Stantec

Stantec Consulting Services Inc.
10509 Timberwood Circle Ste. 100 Louisville, Kentucky 40223

October 6, 2016
File: rpt_004_let_175555021
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Initial Inflow Design Flood Control System Plan
Bottom Ash Pond
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Cumberland Fossil Plant
Cumberland City, Tennessee

1.0 PURPOSE

This letter documents Stantec's certification of the initial inflow design flood control system plan for the TVA Cumberland Fossil Plant's Bottom Ash Pond. Based on the assessment, the Bottom Ash Pond complies with the inflow design flood control requirements in the EPA Final CCR Rule at 40 CFR 257.82.

2.0 INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

As described in 40 CFR 257.82(c), an inflow design flood control system plan must be prepared to document how the inflow design flood control system has been designed and constructed to manage the design storm required by the hazard classification. Stantec has assigned the Bottom Ash Pond a low hazard potential classification rating. Thus, the inflow design storm event was selected from §257.82(a)(3) as the 100-year flood event based upon a hazard potential classification of "low".

3.0 SUMMARY OF FINDINGS

The attached plan presents the analysis of the inflow design flood control system for the Bottom Ash Pond. The resulting water surface elevations are shown in the following table. The plan and results show that the impoundment meets the requirements set forth in 40 CFR 257.82(a) and (b).

Plant	Facility	Inflow Design Storm	Water Surface Elevation (feet)	Minimum Embankment Elevation (feet)
CUF	Bottom Ash Pond	100-year storm	403.0	404.0
		100-year storm	401.5	403.0
		100-year storm	397.7	399.0

Re: **Initial Inflow Design Flood Control System Plan**
Bottom Ash Pond
EPA Final Coal Combustion Residuals (CCR) Rule
TVA Cumberland Fossil Plant
Cumberland City, Tennessee

4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stephen H. Bickel, being a Professional Engineer in good standing in the State of Tennessee do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and
3. that the inflow design flood control system plan for the TVA Cumberland Fossil Plant's Bottom Ash Pond meets the requirements specified in 40 CFR 257.82(a), (b), and (c)(1).

SIGNATURE ______________________ DATE 10/6/2016

ADDRESS: Stantec Consulting Services Inc.
10509 Timberwood Circle, Suite 100
Louisville, Kentucky 40223-5308

TELEPHONE: (502) 212-5075

ATTACHMENTS: Inflow Design Flood Control System Plan

Initial Inflow Design Flood Control System Plan

Cumberland Fossil Plant– Bottom Ash Pond
Cumberland City, Tennessee

Stantec

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

October 6, 2016
Revision 0

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 BACKGROUND

On April 17, 2015, the Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities [RIN-2050-AE81; FRL-9149-4] (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services, Inc. (Stantec) was contracted by the Tennessee Valley Authority (TVA) to analyze the inflow design flood for Cumberland Fossil Plant's (CUF) Bottom Ash Pond CCR surface impoundment (SI) and evaluate compliance with section §257.82 of the EPA Final CCR Rule.

CUF is a coal-fired, electric generating plant located in Stewart County, Tennessee. CUF is approximately 60 miles northwest from Nashville. The plant is located on the southern bank of the Cumberland River at Cumberland River Mile 103. Wells Creek flows around the southwest perimeter of CUF. A map showing the location of CUF in relation to the surrounding hydrologic features is included as Appendix A. CUF has two SI's, the Bottom Ash Pond and Stilling Pond (including Retention Pond). CUF also has two CCR Landfills, the Gypsum Storage Area and Dry Ash Stack. A separate inflow design flood control plan has been prepared for the Stilling Pond (including Retention Pond). In addition, a run-on and run-off control system plan has been prepared for the Gypsum Storage Area and Dry Ash Stack. This inflow design flood control plan addresses the Bottom Ash Pond SI, which is an Existing CCR SI as defined by the EPA Final CCR Rule and consists of the approximate boundary area denoted in Figure 1.

Figure 1 Cumberland Fossil Plant

2.0 EXISTING CONDITIONS

The Bottom Ash Pond is approximately 5.3 acres and located west of CUF's electric generating facility. CUF utilizes coal to generate electricity. Bottom ash, fly ash, and gypsum are coal combustion residuals. The non-marketed fly ash is conditioned and transported by truck to the Dry Ash Stack where it is spread and compacted. Bottom ash is sluiced to the Bottom Ash Pond, reclaimed and then spread and compacted on the Dry Ash Stack. Gypsum slurry is processed and dewatered either at the nearby plant or within two lined settling channels located on the top of the Gypsum Storage Area. Effluent from the lined settling channels is conveyed to the Bottom Ash Pond. Effluent from the Bottom Ash Pond is conveyed to the Stilling Pond.

In general, the Bottom Ash Pond surface consists of the following. The interior dike surface areas are typically compacted ash. Roads located on the crest of the Bottom Ash Pond are surfaced with gravel. The remaining Bottom Ash Pond area is surfaced with ponding water.

The Bottom Ash Pond conveys run-off from the top area of the Gypsum Storage Area through four, 42-inch diameter gravity pipes and is the discharge location for plant sluiced bottom ash and effluent from the lined settling channels. The Bottom Ash Pond is comprised of two interconnected detention basins (referred to as Settling Basin 1 and Settling Basin 2) and a gravel-lined ditch (Ditch SB) that conveys the flows from the Bottom Ash Pond and discharges into a perimeter gravel-lined ditch (North Ditch). A culvert with four, 30-inch diameter pipes connects Settling Basins 1 and 2. A culvert with two, 24-inch diameter pipes connects Settling Basin 2 and Ditch SB. A culvert with two, 54-inch diameter pipes connects the Ditch SB to the North Ditch. The Bottom Ash Pond is graded so run-off flows to the northwest. Run-off from storm events that overtop the Settling Basin 1 and the Settling Basin 2 is maintained within the Bottom Ash Pond by the Bottom Ash Pond perimeter dike. The dike also slopes to the southwest and does not have a constant elevation. The dike allows for run-off to sheet flow from the upstream Settling Basin1 to the downstream Settling Basin 2 and into Ditch SB before flowing into the North Ditch. The North Ditch flows to the Stilling Pond. Figure 2 shows the location of the hydraulic structures in the Bottom Ash Pond (approximate boundary delineated in red).

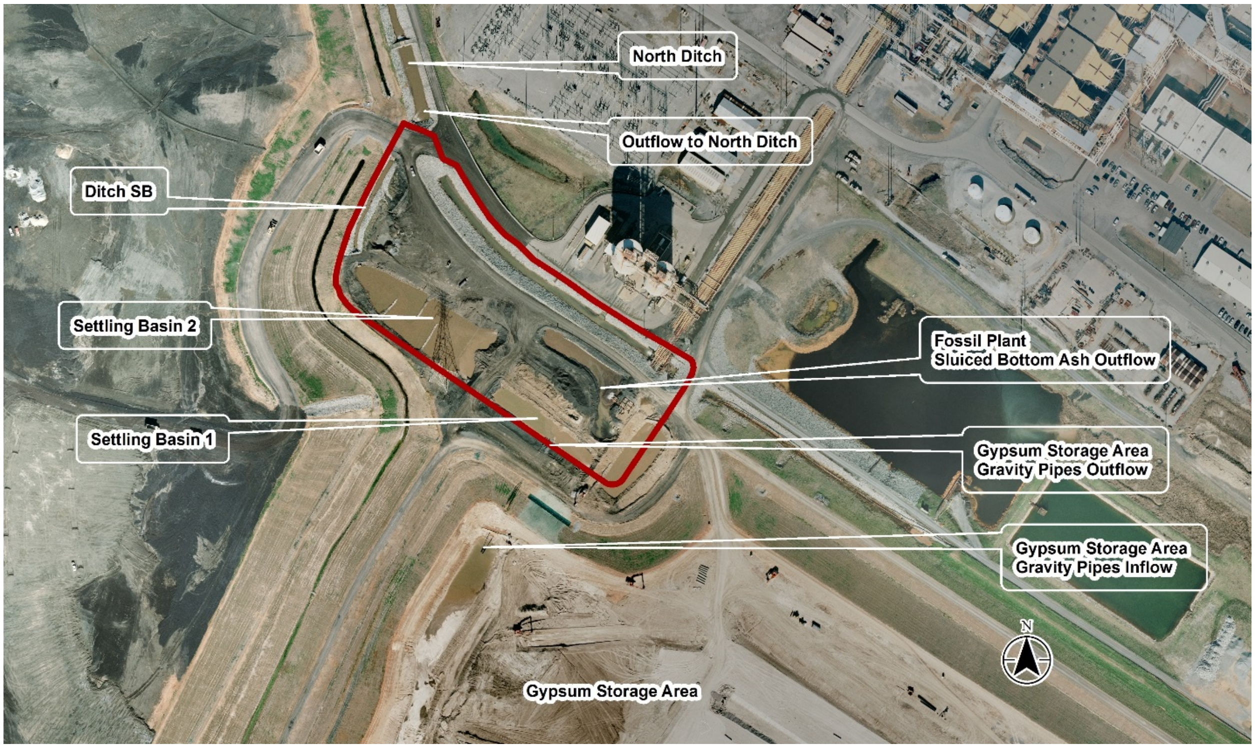


Figure 2 Hydraulic Structures

3.0 METHODS / DESIGN CRITERIA

This Inflow Design Flood Control System Plan has been developed to document how the inflow design flood control system has been designed and constructed to meet the requirements of §257.82. The Bottom Ash Pond was classified as a low hazard structure based on the draft report from Stantec to TVA dated September 30, 2016. This plan has been developed based on that classification and the following EPA Final CCR Rule criteria apply:

1. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood. (Ref. §257.82(a)(1)),
2. The inflow design flood control system must collect and control flow from the CCR unit during and following the peak discharge of the inflow design flood. (Ref. §257.82(a)(2)),
3. The inflow design flood for a low hazard potential CCR surface impoundment is the 100-year flood. (Ref. §257.82(a)(3)(iii)),
4. Discharge from the CCR Unit must be handled in accordance with the surface water requirements under §257.3-3.
5. The owner or operator must prepare an initial inflow design flood control system plan for its existing surface impoundments by October 17, 2016. (Ref. §257.82(c)(3)(i)),
6. The plan must be revised every 5 years, and amendments must be made whenever there is a change in condition(s) that would substantially affect the written plan in effect. (Ref. §257.82)(c)(4) & (2)),
7. This plan will be considered complete upon its placement in the facility's operating record. (Ref. §257.82(c)(1)),
8. The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of §257.82.

Hydrological calculations were performed based on Soil Conservation Service Technical Release 55 (TR-55) methods in U.S. Army Corps of Engineers' Hydrologic Engineering Center-Hydrological Modeling System (HEC-HMS) software to analyze the performance of the impoundments for the 100-year storm. EPA's Final CCR Rule does not specify the storm duration for the inflow design flood; therefore, a 24-hour storm duration was used.

The following sections describe the hydrologic parameter inputs to the HEC-HMS model, including curve number and lag times, in addition to the channel and detention basin hydraulics.

3.1 MODELING ASSUMPTIONS

1. The model represents existing conditions as of January, 2016, plus new conditions created by the "Siphon Improvement Project" that was completed in March, 2016.

2. The aerial imagery (dated September, 2013) shows four interconnected detention basins, however the more recent topographic survey (dated October, 2014) shows two basins and a ditch within the Bottom Ash Pond. The topographic data was used for the modeling and the two basins and ditch were included as storage elements within the model.
3. Because the Bottom Ash Pond consists of a series of interconnected detention basins that discharge to the North Ditch, 100-year water surface elevations needed to be determined for the downstream detention basins and the North Ditch in order to account for tailwater conditions. Therefore, an initial 100-year, 24 hour hydrologic analysis was performed to estimate the peak 100-year water surface elevations within each basin, without assuming any tailwater effects. The peak water surface elevations from this model were then used as the tailwater elevations when computing rating curves for each detention basin.
4. The outlet from the Gypsum Storage Area's 42-inch gravity pipes was assumed to be flowing freely.
5. The Bottom Ash Pond receives a constant plant process flow of 21.7 million gallons per day. The flow was obtained from the Cumberland Fossil Plant Wastewater Flow Schematic, NPDES Permit NO. TN0005789 dated January, 2011.
6. A constant 200 cubic feet per second is discharged from the upstream end of the North Ditch to the confluence of the Bottom Ash Pond ditch and North Ditch. It is assumed that maximum discharge from the upstream end of the North Ditch is 200 cubic feet per second due to the culvert flow restriction. Additional flow in excess of 200 cubic feet per second to the North Ditch upstream is assumed to discharge into the adjacent Coal Yard Pond.
7. Pipes are assumed to be flowing freely and not clogged or leaking.
8. Bottom ash land use cover within the Bottom Ash Pond was treated as water and used a CN of 99.
9. Ditch SB was modeled as a basin, and the storage capacity upstream from culverts was considered in the analyses.

3.2 HYDROLOGY INPUTS

3.2.1 Watershed Parameters

Subwatersheds were delineated in AutoCAD 2015. The watershed delineations were based on topographic data provided by TVA dated October, 2014. The estimated watershed parameters are summarized in Table 1. A figure showing the watershed delineations is included in Appendix B.

Table 1 Watershed Parameters

Watershed	Drainage Area (acers)	Composite Curve Number	Estimated Lag Time (minutes)
GSA3	96.4	91	50.0
GSA15	6.5	99	9.7
GSA16	1.3	87	5.9

3.2.1.1 Curve Number (CN)

The land use cover on the Bottom Ash Pond and contributing watersheds outside the Bottom Ash Pond CCR Unit limits includes water, bottom ash, gypsum, grass, pavement and gravel.

The Bottom Ash Pond ponding water surface used a CN of 99. Bottom ash land use cover within the Bottom Ash Pond was treated as water and used CN of 99.

The Cover Type area within the Gypsum Storage Area for gypsum was judged to be best-represented by "Fallow: Bare soil" per NRCS TR-55, Table 2-2b. Based on the soil conductivity from the "Report of Geotechnical Exploration, Dry Fly Ash Stack and Gypsum Disposal Complex Cumberland Fossil Plant" (Geotechnical Report) developed by Stantec and dated June, 2010, the gypsum land use was classified as HSG C and a CN of 91. The Cover Type for dense grass was judged to be best-represented by "Open Space" per NRCS Table 2-2a, classified as HSG C and used a CN of 74.

The Bottom Ash Pond also contained areas surfaced with gravel and pavement. The gravel surface areas were assumed to be compacted and used a CN 91 per NRCS Table 2-2a. Areas with pavement used a CN of 98 per NRCS Table 2-2a.

A summary of curve number calculations and a map showing the curve numbers for each sub-area is included in Appendix C.

3.2.1.2 Lag Time

The time of concentration for each subwatershed was calculated using the NRCS segmental approach described in TR-55. The longest hydraulic flow path in each subwatershed was delineated using topographic data and aerial imagery data (dated October 2014 and September 2013, respectively). The flowpaths were subdivided into sheet, shallow-concentrated and open-channel flow components. The following methods were used to calculate flow velocities (time of concentration was then found by dividing flow length by velocity) for each flow component:

- Sheet Flow: Sheet flow velocity was computed based on methodology presented in TR-55. This equation calculates time of concentration based on Manning's roughness coefficient for sheet flow, flow length (up to a maximum distance of 100 feet) slope, and the 2-year, 24-hour rainfall depth.
- Shallow Concentrated Flow: Shallow concentrated flow velocity was calculated based on methodology presented in TR-55. This equation calculates average velocity based on the slope and surface of the watercourse.
- Open Channel Flow: Open channel flow velocities were calculated by an iterative process. An initial velocity was assumed and compared to the predicted velocities calculated by HEC-HMS. Successive iterations were calculated until velocities converged.

Lag time calculations are included in Appendix D.

