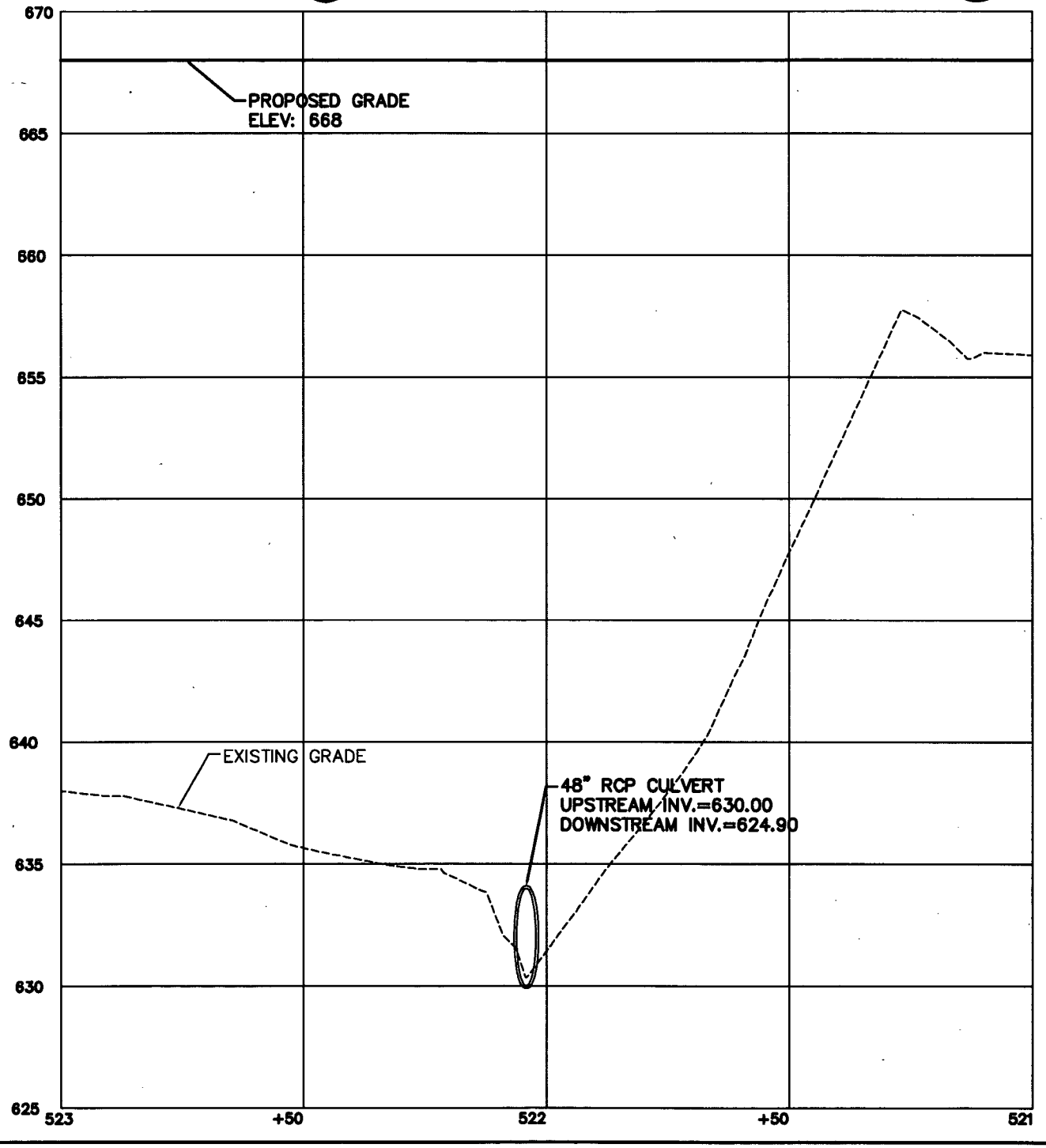
100 N. Wilkes-Barre Blvd.
Wilkes-Barre, PA 18702

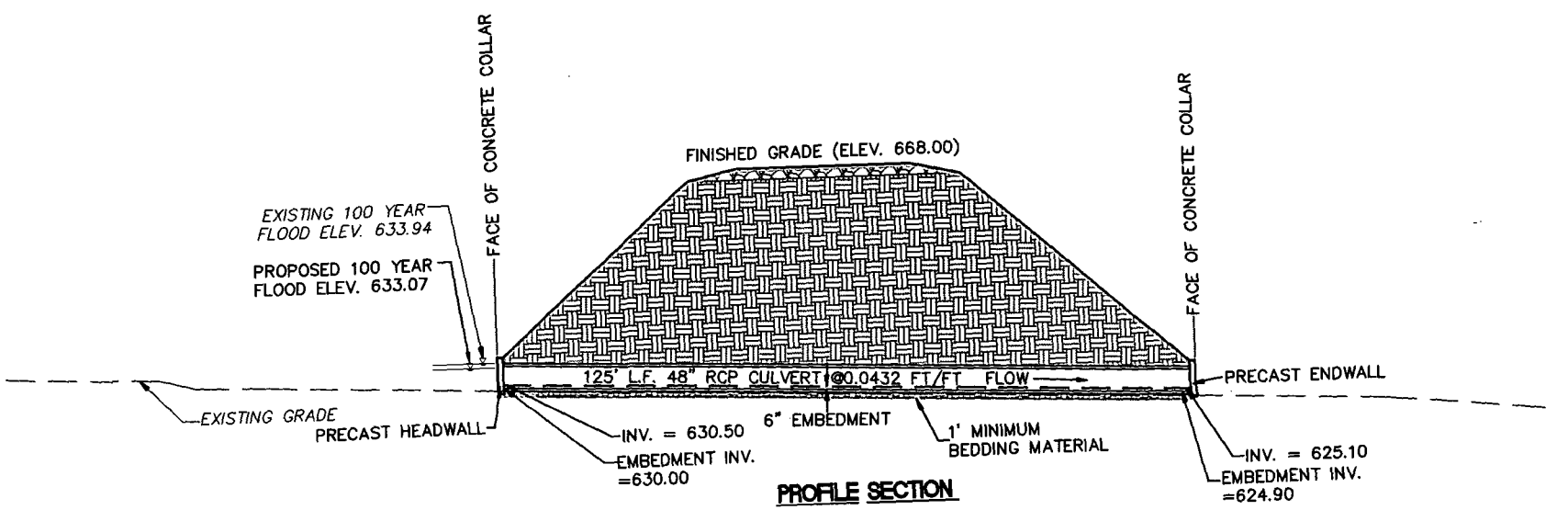
RAILROAD CULVERT - PROFILE

DRAWN BY: JMO
CHECKED BY: LGB
JOB No. PPLS0902
SCALE: AS SHOWN
DATE: 03/29/2011
SKETCH No. 1 OF 2



VERTICAL
SCALE: 1"=6'

HORIZONTAL
SCALE: 1"=30'



PROFILE SECTION

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)

1 inch = 20 ft.

Pennoni

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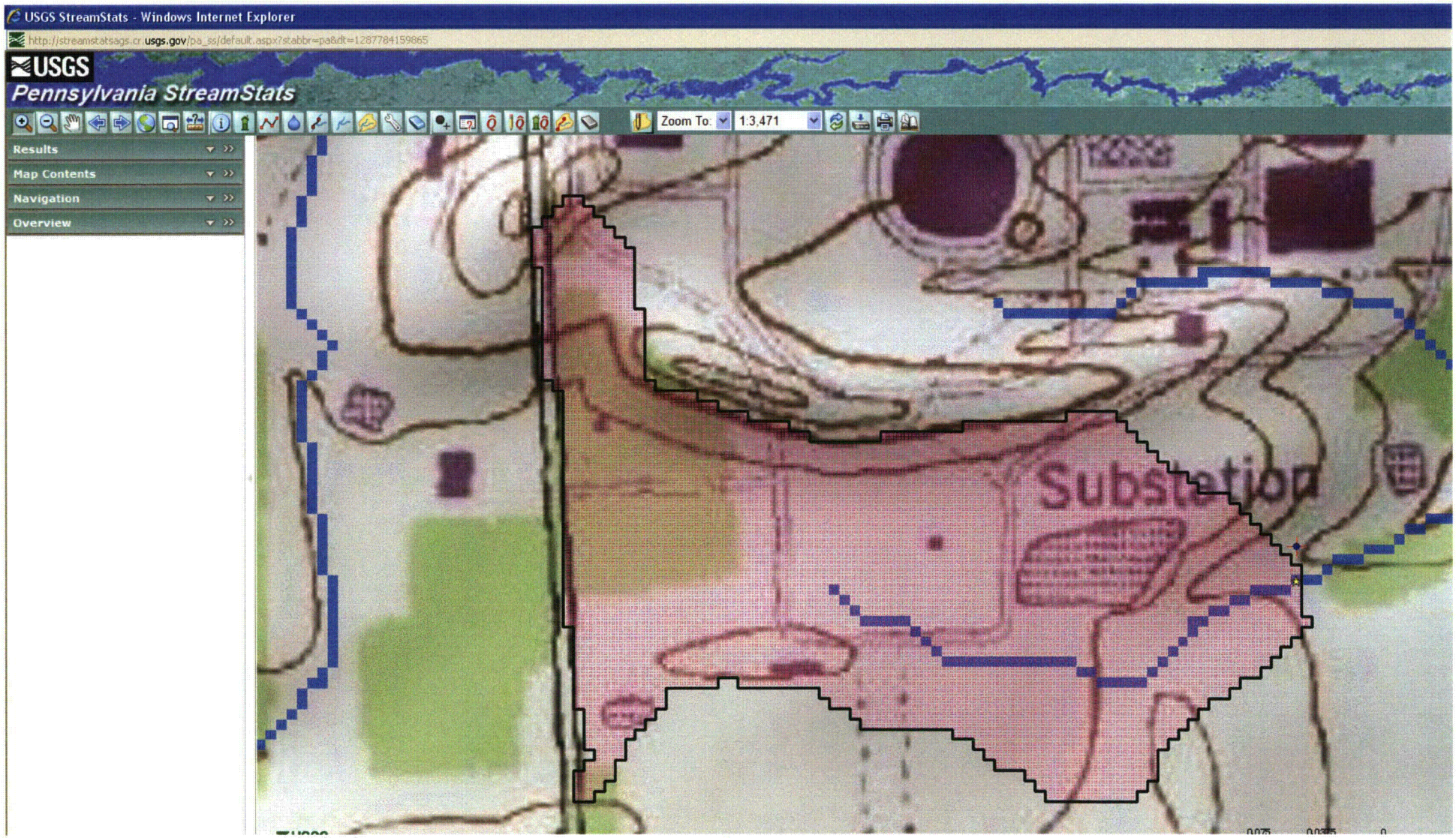
Wilkes-Barre, PA 18702

DRAWN BY:	JMO
CHECKED BY:	LGB
JOB No.	PPLS0902
SCALE:	1":20'
DATE:	03/29/11
SKETCH No.	2 OF 2

RAILROAD CULVERT CROSSING CROSS SECTION


USGS StreamStats - Windows Internet Explorer
http://streamstatsags.cr.usgs.gov/pa_ss/default.aspx?stabbr=pa&dt=128778415986S
USGS
Pennsylvania StreamStats
Zoom To:
1:3,471
Results
Map Contents
Navigation
Overview
Substation

USGS
Pennsylvania StreamStats

Streamstats Ungaged Site Report

Date: Fri Oct 22 2010 15:54:09 Mountain Daylight Time
Site Location: Pennsylvania
NAD27 Latitude: 41.0874 (41 05 15)
NAD27 Longitude: -76.1450 (-76 08 42)
NAD83 Latitude: 41.0875 (41 05 15)
NAD83 Longitude: -76.1447 (-76 08 41)
Drainage Area: 0.086 mi2

Low Flow Basin Characteristics

100% Low Flow Region 2 (0.086 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.086 (below min value 4.93)	4.93	1280
Mean Annual Precipitation (inches)	39.000	35	50.4
Stream Density (miles per square mile)	2.68	0.51	3.1
Depth to Rock (feet)	5.600	3.32	5.65
Percent Carbonate (percent)	0.0000	0	99

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Mean/Base-flow Basin Characteristics

100% Statewide Mean and Base Flow (0.086 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.086 (below min value 2.26)	2.26	1720
Mean Basin Elevation (feet)	676	130	2700
Mean Annual Precipitation (inches)	39.000	33.1	50.4
Percent Carbonate (percent)	0.0000	0	99
Percent Forest (percent)	14.1314	5.1	100
Percent Urban (percent)	2.9703	0	89

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Peak Flow Basin Characteristics

100% Peak Flow Region 1 (0.086 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	0.086 (below min value 1.72)	1.72	1280
Mean Basin Elevation (feet)	676	0	1960
Percent Carbonate (percent)	0.0000	0	83
Percent Urban (percent)	2.9703	0	20
Percent Storage (percent)	0.0000	0	21.2

Warning: Some parameters are outside the suggested range. Estimates will be extrapolations with unknown errors.

Low Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
M7D2Y	0.00461				
M30D2Y	0.00646				
M7D10Y	0.002				
M30D10Y	0.00265				
M90D10Y	0.00435				

Mean/Base-flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
QA	0.0865				
QAH	0.0104				
BF10YR	0.0238				
BF25YR	0.0201				
BF50YR	0.0181				

Peak Flow Streamflow Statistics

Statistic	Flow (ft^3/s)	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
PK2	8.36		3		
PK5	16.2		6		
PK10	22.7		9		
PK50	40.3		13		
PK100	49.2		13		
PK500	73.9		14		

Trapezoidal Channel Analysis - Open Channel Flow (w/ Manning's Eq)

Client/Subject: **PPL, BELL BEND NUCLEAR POWER PLANT**
Description: **EXISTING SWALE UNDER RAIL 521+92.41**
Prepared by: **LGB**
Date: **25 Aug 11**

Print Date: 25 Aug 11 9:44 PM
Project #: PPLS0902

Checked by: CML

Objective:

Using Manning's equation, this spreadsheet will calculate the amount of flow through a trapezoidal or triangular (b=0) channel. By inputting the channel characteristics, the flow depth will be calculated. Other flow characteristics are also computed, including the critical slope and required freeboard based on E&S manual guidelines. The last line calculates the maximum allowable velocity as indicated by the PA E&S manual.

Method: See PA Erosion and Sedimentation Control Manual for reference.

Manning's Equation: $$Q = \frac{1.486}{n} * A * \left(\frac{A}{P}\right)^{2/3} * \sqrt{S}$$

Given Input Data:

	RAIL CROSSING STA 521+92.41	Swale Calculation	
Discharge, Q=		49.20	cfs
Left Side Slope =		1.0	H:1V
Right Side Slope =		1.0	H:1V
Base width of Channel, b=			feet
Bed slope, s=		0.0150	ft/ft
Available depth of channel:		4.00	feet
(OPTIONAL) Input Manning's 'n':		0.0500	
Lining Type:		**Bare**	

Calculate Flow Depth:

Flow depth, d=	**3.44**	**feet**

Calculated Results:

	Design Acceptable?	V too high	
Freeboard, f=		0.56	feet
Calculated Velocity, V=		4.15	fps
Flow Top Width, T=		6.88	feet
Flow Area, A=		11.84	sq ft
Wetted Perimeter, P=		9.73	feet
Hydraulic Radius, R=		1.22	feet
Shear stress on channel bottom, τ =		3.22	lbs/sf
Critical Slope, S_c=		0.0482	ft/ft
Flow stable? (no if $.7S_c < s < 1.3S_c$)=		yes	
Required Freeboard=		0.9	feet
Allowable Velocity for Lining Material=		2.5	fps

Conclusions

R-3 riprap is needed for velocity.

□e□tion M
□tor□ □ater Manage□ ent □naly□i□

1. Post Construction Stormwater Management Plan

Status

On November 12, 2010 an application for an NPDES Individual Permit for Discharges of Stormwater Associated with Construction Activities for the Bell Bend Project was submitted to the Luzerne Conservation District and PA Department of Environmental Protection. The application contained a Post Construction Stormwater Management (PCSM) Plan which was also included in the JPA submittal dated June 2011.

PPL submitted a revised NPDES Stormwater permit application on September 15, 2011. A copy of the of the PCSM plan narrative as contained in the September 15, 2011 revised NPDES permit application is provided herein. Any revisions of the September 15, 2011 PCSM plan will be filed for inclusion in this application record when issued by PPL. Final approval of the PCSM plan by the PA Department of Environmental Protection will be filed as part of the application record when received.

The PCSM plan provides that there will be no increase in stormwater leaving the BBNPP site as a result of the plant construction.

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100 North Wilkes-Barre Blvd
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Phone: (570) 824-2200
Fax: (570) 824-0800

BINDER 2 OF 6

POST CONSTRUCTION STORMWATER MANAGEMENT NARRATIVE

Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

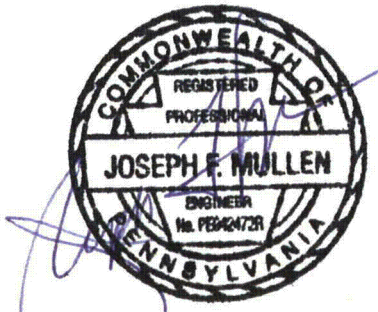
For:
PPL Bell Bend, LLC
38 Bomboy Lane
Suite 2
Berwick, PA 18603

Report Number
PPLS0902-1500-02

Issue Date
November 12th, 2010

Revision Date – Rev 1
September 15th, 2011

PPLS0902



Binder 2 of 6 – Post Construction Stormwater Management Narrative

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Appendices

Table of Contents

I. EXECUTIVE SUMMARY

PPL Bell Bend, LLC is proposing to construct the Bell Bend Nuclear Power Plant (BBNPP) in Salem Township, Luzerne County, Pennsylvania. The proposed site for this project is located north of US 11 and is adjacent to the existing Susquehanna Nuclear Power Plant. See Appendix A for the location map. The drainage areas for the development are adjacent to Walker Run and the Susquehanna River. The project is designed to conform to the requirements of the Act 167 Stormwater Management Plan for Salem Township.

Stormwater runoff is proposed to be conveyed in a closed drainage system consisting of inlets and pipes that ultimately outlet to a total of fourteen (14) underground and three (3) aboveground infiltration and detention basins.

The stormwater design meets the Volume Control Guideline 1 (CG-1) referenced in the Pennsylvania Stormwater BMP Manual. The infiltration basins were designed to infiltrate the increase in volume between the pre and post-development two-year storm events. The intent of the design is to replicate preconstruction stormwater infiltration and runoff conditions so that the post construction stormwater discharges do not degrade the physical, chemical, or biological characteristics of the receiving waters. Also, water quality treatment BMP's will be employed to ensure protection of the existing uses and the level of water quality necessary to protect those existing uses. The stormwater from the intake area, including from the dredging stockpile and the intake structure, will be discharged to the Susquehanna River.

This construction activity and its temporary and permanent stormwater BMP controls are shown on the plans and discussed in this narrative. See the Erosion and Sedimentation plans and narrative for all temporary and permanent E&S BMP controls.

The proposed construction is expected to disturb approximately 687 acres. The sequence of construction and earth disturbance activities on the project will be carried out in conformance with the sequence contained in the E&S narrative and listed on the E&S plan. Compliance with the staging and sequencing within the construction sequence and the methods and materials shown on the plan will accomplish temporary and permanent site stabilization.

II. EXISTING LAND USE AND SITE FEATURES

The PPL Bell Bend NPDES project boundary is proposed on approximately 1,218 acres. It is located in a rural/residential community that contains various types of ground cover such as: wooded areas, paved roadways, agricultural land, grass fields, an existing power plant and numerous wetland areas. There are also approximately 15 acres at the intake area and 17 acres at a construction laydown area located adjacent to the Susquehanna River. See Appendix E for Site Photos. The nearest named waterway is Walker Run which runs through the site. Walker Run is classified as Cold Water Fishery-Migratory Fishery (CWF-MF) by the classifications set forth in Chapter 93 Water Quality Standards, Title 25. A portion of the site drains towards the Susquehanna River which is classified as a Warm Water Fishery-Migratory Fishery (WWF-MF) by the classifications set forth in Chapter 93 Water Quality Standards, Title 25.

The site is comprised of primarily undeveloped parcels of land that contain cultivated fields, forest and wetlands. The past and present land use of the land is a cultivated agriculture. The site is bordered to the north by woods. The existing Susquehanna Nuclear Power Plant is located northeast of the site and cultivated fields border the site to the east, south and west. The existing impervious surfaces on the site are the result of private and public roads and the existing plant. Total existing impervious area is about 151 Acres.

See Appendix B for the soils map. The soils on the site are listed by the United States Department of Agriculture's Natural Resource Conservation Service as:

ASF – Arnot-Rock outcrop complex, Steep – This steep and very steep soil is on convex mountain sides and hillsides. Runoff is rapid, and the hazard of erosion is slight. These soils are low in natural fertility, and content of organic matter is low. Most limitations for non-farm use are related to slope, the stones, the rock outcrop, and the depth to bedrock. The Capability Subclass for this soil is VIIs.

At – Atherton silt loam, gray subsoil variant, 0 to 3 percent slopes – This is a nearly level soil in low lying, uniformly concave positions. Runoff is very slow, ponding is common and the hazard of erosion is slight. These soils are medium in natural fertility, and content of organic matter is moderate. Most limitations for non-farm use are related to the high water table, the slow permeability, and ponding. The Capability Subclass for this soil is IVw.

BrA – Braceville gravelly loam, 0 to 3 percent slopes – This nearly level soil is in smooth, slightly concave positions on glacial outwash terraces. Runoff is slow and the hazard of erosion is slight.

This Braceville soil is medium to low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table and the moderately slow permeability. The Capability Subclass for this soil is IIw.

BrB – Braceville gravelly loam, 3 to 8 percent slopes – This gently sloping soil is in smooth, slightly concave positions on glacial outwash terraces. Runoff is slow to medium, and the hazard of erosion is moderate. This Braceville soil is medium to low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table and the moderately slow permeability. The Capability Subclass for this soil is IIw.

BrC – Braceville gravelly loam, 8 to 15 percent slopes – This gently sloping soil is in smooth, slightly concave positions on glacial outwash terraces. Runoff is medium, and the hazard of erosion is moderate. This Braceville soil is medium to low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table, the moderately slow permeability and slope. The Capability Subclass for this soil is IIIe.

ChA – Chenango gravelly loam, 0 to 3 percent slopes – This nearly level soil is in broad, smooth, slightly convex positions on glacial outwash terraces. Runoff is slow to very slow, and the hazard of erosion is slight. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to moderately rapid to rapid permeability and the possibility of ground water contamination. The Capability Subclass for this soil is IIs.

ChB – Chenango gravelly loam, 3 to 8 percent slopes – This gently sloping soil is in broad, smooth to slightly undulating, convex positions on glacial outwash terraces. Runoff is slow and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to moderately rapid to rapid permeability and the possibility of ground water contamination and the content of coarse fragments. The Capability Subclass for this soil is IIs.

ChC – Chenango gravelly loam, 8 to 15 percent slopes – This sloping soil is in smooth or rolling, convex positions on glacial outwash terraces. Runoff is medium to very slow and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to moderately rapid to rapid permeability and the possibility of ground water contamination and the content of coarse fragments. The Capability Subclass for this soil is IIIe

Ho – Holly silt loam, 0 to 3 percent slopes – This is a nearly level soil on smooth or slightly concave flood plains. Runoff is slow and the hazard of erosion is slight. This soil is subject to frequent flooding. This soil is medium in natural fertility and moderate in content of organic matter. Most limitations for nonfarm use are related to the season high water table and frequent flooding. The Capability Subclass for this soil is IIIw.

OlB – Oquaga and Lordstown channery silt loams, 3 to 8 percent slopes – This gently sloping soil is on convex tops of the hills, knolls and mountain ridges of broad rolling mountaintops and intermountain basins. Runoff is medium, and the hazard of erosion is moderate. This soil is medium in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock. The Capability Subclass for this soil is IIe.

OlC – Oquaga and Lordstown channery silt loams, 8 to 15 percent slopes – This sloping soil is on the convex rounded tops, crests, and sides of and sides of hills, knolls and on the mountain ridges of broad rolling mountaintops and intermountain basins. Runoff is medium to rapid and the hazard of erosion is moderate. This soil is medium in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock and slope. The Capability Subclass for this soil is IIIe.

OlD – Oquaga and Lordstown channery silt loams, 15 to 25 percent slopes – This moderately steep soil is on the sides of hills, knolls, and mountain ridges of broad, rolling mountaintops and intermountain basins. Runoff is rapid, and the hazard of erosion is moderate. This soil is medium in natural fertility and low in content of organic matter.
Most limitations for nonfarm use are related to the depth to bedrock and slope. The Capability Subclass for this soil is IVe.

OpB – Oquaga and Lordstown extremely stony silt loams, 3 to 8 percent slopes – This gently sloping soil is on the convex tops of hills, knolls, and mountain ridges of broad mountaintops and intermountain basins. Runoff is medium, and the hazard of erosion is slight. This soil is medium in natural fertility and moderate in content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock surface stoniness. The Capability Subclass for this soil is VIIs.

OpD – Oquaga and Lordstown extremely stony silt loams, 8 to 25 percent slopes – This sloping and moderately steep soil is on convex, rounded tops, crests and sides of hills; on knolls; and on the mountain ridges of broad rolling mountaintops and intermountain basins. Runoff is medium to rapid, and the hazard of erosion is slight. This soil is medium in natural fertility and moderate in

content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock surface stoniness, and slope. The Capability Subclass for this soil is VIIs.

OXF – Oquaga and Lordstown extremely stony silt loams, steep – This steep and very steep soil is on the sides of hills, mountain ridges, and valleys of broad, rolling mountaintops and intermountain basins. Runoff is rapid to very rapid, and the hazard of erosion is slight. This soil is medium in natural fertility and moderate in content of organic matter. Most limitations for nonfarm use are related to slope, the depth to bedrock and surface stoniness. The Capability Subclass for this soil is VIIs.

Ps – Pope Soils, 0 to 5 percent slopes – These nearly level to gently sloping soils are on smooth, slightly convex high bottom flood plains. Runoff is slow, and the hazard of erosion is none to slight. These soils are high in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the flood hazard. The Capability Subclass for this soil is I.

RdA – Rexford loam, 0 to 3 percent slopes – This nearly level soil is in smooth, concave positions on glacial outwash terraces. Runoff is slow and the hazard of erosion is none to slight. This soil is medium to low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table and slow permeability. The Capability Subclass for this soil is IIIw.

RdB – Rexford Loam, 3 to 8 percent slopes – This gently sloping soil is in smooth, slightly concave positions on glacial outwash terraces. Runoff is slow and the hazard of erosion is slight. This soil is medium to low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table and slow permeability. The Capability Subclass for this soil is IIIw.

WeB – Weikert and Klinesville channery slit loams, 3 to 8 percent slopes – This gently sloping soil is on the convex tops of hills, knolls and ridges. Runoff is medium, and the hazard of erosion is moderate. This soil low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock and the content of coarse fragments. The Capability Subclass for this soil is IIIe.

WeC – Weikert and Klinesville channery slit loams, 8 to 15 percent slopes – This sloping soil is on the convex, rounded tops, crests, and sides of hills, knolls and ridges. Runoff is medium to rapid, and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of

organic matter. Most limitations for nonfarm use are related to the depth to bedrock and slope. The Capability Subclass for this soil is IVe.

WeD – Weikert and Klinesville channery slit loams, 15 to 25 percent slopes – This moderately steep soil is on the sides of hills, knolls, and ridges. Runoff is rapid to very rapid, and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the depth to bedrock and slope. The Capability Subclass for this soil is VIe.

WmB – Wellsboro very stony silt loam, 3 to 8 percent slopes – This gently sloping and soil is on smooth, slightly concave uplands of broad, rolling mountaintops and intermountain basins. Runoff is slow, and the hazard of erosion is slight. This soil is medium in natural fertility and moderate in content of organic matter. Most limitations for nonfarm use are related to the seasonal high water table, the slow permeability and the surface stoniness. The Capability Subclass for this soil is VIs.

WyD – Wyoming gravelly loam, 15 to 25 percent slopes – This moderately steep soil is in broad, smooth or hilly, convex positions on the sides of glacial outwash moraines, kames, and eskers. Runoff is medium to rapid, and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related slope, the rapid permeability, the content of coarse fragments, and the possibility of groundwater contamination. The Capability Subclass for this soil is IVe.

WyF – Wyoming gravelly loam, 25 to 60 percent slopes – This steep to very steep soil is in broad, smooth or complex, convex positions on the sides of glacial outwash moraines, kames, and eskers. Runoff is rapid, and the hazard of erosion is moderate. This soil is low in natural fertility and low in content of organic matter. Most limitations for nonfarm use are related to the slope, the rapid permeability, and the content of coarse fragments. The Capability Subclass for this soil is VIIe.

III. PROPOSED LAND USE AND SITE FEATURES

PPL Bell Bend, LLC is proposing to construct the Bell Bend Nuclear Power Plant (BBNPP). The proposed construction is expected to disturb approximately 687 Ac. The earth moving activities will consist of constructing a main access road off of US 11, other access and security roads, a railroad spur, parking lots, utilities, buildings and two cooling towers that will support the proposed power plant. Additionally, an intake structure for the cooling system will be constructed along the

west bank of the Susquehanna River and east of the proposed plant, and a temporary construction laydown area will be prepared adjacent to the Susquehanna River and northeast of the proposed plant. A large laydown area and permanent spoil site bounded to the north and south by US 11 and the Susquehanna River respectively will be constructed as well. The total proposed impervious area is about 265 Acres. The site will be served by public sewer and water systems.

IV. PRE-DEVELOPMENT HYDROLOGY

The pre-development hydrologic analysis was conducted using Bentley's Pondpack software, version V8i, for the plant area and HEC-HMS for the intake area. The peak runoff rates and hydrographs were computed using the SCS unit hydrograph method utilizing TR-55. The TR-55 segmental approach was used to determine time of concentration and therefore storm duration. The peak runoff rates for the drainage areas were calculated for each point of interest throughout the site.

Point of Interest 1

Point of Interest 1 is a culvert which carries Walker Run under a driveway along North Market Street.

Point of Interest 2

Point of Interest 2 is a culvert crossing US 11 near the intersection of Confers Ln and US 11.

Point of Interest 3A

Point of Interest 3A is a point on the north side of the PPL owned railroad along the Susquehanna River. Surveyed topography reveals an existing drainage path to the railroad. A site visit concluded the existence of a drainage path, but no structures that would lead to the Susquehanna River.

Point of Interest 3B

Point of Interest 3B is a limit on the east side of the south laydown property line. This area presently flows off-site to an adjacent property and ultimately discharges to the Susquehanna River.

Point of Interest 3C

Point of Interest 3C is a limit on the east side of the property line just north of US 11. This area presently flows off-site to an adjacent property and ultimately discharges to the Right-of-Way of US 11.

Point of Interest 4

POI 4 is a culvert under Bell Bend Rd, 900' south of the Quarry entrance.

Point of Interest 5

POI 5 is a culvert under Bell Bend Rd., 230' north of the Quarry entrance.

Point of Interest 6

POI 6 is a culvert under US 11, 2130' south of the SSES Plant entrance.

Point of Interest 7

POI 7 is a culvert under Bell Bend Rd., 750' north of the Quarry entrance.

Point of Interest 8

POI 8 is a culvert under Beach Grove Road 1230' east of the intersection of Beach Grove Rd. and Thomas Rd.

Point of Interest 9

POI 9 is a culvert under Beach Grove Road 3600' east of the intersection of Beach Grove Rd. and Confers Ln.

Point of Interest 10

POI 10 is a culvert under US 11, 4040' north of the SSES Plant entrance.

The following points of interest are located in the area of the proposed intake structure.

Point of Interest I-1

Point of Interest I-1 is located at downstream end (entrance to Susquehanna River) of the swale just south of the intake structure.

Point of Interest I-2

Point of Interest I-2 is a drain pipe outlet to Susquehanna River, between the north side of the proposed intake structure and south of the access road of the existing intake structure.

Point of Interest I-3

Point of Interest I-3 is east of proposed dredging stockpile area, along the left bank of the Susquehanna River.

Point of Interest I-4

Point of Interest I-4 is south of the proposed dredging stockpile area and north of the southern boundary of the intake area (by the access road).

Point of Interest I-5

Point of Interest I-5 is the outlet to the Susquehanna River of the diverted flow from the stream. The inlet to the diversion pipe is just east of the access road for the intake structure.

Point of Interest I-6

Point of Interest I-6 is at the depression southeast of the proposed dredging stockpile.

A copy of the pre-development data and detailed runoff computations can be found in Appendix C. The pre-development drainage areas can be seen on MAP 1 for the plant site in Appendix F and Figure 1 on sheet 16 of 19 in Appendix K for the intake area. A summary of the pre-development hydrologic analysis is presented in Table 1.

Table 1 - Summary of Pre-Development Hydrologic Analysis

	Point of Interest	Storm Event			
		2-year	10-year	25-year	100-year
PRE-DEVELOPMENT PEAK FLOWS (CFS)	1	200.07	598.07	1003.90	1955.30
	2	39.83	132.99	231.04	473.21
	3A	16.66	60.88	103.41	202.69
	3B	0.00	0.04	0.22	8.48
	3C	0.00	0.13	1.89	9.42
	4	0.52	14.46	48.60	157.24
	5	2.59	22.64	48.31	115.21
	6	98.29	206.10	295.38	484.85
	7	0.00	0.09	0.54	15.86
	8	65.78	150.08	222.85	381.57
	9	53.10	121.23	179.63	305.85
	10	127.45	302.63	452.94	787.31
	I-1	0.00	0.00	0.00	0.00
	I-2	0.00	0.00	0.00	0.00
	I-3	0.50	2.50	4.20	8.70
	I-4	0.04	0.20	0.30	0.70
	I-5	2.20	9.00	14.70	28.40
	I-6	1.10	3.80	6.30	12.40

V. POST-DEVELOPMENT HYDROLOGY

The post-development hydrologic analysis was conducted using the same procedures and parameters listed above. A copy of the detailed uncontrolled post-development computations can be found in Appendix D. The post-development drainage area map for the plant site can be found in Appendix F and Appendix K for the intake area. A summary of the post development hydrological analysis without controlling measures are presented in Table 2.

Table 2 - Summary of Uncontrolled Post-Development Hydrologic Analysis

	Point of Interest	Storm Event			
		2-year	10-year	25-year	100-year
POST-DEVELOPMENT PEAK FLOWS (CFS)	1	359.82	805.33	1190.86	2036.39
	2	103.12	238.08	362.61	645.18
	3A	47.75	140.45	224.39	417.17
	3B	0.00	0.00	0.00	0.00
	3C	0.00	0.05	0.78	4.84
	4	36.63	75.94	120.91	235.34
	5	75.52	148.39	212.56	352.43
	6	98.00	204.76	294.25	484.50
	7	0.00	0.08	0.46	13.38
	8	64.49	146.30	216.82	370.33
	9	67.25	143.90	208.34	348.71
	10	126.82	301.14	450.72	783.79
	I-1	0.70	1.50	2.20	3.70
	I-2	2.20	4.50	6.40	10.50
	I-3	3.30	7.10	10.30	17.50
	I-4	0.04	0.20	0.30	0.70
	I-5	2.60	9.00	14.40	28.10
	I-6	1.80	4.50	7.1	13.20

The total post-development runoff rates for areas 1, 2, 3A, 4, 5 and 9 exceed the specified pre-development rates and therefore stormwater management is required. Although the post-development rates for area 6 have been met for the shown storm events, stormwater management is required to meet the 1-year storm. The 1-yr pre-development runoff rate for POI 6 is 63.63cfs. The 1yr post-development uncontrolled rate is 64.01cfs. The total post-development runoff rates for areas I-1, I-2, I-3, I-5, and I-6 exceed the specified pre-development rates but will not require stormwater management due their location along the bank of the Susquehanna River. All the areas abutting the river will drain directly to it. The total post-development runoff rates for Areas 3B, 3C, 7, 8, and 10 and I-4 will be less than the specified pre-development rates due to the re-direction of stormwater due to the development of the site. Seventeen (17) stormwater infiltration/detention basins are provided to manage stormwater for the project.

VI. STORMWATER MANAGEMENT

A. REQUIREMENTS

The runoff requirements include controlling the post-development to pre-development for the 2, 10, and 25, and 100 year storm events, except for the intake area. Stormwater conveyance facilities are required to convey stormwater runoff from the 25-year design storm.

B. STORMWATER DETENTION

There are 17 infiltration/ detention basins located throughout the site. The stormwater detention goal was to store and control the project site's post-development flows into the basins to the site's pre-development flows as well as infiltrating the 2-year storm volume increase. The infiltration testing report can be found in Appendix J. The Basin designs are as follows:

Point of Interest 1

The area draining to Point of Interest 1 is located on the western side of the site. Point of Interest 1 is a culvert which carries Walker Run under a driveway along North Market Street. Development in the area discharging to this point of interest includes the construction of the North Market Street Stockpile Area, Power Block, and Main Parking Lot.

There are eleven underground basins within Point of Interest 1. Basins 1.1, 1.2, 1.3, and 1.5 are located in the Main Parking lot. Basin 1.1, 1.2, and 1.3 are utilized for rate control, volume control, and water quality. Basin 1.5 is used for rate control. Basin 1.1 is 4.5' deep with an applied infiltration rate of 0.274 in/hr. Basin 1.2 is 5' deep with an applied infiltration rate of 2.14in/hr. Basin 1.3 is 5' deep with an applied infiltration rate of 2.25 in/hr.

Two basins are located in the area of the North Market Street Stockpile Area. Basin 8 and Basin 9 are both underground basins used for rate control, volume control, and water quality. Basin 8 is 3' deep and has an applied infiltration rate of 1.51 in/hr. Basin 9 is 3' deep and has an applied infiltration rate of 3.33 in/hr.

The remaining five basins are located in and around the Power Block. Basin 10.1 is 5' deep and has an applied infiltration rate of 1.71 in/hr. Basin 10.4 is 4' deep and has an applied infiltration rate of 3.71 in/hr. Basin 13.1 is 4' deep and has an applied infiltration rate of 0.26 in/hr. Basin 12 is 3' deep and has an applied infiltration rate of 10.0 in/hr. Basin 22 is 3' deep and has an applied infiltration rate of 1.82 in/hr.

The total post-development flows for the 2, 10, 25, and 100 year storm events are less than the required pre-development total flows. See Table 3-1. Detailed computations supporting the results shown in Table 3-1 can be found in Appendix C, D, G and H.

Table 3-1 - Stormwater Management Results- Point of Interest 1

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	200.07	183.80
10-year	598.07	490.18
25-year	1003.90	767.31
100-year	1955.30	1391.31

Point of Interest 2

Point of Interest 2 is a culvert crossing US 11 near the intersection of Confers Ln and US 11. Development within Point of Interest 2 includes the construction associated with the Main Parking Lot, Met Tower/Construction Buildings, and laydown space along SUPP Rd, the main access off of US 11.

There are two basins located within POI 2. Basin 3.1 is an underground basin that is 5' deep and is used for peak flow reduction. Basin 3.2 is an aboveground basin with a depth of 11.5' and an applied infiltration rate of 0.51 in/hr.

The total post-development flows for the 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-2. Detailed computations supporting the results shown in Table 3-2 can be found in Appendix C, D, G and H.

