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MEMORANDUM

16 October 2016
File No. 128064-003

SUBJECT: Inflow Design Flood Control System Plan
Pond 001 - Cell 003
Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
Clifton Hill, Missouri

Haley & Aldrich, Inc. (Haley & Aldrich) has developed this Inflow Design Flood (IDF) Control System Plan (Plan) on behalf of Associated Electric Cooperative, Inc. (AECI) for the existing coal combustion residuals (CCR) surface impoundment referred to as Pond 1 - Cell 003 (Cell 003) at the Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri. This has been completed based on requirements of the Environmental Protection Agency (EPA) 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities" (CCR Rule), specifically section §257.82. The Cell 003 existing conditions and supporting documentation has been reviewed and associated stormwater modeling and analysis performed to satisfy the Inflow Design Flood Control System Plan requirements of CCR Rule section §257.82 as described below.

§257.82(a): The owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system as specified in paragraphs (a)(1) and (a)(2) of this section.

§257.82(a)(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 specified in paragraph (a)(3) of this section.

Cell 003 is used for wet storage of fly ash, bottom ash, boiler slag and sediments from the coal pile runoff. Cell 003 receives decant water and suspended CCR from Cell 001 via an earthen bypass channel which flows from Cell 001 and around inactive/closed Cell 002, discharging into the northwest corner of Cell 003. In addition, stormwater from Cell 002 eastern basin flows to Cell 003, discharging from a submerged pipe in the northeast corner of the impoundment. Water and suspended CCR enter a rectangular concrete decant structure equipped with 60-inch wide concrete stop logs, and flow via a 48-in. diameter concrete outlet pipe which discharges into Cell 004. Water can also discharge to Pond 001 – Cell 004 via the 2-ft. deep trapezoidal emergency spillway

Hydrologic and hydraulic modeling for this Cell 003 IDF Control System Plan was performed using HydroCAD Stormwater Modeling System, version 10.00-12 (HydroCAD) in conjunction with the appropriate IDF as determined per the Hazard Potential Classification Assessment performed under separate cover.

When Cell 003 is maintained at its normal water surface elevation (WSEL) (El. 739.0), the results of the HydroCAD analysis confirm the IDF control system for Cell 003 adequately manage flow into the impoundment during and following the IDF peak discharge. **Table 1** summarizes the effects of the IDF peak discharge during normal operation of the impoundment. The output from the two HydroCAD model simulations is provided as **Appendix 1**. See **Figure 1** for the Pond Cell 003 existing site plan.

Table 1: HydroCAD Output Summary

Peak flood level (ft)	714.5
Minimum Dike Elevation	716.0
Minimum freeboard (ft)	1.5
Peak inflow (cfs)	570.3

<u>§257.82(a)(2)</u>: *The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood specified in paragraph (a)(3) of this section.*

The outlet control structure is detailed in the Burns & McDonnell Ash Grading Plan Area No. 1 dated 06 June 1984 and the GEI Specific Site Assessment for Coal Combustion Waste – Impoundments at Thomas Hill Energy Center dated June 2011. Pertinent pages providing the required information have been provided as **Appendix 2**. Based on the HydroCAD analysis, the IDF control system for Cell 003 was determined to adequately manage flow from the impoundment by collecting and controlling the IDF peak discharge. The peak level and resulting freeboard in Cell 003 during the 100-year flood is noted in Table 1 (above). The HydroCAD model simulation output is provided as **Appendix 1**.

<u>§257.82(a)(3):</u> *The inflow design flood is:*

i. *For a high hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the probable maximum flood;*
ii. *For a significant hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the 1,000-year flood;*
iii. *For a low hazard potential CCR surface impoundment, as determined under § 257.73(a)(2) or § 257.74(a)(2), the 100-year flood; or*
iv. *For an incised CCR surface impoundment, the 25-year flood.*

Cell 003 was determined to be low hazard potential; therefore, the inflow design flood is the 100-year storm. The basis of the determination is discussed in Initial Hazard Potential Classification

Assessment, Cell 003 dated October 2016. The 100-year storm characteristics were detailed in the NOAA Atlas 14 Point Precipitation Frequency Estimates: MO dated 27 August 2014 and prepared by the National Weather Service. Pertinent pages providing the required information have been provided as **Appendix 3**.