3.2.1.3 Reach Routing

Reach routings of subwatersheds through the ditches were analyzed using the Muskingum-Cunge reach routing method.

3.2.2 Bottom Ash Pond Data

Flow from the Bottom Ash Pond is conveyed to the North Ditch and eventually to the Stilling Pond. As described in Section 2 and 3.1, the Bottom Ash Pond manages flow through interconnecting detention basins (Settling Basin 1 and Settling Basin 2) and a ditch (Ditch SB). Run-off is conveyed from the upstream, Settling Basin 1 to Settling Basin 2 before flowing into the downstream Ditch SB.

The Bottom Ash Pond dike overtopping elevation varies since the Bottom Ash Pond dike slopes downward and in the northwest direction. The Settling Basin 1 overtopping elevation is 402-feet and the lowest adjacent dike elevation is approximately 404-feet. Settling Basin 2 overtopping elevation is 400-feet and the lowest adjacent dike elevation is approximately 403-feet. Ditch SB overtops at an elevation of 399-feet which is also the lowest point in the Bottom Ash Pond.

Elevations and storage capacities of the Settling Basin 1, Settling Basin 2 and Ditch SB are obtained from the existing topographic data (dated October, 2014) provided by TVA.

Bottom Ash Pond data is summarized in Table 2.

Table 2 Bottom Ash Pond Data

Drainage Structure	Storage Capacity (acre-feet)	Downstream Culvert Pipe Size (inches)	Basin Overtopping Elevation (feet)	Crest Length (feet)	Top Width (feet)	Dike Overtopping Elevation (feet)
Settling Basin 1	1.22	30 (4)	402.0	50	35	404.0
Settling Basin 2	5.29	24 (2)	400.0	40	20	403.0
Ditch SB	0.87	54 (2)	399.0	40	56	399.0

*Crest lengths and top widths were conservatively measured to allow for higher water elevations. Minimum dike elevations are approximations based on existing topographic data.

3.2.3 Precipitation Data

The rainfall depth for the 100-year, 24-hour storm is 7.83 inches based on NOAA Atlas 14 at CUF. "Early", "Middle" and "Late" Peak" hyetographs were obtained from HydroCAD for a 24-hour storm duration assuming an SCS Type II shape. The modeled distributions are included in Appendix G.

3.2.4 Stage-Storage Data

Areas computed at 1-foot increments for the Settling Basin 1, Settling Basin 2 and Ditch SB using AutoCAD Civil3D are included as Appendix H. A surface was created to represent the bottom of the impoundments using existing topographic data (dated October, 2014) provided by TVA.

3.2.5 Culvert Pipes Rating Curves

Rating curves for the culvert pipes at the downstream end of Settling Basin 1, Settling Basin 2 and Ditch SB were computed using the HY-8 Culvert Hydraulic Analysis Program developed by the US Department of Transportation Federal Highway Administration (FHWA).

3.2.6 Plant Process Flow

A flow schematic (dated January 2011 and provided by TVA), shows the average daily process flows into the Stilling Pond is approximately 21.7 million gallons per day and was applied to the system watershed at the Bottom Ash Pond.

3.2.7 Starting Water Surface Elevations

The starting water surface/tailwater elevations for the Bottom Ash Pond drainage structures were based on peak water surface elevations during an initial 100-year, 24-hour storm event hydrology analysis. Tailwater elevations were set at the initial analysis peak high water elevations.

3.3 HYDROLOGIC AND HYDRAULIC MODELING

Hydrologic and hydraulic modeling was performed using HEC-HMS 4.0 based on the model inputs summarized in Section 3.2. A model schematic is included in Figure 3. This schematic shows that the Bottom Ash Pond (Settling Basin 1, Settling Basin 2 and Ditch SB) receives flow from Gypsum Storage Area (GSA-3) and discharges into the North Ditch before discharging into the Stilling Pond.

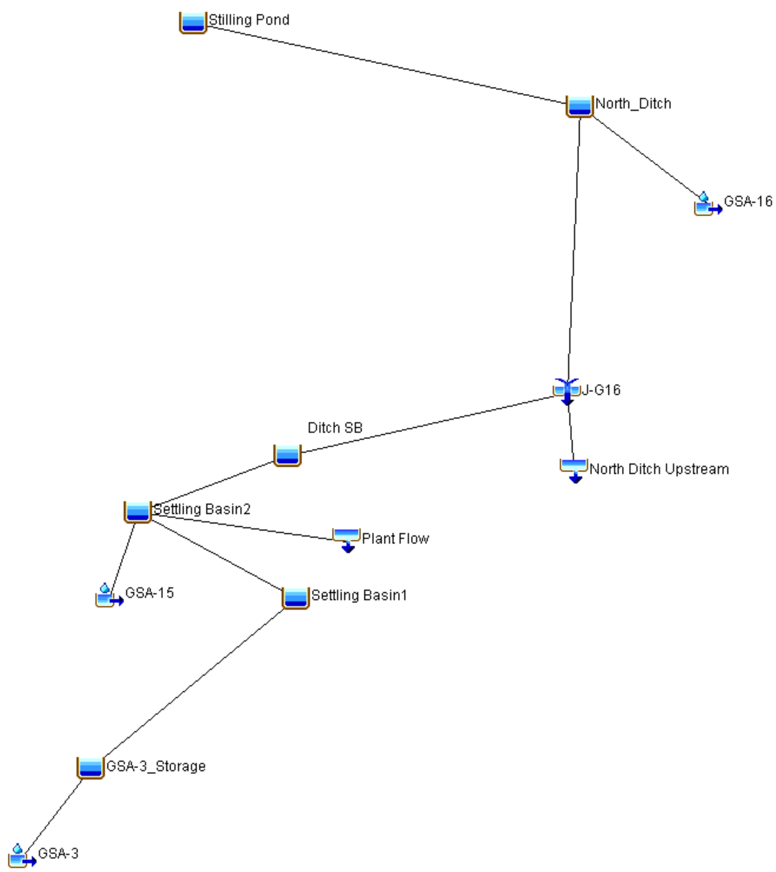


Figure 3 HEC-HMS Model Schematic

4.0 CALCULATION RESULTS

The hydrologic modeling results were used to determine the performance of the Bottom Ash Pond for the 100-year, 24-hour storm for the three precipitation events described in Section 3.2.3.

4.1 CAPACITY AND FREEBOARD RESULTS

The peak pool elevation, inflow and outflow for the Bottom Ash Pond's drainage structures and dike overtopping elevations are summarized in Table 3. The results showed that the Bottom Ash Pond can safely pass the flow from the 100-year 24-hour storm without overtopping.

Table 3 Hydrologic and Hydraulic Modeling Results

Scenario	Storm		Peak Water Surface Elevation (feet)	Peak Inflow (cubic feet per second)	Peak Outflow (cubic feet per second)	Dike Overtopping Elevation (feet)	Freeboard (feet)
1	SCS Type II "Early Peak"	Settling Basin 1	402.2	120.2	120.1	404.0	1.8
		Settling Basin 2	400.7	158.4	151.5	403.0	2.3
		Ditch SB	395.2	151.5	151.5	399.0	3.8
2	SCS Type II "Middle Peak"	Settling Basin 1	402.1	102.1	96.5	404.0	1.9
		Settling Basin 2	400.7	175.4	144.4	403.0	2.3
		Ditch SB	395.1	144.4	140.6	399.0	3.9
3	SCS Type II "Late Peak"	Settling Basin 1	403.0	277.5	277.0	404.0	1
		Settling Basin 2	401.5	314.8	312.5	403.0	1.5
		Ditch SB	397.7	312.5	311.8	399.0	1.3

5.0 CONCLUSIONS

The calculations included in this report demonstrate that the inflow design flood control system adequately manages flow into and from the CCR Unit during and following the peak discharge of the inflow design flood (100-year flood). In addition the CCR Unit discharges through a NPDES permitted outfall, and is therefore handled in accordance with the surface water requirements under §257.3-3. Therefore the Bottom Ash Pond meets the requirements of Section §257.82 of the EPA Final CCR Rule and can safely pass the 100-year, 24-hour storm without overtopping.

6.0 REFERENCES

1. Stantec (2012). "Cumberland Fossil Plant Ash Bottom Ash Pond Spillway Improvements Project, Basis of Design Report." Prepared for Tennessee Valley Authority, March, 2012.

2. Stantec (2010). "Report of Geotechnical Exploration, Dry Fly Ash Stack and Gypsum Disposal Complex Cumberland Fossil Plant" Basis of Design Report." Prepared for Tennessee Valley Authority, June, 2010.

3. "175554020_01_gsxxx_eg01_current.dwg, Topographic data." Provided by Tennessee Valley Authority, October, 2014.

4. Site aerial imagery prepared for Tennessee Valley Authority, September, 2013.

5. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities [RIN-2050-AE81; FRL-9149-4] (EPA Final CCR Rule), April, 2015.

6. United States Department of Agriculture (1986). "Urban Hydrology for Small Watersheds, TR-55."June, 1986.

7. Brater, E.F. and H.W. King (1976), Handbook of Hydraulics, McGraw-Hill, New York.

8. Stantec Consulting Services Inc., "Initial Hazard Potential Classification Assessment – Bottom Ash Pond", September 30, 2016

APPENDIX A
HYDROLOGIC OVERVIEW MAP

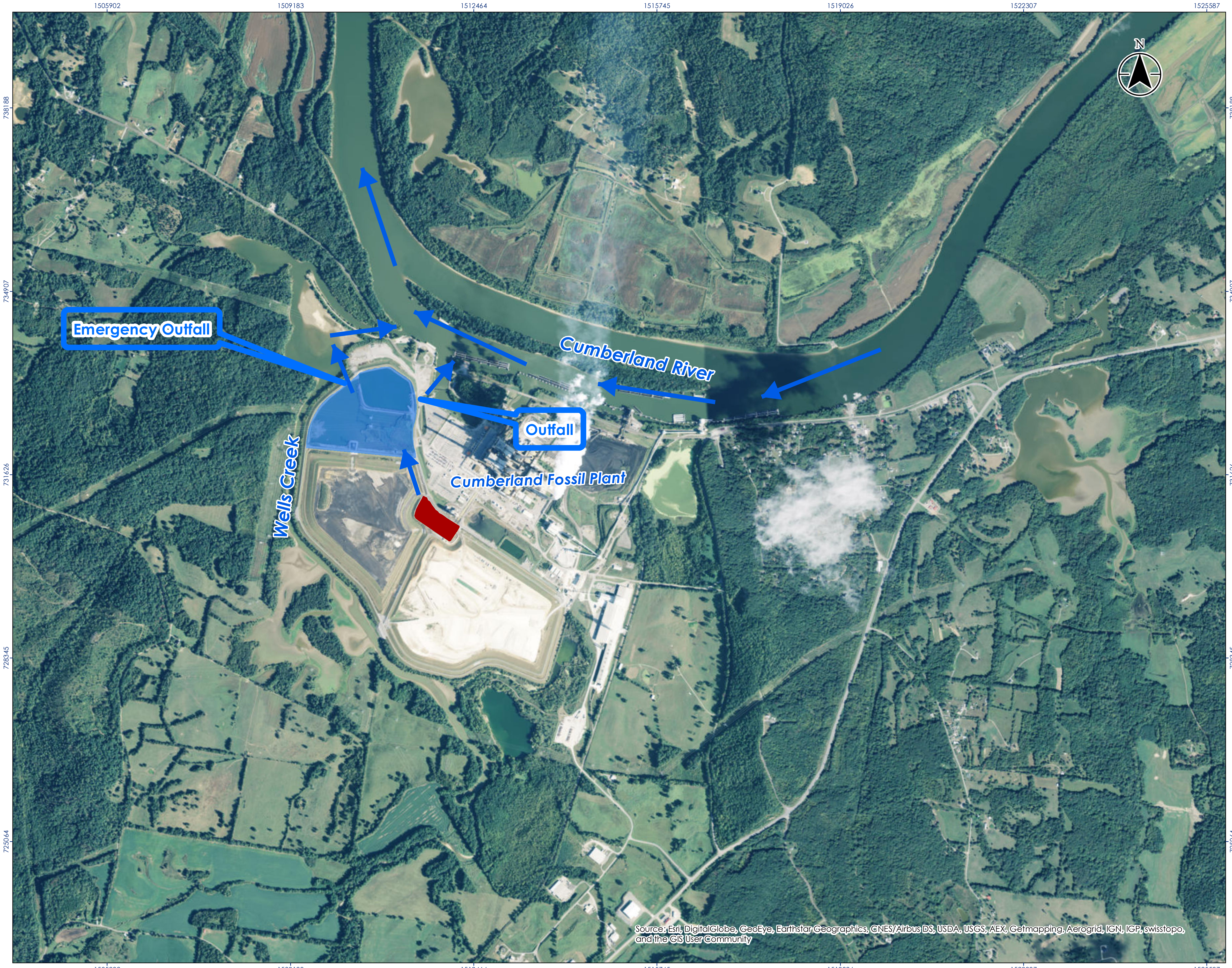


Figure No.
1

Title
HYDROLOGIC OVERVIEW MAP CUF - BOTTOM ASH POND

Client/Project
Tennessee Valley Authority
Inflow Design Flood Control System Plan
175555021

Project Location
815 Cumberland City Rd
Cumberland City,
Stewart County, Tennessee

1755555021
Prepared by MAM on 2015-12-22
Technical Review by JJR on 2015-12-22
Independent Review by MMM on 2015-12-22

0 1,500 3,000 Feet
1:21,345 (At original document size of 11x17)

Legend
- Bottom Ash Pond (Approximate CCR Limits)
- Stilling Pond (including Retention Pond)
- Flow Arrow

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100

Stantec

TVA

\\US1276-F02\shared_projects\175555021\gis\mxd\bottom_ash_pond\figure1.mxd Revised: 2016-09-20 By: jureyes

APPENDIX B
WATERSHED MAP

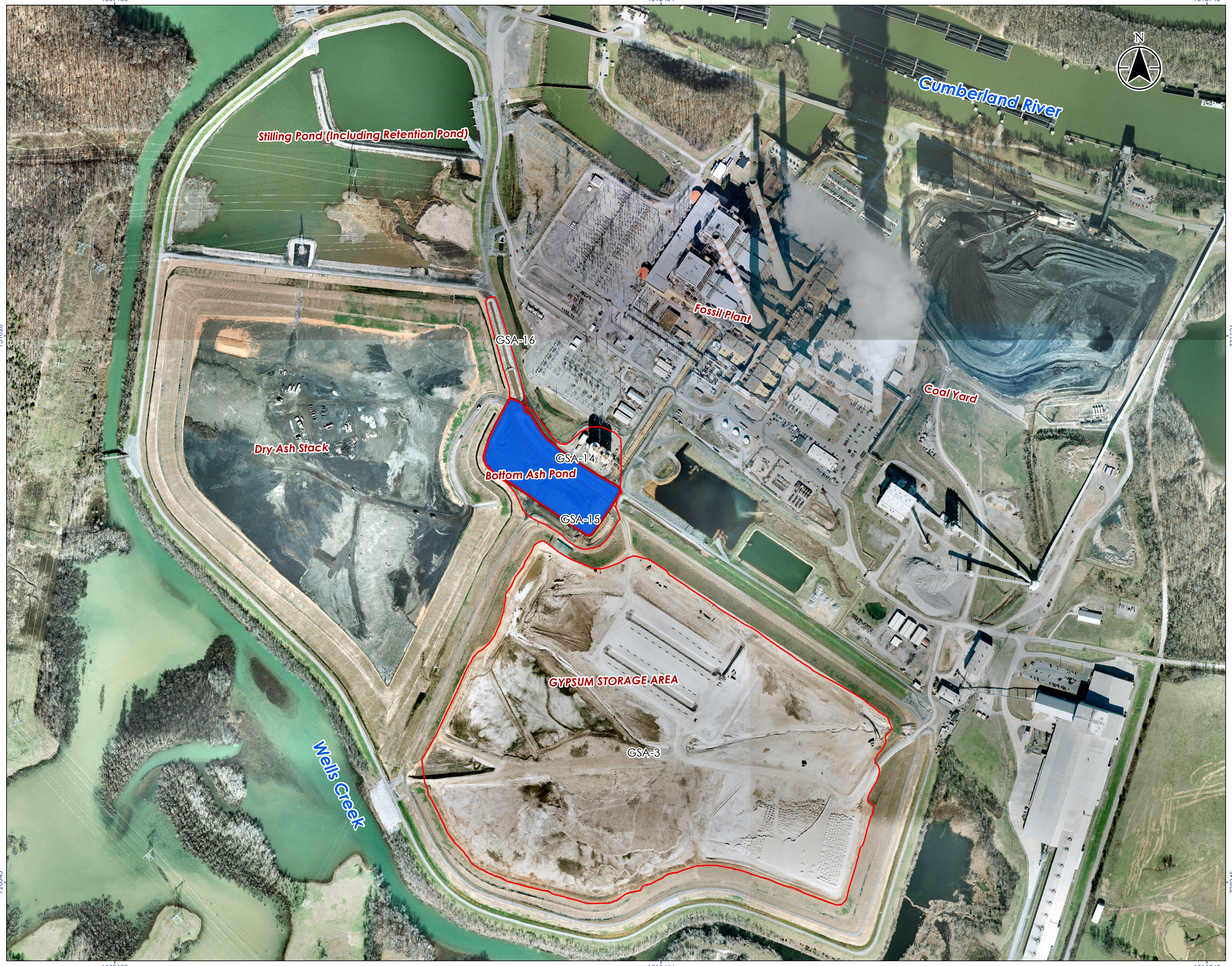


Figure No.
2

Title
WATERSHED MAP
CUF - BOTTOM ASH POND

Client/Project
Tennessee Valley Authority
Inflow Design Flood Control System Plan
175555021