Table 3-2 - Stormwater Management Results- Point of Interest 2

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	39.83	33.76
10-year	132.99	119.56
25-year	231.04	207.84
100-year	473.21	394.50

Point of Interest 3A

The area draining to Point of Interest 3A is located on the south side of US 11 at the PPL owned railroad along the Susquehanna River. The northern portion of the site will drain to the proposed basin, Basin 21. The remaining area, By Basin 21, will drain uncontrolled to Point of Interest 3A. Basin 21 is an aboveground basin used for rate control, volume control, and water quality. The basin will be used as a sediment basin during construction and converted to a permanent basin once the area is stabilized. Conversion will consist of the removal of the top two (2) feet of the basin bottom. The basin is 11' deep with a bottom elevation of 529'. Using an average infiltration rate of 10.00 in/hr. the increase in runoff between the 2-year pre and post-development storms is infiltrated.

The total post-development flows for the 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-3. Detailed computations supporting the results show in Table 3-3 can be found in Appendix C, D, G and H.

Table 3-3 - Stormwater Management Results- Point of Interest 3A

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	16.66	0.01
10-year	60.88	1.25
25-year	103.41	3.71
100-year	202.69	22.72

Point of Interest 4

Point of Interest 4 is a culvert beneath Bell Bend Rd, 900' south of the Quarry entrance. Development within Point of Interest 4 includes the construction associated with the Main Parking Lot, Met Tower/Construction Buildings, and laydown space along SUPP Rd, the main access off of US 11.

There are no constructed basins within POI 4. An existing wetland adjacent to the Met Tower will serve as additional storage for the development in POI 4 due to modifications in the surrounding elevations.

The total post-development flows for the 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-4. Detailed computations supporting the results shown in Table 3-4 can be found in Appendix C, D, G and H.

Table 3-4 - Stormwater Management Results- Point of Interest 4

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	0.52	0.12
10-year	14.46	2.65
25-year	48.60	20.33
100-year	157.24	90.19

Point of Interest 5

Point of Interest 5 is located at a culvert beneath Bell Bend Rd., 230' north of the Quarry entrance. Development in the area discharging to this point of interest includes the construction associated with the Quarry, Construction Buildings, Laydown Space, and Batch Plant.

Runoff will be collected in an underground basin, Basin 6. The remaining area not collected in the basin will drain uncontrolled to this Point of Interest. Basin 12 is an underground basin used for rate control, volume control, and water quality. The basin is 5' deep with a bottom elevation of 630.00. An average infiltration rate of 2.50 in/hr. was applied to the calculations.

The total post-development flows for the 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-5. Detailed computations supporting the results shown in Table 3.-5 can be found in Appendix C, D, G and H.

Table 3-5 - Stormwater Management Results- Point of Interest 5

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	2.59	0.02
10-year	22.64	4.17
25-year	48.31	13.96
100-year	115.21	35.47

Point of Interest 6

Point of Interest 6 is located at a culvert beneath US 11, 2130' south of the SSES Plant entrance. Development in the area discharging to this point of interest includes portion of construction associated with the Batch Plant and railroad.

Runoff will be collected in an aboveground basin, Basin 18. The remaining areas not collected in the basin will drain uncontrolled to this Point of Interest. Basin 18 is an aboveground basin used

for volume control and water quality. The basin is 7' deep with a bottom elevation of 619.00. An average infiltration rate of 1.39 in/hr. was applied.

The total post-development flows for the 1, 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-6. Detailed computations supporting the results shown in Table 3-6 can be found in Appendix C, D, G and H.

Table 3-6 - Stormwater Management Results- Point of Interest 6

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
1-year	63.63	63.10
2-year	98.29	96.55
10-year	206.10	200.99
25-year	295.38	288.76
100-year	484.85	477.75

Point of Interest 9

This area is located at the north portion of the site and ultimately discharges to this Point of Interest at the center of the southern boundary of the drainage area along Beach Grove Road. Development in the area discharging to this point of interest includes construction associated with the New 500kV Switch Yard.

A majority of the area will bypass the basin and drain uncontrolled to this Point of Interest. The area in the 500kV Switch Yard will drain into Basin 15.3, an underground basin, used for rate control, volume control, and water quality. Basin 15.3 is 5' deep with a bottom elevation of 1020.00. An average infiltration rate of 0.250 in/hr. was applied.

The total post-development flows for the 2, 10, 25, and 100 year storms are less than the required pre-development total flows. See Table 3-7. Detailed computations supporting the results shown in Table 3-7 can be found in Appendix C, D, G and H.

Table 3-7 - Stormwater Management Results- Point of Interest 9

Storm Event	Total Pre-Development (CFS)	Total Post-Development Controlled (CFS)
2-year	53.10	44.57
10-year	121.23	109.29
25-year	179.63	167.59
100-year	305.85	294.61

C. INFILTRATION AND VOLUME ANALYSIS

Infiltration testing was performed in accordance with the methodology specified in the Pennsylvania DEP BMP Manual Appendix C. The locations for each test were strategically selected based on the proposed site layout, site features, and planned stormwater management locations. Testing results can be found in Appendix J of this report. The locations of the tests are shown on the PCSM plan set. Per the PA BMP manual Appendix C, 4-6 tests/acre of BMP area is the recommended guideline. The number of tests used for infiltration design rate calculation was 108 tests. There is 26.79 Acres of infiltration basin bottom area. These values provide a ratio of over 4 tests/acre.

The design infiltration rate was established by calculating the geometric mean for the relevant sample at each proposed basin site and applying a safety factor of 2. See Table I.1 in Appendix I for more detailed information on rates, locations, and stormwater management items.

Volume reductions for each Point of Interest were calculated in Table I.2 and summarized in Table I.3 in Appendix I. Although the volume reductions vary positively and negatively for each POI, as seen in Table I.3, the site has an overall reduction in runoff volume.

D. 2-YEAR STORM EVENT RUNOFF VOLUME FOR INTAKE AREA

For the intake area, no stormwater detention is provided, because runoff will be discharged directly to Susquehanna River via protected outlet structures. Instead, the 2-year runoff volumes for pre- and post-development are compared. The estimated pre- and post-development runoff volumes are 23,360 and 38,682 cubic-feet, respectively. The 2-Year runoff volume increase at the intake area is 16,588 cubic-feet. See Appendix K for full Intake area report.

VII. STORMWATER CONVEYANCE

Culvert, and swale flows were calculated using the rational method for the 25-year design storm in PennDOT Region 5. Swales were designed using North American Green Software NAG Version 4.31. Culverts were designed using HY-8 version 7.2.

VIII. STORMWATER BEST MANAGEMENT PRACTICES

Stormwater BMP's are proposed for the site that will provide a total decrease in stormwater volume between the pre and post-development two-year storm event. The systems include a series of structural BMP's including infiltration basins and vegetated swales. The systems will combine to provide water quality treatment that meets the requirements of the Pennsylvania DEP.

Infiltration testing was performed on the site in the areas of proposed stormwater management. See Appendix J for infiltration results performed by Pennoni Associates.

Proposed structural BMP's that will reduce volume, include a series of surface infiltration/detention basins and subsurface infiltration basins. Additional water quality BMP's include: level spreaders, grass-lined swales, and Snout inlet inserts to be installed in inlets prior to the infiltration basins.

Control Guideline 1 for runoff volume control will be met with the implementation of a series of structural BMP's as listed above. They will all combine to limit the effects of the post construction stormwater discharges degradation of the physical, chemical, or biological characteristics of the receiving waters.

IX. ANITDEGRADATION ANALYSIS

Non Discharge Alternatives

Non-discharge alternatives were evaluated before implementing any Antidegradation Best Available Combination Technologies (ABACT) measures. All existing site features were evaluated and used for post-construction management and erosion and sedimentation control. The following are descriptions of all non-discharge alternatives that were evaluated.

E&S Plan

Alternate Siting

- Avoidance of disturbance to wetlands and streams, along with minimization of unavoidable impacts to those features, was a key factor in the current siting of BBNPP. Details of how impacts were reduced to the maximum practicable extent are provided herein to demonstrate the Project's compliance with the "avoid, minimize, mitigate" policy endorsed by the ACOE and PADEP.

  The current project design includes approximately 2.57 acres of permanent impact to wetlands and 997 feet of impacts to streams. The current design also includes 6.8 acres of wetland enhancement, 8.23 acres of creation and 2,213 feet of stream creation/enhancement. Forested wetlands created or converted will total 14.60 acres, exceeding the amount cleared. This level of impact is considered to represent the least impact to wetland and streams possible while fulfilling the Project's overall purpose and need. The current project design also eliminates 100 acres of wetland disturbance from the original design location in 2008 through relocation of site development.

  Since the initiation of the planning and design of BBNPP, PPL has advanced numerous iterations of the layout and design of BBNPP with the goal of avoiding the wetlands and stream features. Pre-application meetings with regulatory agencies and input on required avoidance and minimization measures were considered carefully in the design effort for BBNPP. Once the determination was made that the proposed site was in the preferred location for the construction of BBNPP, PPL investigated numerous options to avoid direct, indirect and reasonably foreseeable cumulative impacts to wetlands and streams. The current BBNPP layout represents the results of this process.

Limited Disturbed Areas

- On a project this large, all efforts will take place to limit the amount of earth disturbance.

Limit Extent and Duration of Disturbance

- On a project this large, all efforts will take place to limit the extent and duration of disturbance.

Vegetated Riparian Buffers

- It was not possible to achieve 100 foot buffers along the entire watercourses and wetlands due to the layout of the project. But, preservation of a 50' buffer zone to the extent practical around wetlands and streams in the Walker Run watershed is proposed to preserve existing riparian zones and undeveloped lands adjacent to wetlands. This measure is expected to significantly reduce secondary impacts to wetland and streams on the BBNPP Site.

PCSM Plan

Alternate Siting

- Avoidance of disturbance to wetlands and streams, along with minimization of unavoidable impacts to those features, was a key factor in the current siting of BBNPP. Details of how impacts were reduced to the maximum practicable extent are provided herein to demonstrate the Project's compliance with the "avoid, minimize, mitigate" policy endorsed by the ACOE and PADEP.

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Low Impact Development

- Adoption of low impact development (LID) practices are proposed that include siting stormwater discharges outside of wetlands and within heavily vegetated buffer areas, reduction in impervious surfaces, and construction of bridges in lieu of culverts.

Vegetated Riparian Buffers

- It was not possible to achieve 100 foot buffers along the entire watercourses and wetlands due to the layout of the project. But, preservation of a 50' buffer zone to the extent practical around wetlands and streams in the Walker Run watershed is proposed to preserve existing riparian zones and undeveloped lands adjacent to wetlands. This measure is expected to significantly reduce secondary impacts to wetland and streams on the BBNPP Site.

Infiltration

- Numerous infiltration basins are proposed throughout the site in order to infiltrate the difference between the 2-year predevelopment and 2-year post development volumes.

Water Reuse

- This was not an option due to the project's intricate and pre-determined design. The proposed non-discharge alternatives will dramatically increase volume reduction, groundwater recharge, peak rate control, and improve water quality before any structural BMP's are implemented.

Antidegradation Best Available Combination Technologies (ABACT)

The following are a description of ABACT measures considered and implemented on this site:

E&S Plan

Treatment BMP's

- A series of sediment basins with skimmers are proposed in various areas on the site to collect and treat the sediment laden runoff from the site. The basins were designed with a ratio of 4:1 or greater. Some of the sediment basins will also have 4-7 day detention times. Sediment basins will be cleaned and converted to an infiltration/detention, where possible, basin once construction is complete.

Land Disposal

- The preservation of a 50' buffer zone around wetlands in the Walker Run watershed is proposed to the greatest extent possible to preserve existing riparian zones and undeveloped lands adjacent to wetlands. This measure is expected to significantly reduce secondary impacts to wetland and streams on the BBNPP Site

- All disturbed areas must be quickly stabilized as discussed in the E&S plans

- A series of vegetated and rock-lined swales are proposed on the site.

PCSM Plan

Treatment BMP's

- Numerous surface and subsurface infiltration basins are proposed for the site to infiltrate the difference between the two year pre-development and post-development storm volumes.
- A series of vegetated and rock-lined swales are proposed on the site.
- Numerous Snout inlet inserts are proposed on the site. The snouts will provide water quality treatment prior to the infiltration basins.

Land Disposal

- The preservation of a 50' buffer zone around wetlands in the Walker Run watershed is proposed to preserve existing riparian zones and undeveloped lands adjacent to wetlands. This measure is expected to significantly reduce secondary impacts to wetland and streams on the BBNPP Site

Pollution Prevention

- PPC plan will be available on site.
- Many non-structural BMP's are to be used on site, ie: protection of sensitive and special value features such as waterbodies, riparian areas, wetlands, woodlands, natural drainage ways and steep slopes.

X. THERMAL IMPACT ANAYLSIS

The potential sources of thermal impact for this development include runoff from the proposed access drives, parking lots and buildings. Runoff from the warm impervious areas will be mitigated by routing the stormwater through a series of grass-lined swale and deep, low sloping pipes before draining into a series of subsurface infiltration/detention basins. The infiltration/detention basins will provide for permanent storage of the first flush storms, thus limiting the discharge of the warmer waters. Many of the basins will discharge via level spreaders to existing wetlands and other vegetated areas before entering the adjacent watercourses. These features will combine to mitigate any thermal impacts and allow the runoff to return to ambient temperature.

For the intake area, most of the discharge from the impervious areas will flow over grassed slopes before discharging into the river. This reduces the thermal impact of warm runoff emanating from impervious areas.

XI. MAINTENANCE OF STORMWATER FACILITIES

Structural BMP's

1. Subsurface Infiltration Basins
    a. All catch basins and inlets should be inspected and cleaned periodically, as required.
    b. The overlying vegetation of Subsurface Infiltration Basin features should be maintained in good condition, and any bare spots re-vegetated as soon as possible.
    c. Remove accumulated sediment from basin as required. Restore original cross section and infiltration rate. Properly dispose of sediment.

2. Snout Inlet Inserts
    a. Normal yearly maintenance consists of:
        i. Routine inspection and rinsing with a hose or pressure washer during the cleaning sequence of the catch basin.
        ii. Flushing the anti-siphon with water or air to verify that it is clear.
        iii. Vacuuming the snout inlet and properly disposing of sediment.
    b. Contact an engineering consultant familiar with BMP design if the inlet is clean of sediment and debris and does not drain properly.

3. Vegetated Swales
    a. Inspect and correct erosion problems, damage to vegetation, and sediment and debris accumulation.
        i. Address when greater than 3-in. at any spot or when covering vegetation. Dispose of accumulated sediment in appropriate locations. Accumulated debris should be disposed of appropriately as well.
    b. Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed.
    c. Inspect for pools of standing water
        i. Dewater and discharge to an approved location and restore to design grade.
    d. Mow and trim vegetation to ensure safety, aesthetics, proper swale operation, or to suppress weeds and invasive vegetation. Swale vegetation shall not be managed as lawn and grass; they shall be allowed to grow tall.
        i. Dispose of cuttings in a local composting facility.
        ii. Mow only when swale is dry to avoid rutting.
    e. Inspect for litter
        i. Remove prior to mowing.
    f. Inspect for uniformity in cross-section and longitudinal slope, correct as needed.
    g. Inspect swale inlet (curb cuts, pipes, etc.) and outlet for signs or erosion or blockage.
        i. Correct as needed.
    h. Plant alternative grass species in the event of unsuccessful establishment

i. Reseed bare area; install appropriate erosion control measures when native soils are exposed or erosion channels are forming.
j. Rototill and replant swale if drawdown time is more than 48 hours.
k. Water during dry periods, fertilize and apply pesticide only when absolutely needed
l. Inspect swale immediately after spring melt, remove residuals and replace damaged vegetation without disturbing remaining vegetation
m. If roadside or parking lot runoff is directed to swale, mulching and/or soil aeration/manipulation may be required in the spring to restore soil structure and moisture capacity and to reduce the impacts of deicing agents.
n. Use non-toxic, organic deicing agents. Applied either as blended, magnesium chloride-based liquid products or as pretreated salt.
o. Use salt tolerant vegetation in swales.

4. Street Sweeping
    a. Bi-annual street sweeping of all parking lots and access drive should be performed.

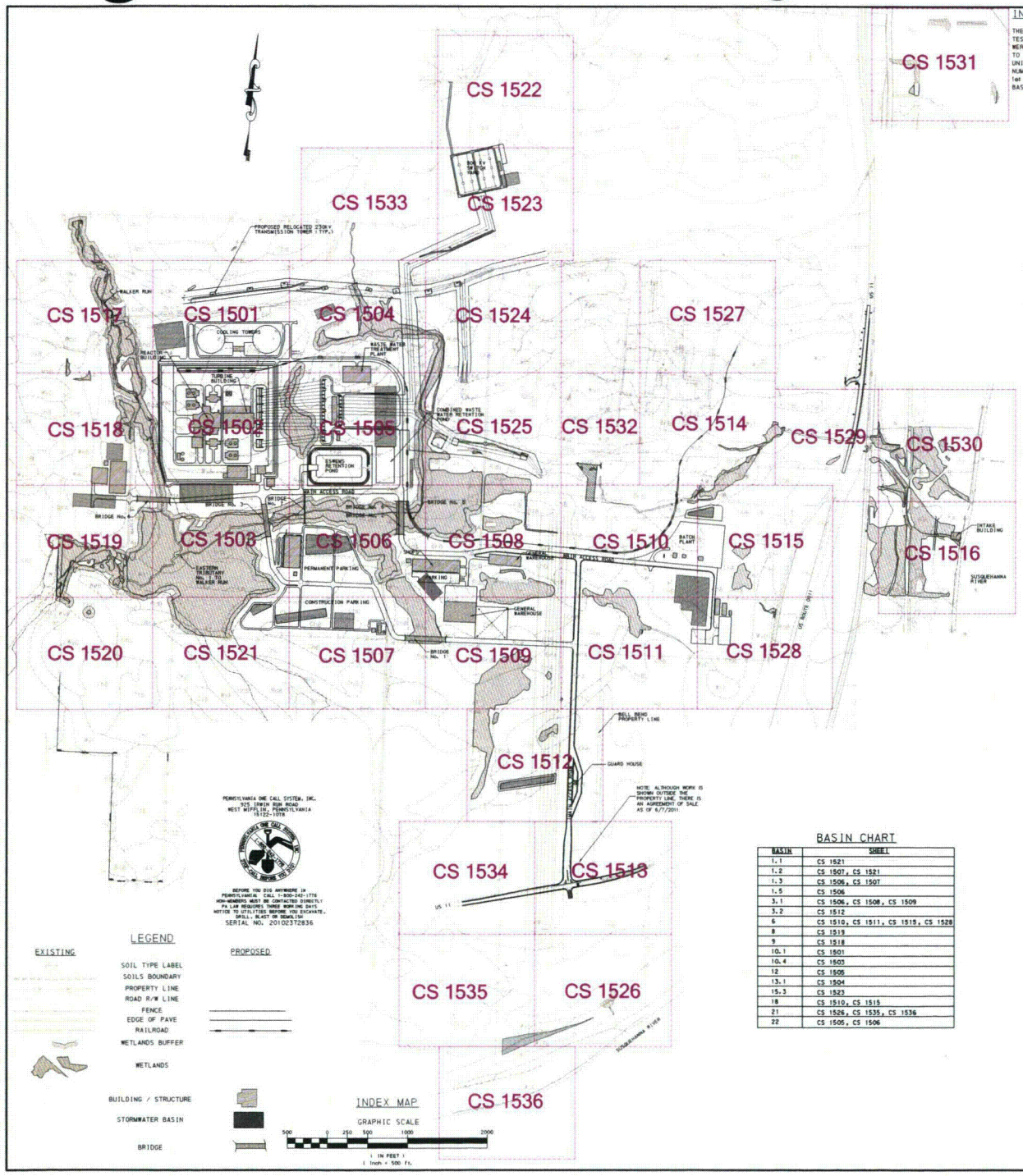
Table 4 summarizes the potential stormwater related problems, their proposed resolutions and responsible parties. (see next page)

Table 4 – Maintenance of Stormwater Facilities

Facility	Potential Problem	Remedy	Responsible Party
Outlet Protection	Dislodged Stones	Replace with larger stones.	Owner
	Erosion below outlet	Enlarge riprap apron; or Line receiving channel below outlet	
	Outlet Scour	Install proper filter fabric or graded bedding beneath riprap apron	
Detention Basin	Obstructed Outlet	Remove debris.	Owner
	Basin not dewatering between storms	Clear orifice and check outlet pipes for debris and sediment. Clean inlet box grate.	Owner
	Outlet Erosion	Make sure outlet is flush with ground and on level grade. Install, extend, or repair riprap apron as required.	Owner
Pipes	Clogged Pipe	Flush pipe.	Owner
Inlets	Silt and Debris	Remove silt and debris.	Owner
Swales	Water Quality	Vegetation in swales should remain uncut to promote the settlement of sediment and evapotranspiration once all swales are fully vegetated. (Applies to swales not adjacent to roads)	Owner

XII. CONCLUSION

The site is designed to safely convey the 25-year storm through a series of inlets, pipes and infiltration/ detention basins. The project site's post development 2, 10, 25, and 100 year storm runoff rates are released from the site below their respective pre-development storm runoffs rates, except for the intake area located directly on the banks of Susquehanna River. The intake area will not require stormwater management due its location along the bank of the Susquehanna River. All the areas abutting the river will drain directly to it in an effort to allow storm run off to pass through the waterway prior to the peak event. The site's cumulative runoff volume for the 2-year storm in post-development conditions will be less than pre-development conditions. The construction of the project will not cause physical degradation of the receiving waters.



INFILTRATION NUMBERING:

THE INITIAL TEST NUMBERS CORRELATE TO A PRELIMINARY CONCEPT PLAN BASIN NUMBERING SCHEME. THE FOLLOW UP ROUND OF TESTING WAS COMPLETED AFTER ALL POINTS OF INTEREST WERE IDENTIFIED. THE NUMBERING SCHEME FOR THE FOLLOW UP ROUNDS WERE ORGANIZED IN THE 200 AND 300 SERIES TO SIGNIFY THE SECOND AND THIRD ROUNDS. ALL TENS AND ONES UNITS RELATE TO THE BASIN NUMBER, AND EACH BASIN NUMBER IS RELATED TO THE POINT OF INTEREST IN WHICH IT IS LOCATED. ANY TENTHS UNITS DIFFERENTIATE BETWEEN MULTIPLE BASINS WITHIN THE SAME POINT OF INTEREST. ANY ALPHA DIGITS IN THE TEST NUMBER ARE USED TO NOTE ADDITIONAL TESTS WITHIN THE SAME BASIN.
1at 203.1.A SIGNIFIES THE FIRST TEST IN THE FOLLOW UP ROUND OF INFILTRATION TESTING, IN POINT OF INTEREST 3, IN BASIN 3.1.

INITIAL TESTS
INFILTRATION TEST PITS

TEST No.	TEST ELEV.	EXISTING ELEV.	TEST DEPTH
1A.1	713.2	760	46.8'
1A.2	713.2	791.4	78.2'
1B.1	713.6	675	-38.6'
1B.2	713.6	680	-33.6
2.1	713.6	785	71.4'
2.2	713.6	750	36.4'
3.1	685	690	5'
3.2	685	687	2'
4.1	657	665	8'
4.2	657	660	3'
5.1	706.4	720	13.6'
5.2	706.4	715	8.6'
6.1	714	722.5	8.5'
6.2	714	721	7'
7.1	712.3	715	2.7'
7.2	712.3	715	2.7'
8.1	687	695	8'
8.2	687	N/A	N/A
9.1	663	670	7'
9.2	663	665.7	2.7'
10.1	669	672.6	3.6'
10.2	669	673.5	4.5'
11.1	660	670	10'
11.2	660	665	5'
12A.1	676	680	4'
12A.2	676	680	4'
12B.1	678.4	670.6	-7.8
12B.2	678.4	670	-8.4
13.1	667	659.3	-7.7
13.2	667	651.9	-15.1
14.1	652	655	3'
14.2	652	655	3'
15.1	630	635	5'
15.2	630	635	5'
16.1	663	668.3	5.3'
16.2	663	668.3	5.3'
17.1	657	665	8'
17.2	657	665	8'
18.1	-	-	-

FOLLOW UP TESTS
INFILTRATION TEST PITS

TEST No.	TEST ELEV.	EXISTING ELEV.	TEST DEPTH
18.2	-	-	-
201.A	663	668.7	5.7'
201.B	663	671	8'
202.A	670	678	8'
202.B	670	676	6'
203.1.A	674	679	5
203.1.B	674	678	4'
203.2.A	648.5	649	0.5'
203.2.B	648.5	653.5	5'
204.2.A	671.4	-	-
204.2.B	671.4	-	-
206.A	630	-	-
206.B	630	-	-
208.A	660	665	5'
208.B	660	666	6'
209.A	663	-	-
209.B	663	-	-
210.1.A	685	-	-
210.1.B	685	-	-
210.4.A	660	667	7'
210.4.B	660	665	5'
212.A	685	712	27'
212.B	685	715	30'
213.1.A	714	718	4'
213.1.B	714	723	9'
213.2.A	-	-	-
213.2.B	-	-	-
215.1.A	990	1011	21'
215.1.B	990	1011	21'
215.2.A	990	1004	14'
215.2.B	990	1004	14'
215.C	990	999	9'
251.D	990	999	9'
218.A	619	625	6'
218.B	619	622	3'
220.A	648	651	3'
220.B	648	649.3	1.3'
221.A	603	607	4'
221.B	603	608	5'
301.1.A	664	667.0	3.0
301.1.B	664	664.5	0.5
301.1.C	664	666.9	2.9
301.2.A	683	685.4	NA
301.2.B	690.8	692.8	2.0
301.2.C	683	688.0	5.0
301.2.D	690.6	693.1	2.5
301.2.E	683	689.1	6.0
301.3.A	682	684.0	2.0

FOLLOW UP TESTS
INFILTRATION TEST PITS

TEST No.	TEST ELEV.	EXISTING ELEV.	TEST DEPTH
301.3.B	687.2	689.2	2.0
301.3.C	690.2	692.2	2.0
301.3.D	686.3	688.3	2.0
301.3.E	685.4	687.4	2.0
301.3.F	689.6	692.6	3.0
301.3.G	686.5	692.5	6.0
301.4.A	673	674.6	NA
301.4.B	673	679.4	NA
301.4.C	673	676.0	NA
301.4.D	673	681.6	NA
301.4.E	673	677.1	NA
301.5.C	680	684.0	NA
301.5.D	680	682.2	NA
301.5.E	680	691.7	NA
301.5.F	680	686.0	NA
301.5.G	680	681.2	NA
301.5.H	680	690.0	NA
301.5.I	680	686.0	NA
301.5.J	680	682.0	NA
301.5.K	680	691.0	NA
301.5.L	680	684.0	NA
303.2.A	648.5	649.4	0.9
303.2.B	648.5	650.3	1.8
303.2.C	648.5	655.0	6.5
306.A	630	639.5	9.5
306.B	630	639.1	9.1
306.C	630	640.5	10.5
306.D	630	637.3	7.3
306.E	630	635.9	5.9
306.F	630	637.6	7.6
306.G	630	640.5	10.5
306.H	630	633.7	3.7
306.I	630	638.7	8.7
306.J	630	641.3	11.3
306.K	630	635.2	5.2
306.L	630	632.6	2.6
306.M	630	634.7	4.7
306.N	630	638.2	8.2
306.O	630	639.4	9.4
306.P	630	641.1	11.1
308.A	664	666.8	2.8
308.B	664	666.1	2.1
308.C	664	665.5	1.5
308.D	664	666.4	2.4
308.E	664	666.3	2.3
308.F	664	665.7	1.7
308.G	664	666.7	2.7
308.H	664	664.4	0.4
309.A	667.9	670.4	2.5
309.B	663.5	669.5	6.0
309.C	663	666.2	3.0
3.1	685	690.0	5.0
3.2	685	687.0	2.0
3101.1.A	685	689.3	4.3
3101.1.B	685	687.6	2.6
3101.1.C	685	685.7	0.7
3101.1.D	685	690.0	5.0
3101.1.E	685	688.1	3.1
3101.1.F	685	688.7	3.7
3101.1.G	685	690.0	5.0
3101.1.H	685	693.3	8.3
3101.1.I	685	692.0	7.0
3101.1.J	685	697.0	12.0
310.4.A	660	660.7	NA
310.4.B	660	661.0	NA
310.4.C	660	662.0	NA
310.4.D	660	662.0	NA
310.4.E	660	662.8	NA
310.4.F	664	668.5	4.5
310.4.G	664	668.0	4.0
310.4.H	664	668.5	4.5
310.4.I	664.5	669.5	5.0
310.4.J	664.0	670.0	6.0
310.4.K	664	666.5	2.5
310.4.L	664	667.5	3.5
310.4.M	664	667.0	3.0
310.4.N	664	668.2	4.2
310.4.O	664	669.0	5.0
310.4.P	664	664.2	0.2
310.4.Q	664	668.0	4.0
310.4.R	664	665.5	1.5
310.4.S	664	664.0	0.0
310.4.T	664	666.5	2.5
312.A	685	689.8	4.8
313.1.A	718	718.1	0.1
313.1.B	718	720.4	2.4
313.1.C	718	723.0	5.0

FOLLOW UP TESTS
INFILTRATION TEST PITS

TEST No.	TEST ELEV.	EXISTING ELEV.	TEST DEPTH
315.3.A	1030	1041.0	NA
315.3.B	1030	1034.9	NA
315.3.C	1030	1036.7	NA
315.3.D	1030	1041.5	NA
315.3.E	1030	1038.0	NA
315.3.F	1030	1035.5	NA
315.3.G	1030	1035.1	NA
315.3.H	1030	1030.8	NA
315.3.I	1030	1031.8	NA
315.3.A1	1020	1022.0	2.0
315.3.B1	1020	1031.0	11.0
315.4.A	1018	1029.2	NA
315.4.B	1018	1018.9	NA
315.4.C	1018	1028.8	NA
315.4.D	1018	1018.5	NA
315.4.E	1018	1028.9	NA
315.4.F	1018	1021.3	NA
318.A	619	629.9	10.9
318.B	619	619.0	0.0
321.A	536.0	541.0	5.0
321.B	536.4	540.9	4.5
321.C	529	529.6	0.6
321.D	529	539.0	10.0
321.E	529	539.3	10.0
321.F	529	532.9	3.9
321.G	529	539.5	10.5
321.H	529	536.9	7.9
322.A	677	681.0	4.0
322.B	677	678.0	1.0

BASIN CHART

BASIN	SHEET
1.1	CS 1521
1.2	CS 1507, CS 1521
1.3	CS 1506, CS 1507
1.5	CS 1506
3.1	CS 1506, CS 1508, CS 1509
3.2	CS 1512
6	CS 1510, CS 1511, CS 1515, CS 1528
8	CS 1519
9	CS 1518
10.1	CS 1501
10.4	CS 1503
12	CS 1505
13.1	CS 1504
15.3	CS 1523
18	CS 1510, CS 1515
21	CS 1526, CS 1535, CS 1536
22	CS 1505, CS 1506

DRAWING LIST

Pennoni Associates Inc.
Engineers • Surveyors • Planners • Landscape Architects
100 N. Wilkes-Barre Boulevard
Wilkes-Barre, PA 18702 (570) 824-2200

Pennoni

DATE	NO	REVISIONS	BY
9/15/11	1	EXCESS EARTHWORK REDUCTION AND LOD CHANGES	LGB

ALL TOPOGRAPHIC MUST BE VERIFIED BY CONTRACTOR AND OWNER MUST BE NOTIFIED OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK

BELL BEND NUCLEAR POWER PLANT
PCSM INDEX PLAN
SALEM TOWNSHIP, PENNSYLVANIA

PPL BELL BEND, LLC
38 BOMBOY LANE, SUITE 2
BERWICK, PA 18603

JOB NO. PPLS0902
SHEET 1 OF 43
SCALE 1"=500'
DRAWN BY LGB
DATE 9/15/2011
APPROVED JFM
DRAWING NO. CS 1401 PCSM

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
and
U.S. ARMY CORPS OF ENGINEERS

ENVIRONMENTAL ASSESSMENT FORM (E.A. Form)

PART 1 - RESOURCE IDENTIFICATION

1. **Indicate water resources which exist on the project site.**

Name of streams(s) and/or body of water (including wetlands) Walker Run, Unnamed Tributaries to Walker Run, North Branch Susquehanna River (NBSR), delineated wetlands, 5 ponds

Size of body of water (in acres) 162 total acres total

Wetland - If wetlands are present at the project site, provide the following information relative to the person(s) or organization performing the wetland identification, delineation and related work:

Paul Harmon and Robert Blye
Name

Normandeau Associates Environmental Consultants
Organization/Company

400 Old Reading Pike, Building A, Suite 101
Address

Stowe, PA 19464

Telephone

QUALIFICATIONS

Normandeau Associates has extensive experience in completing wetlands delineations on many project sites. See the delineation report for additional qualifications.

If wetlands are present, attach a copy of the wetland delineation report identified and labeled as **Enclosure A**. Include all field data sheets, denote the size (in acres) of the wetland. If this information details any physical information or features not shown in the "site plan" please attach additional plans which illustrate these features.

Enclosure A

PART 1 - RESOURCE IDENTIFICATION (continued)	YES	NO
2. **Is the site located within or adjacent to any of the following? Please mark either the "yes" or "no" column for each question.**		
A. National, state or local park, forest or recreation area	☒	☐
B. Natural, wild, or wilderness area	☐	☒
C. National natural landmark	☐	☒
D. National wildlife refuge, or Federal, state, local or private wildlife or plant sanctuaries	☐	☒
E. State Game Lands	☐	☒
F. Areas identified as prime farmland	☒	☐
If not included in the permit application package, please attach a map (e.g. 1:2400 scale or greater) indicating the location of the project, all water resources and the features identified above. Label the map as Enclosure B.	**ENCLOSURE B**	
3. Is the water resource listed as stocked waters by the Pennsylvania Fish and Boat Commission?	☒	☐
4. Is the water resource designated as a wild trout stream by the Pennsylvania Fish and Boat Commission?	☒	☐
5. Is the water resource listed as High Quality or Exceptional Value in Title 25 Pa. Code Chapter 93?	☐	☒
Indicate the stream classification found in Chapter 93. Classification CWF (Walker Run); WWF (NBSR)		
6. Is the water resource designated as a National Wild or Scenic River or as part of the Commonwealth's Scenic Rivers System or classified as priority 1-A for inclusion in the system?	☐	☒
7. Is the water resource part of or located along a private or public water supply?	☐	☒
(IF COMPLETING A SMALL PROJECT APPLICATION ADVANCE TO PART 3)		
8. Provide a written narrative, identified and labeled as "Enclosure C - Description of Aquatic Habitat," discussing the following ecological functions:		
A. Aquatic habitats including:		
(1) Food chain production		
(2) General habitat a. Nesting e. Migration b. Spawning f. Feeding c. Rearing g. Escape Cover d. Resting h. Other		
(3) Habitat for threatened and endangered plant and animal species (Discuss results of the Pennsylvania Natural Diversity Inventory (PNDI) form)		
(4) Environmental Study Areas a. Sanctuaries b. Refuges		
(5) If project proposes a stream relocation, a stream enclosure, or dredging, provide a description of the instream macroinvertebrate community.		

ENCLOSURE C

PART 1 - RESOURCE IDENTIFICATION (continued)	ENCLOSURE C Description of Aquatic Habitat
B. Water Quantity and Streamflow	
(1) Natural drainage patterns	
(2) Flushing characteristics	
(3) Current patterns	
(4) Groundwater discharge for baseflow	
(5) Natural recharge area for ground and surface waters	
(6) Storm and floodwater storage and control	
C. Water Quality	
(1) Preventing Pollution	
(2) Sedimentation control and patterns	
(3) Salinity distribution	
(4) Natural water filtration	
D. Recreation	
(1) Game Species	
(2) Non Game Species	
(3) Fishing	
(4) Hiking	
(5) Observation (plant/wildlife)	
(6) Other	
E. Upstream and Downstream Property	
F. Other Environmental Factors Determined by Site Investigation	
PART 2 - PROJECT DESCRIPTION	
9. **Project Impacts** For impacts to regulated waters of the Commonwealth, answer fully, completely and in detail the following questions; attach and label as **Enclosure D**.	ENCLOSURE D
A. Discuss the impacts on:	
(1) National, state or local park, forest or recreation area	
(2) Natural, wild, or wilderness area	
(3) National, state, or local historic site	
(4) National natural landmark	
(5) National wildlife refuge	
(6) Cultural or archaeological landmarks	
(7) State Game Lands	

PART 2 - PROJECT DESCRIPTION (continued)	
(8) Federal, state, local or private plant or wildlife sanctuaries	
(9) Areas identified as prime farmland	
B. Discuss the environmental impacts on:	
(1) Aquatic habitats including:	
a. Food Chain production	
b. General habitat (1) Nesting (5) Migration (2) Spawning (6) Feeding (3) Rearing (7) Escape Cover (4) Resting (8) Other	
c. Habitat for threatened and endangered plant and animal species	ENCLOSURE D Project Impacts
d. Environmental Study Areas (1) Sanctuaries (2) Refuges	
(2) Water Quantity and Streamflow	
a. Natural drainage patterns	
b. Flushing characteristics	
c. Current patterns	
d. Groundwater discharge for baseflow	
e. Natural recharge area for ground and surface waters	
f. Storm and floodwater storage and control	
(3) Water Quality	
a. Preventing Pollution	
b. Sedimentation control and patterns	
c. Salinity distribution	
d. Natural water filtration	
(4) Recreation	
a. Game Species	
b. Non Game Species	
c. Fishing	
d. Hiking	
e. Observation (wildlife)	
f. Other	
(5) Upstream and downstream property	
(6) Other Environmental Factors	

PART 2 - PROJECT DESCRIPTION (continued)

C. Identify all environmental impacts on other adjacent land and water resources associated with the construction, modification or operation of the dam, reservoir, water obstruction, or encroachment in the area of the project.

D. Identify and evaluate the potential cumulative environmental impacts of this project and other potential or existing projects like it, and the impacts that may result through numerous piecemeal changes to the resource.

E. Identify and describe all other dams, water obstructions or encroachments which may or will be needed, in addition to those described in this Application, to fulfill the purpose of the current project.

ENCLOSURE D

PART 3 - CERTIFICATION

I certify that the above statements, attachments including those labeled and identified as Enclosures, and all conclusions are true, correct, and based upon current environmental principles and science, to the best of my knowledge and belief.

Signature of Person Completing the Environmental Assessment Form

4-29-11

Date

Ben Ehrhart

The Department may waive a specific information requirement in writing, at the request of the Applicant, during the pre-application review process if the Department determines that specific information is not necessary to review the application.