§257.82(b): Discharge from the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.

§257.3-3(a): For purposed of section 4004(a) of the Act, a facility shall not cause a discharge of pollutants into waters of the United States that is in violation of the requirements of the National Pollutant Discharge Elimination System (NPDES) under section 402 of the Clean Water Act, as amended.

§257.3-3(b): For purposed of section 4004(a) of the Act, a facility shall not cause a discharge of dredged material or fill material to waters of the United States that is in violation of the requirements under section 404 of the Clean Water Act, as amended.

§257.3-3(c): A facility or practice shall not cause non-point source pollution of waters of the United States that violates applicable legal requirements implementing an areawide or Statewide water quality management plan that has been approved by the Administrator under section 208 of the Clean Water Act, as amended.

Discharge from the Cell 003 is managed through plant National Pollution Discharge Elimination System permit which was prepared by the Missouri Department of Natural Resources. Pertinent pages providing the required information have been provided as **Appendix 4**.

§257.82(c)(1): Content of the plan. The owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(4).

This document and all attachments serve as the initial IDF Plan. Periodic inflow design flood control system plans will be prepared and placed in the facility operating record at 5-year increments or whenever there is a change in conditions that would affect the Plan.

§257.82(c)(2): Amendment of the plan. The owner or operator of the CCR unit may amend the written inflow design flood control system plan at any time provided the revised plan is placed in the facility's

operating record as required by § 257.105(g)(4). The owner or operator must amend the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect.

The IDF Plan will be amended at least 60 days prior to a planned change in the operation of the facility or the CCR impoundment, or no later than 60 days after an unanticipated event requires the need to revise the IDF Plan. If the Plan needs to be revised after closure activities have commenced, the Plan will be revised no later than 30 days following the triggering event.

Any amendments to the Plan will include written certification from a qualified professional engineer that the initial and any amendments to the IDF Plan meet the requirements of the CCR Rule.

A record of amendments to the Plan will be tracked below. The latest version of the IDF Plan will be noted on the front cover of the Plan.

Version	**Date**	**Description of Changes Made**
1	16 October 2016	Initial Issuance

§257.82(c)(3): Timeframes for preparing the initial plan

i. *Existing CCR surface impoundments. The owner or operator of the CCR unit must prepare the initial inflow design flood control system plan no later than October 17, 2016.*

This IDF Plan has been prepared within the specified timeframe.

ii. *New CCR surface impoundments and any lateral expansion of a CCR surface impoundment. The owner or operator must prepare the initial inflow design flood control system plan no later than the date of initial receipt of CCR in the CCR unit.*

N/A – Cell 003 is an existing CCR impoundment.

§257.82(c)(4): Frequency for revising the plan. The owner or operator must prepare periodic inflow design flood control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first periodic plan.

The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed an inflow design flood control system plan when the plan has been placed in the facility's operating record as required by § 257.105(g)(4).

> This IDF Plan or any subsequent IDF Plan will be assessed and amended whenever there is a change in operation of the CCR impoundment that would substantially affect the IDF Plan or when unanticipated events necessitate a revision of the Plan either before or after closure activities have commenced.

§257.82(c)(5): 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 this section.