Project Location
815 Cumberland City Rd
Cumberland City,
Stewart County, Tennessee

1755555021
Prepared by MAM on 2015-12-22
Technical Review by JJR on 2015-12-22
Independent Review by MMM on 2015-12-22

0 600 1,200 Feet
1:7,200 (At original document size of 11x17)

Legend

- Watershed (Within Approximate CCR Unit Limits)
- Watershed (Outside Approximate CCR Unit Limits)
- Approximate CCR Unit Limits

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Topographic Survey Data dated October 27, 2014
3. Aerial Imagery dated September 2013

Stantec

TVA

\\US1276-F02\shared_projects\175555021\gis\mxd\bottom_ash_pond\figure2.mxd Revised: 2016-09-20 By: jureyes

APPENDIX C
CURVE NUMBER MAP AND COMPUTATIONS

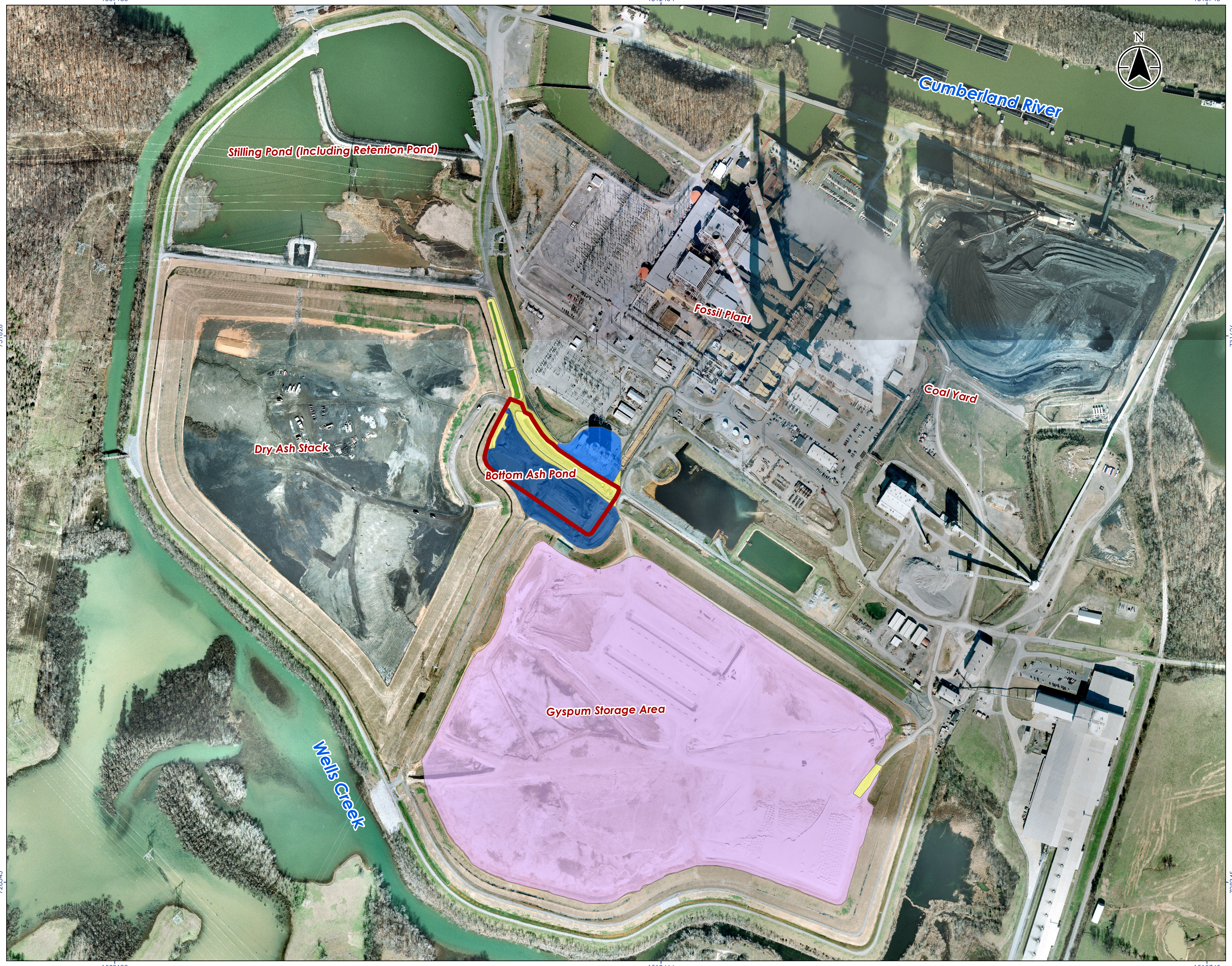


Figure No.
3

Title
CURVE NUMBER MAP
CUF - BOTTOM ASH POND

Client/Project
Tennessee Valley Authority
Inflow Design Flood Control System Plan
175555021

Project Location
815 Cumberland City Rd
Cumberland City,
Stewart County, Tennessee

1755555021
Prepared by MAM on 2015-12-22
Technical Review by JJR on 2015-12-22
Independent Review by MMM on 2015-12-22

0 600 1,200 Feet
1:7,200 (At original document size of 11x17)

Legend
Approximate CCR Unit Limits

CN Boundaries
- Water CN=99
- Gypsum CN=91
- Gravel CN=91
- Pavement CN=98
- Grass CN=74

Notes
1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Topographic Survey Data dated October 27, 2014
3. Aerial Imagery dated September 2013
4. Coal Yard CN=91 and no CN for Fossil Plant - See Report Sec. 3.1

Stantec

TVA

Curve Numbers - H&H
CCR Rule - Cumberland Fossil Plant
12/15/2015

Notes:
1 Areas retrieved from surface developed from TVA survey and aerial photos
2 Below are CN used in calculating weighed CN:

Gypsum	91	Grass	74
Bottom Ash/Fly Ash	91	TBD	0
TBD (old riprap	0	Water	99
Gravel	91	Capped Type 1 (Poor Veg)	89
Pavement	98	Capped Type 2 (Fair Veg)	84

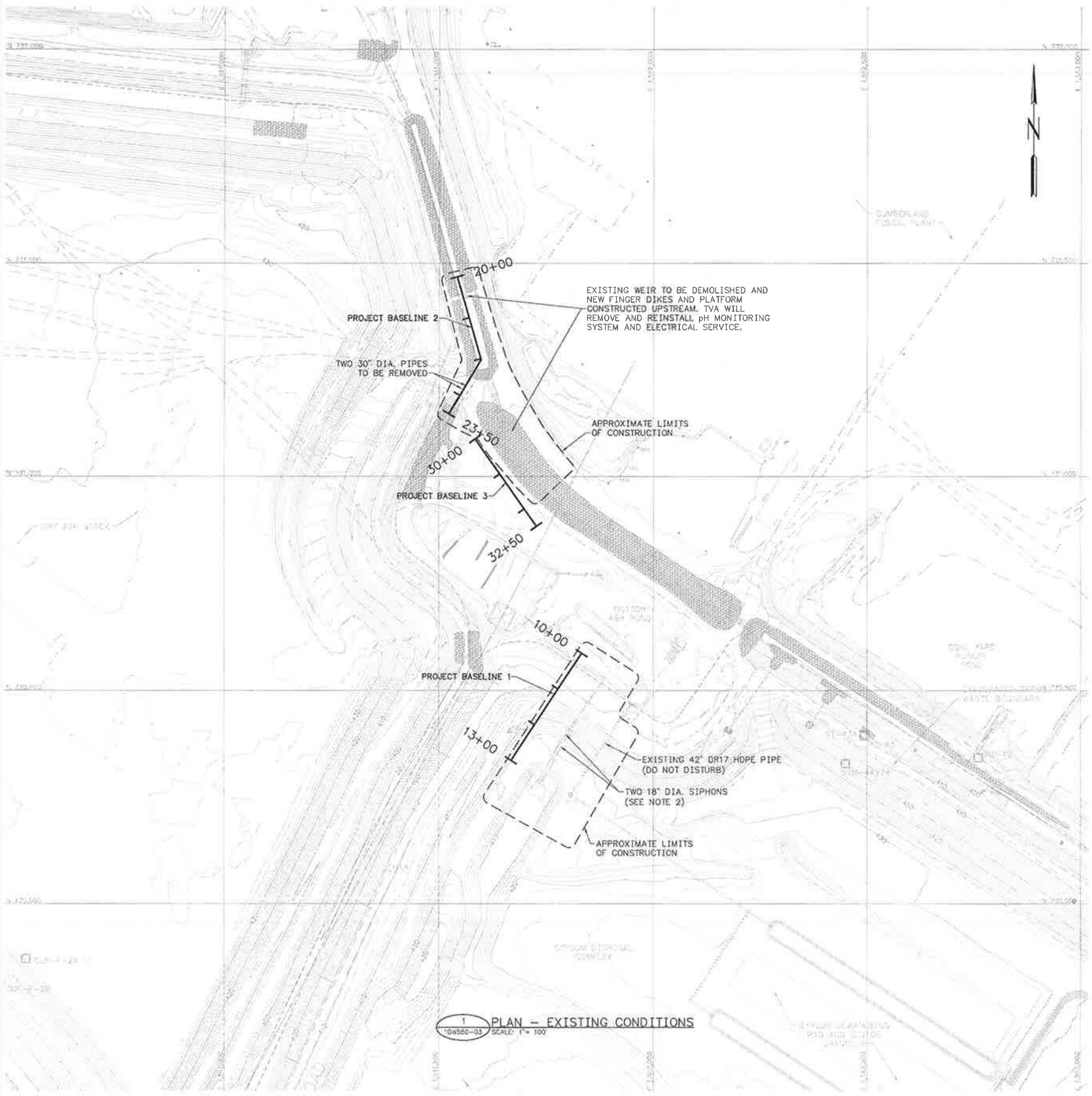
Sub basin	CN (2)	Gypsum (sf)(1)	Bottom Ash/Fly Ash (sf)(1)	TBD (old riprap (sf)(1)	Gravel (sf)(1)	Pavement (sf)(1)	Grass (sf)(1)	TBD (sf)(1)	Water (sf)(1)	Capped Type 1 (Poor Veg) (sf)(1)	Capped Type 2 (Fair Veg) (sf)(1)	Overall Area (sf)(1)
GSA3	91	4,186,602			11,170							4,197,772
GSA15	99								281,425			281,425
GSA16	87				39,975		11,027			4,270		55,273

APPENDIX D
LAG TIME COMPUTATIONS

Lag Time
CUF Bottom Ash Pond IDF Control System Plan

Watershed	Drainage Area (miles squared)	Estimated Lag Time (min)
GSA3	0.1506	50.0
GSA15	0.0101	9.7
GSA16	0.0020	5.9

APPENDIX E
REFERENCE DRAWINGS



1 10W550-03 PLAN – EXISTING CONDITIONS
SCALE: 1"= 100'

GRAPHIC SCALE: 1" = 100'
CONTOUR INTERVAL = 2 FOOT

NOTES:

1. THESE DRAWINGS WERE PREPARED BY STANTEC CONSULTING SERVICES INC. (STANTEC) USING SURVEY INFORMATION–AERIAL AND GROUND SURVEYS PROVIDED BY TVA FROM APRIL AND JUNE 2011, JULY 2012, MARCH 2013 AND OCTOBER 2014.
2. EXISTING 18" DIAMETER SIPHON PIPES TO REMAIN. INLET AND OUTLET OF SIPHONS SHALL BE MOVED TO THE NORTHWEST TO ALLOW FOR CONSTRUCTION OF THE NEW INLET AND OUTLET HEADWALLS, AS NEEDED.