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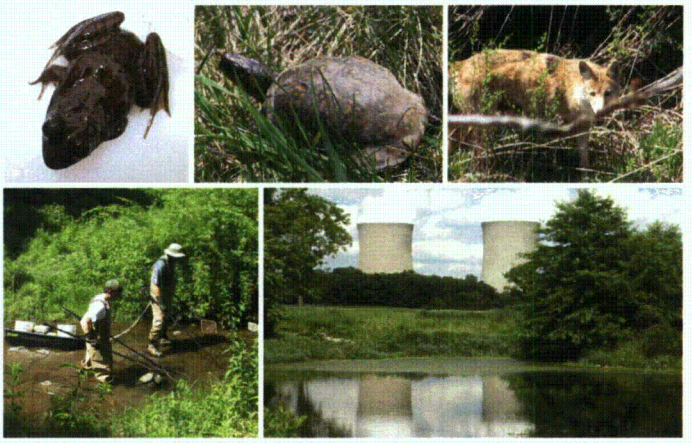
Enclosure A

Wetland Delineation and Exceptional Value Wetlands Analysis Report
for the Proposed Bell Bend Nuclear Power Plant Site,
Luzerne County, Pennsylvania

Rev. 7

Wetlands Delineation and Exceptional Value Wetlands Analysis Report for the Proposed Bell Bend Nuclear Power Plant Site, Luzerne County, Pennsylvania



Submitted to:
AREVA NP, Inc.
Marlborough, MA

September 2011

Bell Bend Nuclear Power Plant

Salem Township
Luzerne County, Pennsylvania

Revision 7

WETLANDS DELINEATION
AND
EXCEPTIONAL VALUE WETLANDS
ANALYSIS REPORT

To satisfy:

Pennsylvania Department of Environmental Protection
Chapter 105 Dam Safety and Waterway Management
Rules and Regulations

and

U.S. Army Corps of Engineers
Regulatory Programs
33 CFR 320-330

Prepared for:

UNISTAR NUCLEAR DEVELOPMENT, LLC

September 2011

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RECORD OF REVISIONS

Revision	Date	Pages/Sections Changed	Brief Description
000	October 2008	All	Initial release
001	February 2009	Title page	Title
001		Page 2	Update definition
001		Pages 8-12	5.0: text revisions
001		Pages 14 and 15	6.0: references added
001		Figure 5	Added new properties delineated wetland boundaries
001		Figure 6	New properties wetland boundaries and documentation
001		Appendix A	Added photographs 1a-1f, 29c, 43a-43d, 51c-51l
001		Appendix B	Added datasheets BBB1-4, CCC1,DDD1, FFF1-4, NNN1-2, PPP1, RRR1-2, SSS1-2, T1, TTT1-2, UUU1-2, VVV1
002	August 2009	Title page	Title
002		Table 2	Text revision
003	July 2010	Title page	Title
003		TOC	Page numbers
003		Pages 3-4	Section 1.0: updated to reflect Plot Plan Change and additional 2010 field surveys
003		Pages 5-8	Section 2.0: updated to reflect Plot Plan Change and additional 2010 field surveys
003		Page 9	Section 3.0: updated to reflect Plot Plan Change and additional 2010 field surveys
003		Page 14-19	Section 5.0: updated to reflect Plot Plan Change and additional 2010 field surveys
003		Pages 15-17	Section 6.0: references updated
003		Figure 1	Revised site boundary, added potential areas of disturbance, and moved location of BBNPP to reflect Plot Plan Change
003		Figure 2	Revised site boundary, added wetland survey area, and moved location of BBNPP to reflect Plot Plan Change
003		Figure 3	Revised site boundary, updated NWI within survey area, and moved location of BBNPP to reflect Plot Plan Change
003		Figure 4	Revised map with new soils within updated site boundary and moved location of BBNPP to reflect Plot Plan Change
003		Figure 5	Revised site boundary, added delineated wetlands within survey area, and moved location of BBNPP to

Revision	Date	Pages/Sections Changed	Brief Description
			reflect Plot Plan Change
003		Figure 6	Revised site boundary, added delineated wetlands within survey area, and moved location of BBNPP to reflect Plot Plan Change
003		Table 1	Added new soil series
003		Table 2	Added new species to plant list and footnote
003		Appendix A	Added photographs 75-85, deleted 51c
003		Appendix B	Added datasheets AM1, AN1, AO1, AO2, AP1, AP2, AQ1, AQ2, AS1, AS2, AV1, AV2, AW1, AW2, AX1, and AX2 Deleted datasheets DPM2 and DPCCC1
003		Appendix C	Added new soil series descriptions
003		Record of Revision	Modified columns and formatting to match other source documents
004	October 2010	Figures	All Figures were revised to include the modified BBNPP Project Boundary and Figures 5 and 6 were revised to include changes to wetland boundaries associated with the preliminary jurisdictional determination walk-through during September 2010
004		References	AREVA reference 2010a, 2010b, and 2010c were updated to include the latest revision of each document
005	November 2010	Figures 5 and 6	Revised wetland boundaries to reflect the wetlands boundaries that had been determined prior to the 2nd JD walk-through
005		Page 3	Revised text to reflect the BBNPP Project Boundary name change
005		Table 1 and 2, Figure 2	Titles were revised to reflect the BBNPP Project Boundary name change
005		References	AREVA 2010 a, b, and c references were revised to reflect most recent revision of each source
006	April 2011	Figure 2	Revised wetlands survey area
006		Figures 5 and 6	Revised wetlands boundaries to reflect the wetlands boundaries that had been determined after the 2nd JD walk-through
007	September 2011	Title page	Title
007		TOC	Page numbers
007		Pages 4-5	Section 1.0: updated to reflect additional 2011 field surveys, minor editorial changes to text, and net relief value changed to 500 ft to reflect value in ER
007		Page 17	Section 5.0: revised description of northern cricket frog observations to indicate that it was heard but

Revision	Date	Pages/Sections Changed	Brief Description
			never visually observed.
007		Pages 15-17, 19	Section 5.0: updated and revised to include additional agency responses, changed DCNR to PDNCR
007		Pages 16, 18-19	Section 5.0: added summary of results from Indiana Bat Roost Tree Survey
		Page 19	Section 5.0: minor text revision to summary discussion
007		Page 21	Section 6.0: added Indiana Bat Roost Tree Survey as reference (AREVA 2011d)
007		Table 2	Added new species to plant list with new footnote
007		Figure 1	Revised site boundary and potential areas of disturbance to reflect changes associated with disposal of excess cut material
007		Figure 2	Revised site boundary and wetland survey area to reflect changes associated with disposal of excess cut material
007		Figure 3	Revised site boundary and updated NWI within survey area per changes associated with disposal of excess cut material
007		Figure 4	Revised map and added soils within updated site boundary per changes associated with disposal of excess cut material
007		Figure 5	Revised site boundary and added delineated wetlands within survey area per changes associated with disposal of excess cut material
007		Figure 6	Revised site boundary and added delineated wetlands within survey area per changes associated with disposal of excess cut material
007		Appendix A	Added photographs 86- 89
007		Appendix B	Added datasheets DPBG-1, DPBG-2 and DPBG-3
007		Appendix D	Added PFBC letter of March 2011
007		References	Updated AREVA references to reflect 2011 revisions to source reports and updated corresponding text citations, updated to include recent agency correspondence letters

1.0 INTRODUCTION

1.1 Study Objectives

Bell Bend Nuclear Power Plant (BBNPP) is proposed to be sited adjacent to the Susquehanna Steam Electric Station (SSES) in Salem Township, Luzerne County, Pennsylvania. The proposed BBNPP Project Boundary, herein referred to as the site, is presented in Figure 1. Normandeau Associates, Inc. (Normandeau) was contracted by AREVA NP, Inc. to delineate the jurisdictional boundaries of wetlands and other waters within and adjacent to potential areas of disturbance onsite that are regulated by the Pennsylvania Department of Environmental Protection (PADEP) and U.S. Army Corps of Engineers (USACE). Potential areas of disturbance are illustrated in Figure 1. The actual wetland survey area that bounds the potential areas of disturbance is displayed in Figure 2.

PADEP regulates nearly all development activities within "Regulated Waters of this Commonwealth", including all wetlands, rivers, streams and other waterbodies, under the Title 25 PA Code Chapter 105 Dam Safety and Waterway Management Regulations. PADEP Chapter 105 jurisdiction also extends to the floodways surrounding these areas. USACE regulates development activities in "Waters of the U.S.", including wetlands, under Section 404 of the Clean Water Act and activities in "Navigable Waters" under Section 10 of the River and Harbors Act . Regulatory approvals are usually required from these agencies for development activities involving wetlands and other waters under their jurisdiction. This report presents the findings of the delineation study and is intended to demonstrate that boundaries for wetlands and other waters were established in accordance with PADEP and USACE regulatory requirements.

To minimize encroachment on wetlands, PPL Bell Bend LLC and Unistar Nuclear Energy have determined that the BBNPP power block needed to be relocated approximately 1,000 ft to the north of its previous location. This alteration required expansion of the site to include several new parcels of property, alteration of the limit of disturbance (LOD), and relocation of certain other plant features. Consequently, field studies of the new parcels were performed to supplement the wetland survey data previously obtained and reported in the prior revision of this report. This revision includes the new data as well as previously reported information.

1.2 Personnel

This wetlands delineation report for the BBNPP site is the product of efforts from many well-trained personnel. The overall effort was coordinated by Project Manager Paul Harmon and Principal Ecologist Robert Blye. Field work was coordinated by Keith Maurice and was conducted during the period of July 2007 through July 2011 by Normandeau biologists Elizabeth Garlo, Jayme Schaeffer, and Christopher Roche. Dr. James Montgomery of Ecology III, Inc. also participated in the field work and provided technical assistance. Keith Maurice prepared the report, Shelly Sherman prepared report maps and figures, and Melonie Ettinger and Brenda Strouse provided secretarial support.

1.3 Description of the Site

Potential areas of disturbance associated with BBNPP extend across 687 acres (1.1 mile^2) of property adjacent to SSES (Figure 1) and are located within a larger 2,055-acre site. The terrain is variable and ranges from steeply sloping hills in the west to the relatively level floodplain of the Susquehanna Riverlands in the east. Net relief is approximately 500 feet.

Land uses consist largely of cropland, fallow farmland including an abandoned orchard and deciduous forest. Prominent hydrologic features include the Susquehanna River, Walker Run, the North Branch Canal, several former farm ponds and a beaver pond. Man-made features consist of two active gravel quarries, several outlying SSES facilities and electric transmission line corridors, and two large soil stockpiles resulting from SSES construction in the 1970s. An aerial view of the site layout is presented in Figure 2.

2.0 DELINEATION METHODOLOGY

2.1 USACE 1987 Wetlands Delineation Manual

Prior to October 2009, jurisdictional areas within the site were identified and delineated in the field solely in accordance with the U.S. Army Corps of Engineers Wetlands Delineation Manual, January 1987 (USACE Manual), which involves the use of vegetation, soils, and hydrologic conditions to define wetlands boundaries. PADEP and USACE require the use of this methodology for establishing their jurisdictional boundaries and, in most cases, the same boundary represents the jurisdictional limits of both agencies. Recent U.S. Supreme Court rulings have limited USACE regulatory jurisdiction over certain categories of streams and wetlands. However, these rulings have had no affect on PADEP's regulatory program, which maintains jurisdiction over these areas.

The USACE Manual describes three diagnostic environmental features that characterize all wetlands and which govern the delineation of wetlands boundaries:

1. Hydrophytic Vegetation: The sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to create anaerobic (oxygen deficient) conditions in the upper part, which then exerts a controlling influence on the plant species present. Hydrophytic vegetation is present when the dominant plant species in a plant community are typically adapted for life in anaerobic soil conditions.

2. Hydric Soils: Soils that have formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part (NRCS, 2010a).

3. Wetlands Hydrology: Encompasses all hydrologic characteristics of areas that are periodically inundated (< 6.6 feet mean depth) or have soils saturated to the surface for sufficient duration during the growing season to develop hydric soils and support vegetation typically adapted for life in periodically anaerobic soil conditions.

The manual provides specific field indicators that can be used to determine if the mandatory technical criteria are met for each parameter. In order for an area to be considered a wetland, at least one field indicator must be present for each parameter. Application of this methodology to the site is discussed in Section 2.3.

2.2 Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region

Effective October 2009, jurisdictional areas within the site were identified and delineated in the field in accordance with the USACE Manual and the Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Regional Supplement). Although identification and delineation of wetlands is still based on the USACE Manual's three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology; the Regional Supplement presents wetland indicators, delineation guidance,

and other information that is specific to the Northcentral and Northeast Region. This Regional Supplement is designed for use with the current version of the USACE Manual. Where differences occur, the Regional Supplement takes precedence over the USACE Manual for applications in the Northcentral and Northeast Region. A summary of the specific sections of the USACE Manual replaced by the Regional Supplement are as follows:

1. Hydrophytic Vegetation Indicators: Chapter 2 of the Regional Supplement replaces Paragraph 35, all subparts, and all references to specific indicators in Part IV of the USACE Manual.

2. Hydric Soil Indicators: Chapter 3 of the Regional Supplement replaces Paragraphs 44 and 45, all subparts, and all references to specific indicators in Part IV of the USACE Manual.

3. Wetlands Hydrology Indicators: Chapter 4 of the Regional Supplement replaces Paragraph 49(b), all subparts, and all references to specific indicators in Part IV of the USACE Manual.

4. Growing Season Definition: The definition of the Growing Season in Chapter 4 and the Glossary of the Regional Supplement replaces the definition of the Growing Season in the Glossary of the USACE Manual.

5. Hydrology Standard for Highly Disturbed or Problematic Wetland Situations: Chapter 5, Wetlands that Periodically Lack Indicators of Wetland Hydrology, Procedure item 3(g) of the Regional Supplement replaces Paragraph 48, including Table 5 and the accompanying User Note in the online version of the USACE Manual.

Application of this methodology to the site is discussed in Section 2.3.

2.3 Delineation of the Bell Bend Nuclear Power Plant Site

Prior to October 2009, wetlands were delineated solely following the methodology specified in the USACE Manual, Routine Wetlands Determination Subsection 2: On-site Inspection Necessary. This technique was the most appropriate for the size and environmental characteristics of the site. Effective October 2009, all wetlands were delineated following the methodology specified in the USACE Manual except where replaced by the Regional Supplement methodology. The delineation process was initiated by researching available reference materials in order to anticipate site conditions. References consulted included the Natural Resources Conservation Service (NRCS) Luzerne County Soil Survey, National Wetlands Inventory (NWI) mapping, aerial photography and other natural resources information. Examination of these references revealed which portions of the survey area would most likely be included within USACE and PADEP jurisdictions so that special attention could be focused on these areas.

The survey area was then systematically searched for wetlands and other regulated waters. During this process all plant communities within the survey area (Figure 2) were mapped and documented. Data collected for each community included dominant vegetation, hydrology, soil

conditions and evidence of disturbance. This information was recorded on the appropriate USACE data form (Appendix B).

Prior to October 2009, vegetation data was evaluated using the U.S. Fish and Wildlife Service's (USFWS) 1988 National List of Plant Species that Occur in Wetlands Northeast (Region 1) and 1995 supplement to the list, augmented by information from various vegetation identification keys for species not found on either list. The plant lists categorizes species according to the following system of indicators:

Obligate (OBL): Always found in wetlands under natural (not planted) conditions (> 99% frequency), but may persist in nonwetlands if planted there by man or in wetlands that have been drained, filled, or otherwise transformed into nonwetlands.

Facultative Wetlands (FACW): Usually found in wetlands (67%-99% frequency), but occasionally found in nonwetlands.

Facultative (FAC): Sometimes found in wetlands (34%-66% frequency), but also occurs in nonwetlands.

Facultative Uplands (FACU): Seldom found in wetlands (1%-33% frequency) and usually occurs in nonwetlands.

Nonwetlands (UPL): Occurs in wetlands in another region, but not found (<1% frequency) in wetlands in the region specified. If a species does not occur in wetlands in any region, it is not on the list.

Beginning October 2009, vegetation data was identified and characterized similarly except that the Regional Supplement (Chapter 2, Hydrophytic Vegetation Indicators) dropped all (+) and (-) modifiers from the indicator status (e.g., FACW+ is now considered FACW). In addition, the Regional Supplement requires that absolute percent cover for each plant and total percent cover per stratum be recorded. Vegetation data is then evaluated beginning with a rapid field test for hydrophytic vegetation (Indicator 1) to determine if there is a need to collect more detailed vegetation information. If the first indicator is not met, then a standard dominant test (Indicator 2) is performed. If this test fails, then vegetation is re-evaluated using the prevalence index (Indicator 3) or by observing plant morphological adaptations for life in wetlands (Indicator 4).

Prior to October 2009, soils were evaluated based on a detailed examination of color, mottling, consistence and other characteristics as specified in the USACE Manual (Routine Determination Method Subsection 2: On-site Inspection Necessary - Step 14). Additional guidance for interpreting soil conditions was provided by "*Field Indicators of Hydric Soils in the United States*." Munsell color charts were used to determine soil color. Typically, presence or absence of hydric soil conditions is determined within a diagnostic horizon extending from immediately below the A horizon (topsoil) to a depth of 10-inches, whichever is shallower. In plowed soils (>10-inches), hydric conditions must be present immediately below the Ap horizon (plow horizon). Beginning October 2009, soils were evaluated based on a detailed examination of color, redoximorphic features and other characteristics as specified in the Regional Supplement (Chapter 3, Hydric Soil Indicators). The soil indicators in the Regional Supplement are designed

to help identify hydric soils in the Northcentral and Northeast Region and are a regional subset of those indicators provided by "*Field Indicators of Hydric Soils in the United States.*"

Prior to October 2009, hydrology was evaluated based on topographic position and the list of indicators from the USACE Manual (Routine Determination Method Subsection 2: On-site Inspection Necessary - Step 10). Evidence of wetlands hydrology includes inundation, saturated soils, watermarks and/or sediment deposits on vegetation and drainage patterns characteristic of wetlands. Beginning October 2009, hydrology was evaluated based on topographic position and the list of Northcentral and Northeast Region-specific indicators from the Regional Supplement (Chapter 4, Wetland Hydrology Indicators).

The results of the data collection effort were used to identify wetlands and upland plant communities, and to determine the site-specific indicators of transition between these communities. The wetlands-uplands transition point corresponds to the wetlands jurisdictional boundary and a single boundary was determined that is intended to satisfy both the USACE and PADEP regulatory requirements. The wetlands boundaries were marked in the field with numbered surveyors' flags.

Prior to January 2010, wetland boundaries were located by a registered professional surveyor and, thereafter, by Normandeau personnel using a Trimble sub-meter GPS unit. The USACE Baltimore District has approved the use of sub-meter GPS units for mapping wetland boundaries. The wetland boundaries were plotted on the site topographic map and verified by Normandeau to ensure accuracy. A copy of the wetlands boundary map is enclosed (Figure 6).

3.0 REVIEW OF EXISTING RESOURCE INFORMATION

3.1 Wetlands

U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) mapping (dated 1976) shows palustrine emergent (herbaceous), scrub/shrub and forested wetlands in the western section of the site. Hydrologic regimes for the wetlands were designated as temporarily flooded, seasonally flooded/saturated and semi-permanently flooded. In addition, several farm ponds in the western end of the site were classified as palustrine waterbodies (Figure 3). Most of the wetlands and waterbodies are associated with the main stem and eastern branch of Walker Run.

NWI mapping is useful for screening sites for larger wetlands but does not necessarily detect all wetlands, or show the full extent of mapped wetlands. Map resolution varies from 1 to 5 acres depending on the scale of the source aerial photography and vegetation cover of the mapped area. Typically, wetlands boundaries are generalized and are not as accurate as ground-based delineations. In addition, most of this mapping is based on aerial photography from the 1980's or earlier and, therefore, may not always reflect current site conditions (NWI 1998).

3.2 Soils

The Natural Resources Conservation Service (NRCS) mapped the majority of the site as upland soils encompassing Chenango gravelly loam, Arnot-Rock outcrop complex, Braceville gravelly loam, Morris very stony silt loam, Oquaga and Lordstown loams, Pope soils, Wayland silt loam, Weikert and Klinesville channery silt loam, Wellsboro very stony silt loam and Wyoming gravelly loam (Figure 4). These soils are classified as somewhat poorly drained to excessively drained and have seasonal high water tables ranging from 6 inches in depth to greater than 72 inches in depth (Table 1). NRCS information indicates that Chenango and Wyoming soils are unlikely to have inclusions of hydric soil. However, the other six upland soils may potentially have inclusions of hydric soil in areas such as depressions, drainageways and bottomlands (NRCS, undated; 1981; 2010b).

Hydric soils mapped onsite consist of Atherton silt loam, Holly silt loam, Rexford loam and Wayland silt loam which are classified as somewhat poorly drained to very poorly drained. Consequently, the range for seasonal high water tables in these soils extends from the soil surface to a depth of 18-inches. Atherton and Rexford soils were largely mapped in association with Walker Run and its network of small tributaries in the western section of the site. Rexford soil is also mapped in association with a small stream in the eastern section of the site and in headwaters areas in the southern end of the site. Holly and Wayland soil is mapped exclusively in the Riverlands along the Susquehanna River floodplain (NRCS, 1981; 2010b). NRCS soil series descriptions are provided in Appendix C.

3.3 Hydrology

NWI and NRCS mapping indicates that wetlands, waterbodies and poorly drained soils are largely associated with headwaters areas and small streams that drain the site. West of Confers Lane, the site drains to the Susquehanna River via Walker Run. East of Confers Lane, the site drains through two small-unnamed streams. One stream flows into the southern end of Lake Took-A-While and the other flows into the northern end of the reconstructed North Branch Canal.

Lake Took-A-While also drains into the North Branch Canal, which then drains through an outlet channel into the Susquehanna River.

PADEP's Chapter 93 Water Quality Standards (Chapter 93) designates Walker Run as having the protected water use of Cold Water Fishes (CWF). A CWF classification is intended to provide for the maintenance and propagation of fish species including the family Salmonidae and additional flora and fauna indigenous to cold water habitats. Chapter 93 designates the Susquehanna River in the vicinity of the site as having the protected use of Warm Water Fishes (WWF). A WWF classification is intended to provide for the maintenance and propagation of fish species and additional flora and fauna indigenous to warm water habitats (PADEP, 2006a).

4.0 RESULTS OF THE FIELD INVESTIGATION

The wetlands delineation determined that the survey area was primarily upland habitat composed of cropland, and old-field, shrub and deciduous forest communities. Wetlands consisted of palustrine emergent (herbaceous), scrub/shrub and forest communities (Figure 5). Many wetlands were composed of multiple vegetation communities and several contained large areas of open water. Wetlands distribution was generally consistent with NWI wetlands and NRCS soils mapping. The vegetation, soils and hydrologic conditions of uplands and wetlands habitats observed during the field delineation are summarized in the following sections.

4.1 UPLAND PLANT COMMUNITIES

Old-Field

Old-field vegetation cover was composed of a largely upland-preferring assemblage of grasses and herbaceous plants. During 2007, old-field vegetation extended over much of the fallow farmland in the western section of the site. However, during 2008 some of this habitat was returned to agricultural use for the production of corn. Dominant species included daisy fleabane (*Erigeron annuus,* FACU), Canada thistle *(Cirsium arvense*, FACU), wrinkled goldenrod (*Solidago rugosa*, FAC), flat-top fragrant goldenrod (*Euthamia graminifolia,* FAC), Canada goldenrod (*Solidago canadensis*, FACU), giant foxtail grass (*Setaria faberi,*UPL), white heath aster (*Aster pilosus,* UPL), lamb's quarters (*Chenopodium album,* FACU+), red clover *(Trifolium pretense*, FACU-) and common ragweed *(Ambrosia artemisiifolia,* FACU). A list of common plant species observed onsite is presented in Table 2.

Upland Scrub/Shrub

Upland shrub habitat was found mostly along transmission line corridors and in several abandoned farm fields located around the site that were undergoing secondary succession. This community consisted primarily of bush honeysuckle (*Lonicera tatarica*, FACU), multiflora rose (*Rosa multiflora*, FACU), Allegheny blackberry (*Rubus allegheniensis*, FACU-), and Russian olive (*Elaeagnus angustifolia*, FACU).

Upland Deciduous Forest

Upland deciduous forest covered a large portion of the site to the west of Route 11. Common overstory species included northern red oak (*Quercus rubra,* FACU-), white oak (*Quercus alba*, FACU-), black cherry (*Prunus serotina,* FACU), white ash (*Fraxinus americana*, FACU), shagbark hickory (*Carya ovata*, FACU-), bitternut hickory (*Carya cordiformis*, FACU+), sweet birch (*Betula lenta*, FACU), black walnut (*Juglans nigra*, FACU), black locust (*Robinia pseudoacacia*, FACU-), yellow poplar *(Liriodendron tulipifera,* FACU) and red maple (*Acer rubrum*, FAC).

Upland forest understories were composed predominantly of spicebush (*Lindera benzoin*, FACW), round-leaved greenbrier (*Smilax rotundifolia*, FAC), Virginia creeper (*Parthenocissus quinquefolia*, FACU) and saplings of overstory species. The groundcover included may-apple (*Podophyllum peltatum*, FACU), garlic mustard (*Allaria petiolata*, FACU), hayscented fern (*Dennsteadtia punctilobula*, UPL), tree clubmoss (*Lycopodium obscurum*, FACU), partridge berry (*Mitchella repens*, FACU), ground cedar (*Lycopodium tristachyum*, UPL) and stilt grass (*Eulalia viminea*, FAC).

Hydrology and Soils

Numerous borings were taken in upland soils during the delineation fieldwork and to formally document soil conditions at upland data points. Typical soil matrix colors at the diagnostic horizon ranged from brown (10YR 4/3) to light yellowish brown (10YR 6/4), indicating an absence of hydric conditions. In addition, mottling was usually absent indicating that the soils were reasonably well drained. Saturated soils and high water tables were observed in some upland areas during wetter parts of the year. However, high soil matrix chromas and a general absence of soil mottling indicated that these observations reflected hydrologic conditions that were short-term in nature.

4.2 WETLANDS PLANT COMMUNITIES

Palustrine Emergent

Palustrine emergent wetlands were located throughout the site. A diverse group of herbaceous hydrophytic plants was present including soft rush (*Juncus effusus*, FACW+), sedges (*Carex spp.*, FAC – OBL), arrow-leaf tearthumb (*Polygonum sagittatum*, OBL), common boneset (*Eupatorium perfoliatum*, FACW+), giant goldenrod (*Solidago gigantea*, FACW), seedbox (*Ludwigia alternifolia*, FACW+), nutsedges (*Cyperus spp.*, FAC-OBL), blue vervain (*Verbena hasta*, FACW+), New York ironweed (*Vernonia noveboracensis*, FACW+), swamp aster (*Aster puniceus*, OBL), cut-leaf coneflower (*Rudbeckia laciniata*, FACW), broad-leaved cattail (*Typha latifolia*, OBL), reed canary grass (*Phalaris arundinacea*, FACW+) and purple loosestrife (*Lythrum salicaria*, FACW+).

Palustrine Scrub/Shrub

Several large palustrine scrub/shrub wetlands were located in the western part of the site. In addition, hydrophytic shrubs were a component of many wetlands across the site. Spicebush was overwhelmingly the most abundant wetlands-preferring shrub onsite. Other frequently occurring

wetlands shrubs were highbush blueberry (*Vaccinium corymbosum*, FACW-), meadowsweet (*Spirea latifolia*, FAC+), alders (*Alnus spp.*, FAC-OBL), silky dogwood (*Cornus ammomum*, FACW), arrow-wood (*Viburnum dentatum*, FAC) and grey dogwood (*Cornus racemosa*, FAC).

Palustrine Forested

Palustrine forested wetlands were the principal wetlands type onsite and large contiguous blocks of this habitat extended across the western section. Trees commonly found in forested wetlands habitat included red maple, silver maple (*Acer saccharinum*, FACW) black gum (*Nyssa sylvatica*, FAC), pin oak (*Quercus palustris*, FACW) and river birch (*Betula nigra*, FACW+). In addition, upland-preferring species such as white ash and yellow poplar were present on upland microsites scattered throughout some forested wetlands.

Understories of forested wetlands were comprised largely of spicebush, highbush blueberry, arrow-wood and winterberry (*Ilex verticellata*, FACW+). Skunk cabbage (*Symplocarpus foetidus*, OBL) predominated in the groundcover along with sedges, jewelweed (*Impatiens capensis*, FACW), sensitive fern (*Onoclea sensibilis*, FACW), clearweed (*Pilea pumila*, FACW), cinnamon fern (*Osmunda cinnamomea*, FACW), stout woodreed grass (*Cinna arundinacea*, FACW+), and swamp dewberry (*Rubus hispidus*, FACW).

Hydrology and Soils

Wetlands habitat typically occurred in low-lying poorly drained lands adjacent to Walker Run and its tributaries, in headwaters areas, and along the other small streams that drain the site. A few isolated wetlands were also present. Indicators of wetlands hydrology observed during the delineation field work included prolonged inundation, saturated soils, sediment deposits on vegetation, water-stained leaves and oxidized rhizospheres associated with living roots within 12-inches of the soil surface. In addition, many wetlands were associated with multiple actively flowing groundwater seeps and exhibited a characteristic braided drainage pattern. Trees with buttressed trunks and surface roots were also common in forested wetlands.

Numerous borings were taken in wetlands soils during the delineation fieldwork and to formally document soil conditions at wetlands data points. Coal overwash was detected in some of the soils examined in the Susquehanna Riverlands. Typical soil matrix colors at the diagnostic horizon ranged from gray (6/N) to very dark grayish brown (10YR 3/2) with mottling, indicating hydric conditions.

4.3 WETLANDS BOUNDARIES

Wetlands boundaries were usually associated with gradual to steep increases in slope and a distinct change from low chroma hydric soil matrix colors to the much brighter matrix colors of upland soils. In addition, wetlands were distinguished by the generally strong evidence of requisite hydrology, particularly the abundance of groundwater seeps.

Vegetation indicators were not always as definitive as soil and hydrology indicators. There was considerable vegetation overlap between wetlands and uplands, particularly in forest understories and overstories. As a rule, red maple and spicebush were abundant in both forested wetlands and upland deciduous forests. However, in upland forests spicebush tended to be less common in the

understory, and upland preferring species as well as red maple predominated in the overstory. Boundaries between palustrine emergent wetlands and old field habitat were typically more distinct and characterized by a transition from hydrophytic cover to largely upland-preferring herbaceous plant communities dominated by Canada goldenrod, daisy fleabane and/or Canada thistle.

Many wetlands were bounded in part by manmade structures, especially in the Susquehanna Riverlands to the east of Route 11. These structures included roads, trails, SSES facilities and soil stockpiles created during SSES construction. Also, some farmlands in the western part of the site were tilled up to or within a few feet of wetlands.

Wetlands boundaries were documented by photographs (Appendix A) and data sheets (Appendix B). Wetlands boundaries, data points, and photograph locations are shown in Figure 6.

5.0 EXCEPTIONAL VALUE WETLANDS ANALYSIS

This section evaluates wetlands onsite against the PADEP Chapter 105 Dam Safety and Waterway Management Regulations criteria defining Exceptional Value Wetlands. According to Title 25 Pa. Code 105.17, Exceptional Value Wetlands are wetlands that exhibit one or more of the following characteristics:

1. ***Wetlands which serve as habitat for fauna or flora listed as "threatened" or "endangered" under the Endangered Species Act of 1973, the Wild Resource Conservation Act, 30 Pa. C.S. (relating to the Fish and Boat Code), or 34 Pa. C.S. (relating to the Game and Wildlife Code).***

Information concerning the presence of species of special concern within a 0.5-mile radius of an area encompassing the site, PPL-owned lands to the north and the Susquehanna Riverlands was requested via correspondence submitted December 21, 2007 and September 20, 2010 to the U. S. Fish and Wildlife Service (USFWS), Pennsylvania Department of Conservation and Natural Resources (PDCNR), Pennsylvania Game Commission (PGC) and Pennsylvania Fish and Boat Commission (PFBC). These requests were intended to cover all categories of Federal and state tracked species of flora and fauna, as well as other ecological resources of special concern. Responses from the agencies to the letters are presented in Appendix D and the findings of studies conducted to address their concerns are summarized in the following sections. Responses to the 2010 correspondence were received from the three state agencies but not from USFWS. The USFWS response will be incorporated into Appendix D upon receipt. Please note that classification systems for species of special concern vary by jurisdictional agency. The more important species rankings are defined at the Pennsylvania Natural Heritage Program Internet site (PNHP, 2010).

U. S. Fish and Wildlife Service

USFWS has jurisdiction over species of flora and fauna designated as listed, proposed or candidate under the Federal Endangered Species Act. The agency's reply indicated that the site was within the range of the federally endangered Indiana bat (*Myotis sodalis*). Furthermore, based on life history information cited in the response letter, the site contains suitable habitat for foraging and roosting by Indiana bats during the spring through fall. No other Federal threatened, endangered or other species of special concern were indicated as potentially occurring within the study area.

Comprehensive field studies were undertaken during the period of July 2007 through June 2010 to document the occurrence and distribution of terrestrial and aquatic fauna onsite. Taxonomic groups covered by these surveys encompassed mammals, birds, fish, reptiles, amphibians and freshwater mussels. No Federal proposed, candidate, or listed threatened or endangered species were detected (AREVA, 2011c).

At the request of the USFWS, the terrestrial fauna studies included a survey for Indiana bats. This investigation was conducted by Dr. Karen Campbell, an USFWS-approved Indiana bat surveyor, between June 7 and July 11, 2008 following the USFWS Bat Mist Netting Guidelines. Study techniques included mist net sampling, acoustic (echolocation) monitoring using hand-held AnaBat ultrasonic detectors, and a survey for cave and mine openings that could indicate the

potential presence of hibernacula onsite. No Indiana bats were collected by the mist net surveys and none were detected by acoustic monitoring. In addition, no potential hibernacula were identified. However, forested areas throughout much of the site provide potential roosting and maternity den sites for Indiana bats in the form of large trees with shaggy, platy or exfoliating bark, crevices and/or cavities (AREVA, 2011c). In October 2010 and July 2011, Indiana bat roost tree surveys were conducted in the forested areas proposed to be cleared during construction activities. Some of the surveyed interior forest and many of the forest edges provided densities of potential roost trees (PRTs) suitable for Indiana bat roosting habitat with forested wetlands providing higher quality roosting habitat than forested uplands on the site (AREVA, 2011d).

USFWS recommended the implementation of tree-cutting guidelines to protect Indiana bats potentially using forests onsite for roosting and maternity dens. The agency advised that any necessary tree-cutting take place during November 16 to March 31, when the bats are hibernating. Furthermore, cutting or physical disturbance of suitable trees (live or dead) between April 1 and November 15, if necessary, should be limited to those with a diameter at breast height (dbh) of less than 5 inches (AREVA, 2011c). The Project team has initiated consultation with USFWS with respect to the project's impacts to Indiana bat.

Pennsylvania Game Commission

PGC has jurisdiction over birds and mammals designated as special concern in Pennsylvania. The agency's 2008 response letter indicated that the site is located in the vicinity of known bat hibernacula and is concerned with potential impacts to five bat species encompassing the eastern small-footed myotis (*Myotis leibii*), northern myotis, also known as the northern long-eared myotis, (*Myotis septentrionalis*), little brown (*Myotis lucifugas*), big brown (*Eptesicus fucsus*) and the pipistrelle (*Pipistrellus subflavus*). The eastern small-footed myotis is listed as threatened in Pennsylvania and the northern myotis is classified as Pennsylvania candidate rare. However, the little brown and big brown are classified as common in Pennsylvania, while the pipistrelle was previously listed as a species of concern but is now considered secure (PBS, 2010). The agency's 2010 response letter indicated that Indiana bat, a state and federally endangered species, may potentially be impacted by the project. No other species were listed in this letter as potentially being impacted by the project.

Although no Indiana bats were collected during the mist net survey described above, 4 northern myotis, 8 little brown bats, and 4 big brown bats were captured, tagged and released. Results of acoustic monitoring were consistent with the echolocation signatures for big brown bats and the *Myotis* species captured during mist netting. Small-footed myotis and pipistrelle were not detected by either survey method (AREVA, 2011c).

The little brown and big brown specimens included reproductively active females, and adult or juvenile males, while the northern myotis specimens were all adult males. These findings suggest that northern myotis use of the site may be limited to roosting only, while the other two bat species utilize the site for both roosting and maternity dens (AREVA, 2011c). USFWS tree-cutting guidelines for Indiana bats, noted above, would provide similar protection to these other three bat species when utilizing forests onsite for roosting and maternity dens.

As noted above, the bat mist net study was a component of the terrestrial fauna studies conducted onsite July 2007 through June 2010. No other state level birds or mammals of special concern

were detected during these studies with the exception of the peregrine falcon (*Falco peregrinus*). In 2007 and 2008, a pair of peregrine falcons (Pennsylvania endangered) nested and successfully raised young on a cliff site along the Susquehanna River approximately 2 miles from the site. Despite the nearby nest, only one observation of a peregrine falcon was made over the site during the 41 field-days of the terrestrial fauna surveys. Therefore, most peregrine falcon activity associated with this nest site likely takes place closer to the river (AREVA, 2011c).

Pennsylvania Department of Conservation and Natural Resources

PDCNR has jurisdiction over rare plants, natural communities, terrestrial invertebrates and certain geological features in Pennsylvania. PDCNR replied that there were no known occurrences of plants or geological features of state concern within the site. However, in the 2008 response letter the agency listed four butterfly species of concern known to occur in the project vicinity including the northern pearly-eye (*Enodia anthedon*), Baltimore checkerspot (*Euphydras phaeton*), mulberry wing (*Poanes massasoit*) and long dash (*Polites mystic*). In the 2010 response letter the agency revised the initial list to include only Baltimore checkerspot and mulberry wing as species of concern known to occur in the project vicinity. Long dash and northern pearly-eye have been removed from the Pennsylvania Natural Heritage Program (PNHP) tracked species list due to a recent revision of state ranks (AREVA, 2011c).

Butterfly surveys were conducted onsite during June and July 2008 by an experienced entomologist (Daniel Bogar) to determine the presence or absence of species of special concern. No northern pearly-eye, mulberry wing or Baltimore checkerspot butterflies were detected during the study; however, one long dash was collected. In addition, black dash (*Euphyes conspicua*), a new butterfly species of special concern for Luzerne County, was collected and observed during the survey (AREVA, 2011c). The black dash is no longer a species of special concern and has been removed from the PNHP list of tracked species.

The PNHP classifies mulberry wing as vulnerable (S2) and the Baltimore checkerspot as imperiled (S3) (PNHP, 2011). Wetlands onsite potentially provide suitable habitat for these butterflies based on habitat descriptions provided by PDCNR and information researched by Normandeau concerning life histories, and breeding/foraging preferences of these species (AREVA, 2011c; USGS, 2010). PDCNR requested that attempts be made to minimize impacts to potential habitat for these butterflies within the site. Current development plans largely avoid all wetlands habitat and, therefore, comply with PDCNR requests.

Pennsylvania Fish and Boat Commission

PFBC has jurisdiction over fishes, reptiles, amphibians, aquatic invertebrates and freshwater mussels designated as special concern in Pennsylvania. The agency's 2008 reply indicated that three species classified as "special concern" were known from the vicinity of the site and comprised the eastern hognose snake (*Heterodon platyrhinos*), yellow lampmussel (*Lampsilis cariosa*) and green floater (*Lasmigona subviridis*). In the 2010 response letter the agency revised the initial list to include northern cricket frog (*Acris crepitans crepitans*), a state endangered species, and no longer listed the eastern hognose snake. In addition, the status of yellow lampmussel and green floater was changed from special concern to rare.

As noted above, comprehensive field studies were undertaken during the period of July 2007

through June 2010 to document the occurrence and distribution of terrestrial and aquatic fauna onsite. Taxa surveyed included fishes, reptiles, amphibians and freshwater mussels. No Federally listed threatened or endangered species were observed; however, the northern cricket frog, a state listed endangered species, was heard vocalizing within the project area (AREVA, 2010; 2011a; 2011c). Note that the presence of the northern cricket frog was limited to two separate auditory observations of the species and no individuals of the species were observed visually. A 2011 letter from the PFBC indicated that adverse impacts to northern cricket frog were not anticipated as a result of the project. One state listed candidate fish species, brook stickleback (*Culaea inconstans*), was collected during the aquatic survey (AREVA, 2011a). No previous occurrences of the brook stickleback are known from the Susquehanna River or adjacent waterbodies in the vicinity of BBNPP and it is probable that the single brook stickleback was introduced through human action (i.e. bait bucket or aquarium fish). In addition, these surveys also detected the presence of four other reptiles designated by the PFBC as "Species of Special Concern" (PFBC 2010a). Species observed consisted of the eastern ribbon snake (*Thamnophis sauritus*), wood turtle (*Glyptemys insculpta*), map turtle (*Graptemys geographica*), and eastern box turtle (*Terrapene carolina carolina*) (AREVA, 2011c). To varying degrees, wetlands onsite would provide habitat for all of these species (Shaffer 1999).