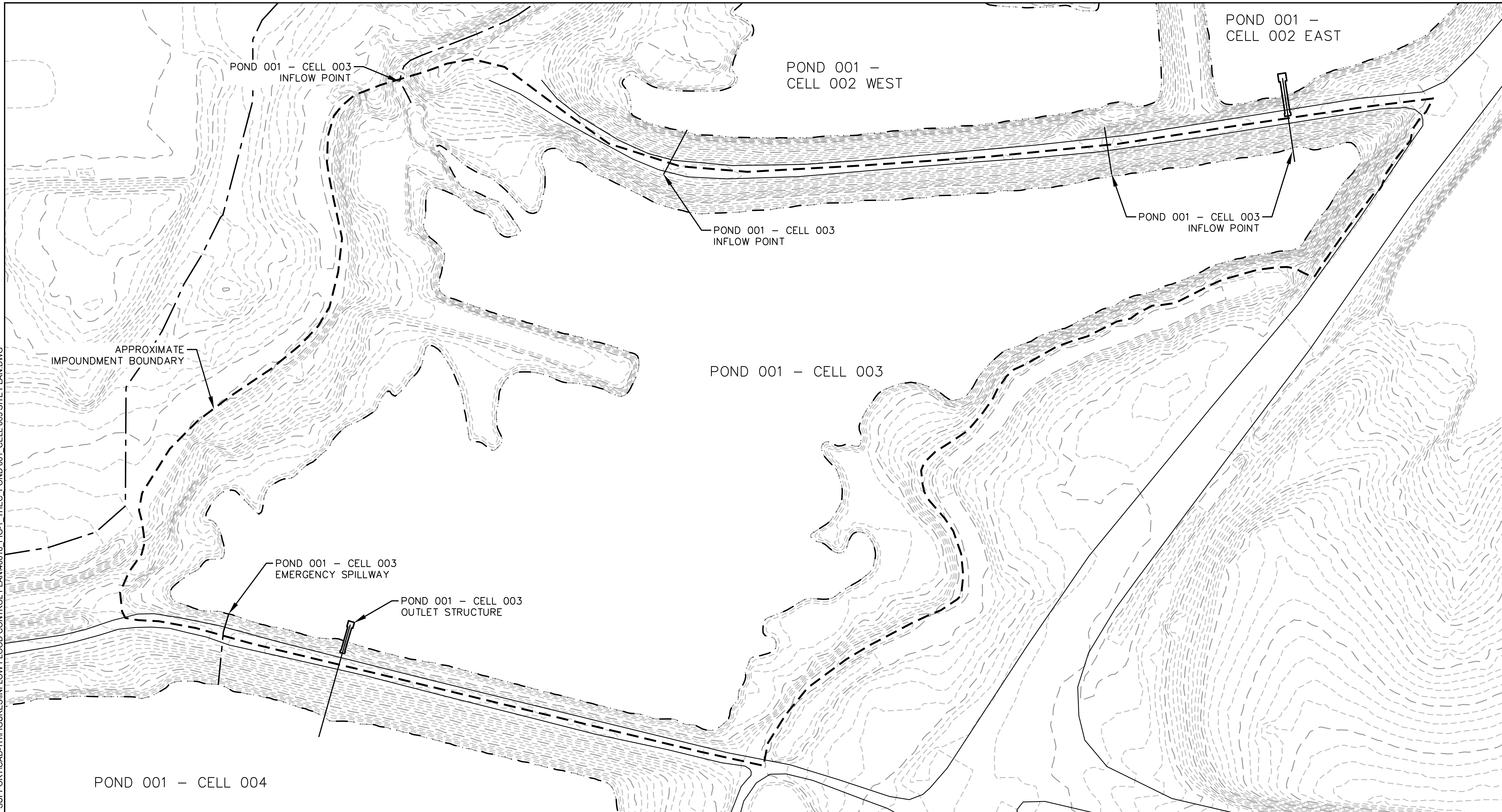
> I certify that the design of the flood control system referenced in this Inflow Design Flood Control System Plan for AECI's Pond 001 - Cell 003 at the Thomas Hill Energy Center meets the USEPA's CCR Rule requirements of §257.82.

Signed:______________________________
Consulting Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Sea

Cc: Kim Dickerson-AECI; Jason Pokorny-Haley & Aldrich



LEGEND

- - - - -	EXISTING MINOR CONTOUR	———	DITCH
—745—	EXISTING MAJOR CONTOUR	———	ROAD
— — —	APPROXIMATE IMPOUNDMENT BOUNDARY	- · · · -	WATER
———	PIPE		

NOTES

1. EXISTING TOPOGRAPHY FROM ASSOCIATED ELECTRIC COOPERATIVE, INC. DATED AUGUST 2016. HORIZONTAL IS BASED ON NAD83 ZONE 15N. VERTICAL CONTROL IS BASED ON NAVD88.