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751–8416 OR (423)751–2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

TABLE OF PROJECT BASELINE COORDINATES

STATION	BASELINE	NORTHING	EASTING
10+00.00	BEGIN BASELINE 1	730,587.21	1,511,833.32
13+00.00	END BASELINE 1	730,336.41	1,511,668.71
20+00.00	BEGIN BASELINE 2	731,468.22	1,511,541.79
22+02.64	P.I. STA. BASELINE 2	731,273.51	1,511,597.93
23+50.00	END BASELINE 2	731,146.79	1,511,522.71
30+00.00	BEGIN BASELINE 3	731,087.87	1,511,583.98
32+50.00	END BASELINE 3	730,883.35	1,511,727.76

LEGEND

- PROJECT BASELINE
- LIMITS OF CONSTRUCTION
- INDEX CONTOUR
- INTERMEDIATE CONTOUR
- UNDER DRAIN
- DISCHARGE PIPE
- ACCESS ROAD
- EXISTING SIPHONS
- EXISTING DRAINAGE PIPES
- DELINEATED PERMIT WASTE BOUNDARY
- RIPRAP
- PIEZOMETER
- SLOPE INCLINOMETER

ISSUED FOR CONSTRUCTION

Stantec

SEE 10W550-01 FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

R 0 | 09/21/15 | CLH | RRP | NAB | NAB | DGS | MST | JCK
ISSUED FOR CONSTRUCTION

SCALE: 1"=100' EXCEPT AS NOTED

YARD
GYPSUM DISPOSAL COMPLEX

SIPHON IMPROVEMENTS PROJECT EXISTING CONDITIONS

DESIGNED BY: C.L. HAY | DRAWN BY: R.R. PETTY | CHECKED BY: N.A. BADER | SUPERVISED BY: N.A. BADER | REVIEWED BY: D.G. STEPHENS | APPROVED BY: M.S. TURNBOW | ISSUED BY: J.C. KAMMEYER

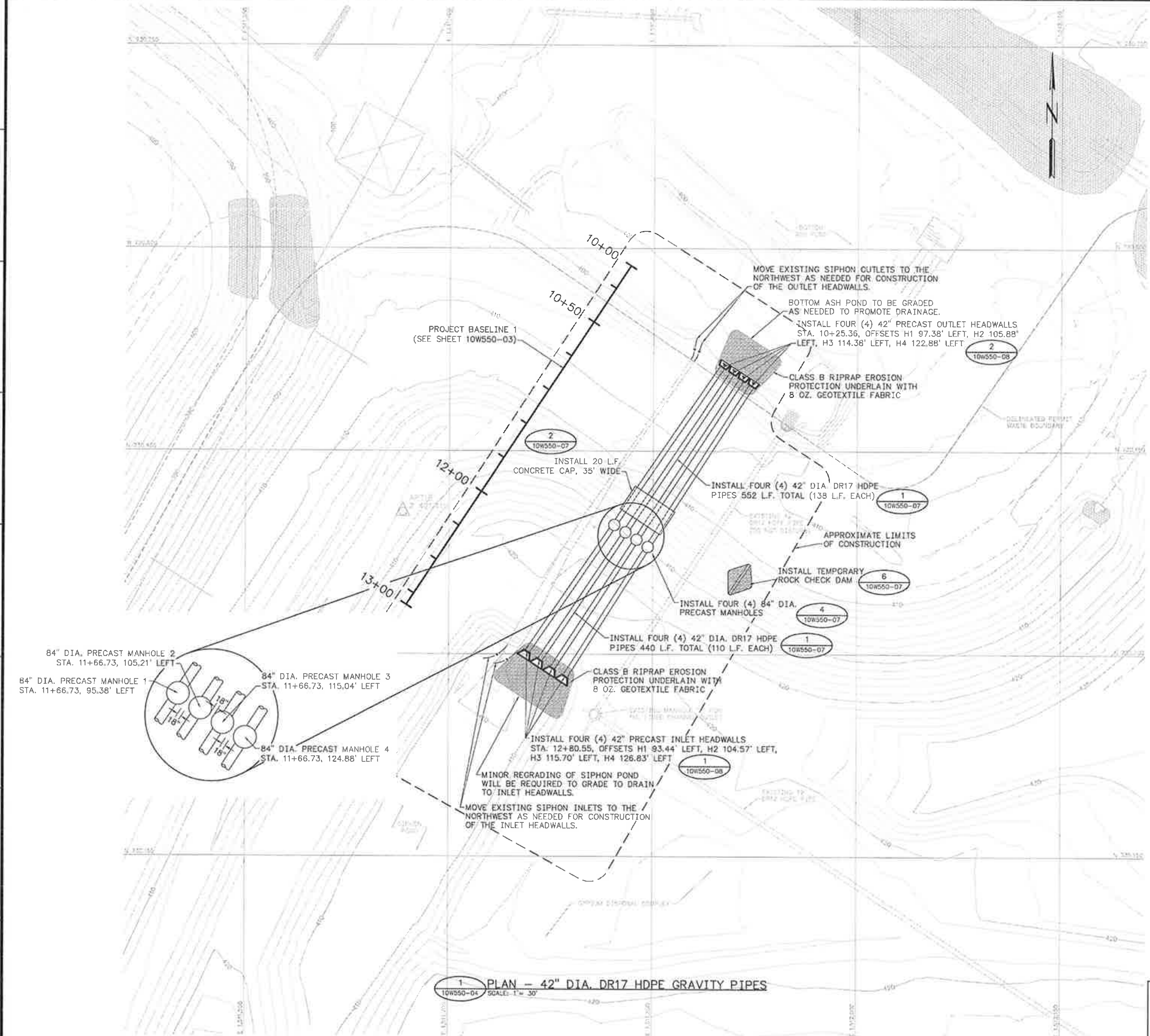
CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | 09/21/15 | 46 | C | 10W550–03 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



1 10W550-04 PLAN – 42" DIA. DR17 HDPE GRAVITY PIPES
SCALE: 1" = 30'

NOTE:

THESE DRAWINGS WERE PREPARED BY STANTEC CONSULTING SERVICES INC. (STANTEC) USING SURVEY INFORMATION–AERIAL AND GROUND SURVEYS PROVIDED BY TVA FROM APRIL AND JUNE 2011, JULY 2012, MARCH 2013 AND OCTOBER 2014.

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

LEGEND

- PROJECT BASELINE
- LIMITS OF CONSTRUCTION
- PROPOSED RIPRAP
- DELINEATED PERMIT WASTE BOUNDARY
- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING SIPHONS
- EXISTING DRAINAGE PIPES
- EXISTING HDPE DISCHARGE PIPE
- EXISTING ACCESS ROAD
- EXISTING RIPRAP

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

GRAPHIC SCALE: 1" = 30'
CONTOUR INTERVAL = 2 FOOT

ISSUED FOR CONSTRUCTION

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R –	–	–	–	–	–	–	–	–	–	–
R 0	09/21/15	CLH	RRP	NAB	NAB	DGS	MST	JCK	608929	–

ISSUED FOR CONSTRUCTION

SCALE: 1"=30' EXCEPT AS NOTED

YARD
GYPSUM DISPOSAL COMPLEX

SIPHON IMPROVEMENTS PROJECT
42" DIAMETER GRAVITY PIPES
PLAN VIEW

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
C.L. HAY	R.R. PETTY	N.A. BADER	N.A. BADER	D.G. STEPHENS	M.S. TURNBOW	J.C. KAMMEYER

CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

SEE 10W550-01 FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

NATHAN A. BADER REGISTERED ENGINEER AGRICULTURE COMMERCE No. 115000 STATE OF TENNESSEE
9/21/15

Stantec
10509 Timberwood Circle Suite 100
Louisville, Kentucky 40223-5301
www.stantec.com

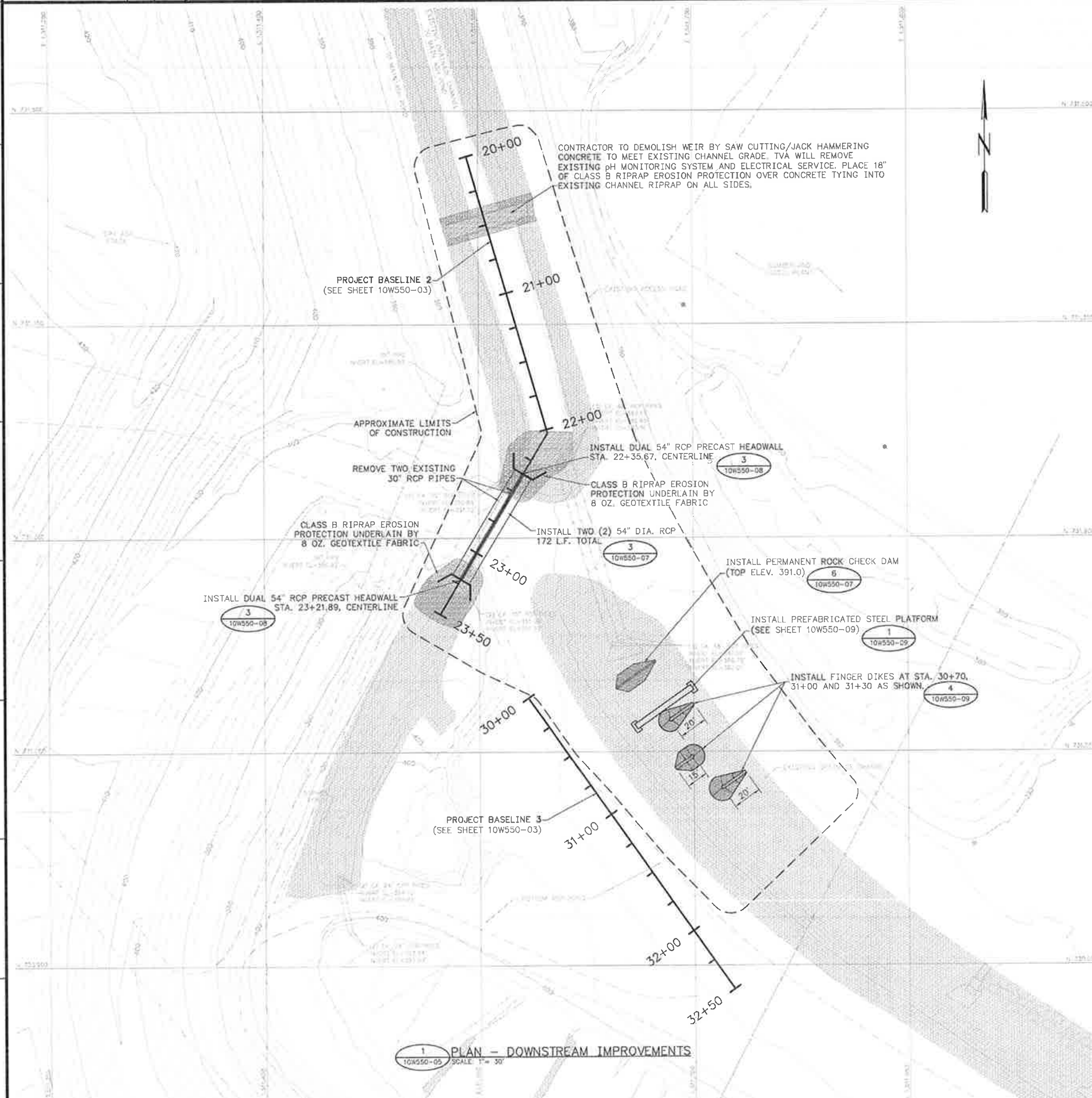
AUTOCAD R 2010 | DATE 09/21/15 | 46 | C | 10W550–04 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

46 C 10W550-04



1 10W550-05 PLAN – DOWNSTREAM IMPROVEMENTS
SCALE: 1"= 30'

SURVEY CONTROL NOTE:

A GLOBAL POSITIONING SYSTEM (GPS) BASE STATION HAS BEEN ESTABLISHED AND TRANSFORMATION PARAMETERS DETERMINED BY TVA USING SELECTED SURVEY CONTROL MONUMENTS. CONTACT WITH TVA SURVEYING DEPARTMENT (423)751-8416 OR (423)751-2571 SHALL BE MADE BEFORE ANY SURVEY OR CONSTRUCTION WORK IS COMMENCED. BASE STATION FREQUENCIES AND TRANSFORMATION PARAMETERS WILL BE PROVIDED TO THE CONTRACTOR FOR USE IN CONSTRUCTION ACTIVITIES AT THE SITE. PREVIOUSLY USED OR ESTABLISHED CONTROL POINTS AND MONUMENTS SHALL NOT BE USED BY THE CONTRACTOR WITHOUT PRIOR APPROVAL BY TVA SURVEYING DEPARTMENT.

NOTE:

1. THESE DRAWINGS WERE PREPARED BY STANTEC CONSULTING SERVICES INC. (STANTEC) USING SURVEY INFORMATION–AERIAL AND GROUND SURVEYS PROVIDED BY TVA FROM APRIL AND JUNE 2011, JULY 2012, MARCH 2013 AND OCTOBER 2014.
2. MINOR REGRADING OF CHANNEL INLET AND OUTLET WILL BE REQUIRED TO CLEAR SEDIMENTATION.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DISASSEMBLING THE EXISTING WEIR AND INSTALLING THE FINGER DIKES AND STEEL PLATFORM UPSTREAM. TVA WILL BE RESPONSIBLE FOR DISASSEMBLING pH MONITORING SYSTEM AND INSTALLING THE SYSTEM UPSTREAM. TVA WILL BE RESPONSIBLE FOR REMOVING THE ELECTRICAL SERVICE TO THE EXISTING SYSTEM AND INSTALLING ELECTRICAL SERVICE AT THE NEW LOCATION. PRIOR TO DISASSEMBLY, THE CONTRACTOR SHALL COORDINATE WITH TVA PERSONNEL RESPONSIBLE FOR THE DISASSEMBLY AND INSTALLATION OF THE NEW ELECTRICAL SERVICE AND pH MONITORING SYSTEM.
4. FINGER DIKE AND PERMANENT ROCK CHECK DAM HEIGHT MAY VARY IN FIELD DUE TO SITE CONDITIONS AT THE TIME OF CONSTRUCTION.

LEGEND

- PROJECT BASELINE
- LIMITS OF CONSTRUCTION
- PROPOSED RIPRAP
- DELINEATED PERMIT WASTE BOUNDARY
- EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- EXISTING SIPHONS
- EXISTING DRAINAGE PIPES
- EXISTING HDPE DISCHARGE PIPE
- EXISTING ACCESS ROAD
- EXISTING RIPRAP

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

GRAPHIC SCALE: 1" = 30'
CONTOUR INTERVAL = 2 FOOT

ISSUED FOR CONSTRUCTION

REV NO	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/21/15	CLH	RRP	NAB	NAB	DGS	MST	JCK	508929	–

ISSUED FOR CONSTRUCTION

SCALE: 1"=30' EXCEPT AS NOTED

YARD
GYPSUM DISPOSAL COMPLEX

SIPHON IMPROVEMENTS PROJECT DOWNSTREAM IMPROVEMENTS PLAN VIEW

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
C.L. HAY	R.R. PETTY	N.A. BADER	N.A. BADER	D.G. STEPHENS	M.S. TURNBOW	J.C. KAMMEYER

CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

Stantec

SEE 10W550-01 FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

NATHAN A. BADER REGISTERED ENGINEER STATE OF TENNESSEE No. 116000
9/21/15

AUTOCAD R 2010 | DATE 09/21/15 | 46 | C | 10W550–05 | R 0

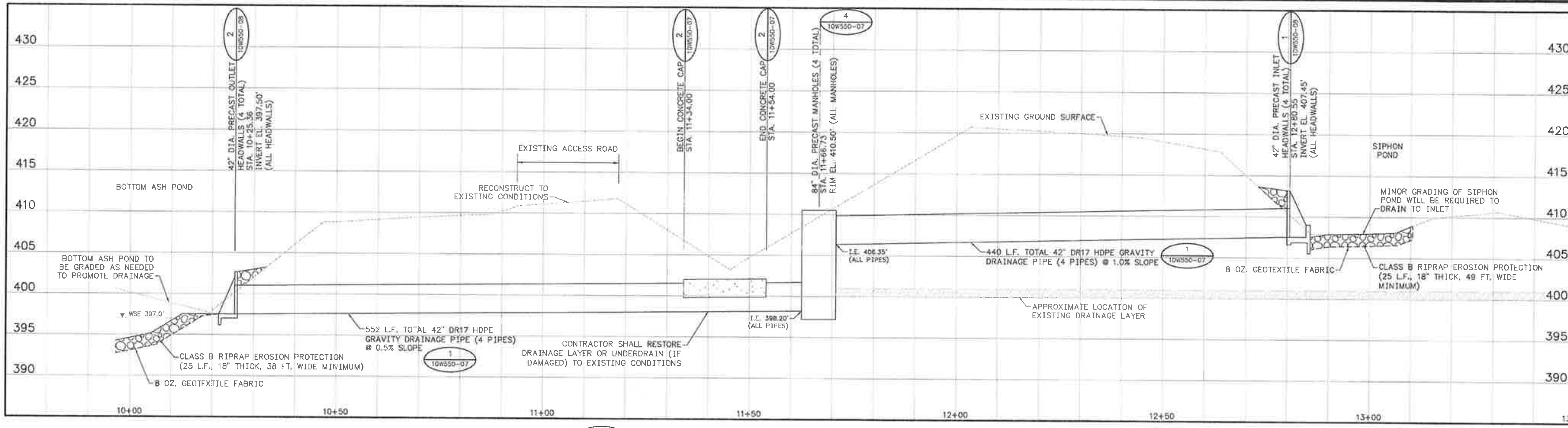
PLOT FACTOR:1
W_TVA

C.A.D. DRAWING DO NOT ALTER MANUALLY

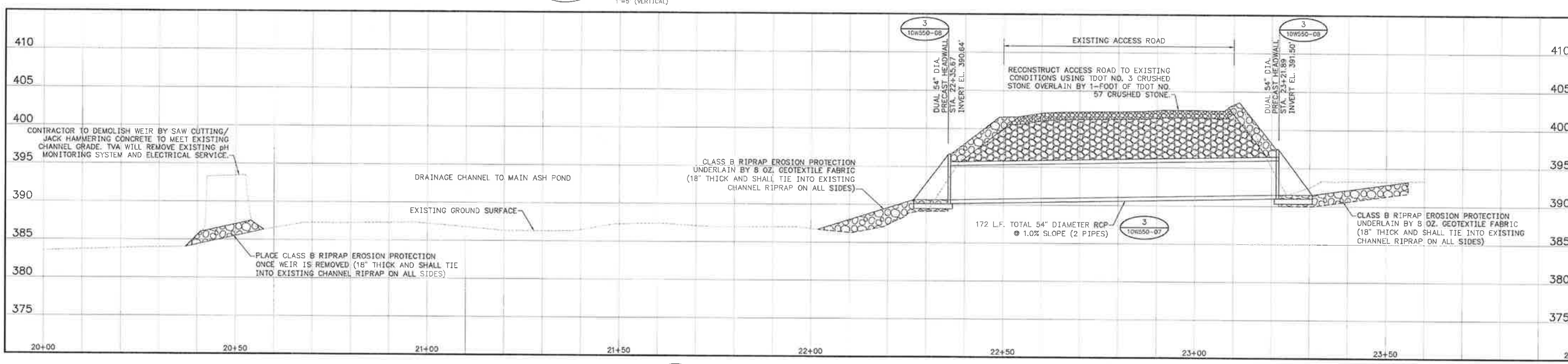
STANTEC | 0
TASK COMPLETED BY: | REV NO.