Additionally, aquatic ecological surveys conducted during 2007 in the Susquehanna River confirmed the presence of the yellow lampmussel and green floater in the vicinity of the proposed BBNPP intake and discharge structures (AREVA, 2010). The PNHP classifies yellow lampmussel as vulnerable (S3) to apparently secure (S4) and the green floater as imperiled (S2) (PNHP, 2011).

Summary

Jurisdictional Federal and state natural resource management agencies were contacted regarding the potential presence of species of special concern within 0.5-miles radius of an area encompassing the site, PPL-owned lands to the north and the Susquehanna Riverlands. Responses from these agencies indicated that potential occurrences of Federally-listed threatened or endangered species were limited to the Indiana bat, only. In addition, the only potential occurrence of a state-listed threatened or endangered species was the northern cricket frog. However, seven special concern taxa that are still currently tracked by state agencies were noted as potentially occurring onsite. These species consisted of two bats, eastern small-footed myotis and northern myotis; two butterflies, Baltimore checkerspot and mulberry wing; one snake, eastern hognose snake; and two mussels, yellow lampmussel and green floater.

Comprehensive field studies of aquatic and terrestrial fauna, including an Indiana bat mist net survey and an Indiana bat roost tree survey, were conducted throughout the site during the period of July 2007 through July 2011. These studies did not detect any Federally-listed threatened or endangered species, or other Federal species of special concern. However, some of the interior forest and many of the forest edges surveyed during the Indiana bat roost tree survey provided densities of potential roost trees (PRTs) suitable for Indiana bat roosting habitat with forested wetlands providing higher quality roosting habitat than forested uplands on the site (AREVA, 2011d). No Pennsylvania-listed threatened species were detected and occurrences of state-listed endangered species were limited to a single peregrine falcon observation and two auditory observations of the northern cricket frog. The peregrine falcon nest is located along the Susquehanna River approximately 2-miles from the site.

A total of seven other state-tracked species were documented onsite during these studies and included one bat, northern myotis (candidate rare); and two mussels, yellow lampmussel (vulnerable to apparently secure), and green floater (imperiled). Four reptiles designated as species of special concern were also observed and consisted of the eastern ribbon snake, wood turtle, map turtle, and eastern box turtle. Northern myotis was the only species of special concern that was both observed onsite and reported by the jurisdictional agencies as potentially occurring in the vicinity of the BBNPP site. Various measures are available to protect rare species during site construction.

In conclusion, site wetlands do not qualify as Exceptional Value under this criterion since they do not provide habitat for Federal or state-listed threatened or endangered species. Even though PRT densities in some of the surveyed forested areas were suitable for Indiana bat roosting habitat, there are no known occurrences of Indiana bat in the wetland or upland areas on the site Additionally, the northern cricket frog was heard during a 2007 field survey but was not visually confirmed as being present onsite.

2. ***Wetlands that are hydrologically connected to or located within 1/2-mile of wetlands identified in question 1 and that maintain the habitat of the threatened or endangered species within the wetlands identified above.***

Information concerning the presence of species of special concern within a 0.5-mile radius of an area encompassing the site, PPL-owned lands to the north and the Susquehanna Riverlands was requested from jurisdictional natural resource management agencies and is summarized above. Site wetlands do not qualify as Exceptional Value under this criterion.

3. ***Wetlands that are located in or along the floodplain of the reach of a wild trout stream or waters listed as Exceptional Value under Chapter 93 (relating to water quality standards) and the floodplain of streams tributary thereto, or wetlands within the corridor or a watercourse or body of water that has been designated as a National wild or scenic river in accordance with the Wild and Scenic Rivers Act of 1968 or designated as wild or scenic under the Pennsylvania Scenic Rivers Act.***

Wetlands onsite are not located in or along the floodplain of an Exceptional Value water, or within the corridor of a watercourse or body of water that has been designated as a wild or scenic river at the state or Federal level. Walker Run and the Susquehanna River are not designated as Exceptional Value in PADEP's Chapter 93 Water Quality Standards. They are classified as having the protected uses of Cold Water Fishes (CWF) and Warm Water Fishes (WWF), respectively (PADEP, 2006a). In addition, neither watercourse is designated as wild or scenic at either the state or federal level (PDCNR 2010).

Walker Run is not designated by PFBC as a Class A Wild Trout Stream but is included in the agency's May 2010 list of "Pennsylvania Stream Sections that Support Wild Trout" from its headwaters down to the confluence with the North Branch of the Susquehanna River. In April and July 2008, Normandeau collected small numbers of brown trout (*Salmo trutta*) in Walker Run at stations located onsite, as well as stations located upstream and downstream of the site. . The size range of the specimens indicated the presence of a naturally reproducing brown trout population and this was confirmed by a subsequent PFBC fisheries survey of the stream. As a

result, Walker Run was designated by PFBC as a Wild Trout Stream from its headwaters down to the confluence with the North Branch of the Susquehanna River on December 19, 2009. Therefore, 25 PA Code 105.17 condition 3 "Wetlands that are located in or along the floodplain of the reach of a wild trout stream" is met and the wetlands associated with Walker Run and its eastern tributary are Exceptional Value wetlands.

4. ***Wetlands located along an existing public or private drinking water supply, including both surface water and groundwater sources, which maintain the quality or quantity of the drinking water supply.***

Walker Run is not used as a public or private drinking water supply. Although the Susquehanna River may be used as a water supply in some regions, the river is not used for this purpose in the vicinity of the site. Site wetlands do not qualify as Exceptional Value under this criterion.

5. ***Wetlands located in areas designated by the Department as "natural" or "wild" areas within state forest or park lands, wetlands located in areas designated as Federal wilderness areas under the Wilderness Act or the Federal Eastern Wilderness Act of 1975 or wetlands located in areas designated as National Natural Landmarks by the Secretary of the Interior under the Historic Sites Act of 1935.***

The site is wholly-owned by PPL and none of the above state or Federal designations are applicable. Site wetlands do not qualify as Exceptional Value under this criterion.

SUMMARY

In summary, BBNPP site wetlands do meet Exceptional Value Wetlands criterion 3. BBNPP site wetlands associated with Walker Run and its eastern tributary meet the Chapter 105.17 criteria for Exceptional Value wetlands since it has been determined by the PFBC that Walker Run meets the criteria for classification as a stream section that supports naturally reproducing wild trout.

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TABLES

Table 1. Soils Mapped in the BBNPP Project Boundary[1].

Name	Drainage Class	Hydric Status
Atherton silt loam	Poorly to very poorly	Hydric
Arnot-Rock outcrop complex, steep	Well	Not hydric
Braceville gravelly loam	Moderately well	Not hydric[2]
Chenango gravelly loam	Well	Not hydric
Holly silt loam	Poorly	Hydric
Morris very stony silt loam	Somewhat poorly and poorly	Not hydric[2]
Oquaga & Lordstown channery silt loams	Well	Not hydric[2]
Oquaga & Lordstown extremely stony loams	Well	Not hydric[2]
Pope soils	Well	Not hydric[2]
Rexford loam	Somewhat poorly and poorly	Hydric
Wayland silt loam	Poorly and very poorly	Hydric
Weikert & Klinesville channery silt loam	Well	Not hydric[2]
Wellsboro very stony silt loam	Moderately well and somewhat poorly	Not hydric[2]
Wyoming gravelly loam	Somewhat excessively	Not hydric

[1] Sources: Penn State Cooperative Extension. 2010. SoilMap Version 2.
[2] May have inclusions of hydric soil in seepage areas, bottomlands, depressions and/or drainageways.

Table 2. Common plants identified in the BBNPP Project Boundary.

Scientific Name[3,4]	Common Name	Indicator Status[1, 2]
Trees and Saplings		
Acer saccharinum	silver maple	FACW
Acer rubrum	red maple	FAC
Ailanthus altissima	tree-of-heaven	FACU-
Betula alleghaniensis	yellow birch	FAC
Betula lenta	sweet birch	FACU
Betula nigra	river birch	FACW
Betula populifolia	gray birch	FAC
Carya cordiformis	bitternut hickory	FACU+
Carya ovata	shagbark hickory	FACU-
Carya tomentosa	mockernut hickory	UPL
Celtis occidentalis	hackberry	FACU
Cornus florida	flowering dogwood	FACU-
Fagus grandifolia	American beech	FACU
Fraxinus americana	white ash	FACU
Fraxinus pennsylvanica	green ash	FACW
Juglans nigra	black walnut	FACU
Juniperus virginiana	eastern red cedar	FACU
Liriodendron tulipifera	yellow poplar	FACU
Malus spp.	apple	UPL
Nyssa sylvatica	black gum	FAC
Pinus resinosa	red pine	FACU
Pinus strobus	eastern white pine	FACU
Pinus sylvestris	Scots pine	UPL
Platanus occidentalis	American sycamore	FACW-
Populus deltoides	eastern cottonwood	FAC
Populus tremuloides	quaking aspen	FACU
Prunus serotina	black cherry	FACU
Quercus alba	white oak	FACU-
Quercus bicolor	swamp white oak	FACW+
Quercus palustris	pin oak	FACW
Quercus rubra	northern red oak	FACU-
Quercus velutina	black oak	UPL
Robinia pseudoacacia	black locust	FACU-
Sassafras albidum	sassafras	FACU-
Tilia americana	American basswood	FACU
Tsuga canadensis	eastern hemlock	FACU
Ulmus rubra	slippery elm	FAC
Woody Vines		
Lonicera japonica	Japanese honeysuckle	FAC-
Parthenocissus quinquefolia	Virginia creeper	FACU
Rubus flagellaris	northern dewberry	UPL
Smilax glauca	cat greenbrier	FACU

Table 2. (Continued)

Scientific Name[3,4]	Common Name	Indicator Status[1, 2]
Woody Vines		
Smilax rotundifolia	common greenbrier	FAC
Toxicodendron radicans	poison ivy	FAC
Vitis labrusca	fox grape	FACU
Shrubs		
Alnus spp.	alders	FAC-OBL
Alnus serrulata	smooth alder	OBL
Cornus amomum	silky dogwood	FACW
Cornus racemosa	swamp dogwood	FAC
Elaeagnus angustifolia	Russian olive	FACU
Hamamelis virginianus	American witch-hazel	FAC-
Ilex verticillata	winterberry	FACW+
Kalmia latifolia	mountain laurel	FACU
Ligustrum obtusifolium	privet	FACU
Lindera benzoin	northern spicebush	FACW-
Lonicera tatarica	tartarian honeysuckle	FACU
Rhus typhina	staghorn sumac	FACU
Rosa multiflora	multiflora rose	FACU
Rubus allegheniensis	Allegheny blackberry	FACU-
Rubus occidentalis	black raspberry	UPL
Sambucus canadensis	American elder	FACW-
Salix discolor	pussy willow	FACW
Salix nigra	black willow	FACW+
Spiraea latifolia	broad-leaf meadow-sweet	FAC+
Vaccinium corymbosum	highbush blueberry	FACW-
Viburnum cassinoides	withe-rod	FACW
Viburnum dentatum	arrow-wood	FAC
Viburnum prunifolium	black-haw	FACU
Herbs		
Achillea millefolium	common yarrow	FACU
Acorus calamus	sweetflag	OBL
Agropyron repens	quack grass	FACU-
Agrostis gigantea	redtop	FACW
Alisma subcordatum	subcordate water-plantain	OBL
Alliaria petiolata	garlic mustard	FACU-
Allium vineale	field garlic	FACU-
Ambrosia artemisiifolia	common ragweed	FACU
Anthoxanthum odoratum	sweet vernal grass	FACU
Apocynum cannabinum	clasping leaf dogbane	FACU
Arctium minus	common burdock	UPL
Arisaema triphyllum	swamp jack-in-the-pulpit	FACW-

Table 2. (Continued)

Scientific Name[3,4]	Common Name	Indicator Status[1, 2]
Herbs		
Artemisia vulgaris	mugwort	UPL
Asclepias incarnata	swamp milkweed	OBL
Asclepias syriaca	common milkweed	FACU-
Aster pilosus	white heath aster	UPL
Aster puniceus	swamp aster	OBL
Aster simplex	panicled aster	FACW
Barbarea vulgaris	winter-cress	FACU
Bidens spp.	beggar-ticks	FACW-OBL
Boehmeria cylindrica	false nettle	FACW+
Bromus inermis	smooth brome grass	UPL
Carex spp.	sedges	FAC-OBL
Carex lurida	shallow sedge	OBL
Carex stricta	uptight sedge	OBL
Chenopodium album	lamb's quarters	FACU+
Cicuta bulbifera	water hemlock	OBL
Cinna arundinacea	stout wood-reedgrass	FACW+
Cirsium arvense	Canada thistle	FACU
Cirsium vulgare	bull thistle	FACU-
Claytonia virginica	spring beauty	FACU
Conyza canadensis	horseweed	UPL
Coronilla varia	crown-vetch	UPL
Cyperus spp.	nutsedges	FACW
Dactylis glomerata	orchard grass	FACU
Daucus carota	Queen Anne's lace	FACU
Dennstaedtia punctilobula	hayscented fern	UPL
Dichanthelium clandestinum	deer-tongue witchgrass	FAC+
Digitaria sanguinalis	common crabgrass	FACU-
Dipsacus sylvestris	teasel	FACU-
Dryopteris spinulosa	spinulose wood-fern	FAC+
Eleocharis spp.	spikerushes	FACW-OBL
Erechtites hieraciifolia	American burn	FACU
Erigeron annuus	daisy fleabane	FACU
Erigeron philadelphicus	Philadelphia fleabane	FACU
Erythronium americanum	dogtooth violet	FAC
Eulalia viminea	Nepal microstegium	FAC
Eupatoriadelphus spp.	Joe-Pye-weed	FAC-FACW
Eupatorium perfoliatum	common boneset	FACW+
Euthamia graminifolia	flat-top fragrant goldenrod	FAC
Fragaria virginianum	Virginia strawberry	FACU
Fragaria virginianum	Virginia strawberry	FACU
Galium mollugo	wild madder	FACU
Geum canadense	white avens	FACU
Glyceria striata	fowl manna grass	OBL
Hesperis matronalis	dames rocket	FACU-

Table 2. (Continued)

Scientific Name[3,4]	Common Name	Indicator Status[1, 2]
Herbs		
Holcus lanatus	common velvet grass	FACU
Hypericum perforatum	St. John's wort	FACU
Impatiens capensis	jewelweed	FACW
Juncus effusus	soft rush	FACW+
Juncus tenuis	path rush	FAC-
Lamium purpureum	purple dead nettle	UPL
Leersia oryzoides	rice cutgrass	OBL
Lemna spp.	duckweeds	OBL
Leucanthemum vulgare	oxeye daisy	UPL
Lilium canadense	Canada lily	FAC+
Lotus corniculatus	birds-foot trefoil	FACU-
Ludwigia alternifolia	seedbox	FACW+
Ludwigia palustris	marsh seedbox	OBL
Lycopodium obscurum	tree clubmoss	FACU
Lycopodium tristachyum	ground cedar	UPL
Lycopus spp.	bugleweeds	OBL
Lysimachia ciliata	fringed loosestrife	FACW
Lysimachia nummularia	moneywort	OBL
Lythrum salicaria	purple loosestrife	FACW+
Maianthemum canadense	false lily-of-the-valley	FAC-
Mentha spp.	mints	FACU-OBL
Mitchella repens	partridge-berry	FACU
Oenothera biennis	common evening-primrose	FACU-
Onoclea sensibilis	sensitive fern	FACW
Osmunda cinnamomea	cinnamon fern	FACW
Oxalis spp.	wood-sorrel	FACU-UPL
Panicum dichotomiflorum	fall panic grass	FACW-
Phalaris arundinacea	Reed canary grass	FACW+
Phleum pretense	timothy grass	FACU
Phragmites australis	common reed	FACW
Phytolacca americana	common pokeweed	FACU+
Plantago lanceolata	English plantain	UPL
Plantago major	common plantain	FACU
Pilea pumila	clearweed	FACW
Poa pratensis	Kentucky bluegrass	FACU
Poa trivialis	rough bluegrass	FACW
Podophyllum peltatum	may-apple	FACU
Polygonum arifolium	halberd-leaf tearthumb	OBL
Polygonum cespitosum	cespitose knotweed	FACU-
Polygonum hydropiperoides	swamp smartweed	OBL
Polygonum pennsylvanicum	Pennsylvania smartweed	FACW
Polygonum perfoliatum	mile-a-minute	FAC
Polygonum perfoliatum	mile-a-minute	FAC
Polygonum sagittatum	arrow-leaved tearthumb	OBL

Table 2. (Continued)

Scientific Name[3,4]	Common Name	Indicator Status[1, 2]
Herbs		
Polygonum virginianum	Virginia knotweed	FAC
Potentilla canadense	dwarf cinquefoil	UPL
Potentilla simplex	old field cinquefoil	FACU-
Prunella vulgaris	heal-all	FACU+
Ranunculus acris	common buttercup	FAC+
Rubus hispidus	bristly blackberry	FACW
Rudbeckia hirta	black-eyed Susan	FACU-
Rudbeckia laciniata	cut-leaf coneflower	FACW
Rumex crispus	curly dock	FACU
Sagittaria latifolia	broad-leaf arrow-head	OBL
Saponaria officinalis	bouncing-bet	FACU-
Schizachrium scoparium	little bluestem	FACU-
Scirpus cyperinus	wool-grass	FACW+
Scirpus spp.	bulrushes	FACW-OBL
Setaria faberi	Japanese bristle grass	UPL
Setaria glauca	yellow bristle grass	FAC
Smilacina racemosa	feather false-Solomon's-seal	FACU
Solanum carolinense	Carolina nightshade	UPL
Solidago canadensis	Canada goldenrod	FACU
Solidago gigantea	giant goldenrod	FACW
Solidago rugosa	wrinkled goldenrod	FAC
Sparganium spp.	burreeds	OBL
Symplocarpus foetidus	skunk-cabbage	OBL
Taraxacum officinale	common dandelion	FACU-
Thelypteris noveboracensis	New York fern	FAC
Tridens flavus	purple-top tridens	FACU
Trifolium pratense	red clover	FACU-
Typha latifolia	broad-leaved cattail	OBL
Urtica dioica	stinging nettle	FACU
Uvularia sessilifolia	sessile-leaf bellwort	FACU-
Verbascum blattaria	moth mullein	UPL
Verbascum thapsus	common mullein	UPL
Verbena hastata	blue vervain	FACW+
Vernonia noveboracensis	New York ironweed	FACW+

[1]National List of Plant Species that Occur in Wetlands 1996 National Summary: Northeast (Region 1).
[2]All Modifiers of (+) and (-) Have been Dropped from Indicator Status for Wetland Delineations Conducted Under the USACE Regional Supplements.
[3]Additional species observed only during the 2010 surveys are indicated in blue font.
[4]Additional species observed only during the 2011 surveys are indicated in red font.

FIGURES

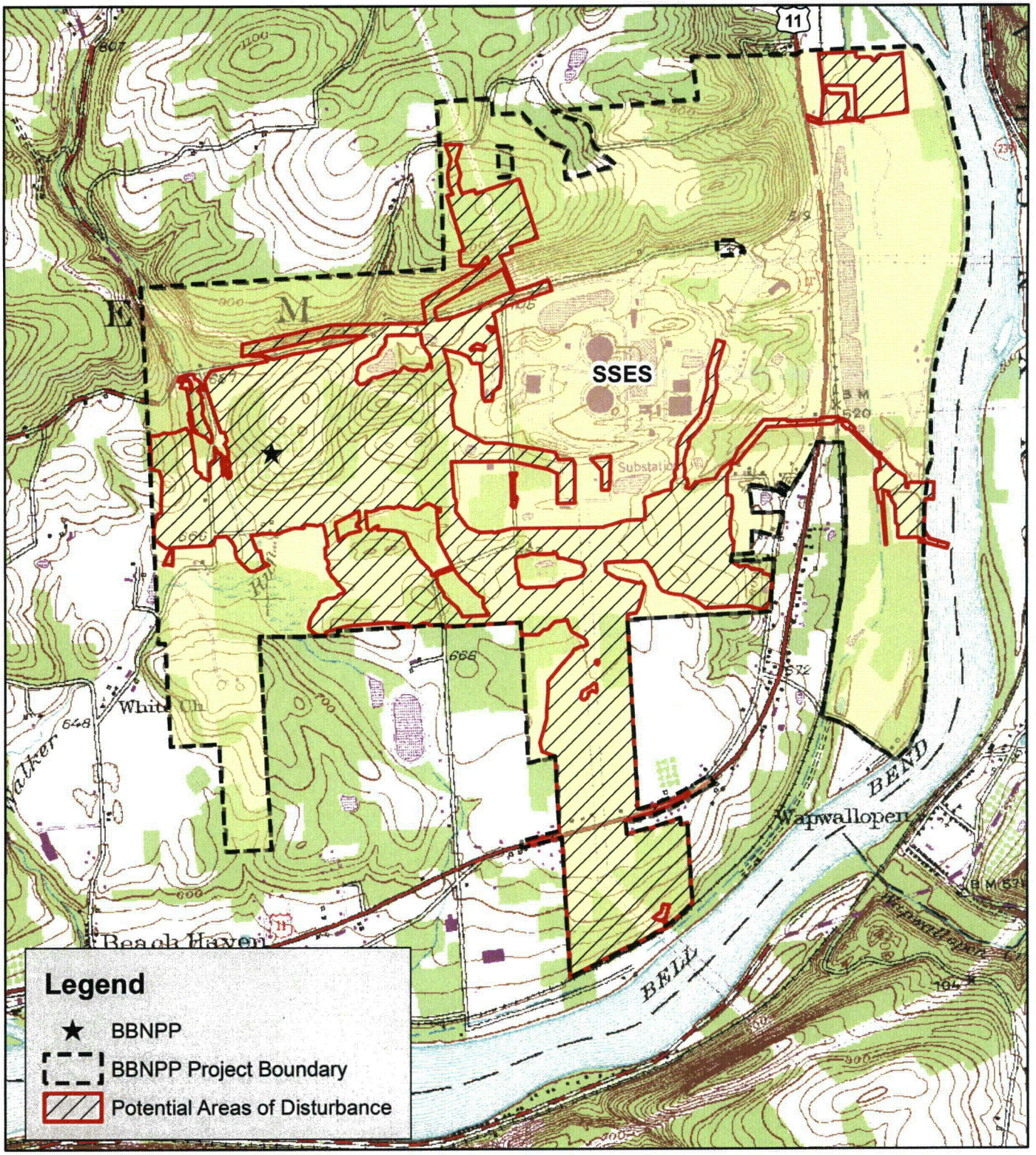
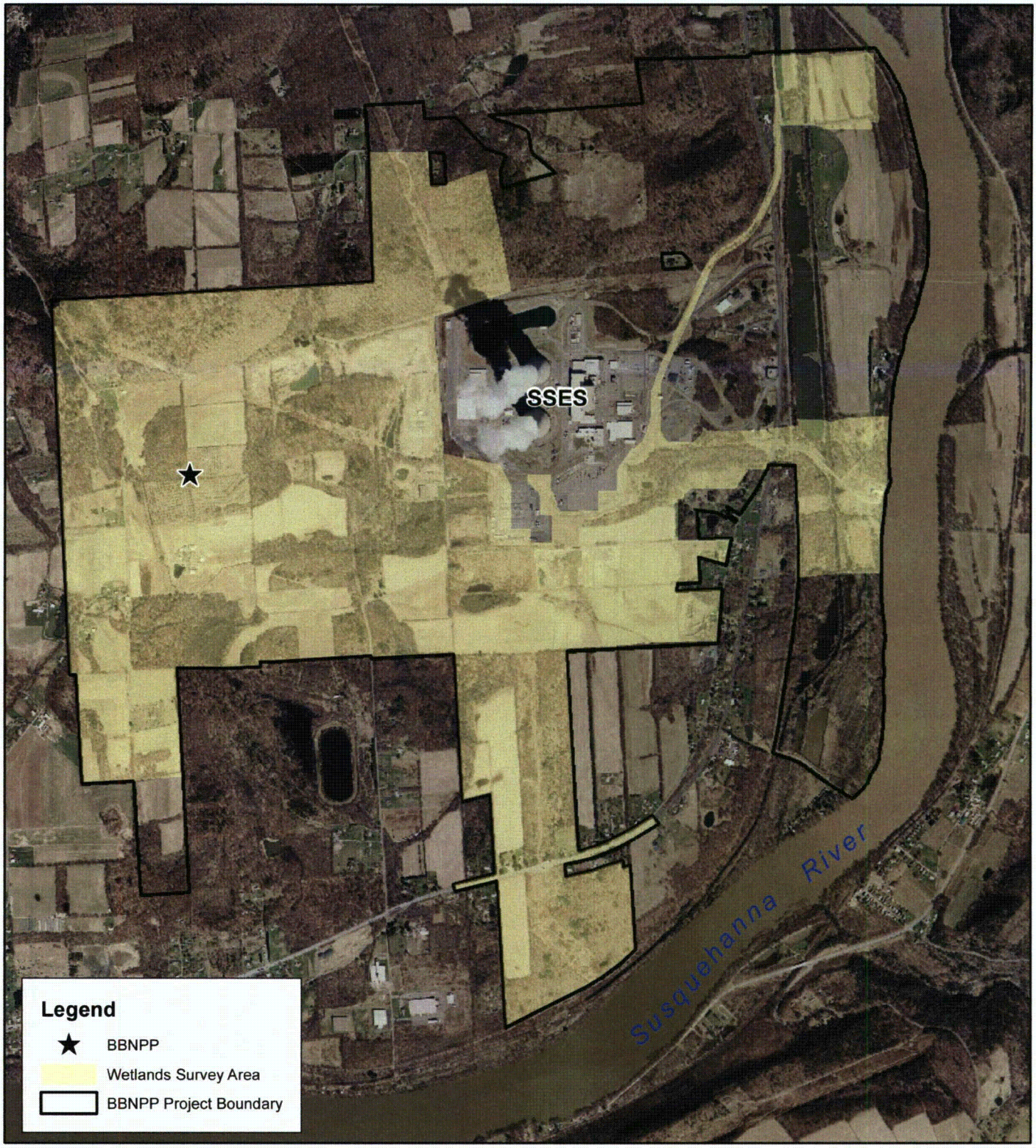


Figure 1.
Bell Bend NPP
Site Location Map

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS
400 Old Reading Pike, Bldg A, Suite 101 Stowe, PA 19464

date: 07/27/10
prepared by: s.sherman
project: 22474.000

rev. date: 09/30/10, 09/06/11
prepared for: b.lees
file name: Figure1.BBNPP_Site_USGS



Note:
Aerial Photography from PAMAP Program, PA DCNR, Bureau of Topographic and Geologic Survey, 2005

2,000 1,000 0 2,000 Feet

Figure 2.
Location of the Wetlands Survey Area within the BBNPP Project Boundary

N

NORMANDEAU ASSOCIATES
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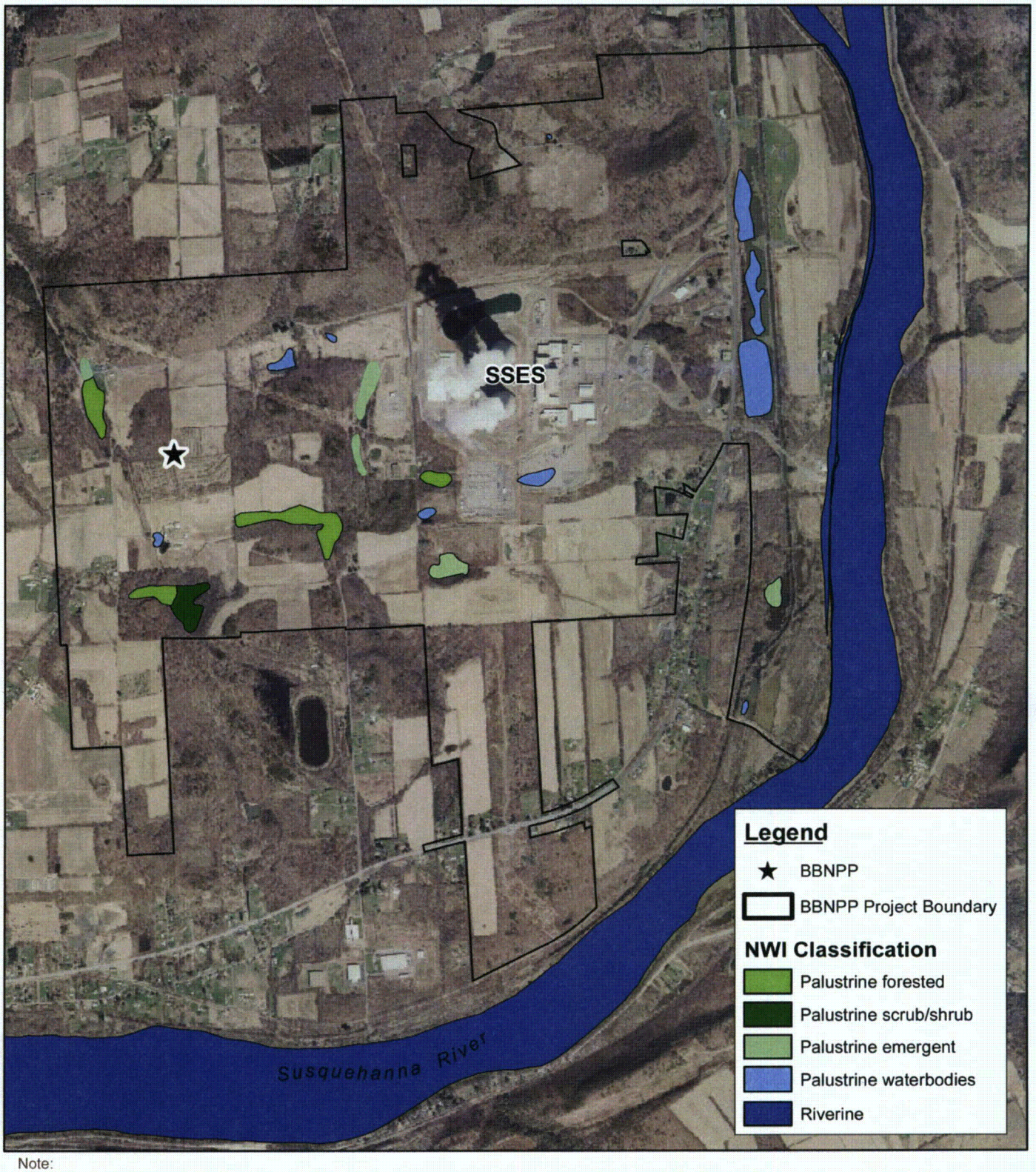
400 Old Reading Pike, Bldg A, Suite 101 Stowe, PA 19464

date: 07/29/10
prepared by: s.sherman
project: 22474.000

rev. date: 10/01/10, 09/07/11
prepared for: b. lees
file name: Figure2.BBNPP_Site_Aerial



Note:
Aerial Photography from PAMAP Program, PA DCNR, Bureau of Topographic and Geologic Survey, 2005
USFWS NWI Berwick, PA Quad, 1976

2,000 1,000 0 2,000 Feet

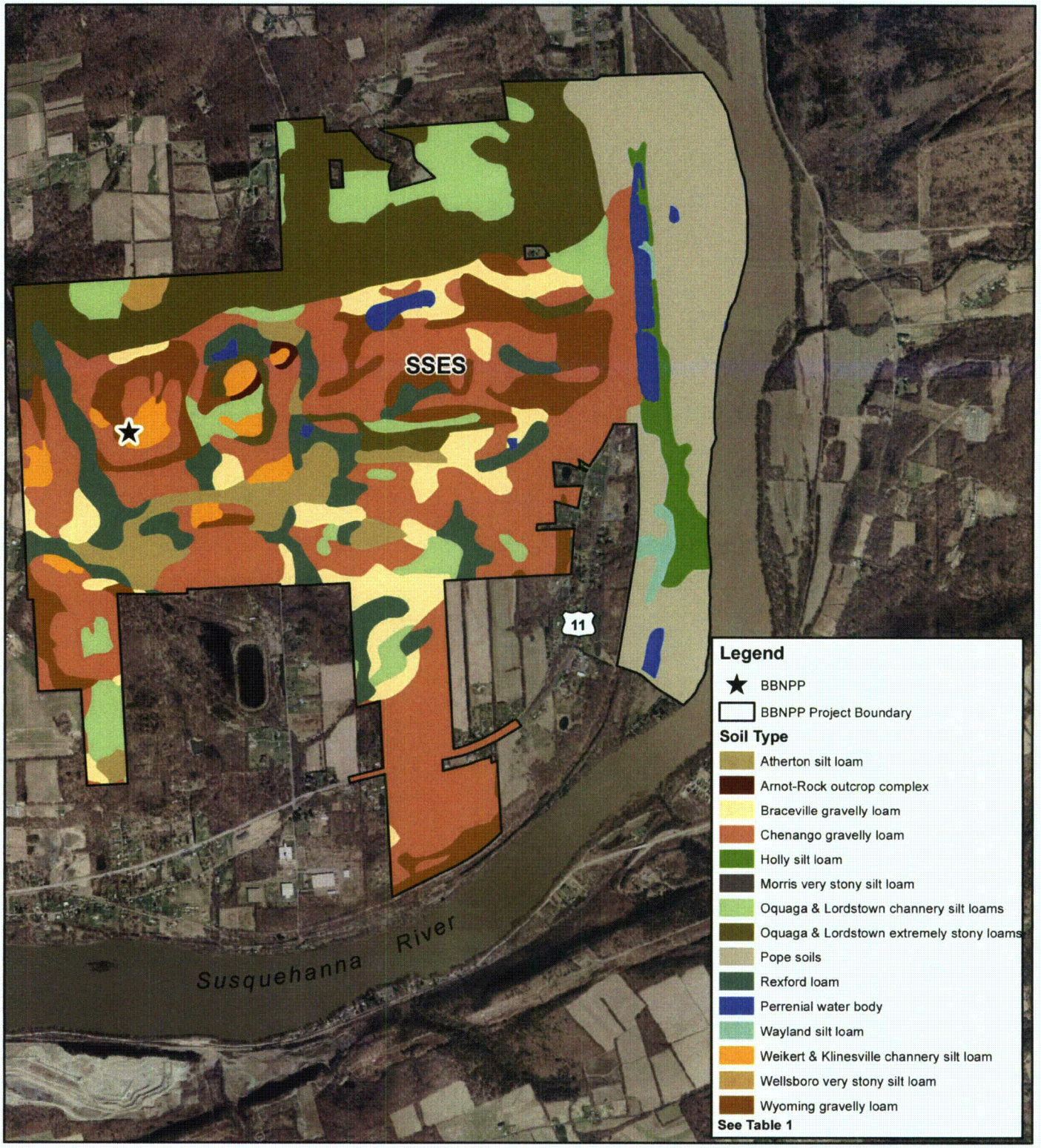
Figure 3.
Bell Bend NPP
National Wetlands Inventory Map

N

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS
400 Old Reading Pike, Bldg A, Suite 101 Stowe, PA 19464

date: 07/27/10
prepared by: s.sherman
project: 22474.000

rev. date: 10/01/10, 09/06/11
prepared for: b.lees
file name: Figure3.BBNPP_Site_NWI



Note:
Aerial Photography from PAMAP Program, PA DCNR, Bureau of Topographic and Geologic Survey, 2005
SoilDataMart.nrcs.usda.gov

2,600 1,300 0 2,600 Feet

Figure 4.
Bell Bend NPP
Soil Survey Map

N

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS
400 Old Reading Pike, Bldg A, Suite 101 Stowe, PA 19464

date: 07/27/10
prepared by: s.sherman
project: 22474.000

rev. date: 09/30/10, 09/06/11
checked by: b.lees
file name: Figure4.BBNPP Site Soils

N

Legend

- ★ BBNPP
- BBNPP Project Boundary

Wetland Type

- Wetlands
- Stream Channel
- Waterbodies

Note:
Aerial Photography from PAMAP Program, PA DCNR, Bureau of Topographic and Geologic Survey, 2005

Wetlands delineated by Normandeau Associates, Inc. and surveyed by Peters Consultants, Inc.

Beginning January 2010, all wetland coordinates were located by Normandeau Associates, Inc. with a sub-meter GPS unit.

This figure illustrates wetlands delineated within the wetlands survey area as shown in Figure 2. The survey area captures potential areas of disturbance within the BBNPP Project Boundary displayed in Figure 1. Presence of wetlands outside of the survey area have not been determined.

0.3 0.15 0 0.3 Miles

Figure 5.
Bell Bend NPP
Wetlands Map

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS
400 Old Reading Pike; Bldg A, Suite 101 Stowe, PA 19464

date: 07/28/10
prepared by: s.sherman
project: 21766.004

rev. date: 10/01/10, 11/12/10
checked by: k.maurice
file name: Figure5.BBNPP_Wetlands

N

Legend

- BBNPP
- Data Points
- Photograph Location and Orientation
- BBNPP Project Boundary

Wetland Type

- Wetlands
- Stream Channel
- Waterbodies

Note:
Aerial Photography from PAMAP Program, PA. DCNR Bureau of Topographic and Geologic Survey, 2005.

Wetlands delineated by Normandeau Associates, Inc. and surveyed by Peters Consultants, Inc.

Beginning January 2010, all wetland coordinates were located by Normandeau Associates, Inc. with a sub-meter GPS unit.

This figure illustrates wetlands delineated within the wetlands survey area as shown in Figure 2. The survey area captures potential areas of disturbance within the BBNPP Project Boundary displayed in Figure 1. Presence of wetlands outside of the survey area have not been determined.

0.25 0.125 0 0.25 Miles

Figure 6.
Bell Bend NPP
Wetlands Boundary Map

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

date: 07/26/10 rev. date: 10/01/10, 11/11/10, 09/07/11
project: 22474.000 checked by: k.maurice
prepared by: s.sherman file name: Figure6 BBNPP_WetlandsandPhotos

APPENDIX A

Photographs

This document does not contain the full report. The remaining pages and/or appendices can be found in:

□P□□□□□□□ □□:
□2 □□□L□□□□□ □ □ □□L□□□ □□L□□□□□□□ □ □□P□□□□□□□ □

Environmental Assessment
Part 1 - Resource Identification
Enclosure C - Description of Aquatic Habitat

PPL Bell Bend Nuclear Power Plant
Salem Township, Luzerne County, PA

1. Introduction

The BBNPP site has been thoroughly studied to provide documentation of flora, fauna, and aquatic resources.

There are 159.0 acres of wetland, 6.62 acres of waterbodies, and 24,014 feet of stream within the Project Boundary (BBNPP ACOE Third Preliminary JD Wetland Mapping, Normandeau, 2011). The aquatic resource descriptions provided in this document focus on regions surrounding the proposed impacts of BBNPP construction. The Wetland and Watercourse Impact Map for the ACOE and DEP, included as Enclosure D1 and D2, provide the location of all wetlands and water bodies within the Project Boundary. Enclosure A1 (Jurisdictional Determination documentation) includes a map and summary table of all delineated wetlands within the project site including wetland classifications, acreages, and coordinates of each individual wetland.