N

0 120 240
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

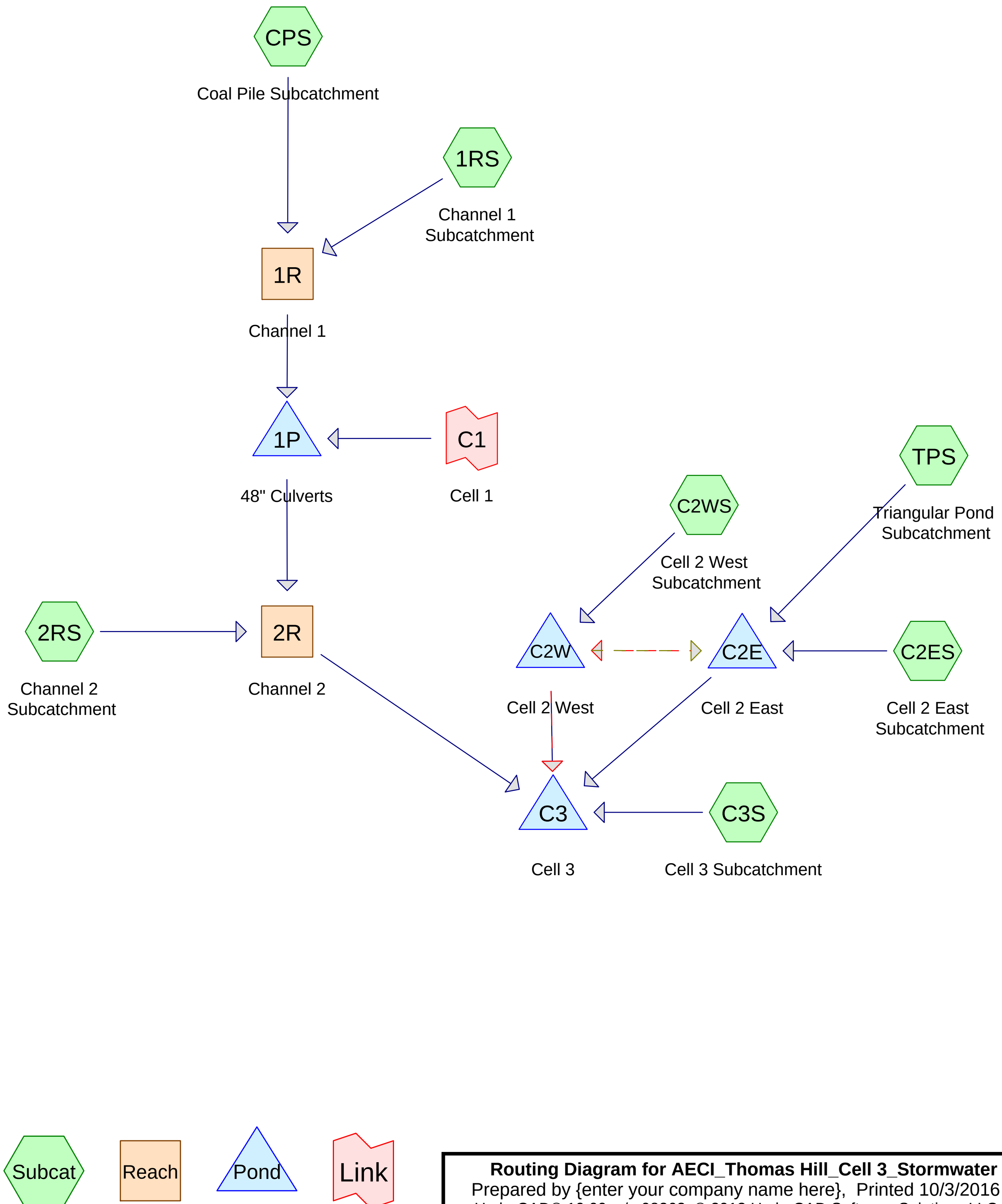
POND 001 - CELL 003
SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 1

LUCAS, ANDY Printed: 10/15/2016 12:26 PM Layout: HA-FIG-B-L-H
G:\40616_AECI-CCR ELG MANAGEMENT SUPPORT\CAD-TH\FIGURES\INFLOW FLOOD CONTROL PLAN\40616_FIG-1 THEC_POND 001_CELL 003 SITE PLAN.DWG