46 | C | 10W550-05

46	C	10W550-06



1 10W550-06 PROFILE – 42" DIA. DR17 HDPE GRAVITY PIPES
SCALE: 1"=10' (HORIZONTAL) 1"=5' (VERTICAL)



2 10W550-06 PROFILE – DUAL 54" DIA. RCP
SCALE: 1"=10' (HORIZONTAL) 1"=5' (VERTICAL)

SECTION OR DETAIL NO.
DRAWING WHERE SHOWN
REFERENCE KEY

GRAPHIC SCALE: 1" = 10' (HORIZ.) 1" = 5' (VERT.)

ISSUED FOR CONSTRUCTION

Stantec
10509 Timberwood Circle, Suite 100 Louisville, Kentucky 40223-5301 www.stantec.com

SEE 10W550-01 FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

R0 | 09/21/15 | CLH | RRP | NAB | NAB | DGS | MST | JCK | 656929
ISSUED FOR CONSTRUCTION

SCALE: 1"=10' HORIZONTAL 1"=5' VERTICAL EXCEPT AS NOTED

YARD
GYPSUM DISPOSAL COMPLEX
SIPHON IMPROVEMENTS PROJECT
42" DIA. HDPE & 54" DIA. RCP PIPE PROFILES

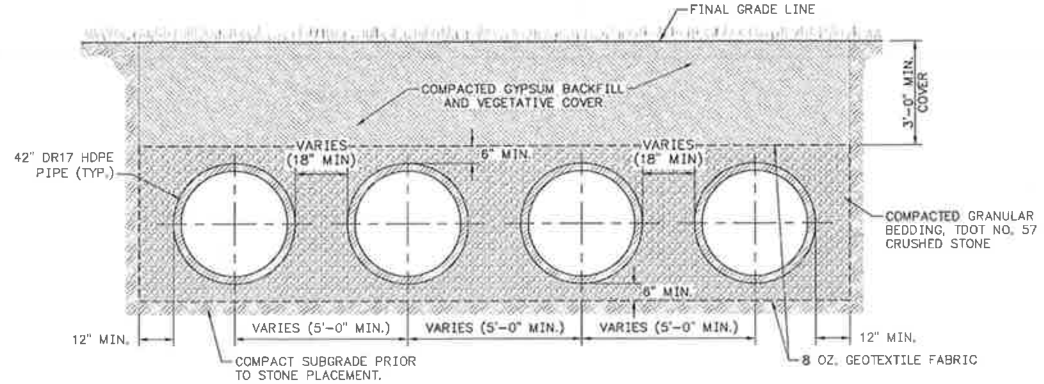
DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
C.L. HAY	R.R. PETTY	N.A. BADER	N.A. BADER	D.G. STEPHENS	M.S. TURNBOW	J.C. KAMMEYER

CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

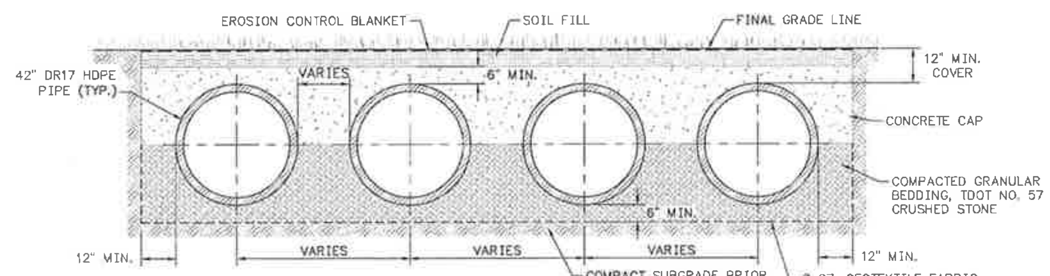
AUTOCAD R 2010 | 09/21/15 | 46 | C | 10W550-06 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA
C.A.D. DRAWING DO NOT ALTER MANUALLY

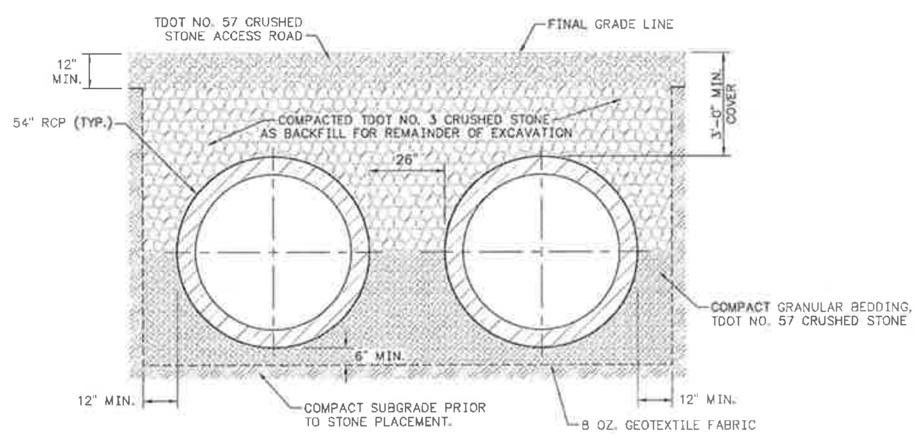


1 / 10W550-07 DETAIL – HDPE PIPE BEDDING/BACKFILL
SCALE: 1/2"=1'-0"

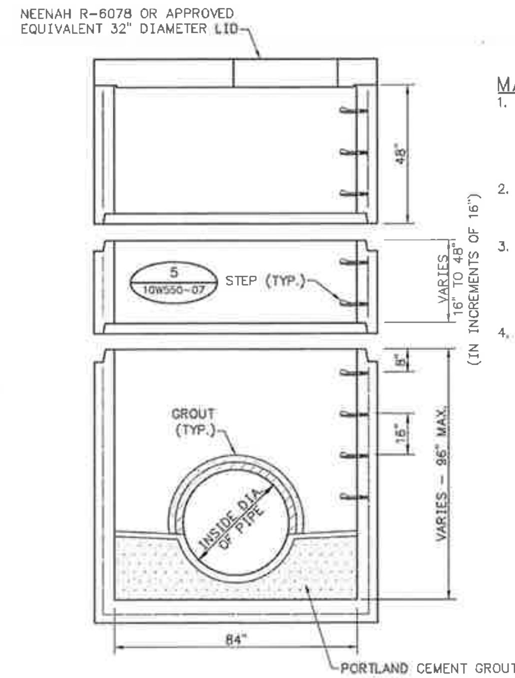


NOTE:
CONCRETE CAP SHALL BE TDOT CLASS A.

2 / 10W550-07 DETAIL – HDPE PIPE CONCRETE CAP
SCALE: 1/2"=1'-0"



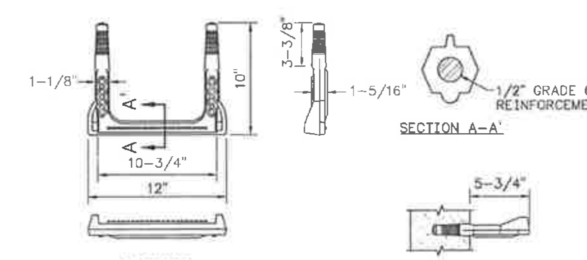
3 / 10W550-07 DETAIL – RCP BEDDING/BACKFILL
SCALE: 1/2"=1'-0"



MANHOLE GENERAL NOTES:

1. CONTRACTOR TO REFER TO TDOT DRAWING D-MH-2 FOR COMPLETE DETAIL INFORMATION ON MANHOLE CONSTRUCTION AND REINFORCING STEEL.
2. PRECAST CONCRETE MANHOLE SHALL MEET THE REQUIREMENTS IN THE SPECIFICATIONS.
3. CUT-OUTS FOR PIPE PENETRATIONS AS SHOWN ON SHEET 10W550-06 SHALL BE CORED OR FORMED IN ORDER TO OBTAIN A SMOOTH EDGED HOLE.
4. PROVIDE A 6-INCH BEDDING LAYER OF COMPACTED TDOT NO. 57 CRUSHED STONE EXTENDING AT LEAST 6-INCHES OUTSIDE OF STRUCTURE FOOTPRINT.

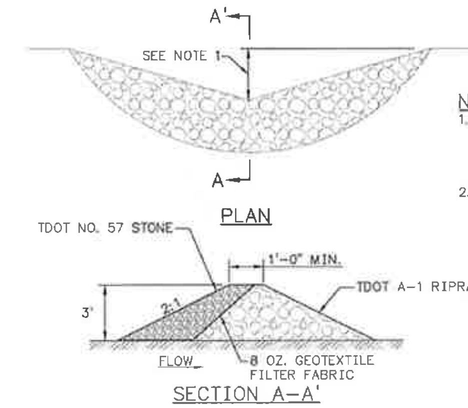
4 / 10W550-07 DETAIL – TDOT STANDARD FLAT TOP 84-INCH I.D. MANHOLE
SCALE: 1/2"=1'-0"



NOTES:

1. THIS STEP TO BE DRIVEN INTO TAPERED HOLES IN PRECAST MANHOLE SECTIONS. DO NOT USE AS A GROUTED-IN STEP.
2. 1000 LB. PULLOUT TEST REPORT REQUIRED ON EACH STEP.

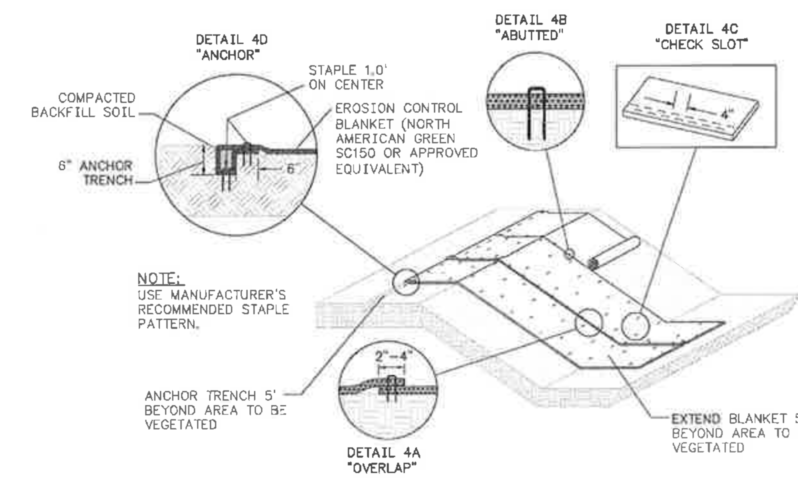
5 / 10W550-07 DETAIL – COPOLYMER POLYPROPYLENE PLASTIC STEP
NOT TO SCALE



NOTES:

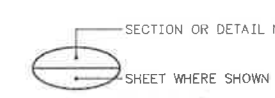
1. MIDDLE OF ROCK CHECK DAM SHALL BE A MINIMUM OF 1'-0" LOWER THAN SIDES SO FLOW WILL NOT BYPASS TRAP OR ERODE BANKS.
2. SPACE ROCK CHECK DAMS AT LOCATIONS AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER.

6 / 10W550-07 DETAIL – ROCK CHECK DAM
NOT TO SCALE



7 / 10W550-07 DETAIL – EROSION CONTROL BLANKET
NOT TO SCALE

ISSUED FOR CONSTRUCTION



Stantec
10509 Timberwood Circle, Suite 100
Louisville, Kentucky 40223-5301
www.stantec.com

NATHAN A. BADER — REGISTERED ENGINEER — STATE OF TENNESSEE
9/21/15

SEE 10W550-01 FOR LIST OF DESIGN, COMPANION, REFERENCE DRAWINGS AND SUPPORTING DESIGN CALCULATIONS NUMBER.

REV NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST
R 0	09/21/15	CLH	RRP	NAB	NAB	DOS	MST	JCK	508929	-
ISSUED FOR CONSTRUCTION										

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
GYPSUM DISPOSAL COMPLEX

SIPHON IMPROVEMENTS PROJECT
DETAILS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
C.L. HAY	R.R. PETTY	N.A. BADER	N.A. BADER	D.O. STEPHENS	M.S. TURNBOW	J.C. KAMMEYER

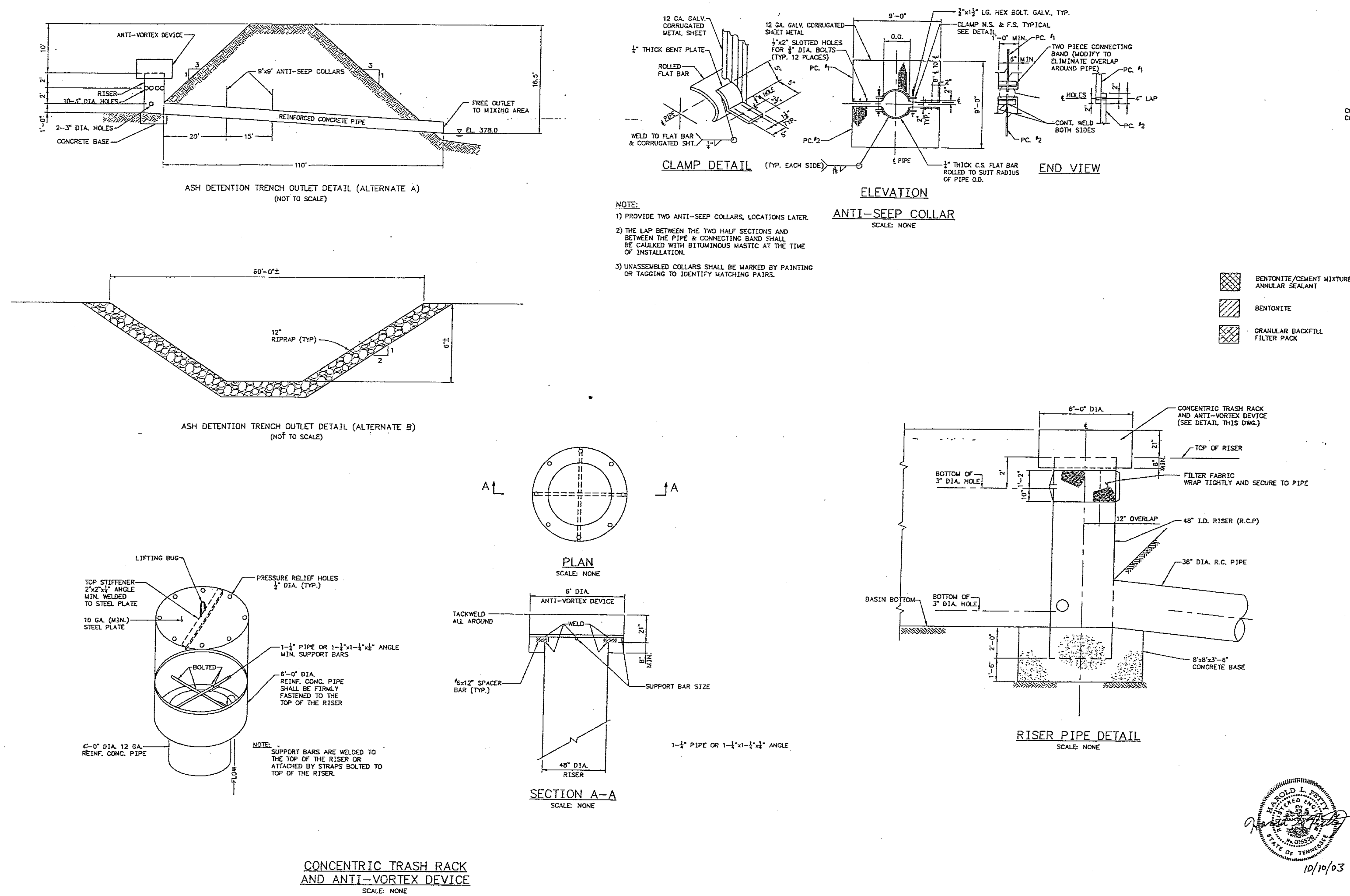
CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2010 | DATE 09/21/15 | 46 | C | 10W550-07 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:1
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



NOTE:
1) PROVIDE TWO ANTI-SEEP COLLARS, LOCATIONS LATER.
2) THE LAP BETWEEN THE TWO HALF SECTIONS AND BETWEEN THE PIPE & CONNECTING BAND SHALL BE CAULKED WITH BITUMINOUS MASTIC AT THE TIME OF INSTALLATION.
3) UNASSEMBLED COLLARS SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PAIRS.