Many of the upland and aquatic areas within the BBNPP site boundary have been altered by land use practices including recreation, agriculture, logging, canal transportation and electric power generation. Much of the original forest cover was cleared and the remainder became fragmented as a result of these activities. No active timber cutting for these purposes has recently occurred within the Project Boundary. Current vegetation management consists largely of agricultural crop production and maintenance of transmission line corridors. In addition, infrastructure construction has caused topographic alterations within the BBNPP Project Boundary altering surface water flow paths and dividing wetlands. These land use practices resulted in stream channelization, stream erosion, and sediment deposition in the stream valleys creating some of the poor habitat characteristics and substrate embeddedness problems documented in the report findings and summarized in this Environmental Assessment.

2. Aquatic Habitats

2.1 North Branch Susquehanna River Watershed: Stream Habitat: General Habitat, Food Chain Production, Macroinvertebrate and Fish Communities

The project site is located on the west side of the North Branch of the Susquehanna River (NBSR), a navigable waterway. The NBSR flows from north to south past the SSES, makes a broad 90 degree turn to the west, and flows to the south of the Project Boundary before reaching Berwick, PA.

Streams and waterbodies within the NBSR watershed and the project boundary include the NBSR, the North Branch Canal (NBC), the NBC outfall channel, and unnamed tributaries to the NBSR.

The habitat in the NBSR in the vicinity of the proposed BBNPP intake structure is similar to habitat found both upstream and downstream of the proposed intake structure (Unistar, 2011). An Instream Flow Incremental Methodolgy (IFIM) Study has been completed on the NBSR. This purpose of this study was to determine the impact of a small change in NBSR flow on aquatic habitat. The study documents existing usable habitat area for eight aquatic species at various NBSR flows using historical data from the United States Geological Survey (USGS) NBSR Wilkes-Barre gage and current field data collected specifically for this study. The results of this study are included in the draft report "Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users," within Appendix B of this JPA.

Fish studies were completed on the NBSR between 2004 and 2007 in the vicinity of the SSES intake structure and the proposed BBNPP intake structure. A majority of the fish species collected were from the following families: Cyprinidae (minnow family), Centrarchidae, and Percidae (perch family). The following fish species were abundant: spotfin and spottail shiner, white sucker, bluntnose minnow, smallmouth bass, walleye, quillback, northern hog sucker, shorthead redhorse, and rock bass (Unistar, 2011). The NBSR sustains recreational fisheries for several fish species including smallmouth bass, muskellunge, yellow perch, bluegill, redbreast sunfish, northern pike, channel catfish, walleye, and bullhead, among others (Unistar, 2011). No migratory species have been collected in the reach of the river surrounding the BBNPP intake structure (Unistar, 2011).

Macroinvertebrate communities on the NBSR are diverse and characteristic of a large river system. The dominant groups collected during sampling in 2007 were Ephemeroptera (mayflies), Coleoptera (beetles), and Mollusca (snails and clams). Many taxa were present in relatively low proportions (less than 2%); a large proportion of the total number of organisms was contributed by a few taxa including the mayfly *Anthopotamus*, a beetle *Stenelmis*, and fingernail clam *Musculium* (Unistar, 2011). Many of the pollution intolerant taxa collected were Ephemeroptera, Plecoptera, or Trichoptera (EPT) species. Anthopotamus (mayfly) was the dominant EPT taxa collected. All samples collected on the NBSR were similar with no significant differences (Unistar, 2011).

Five species of mussel were observed during the "Mussel Survey in the Susquehanna River in the Vicinity of the Proposed Bell Bend Nuclear Power Plant Site," study including the Yellow Lampmussel, a protected specie. The Yellow Lampmussel was widely distributed throughout the sampling area. One Green Floater, another protected specie was observed during macroinvertebrate sampling but not during the mussel survey (Normandeau, 2011). This section of NBSR is typical of habitat found upstream and downstream of the BBNPP site and otherwise provides no unique or protected habitat (Unistar, 2011). In 2010, the PFBC changed the classification of the Yellow Lampmussel and the Green Floater from species of special concern to rare.

The habitat in the NBSR provides adequate nesting, spawning, rearing, resting, migration, feeding opportunities, and escape cover. Vegetation production, leaf matter, macroinvertebrates, and a variety of fish species all contribute to food chain production.

Lake Took-A-While is a 30 acre lake located within the Riverlands Recreation Area. A small portion of the southern tip of the lake is located within the Project Boundary. The lake is maintained for recreational use with some manicured grass banks. Some lacustrine fringe wetlands with dense wetland vegetation also border the lake. The lake provides habitat to numerous fish species including bass, sunfish, minnows and catfish (Ecology III, 2000). Lake Took-A-While discharges into the NBC.

A portion of the NBC is located with the project boundary. "A Field Survey of Fish and Aquatic Macroinvertebrates at the Proposed Bell Bend Nuclear Power Plant Site," documents fish and macroinvertebrates that were sampled at three stations within the NBC. A total of seven fish species (59 individuals) were collected. Bluegill and green

sunfish were the two most dominant species. The fish species present are common in warmwater lentic waterbodies in eastern PA. Midges were the dominant macroinvertebrate collected. No other EPT species and no mussel species were collected (Normandeau Associates, 2011).

The lake and canal system provides unique open water habitat to the area including adequate nesting, spawning, rearing, resting, migration, feeding opportunities and escape cover and is an important part of food chain production.

The NBC outfall channel is a manmade channel formed by overflow and seepage from the NBC and adjacent wetland that discharges directly into the NBSR. The NBC outfall channel has intermittent flow controlled by a weir at the NBC. The channel becomes increasingly incised as it approaches the NBSR. The steep, high banks are primarily vegetated with some areas of instability.

Normandeau Associates evaluated fish species within the NBC outfall channel. The fish species were comprised of warm water fish characteristic of both lentic and lotic systems. A total of 160 fish representing 12 species were collected. Golden shiner was the most abundant species comprising 27% of the total catch. A single brook stickleback species was collected during sampling which is considered a candidate species in Pennsylvania. No previous occurrences of the brook stickleback are known in the vicinity of BBNPP. This species was likely introduced through human action, such as a fisherman dumping bait fish, because the NBC and adjacent waters are not the typical habitat preferred by this species (A Field Survey of Fish and Aquatic Macroinvertebrates at the Proposed Bell Bend Nuclear Power Plant Site, Normandeau, 2011).

In the report "Bell Bend Project Site: Supplemental Field Assessments for PPL Riverlands" the NBC outfall channel habitat was rated marginal using the EPA Rapid Bioassessment Protocol due to characteristics such as poor pool variability, channel alteration, low channel sinuosity, and bank stability. Multiflora rose is dominant along the NBC outfall channel. Substrate embeddedness measurements were also performed at two reaches within the NBC outfall channel. Downstream, towards the Susquehanna River, good substrate conditions existed dominated by cobble and gravel while

embeddedness measurements at the upper reach indicated high substrate embeddedness (LandStudies, 2010).

Macroinvertebrates collected at two locations on the NBC outfall channel indicated fair to poor water quality. A total of 28 taxa were collected. The community was dominated by sow bugs (*Caecidotea*, 25%), moths (*Neocataclysta*, 21%), midges (Chironomidae, 15%), and flatworms (*Phagocata*, 10%). These four groups constituted about 71% of the macroinvertebrate community in the outfall channel. For a complete inventory of macroinvertebrates collected see the report "Supplemental Field Assessments for PPL Riverlands" (LandStudies, 2010). Additional macroinvertebrate information is provided in "A Field Survey of Fish and Macroinvertebrates" (Normandeau, 2011).

The unnamed Tributary to Lake Took-A-While is not a navigable waterway. It is located southeast of the BBNPP site and its drainage area is not part of the Walker Run watershed. Macroinvertebrate results for sampling conducted on the unnamed tributary to Lake Took-A-While are included in the Field Survey of Fish and Aquatic Macroinvertebrates (Normandeau, 2011). The macroinvertebrate community was dominated by the amphipod Gammarus and only one EPT species was collected which compromised 0.3% of the collection. This may indicate either poor benthic habitat conditions or poor water quality.

An additional unnamed tributary to the NBSR flows southeastward from the Project Boundary and empties into the NBSR about 0.8 mi upstream from the Walker Run confluence. It is not a navigable waterway. Its drainage area is not part of the Walker Run watershed. Studies were not completed on this stream because there are no planned stream impacts to this unnamed tributary.

2.1.1 Walker Run Watershed

Walker Run is a second order tributary to the NBSR and enters the NBSR at approximately river mile 164. It is not a navigable river. Walker Run is a relatively small stream, but is the largest in the immediate vicinity of the Project Boundary. It flows south toward the NBSR and west of the BBNPP footprint.

Walker Run is shallow and flows through a mixture of agricultural and forested lands. It is listed as a Cold Water Fishery by PADEP Chapter 93 Water Quality Standards. Walker Run supports reproducing brown trout populations; therefore all wetlands

hydrologically connected to Walker Run or its tributaries are considered exceptional value (EV) wetlands.

Walker Run has two unnamed tributaries. Neither are navigable waterways. Unnamed Tributary 1 (also referred to as UNT1 or the Eastern Tributary) flows along the eastern and southern site boundaries of the BBNPP footprint and discharges into Walker Run on the southwest side of the site. Tributary 2 (UNT2) is a tributary to Tributary 1. It flows south from the BBNPP power block (originating in the "teardrop wetland") and is piped beneath agricultural fields before emptying into the unnamed tributary.

According to "Walker Run Surveys: Wild Trout Habitat Assessment," Walker Run stream characteristics change significantly throughout the length of the watercourse. In this study, Walker Run and its tributaries were evaluated using the EPA Rapid Bioassessment Protocol. In general, upstream of Beach Grove Road, stream habitat is optimal to near optimal due to adequate shade, low substrate embeddedness, and sufficient riffle areas. The reach downstream of Beach Grove Road has marginal habitat quality attributed to greater substrate embeddedness, greater sediment deposition, fewer riffle areas, channelization, poor bank stability and poor vegetative protection (LandStudies, 2009). Despite these negative characteristics, a reproducing brown trout population was documented both downstream and upstream of Beach Grove Road. See the "Walker Run Trout Enhancement Plan" (LandStudies, 2010) for detailed existing characteristics of Walker Run relating to ideal brown trout habitat. Other species of fish that were relatively abundant within Walker Run include blacknose dace, creek chub, white sucker, and tessellated darter (A Field Survey of Fish and Macroinvertebrates at the Proposed Bell Bend Nuclear Power Plant Site, Normandeau, 2011).

"Walker Run Surveys: Wild Trout Habitat Assessment," also evaluates macroinvertebrates populations. Using the Hilsenhof Biotic Index, sampling results coupled with macroinvertebrate tolerance values were used to indicate water quality. Generally, macroinvertebrates collected upstream of Beach Grove Road indicated very good water quality while downstream reaches indicated good to fair water quality. The blackfly, *Prosimulium,* was the dominant taxa collected in Walker Run. The EPT group generally comprised a large number of the taxa identified (LandStudies, 2009).

"Bell Bend Project Site: Supplemental Field Assessments for the Walker Run Watershed" discusses habitat, macroinvertebrates, and substrate embeddedness in the

unnamed tributaries. Habitat characteristics of the unnamed tributaries to Walker Run were rated marginal due to poor epifaunal substrate, pool variability, and low channel sinuosity. The unnamed tributaries had a high embeddedness rating with a dominant substrate of silt and sand. Portions of Tributary 1 did not contain flow during summer 2010. Tributary 2 is piped beneath a corn field which serves as a habitat barrier.

Macroinvertebrates collected at unnamed tributaries 1 and 2 indicated fair to poor water quality. The community at Tributary 1 was dominated by pill clams (*Pisidium*), scuds (*Hyalella*), freshwater worms (*Oligochaeta*), and midges (Chironomidae). The community at Tributary 2 was dominated by midges and pill clams (LandStudies, 2010). Ephemeroptera was the dominant EPT taxon (LandStudies, 2009).

For a complete inventory of macroinvertebrates collected in the Walker Run Watershed see the "Walker Run Surveys: Wild Trout Habitat Assessment" (LandStudies, 2009), "Bell Bend Project Site: Supplemental Field Assessments for the Walker Run Watershed" (LandStudies, 2010), and "A Field Survey of Fish and Aquatic Macroinvertebrates at the Proposed Bell Bend Nuclear Power Plant Site" (Normandeau, 2011).

Vegetative production, leaf matter, macroinvertebrates, and a variety of fish species all contribute to food chain production within the Walker Run watershed. Plant species and plant community structure diversity provide adequate nesting, spawning, rearing, resting, migration, feeding and escape cover for wildlife. There is ample food supply for insect, amphibian, and avian populations. Fragmented forested areas serve as buffers to segments of Walker Run, the unnamed tributaries 1 and 2, and some wetland areas. These buffers provide valuable habitat for terrestrial and aquatic species. Wetlands, both forested and emergent, appear hydrologically connected to the unnamed tributaries and provide excellent habitat. Within the project boundary some reaches of Walker Run have productive wetland complexes adjacent to the stream channel. A reach of Walker Run south and west of the power block footprint is severely incised and manipulated with no forested cover. Few wetlands are connected to the stream throughout this reach.

2.2 Wetlands: General Habitat and Food Chain Production

Wetland types within the project boundary include Palustrine Emergent Wetland (PEM), Palustrine Scrub/Shrub Wetland (PSS), Paulstrine Forested Wetland (PFO) and open water areas. There are no named wetlands or swamps within the project boundary.

"A Field Survey of Plant Communities at the Proposed Bell Bend Nuclear Power Plant Site," describes the wetland types found within the project boundary. Typical PEM wetlands within the project boundary include a diverse group of herbaceous hydrophytic plants including soft rush, sedges, arrow-leaf tearthumb, common boneset, giant goldenrod, seedbox, nutsedges, blue vervain, New York ironweed, swamp aster, cut-leaf coneflower, broad-leaved cattail, reed canary grass and purple loosestrife.

Several large PSS wetlands are located in the western part of the Project Boundary. Hydrophytic shrubs are also a component of many wetland habitat types across the Project Boundary. Spicebush is overwhelmingly the most abundant wetland shrub on site. Other frequently occurring wetland shrubs include: highbush blueberry, meadowsweet, alders, silky dogwood, arrow-wood and grey dogwood.

Palustrine forested wetlands are the principal wetland habitat type within the Project Boundary. Large contiguous blocks of this wetland type extend across the western section of the Project Boundary. Trees commonly found in wetland forest habitat include red maple, silver maple, black gum, pin oak and river birch. In addition, upland preferring species such as white ash and yellow poplar are present on upland microsites scattered throughout some forested wetlands. Wetland forest understories are comprised largely of spicebush, highbush blueberry, arrow-wood, and winterberry. Skunk cabbage is predominant in the groundcover along with sedges, jewelweed, sensitive fern, clearweed, cinnamon fern, stout woodreed grass, and swamp dewberry" (Normandeau, 2011).

The majority of wetlands and ponds evaluated in the "Wetlands Functions and Values Assessment" were found to have adequate nesting, spawning, rearing, resting, migration, feeding and escape cover for wildlife. Wildlife habitat qualified as a principle function for most wetlands due to habitat connectivity, ample food supply for insect, amphibian, and avian populations, plant species and community structure diversity, as well as changing seasonal wetland uses. Many wetlands provide ideal habitat for a

large range of wildlife including mammals, birds, amphibians or reptiles. The PPL Riverlands Property has also been identified by The Pennsylvania Audubon Society as an Important Bird Area (IBA). Wetlands within the Walker Run watershed are considered EV due to reproducing brown trout populations in Walker Run.

Wetlands evaluated as not-suitable wildlife habitat during the Wetland Functions and Values Assessment include Wetlands 2, 3, 5, 13, 15, 22-24, 33, 49A, B and C, 54, 55, and 62 shown on the Wetland JD Map and Wetland and Watercourse Impact Map in Enclosures A1 and D1, respectively (note: wetland expansions or additions resulting from the third JD were not evaluated). These wetlands are small, lack plant community diversity, and/or are surrounded by developed upland.

Although habitat was identified as a principle function of the proposed wetland impact areas at the Riverlands property, this area has a large invasive species population including purple loosestrife, mile-a-minute, and multiflora rose (LandStudies, 2011).

Five ponds exist within the BBNPP Project Boundary. Johnson's Pond and the Farm Pond are spring fed. The Beaver Pond was created by beaver activity around an existing culvert crossing. The beaver dam at the Beaver Pond was removed and a weir structure installed to re-establish the open water that existed upstream of the beaver dam. Unnamed Ponds 1 and 2 are isolated ponds east of Confers Lane. All ponds are shallow. Johnson's Pond is the deepest with up to 5 foot water depths.

3. Habitat for Threatened and Endangered Species

The Pennsylvania Natural Diversity Inventory indicated multiple species of concern listed below:

- Indiana Bat (endangered) – United States Fish and Wildlife Service, PA Game Commission
- Butterflies (species of special concern) – Baltimore Checkerspot and Mulberry Wing – PA Department of Conservation and Natural Resources
- Mussels (PA rare) - Yellow Lampmussel and Green Floater– PA Fish and Boat Commission
- Northern Cricket Frog (PA endangered) – PA Fish and Boat Commission

"A Field Survey of Terrestrial Flora and Fauna," documents the species found within the BBNPP Project Boundary, including threatened, endangered, and species of concern. Butterfly surveys were documented in this report. Baltimore Checkerspot and Mulberry Wing butterflies were not found on-site. The life cycle of the Baltimore Checkerspot is tied closely to its host plant, turtlehead (*Chelone glabra*). Turtlehead was not found in the wetlands at the BBNPP site. The Mulberry Wing butterfly prefers tall grass meadow and sedge meadow habitat. These habitats occur in moderate amount at the BBNPP site (Normandeau, 2011).

The proposed BBNPP is located in close proximity to overwintering hibernacula for Indiana Bats. The results of a Bat Mist Net Survey are included in the Terrestrial Flora and Fauna Report. Despite suitable habitat, no Indiana bats were captured (Normandeau, 2011). An additional study, requested by the USFWS, was completed in fall 2010 and revised in fall 2011. The "Indiana Bat Roost Tree Survey Report" evaluates the interior forests and forest edges within the Project Boundary to identify potential roost trees (PRTs) and to qualify the Indiana bat habitat found within the Project Boundary. Out of the 255 PRTs indentified in the interior forest survey area, 118 were live, 114 were dead, and 23 were partially dead. Roost types included 252 PRTs with exfoliating or defoliating bark, 13 with suitable crevices, and 5 with suitable cavities. The United States Department of the Interior (USDOI) criteria recommends a minimum of 6 potential roost trees (PRTs) per acre for interior forest. Of the eighteen forest area interior sites studied, five exceeded the USDOI recommended PRT density. Forested wetlands generally exceeded this threshold and also contained higher densities of high quality PRTs. The aggregate PRT density within interior forest uplands and the interior forest on the site, as a whole, was slightly below the recommended threshold, however one upland site had significantly higher PRT density than the others (19.4 PRTs per acre). As a whole, 1.7 high quality PRTs per acre were identified within the interior forest studied.

Of the 286 PRTs identified along forest edges, 192 were live, 77 were dead, and 17 were partially dead. Roost types included 295 exfoliating or defoliating bark, 4 with a crevice, and 1PRT with a cavity suitable for roosting. USDOI suggests a minimum PRT density of 1.0 PRT per 500 feet along forest edges. Thirteen of the 18 forest area edges characterized met this criterion. The 286 PRTs observed resulted in 1.9 PRTs per 500 ft

across the forest edge studied. The forest edges as a whole yielded 0.6 high quality PRTs per 500 ft (Normandeau, 2011).

One Northern Cricket Frog call was heard by Normandeau Associates during field surveys south of the BBNPP footprint. The call was heard near the farm pond, which will not be impacted by project construction or operation. The Northern Cricket Frog had not been heard prior and has not been heard since, near the farm pond or at any other location within the BBNPP Project Boundary. The Northern Cricket Frog has also never been sighted within the BBNPP Project Boundary. Habitat preferences include sunny, shallow ponds with abundant vegetation in the water and on the shore and slow-moving, algae covered water courses with sunny banks (NYDEC, 2009). The BBNPP project will not affect the existing ponds on-site. In addition the planned mitigation on Walker Run should benefit any potential Northern Cricket Frog populations through increasing the quantity and quality of wetlands adjacent to Walker Run. Details regarding the mitigation plans can be found in Section R of the JPA.

A "Mussel Survey in the Susquehanna River in the Vicinity of the Proposed Bell Bend Nuclear Power Plant Site" was completed near the proposed intake structure location. The survey revealed relatively wide distribution of the Yellow Lampmussel. The Yellow Lampmussel is relatively abundant within the main stem of the Susquehanna River but is less common in tributaries to the Susquehanna and other river systems (Normandeaeu, 2010). Its condition is considered vulnerable to relatively stable by the PA Natural Heritage Program. One Green Floater was collected during macroinvertebrate sampling on the NBSR completed by Ecology III in 2007 (Normandeau, 2010). The Green Floater is considered imperiled by the PA Natural Heritage Program. This species is not common in Pennsylvania but has been found in the Susquehanna, Delaware, and Ohio river drainages (Unistar, 2011). The Green Floater prefers pools and other calm areas within streams with hydrologic stability (Unistar, 2011). This section of NBSR is typical of habitat found upstream and downstream of the BBNPP site and otherwise provides no unique or protected habitat.

4. Environmental Sanctuaries and Study Areas

There is one environmental study area and wildlife sanctuary that is adjacent to and within a small portion of the Project Boundary. PPL owns and operates the Riverlands Recreation Area, a 400 acre strip of land east of US 11 and west of the NBSR. This

tract of land contains a nature center, a recreation area with ball fields and picnicking pavilions, Lake Took-A-While and a Wetlands Nature Area. A portion of the Recreation Area, Wetlands Nature Area and Lake Took-A-While lie within the Project Boundary. The Wetlands Nature Area provides an area for nature study and educational programs and was designated an Urban Wildlife Sanctuary in 1988. The Humane Society of the United States Urban Wildlife Sanctuary Program fosters a greater understanding and appreciation of wildlife in urban areas by encouraging stewardship practices that improve conditions for wild animals, and by promoting humane solutions for resolving human-wildlife conflicts, when they occur. PPL also prohibits hunting, fishing, trapping and pets within the Wetlands Nature Area.

5. Water Quantity and Stream Flow

5.1 Streams

5.1.1 NBSR Watershed

The NBSR flows southeast through high, flat-topped plateaus separated by steep-sided valleys. As it flows downstream, the NBSR is joined by the Lackawanna River where it turns southwest and flows towards Sunbury, PA" (Unistar, 2011). Major upstream tributaries include the Lackawanna and the Chemung rivers. The total drainage area above the proposed BBNPP site is approximately 10,240 square miles (Unistar, 2011).

An east-west trending ridge runs along the north side of the BBNPP and SSES site. The ground surface is highest in elevation along the ridge top; surface elevation decreases to the east and south toward the NBSR. Surface drainage from the ridge, the BBNPP and SSES sites, and adjacent farmlands drains via small creeks southward and eastward toward the NBSR. These creeks include Walker Run and small unnamed tributaries. Confer's Lane acts as the drainage divide between the NBSR and Walker Run watershed within the BBNPP Project Boundary. Runoff from the SSES flows eastward towards the NBSR and does not enter the Walker Run watershed.

The USGS has two river gages upstream and downstream of the BBNPP site. Table 1 provides a summary of the gages.

Table 1. Summary of USGS River Gages Upstream and Downstream of BBNPP

	Wilkes-Barre	Danville
USGS Gage No.	01536500	01540500
Distance from BBNPP intake	20 miles upstream	26 miles downstream
Drainage area	9,960 sq miles	11,220
Daily flow record	April 1899 to present	April 1905 to present
Long-term average flow	13,700 cfs	15,500 cfs

The flow in the river at BBNPP is largely unregulated. The ACOE operates eight reservoirs upstream from BBNPP, all of which provide flood control. Three of the ACOE reservoirs -- Cowanesque, Tioga-Hammond and Whitney Point -- also provide low flow augmentation. However, the combined usable storage of these eight reservoirs, excluding uncontrolled flood storage, amounts to approximately two-thirds of one inch of runoff within the NBSR watershed at BBNPP.

There are also numerous recreation and municipal water supply reservoirs upstream from BBNPP, but these reservoirs are relatively small and contribute relatively little flow regulation.

Susquehanna River flows vary significantly throughout the year. As is typical of streams in this region, the lowest river flows generally occur in September and October and the highest flows in March and April. The river flow at BBNPP generally reflects the flow at the Wilkes-Barre gaging station, due to the relatively small drainage area between the gage and BBNPP. Table 2 shows the flows as recorded at Wilkes-Barre that are exceeded at various percentages of time during the year and by month, based on the 111-year flow record. (To determine flow rates at BBNPP for purposes evaluating the potential effects of BBNPP on the local, riverine aquatic habitat, flows at the Wilkes-Barre gage are increased by 2.8 percent to reflect the increased drainage area at BBNPP).

The reach of the NBSR in the vicinity of BBNPP is a pool, at least at relatively low flows. The pool begins at the SSES Environmental Laboratory (approximately 0.2 miles upstream from the BBNPP intake location) and extends downriver approximately 0.7

miles. At a river flow of 1,570 cfs, the estimated average width and depth of the pool are 790 ft and 5 ft, respectively, equivalent to a volume of approximately 110 million gallons.

Table 2. River Flow Exceedances at Wilkes-Barre (April 1899-March 2010)

Percent Time Exceeded	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
100 (minimum)	532	1,010	1,060	2,100	5,210	2,000	1,350	787	716	532	658	627	860
90	1,690	3,300	3,700	7,000	11,000	5,160	2,600	1,450	1,100	1,040	1,180	1,930	3,070
80	2,660	4,500	4,758	10,300	14,400	6,690	3,270	1,890	1,410	1,290	1,540	3,260	4,850
70	3,980	5,600	5,990	13,900	17,000	8,180	3,930	2,310	1,670	1,580	1,910	4,570	6,400
60	5,440	7,100	7,186	17,600	20,200	9,970	4,746	2,860	2,000	1,890	2,490	5,910	8,090
50	7,400	9,100	8,800	22,100	24,000	12,000	5,775	3,480	2,440	2,290	3,360	7,540	10,200
40	10,100	11,500	11,100	27,300	28,400	14,600	7,194	4,240	3,000	2,810	4,500	9,548	12,500
30	14,100	14,900	14,680	34,200	34,000	18,000	9,172	5,220	3,840	3,700	6,000	12,700	15,700
20	20,300	21,000	21,120	44,200	42,700	22,500	12,820	7,080	5,310	5,434	9,000	17,000	20,700
10	32,500	32,500	34,100	64,900	58,520	31,800	19,300	11,100	8,270	9,000	16,000	24,620	30,100
0 (maximum)	329,000	210,000	179,000	229,000	206,000	206,000	329,000	142,000	95,300	244,000	151,000	123,000	184,000

The NBC watershed begins east of Confers Lane at the unnamed tributary to Lake Took-A-While as well as an additional unnamed tributary which flows into the northern segment of the NBC near the temporary laydown area. The unnamed tributary to Lake Took-A-While is fed by spring sources and surface water runoff. It flows southeast from the BBNPP site and empties into the NBSR via Lake Took-A-While and the NBC about 0.8 mi upstream from the Walker Run confluence. Its drainage area is not part of the Walker Run watershed. Flushing events are expected to occur within the unnamed tributary to Lake Took-A-While.

Lake Took-A-While is a constructed lake that covers approximately 30 acres. Hydraulically, Lake Took-A-While and the NBC both function as stormwater impoundments that are large in proportion to the watersheds that they serve. The presence of these impoundments results in a very slow hydrologic response to a storm event. Flushing events do not occur within the NBC.

The hydrology within the NBC outfall channel is subject to high flows in the NBSR as well as artificially controlled by the weir at the NBC. Flow from the weir outlets into the NBC outfall channel which carries storm flows from the weir to the NBSR. Groundwater discharge provides minimal flow to the NBC outfall channel. Over time, the channel has deteriorated into its present ditch-like condition. Flushing events are expected to occur in the NBC outfall channel during high flows.

5.1.2 Walker Run Watershed

Walker Run and other small streams in the vicinity of the Project drain from the east-west trending ridge north of the project boundary and flow southward toward the NBSR. Water levels in Walker Run appear to be heavily influenced by surface runoff and from upstream drainages to the north and northwest of the site in addition to springs and snowmelt. The majority of spring flow is located upstream of Beach Grove Road, however a few springs are located downstream. Walker Run is a low to moderate gradient stream with a gradient drop from Upper Walker Run to Lower Walker Run of almost 290 ft over a distance of approximately 4 mi. Walker Run's drainage area to the NBSR is about 4.1 mi^2 (Unistar, 2011).

The majority of Walker Run, south of Beach Grove Run, is incised. The incised nature of the stream causes a disconnection between the stream and the floodplain.

Floodwaters are confined to Walker Run with little access to the floodplains except during high flow events. High flows "trapped" within the stream channel increase the bank erosion and sediment embeddedness problems documented throughout the southern portion of Walker Run. Most wetlands adjacent to Walker Run provide limited storage for upland surface water runoff but rarely receive stream floodflows.

A large forested wetland complex exists south of the proposed BBNPP footprint and adjacent to Walker Run. Although portions of this channel are incised, a strong connection remains between the groundwater, stream, and floodplain.

Stream flow data collected between November 2009 and June 2010 indicate that Walker Run is a balanced system (not gaining or losing), although a statistical analysis was not performed to determine if the results can be considered significant (Bell Bend Project Site: Supplemental Field Assessments for the Walker Run Watershed, LandStudies, 2010).

The removal of a beaver dam on Walker Run south of the BBNPP footprint affected the hydrology of the stream and the adjacent wetland. Prior to this beaver dam removal, backwater conditions existed upstream of the beaver dam on Walker Run and its Tributary 1. Beavers were trapped and relocated and the beaver dam was removed on April 12, 2010. Beaver dam removal resulted in a small decrease (6 inches) in local groundwater elevation based on changes in observed water levels in piezometers installed before dam removal. Beaver dam removal improved the flushing capacity of Walker Run.

Tributary 1 to Walker Run has a drainage area of about 0.68 mi^2 and an approximate length of 2.1 miles (Unistar, 2011). It is fed by both surface water runoff and groundwater discharge from spring seeps and wetlands. A culvert crossing and weir structure is located on Tributary 1 forming the surface water body named the "Beaver Pond." Beaver activity around the old culvert structure formed the pond before culvert replacement. The north/south reach of the unnamed tributary below the Beaver Pond is incised due to a man-made berm that runs adjacent to the stream preventing floodflows from accessing the floodplain. Downstream, the east-west reach of Tributary 1 is well connected to its floodplain, helping to attenuate floodflows and stabilize the stream. Current impediments to flushing events within the unnamed tributary include the weir structure and an existing culvert restriction between wetlands 10 and 12.

Tributary 2 is fed primarily by multiple springs within the tear drop wetland, but also receives surface water runoff. Tributary 2 is piped underneath a fallow crop field. A grassed waterway is also present for high flows overtopping the pipe. The pipe limits but does not eliminate the flushing ability of Tributary 2.

5.2 Wetlands: Water Quantity and Streamflow

The wetlands within the BBNPP Project Boundary perform various hydrologic functions including groundwater discharge and recharge, storm and floodwater storage and control, and flushing characteristics. For a summary of all the functions and values of the wetlands within the BBNPP project boundary and how each wetland affects hydrology within the watershed see the "Wetland Functions and Values Report" (LandStudies, 2011). The existing hydrology of the permanent and temporarily impacted wetlands is described below. Impacts as well as wetland reference numbers are shown on the Wetland and Watercourse Impact Location Map for ACOE and DEP, Enclosures D1 and D2.

Wetland 5 is a small, isolated wetland east of North Market Street. The wetland is a groundwater discharge point on a hillside. The wetland is considered isolated because discharged water is reabsorbed and does not affect Walker Run flow conditions. The soils down slope seem to have a high infiltration rate. The discharge is likely seasonal.

Wetland 11, or the "teardrop" wetland, is the result of multiple groundwater seeps at the base of the wooded slope east of Tributary 2 and groundwater seeps forming an intermittent drainage channel to the north. Groundwater recharge is minimally occurring in the wetland. The wetland is not permanently flooded and is located in a flat valley bottom where depressions may hold and infiltrate runoff affecting floodflows downstream. A diffuse but channelized flow forms (Tributary 2) in the northern portions of the wetland. The flow varies from above to below ground. The underground flow comes out at 3 distinct headcut locations in the middle of the wetland. From the headcuts, the flow is channelized until it is piped underneath agricultural fields at the base of the wetland before discharging into Tributary 1.

Wetland 12 begins south of Beach Grove Road and east of Johnson Pond and follows Tributary 1 to Walker Run. A culvert under an old farm lane acts as the southeastern

boundary of the wetland and as a separation between the forested and emergent vegetated areas. Hydrology is provided by groundwater seeps and surface water runoff.

Tributary 1 is formed by the Johnson Pond outlet as well as two drainage features originating from culvert pipes under Beach Grove Road. Groundwater discharge and recharge vary seasonally in this area. An existing culvert crossing is located at the southern tip of the Beaver Pond. A beaver dam previously existed on the manmade crossing, creating a large pond upstream. The beaver dam was removed as part of the culvert replacement.

Downstream of the Beaver Pond to the 90 degree bend in Tributary 1 the wetland is inundated during winter and spring with drier conditions during the summer months. Seasonal groundwater discharge and recharge is likely occurring. The wetland is flat and capable of detaining surface water runoff from surrounding upland during rain events, minimally affecting floodflows in Tributary 1. Two channels of water fed by surface water runoff from the west building parking lot and Confers Lane feed the wetland and Tributary 1 during rain events. These two flat but channelized flows join within the wetland and then flow to Tributary 1 as it begins to flow in an east-west direction. Tributary 1 appears to have been channelized throughout the north-south section, especially west of the West Building where berms have been built on either side of the stream. The berms appear to be sidecast from digging out the channel and limit the connection of Tributary 1 and surrounding wetland except during high flow events.

The source of hydrology for the wetland associated with the east-west reach of Tributary 1 appears to be overland flow, groundwater upwellings when the water table is high, as well as excess stream flow from Tributary 1 and Tributary 2. The culvert causes backwater conditions, therefore floodflow alteration is a suitable function of this wetland. The wetland can hold and infiltrate some surface runoff from surrounding upland areas. During larger storm events the east-west stream reach will overflow its banks and utilize the surrounding flat wetland. In smaller rain events the stream channel is defined enough that flow will remain in the channel. In this area, the wetland performs stream stabilizing functions. Seasonal groundwater recharge and discharge is believed to be a suitable function in the east-west area of the wetland. The topography, lack of standing water, and constricted outlet are some characteristics that imply recharge is occurring.

Wetland 10 is an emergent wetland adjacent to wetland 12, separated by the farm lane and culvert crossing. This wetland is unique because hydrologic conditions were significantly affected by a beaver dam. The beaver dam was located on Walker Run, downstream of the confluence with Tributary 1. The beaver dam caused significant backwater to inundate the area surrounding the tributary raising groundwater elevations. Inundation increased with proximity to the beaver dam. The beaver dam was removed in April 2010, affecting the hydrologic conditions in this wetland. The removal of the beaver dam drained the inundated area and caused intermittent flow within Tributary 1 during dry months. The wetland also contains sandy soils, and flat, favorable topography to detain and infiltrate surface water runoff and seasonal high flow from Tributary.

Within this wetland, Tributary 1 to Walker Run channel appears to have been historically straightened and channelized for agricultural use. This wetland can retain higher volumes of water under flood conditions than in normal or average rainfall conditions. This wetland receives overland flow from surrounding uplands and excess flow from the eastern tributary during rain events. The culvert located at the upstream edge of this emergent wetland creates floodflow storage upstream in Wetland 12; however, this reduces the amount of flow wetland 10 can receive during a storm. Flushing events are infrequent due to flat topography, low channel grade, and intermittent channel flow within Tributary 1.

Wetland 18 surrounds an open water pocket east of Confers Lane. The hydrology of this wetland is stable with regard to seasonal water fluctuations; remaining saturated and inundated throughout the year. It collects direct precipitation as well as surface water runoff and likely has a water table at or near the soil surface during wet periods. This wetland does not have an outlet, however prior to land alteration for transmission line construction the wetland likely drained towards wetland 25 to its east. Water is retained in this wetland until it evaporates, infiltrates, or is used by plants through evapotranspiration.

Wetland 19, south of the BBNPP site and east of Confers Lane, is a forested wetland associated with the Susquehanna River watershed. This wetland is contiguous with wetland #20, although a portion lies outside the BBNPP Project Boundary. The wetland is large compared to the size of its watershed. Its large area and flat topography make it

suitable to store surface water runoff from surrounding uplands and therefore influence floodflows in the downslope watershed. Hydrology is provided by surface runoff during rain events. Additional hydrology may be provided by seasonal groundwater discharge. This wetland is inundated during the winter months. The wetland is flat and water drains slowly towards an undefined swale at the center of the wetland. The swale runs southeast towards wetland #20. The soils observed appear to be fine-grained silts with a less permeable clay layer near the surface. As a result, infiltration rates appear to be very slow but limited groundwater recharge is likely occurring. There is a slight indication of diffuse flow and there is no distinct channelization or erosion.

Wetland 49 consists of three separate wetlands designated A, B, and C. These wetlands are manmade and were created by grading around the existing SSES facilities. One of these small wetland pockets (49A) is an isolated depression located on fill adjacent to the switchyard fence. This wetland does not affect hydrology. The other two small wetlands (49B and 49C) receive stormwater runoff from the switchyard and SSES. Wetland 49B is an emergent grass wetland that briefly receives stormwater flow before it outlets through a culvert into 49 C. Wetland 49C is a rip-rap, steeply-sloped basin with wetland vegetation at the bottom of the basin. Inlet and outfall pipes are present in the basin. Water may be briefly retained before it is discharged into the unnamed tributary to Lake Took-A-While. These wetlands could minimally affect floodflows, however, significant quantities of water do not appear to be detained based on basin design.

Wetlands 37, 38, and 43 are located at PPL Riverlands. Wetland drainage areas are extremely small because walking trails and roads create artificial boundaries. Two distinct hydrologic areas will be impacted; the flat, emergent wetlands adjacent to the intake structure access roads and walking trails, and the forested wetland directly adjacent to the NBC outfall channel. The flat emergent wetland areas receive direct rainfall and some road/walking trail runoff. These wetlands are perched on a compacted fill layer preventing groundwater recharge or discharge. Direct precipitation and poorly drained soils contribute to the hydrology of this wetland. Due to the flat topography, lack of an outlet, and impermeable layer, evaporation and evapotranspiration are assumed to be removing water from the wetland. A portion of these wetlands are within the floodplain of the NBSR and could provide flood conveyance and storage during large occasional flood events. These wetlands also collect and temporarily store stormwater runoff; however, the wetlands adjacent to the NBC outfall channel do little to decrease

flood flows as the channel is severely incised. Towards the NBC weir the wetland topography is flatter.

Wetland 44 is located east of an access road/walking trail. The north boundary of the wetland is defined by the NBC outfall channel. This wetland is primarily PFO wetland with some emergent areas. A large raised area, likely an old fill pile exists between the wetland and the NBSR to the east. The NBC flows north to south dividing the wetland. The topography flat, but the majority of the area drains slowly towards the NBC outfall channel. The hydrologic conditions of this wetland change significantly with the seasons. During wet seasons the majority of the wetland retains water for long periods of time and exhibits diffuse flow with high interspersion of vegetation and water. Hydrology is provided by direct precipitation, occasional stream overflow from the canal, and close proximity to groundwater.

This wetland seasonally provides groundwater recharge and discharge. A compact soil layer exists approximately 18-24 inches deep. This could potentially serve as a barrier between the surface and groundwater limiting recharge or discharge. This wetland retains water due to its flat topography, dense vegetation, and the slow movement of water through the wetland. Thus, the wetland has the capability to provide some flood storage if the NBC were to overflow or if the NBSR experienced a large flood event. However, the small size of the wetland compared to the watershed would be of little significance in providing this function.

6. Water Quality

6.1 NBSR Watershed

NBSR water quality has been significantly degraded by mining practices and other anthropogenic sources. SSES has monitored water quality on the Susquehanna since 1968. Water quality in the NBSR in the vicinity of the BBNPP site has improved steadily since the early 1970's (Unistar, 2011). The water quality improvements have been attributed to a reduction in abandoned mine drainage and a reduction in point source pollutants from municipal wastewater treatment plants and industries. According to the Environmental Report in the BBNPP Combined Licensing Application, the most obvious water quality improvement in the NBSR has been the reduction in total iron levels along with decreasing concentrations of several other water quality indicators including

turbidity, sulfate, and total suspended solid. pH and alkalinity have increased on the NBSR over the past 30 years, resulting from reduced mining within the watershed. Between 2002 and 2008 the pH ranged from 6.8 to 7.8. Specific conductance has also decreased as a result of declining mining operations (Unistar, 2011).

The Nescopeck Creek, a tributary to the NBSR downstream of the BBNPP project site, is impaired by acidic drainage from abandoned mines within its watershed. Currently the affects of abandoned mine drainage on the NBSR at the confluence with the Nescopeck is contained to the NBSR south shoreline and traceable effects dissipate within 0.6 miles of the confluence (Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users, Normandeau, 2011).

Recent dissolved oxygen measurements of the NBSR reveal good aeration, near saturation. Measurements ranged from 8.9 mg/L to 11.0 mg/L (Unistar, 2011). Nitrate, ammonia, and total phosphorus concentrations can be slightly elevated which is typical of rivers in agricultural areas that also receive sewage treatment plant effluents. Fecal coliform was at detectable levels in each river sample. No minor or trace metal concentrations are elevated in the NBSR except iron concentrations which range from undetectable to slightly elevated. Radionuclides were tested for in 2008, none were detected (Unistar 2011).

Appendix A of the JPA, Items 30 and 31, provide additional information regarding stream bottom sediment substrate composition and a sediment analysis for the presence of hazardous dredgate and pollutants. The full report, "Sediment Characterization Report Bell Bend Nuclear Power Plant, Susquehanna River, Berwick, Pennsylvania" (AECOM, 2011) is provided in Appendix B.

"Bell Bend Project Site: Supplemental Field Assessments for PPL Riverlands" documents the macroinvertebrates collected at the NBC outfall channel. The macroinvertebrates collected indicated fair to poor water quality using the Hilsenhoff biotic index, even at the downstream reach (LandStudies, 2010).

The only data collected on the unnamed tributary to Lake Took-A-While (with headwaters southeast of SSES) indicative of water quality was the macroinvertebrate sampling described in "A Field Study of Fish and Aquatic Macroinvertebrates." The macroinvertebrate community was dominated by the amphipod Gammarus and only one

EPT species was collected which comprised 0.3% of the collection. This may indicate either poor benthic habitat conditions or poor water quality (Normandeau, 2011).

6.2 Walker Run Watershed

In general, the incised nature throughout the majority of Walker Run prevents adequate filtering of high flows which are trapped within the banks. Wetlands along the stream may detain and filter surface water runoff but rarely receive high stream flows from banks over-topping.

Water quality parameters were similar for Walker Run and its tributaries. The pH values typically fell between 7.0 and 7.9. The alkalinity of Walker Run ranged between 5.9 mg/L and 38 mg/L, which is lower than the NBSR. This is expected since the specific conductance and TDS of the water are also low (Unistar, 2011).

High specific conductivity values were measured at the discharge pipe of Tributary 2 (Unistar, 2011). These measurements indicate a high proportion of groundwater from springs in the teardrop wetland. These results were corroborated in the "Bell Bend Project Site: Supplemental Field Assessments for the Walker Run Watershed" (LandStudies, 2010).

According to the Environmental Report in the Combined License Application, total dissolved solid measurements ranged from 45-80 mg/L within the project boundary. Dissolved oxygen typically measure 9.0 mg/L or greater. Nitrate, ammonia, total Kjeldahl nitrogen, organic nitrogen, and total nitrogen were detected in the creeks on occasion, but at concentrations less than 1.5 mg/L. Ammonia nitrogen was somewhat elevated in Walker Run in April 2008. Orthophosphate was detected in one sample collected in October 2008. All metal concentrations measured were either low or not detectable. Manganese was found at higher levels in the creeks than in the NBSR due to groundwater discharges from springs and wetlands which commonly contain higher levels of manganese and iron (Unistar, 2011).

Fecal coliform bacteria and total coliform bacteria were detected in all creek samples (Unistar, 2011). Farm animals and septic tanks probably account for the majority of the detections.

Macroinvertebrates in Walker Run were collected and identified. Sampling results coupled with macroinvertebrate tolerance values were used to indicate water quality. Generally, macroinvertebrates collected upstream of Beach Grove Road indicated very good water quality while downstream reaches indicated good to fair water quality. Macroinvertebrates collected at both unnamed tributaries indicated fair to poor water quality (Walker Run Surveys: Wild Trout Habitat Assessment Report, LandStudies, 2009).

6.3 Wetlands

Many of the wetlands within the BBNPP property boundary provide filtering functions, removing sediments, nutrients, and toxins from surface water. For a summary of all wetland functions and values within the BBNPP property boundary see the "Wetland Functions and Values Report" (LandStudies, 2011). The water quality functions of permanently and temporarily impacted wetlands are discussed below.

Wetland 5 does not provide water quality improvement functions. The wetland is small (0.12 acres) and isolated. It is located on a steep hillside in the upper region of the watershed. Forest and shrub areas comprise the upstream watershed; therefore pollutants entering the watershed are minimal.

Wetland 11 does not perform water quality improvement functions because a significant source of pollutants does not exist in the upslope watershed. The stable upper reach of Tributary 2 has low vegetated banks that can slow and filter water. This wetland also contains a flat valley bottom with a high density of vegetation throughout the wetland and some vegetation and water interspersion in the upper, stable portion of the channel. Below the headcut, water in the channel is not slowed by vegetation or a low easy accessible floodplain. Filtering of sediments in this portion of the wetland would only occur during high flows. Minimal sources of sediment (except stream bank erosion) and no sources of nutrients were identified in this wetland's watershed.

Wetland 12 provides water quality improvement functions. Wetland characteristics including flat topography and depressions, and backwater from undersized culverts and the weir structure promote water retention, sediment detention, and nutrient uptake. Normandeau's water quality testing revealed high conductivity levels within the unnamed tributary. This could indicate groundwater discharge into the steam.

Wetland 10 could provide water quality improvement functions due to its flat topography with dense emergent vegetation that slows and detains water. However, there is a lack of upslope nutrients and sediment pollution within the watershed.

Wetland 18 performs water quality improvement functions such as nutrient and sediment retention. This wetland is an isolated depression consisting of PFO, PSS, PEM, and Palustrine Open Water. The majority of the wetland was saturated or inundated with very mucky soils. A wide diversity and high density of vegetation was also present. Poorly drained soils allow the wetland to retain water for long periods of time. This wetland likely traps nutrients and sediments from the adjacent crop ground upslope.

Wetland 19 does not provide water quality improvement functions. If sources of sediment or nutrients were present in the upslope watershed this wetland could serve as a sediment and/or nutrient trap due dense woody vegetation and relatively flat topography which causes water to move slowly (diffusely) within the wetland. There is no defined outlet and surface water is retained for long periods of time, especially outside of the growing season. There is not a substantial source of pollutants in wetland's watershed which reduces the wetlands ability improve water quality.

Wetland 49 includes three wetland pockets; A, B, and C. Of the three small wetland pockets, wetland 49C (a stormwater basin) is the most likely to have a positive effect on water quality based on its size and design.

Wetlands 37, 38 and 39 are not suited to improve the water quality of adjacent water bodies. The restricting factor is the lack of a source of pollutants due to the small watershed. If a source existed this wetland would provide this valuable function due to areas of saturation and ponded water, and dense vegetation for nutrient uptake.

Wetland 44 is not suited to improve water quality. Although this wetland has flat topography and detains water it lacks a source of pollutants due to the small watershed size.

7. Recreation

Part of the Susquehanna Riverlands Environmental Preserve is located within the BBNPP project boundary, east of US 11. The Preserve provides refuge for a wide variety of flora and fauna and gives visitors the chance to observe these species in their

natural surroundings. Riverlands property is also part of a Pennsylvania Audubon Important Bird Area.

PPL provides educational programs at this facility. The historical NBC system is located on the PPL Riverlands property. Many walking trails are accessible for exercise and wildlife observation. Walking trails pass through a variety of upland and wetland habitats and follow the canal. Lake Took-A-While is also part of the PPL Riverlands. Fisherman can utilize this Lake. Commonly caught fish include sunfish, bass, cyprinids (minnows), and catfish (Ecology III, 2000). The fish community in the Lake is typical of other warmwater lentic waterbodies in Pennsylvania. Boats are allowed on the lake, however gasoline engines are not permitted.

Common recreational activities along the Susquehanna River include swimming, fishing, and boating. The NBSR sustains recreational fisheries for several fish species including smallmouth bass, muskellunge, northern pike, channel catfish, walleye, yellow perch, bluegill, and redbreast sunfish. Creel surveys performed during 1986 near BBNPP indicated that the majority of anglers fished for walleye, muskellunge, and smallmouth bass and that walleye, smallmouth bass, and channel catfish were the species most often caught (PPL, 2006).

The normal flow of the Susquehanna River within this river reach accommodates private recreational boats that are generally less than 24 feet in length, have shallow drafts, are both powered and non-powered, and launch from nearby ramps. Within a 10 mile radius from the BNNPP, three boat ramps area available to the public on the Susquehanna River. The Pennsylvania Fish and Boat Commission operates a recreational boat ramp about 5 mi upstream of BBNPP; a private club operates the Wapwallopen boat ramp approximately 1.5 miles downstream of BBNPP and the Borough of Berwick operates the Berwick Test Track boat ramp approximately 8 miles downstream of BBNPP. A fourth boat ramp is located in Hunlock Township approximately 10 miles upstream of BBNPP. In addition, several small private boat ramps exist along this segment of the Susquehanna including one commercial ramp owned by PPL, located approximately 2,100 feet north of the proposed BNPP cooling water intake. This ramp will be used to support BBNPP and SSES needs for river access. The proposed project will not affect recreational river access from these facilities. The NBSR is not used for commercial

navigation within the project vicinity. No navigation or swimming is permitted in the vicinity of the BNNPP.

Game and non-game fish species exist in Walker Run, Beaver Pond, Johnson's Pond and the Susquehanna River. Small fish populations also exist in the unnamed tributaries.

All property located west of US 11 within the BBNPP Project Boundary is closed to the public. Recreation activities, including fishing and hiking, are prohibited within this area.

8. Upstream and Downstream Property

Land use within a 6 mile radius of the BBNPP is primarily forested (66%). Agriculture is the second largest land use at 20%. Urban or built up land represents 9% and the remaining 5 percent represents water, wetlands and barren land.

PPL owns the property directly upstream and downstream of the BBNPP intake structure along the NBSR. Characteristics of the NBSR are similar both upstream and downstream of the BBNPP intake structure and consist mostly of forested and agricultural land.

Downstream of the BBNPP Project Boundary to Denns Road Walker Run passes behind a number of residential homes and agricultural areas. Within this reach the channel appears to have been straightened. Throughout this reach an earthen berm prevents floodflows from reaching the floodplain. The bottom substrate is composed of mostly silts and sands (Walker Run Geomorphic Assessment, LandStudies, 2009).

Upstream of the project boundary Walker Run's channel grade increases and the valley narrows. This reach is characteristic of a mountain headwater stream. The land use is primarily forested with some residences located upslope from the stream. Walker Run appears to be in a more stable condition and the stream has access to the floodplain (Walker Run Geomorphic Assessment, LandStudies, 2009).

A map of contiguous property owners is included within this JPA section.

9. Other Environmental Factors Determined by Site Investigation

9.1 Summary of Relevant Studies

Aquatic habitat characteristics and other biological resources within the BBNPP project boundary were evaluated in the following studies that will be referenced frequently throughout the Environmental Assessment and are provided in Appendix B of the JPA.

1. "Wild Trout Habitat Assessment" dated May 2009, documents fish and macroinvertebrate populations, general habitat conditions, substrate composition and embeddedness measurements, and spawning gravel surveys within Walker Run.

2. "Bell Bend Project Site: Supplemental Field Assessments for the Walker Run Watershed" dated September 2010, documents the macroinvertebrate community and substrate embeddedness measurements of Tributary 1 to Walker Run and Tributary 2 to Walker Run. Water quality testing results and pressure transducer trends for Walker Run is also published in this report.

3. "Bell Bend Project Site: Supplemental Field Assessments for PPL Riverlands" dated January 2010, describes macroinvertebrate community and substrate embeddedness measurement results of the NBC outfall channel.

4. "Walker Run Trout Enhancement Plan" dated October 2010, summarizes habitat needed by brown trout at various life stages and evaluates Walker Run in terms of brown trout habitat suitability. The report recommends strategies to enhance trout habitat during the stream and floodplain restoration project as well as outlines a plan for repopulating restored reaches of Walker Run with brown trout post-restoration.

5. "A Field Survey of Fish and Aquatic Macroinvertebrates at the Proposed Bell Bend Nuclear Power Plant Site" dated September 2011 documents fish and macroinvertebrate surveys performed within Walker Run, unnamed tributaries to Walker Run, NBSR, the NBC, NBC outfall channel, and ponds within the BBNPP project boundary. Habitat assessments and some water quality data are also provided in this report.

6. "Impingement and Entrainment Sampling for the Proposed Bell Bend Nuclear Power Plant at the SSES Circulating Water Supply System Intake Structure" dated June

2010, documents the species composition and number of organisms that may possibly be impinged and entrained at the future intake of the proposed BBNPP.

7. "Mussel Survey in the Susquehanna River in the Vicinity of the Proposed Bell Bend Nuclear Power Plant Site" dated July 2010 provides the results of a mussel study.

8. "Walker Run Stream Survey Report" dated August 2009 and written by the PA Fish and Boat Commission, documents their electrofishing results regarding the presence of reproducing brown trout populations.

9. The "Sediment Characterization Report, Bell Bend Nuclear Power Plant, Susquehanna River, Berwick, PA" dated March 2011, documents the NBSR river substrate composition and analyzes sediment for the presence of hazardous pollutants.

10. "Wetlands Functions and Values Assessment" dated April 2011 characterizes the functions and values of wetlands within the BBNPP site boundary based on a set list of criteria through field visits and analysis of existing information.

11. "A Field Survey of Plant Communities at the Proposed Bell Bend Nuclear Power Plant Site" dated September 2011 documents wetland and upland plant communities as well as invasive plant species.

12. "A Field Survey of Terrestrial Flora and Fauna at the Proposed Bell Bend Nuclear Power Plant Site" dated September 2011 documents the results of surveys of birds, mammals, reptiles, amphibians, bats, and butterflies.

13. "Indiana Bat Roost Tree Survey Report for the Proposed Bell Bend NPP Site Luzerne County Pennsylvania" dated October 2011 describes the amount, type, and quality of Indiana Bat habitat within forested areas designated for clearing.

14. The "Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users, Proposed Bell Bend Nuclear Power Plant Site" dated June 2011 documents the results of various water quality studies on the NBSR related to BBNPP consumptive use and blowdown discharge.

9.2 Upland Land Use Summary

The BBNPP project site is located along the NBSR in an area of open deciduous woodlands interspersed with grasslands, previously cultivated fields, and orchards. The areas devoted to major uses of the land within the Project Boundary are summarized in Table 1.

Table 1. Existing Land Use within the Bell Bend Nuclear Power Plant Site

Land Use Type	Pre-Construction Area (acres)	Percent of Total
Urban or Built-Up	220.8	10.7
Forest	1141.7	55.6
Barren	21.5	1.0
Wetlands	159.0	7.7
Water	71.9	3.5
Agricultural	440.0	21.4
Total Site Boundary	2054.9	100.0

"A Field Survey of Plant Communities at the Proposed Bell Bend Nuclear Power Plant Site" characterizes upland vegetative communities within the Project Boundary. Upland habitat within the project boundary includes old field/former agricultural, upland scrub/shrub and upland deciduous forest. Old-field vegetation is composed of a largely upland-preferring assemblage of grasses and herbaceous plants. This habitat type extends over much of the fallow farmland in the western section of the project boundary. Dominant species include daisy fleabane, Canada thistle, wrinkled goldenrod (*Solidago rugosa*), flat-top fragrant goldenrod (*Euthamia graminifolia*), Canada goldenrod (*Solidago canadensis*), giant foxtail grass, white heath aster (*Aster pilosus*), lamb's quarters, red clover, and common ragweed.

Upland scrub shrub is found along transmission line corridors and in several abandoned farm fields within the Project Boundary that are undergoing secondary succession. The plant community consisted primarily of bush honeysuckle, multiflora rose, Allegheny blackberry, and Russian olive.

Upland Deciduous forest covers a large portion of the project boundary to the west of US 11. Common overstory species include northern red oak, white oak, black cherry, white ash, shagbark hickory, bitternut hickory, sweet birch, black walnut, black locust, yellow poplar and red maple. Upland forest understories are composed predominantly of spicebush, round-leaved greenbrier, Virginia creeper, and saplings of overstory species. The groundcover includes may-apple, garlic mustard, hayscented fern, tree clubmoss, partridge berry, ground cedar, and stilt grass (Normandeau, 2011).

No significant mineral resources have been identified within the Project Boundary. The only mineral resources occurring within the Project Boundary are siltstone and sand and gravel (PPL, 1972). The siltstone cannot be mined economically due to its depth. Deposits of sand and gravel underlie most portions of the Susquehanna River Valley. A very small portion of these deposits are under the Susquehanna River floodplain within the Project Boundary.

Project Boundary landscape has been substantially altered to support agriculture, electric power generation, recreation, and canal transportation uses. Much of the original forest cover was cleared and the remainder became highly fragmented as a result of these activities. No active timber cutting for these purposes has recently occurred within the Project Boundary.

9.3 Hydrogeology

Geologic conditions beneath the site consist of sand and gravel deposits underlain by shale bedrock. The overburden soils range from 0 to 100 feet of depth. Overburden is thinner on ridges and hills. Generally, borings southwest of the North Market Street and Beach Grove Road intersection did not encounter groundwater in the overburden soils. In this upland area vertical groundwater flow is typically downward. North of Tributary 1 to Walker Run and Wetland 12, groundwater in the overburden layer typically ranged from 30 to 55 feet deep and moves from the northeast to the southwest. Vertical groundwater flow is typically upward in this area of lower topography (Sargent and Lundy, 2010).

9.4 Special Designations within the Project Boundary

The following special designations are not present within the BBNPP Project Boundary:

- Native American or military reservations
- State or national, parks, forest or recreation areas
- Natural, wild, or wilderness areas
- National natural landmark
- National wildlife refuge
- State Gamelands

State and local historical resources and artifacts have been located within the project boundary. The NBC was historically used within the region for transportation from 1830 to 1900. Additionally, eel walls (or eel weirs) are still visible today along the NBSR during low flows both upstream and downstream of BBNPP. These structures are considered a historical resource and will not be affected by project implementation. During the early part of the 20th century these structures were built in shallow parts of the NBSR to trap out-migrating eel and other fish which were important food sources during that time period. The installation of these structures became illegal due largely to increased mortality of juvenile American shad populations. Many of these structures were destroyed by fish wardens. Additional terrestrial historical sites and artifacts have been identified within the project boundary. Required supplemental cultural resources information can be found in Section D of the JPA, Appendix A Item 2 (summary of findings) and Appendix C (full text of cultural resource studies).

There is one environmental study area and wildlife sanctuary that is adjacent to and within a small portion of the Project Boundary. A portion of Susquehanna Riverlands property, which includes a Wetlands Nature Area, lies within the Project Boundary. The Wetlands Nature Area provides an area for nature study and educational programs and was designated an Urban Wildlife Sanctuary in 1988. The Susquehanna Riverlands property is also a recreational area for public use and environmental education. Portions of the PPL Susquehanna Riverlands, PPL SSES and BBNPP properties have also been identified by the Pennsylvania Audubon Society as an Important Bird Area (IBA).

The BBNPP site boundary contains 3 soil types designated as prime farmland by the Natural Resources Conservation Service (USDA, 2004). Most of the lands making up BBNPP were zoned agricultural district with a much smaller portion zoned as a

conservation district. Small areas of the Project Boundary associated with SSES facility are zoned heavy industrial (Salem, 2008). In February 2011 Salem Township rezoned the area involving BBNPP and SSES as a new Heavy Industrial, I-3, classification that allows power plants.

10. References

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Environmental Assessment
Part 2 - Project Description
Enclosure D - Project Impacts

PPL Bell Bend Nuclear Power Plant
Salem Township, Luzerne County, PA

1. Introduction

As part of this project there will be unavoidable wetland and stream impacts that are under the jurisdiction of the DEP and the ACOE. This document will describe impacts to jurisdictional waters and is intended to meet the JPA requirements of the Environmental Assessment.

2. Special Designations

No impacts to Native American or military reservations, or any National parks, forests, recreation areas, natural landmarks, or wildlife refuges are proposed. No state parks, forests, recreation areas or gamelands will be permanently impacted by the project. Natural, wild, or wilderness areas will also not be impacted.

There is one environmental study area and wildlife sanctuary that is adjacent to and within a small portion of the Project Boundary. A portion of Susquehanna Riverlands property, which includes a Wetlands Nature Area, lies within the Project Boundary. The Wetlands Nature Area provides an area for nature study and educational programs and was designated an Urban Wildlife Sanctuary in 1988. The Susquehanna Riverlands property is also a recreational area for public use and environmental education. It is owned and operated by PPL.

The Susquehanna Riverlands is partially located within the BBNPP project boundary east of US 11 and will be impacted by construction of the proposed intake structure and associated infrastructure. It is the only recreational area open to the public within the BBNPP Project Boundary. Expected impacts to recreational use of the Susquehanna Riverlands area are discussed below.

The Pennsylvania Audubon Society designated a 2,111 ac Important Bird Area (IBA # 50), on both sides of the North Branch Susquehanna River (NBSR) and also spanning US 11. IBA #50 includes the majority of the Susquehanna Riverlands property as well

as a portion of the BBNPP project boundary. Except for impacts associated with the intake structure, discussed below, a large contiguous area of IBA # 50 east of US 11 will be unaffected. Greater impacts will occur west of US 11 where the majority of BBNPP infrastructure will be located. There is no recreational use within the BBNPP project boundary west of US 11. The IBA program in Pennsylvania confers no regulatory requirements or obligations on the part of the landowner, however, the Pennsylvania Audubon Society and PPL Electric Utilities are working together to manage power line rights-of-way to provide important bird habitat while maintaining consistency with PPL's vegetation management practices to support electric reliability.

The extensive clearing and grading needed to construct BBNPP has the potential to affect cultural resources. PPL has conducted cultural resource investigations at BBNPP including a Phase Ib archaeological survey, an architectural survey, a Supplemental Phase Ib cultural resources survey, Phase II National Register site evaluations, and a Second Supplemental Phase Ib cultural resources survey (supporting the movement of the plant footprint in 2010). PPL will continue to coordinate with the Pennsylvania Historical and Museum Commission (PHMC) on additional cultural resource investigations. All cultural resource clearances will be obtained from PHMC prior to commencing work on BBNPP. All cultural resource reports are provided in Appendix C of this JPA.

The Project Boundary contains three soil types designated as prime farmland according to the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). They are Braceville gravelly loam, Chenango gravelly loam, and Pope soils (USDA, 2004). The majority of the farmland or fallow farmland within the BBNPP project boundary is considered prime. Approximately 350 ac of prime farmland will be permanently impacted by BBNPP construction.

3. Wetland and Stream Impact Discussion

The Applicant has undergone a thorough wetland avoidance and minimization process during the course of the planning stages for the proposed BBNPP. This section will summarize the remaining wetland and stream impacts anticipated as a result of construction and operation of BBNPP. Impacts and mitigation will be evaluated quantitatively (disturbed acreage and stream length) and qualitatively (lost functions and values). Each impact is identified by a letter designation. Impact locations by letter

designation are shown on the "Wetland and Watercourse Impact Location Map" provided as Enclosure D1 (ACOE) and D2 (DEP). The tables "BBNPP Wetland and Watercourse Impacts and Mitigation" are included as Enclosure D3 (ACOE) and D4 (DEP) and provide a detailed characterization of each wetland impact including impact type, wetland type, and quantification of the affected area.

Permanent impacts are characterized by the placement of fill or grading in a wetland or any structure or activity which changes, expands or diminishes the course, current or cross-section of a watercourse, floodway or body of water (obstructions or encroachments). There are differences between DEP and ACOE wetland and stream jurisdiction within the Project Boundary. ACOE does not take jurisdiction over isolated wetlands; however, these wetlands are considered Waters of the Commonwealth and are regulated by DEP. In addition, DEP considers bridge spans a permanent wetland and stream impact while ACOE only considers structures placed within the wetland (pier footings) to be a permanent impact.

Temporary impacts result from disturbances necessary to perform work where the temporarily disturbed area will be restored to its original grade and hydrology. Because temporary impacts will be restored to their original grade, wetland replacement acreage is not required; however, these impacts must still be avoided and minimized to the greatest extent practicable. The acreage of DEP temporary project impacts is smaller than ACOE because the DEP designates the bridge spans as a permanent impact.

Indirect impacts result when there is no physical obstruction or encroachment, but changes to vegetation, hydrology, or other factors may alter the functions or values of a wetland. In these cases, the overall wetland location and acreage is not affected, but the lost functions and values must be considered and mitigated. A Functions and Values Assessment was performed to identify the existing functions and values of wetlands within the BBNPP project boundary and was used as a foundation to determine indirect wetland impacts. The "Functions and Values Assessment," (LandStudies, April 2011) is included in Appendix B of this JPA. Most indirect impacts caused by the construction of the BBNPP are related to habitat changes resulting from tree removal.

A complete discussion of each impacted area follows.

3.1 Project Impacts

Impact A is a vehicle bridge (Bridge # 4) over Walker Run's channel near the existing farm road crossing and directly west of the proposed facility. The bridge is necessary to access the proposed BBNPP facility. The bridge dimensions are 400 ft long by 57 ft wide. Wetlands are not present at the proposed crossing. DEP permanent stream impacts resulting from the shadow of the bridge span a total 65 LF and 0.03 ac.

As part of the mitigation for the BBNPP wetland impacts, this reach of Walker Run's stream channel and floodplain will be restored and wetlands will be created. The stream restoration design was prepared in conjunction with the bridge design, therefore, the proposed bridge will not negatively affect food chain production, general habitat, or habitat for threatened and endangered species in the created wetland.

The stream channel relocation and restoration, wetland creation, and a new bridge will improve hydrology. The proposed bridge structure will span the entire stream and floodplain, improving the conveyance in Walker Run. An anticipated reduction of the 100-year flood elevation will result from Walker Run mitigation, so upstream and downstream properties will be unaffected or positively affected. Created wetlands will improve groundwater recharge along Walker Run and alleviate flood flows. The created wetlands and stabilized stream channel will also improve Walker Run's water quality through more natural sediment conveyance patterns and improved filtration of sediments and nutrients.

Water quality will not be affected by bridge construction. Runoff from the bridge, potentially containing road salts and other pollutants will be directed away from the created wetlands to a water quality treatment BMP as described in the Post Construction Stormwater Management plan and will comply with NPDES requirements. Created wetlands will improve water filtration and create a forest buffer along Walker Run. In addition, bank stabilization will reduce sediment in Walker Run. Details regarding the Walker Run mitigation project are located in Section R of the JPA.

Impact B is a proposed vehicle bridge (Bridge #3) spanning the Unnamed Tributary to Walker Run (Tributary 1) and Wetlands 10 and 12. It is located directly south of the BBNPP facility. The bridge will be 408 ft long by 57 ft wide and will span the entire width of the wetland, 50 ft of EV wetland buffer, and the 100-year floodplain. The pier footings

for the bridge are permanent wetland impacts, totaling 0.02 ac of palustrine emergent wetland (PEM). The area of the bridge span over wetlands and streams is 0.16 ac. Temporary impacts include the construction of temporary 40 ft by 40 ft stone crane pads contained within the bridge span. Temporary impacts also extend approximately 15 ft beyond the bridge footings (and beyond the bridge span) to include over-excavation around bridge piers. The wetland areas temporarily impacted will be returned to their original grade with adequate topsoil and seeded with a mix consisting of native wetland species. Tree removal, an indirect impact, will affect approximately 0.09 ac.

The impacted area divides a large contiguous forest and emergent wetland complex along Tributary 1. Multiple potential roosting trees (PRTs) with high and medium summer roosting potential for the Indiana bat were identified within the forested edge to be cleared for bridge construction. A detailed discussion of tree clearing impacts on Indiana bats is provided in Section 5.2.2. Food chain production and general habitat functions including nesting, spawning, rearing, resting, migration, feeding, or escape cover will not be affected for other species. Habitat changes resulting from the conversion of 0.09 ac from Palustrine Forested wetland (PFO) to Palustrine Scrub Shrub wetland (PSS) will have a small affect on habitat within the overall PFO wetland complex.

Bridge construction will improve the natural drainage pattern of the wetland, and improve flushing characteristics. Currently, a small farm road and culvert crossing divide the wetland at the proposed impact location. In proposed conditions, the farm road and culvert will be removed and a bridge will span the entire width of the wetlands and 100-year floodplain. Current hydrology including groundwater discharge and recharge will not be affected.

The water quality of the existing wetland will not be impacted by the proposed bridge. Runoff from the bridge, potentially containing road salts and other pollutants will be directed away from the wetland to a water quality treatment BMP as described in the Post Construction Stormwater Management plan and will comply with NPDES requirements. The wetland will continue to filter sediments and nutrients from other surface water runoff. Culvert removal will diminish the existing backwater condition and reduce sediment deposition.

Upstream and downstream property will not be affected. The current backwater condition caused by the culvert crossing will be eliminated by the proposed bridge which will span the 100-year floodplain. The 100-year floodplain will not change with this impact. Therefore, the water surface elevation is not expected to increase as a result of Impact B (Flood Study Walker Run, LandStudies, 2011).

Impact C is a proposed bridge (Bridge #7) for domestic water and sanitary sewer lines spanning Wetland 12 and Tributary 1. It is located south of the BBNPP facility. The bridge will be 340 foot long by 18 ft wide and will span the entire width of the existing wetlands, 50 ft of EV wetland buffer, and the 100-year floodplain. The pier footings for the bridge are permanent wetland impacts, totaling 0.01 ac of PFO. The area of the bridge span over wetlands and streams is 0.05 ac. Temporary impacts include the construction of temporary 40 ft by 40 ft stone crane pads contained within the bridge span. Temporary impacts also extend approximately 15 ft beyond the bridge footings (and beyond the bridge span) to include over-excavation around bridge piers. The wetland areas temporarily impacted will be returned to their original grade with adequate topsoil and a seed mix consisting of native wetland species. Tree removal, an indirect impact, will affect 0.41 ac.

Tree removal totaling 0.42 ac (includes permanent and indirect impacts) may increase plant species diversity by creating a scrub shrub habitat pocket within the forested wetland. The impacted area is a small portion of a larger wetland complex. Therefore, any vegetation or habitat changes to the wetland resulting from the impact will have a small affect on habitat within the wetland complex. Indiana bats could potentially be affected by the forest clearing, although there were no PRTs identified within the wetland area to be cleared.

The hydrology, water quality and adjacent property will be unaffected by the impact. The 100-year floodplain will not change with this impact (Flood Study Walker Run, LandStudies, 2011). Flushing characteristics will not be affected. The wetland will continue to filter sediments and nutrients from other surface water runoff. Current hydrology including seasonal groundwater recharge and discharge will not be affected.

Impact D is a proposed vehicle bridge and adjoining pipe bridge (Bridge #2 and Pipe Bridge #6) spanning Tributary 1 and Wetland 12. It is located southeast of the BBNPP facility. The bridge will be 410 ft long by 82 ft wide and will span the entire width of the

wetland, the 100-year floodplain, and 50 ft of wetland buffer. The pier footings for the bridge are permanent wetland impacts, totaling 0.08 ac of PFO. The area of the bridge span over wetlands and streams is 0.50 ac. Temporary impacts include the construction of temporary 40 ft by 40 ft stone crane pads contained within the bridge span. Temporary impacts also extend approximately 15 ft beyond the bridge footings (and beyond the bridge span) to include over-excavation around bridge piers. The wetland areas temporarily impacted will be returned to their original grade with adequate topsoil and a seed mix consisting of native wetland species. Tree removal, an indirect impact, will affect 0.92 ac.

Multiple PRTs with high and medium summer roosting potential for the Indiana Bat were identified within the forested area to be cleared for bridge construction. A detailed discussion of tree clearing impacts on Indiana Bats is provided in Section 5.2.2. Food chain production and general habitat functions including nesting, spawning, rearing, resting, migration, feeding, or escape cover will not be affected for other species. Habitat changes resulting from the conversion of 1.0 ac (includes permanent and indirect impacts) from PFO wetland to PSS wetland will have a small affect on habitat within the overall PFO wetland complex. Tree removal may increase plant species diversity by creating a scrub shrub habitat pocket within the forested wetland.

Hydrology in the wetland will not be impacted by the addition of the bridge. The bridge will span the entire width of the wetland and it is anticipated that the 100-year floodplain will not change with this impact (Flood Study Walker Run, LandStudies, 2011). Drainage patterns will not be altered and the wetland will continue to store flood flows. Flushing capabilities will not be affected. Groundwater discharge and recharge will continue to seasonally occur.

Water quality will not be affected by bridge construction. Runoff from the bridge, potentially containing road salts and other pollutants will be directed away from the wetland to a water quality treatment BMP as described in the Post Construction Stormwater Management Plan and will comply with NPDES requirements. The wetland will continue to filter sediments and nutrients from other surface water runoff.

The upstream and downstream property will not be affected. The water surface elevation is not expected to increase as a result of Impact D (Flood Study Walker Run, LandStudies, 2011).

Impact E is a railroad bridge (Bridge #5) spanning Tributary 1 and Wetland 12. It is located southeast of the BBNPP facility at the 90° bend in Tributary 1. The proposed bridge is 535 ft long by 25 ft wide and will span the entire width of the wetland, 50 ft of EV wetland buffer, and the 100-year floodplain. The pier footings for the bridge are permanent wetland impacts, totaling 0.03 ac of PFO. The area of the bridge span over wetlands and streams is 0.17 ac. Temporary impacts include the construction of temporary 40 ft by 40 ft stone crane pads contained within the bridge span. Temporary impacts may also extend approximately 15 ft beyond the bridge footings (and beyond the bridge span) to include over-excavation around bridge piers. The wetland areas temporarily impacted will be returned to their original grade with adequate topsoil and a seed mix consisting of native wetland species. Tree removal, an indirect impact, will affect 0.60 ac.

Tree removal totaling 0.63 ac (includes permanent and indirect impacts) may increase plant species diversity by creating a scrub shrub habitat pocket within the forested wetland. General habitat functions will be reduced for species relying on forested cover, including the Indiana Bat. No PRTs were identified in the portion of this area surveyed. The impacted area is a small portion of a larger wetland complex; therefore, any changes to vegetation, habitat, or food production resulting from the impact will have a small affect within the entire wetland.

Hydrology in the wetland will not be impacted by the addition of a bridge. The 100-year floodplain will not change (Flood Study Walker Run, LandStudies, 2011). Drainage patterns will not be altered and the wetland will continue to store flood flows. Production export will not be affected. Groundwater discharge and recharge occur seasonally and will not be affected.

Water quality will not be affected by bridge construction. Runoff from the bridge, potentially containing road salts and other pollutants will be directed away from the wetland to a water quality treatment BMP as described in the Post Construction Stormwater Management Plan and will comply with NPDES requirements. The wetland will continue to filter sediments and nutrients.

Upstream and downstream properties will not be affected.

Impact F is a vehicle bridge (Bridge #1) spanning wetland 19. There is no stream associated with this crossing. The bridge is located on the south side of the BBNPP facility and east of Confers Lane. The wetland is part of a larger contiguous forest wetland complex extending outside the BBNPP Project Boundary, with 6.13 acres located within the Project Boundary. The proposed bridge is 500 ft long by 57 ft and will span the entire wetland. The pier footings for the bridge are permanent wetland impacts, totaling 0.09 ac of PFO. The area of the bridge span over the wetland is 0.55 ac. Temporary impacts include the construction of temporary 40 ft by 40 ft stone crane pads contained within the bridge span. Temporary impacts also extend approximately 15 ft beyond the bridge footings (and beyond the bridge span) to include over-excavation around bridge piers. The wetland areas temporarily impacted will be returned to their original grade with adequate topsoil and a seed mix consisting of native wetland species. Tree removal, an indirect impact, will affect 0.98 ac.

Multiple PRTs with high and medium summer roosting potential for the Indiana bat were identified within the forested area to be cleared for bridge construction. A detailed discussion of tree clearing impacts on Indiana bats is provided in Section 5.2.2. Food chain production and general habitat functions including nesting, spawning, rearing, resting, migration, feeding, or escape cover will not be affected for other species. Habitat changes resulting from the conversion of 1.07 ac (includes permanent and indirect impacts) from PFO to PSS wetland will have a small affect on habitat within the overall PFO wetland complex. Tree removal may increase plant species diversity by creating a scrub shrub habitat pocket within the forested wetland.

Hydrology in the wetland will not be impacted by the addition of a bridge; the drainage pattern towards the NBSR will be unaffected and the wetland will continue to store storm and floodwaters. Groundwater recharge and discharge functions will not be altered.

The water quality of the existing wetland will not be impacted by the proposed bridge. Runoff from the bridge, potentially containing road salts and other pollutants will be directed away from the wetland to a water quality treatment BMP as described in the Post Construction Stormwater Management Plan and will comply with NPDES requirements. The wetland will continue to filter sediments and nutrients from surface water runoff.

The upstream and downstream property will not be affected. The water surface elevation is not expected to increase as a result of Impact F.

Impact G affects the unnamed tributary to Lake Took-A-While, located east of Confers Lane. A 125 ft, 48 inch reinforced concrete culvert with concrete endwalls will be installed on a 4.32% grade to convey the stream under the proposed rail line. The pipe invert will be depressed six inches below the stream bed elevation. Rip-rap outfall protection is proposed to stabilize the outfall of the culvert. The culvert is necessary to gain rail access to the BBNPP site.

No wetland impacts will result from the railroad crossing; however, 125 LF (0.07 ac) of stream will be permanently impacted. The culvert crossing will eliminate benthic habitat within the 125 foot length of culvert. The culvert invert will be depressed six inches below the stream bed to facilitate fish movement and to allow for the deposition of native gravels within the pipe. Erosion and sediment control BMPs will be utilized to minimize potential pollution during installation of the crossing. There will be no changes in water quality. The 48 in. culvert has been sized to convey the 100-year peak runoff. This culvert may result in a localized backwater, but any increase in flood elevation will be limited to the area immediately upstream of the pipe entrance. Recreational opportunities and adjacent property owners will not be affected.