SEE 10W302-1 FOR DRAWING INDEX/COMPANION DRAWINGS LIST

10/10/03

R											
R 0		JLG	MGH	JGA	HLP	REP		JGA			D
INITIAL ISSUE: FOR DCN CUF-03-536											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

SCALE: 3/8"=1'-0" EXCEPT AS NOTED

FGD RETROFIT PROJECT
UNITS 1 & 2

PROPOSED WASTE DISPOSAL FACILITY DETAILS SHEET 1 OF 3

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
J.L. GRAY	M.G. HRANEK	J.G. ALBRIGHT	H.L. PETTY	R.E. PURKEY		J.G. ADAIR

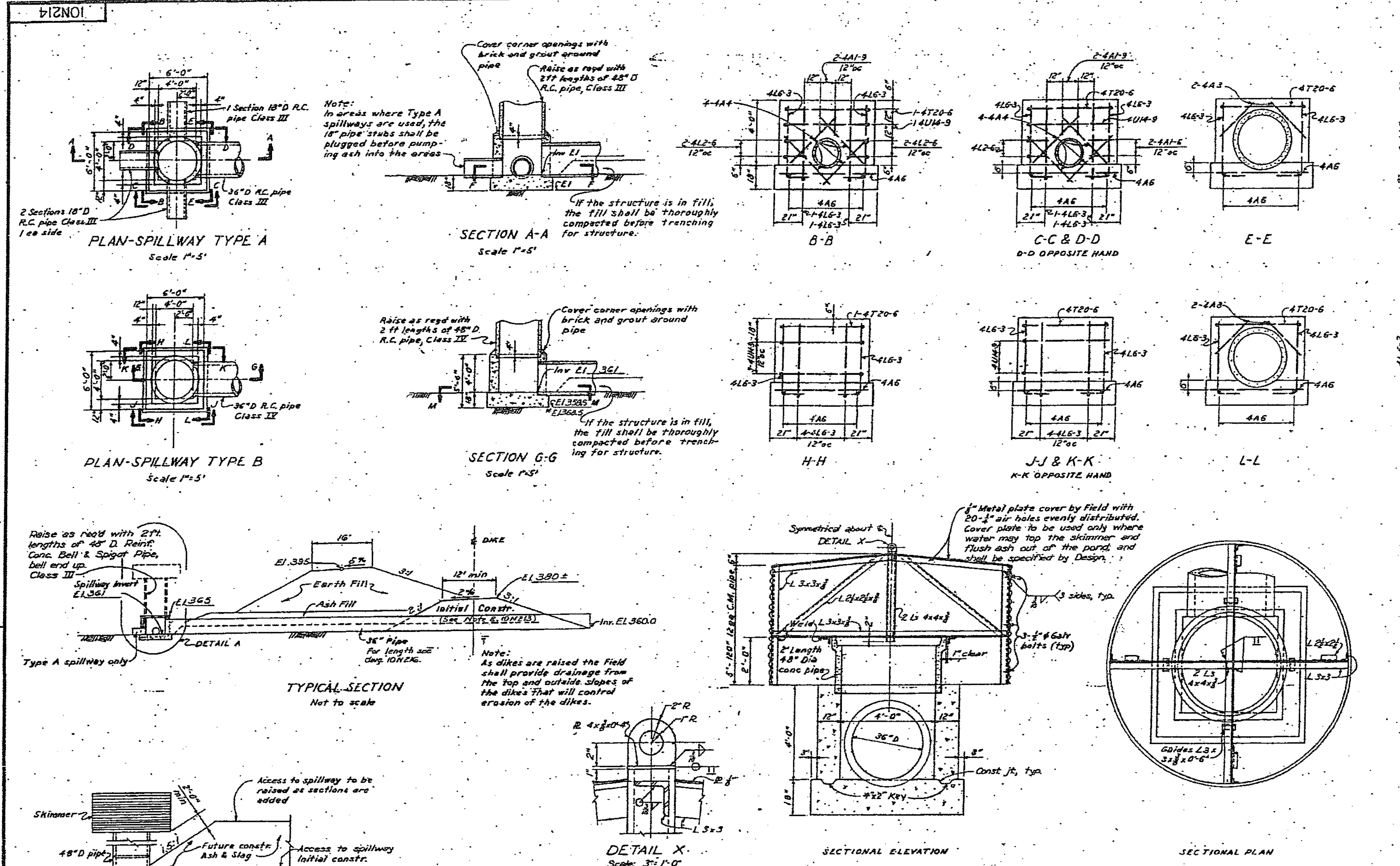
CUMBERLAND FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R14 | DATE | 46 | C | 10W302-24 | R 0

PLOT FACTOR:32
W_TVA

C.A.D. DRAWING
DO NOT ALTER M/

TASK COMPLETED BY: | REV NO.



SKIMMER DETAILS

Scale 1/2"=1'-0"

NOTES:

① SPECIFICATIONS: All work shall be done in accordance with the T-1 Specifications.

② All concrete shall be Class A in accordance with Section 400.

③ Where earth borrow can be obtained economically, for example, from disposal area, it may be used to raise dikes.

④ Vegetation shall be established on all earth slopes, initial and future construction. Seeding specifications to be furnished with drawings for each project. In general, Type G, Mixture E, Section 180 of T-1 Specifications is recommended.

⑤ Location and elevation of the spillways shall be selected so as to maintain the depth of water in the ash pond at an absolute minimum.

⑥ Use Type A spillways for ash areas not scheduled for immediate use.

⑦ A section of 120" corrugated metal pipe is recommended for skimmer device. If structural plates or other metal shapes are used for fabrication at the plant, special care shall be taken to seal all joints by welding or with asphalt paint.

⑧ One 2' section of 48" Dia pipe shall be installed during initial construction.

⑨ As additional sections of 48" pipe are added, grout the joint to form a stable and water-tight connection.

REFERENCE DRAWINGS:

30B519 — REINFORCEMENT BENDING DIAGRAMS

REINFORCEMENT SCHEDULE

TYPE A SPILLWAY

Location	Mark	No. of Units	Per Unit	Total Req'd	Bend Dim. a	b	c
Sect B-B	4T20-6	1		1	5-0	5-0	
	4U14-9	1		1	5-0	5-0	Ex
	4L6-3	1		2	2-0	Ex	
	4L2-6	1		4	1-3	Ex	
	4A4	1		4			
	4A1-9	1		2			
Sect C-C & D-D	4L6-3	2	2	4	2-0	Ex	
	4A4	2	4	8			
	4A1-9	2	2	4			
	4A1-6	2	2	4			
Sect E-E	4A3	1		2			
Sect F-F	4L6-3	1		4	2-0	Ex	
	4A6	1		12			

TYPE B SPILLWAY

Location	Mark	No. of Units	Per Unit	Total Req'd	Bend Dim. a	b	c
Sect H-H	4T20-6	1		1	5-0	5-0	
	4U14-9	1		3	5-0	5-0	Ex
	4L6-3	1		4	2-0	Ex	
Sect J-J & K-K	4L6-3	2	4	8	2-0	Ex	
Sect L-L	4A3	1		2			
Sect M-M	4L6-3	1		4	2-0	Ex	
	4A6	1		12			

BILL OF MATERIAL

ITEM	DESCRIPTION	NO. of Splwys	PER SPLWY	TOTAL REQD
401	Class A Concrete	4	5 cu yd	20 cu yd
418	Reinforcing Steel	4	170 lb	680 lb
602	18"D Reinforced Concrete Pipe-Class III - Type A Only			
602	36"D Reinforced Concrete Pipe-Class IV	4		876 ft
602	48"D Reinforced Concrete Pipe-Class III (Bell & Spigot)	4	2 ft	8 ft
660	120"-12 Gage Corrugated Metal Pipe	4	5 ft	20 ft
	1/2" ø Galvanized Bolt	4	12	48
	1/8" Metal cover (By field - see Skimmer Details)	4	1	4
	2½x2½x3/8 Angle	4	23 ft	92 ft
	3x3x3/8 Angle	4	67 ft	268 ft
	4x4x3/8 Angle	4	8 ft	32 ft

COMPANION DRAWING: 10N212, 213, 216, 218

Scale 1/3"=1'-0"
Except as noted

STANDARD DRAWING

ASH DISPOSAL SPILLWAY

CUMBERLAND STEAM PLANT
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
[signature]	[signature]	[signature]
KNOXVILLE	1-13-69	46 C 4 10N214 R2

RECORD DRAWING AS CONSTRUCTED R2 — Frank Van Meter 9-3-85

10N214

APPENDIX F
RATING CURVES

Gypsum Basin (GSA-3)

Headwater Elevation (ft)	Total Discharge (cfs)
407.45	0
408.53	30
409.01	60
409.42	90
409.79	120
410.12	150
410.42	180
410.72	210
411.03	240
411.36	270
411.48	280

Settling Basin 1

Headwater Elevation (ft)	Total Discharge (cfs)
396.2	0
401.5	0
401.69	50
402.14	100
402.43	150
402.66	200
402.87	250
403.06	300
403.23	350
403.4	400
403.56	450
403.7	500

Settling Basin 2

Headwater Elevation (ft)	Total Discharge (cfs)
393.93	0
396.21	32
398.61	64
400.3	96
400.58	128
400.79	160
400.98	192
401.15	224
401.3	256
401.37	270
401.58	320

Ditch SB

Headwater Elevation (ft)	Total Discharge (cfs)
391.5	0
391.57	0
393.18	35
393.91	70
394.54	105
395.07	140
395.56	175
396.04	210
396.55	245
397.12	280
397.48	300
398.48	350

North Ditch

Headwater Elevation (ft)	Total Discharge (cfs)
383.21	0
385.07	55
385.89	110
386.6	165
387.22	220
387.76	275
388.27	330
388.75	385
389.25	440
389.34	450
390.34	550

APPENDIX G
PRECIPITATION DATA

NOAA Atlas 14, Volume 2, Version 3
Location name: Cumberland City, Tennessee, US*
Latitude: 36.3843°, Longitude: -87.6554°
Elevation: 386 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.393 (0.361-0.431)	0.462 (0.424-0.507)	0.532 (0.488-0.583)	0.588 (0.538-0.642)	0.657 (0.598-0.718)	0.709 (0.644-0.775)	0.761 (0.686-0.832)	0.810 (0.727-0.887)	0.873 (0.776-0.959)	0.923 (0.812-1.01)
10-min	0.629 (0.577-0.689)	0.739 (0.679-0.811)	0.852 (0.781-0.933)	0.940 (0.861-1.03)	1.05 (0.954-1.14)	1.13 (1.02-1.23)	1.21 (1.09-1.32)	1.28 (1.15-1.41)	1.38 (1.23-1.52)	1.45 (1.28-1.60)
15-min	0.786 (0.721-0.861)	0.929 (0.853-1.02)	1.08 (0.988-1.18)	1.19 (1.09-1.30)	1.33 (1.21-1.45)	1.43 (1.30-1.56)	1.53 (1.38-1.67)	1.62 (1.45-1.77)	1.74 (1.54-1.91)	1.82 (1.60-2.01)
30-min	1.08 (0.988-1.18)	1.28 (1.18-1.41)	1.53 (1.40-1.68)	1.72 (1.58-1.88)	1.97 (1.79-2.15)	2.15 (1.96-2.35)	2.34 (2.11-2.56)	2.52 (2.26-2.76)	2.77 (2.46-3.04)	2.95 (2.60-3.25)
60-min	1.34 (1.23-1.47)	1.61 (1.48-1.77)	1.96 (1.80-2.15)	2.24 (2.06-2.45)	2.62 (2.38-2.86)	2.92 (2.65-3.19)	3.22 (2.91-3.53)	3.54 (3.17-3.87)	3.97 (3.53-4.36)	4.31 (3.79-4.74)
2-hr	1.56 (1.43-1.71)	1.87 (1.71-2.04)	2.28 (2.08-2.48)	2.61 (2.39-2.85)	3.07 (2.79-3.34)	3.44 (3.11-3.75)	3.83 (3.44-4.17)	4.23 (3.78-4.62)	4.79 (4.22-5.24)	5.23 (4.58-5.75)
3-hr	1.70 (1.56-1.85)	2.03 (1.87-2.21)	2.47 (2.27-2.69)	2.84 (2.60-3.09)	3.35 (3.05-3.63)	3.76 (3.42-4.09)	4.19 (3.78-4.56)	4.65 (4.17-5.07)	5.29 (4.68-5.78)	5.80 (5.08-6.36)
6-hr	2.09 (1.92-2.28)	2.49 (2.29-2.72)	3.04 (2.79-3.32)	3.50 (3.20-3.81)	4.14 (3.77-4.51)	4.68 (4.23-5.09)	5.25 (4.71-5.72)	5.85 (5.21-6.39)	6.71 (5.89-7.34)	7.40 (6.43-8.13)
12-hr	2.54 (2.33-2.80)	3.04 (2.78-3.34)	3.72 (3.40-4.09)	4.28 (3.90-4.70)	5.08 (4.60-5.57)	5.74 (5.17-6.29)	6.44 (5.74-7.06)	7.18 (6.36-7.89)	8.24 (7.19-9.07)	9.10 (7.87-10.1)
24-hr	3.09 (2.88-3.33)	3.69 (3.44-3.98)	4.53 (4.22-4.89)	5.22 (4.85-5.63)	6.20 (5.73-6.66)	6.99 (6.44-7.52)	7.83 (7.17-8.42)	8.71 (7.92-9.38)	9.95 (8.96-10.7)	11.0 (9.79-11.8)
2-day	3.68 (3.44-3.96)	4.40 (4.12-4.74)	5.41 (5.06-5.83)	6.24 (5.83-6.71)	7.42 (6.89-7.96)	8.38 (7.75-8.99)	9.39 (8.63-10.1)	10.5 (9.55-11.3)	12.0 (10.8-12.9)	13.2 (11.8-14.3)
3-day	3.91 (3.65-4.20)	4.67 (4.37-5.03)	5.74 (5.36-6.17)	6.60 (6.16-7.09)	7.81 (7.26-8.39)	8.80 (8.14-9.45)	9.84 (9.04-10.6)	10.9 (9.98-11.8)	12.4 (11.3-13.4)	13.7 (12.2-14.8)
4-day	4.14 (3.87-4.45)	4.95 (4.63-5.32)	6.06 (5.67-6.52)	6.96 (6.50-7.47)	8.21 (7.63-8.81)	9.23 (8.54-9.91)	10.3 (9.46-11.1)	11.4 (10.4-12.3)	12.9 (11.7-13.9)	14.1 (12.7-15.3)
7-day	4.91 (4.57-5.29)	5.87 (5.47-6.32)	7.20 (6.70-7.76)	8.29 (7.69-8.93)	9.84 (9.09-10.6)	11.1 (10.2-12.0)	12.5 (11.4-13.4)	13.9 (12.6-15.0)	15.9 (14.3-17.2)	17.6 (15.7-19.1)
10-day	5.57 (5.21-5.97)	6.64 (6.21-7.13)	8.07 (7.55-8.66)	9.22 (8.60-9.88)	10.8 (10.0-11.6)	12.1 (11.2-13.0)	13.4 (12.3-14.4)	14.8 (13.5-15.9)	16.7 (15.1-18.0)	18.2 (16.3-19.7)
20-day	7.56 (7.13-8.03)	8.97 (8.45-9.53)	10.7 (10.0-11.3)	11.9 (11.2-12.7)	13.7 (12.8-14.5)	15.0 (14.0-15.9)	16.3 (15.2-17.3)	17.6 (16.3-18.7)	19.3 (17.8-20.6)	20.6 (18.8-22.0)
30-day	9.20 (8.68-9.75)	10.9 (10.3-11.5)	12.8 (12.0-13.5)	14.2 (13.4-15.1)	16.2 (15.2-17.1)	17.6 (16.5-18.7)	19.1 (17.8-20.3)	20.5 (19.1-21.8)	22.4 (20.7-23.9)	23.8 (21.9-25.4)
45-day	11.5 (10.9-12.2)	13.6 (12.9-14.3)	15.8 (14.9-16.6)	17.4 (16.5-18.3)	19.5 (18.4-20.6)	21.1 (19.9-22.2)	22.6 (21.3-23.9)	24.1 (22.6-25.5)	26.0 (24.3-27.5)	27.3 (25.4-29.0)
60-day	13.8 (13.1-14.6)	16.2 (15.4-17.1)	18.7 (17.8-19.7)	20.6 (19.5-21.7)	22.8 (21.6-24.1)	24.5 (23.1-25.9)	26.1 (24.6-27.6)	27.6 (25.9-29.1)	29.4 (27.5-31.1)	30.7 (28.6-32.5)