Impact H affects the teardrop wetland drainage and Unnamed Tributary 2 (Tributary 2) to Walker Run. This reach of Tributary 2 is designated Waters of the Commonwealth and not Waters of the United States. A 428 ft long, 36 in. reinforced concrete pipe is proposed to convey the teardrop wetland drainage underneath formerly farmed agricultural fields. This structure is designed to replace an existing 567 ft long by 8 in. diameter PVC pipe and tile drainage system which currently conveys the teardrop wetland drainage underneath adjacent fields. The proposed structure is designed to convey the 100-year peak runoff event. The pipe will outlet onto a rip-rap pad. The culvert invert will be depressed twelve inches below the stream bed to facilitate fish movement and to allow for the deposition of native gravels within the pipe. No wetlands will be impacted. Food chain and general habitat characteristics will remain the same. Increased pipe size will reduce restricted flow and improve flushing characteristics. Water quality will not change as a result of this impact. Downstream and upstream property will not be affected.

Impact I is the proposed fill of Wetland #5, an isolated wetland east of North Market Street and west of the BBNPP facility. This wetland is Waters of the Commonwealth but not Waters of the United States. Construction plans propose filling the entire wetland to grade around the power block. Permanent impacts total 0.12 ac of PEM wetland. Site utilization plans were drastically changed in 2009 to avoided greater acreages of wetland impact to EV wetlands adjacent to the Tributary 1.

This wetland does not perform any principal functions and values affecting habitat, hydrology, or water quality. The groundwater discharged from this wetland is reabsorbed into the landscape immediately downslope of the wetland. Since the wetland does not currently affect Walker Run flow conditions, the impact to the wetland will not impact Walker Run hydrology or its surrounding wetlands.

Adjacent property will not be affected by this impact.

Impact J affects Wetland 49A and 49B, located east of Confers Lane near the existing SSES Switchyard. The switchyard will be expanded and Wetland 49A and 49B will be filled to accommodate the expansion. Permanent impacts resulting from this fill total 0.06 acres. Wetland 49A is isolated; therefore ACOE only takes jurisdiction of 49B (0.04 ac of permanent wetland impacts).

The switchyard will be expanded to the east to avoid greater impacts to EV wetlands located west of the switchyard. This impact will not affect any wetland functions or values. These small wetland impacts do not affect habitat and food chain production. They also do not affect hydrology or water quality due to their small size. Adjacent property owners will not be affected by this impact.

Impact K is the construction of the intake structure, access roads, and parking lot. The intake structure building will be 124 feet long by 90 feet wide with three individual pump bays. The North Branch Canal (NBC) outfall channel and its adjacent wetlands (Wetlands 43 and 44 which are both classified as PFO/PEM wetlands) will be permanently impacted by the proposed intake structure and the subsequent grading that will occur in the area.

Clearing and grading for the intake structure will permanently impact 0.98 ac of wetland. The NBC outfall channel will be eliminated which equates to 617 LF (0.07 ac) of permanently impacted stream channel.

The general habitat characteristics provided by Wetlands 43 and 44 will be permanently lost. Of the 0.98 ac of wetland impacts, 0.30 ac will be a loss of PFO. These wetlands are not unique compared to other wetlands in the area. The aquatic habitat within the intermittent NBC outfall channel will also be eliminated.

The floodflow alteration function that Wetlands 43 and 44 provide will be reduced resulting from the reduced wetland size, however no rise in the 100-year flood elevation is expected (Flood Study Susquehanna River, LandStudies, 2011) and no change to the adjoining properties will occur. Existing drainage patterns will be altered. Currently, flow within the NBC outfall channel is controlled by a weir at the NBC. The outlet channel will be eliminated and the canal will be restored to its historic condition, offering benefits to both cultural and recreational functions. In the restored historic condition, water will be contained within the NBC, offering a more stable drainage pattern and improved water quality than under existing conditions. The NBC restoration and adjacent wetland enhancement is part of the Mitigation Plan found in Section R of the JPA.

The wetlands permanently impacted by intake structure construction are not easily accessible to the public by walking trail therefore wetland values such as recreation, education, uniqueness, and visual quality will be minimally affected by this permanent impact.

Impact L affects portions of Wetlands 11 and 12, as well as Tributary 1 and Tributary 2. Impact L is caused by dewatering necessary to construct the Essential Service Water Emergency Makeup System (ESWEMS) pond. Dewatering will be accomplished through the installation of an active extraction system of wells, collection trenches and sump pumps situated at the overburden/rock interface that will be installed and maintained for up to 24 months.

At a maximum, 60 ft of water-bearing sands and gravels (part of the highly permeable glacial overburden aquifer) will be excavated for the ESWEMS pond. Approximately 230 gallons per minute (gpm) will be pumped to keep the ESWEMS pond construction area dry (Sargent and Lundy, 2010). Based upon computer modeling of groundwater levels in the vicinity of the ESWEMS pond, without minimization or mitigation, a significant depression of groundwater levels will occur over the multi-year pumping period affecting nearby wetlands and streams.

This temporary impact cannot be avoided. The ESWEMS pond is safety-related; therefore the foundation for the structure must be placed on competent bedrock. The excavation and placement of clean structural fill on bedrock must be done under dry conditions. Suitable alternative locations for the ESWEMS pond do not exist. For security purposes the ESWEMS, nuclear island, and cooling towers must all be located in close proximity. In 2009 PPL made a significant plot plan change to avoid permanently impacting EV wetlands along Walker Run and Tributary 1. The current location of the ESWEMS pond was a result of that plot plan change. The location of the pond cannot be changed without causing additional permanent wetland impacts or creating unacceptable security concerns.

A bentonite slurry wall flow barrier will be constructed to minimize the extent of groundwater drawdown resulting from ESWEMS pond construction. The slurry wall will slow ground water movement into the excavation area, thereby reducing the extent of drawdown surrounding the ESWEMS pond construction site. With the slurry wall in place, modeling indicates drawdowns of approximately 5 ft extending no further than approximately 400 ft west of the ESWEMS pond. Based on groundwater modeling, dewatering will result in temporary impacts to approximately 5.56 ac of Wetlands 11 and 12 and 1,396 LF (0.30 ac) of Tributary 1 and Tributary 2. Absent additional mitigation, this level of drawdown is likely to have a negative impact on wetland vegetation, habitat, hydrology, overall wetland biochemistry, and would reduce the functions and values of the affected wetlands over the period of impact.

Impacts must be mitigated to maintain appropriate hydrologic conditions in affected wetlands during periods of intense groundwater withdrawal. Monitoring over the next two to three years will establish baseline hydrology for the area of effect. Mitigation measures will include an irrigation system to introduce water to affected wetlands from a storage reservoir constructed on the site to store pumped groundwater. Application of stored water will be completed by a sprinkler system as needed to sustain baseline conditions. With the proposed irrigation system, wetland hydrology and vegetation will be maintained and wetland habitat will not be affected. Water quality will not change because the surface water present within the wetlands is hydraulically connected to the groundwater; therefore, the water chemistry of the irrigated water is very similar. Slurry wall use will prevent impacts to adjacent property's well water supply. Once construction is complete, the bentonite barrier will be perforated to re-establish groundwater flow

through the permeable structural fill and natural hydrology is expected to return to the wetlands and streams. Mitigation can be extended post-construction to account for any lag time. Detailed mitigation plans, including a contingency plan, is described, in detail, in Section R of this JPA.

Impact M affects portions of Wetlands 37, 38, 43, 44 and the NBC. The underground Intake lines will be 20 inch carbon steel for the Raw Water Supply and 32 inch carbon steel for the Cooling Water System Makeup Water Supply. The Blowdown line will be 26 inch HDPE. These pipes will be combined into a single trench in all locations. These lines are routed through these wetlands and the NBC to the NBSR near the proposed intake structure. No permanent impacts will result from these pipe crossings. Temporary impacts from the installation of these utilities total 0.78 ac. Tree clearing, an indirect impact, will affect 0.07 ac.

The habitat, hydrology, water quality, recreation, scientific value, uniqueness, and visual quality of the wetlands will be temporarily affected, however, the site will be returned to existing conditions following installation. Adjacent property will be unaffected by the impact.

The wetland areas temporarily impacted as a result of construction will be returned to their original grade with adequate topsoil and a seed mix consisting of native wetland species.

Impact N is the required dredging within the NBSR to create a forebay adjacent to the Intake Structure where water will be withdrawn from the river. The area within the cofferdam will be dewatered and dredged by hydraulic or mechanical methods, and the existing shoreline will be excavated to create an approximately 100-foot by 100-foot forebay for the intake structure. The dredged area of 0.61 ac will affect 220 LF of the NBSR.

The installation of sheet pile may create some suspended sediment and remove some benthic substrate. However, the river bed in this area is coarse sand and gravel and, and as a result, excess turbidity during construction activities will be limited. It is expected that approximately 17,000 to 25,000 cubic yards (c.y.) of in-place Susquehanna River bottom substrate will be removed to accommodate the proposed in-water structures (including blowdown line) included in BBNPP design. Dredged material

will be utilized as clean, non-structural fill and will be disposed of within the BBNPP site at one or more of the laydown areas to the north and southeast of the BBNPP power block, or on lands at the perimeter of the facility. The capacity of these areas is more than sufficient to accommodate the expected volume. Additional information about the handling of dredged material is provided in Appendix A, Item 25. Activities in navigable waters will conform to applicable Pennsylvania and ACOE regulations.

Impacts to aquatic macroinvertebrates from dredging will be negligible as previous studies conducted for SSES Units 1 and 2 indicate that the benthic organisms are similar at locations upstream and downstream of the BBNPP site and are not otherwise unique (Unistar, 2011). Upon removal of the cofferdams, the benthic substrate should stabilize, allowing benthic species to quickly re-colonize (Unistar, 2011).

The Yellow Lampmussel and Green Floater are state protected species that have been found in the NBSR within the vicinity of the BBNPP intake structure. The Yellow Lampmussel is widely distributed and will not be affected by the limited area of disturbance needed for intake structure dredging. The Pennsylvania DCNR website states, "The green floater is often found in small creeks and large rivers and sometimes canals. This species is intolerant of strong currents and occurs in pools and other calm water areas (NatureServe 2005, North Carolina Mussel Atlas, Strayer and Jirka 1997). Preferred substrate is gravel and sand in water depths of one to four feet. This species is more likely to be found in hydrologically stable streams, not those prone to flooding and drying. Good water quality is also important for this mussel species (North Carolina Mussel Atlas)." While the intake structure will be constructed in a calm pool, the depth and substrate in this area make impacts to Green Floater habitat unlikely. PPL is coordinating with the PA Fish and Boat Commission and will obtain clearance before dredging commences.

Recreation will not be affected by this temporary impact. Boating and swimming is not allowed in the NBSR in close proximity to the SSES intake structure. This reach of the NBSR is not a spawning area for key species of recreational value.

During utilization of the cofferdam, stream flow will be directed around the dredging area. Upon cofferdam removal NBSR hydrology will return to existing conditions. Upstream and downstream property owners will not be affected by this impact.

Impact O is the required dredging within the NBSR to install the blowdown line and diffuser pipe. A temporary cofferdam confining an area approximately 50 feet wide by 350-foot long, extending into the river will be used during installation of the blowdown line to dewater the area and contain sediment. The area within the cofferdam will be dewatered and dredged by hydraulic or mechanical method and the NBSR bottom will be excavated to bury the blowdown line and install the diffuser pipe, concrete pad, and associated riprap. The blowdown line will extend approximately 325 feet from the shoreline on a slight downstream angle with the diffuser portion starting 203 feet from the shoreline. The pipe will be either 24 inch carbon steel, 24 inch RCP or 26 inch HDPE. The pipe will be anchored to a concrete pad set on the river bottom and covered with riprap for protection.

Dredged material will be disposed of within the BBNPP site at one or more of the laydown areas to the north and southeast of the BBNPP power block, or on lands at the perimeter of the facility where it may be used as non-structural fill. The capacity of these areas is more than sufficient to accommodate the expected volume. Additional information about the handling of dredged material is provided in Appendix A, Item 25. Activities in navigable waters will conform to applicable Pennsylvania and ACOE regulations.

Impacts to aquatic habitat, water quantity and streamflow, water quality, recreation, and upstream and downstream property will be similar to those described for the intake structure.

Impact P covers the expanse of Wetland #11, the teardrop wetland. Proposed transmission lines will span the width of this wetland. No permanent or temporary impacts will result from the transmission lines; however indirect impacts totaling 3.46 acres will result from tree removal. The wildlife habitat function of this wetland will be affected by this impact.

Tree removal will change the vegetative composition within this wetland from forested to scrub shrub. Food sources will change supporting different wildlife communities. General habitat including nesting, rearing, resting, migration, feeding, and escape cover will be reduced for certain forest dependent species. Removing the over-story will reduce plant community structure diversity (trees, shrubs, and emergent plants) that currently form the wetland plant community.

Few Indiana bat PRTs were identified within the impacted area. A detailed discussion of tree clearing impacts on Indiana bats is provided in Section 5.2.2.

The hydrology functions the wetland performs will not be changed by the indirect wetland impact. Increased water temperatures may result from decreased canopy cover. Otherwise, water quality should remain unchanged. Production export, seasonal groundwater discharge and recharge as well as recreation and upstream and downstream properties will not be affected.

Impact Q represents three locations where overhead transmission lines will span Wetland 12. Indirect impacts totaling 1.72 ac of tree removal will result from these crossings and rights-of-way. General habitat will be reduced for certain species. Multiple Indiana bat PRTs are located within this impact area surrounding the Beaver Pond. A detailed discussion of tree clearing impacts on Indiana bats is provided in Section 5.2.2. Food chain production and general habitat functions including nesting, spawning, rearing, resting, migration, feeding, or escape cover will not be affected for other species. This impact will affect the types of vegetation and therefore the types of food available in this portion of the wetland.

The impacted area is a small portion of a larger wetland complex. Therefore, any vegetation or habitat changes to the wetland resulting from the impact will have a small affect on habitat within the wetland complex.

Hydrology, water quality, recreation, and adjacent property will be unaffected by the impact. Seasonal groundwater recharge and discharge will continue to occur.

Impact R is within Wetland 18, located southeast of the BBNPP facility and east of Confers Lane. A transmission line and right-of-way will indirectly impact 0.75 ac of forested wetland. No permanent or temporary impacts will result from this crossing. The proposed overhead wires and right-of-way will be maintained as scrub-shrub. Nesting and escape cover will be reduced for certain species. This impact will affect the types of vegetation and therefore the types of food available in this portion of the wetland. Hydrology, water quality, recreation and adjacent property will be unaffected by the impact. The impacted area is a portion of a larger forested wetland. PRTs were not evaluated within this impact area.

Impact S is the water withdrawal from the NBSR associated with the operation of the Circulating Water System (CWS) and Raw Water Supply System (RWSS). The CWS provides water to the cooling towers and the RWSS provides treated water to the power plant and the Essential Service Water System (ESWS). Impact S does not cause any wetland impacts. The Susquehanna River Basin Commission (SRBC) application will address the affects of this impact including water quantity and stream flow, water quality, aquatic habitat, as well as provisions for low flow conditions and consumptive use mitigation. A summary of these impacts is provided below.

Physical impacts of cooling system water withdrawal could include alteration of site hydrology in the immediate vicinity and downstream of the intake structure. It is estimated that the BBNPP CWS and Raw Water Supply System (RWSS) will withdraw 25,729 gallons per minute (gpm) on average from the NBSR to replace evaporative loss, drift, and blowdown. Maximum CWS and RWSS cooling water makeup demand is approximately 28,179 gpm. BBNPP makeup water withdrawal rate during normal operations represents less than 1% of average annual Susquehanna River flow and approximately 5% of the 7Q10 low flow as measured at the USGS Wilkes-Barre Gage. Studies have been completed to determine if the new flow rates, based on BBNPP consumptive use, will have a negative effect on aquatic habitat, vulnerable aquatic species, and water quality, especially during drought or low flow conditions.

An Instream Flow Incremental Methodology (IFIM) Study has been completed on the NBSR (Normandeau, 2011). The purpose of this study is to determine the impact of a small change in NBSR flow on aquatic habitat. Various time-series analyses were performed using historical gage data from the USGS Wilkes-Barre stream gage on the Susquehanna River, alternative consumptive use and flow scenarios, and daily flows converted to weighted useable areas (WUAs) for eight fish species during various life stages. The NBSR flow, velocity, and depth information were analyzed to determine WUAs for the eight species. Seven life stages including four of the species showed no negative impact because decreases in flow represented increased weighted usable area. For 16 life stages involving eight species, small and infrequent negative impacts were detected. Negative impacts represented two to three percent of the weighted usable area and only occurred approximately ten percent of the time-series record. The greatest decreases on weighted usable habitat were for the Northern Hogsucker adult. The complete IFIM results are included in the report "Potential Effects of the Bell Bend

Project on Aquatic Resources and Downstream Users" (Normandeau, 2011, draft) provided in Appendix B of the JPA.

Water quality concerns relating to decreased River flow in relationship to the Nescopeck Creek abandoned mine drainage (AMD) plume at the confluence of the NBSR were also studied. Alkalinity, pH, temperature, and conductivity were measure to map the AMD plume within the NBSR. Results of the study demonstrate that AMD effects are only detectable on the south shoreline and dissipate with 0.6 miles of the confluence. The anticipated reduction in flow from BBNPP consumptive use will not change the plume behavior. Complete study results are included in the report, "Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users" (Normandeau, 2011, draft) provided in Appendix B of the JPA.

The affect of summertime conditions in the NBSR including low flow and increased river temperatures may negatively affect spawning, fry emergence, rearing, and nursery habitat suitability for juvenile smallmouth bass. A study was conducted to continuously measure NBSR pH, dissolved oxygen levels and water temperature in backwater habitat areas used by young-of-year smallmouth bass. Water quality measurements were taken between June and September 2010. Based on historical NBSR flow data, measurements taken during summer 2010 represented near worst case flow conditions. The data was used to determine potential affect of BBNPP discharge on the water quality of the NBSR. Stressful water quality conditions are those which deviate from Pennsylvania's water quality standards for pH, dissolved oxygen, and water temperature. Data suggests that during the summer months associated with periods of significant low flow, incipient, or apparent drought similar to those recorded in 2005 and 2010, there are natural occurrences of water quality not meeting State standards. These naturally occurring variations from the Pennsylvania Water Quality Criteria in water temperature and dissolved oxygen were of short duration and were limited to the shallow and inshore locations. The consumptive water use of 43 cfs from the NBSR during average low flow summer periods would represent a small percentage reduction in flow (approx. 1%) which would not be expected to exacerbate naturally occurring variations from the standards. It may be surmised that these conditions will occur in the future with or without the proposed consumptive water use associated with the Bell Bend Project and that this project will not contribute in any appreciable way to the temporal or spatial increase of these occurrences. Complete study results are included in the report

"Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users" (Normandeau, 2011, draft) provided in Appendix B of the JPA.

Aquatic impacts attributable to operation of the BBNPP intake structure and cooling water systems include impingement of organisms on the traveling screens and entrainment of fish eggs and larvae within the cooling system. Use of closed-cycle cooling systems at BBNPP will significantly reduce these impacts compared to power plants that operate open-cycle (once-through) cooling. In addition, BBNPP will incorporate NPDES design criteria to limit intake approach water velocities to less than 0.5 ft/sec.

The "Impingement and Entrainment Sampling for the Proposed Bell Bend Nuclear Power Plant at the SSES Circulating Water Supply System Intake Structure" (Normandeau, 2010) results found crayfish to be the dominant organism and bluegill the most abundant fish in the impingement samples. Other common fish species affected by impingement included rock bass, channel catfish, tessellated darter, and spotfin shiner. Fish size ranged from 40 mm to 381 mm. Cyprinidae was estimated to be the most abundant species affected by entrainment. Other common fish affected by entrainment include channel catfish, quillback, darter species, white sucker, and common carp. A majority (55.9%) of the entrained fish were larvae in the post yolk-sac life stage. No fish eggs were collected in entrainment sample. Impingement and entrainment will affect some recreationally important species such as channel catfish, smallmouth bass, walleye, rock bass, and yellow perch. Studies completed in the vicinity of the SSES intake structure have not shown measurable impacts on fish populations within the NBSR from entrainment.

It is unlikely that the Yellow Lampmussel or Green Floater mussels will be susceptible to impingement or entrainment. Mussels are burrowing, bottom oriented species and it is unlikely that these organisms would become entrained in the water column and enter the CWS Makeup Water Intake Structure. Neither of these species has been collected in impingement studies at SSES, Brunner Island Steam Electric Station, or Hunlock Power Station (Unistar, 2011). However, the small possibility does exist that fish that have been infected with glochidia (mussel larvae) could become entrained or impinged (Unistar, 2011). This occurrence could make the glochidia susceptible to both entrainment and impingement. The host fish species for larvae of Green Floater are

unknown. Yellow Lampmussel glochidia hosts include White perch and Yellow perch. No White perch were collected during impingement and entrainment sampling at SSES during 2008. Yellow perch was collected in low numbers in both entrainment (52 individuals) and impingement samples (3 individuals) at SSES during 2008 (Unistar, 2011, draft).

Recreation will be minimally impacted by consumptive water use. Small and infrequent impacts on game species of fish and non-game species of fish will occur. Boating, swimming, and other activities common upstream and downstream of the BBNPP will not be affected.

The BBNPP consumptive water use was also analyzed in relation to low flows and impacts on downstream water users. The study reviewed NPDES and SRBC withdrawal permits and the flow requirements of each user based on the range of flows throughout the stream reaches. Complete study results are included in "Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users" (Normandeau, 2011 draft) provided in Appendix B of the JPA.

Consumptive water use will not increase flood elevation or frequency. See "Susquehanna River Flood Study" (LandStudies, 2011) for additional information.

PPL continues to discuss appropriate mitigation for water withdrawals with the SRBC. A conceptual mitigation plan is described in Section R of this JPA.

Impact T is the blowdown discharge into the NBSR through a submerged multi-port diffuser. The diffuser pipe will be either 24 inch carbon steel, 24 inch RCP or 26 inch HDPE. Blowdown from the cooling towers is stored in the Combined Waste Water Retention Pond allowing retention time for settling of suspended solids as well as additional cooling and chemical treatment of the wastewater, if required, prior to discharge to the NBSR. Under normal conditions approximately 8,665 gpm of blowdown water will be discharged. Maximum flow is anticipated to be 9,367 gpm. No aquatic impacts are expected to result from the blowdown water based on Ecology III studies of the SSES blowdown flow that began in 1983. SSES flow exceeds the projected BBNPP blowdown flow by approximately 8 million gallons per day (mgd). The BBNPP diffuser design is similar to the SSES diffuser. Temperature of this discharge will be less than two degrees above ambient creating a small thermal plume which quickly dissipates to

ambient river temperature. A discharge plume model was used to compute the size, configuration, and dilution rates of the thermal plume resulting from discharges into the NBSR. Modeling of this plume shows that its size and distribution will meet all state and federal water quality criteria and will be sufficiently small that it is unlikely to cause impacts to the Susquehanna River's benthic community or motile organisms in the area (ERM, 2008). Additional information is provided in Appendix A Item 34.

An additional study of the blowdown plume has been implemented at the request of the SRBC. The study modeled increases in NBSR temperature and decreases in dissolved oxygen resulting from the plume at various River flow scenarios, taking into account the consumptive use of BBNPP. Results from an EPA model were compared to actual observed field plume measurements for the SSES. The model results were field verified. The EPA model demonstrated similar small plumes for BBNPP blowdown under normal circumstances and extreme flow conditions. Complete study results are included in "Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users" (Normandeau, 2011, draft) provided in Appendix B of the JPA.

Included in the blowdown discharge are residual chemicals used in biocide treatment and in plant process control. The concentrations discharged will be in conformance with NPDES permit conditions and applicable water quality criteria. Additionally, the amount of water being discharged from the closed-cycle system will be small compared to river flow, such that concentrations of chemicals discharged will rapidly disperse. Solids will be allowed time for settlement and chemical treatment, if required, in the Combined Waste Water Retention Pond. Water will be returned to the NBSR at velocities that will not cause riverbed materials to go into suspension.

Water quantity and adjacent property owners will not be affected by this impact.

Blowdown water will not affect recreational activities in the vicinity of the NBSR such as boating, swimming or fishing. Recreational activities are not currently permitted in the vicinity of SSES intake. SSES utilizes "No Trespassing" signs along the shoreline and around the structure. There is a sign on the intake structure telling boaters to stay back. Plant Security uses remote sensing technologies to enforce the warnings.

Impact U represents all of the storm sewer outfalls, most of which are level spreader stormwater discharges as shown on the plan sheets in Section F of the JPA. One 18

inch pipe outfall is proposed to provide drainage to the area impounded behind the intake structure fill. This impact will be in compliance with existing NPDES stormwater requirements.

The project involves substantial land alteration, implementation of BMPs throughout the site, and discharges of treated stormwater to on-site wetlands and the NBSR. The BBNPP plans to use appropriately designed and sited BMPs to minimize impacts that can result from stormwater discharges such as changes to watersheds, water temperatures, water chemistry or hydrologic cycles.

Subsurface infiltration is used extensively in BBNPP design to regulate temperature, water quality, and velocity of collected stormwater prior to reintroduction to wetlands and waterways at the site. Further, project design also incorporates capture, treatment, and return of stormwater in a manner which preserves existing water budgets and prevents disruption of hydrologic cycles which may impact wetland function.

Potential sources of thermal impact include runoff from the proposed access drives, parking lots and buildings. Runoff from the warm impervious areas will be mitigated by routing the stormwater through a series of grass-lined swales, rain gardens, and deep, low sloping pipes before draining into a series of subsurface infiltration/detention basins. The infiltration/detention basins and rain gardens areas will provide for permanent storage of the first flush storms, thus limiting the discharge of the warmer waters. Many of the basins will discharge via level spreaders to existing wetlands and other vegetated areas before entering the adjacent watercourses. These features will combine to mitigate any thermal impacts and allow the runoff to return to ambient temperature. Additional detail on BMPs and operation practices is provided in the referenced NPDES application as well as the BBNPP Post Construction Stormwater Management (PCSM) Plan.

3.2 Cumulative Loss of Forested Wetlands

Cumulatively, including permanent, temporary, and indirect impacts, 9.51 acres of forested wetland will be cleared. This cumulative impact will affect food chain production, general habitat functions including nesting, spawning, rearing, resting, migration, feeding, and escape cover. Specifically, potential Indiana Bat habitat will be affected. PFO clearing, generally occurs in small pockets. The change in cover will not

affect water quantity and stream flow, water quality, or upstream and downstream property. Most forest clearing is on project property therefore recreation will not be affected.

PFO will be replaced through the mitigation strategy described in Section R. In addition, 50 foot forested buffers will remain surrounding the majority of EV wetlands within the Project Boundary.

3.3 Additional Information

Additional information regarding the acreage of each proposed wetland impact, broken down by cover type is provided in the Wetland Impact Tables included in Enclosures D3 and D4.

Use of marsh mats will be limited to areas with permanent impacts and the areas under the proposed bridges, as described above. Site conditions may warrant additional use, however, marsh mat use will be limited to the greatest extent practicable.

The following additional project impact information is provided in Appendix A of the JPA.

1. The length and average width at the approximate ordinary high water mark of each stream proposed to be impacted (Item 20).
2. Description of invasive plant species monitoring and restoration in proposed work area (Item 32).
3. Additional descriptions, including whether an impacted wetland abuts, is adjacent to a stream or isolated is provided in the draft Approved JD forms (Item 37).

4. Upstream and Downstream Property

There will be no affect on upstream or downstream property.

5. Other Environmental Factors

5.1 Maintenance Impacts

5.1.1 Intake Structure

The BBNPP cooling water intake structure (CWIS) will require regular maintenance actions to ensure safe and efficient mechanical performance over the lifespan of the BBNPP facility.

The primary components of the CWIS are the intake bay itself, which is to be constructed on the west bank of the NBSR, a blowdown diffuser line constructed on the riverbed and extending downstream (south) of the intake bay, and the dredge envelope within the river. The BBNPP CWIS is physically similar to the existing SSES CWIS, and maintenance needs are anticipated to be effectively the same.

Intake Bay Cleaning - The BBNPP intake bay will be constructed with a 3 bay arrangement, with each bay being approximately 30 feet wide. It is expected that all 3 bays will be cleaned (de-mucked) every 18 to 36 months. Unlike the SSES intake, the intake bay for BBNPP is contiguous to the NBSR and will not be dewatered prior to cleaning, however the intake bay will be closed off from the river to the extent practical to prevent loss of sediment-laden water to the river.

Accumulated sediment (wet silt and debris) will be trucked to the BBNPP facility and stockpiled in an appropriate upland location. It is PPL's practice at SSES to use this sediment as fill material on an as-needed-basis, and this practice is proposed to be continued at BBNPP. It is expected that this practice would produce approximately 50 cubic yards of mud and debris (or less) during each cleaning event.

Maintenance Dredging - Maintenance dredging in the NBSR is proposed to be performed throughout the same dredge envelope and to the same depth (including overdredge) as proposed during initial construction. It is projected that this activity would be required every five to ten years, depending on Susquehanna River flow rates. Approximately 250 to 1,000 C.Y. of sediment is expected to be removed from the dredge envelope using mechanical dredge equipment and best management practices (BMPs) identical to those proposed to be used during initial dredging (described in Appendix A, Item 21). The dredged material is proposed to be used as clean fill at BBNPP, and handled in the same manner as described for the material removed from the intake bay. PPL requests that the ACOE and DEP include maintenance dredging in BBNPP project permits.

5.1.2 Diffuser Maintenance

The BBNPP blowdown diffuser will be constructed with a flap gate on its end to allow access by divers. Every 18 to 36 months, divers will access the diffuser pipe through a flap gate at its end and loosen accumulated material (silt and stones), which will be allowed to be flushed from the diffuser and from the riverbed area immediately adjacent to the flap gate. Less than 10 C.Y. of material is expected to be flushed into the Susquehanna River during each cleaning.

5.1.3 Transmission Line Maintenance

Forested areas within transmission line right-of-ways will be cleared initially for project construction. Post construction the vegetation in these areas will be maintained as scrub/shrub. The Pennsylvania Audubon Society and PPL Electric Utilities are working together to manage power line rights-of-way to provide important bird habitat while maintaining consistency with PPL's vegetation management practices to support electric reliability.

5.2 Cumulative Environmental Impacts

No other dams, water obstruction or encroachments will be needed in addition to those described in this application. A summary of stream and wetland cumulative environmental impacts is provided below. To determine cumulative effects at BBNPP, readily available environmental documentation regarding known current and past actions in the project area were reviewed. For the region of influence, specific emphasis was placed on projects in and adjacent to the Project Boundary and Luzerne and Columbia counties. Cumulative impacts include those that are incremental to past and ongoing activities on the site, along with those that are reasonably foreseeable in the future.

Construction impacts associated with BBNPP include grading and clearing, allocation of land to material lay-down and parking, use of ground and surface waters, equipment noise and emissions, increased traffic and use of public resources. These activities are consistent with those conducted during the construction of Susquehanna Steam Electric Station (SSES) Units 1 and 2. Many of the impacts will be temporary and most can be mitigated through the use of best management construction practices and stormwater pollution prevention planning required under State and Federal regulation.

A detailed description of all cumulative impacts resulting from BBNPP construction and operation that are not directly related to streams and wetlands are provided in Appendix

A of the JPA, Item 10. Cumulative impacts relating to surface and groundwater resources, aquatic and terrestrial organisms, recreation, and land use are described below.

5.2.1 Impacts to Groundwater, Surface Water, and Aquatic Organisms

The Project Boundary sits on an upland area, approximately 174 ft above the NBSR water level and approximately 1.6 mi north-northeast of the confluence of Walker Run and the NBSR. The proposed BBNPP CWS Makeup Water Intake Structure site is approximately 22 miles downstream of Wilkes-Barre, PA and 5 miles upstream of Berwick, PA (Unistar, 2011). The NBSR ultimately receives all surface water and groundwater that drains from the BBNPP site.

Impacts on wetlands, surface waters and groundwater resources may result from construction activities that change flow patterns such as construction of sedimentation impoundments, stormwater runoff and dewatering, or discharge of construction related waste effluents. Environmental controls will conform to applicable regulations and best management practices to minimize these effects. Examples include sediment control, stormwater retention, spill prevention, and control of construction debris. Efforts to reclaim areas not occupied by permanent structures or to provide offsetting habitat such as reforestation and constructed wetlands have also been planned.

Walker Run has been classified as a Wild Trout stream by the PA Fish and Boat Commission. Wetlands contiguous to Walker Run are consequently classified as EV per 25 PA Code Chapter 105. Additional attention was given to avoiding and minimizing impacts to Walker Run and the associated wetlands, and major design changes were made to this end at great expense to the applicant. No cumulative impacts to Walker Run are expected.

Preventative measures and corrective actions identified above and the short-term nature of construction activities should limit long-term cumulative impacts.

Minimal cumulative impacts to hydrology, water quality, and aquatic organisms are expected as a result of plant operation. Stormwater best management practices will limit long-term impacts to Walker Run, its tributaries, as well the NBSR. EV wetlands will be protected by 50-ft forested buffers to the greatest extent practicable. Cumulative impacts from water intake and blowdown will be small based on aquatic studies

performed for the proposed BBNPP as well as long-term monitoring of the affects of the SSES on the NBSR.

As a result, the cumulative impact on regional surface and groundwater from BBNPP construction in conjunction with the continued operation of SSES Units 1 and 2 should be small.

5.2.2 Land Use Impacts

The topography of the site is a gently rolling plateau with east-west trending ridges to the north. Grade elevations at the site range from 485 ft mean sea level at the NBSR to approximately 800 ft on the hill where the power block is located. The highest point of the proposed finished grade level is approximately 719 ft above sea level.

BBNPP construction will require land cover alteration of non-jurisdictional upland features within the 2,055 acre Project Boundary. Table 1 provides an overview of the pre- and post-construction land use areas generally conforming to United States Geologic Survey (USGS) cover type classifications. The majority of land use conversion will result from the footprint of the plant and vegetation clearing for transmission line rights-of-way.

Table 1: Land Alteration by Cover Type

Land Use Type	Pre-Construction Area (acres)	Post-Construction Area (acres)
Urban or Built-Up	220.8	859.6
Forest	1141.7	730.4
Barren	21.5	19.2
Wetlands	159.0	157.6
Water	71.9	71.8
Agricultural	440.0	216.3
Total Site Boundary	2054.9	2054.9

The BBNPP will occupy areas that currently include both farmland and forest. Structures and construction activities were located to minimize impacts on the remaining

forest. Approximately 234 acres of forested habitat will be cleared, of which 224.5 acres are upland and 9.51 are wetland. Impacts from this activity include potential habitat disruption and loss of water quality, shading, and windbreak benefits supporting local wetland and upland habitat quality. The proposed clearing will increase the fragmentation of the existing forest cover. As part of mitigation activities an effort will be made to replant forested areas in strategic locations that will create forested corridors throughout the BBNPP property boundary. In addition, 50 foot (minimum) forested buffers will be maintained, to the greatest extent practicable, adjacent to EV streams and wetlands to protect these resources during construction and operation of the BBNPP and reduce the potential for any additional impacts. In addition, the extent of the forested buffers will be increased as part of the mitigation strategy and bat management strategy.

5.2.3 Impacts on Terrestrial Species of Concern

Through correspondence with state and federal agencies and in-field reconnaissance, the diverse upland habitats at the BBNPP site have been determined to potentially support several rare or protected terrestrial species, including the butterflies Baltimore Checkerspot (*Euphydryas phaeton*) and Mulberry Wing (*Poanes massasoit*), the Northern Cricket Frog (*Acris crepitans*), and the (state and federally listed) endangered Indiana bat (Myotis sodalis).

The state and federally protected Indiana bat is known to use hibernacula located within 10 miles of the BBNPP site. Based upon USFWS correspondence, the existence of these hibernacula, along with suitable habitat (wetlands, forests, and riparian areas), make the site suitable for use by this species. A Bat Roost Tree Survey confirmed suitable Indiana Bat habitat in areas proposed to be impacted by BBNPP construction. PPL is coordinating with the USFWS to ensure impacts to the Indiana bat are avoided through project design and provision of suitable on- and off-site mitigation.

Tree clearing will occur between November 15 and March 31 while bats are hibernating to avoid direct mortality during time periods when the bats could potentially be using the site. PPL will adopt design measures that are intended to avoid and minimize potential indirect impacts on Indiana bats due to habitat loss that may occur as a result of the construction of BBNPP. The effort to minimize habitat loss will be focused on wetland

and riparian areas, where roost trees are present in greater densities and Indiana bats also drink and often forage. Minimizing impacts to wetland and riparian areas includes retaining a 50-ft buffer around Walker Run and its tributaries and adjacent wetlands. These BMPs will minimize the indirect effects on Indiana Bats by reducing adverse impacts on aquatic insect populations and riparian and wetland foraging habitat. Minimal impacts to potential bat populations are expected as a result of plant operation. No impacts are expected as a result of plant maintenance since areas requiring maintenance will have been previously altered and will not contain any Indiana bat habitat.

The life cycle of the Baltimore Checkerspot is tied closely to its host plant, turtlehead (*Chelone glabra*). Turtlehead was not found in the wetlands at the BBNPP site. The Mulberry Wing butterfly prefers tall grass meadow and sedge meadow habitat. Neither of these butterfly species has been sighted within the BBNPP project boundary. For these reasons no significant impact is expected to occur to either butterfly species.

One Northern Cricket frog call was heard by Normandeau Associates during field surveys on the Bell Bend Nuclear Power plant site. The call was heard near the farm pond, which will not be impacted by project construction or operation. The Northern Cricket frog had not been heard prior and has not been heard since, near the farm pond or at any other location within the BBNPP project boundary. The Northern Cricket frog has also never been sighted within the BBNPP project boundary. Habitat preferences include sunny, shallow ponds with abundant vegetation in the water and on the shore and slow-moving, algae covered water courses with sunny banks (NYDEC, 2009). The BBNPP project will not affect the existing ponds on-site. In addition the planned mitigation on Walker Run should benefit any potential cricket frog populations through increasing the quantity and quality of wetlands adjacent to Walker Run. Details regarding the mitigation plans can be found in Section R of the JPA. In a letter dated March 11, 2011 the PA Fish and Boat Commission stated "According to our review of the wetland delineation report, the field survey of terrestrial fauna, and the proposed project plan, we do not anticipate adverse impacts from the proposed project to the Northern Cricket Frog, which has not been confirmed on the site." This letter is included in Section E of this JPA.

Clearance for proposed actions potentially affecting important species will be secured from each respective agency prior to commencing work on the proposed project.