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

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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

100-year 24-hour SCS Type II "Late Peak" Hydrograph		
Time	Incremental Depth	Cumulative Depth
0	0	0
0.1	0.00783	0.00783
0.2	0.00783	0.01566
0.3	0.00783	0.02349
0.4	0.008613	0.032103
0.5	0.00783	0.039933
0.6	0.008613	0.048546
0.7	0.00783	0.056376
0.8	0.008613	0.064989
0.9	0.008613	0.073602
1	0.008613	0.082215
1.1	0.008613	0.090828
1.2	0.008613	0.099441
1.3	0.008613	0.108054
1.4	0.009396	0.11745
1.5	0.008613	0.126063
1.6	0.009396	0.135459
1.7	0.008613	0.144072
1.8	0.009396	0.153468
1.9	0.009396	0.162864
2	0.009396	0.17226
2.1	0.009396	0.181656
2.2	0.009396	0.191052
2.3	0.010179	0.201231
2.4	0.009396	0.210627
2.5	0.009396	0.220023
2.6	0.010179	0.230202
2.7	0.009396	0.239598
2.8	0.010179	0.249777
2.9	0.010179	0.259956
3	0.010179	0.270135
3.1	0.010179	0.280314
3.2	0.010179	0.290493
3.3	0.010179	0.300672
3.4	0.010962	0.311634
3.5	0.010179	0.321813
3.6	0.010962	0.332775
3.7	0.010962	0.343737
3.8	0.010179	0.353916
3.9	0.010962	0.364878
4	0.010962	0.37584
4.1	0.010962	0.386802
4.2	0.010962	0.397764
4.3	0.011745	0.409509
4.4	0.011745	0.421254
4.5	0.011745	0.432999
4.6	0.011745	0.444744

100-year 24-hour SCS Type II "Middle Peak" Hydrograph		
Time	Incremental Depth	Cumulative Depth
0	0	0
0.1	0.00783	0.00783
0.2	0.00783	0.01566
0.3	0.00783	0.02349
0.4	0.00783	0.03132
0.5	0.00783	0.03915
0.6	0.008613	0.047763
0.7	0.008613	0.056376
0.8	0.008613	0.064989
0.9	0.008613	0.073602
1	0.008613	0.082215
1.1	0.008613	0.090828
1.2	0.008613	0.099441
1.3	0.008613	0.108054
1.4	0.008613	0.116667
1.5	0.008613	0.12528
1.6	0.008613	0.133893
1.7	0.008613	0.142506
1.8	0.008613	0.151119
1.9	0.008613	0.159732
2	0.008613	0.168345
2.1	0.008613	0.176958
2.2	0.008613	0.185571
2.3	0.008613	0.194184
2.4	0.008613	0.202797
2.5	0.008613	0.21141
2.6	0.009396	0.220806
2.7	0.009396	0.230202
2.8	0.009396	0.239598
2.9	0.009396	0.248994
3	0.009396	0.25839
3.1	0.009396	0.267786
3.2	0.009396	0.277182
3.3	0.009396	0.286578
3.4	0.009396	0.295974
3.5	0.009396	0.30537
3.6	0.009396	0.314766
3.7	0.009396	0.324162
3.8	0.009396	0.333558
3.9	0.009396	0.342954
4	0.009396	0.35235
4.1	0.009396	0.361746
4.2	0.009396	0.371142
4.3	0.009396	0.380538
4.4	0.009396	0.389934
4.5	0.009396	0.39933
4.6	0.009396	0.408726

100-year 24-hour SCS Type II "Early Peak" Hydrograph		
Time	Incremental Depth	Cumulative Depth
0	1.073493	1.073493
0.1	0.744633	1.818126
0.2	0.598212	2.416338
0.3	0.372708	2.789046
0.4	0.186354	2.9754
0.5	0.14877	3.12417
0.6	0.129978	3.254148
0.7	0.112752	3.3669
0.8	0.095526	3.462426
0.9	0.090045	3.552471
1	0.082998	3.635469
1.1	0.076734	3.712203
1.2	0.075168	3.787371
1.3	0.067338	3.854709
1.4	0.065772	3.920481
1.5	0.06264	3.983121
1.6	0.060291	4.043412
1.7	0.057942	4.101354
1.8	0.05481	4.156164
1.9	0.053244	4.209408
2	0.051678	4.261086
2.1	0.050112	4.311198
2.2	0.048546	4.359744
2.3	0.04698	4.406724
2.4	0.045414	4.452138
2.5	0.043848	4.495986
2.6	0.042282	4.538268
2.7	0.042282	4.58055
2.8	0.040716	4.621266
2.9	0.039933	4.661199
3	0.037584	4.698783
3.1	0.037584	4.736367
3.2	0.036018	4.772385
3.3	0.036018	4.808403
3.4	0.034452	4.842855
3.5	0.034452	4.877307
3.6	0.032886	4.910193
3.7	0.032103	4.942296
3.8	0.03132	4.973616
3.9	0.030537	5.004153
4	0.029754	5.033907
4.1	0.029754	5.063661
4.2	0.028971	5.092632
4.3	0.028188	5.12082
4.4	0.028188	5.149008
4.5	0.027405	5.176413
4.6	0.026622	5.203035

4.7	0.011745	0.456489
4.8	0.011745	0.468234
4.9	0.012528	0.480762
5	0.012528	0.49329
5.1	0.012528	0.505818
5.2	0.012528	0.518346
5.3	0.013311	0.531657
5.4	0.013311	0.544968
5.5	0.012528	0.557496
5.6	0.014094	0.57159
5.7	0.013311	0.584901
5.8	0.013311	0.598212
5.9	0.014094	0.612306
6	0.014094	0.6264
6.1	0.014094	0.640494
6.2	0.014094	0.654588
6.3	0.014877	0.669465
6.4	0.014877	0.684342
6.5	0.014094	0.698436
6.6	0.01566	0.714096
6.7	0.014877	0.728973
6.8	0.014877	0.74385
6.9	0.01566	0.75951
7	0.01566	0.77517
7.1	0.01566	0.79083
7.2	0.01566	0.80649
7.3	0.016443	0.822933
7.4	0.016443	0.839376
7.5	0.016443	0.855819
7.6	0.016443	0.872262
7.7	0.016443	0.888705
7.8	0.016443	0.905148
7.9	0.017226	0.922374
8	0.017226	0.9396
8.1	0.017226	0.956826
8.2	0.018792	0.975618
8.3	0.018792	0.99441
8.4	0.020358	1.014768
8.5	0.020358	1.035126
8.6	0.021924	1.05705
8.7	0.022707	1.079757
8.8	0.022707	1.102464
8.9	0.02349	1.125954
9	0.025056	1.15101
9.1	0.025056	1.176066
9.2	0.025056	1.201122
9.3	0.025056	1.226178
9.4	0.025056	1.251234
9.5	0.025056	1.27629
9.6	0.025839	1.302129
9.7	0.026622	1.328751
9.8	0.028188	1.356939
9.9	0.029754	1.386693
10	0.030537	1.41723

4.7	0.009396	0.418122
4.8	0.009396	0.427518
4.9	0.009396	0.436914
5	0.009396	0.44631
5.1	0.009396	0.455706
5.2	0.009396	0.465102
5.3	0.009396	0.474498
5.4	0.009396	0.483894
5.5	0.009396	0.49329
5.6	0.010179	0.503469
5.7	0.010179	0.513648
5.8	0.010179	0.523827
5.9	0.010179	0.534006
6	0.010179	0.544185
6.1	0.010179	0.554364
6.2	0.010179	0.564543
6.3	0.010179	0.574722
6.4	0.010179	0.584901
6.5	0.010179	0.59508
6.6	0.010179	0.605259
6.7	0.010179	0.615438
6.8	0.010179	0.625617
6.9	0.010179	0.635796
7	0.010179	0.645975
7.1	0.010179	0.656154
7.2	0.010179	0.666333
7.3	0.010179	0.676512
7.4	0.010179	0.686691
7.5	0.010179	0.69687
7.6	0.010179	0.707049
7.7	0.010179	0.717228
7.8	0.010962	0.72819
7.9	0.010962	0.739152
8	0.010962	0.750114
8.1	0.010962	0.761076
8.2	0.010962	0.772038
8.3	0.010962	0.783
8.4	0.010962	0.793962
8.5	0.010962	0.804924
8.6	0.010962	0.815886
8.7	0.010962	0.826848
8.8	0.010962	0.83781
8.9	0.011745	0.849555
9	0.011745	0.8613
9.1	0.011745	0.873045
9.2	0.011745	0.88479
9.3	0.011745	0.896535
9.4	0.011745	0.90828
9.5	0.011745	0.920025
9.6	0.011745	0.93177
9.7	0.011745	0.943515
9.8	0.011745	0.95526
9.9	0.012528	0.967788
10	0.012528	0.980316

4.7	0.026622	5.229657
4.8	0.026622	5.256279
4.9	0.025839	5.282118
5	0.025839	5.307957
5.1	0.025839	5.333796
5.2	0.025056	5.358852
5.3	0.025056	5.383908
5.4	0.025056	5.408964
5.5	0.025056	5.43402
5.6	0.025056	5.459076
5.7	0.025056	5.484132
5.8	0.025056	5.509188
5.9	0.024273	5.533461
6	0.02349	5.556951
6.1	0.02349	5.580441
6.2	0.02349	5.603931
6.3	0.022707	5.626638
6.4	0.022707	5.649345
6.5	0.022707	5.672052
6.6	0.021924	5.693976
6.7	0.021924	5.7159
6.8	0.021141	5.737041
6.9	0.021141	5.758182
7	0.020358	5.77854
7.1	0.020358	5.798898
7.2	0.020358	5.819256
7.3	0.020358	5.839614
7.4	0.019575	5.859189
7.5	0.018792	5.877981
7.6	0.018792	5.896773
7.7	0.018792	5.915565
7.8	0.018009	5.933574
7.9	0.018009	5.951583
8	0.018009	5.969592
8.1	0.017226	5.986818
8.2	0.017226	6.004044
8.3	0.017226	6.02127
8.4	0.017226	6.038496
8.5	0.017226	6.055722
8.6	0.017226	6.072948
8.7	0.017226	6.090174
8.8	0.016443	6.106617
8.9	0.016443	6.12306
9	0.016443	6.139503
9.1	0.016443	6.155946
9.2	0.016443	6.172389
9.3	0.016443	6.188832
9.4	0.016443	6.205275
9.5	0.016443	6.221718
9.6	0.016443	6.238161
9.7	0.016443	6.254604
9.8	0.01566	6.270264
9.9	0.01566	6.285924
10	0.01566	6.301584

10.1	0.032103	1.449333
10.2	0.034452	1.483785
10.3	0.036018	1.519803
10.4	0.037584	1.557387
10.5	0.039933	1.59732
10.6	0.042282	1.639602
10.7	0.045414	1.685016
10.8	0.048546	1.733562
10.9	0.051678	1.78524
11	0.05481	1.84005
11.1	0.060291	1.900341
11.2	0.067338	1.967679
11.3	0.075168	2.042847
11.4	0.082998	2.125845
11.5	0.090045	2.21589
11.6	0.186354	2.402244
11.7	0.372708	2.774952
11.8	0.598212	3.373164
11.9	1.073493	4.446657
12	0.744633	5.19129
12.1	0.14877	5.34006
12.2	0.129978	5.470038
12.3	0.112752	5.58279
12.4	0.095526	5.678316
12.5	0.076734	5.75505
12.6	0.065772	5.820822
12.7	0.06264	5.883462
12.8	0.057942	5.941404
12.9	0.053244	5.994648
13	0.050112	6.04476
13.1	0.04698	6.09174
13.2	0.043848	6.135588
13.3	0.042282	6.17787
13.4	0.040716	6.218586
13.5	0.037584	6.25617
13.6	0.036018	6.292188
13.7	0.034452	6.32664
13.8	0.032886	6.359526
13.9	0.03132	6.390846
14	0.029754	6.4206
14.1	0.028971	6.449571
14.2	0.028188	6.477759
14.3	0.027405	6.505164
14.4	0.026622	6.531786
14.5	0.026622	6.558408
14.6	0.025839	6.584247
14.7	0.025839	6.610086
14.8	0.025056	6.635142
14.9	0.024273	6.659415
15	0.02349	6.682905
15.1	0.02349	6.706395
15.2	0.022707	6.729102
15.3	0.021924	6.751026
15.4	0.021141	6.772167

10.1	0.012528	0.992844
10.2	0.012528	1.005372
10.3	0.012528	1.0179
10.4	0.012528	1.030428
10.5	0.012528	1.042956
10.6	0.012528	1.055484
10.7	0.012528	1.068012
10.8	0.013311	1.081323
10.9	0.013311	1.094634
11	0.013311	1.107945
11.1	0.013311	1.121256
11.2	0.013311	1.134567
11.3	0.013311	1.147878
11.4	0.013311	1.161189
11.5	0.013311	1.1745
11.6	0.014094	1.188594
11.7	0.014094	1.202688
11.8	0.014094	1.216782
11.9	0.014094	1.230876
12	0.014094	1.24497
12.1	0.014094	1.259064
12.2	0.014094	1.273158
12.3	0.014094	1.287252
12.4	0.014094	1.301346
12.5	0.014094	1.31544
12.6	0.014877	1.330317
12.7	0.014877	1.345194
12.8	0.014877	1.360071
12.9	0.014877	1.374948
13	0.014877	1.389825
13.1	0.014877	1.404702
13.2	0.014877	1.419579
13.3	0.014877	1.434456
13.4	0.01566	1.450116
13.5	0.01566	1.465776
13.6	0.01566	1.481436
13.7	0.01566	1.497096
13.8	0.01566	1.512756
13.9	0.01566	1.528416
14	0.01566	1.544076
14.1	0.01566	1.559736
14.2	0.01566	1.575396
14.3	0.016443	1.591839
14.4	0.016443	1.608282
14.5	0.016443	1.624725
14.6	0.016443	1.641168
14.7	0.016443	1.657611
14.8	0.016443	1.674054
14.9	0.016443	1.690497
15	0.016443	1.70694
15.1	0.016443	1.723383
15.2	0.016443	1.739826
15.3	0.017226	1.757052
15.4	0.017226	1.774278

10.1	0.01566	6.317244
10.2	0.01566	6.332904
10.3	0.01566	6.348564
10.4	0.01566	6.364224
10.5	0.01566	6.379884
10.6	0.01566	6.395544
10.7	0.014877	6.410421
10.8	0.014877	6.425298
10.9	0.014877	6.440175
11	0.014877	6.455052
11.1	0.014877	6.469929
11.2	0.014877	6.484806
11.3	0.014877	6.499683
11.4	0.014877	6.51456
11.5	0.014094	6.528654
11.6	0.014094	6.542748
11.7	0.014094	6.556842
11.8	0.014094	6.570936
11.9	0.014094	6.58503
12	0.014094	6.599124
12.1	0.014094	6.613218
12.2	0.014094	6.627312
12.3	0.014094	6.641406
12.4	0.014094	6.6555
12.5	0.013311	6.668811
12.6	0.013311	6.682122
12.7	0.013311	6.695433
12.8	0.013311	6.708744
12.9	0.013311	6.722055
13	0.013311	6.735366
13.1	0.013311	6.748677
13.2	0.013311	6.761988
13.3	0.012528	6.774516
13.4	0.012528	6.787044
13.5	0.012528	6.799572
13.6	0.012528	6.8121
13.7	0.012528	6.824628
13.8	0.012528	6.837156
13.9	0.012528	6.849684
14	0.012528	6.862212
14.1	0.012528	6.87474
14.2	0.011745	6.886485
14.3	0.011745	6.89823
14.4	0.011745	6.909975
14.5	0.011745	6.92172
14.6	0.011745	6.933465
14.7	0.011745	6.94521
14.8	0.011745	6.956955
14.9	0.011745	6.9687
15	0.011745	6.980445
15.1	0.011745	6.99219
15.2	0.010962	7.003152
15.3	0.010962	7.014114
15.4	0.010962	7.025076

15.5	0.021141	6.793308
15.6	0.020358	6.813666
15.7	0.020358	6.834024
15.8	0.019575	6.853599
15.9	0.018792	6.872391
16	0.018009	6.8904
16.1	0.018009	6.908409
16.2	0.017226	6.925635
16.3	0.018009	6.943644
16.4	0.017226	6.96087
16.5	0.017226	6.978096
16.6	0.017226	6.995322
16.7	0.016443	7.011765
16.8	0.016443	7.028208
16.9	0.016443	7.044651
17	0.016443	7.061094
17.1	0.01566	7.076754
17.2	0.01566	7.092414
17.3	0.01566	7.108074
17.4	0.014877	7.122951
17.5	0.01566	7.138611
17.6	0.014877	7.153488
17.7	0.014877	7.168365
17.8	0.014094	7.182459
17.9	0.014877	7.197336
18	0.014094	7.21143
18.1	0.014094	7.225524
18.2	0.013311	7.238835
18.3	0.014094	7.252929
18.4	0.013311	7.26624
18.5	0.013311	7.279551
18.6	0.012528	7.292079
18.7	0.013311	7.30539
18.8	0.012528	7.317918
18.9	0.012528	7.330446
19	0.011745	7.342191
19.1	0.012528	7.354719
19.2	0.011745	7.366464
19.3	0.011745	7.378209
19.4	0.011745	7.389954
19.5	0.010962	7.400916
19.6	0.010962	7.411878
19.7	0.010962	7.42284
19.8	0.010179	7.433019
19.9	0.010962	7.443981
20	0.010179	7.45416
20.1	0.010179	7.464339
20.2	0.010179	7.474518
20.3	0.010179	7.484697
20.4	0.010179	7.494876
20.5	0.009396	7.504272
20.6	0.010179	7.514451
20.7	0.010179	7.52463
20.8	0.009396	7.534026

15.5	0.017226	1.791504
15.6	0.017226	1.80873
15.7	0.017226	1.825956
15.8	0.017226	1.843182
15.9	0.017226	1.860408
16	0.018009	1.878417
16.1	0.018009	1.896426
16.2	0.018009	1.914435
16.3	0.018792	1.933227
16.4	0.018792	1.952019
16.5	0.018792	1.970811
16.6	0.019575	1.990386
16.7	0.020358	2.010744
16.8	0.020358	2.031102
16.9	0.020358	2.05146
17	0.020358	2.071818
17.1	0.021141	2.092959
17.2	0.021141	2.1141
17.3	0.021924	2.136024
17.4	0.021924	2.157948
17.5	0.022707	2.180655
17.6	0.022707	2.203362
17.7	0.022707	2.226069
17.8	0.02349	2.249559
17.9	0.02349	2.273049
18	0.02349	2.296539
18.1	0.024273	2.320812
18.2	0.025056	2.345868
18.3	0.025056	2.370924
18.4	0.025056	2.39598
18.5	0.025056	2.421036
18.6	0.025056	2.446092
18.7	0.025056	2.471148
18.8	0.025056	2.496204
18.9	0.025839	2.522043
19	0.025839	2.547882
19.1	0.025839	2.573721
19.2	0.026622	2.600343
19.3	0.026622	2.626965
19.4	0.026622	2.653587
19.5	0.027405	2.680992
19.6	0.028188	2.70918
19.7	0.028188	2.737368
19.8	0.028971	2.766339
19.9	0.029754	2.796093
20	0.029754	2.825847
20.1	0.030537	2.856384
20.2	0.03132	2.887704
20.3	0.032103	2.919807
20.4	0.032886	2.952693
20.5	0.034452	2.987145
20.6	0.034452	3.021597
20.7	0.036018	3.057615
20.8	0.036018	3.093633

15.5	0.010962	7.036038
15.6	0.010962	7.047
15.7	0.010962	7.057962
15.8	0.010962	7.068924
15.9	0.010962	7.079886
16	0.010962	7.090848
16.1	0.010962	7.10181
16.2	0.010962	7.112772
16.3	0.010179	7.122951
16.4	0.010179	7.13313
16.5	0.010179	7.143309
16.6	0.010179	7.153488
16.7	0.010179	7.163667
16.8	0.010179	7.173846
16.9	0.010179	7.184025
17	0.010179	7.194204
17.1	0.010179	7.204383
17.2	0.010179	7.214562
17.3	0.010179	7.224741
17.4	0.010179	7.23492
17.5	0.010179	7.245099
17.6	0.010179	7.255278
17.7	0.010179	7.265457
17.8	0.010179	7.275636
17.9	0.010179	7.285815
18	0.010179	7.295994
18.1	0.010179	7.306173
18.2	0.010179	7.316352
18.3	0.010179	7.326531
18.4	0.010179	7.33671
18.5	0.009396	7.346106
18.6	0.009396	7.355502
18.7	0.009396	7.364898
18.8	0.009396	7.374294
18.9	0.009396	7.38369
19	0.009396	7.393086
19.1	0.009396	7.402482
19.2	0.009396	7.411878
19.3	0.009396	7.421274
19.4	0.009396	7.43067
19.5	0.009396	7.440066
19.6	0.009396	7.449462
19.7	0.009396	7.458858
19.8	0.009396	7.468254
19.9	0.009396	7.47765
20	0.009396	7.487046
20.1	0.009396	7.496442
20.2	0.009396	7.505838
20.3	0.009396	7.515234
20.4	0.009396	7.52463
20.5	0.009396	7.534026
20.6	0.009396	7.543422
20.7	0.009396	7.552818
20.8	0.009396	7.562214

20.9	0.010179	7.544205
21	0.009396	7.553601
21.1	0.010179	7.56378
21.2	0.009396	7.573176
21.3	0.010179	7.583355
21.4	0.009396	7.592751
21.5	0.009396	7.602147
21.6	0.010179	7.612326
21.7	0.009396	7.621722
21.8	0.009396	7.631118
21.9	0.009396	7.640514
22	0.009396	7.64991
22.1	0.009396	7.659306
22.2	0.009396	7.668702
22.3	0.009396	7.678098
22.4	0.009396	7.687494
22.5	0.008613	7.696107
22.6	0.009396	7.705503
22.7	0.009396	7.714899
22.8	0.008613	7.723512
22.9	0.009396	7.732908
23	0.008613	7.741521
23.1	0.009396	7.750917
23.2	0.008613	7.75953
23.3	0.009396	7.768926
23.4	0.008613	7.777539
23.5	0.008613	7.786152
23.6	0.009396	7.795548
23.7	0.008613	7.804161
23.8	0.008613	7.812774
23.9	0.008613	7.821387
24	0.008613	7.83

20.9	0.037584	3.131217
21	0.037584	3.168801
21.1	0.039933	3.208734
21.2	0.040716	3.24945
21.3	0.042282	3.291732
21.4	0.042282	3.334014
21.5	0.043848	3.377862
21.6	0.045414	3.423276
21.7	0.04698	3.470256
21.8	0.048546	3.518802
21.9	0.050112	3.568914
22	0.051678	3.620592
22.1	0.053244	3.673836
22.2	0.05481	3.728646
22.3	0.057942	3.786588
22.4	0.060291	3.846879
22.5	0.06264	3.909519
22.6	0.065772	3.975291
22.7	0.067338	4.042629
22.8	0.075168	4.117797
22.9	0.076734	4.194531
23	0.082998	4.277529
23.1	0.090045	4.367574
23.2	0.095526	4.4631
23.3	0.112752	4.575852
23.4	0.129978	4.70583
23.5	0.14877	4.8546
23.6	0.186354	5.040954
23.7	0.372708	5.413662
23.8	0.598212	6.011874
23.9	0.744633	6.756507
24	1.073493	7.83

20.9	0.009396	7.57161
21	0.009396	7.581006
21.1	0.009396	7.590402
21.2	0.009396	7.599798
21.3	0.009396	7.609194
21.4	0.009396	7.61859
21.5	0.008613	7.627203
21.6	0.008613	7.635816
21.7	0.008613	7.644429
21.8	0.008613	7.653042
21.9	0.008613	7.661655
22	0.008613	7.670268
22.1	0.008613	7.678881
22.2	0.008613	7.687494
22.3	0.008613	7.696107
22.4	0.008613	7.70472
22.5	0.008613	7.713333
22.6	0.008613	7.721946
22.7	0.008613	7.730559
22.8	0.008613	7.739172
22.9	0.008613	7.747785
23	0.008613	7.756398
23.1	0.008613	7.765011
23.2	0.008613	7.773624
23.3	0.008613	7.782237
23.4	0.008613	7.79085
23.5	0.00783	7.79868
23.6	0.00783	7.80651
23.7	0.00783	7.81434
23.8	0.00783	7.82217
23.9	0.00783	7.83
24	0	7.83

APPENDIX H
STAGE-STORAGE DATA

GSA-3 Storage (Top of Gypsum Storage Area)

Item No.	Basin Elevation (ft) (1)	Height (ft)	Surface Area (sf) (1)	Surface Area (ac)	Storage per Elevation Interval (ac-ft) (2)	Cumulative Storage (ac-ft)	Item No.
1	407.45		467	0.011	0.00	0.00	1
2	408	0.6	1,229	0.028	0.01	0.01	2
3	409	1.6	15,841	0.364	0.20	0.21	3
4	410	2.6	22,991	0.528	0.45	0.65	4
5	411	3.6	27,304	0.627	0.58	1.23	5
6	412	4.6	34,042	0.781	0.70	1.93	6
7	413	5.6	164,476	3.776	2.28	4.21	7
8	414	6.6	257,590	5.913	4.84	9.06	8

Settling Basin 1

Item No.	Basin Elevation (ft) (1)	Height (ft)	Surface Area (sf) (1)	Surface Area (ac)	Storage per Elevation Interval (ac-ft) (2)	Cumulative Storage (ac-ft)	Item No.
1	396.2		-	0.000	0.00	0.00	1
2	397	0.8	228	0.005	0.00	0.00	2
3	398	1.8	1,493	0.034	0.02	0.02	3
4	399	2.8	6,266	0.144	0.09	0.11	4
5	400	3.8	9,755	0.224	0.18	0.29	5
6	401	4.8	13,325	0.306	0.26	0.56	6
7	402	5.8	19,199	0.441	0.37	0.93	7
8	403	6.8	23,690	0.544	0.49	1.43	8
9	404	7.8	54,350	1.248	0.90	2.32	9

Settling Basin 2

Item No.	Basin Elevation (ft) (1)	Height (ft)	Surface Area (sf) (1)	Surface Area (ac)	Storage per Elevation Interval (ac-ft) (2)	Cumulative Storage (ac-ft)	Item No.
1	393.93		-	0.000	0.00	0.00	1
2	394	0.1	4	0.0001	0.00	0.00	2
3	395	1.1	182	0.004	0.00	0.00	3
4	396	2.1	14,471	0.332	0.17	0.17	4
5	397	3.1	33,462	0.768	0.55	0.72	5
6	398	4.1	39,682	0.911	0.84	1.56	6
7	399	5.1	43,378	0.996	0.95	2.51	7
8	400	6.1	47,239	1.084	1.04	3.55	8
9	402	8.1	62,710	1.440	2.52	6.08	9
10	403	9.1	74,944	1.720	1.58	7.66	10

Ditch SB

Item No.	Basin Elevation (ft) (1)	Height (ft)	Surface Area (sf) (1)	Surface Area (ac)	Storage per Elevation Interval (ac-ft) (2)	Cumulative Storage (ac-ft)	Item No.
1	391.5		-	0.00	0.00	0.00	1
2	392		31	0.001	0.00	0.00	2
3	393	0.0	101	0.002	0.00	0.00	3
4	394	1.0	1,922	0.044	0.02	0.02	4
5	395	2.0	3,058	0.070	0.06	0.08	5
6	396	3.0	4,027	0.092	0.08	0.16	6
7	397	4.0	5,171	0.119	0.11	0.27	7
8	398	5.0	7,215	0.166	0.14	0.41	8
9	399	6.0	9,174	0.211	0.19	0.60	9

North Ditch

Item No.	Basin Elevation (ft) (1)	Height (ft)	Surface Area (sf) (1)	Surface Area (ac)	Storage per Elevation Interval (ac-ft) (2)	Cumulative Storage (ac-ft)	Item No.
1	383.21		1.00	0.000	0.00	0.00	
2	384	0.8	4,299	0.099	0.04	0.04	2
3	385	1.8	5,369	0.123	0.11	0.15	3
4	386	2.8	7,109	0.163	0.14	0.29	4
5	387	3.8	10,926	0.251	0.21	0.50	5
6	388	4.8	15,441	0.354	0.30	0.80	6
7	389	5.8	18,044	0.414	0.38	1.19	7
8	390	6.8	20,873	0.479	0.45	1.63	8
9	391	7.8	23,795	0.546	0.51	2.15	9