6. References

- Bell Bend Nuclear Power Plant Flood Study Susquehanna River. August 2011. LandStudies, Inc.
- Bell Bend Nuclear Power Plant Flood Study Walker Run. September 2011. LandStudies, Inc.
- Construction Dewatering Design. October 2010. Sargent & Lundy.
- Impingement and Entrainment Sampling for the Proposed Bell Bend Nuclear Power Plant at the SSES Circulating Water Supply System Intake Structure, Luzerne County, PA; Rev. 1, June 2010.Normandeau Associates, Inc.
- Indiana Bat Roost Tree Survey Report Proposed Bell Bend NPP Site Luzerne County, Pennsylvania. October 2011. Normandeau Associates, Inc.
- Potential Effects of the Bell Bend Project on Aquatic Resources and Downstream Users, Proposed Bell Bend Nuclear Power Plant Site, Luzerne County, Pennsylvania. June 2011. Normandeau Associates, Inc. (Draft)
- Soil Survey Geographic Database for Luzerne County, PA. 2004. USDA.
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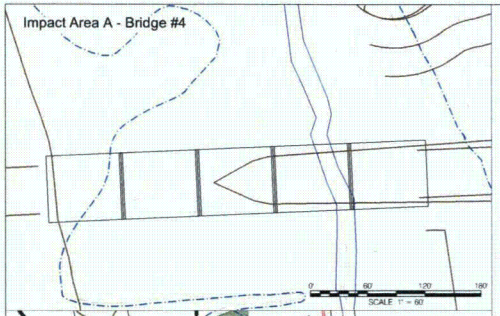
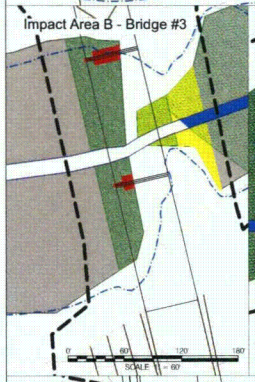
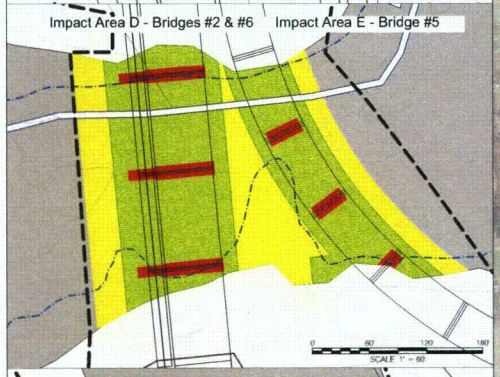
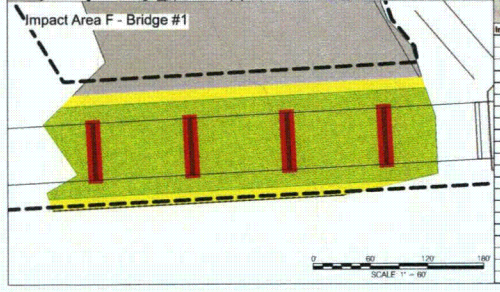
- UniStar Nuclear Services, LLC. 2011. Bell Bend Nuclear Power Plant Combined License Application Part 3: Environmental Report, Revision 2.
- Wetland Functions and Values Assessment. April 2011. LandStudies, Inc.



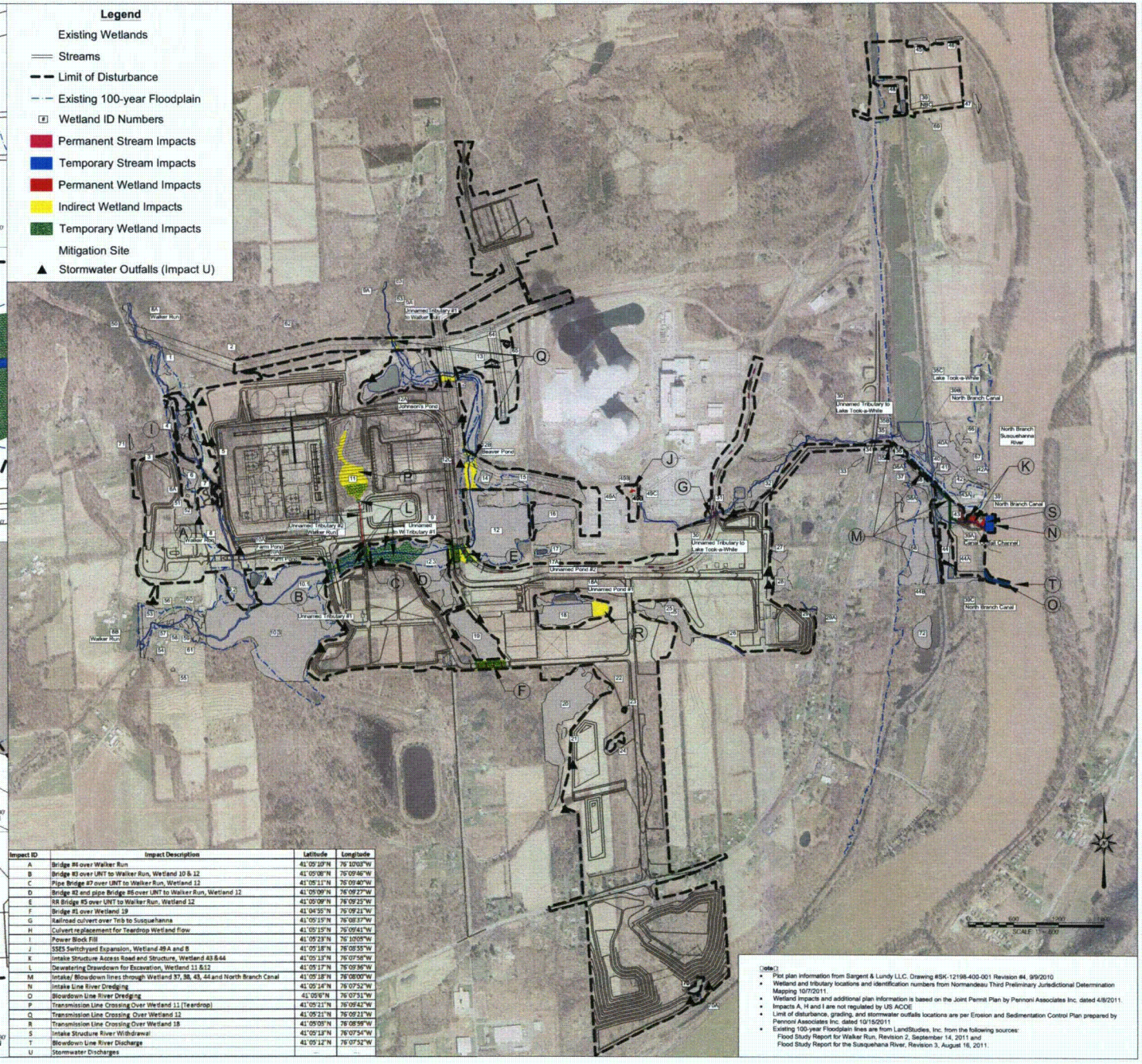






Legend

- Existing Wetlands
- Streams
- Limit of Disturbance
- Existing 100-year Floodplain
- Wetland ID Numbers
- Permanent Stream Impacts
- Temporary Stream Impacts
- Permanent Wetland Impacts
- Indirect Wetland Impacts
- Temporary Wetland Impacts
- Mitigation Site
- Stormwater Outfalls (Impact U)



Impact ID	Impact Description	Latitude	Longitude
A	Bridge #4 over Walker Run	41°05'10"N	76°10'03"W
B	Bridge #3 over UNT to Walker Run, Wetland 10 & 12	41°05'08"N	76°09'46"W
C	Pipe Bridge #7 over UNT to Walker Run, Wetland 12	41°05'11"N	76°09'40"W
D	Bridge #2 and pipe Bridge #6 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'27"W
E	RR Bridge #5 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'25"W
F	Bridge #1 over Wetland 19	41°04'55"N	76°09'21"W
G	Railroad culvert over Trib to Susquehanna	41°05'15"N	76°08'37"W
H	Culvert replacement for Teardrop Wetland flow	41°05'15"N	76°09'41"W
I	Power Block Fill	41°05'23"N	76°10'05"W
J	SSES Switchyard Expansion, Wetland 49A and B	41°05'18"N	76°08'55"W
K	Intake Structure Access Road and Structure, Wetland 43 & 44	41°05'13"N	76°07'58"W
L	Dewatering Drawdown for Excavation, Wetland 11 &12	41°05'17"N	76°09'36"W
M	Intake/ Blowdown lines through Wetland 37, 38, 43, 44 and North Branch Canal	41°05'18"N	76°08'05"W
N	Intake Line River Dredging	41°05'14"N	76°07'52"W
O	Blowdown Line River Dredging	41°05'6"N	76°07'51"W
P	Transmission Line Crossing Over Wetland 11 (Teardrop)	41°05'21"N	76°09'42"W
Q	Transmission Line Crossing Over Wetland 12	41°05'21"N	76°09'21"W
R	Transmission Line Crossing Over Wetland 18	41°05'05"N	76°08'59"W
S	Intake Structure River Withdrawal	41°05'18"N	76°07'54"W
T	Blowdown Line River Discharge	41°05'12"N	76°07'52"W
U	Stormwater Discharges		

Note:

- Plot plan information from Sargent & Lundy LLC. Drawing #SK-12198-400-001 Revision #4, 9/9/2010
- Wetland and tributary locations and identification numbers from Normandeau Third Preliminary Jurisdictional Determination Mapping 10/7/2011.
- Wetland impacts and additional plan information is based on the Joint Permit Plan by Pennoni Associates Inc, dated 4/8/2011.
- Impacts A, H and I are not regulated by US ACOE
- Limit of disturbance, grading, and stormwater outfalls locations are per Erosion and Sedimentation Control Plan prepared by Pennoni Associates Inc, dated 10/15/2011
- Existing 100-year Floodplain lines are from LandStudies, Inc. from the following sources:
  Flood Study Report for Walker Run, Revision 2, September 14, 2011 and
  Flood Study Report for the Susquehana River, Revision 3, August 16, 2011.

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Land Studies

PROJECT:
PPL, BELL BEND
Bomboy Lane
Berwick, PA 18603

SHEET TITLE:
ENCLOSURE D1 - BBNPP WETLAND & WATERCOURSE IMPACT LOCATION MAP - US ACOE
Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

Revisions		
No.	Date	Description
1	6/14/11	UPDATE LOD & STORMWATER OUTFALLS
2	10/14/11	UPDATE LOD & WETLAND AREAS

Project Number	E-726-L8
Drawn By	JS
Checked By	BE
Date	April 29, 2011
Scale	1" = 600'
Drawing Number	WI-COE-001
Sheet Number	1 OF 2

Enclosure D3 4/29/2011

BBNPP Wetland and Watercourse Impacts and Mitigation

ACOE Impacts and Mitigation

						ACOE Jurisdictional Wetland Impacts					ACOE Stream Impacts				ACOE		PFO Loss
						Temporary	Permanent	PFO	PSS	PEM	Permanent		Temporary		Indirect Impacts	Fxn./ Values Lost	
Impact ID	Impact Description	Latitude	Longitude	EV Wetland?	Water Dependent?	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(LF)	(ac.)	(LF)	(ac.)	(ac.)		(ac.)
A	Bridge #4 over Walker Run	41°05'10"N	76°10'03"W	N/A	YES	---	---	---	---	---	---	---	---	---	---	None	---
B	Bridge #3 over UNT to Walker Run, Wetland 10 & 12	41°05'08"N	76°09'46"W	YES	YES	0.22	0.02	---	---	0.02	---	---	---	---	0.09	PFO wildlife habitat	0.09
C	Pipe Bridge #7 over UNT to Walker Run, Wetland 12	41°05'11"N	76°09'40"W	YES	YES	0.20	0.01	0.01	---	---	---	---	---	---	0.41	PFO wildlife habitat	0.42
D	Bridge #2 and pipe Bridge #6 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'27"W	YES	YES	0.60	0.08	0.08	---	---	---	---	---	---	0.92	PFO wildlife habitat	1.00
E	RR Bridge #5 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'25"W	YES	YES	0.37	0.03	0.03	---	---	---	---	---	---	0.60	PFO wildlife habitat	0.63
F	Bridge #1 over Wetland 19	41°04'55"N	76°09'21"W	NO	YES	0.79	0.09	0.09	---	---	---	---	---	---	0.98	PFO wildlife habitat	1.07
G	Railroad culvert over Trib to Susquehanna	41°05'15"N	76°08'37"W	NO	YES	---	---	---	---	---	125	0.07	---	---	---	---	---
H	Culvert replacement for Teardrop Wetland flow	41°05'15"N	76°09'41"W	YES	YES	---	---	---	---	---	---	---	---	---	---	---	---
I	Power Block Fill	41°05'23"N	76°10'05"W	NO	NO	---	---	---	---	---	---	---	---	---	---	---	---
J	SSES Switchyard Expansion, Wetland 49 A and B	41°05'18"N	76°08'55"W	NO	NO	---	0.04	---	---	0.04	---	---	---	---	---	None	---
K	Intake Structure Access Road and Structure, Wetland 43 &44	41°05'13"N	76°07'58"W	NO	YES	---	0.98	0.30	---	0.68	617	0.07	---	---	---	PFO wildlife habitat, fish habitat, floodflow alteration, all 4 values	0.30
L	Dewatering Drawdown for Excavation, Wetland 11 &12	41°05'17"N	76°09'36"W	YES	YES	5.56	---	---	---	---	---	---	1188	0.30	---	Groundwater discharge	---
M	Intake/ Blowdown lines through Wetland 37, 38, 43, 44 and North Branch Canal	41°05'18"N	76°08'00"W	NO	YES	0.78	---	---	---	---	---	---	47	0.04	0.07	Temporary PFO wildlife habitat	0.07
N	Intake Line River Dredging	41°05'14"N	76°07'52"W	NO	YES	---	---	---	---	---	---	---	220	0.61	---	---	---
O	Blowdown Line River Dredging	41°05'6"N	76°07'51"W	NO	YES	---	---	---	---	---	---	---	50	0.46	---	---	---
P	Transmission Line Crossing Over Wetland 11 (Teardrop)	41°05'21"N	76°09'42"W	YES	NO	---	---	---	---	---	---	---	---	---	3.46	PFO wildlife habitat	3.46
Q	Transmission Line Crossing Over Wetland 12	41°05'21"N	76°09'21"W	YES	NO	---	---	---	---	---	---	---	---	---	1.72	PFO wildlife habitat	1.72
R	Transmission Line Crossing Over Wetland 18	41°05'03"N	76°08'59"W	NO	NO	---	---	---	---	---	---	---	---	---	0.75	PFO wildlife habitat	0.75
S	Intake Structure River Withdrawal	41°05'13"N	76°07'54"W	N/A	YES	---	---	---	---	---	---	---	---	---	---	---	---
T	Blowdown Line River Discharge	41°05'12"N	76°07'52"W	NO	YES	---	---	---	---	---	---	---	---	---	---	---	---
U	Stormwater Discharges	---	---	YES/NO	YES	---	---	---	---	---	---	---	---	---	---	None	---
					Subtotals	8.52	1.25	0.51	0.00	0.74	742	0.14	1505	1.41	9.00		9.51
					EV Totals	6.95	0.14	0.12	0.00	0.02	0.00	0.00	1188	0.30	7.20		7.32
					Total Impacts Requiring Mitigation	8.52	1.25	0.51	0.00	0.74	742.00	0.14	0	0.00	9.00		9.51

Minimum Wetland Replacement Acreage

ACOE (2:1 PFO, 1.5:1 PSS, 1:1 PEM) 1.76 ac.

	Wetland Creation				Wetland Enhancement				Stream Restoration				PFO created/ converted (acres)
Mitigation Sites	Total (ac.)	PFO (ac.)	PSS (ac.)	PEM (ac.)	Total (ac.)	PFO (ac.)	PSS (ac.)	PEM (ac.)	Total (LF)	Creation (LF)	Enhancement (LF)	Description of Primary Functions and Values Created/ Enhanced	
Walker Run, Site A and B	7.87	8.12	0	-0.25	5.52	5.52	0.00	0.00	2213	1360	853	PFO wildlife habitat, fish habitat, stream stabilization, groundwater recharge, sediment reductions, flood flow alteration	13.72
Riverlands- North Branch Canal Restoration	0.00	0.00	0.00	0.00	1.24	1.24	0.00	0.00	0	0	0	Uniqueness/heritage, recreation, educational/scientific value, flood flow alteration, PFO wildlife habitat	0.48
Confers Lane Removal	0.36	0.36	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	PFO wildlife habitat	0.40
Total Mitigation Sites	**8.23**	**8.48**	**0.00**	**-0.25**	**6.80**	**6.80**	**0.00**	**0.00**	**2213.00**	**1360.00**	**853.00**		**14.60**

* Impacts associated with the relocation of the Walker Run Stream Channel are reported as negative values. See Mitigation narrative for more details.

Replacement Ratios Provided (Recommended Sites)	Total (ac.)	PFO (ac.)	PSS (ac.)	PEM (ac.)
Replacement Ratio (ACOE)	12.07	29.96	N/A	-0.34

Note: Replacement Ratios based on impacts from project, excluding mitigation impacts

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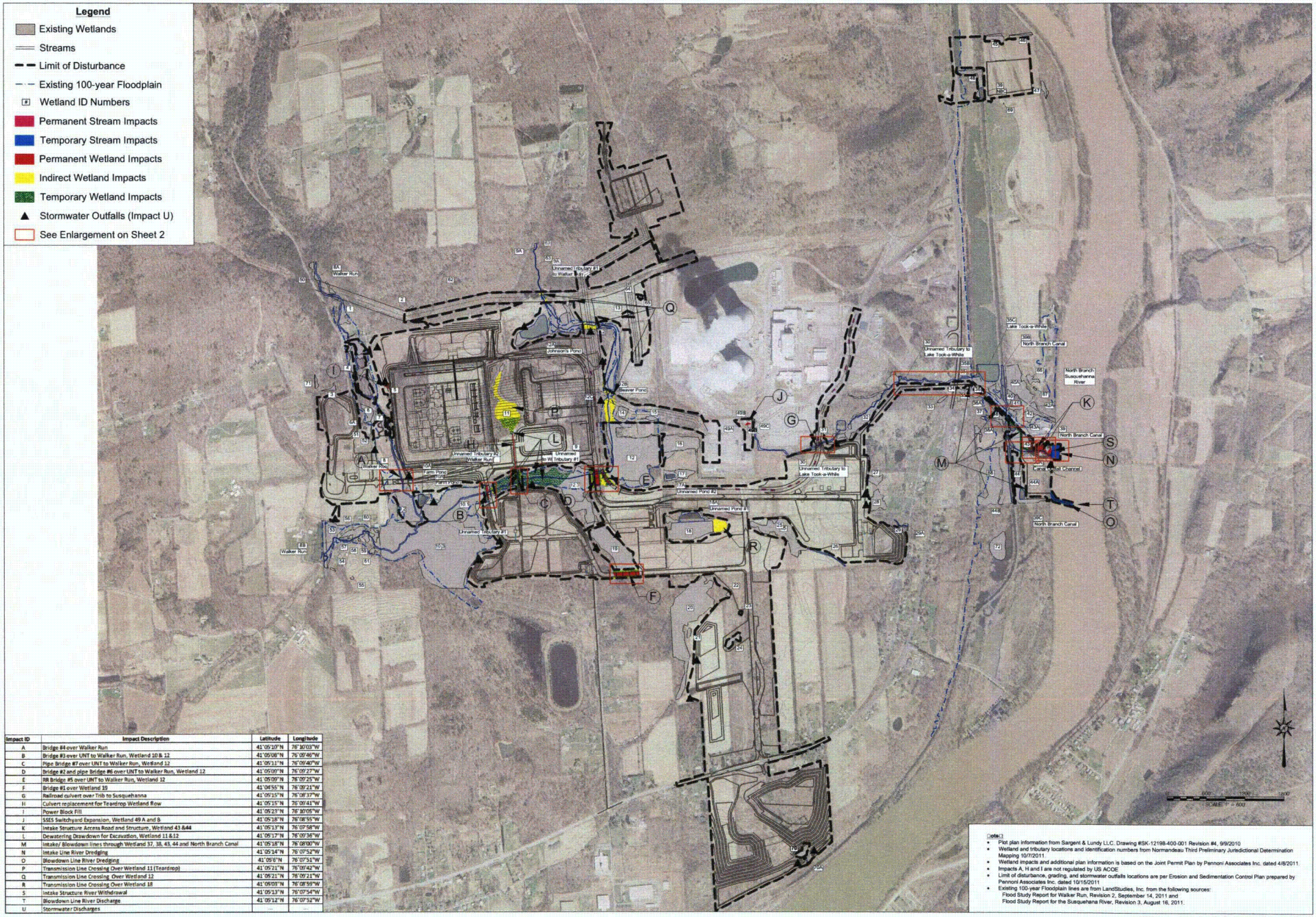
PROJECT:
PPL, BELL BEND
Bomboy Lane
Berwick, PA 18603

SHEET TITLE:
ENCLOSURE D3 - BBNPP WETLAND & WATERCOURSE IMPACTS - US ACOE
Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

Revisions		
No.	Date	Description
0	10/14/11	--

Project Number: E-726-L8
Drawn By: JS
Checked By: BE
Date: October 14, 2011
Scale: NA
Drawing Number: WI-COE-002
Sheet Number: 2 OF 2



Impact ID	Impact Description	Latitude	Longitude
A	Bridge #4 over Walker Run	41°05'10"N	76°10'03"W
B	Bridge #3 over UNT to Walker Run, Wetland 10 & 12	41°05'08"N	76°09'46"W
C	Pipe Bridge #7 over UNT to Walker Run, Wetland 12	41°05'11"N	76°09'40"W
D	Bridge #2 and pipe Bridge #6 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'27"W
E	RR Bridge #5 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'25"W
F	Bridge #1 over Wetland 19	41°04'55"N	76°09'21"W
G	Railroad culvert over Trib to Susquehanna	41°05'15"N	76°08'37"W
H	Culvert replacement for Teardrop Wetland flow	41°05'15"N	76°09'41"W
I	Power Block Fill	41°05'23"N	76°10'05"W
J	SSES Switchyard Expansion, Wetland 49 A and B	41°05'18"N	76°08'55"W
K	Intake Structure Access Road and Structure, Wetland 43 &44	41°05'13"N	76°07'58"W
L	Dewatering Drawdown for Excavation, Wetland 11 &12	41°05'17"N	76°09'36"W
M	Intake/ Blowdown lines through Wetland 37, 38, 43, 44 and North Branch Canal	41°05'18"N	76°08'00"W
N	Intake Line River Dredging	41°05'14"N	76°07'52"W
O	Blowdown Line River Dredging	41°05'6"N	76°07'51"W
P	Transmission Line Crossing Over Wetland 11(Teardrop)	41°05'21"N	76°09'42"W
Q	Transmission Line Crossing Over Wetland 12	41°05'21"N	76°09'21"W
R	Transmission Line Crossing Over Wetland 18	41°05'03"N	76°08'59"W
S	Intake Structure River Withdrawal	41°05'13"N	76°07'54"W
T	Blowdown Line River Discharge	41°05'12"N	76°07'52"W
U	Stormwater Discharges	---	---

Notes:

- Plot plan information from Sargent & Lundy LLC. Drawing #SK-12198-400-001 Revision #4, 9/9/2010
- Wetland and tributary locations and identification numbers from Normandeau Third Preliminary Jurisdictional Determination Mapping 10/7/2011
- Wetland impacts and additional plan information is based on the Joint Permit Plan by Pennoni Associates Inc. dated 4/8/2011
- Impacts A, H and I are not regulated by US ACOE
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- Existing 100-year Floodplain lines are from LandStudies, Inc. from the following sources:
  Flood Study Report for Walker Run, Revision 2, September 14, 2011 and
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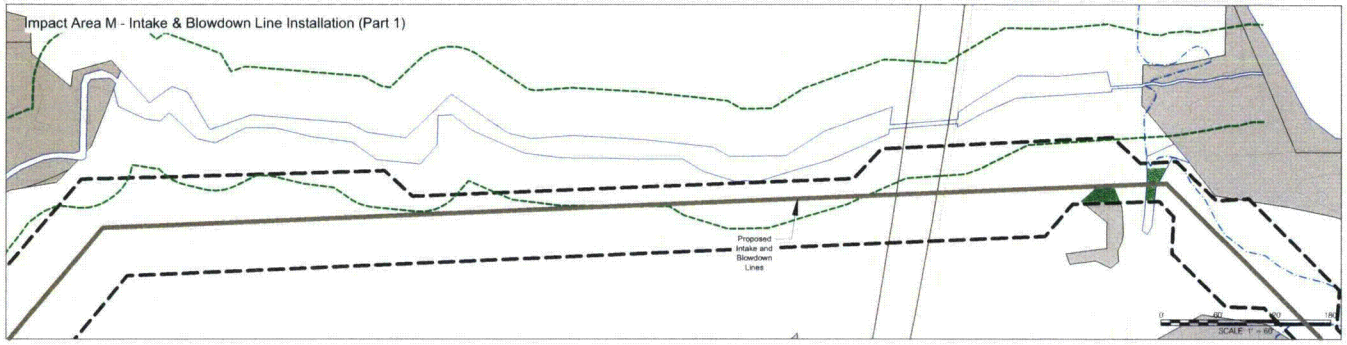
Land Studies

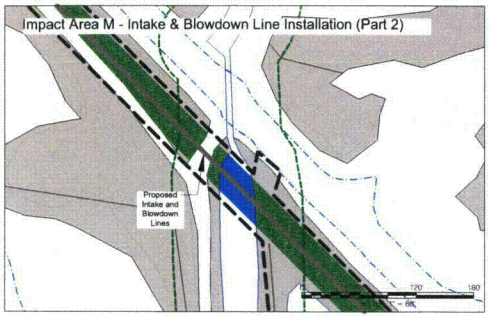
PROJECT:
PPL, BELL BEND
Bomboy Lane
Berwick, PA 18603

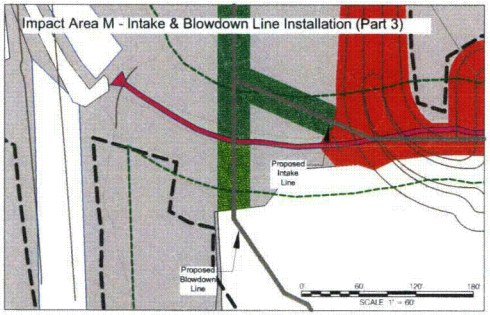
SHEET TITLE:
ENCLOSURE D2 - BBNPP WETLAND & WATERCOURSE IMPACT LOCATION MAP - DEP
Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

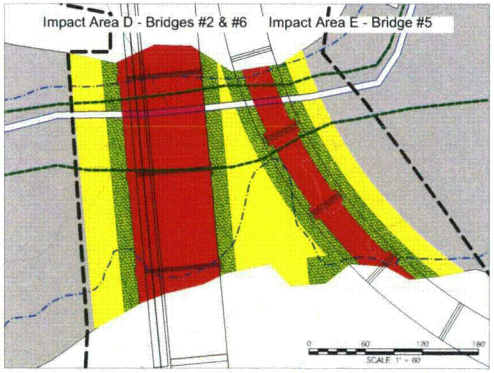
Revisions		
No.	Date	Description
1	6/14/11	UPDATE LOD & STORMWATER OUTFALLS
2	10/14/11	UPDATE LOD & WETLAND AREAS ADD FLOODWAY ENLARGEMENTS
3	11/8/11	

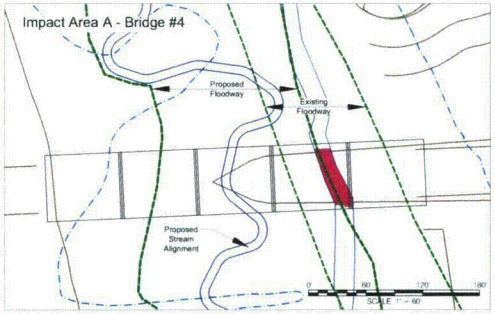
Project Number	E-726-L8
Drawn By	JS
Checked By	BE
Date	April 29, 2011
Scale	1" = 600'
Drawing Number	WI-DEP-001
Sheet Number	1 OF 3

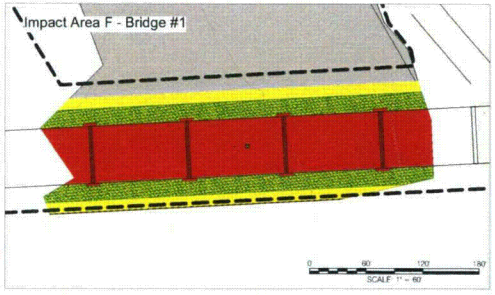


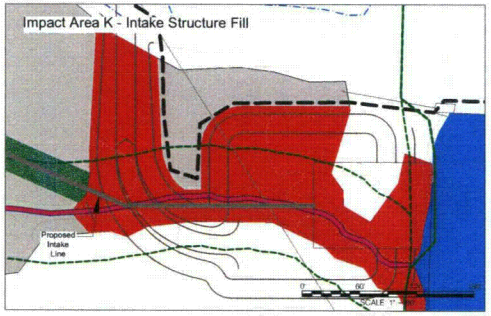


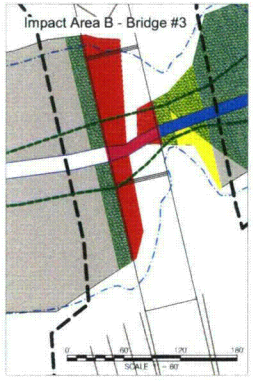


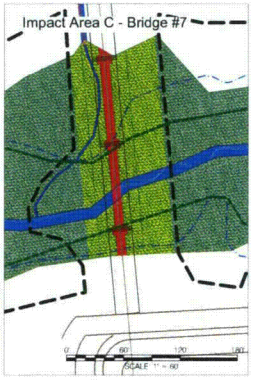


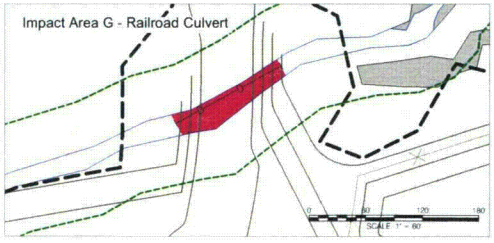


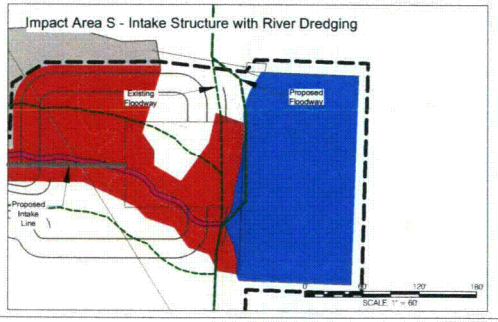












Legend

- Existing Wetlands
- Streams
- Limit of Disturbance
- Existing 100-year Floodplain
- Floodway (FEMA, LandStudies Inc. & 50' Buffer)*
- Wetland ID Numbers
- Permanent Stream Impacts
- Temporary Stream Impacts
- Permanent Wetland Impacts
- Indirect Wetland Impacts
- Temporary Wetland Impacts
- Stormwater Outfalls (Impact U)

* Regulatory floodways delineated on this plan are from the following sources:
  - Susquehanna River: *Bell Bend Nuclear Power Plant Flood Study Report Susquehanna River (LSI Doc. No. FS-SR-001)* by LandStudies, Inc. Revision 3, August 16, 2011
  - Walker Run: *FEMA Flood Insurance Study Panel 20 of 20 for the Township of Salem, Pennsylvania, Luzerne County Community-Panel Number 420625 0020 B*, Effective March 18, 1980 and *Bell Bend Nuclear Power Plant Flood Study Report Walker Run (LSI Doc. No. FS-WR-001)* by LandStudies Inc. Revison 2, September 14, 2011
  - All Other Areas: 50' from existing edge of water

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PROJECT:
PPL, BELL BEND
Bomboy Lane
Berwick, PA 18603

SHEET TITLE:
ENCLOSURE D2, ENLARGEMENTS - BBNPP WETLAND & WATERCOURSE IMPACT LOCATION MAP - DEP
Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

No.	Date	Description
1	6/14/11	UPDATE LOD & STORMWATER OUTFALLS
2	10/14/11	UPDATE LOD & RETURNS AREAS ADD FLOODWAY ENLARGEMENTS
3	11/8/11	

Project Number: E-726-L8
Drawn By: JS
Checked By: BE
Date: April 29, 2011
Scale: 1" = 60'
Drawing Number: WI DEP-001A
Sheet Number:

2
OF 3

Enclosure D4 11/3/2011

BBNPP Wetland and Watercourse Impacts and Mitigation

DEP Impacts and Mitigation

							DEP Jurisdictional Wetland Impacts					DEP Stream Impacts				DEP		
							Temporary	Permanent *	PFO	PSS	PEM	Permanent*		Temporary		Indirect Impacts		PFO Loss
Impact ID	Impact Description	Latitude	Longitude	EV Wetland?	Water Dependent?	Qualifies for GP or Waiver?	(ac.)	(ac.)	(ac.)	(ac.)	(ac.)	(LF)	(ac.)	(LF)	(ac.)	(ac.)	Fxn./ Values Lost	(ac.)
A	Bridge #4 over Walker Run	41°05'10"N	76°10'03"W	NO	YES	YES -GP7	---	---	---	---	---	65	0.03	---	---	---	None	---
B	Bridge #3 over UNT to Walker Run, Wetland 10 & 12	41°05'08"N	76°09'46"W	YES	YES	NO	0.09	0.14	0.01	---	0.13	62	0.02	---	---	0.07	PFO wildlife habitat	0.09
C	Pipe Bridge #7 over UNT to Walker Run, Wetland 12	41°05'11"N	76°09'40"W	YES	YES	NO	0.16	0.05	0.05	---	---	12	0.00	---	---	0.37	PFO wildlife habitat	0.42
D	Bridge #2 and pipe Bridge #6 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'27"W	YES	YES	NO	0.18	0.50	0.50	---	---	87	0.01	---	---	0.50	PFO wildlife habitat	1.00
E	NR Bridge #5 over UNT to Walker Run, Wetland 12	41°05'09"N	76°09'25"W	YES	YES	NO	0.23	0.17	0.17	---	---	29	0.00	---	---	0.47	PFO wildlife habitat	0.63
F	Bridge #1 over Wetland 19	41°04'55"N	76°09'21"W	NO	YES	NO	0.33	0.55	0.55	---	---	---	---	---	---	0.52	PFO wildlife habitat	1.07
G	Railroad culvert over Trib to Susquehanna	41°05'15"N	76°08'37"W	NO	YES	NO	---	---	---	---	---	125	0.070	---	---	---	---	---
H	Culvert replacement for Teardrop Wetland flow	41°05'15"N	76°09'41"W	YES	YES	YES - Waiver 2	---	---	---	---	---	---	---	567	0.01	---	---	---
I	Power Block Fill	41°05'23"N	76°10'05"W	NO	NO	NO	0.00	0.12	---	---	0.12	---	---	---	---	---	---	---
J	SSES Switchyard Expansion, Wetland 49 A and B	41°05'18"N	76°08'55"W	NO	NO	NO	---	0.06	---	---	0.06	---	---	---	---	---	None	---
K	Intake Structure Access Road and Structure, Wetland 43 &44	41°05'13"N	76°07'58"W	NO	YES	NO	---	0.98	0.30	---	0.68	617	0.07	---	---	---	PFO wildlife habitat, fish habitat, floodflow alteration, all 4 values	0.30
L	Dewatering Drawdown for Excavation, Wetland 11 &12	41°05'17"N	76°09'36"W	YES	YES	NO	5.56	---	---	---	---	---	---	1306	0.30	---	Groundwater discharge	---
M	Intake/ Blowdown lines through Wetland 37, 38, 43, 44 and North Branch Canal	41°05'18"N	76°08'00"W	NO	YES	YES - GP5	0.78	---	---	---	---	---	---	47	0.04	0.07	Temporary PFO wildlife habitat	0.07
N	Intake Line River Dredging	41°05'14"N	76°07'52"W	NO	YES	NO	---	---	---	---	---	---	---	220	0.61	---	---	---
O	Blowdown Line River Dredging	41°05'6"N	76°07'51"W	NO	YES	NO	---	---	---	---	---	---	---	50	0.46	---	---	---
P	Transmission Line Crossing Over Wetland 11 (Teardrop)	41°05'21"N	76°09'42"W	YES	NO	YES-GP5	---	---	---	---	---	---	---	---	---	3.46	PFO wildlife habitat	3.46
Q	Transmission Line Crossing Over Wetland 12	41°05'21"N	76°09'21"W	YES	NO	YES-GP5	---	---	---	---	---	---	---	---	---	1.72	PFO wildlife habitat	1.72
R	Transmission Line Crossing Over Wetland 18	41°05'05"N	76°08'59"W	NO	NO	YES-GP5	---	---	---	---	---	---	---	---	---	0.75	PFO wildlife habitat	0.75
S	Intake Structure River Withdrawal	41°05'13"N	76°07'54"W	NO	YES	YES-GP4	---	---	---	---	---	---	---	---	---	---	---	---
T	Blowdown Line River Discharge	41°05'12"N	76°07'52"W	NO	YES	NO	---	---	---	---	---	---	---	---	---	---	---	---
U	Stormwater Discharges	---	---	YES/NO	YES	YES - GP4	---	---	---	---	---	---	---	---	---	---	None	---
						Subtotals	7.33	2.57	1.58	0.00	0.99	997	0.21	2280	1.42	7.93		9.51
						EV Totals	6.22	0.86	0.73	0.00	0.13	190.00	0.04	1963	0.31	6.59		7.32
						Requiring Mitigation	0.00	1.39	0.51	0.00	0.88	742.00	0.14	0	0.00	7.93		9.51

Minimum Wetland Replacement Acreage

DEP (1:1 Ratio)	1.39	ac.

*Bridge span shadows over wetlands and streams are permanent DEP impacts that do not require mitigation.

Mitigation Sites	Wetland Creation						Stream Restoration					Description of Primary Functions and Values Created/ Enhanced	PFO created/ converted
	Total	PFO Created	PFO Impacted*	PSS	PEM Created	PEM Impacted*	Total	Abandoned*	Created	Net Creation	Enhancement		
	(ac.)	(ac.)		(ac.)		(ac.)	(LF)	(LF)	(LF)	(LF)	(LF)		(ac)
Walker Run, Site A and B	7.87	8.20	-0.08	0.00	0.00	-0.25	2213	-2799	4159	1360	853	PFO wildlife habitat, fish habitat, stream stabilization, groundwater recharge, sediment reductions, flood flow alteration	13.72
Riverlands- North Branch Canal Restoration	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Uniqueness/heritage, recreation, educational/scientific value, flood flow alteration, PFO wildlife habitat	0.48
Confers Lane Removal	0.36	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	PFO wildlife habitat	0.40
Total Mitigation Sites	**8.23**	**8.56**	**-0.08**	**0.00**	**0.00**	**-0.25**	**2213**	**-2799**	**4159**	**1360**	**853.00**		**14.60**

* Impacts associated with the relocation of the Walker Run stream channel are reported as negative values. Permanent wetland impacts are a result of the channel being relocted to wetland areas. Abandoned stream channel to be converted to wetlands. See Mitigation Narrative for more details.

Replacement Ratios Provided (Recommended Sites)	Total (ac.)	PFO (ac.)	PSS (ac.)	PEM (ac.)
Replacement Ratio (DEP)	5.94	16.78	N/A	-0.29

Note: Replacement Ratios based on impacts from project, excluding mitigation impacts

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PROJECT:
PPL, BELL BEND
Bomboy Lane
Berwick, PA 18603

SHEET TITLE:
ENCLOSURE D4 - BBNPP WETLAND & WATERCOURSE IMPACTS - DEP
Bell Bend Nuclear Power Plant
Salem Township
Luzerne County, PA

Revisions		
No.	Date	Description
0	10/14/11	-
1	11/3/11	REVISE TABLE

Project Number: E-726-L8
Drawn By: JS
Checked By: BE
Date: October 14, 2011
Scale: NA
Drawing Number: WI-DEP-002
Sheet Number: 3 OF 3