Appendix 1



Routing Diagram for AECI_Thomas Hill_Cell 3_Stormwater
Prepared by {enter your company name here}, Printed 10/3/2016
HydroCAD® 10.00 s/n 08262 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
61.372	84	50-75% Grass cover, Fair, HSG D (1RS, 2RS, C2ES, C2WS, C3S, TPS)
67.122	93	Urban industrial, 72% imp, HSG D (CPS)
17.863	98	Water Surface, HSG A (C2ES, C2WS, C3S)
146.357	**90**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
17.863	HSG A	C2ES, C2WS, C3S
0.000	HSG B	
0.000	HSG C	
128.494	HSG D	1RS, 2RS, C2ES, C2WS, C3S, CPS, TPS
0.000	Other	
146.357		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	61.372	0.000	61.372	50-75% Grass cover, Fair	1RS, 2RS, C2ES, C2WS, C3S, TPS
0.000	0.000	0.000	67.122	0.000	67.122	Urban industrial, 72% imp	CPS
17.863	0.000	0.000	0.000	0.000	17.863	Water Surface	C2ES, C2WS, C3S
17.863	**0.000**	**0.000**	**128.494**	**0.000**	**146.357**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	734.00	733.00	100.0	0.0100	0.012	48.0	0.0	0.0
2	C2E	705.00	704.00	100.0	0.0100	0.012	48.0	0.0	0.0
3	C2W	718.00	716.50	100.0	0.0150	0.020	15.0	0.0	0.0
4	C2W	719.00	716.50	100.0	0.0250	0.020	15.0	0.0	0.0
5	C3	695.00	693.75	125.0	0.0100	0.012	48.0	0.0	0.0

Time span=0.00-144.00 hrs, dt=0.01 hrs, 14401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment 1RS: Channel 1 Runoff Area=3.169 ac 0.00% Impervious Runoff Depth=6.02"
Flow Length=331' Tc=10.7 min CN=84 Runoff=27.36 cfs 1.589 af

Subcatchment 2RS: Channel 2 Runoff Area=5.195 ac 0.00% Impervious Runoff Depth=6.02"
Flow Length=398' Tc=13.4 min CN=84 Runoff=41.10 cfs 2.605 af

Subcatchment C2ES: Cell 2 East Runoff Area=22.599 ac 19.87% Impervious Runoff Depth=6.37"
Flow Length=880' Tc=10.4 min CN=87 Runoff=204.75 cfs 12.000 af

Subcatchment C2WS: Cell 2 West Runoff Area=16.395 ac 16.39% Impervious Runoff Depth=6.25"
Flow Length=2,301' Tc=12.7 min CN=86 Runoff=136.37 cfs 8.544 af

Subcatchment C3S: Cell 3 Subcatchment Runoff Area=21.567 ac 49.54% Impervious Runoff Depth=6.85"
Flow Length=66' Slope=0.3182 '/' Tc=2.6 min CN=91 Runoff=261.61 cfs 12.303 af

Subcatchment CPS: Coal Pile Runoff Area=67.122 ac 72.00% Impervious Runoff Depth=7.08"
Tc=10.0 min CN=93 Runoff=653.22 cfs 39.620 af

Subcatchment TPS: Triangular Pond Runoff Area=10.310 ac 0.00% Impervious Runoff Depth=6.02"
Tc=5.0 min CN=84 Runoff=107.48 cfs 5.171 af

Reach 1R: Channel 1 Avg. Flow Depth=5.28' Max Vel=8.10 fps Inflow=680.43 cfs 41.210 af
n=0.025 L=550.0' S=0.0055 '/' Capacity=952.16 cfs Outflow=678.10 cfs 41.210 af

Reach 2R: Channel 2 Avg. Flow Depth=3.83' Max Vel=9.93 fps Inflow=439.43 cfs 555.512 af
n=0.025 L=1,350.0' S=0.0126 '/' Capacity=1,446.73 cfs Outflow=437.42 cfs 555.308 af

Pond 1P: 48" Culverts Peak Elev=744.08' Storage=6.981 af Inflow=731.83 cfs 553.095 af
48.0" Round Culvert x 2.00 n=0.012 L=100.0' S=0.0100 '/' Outflow=407.32 cfs 552.942 af

Pond C2E: Cell 2 East Peak Elev=718.70' Storage=22.914 af Inflow=295.26 cfs 19.908 af
Primary=48.39 cfs 24.778 af Secondary=0.00 cfs 0.000 af Outflow=48.39 cfs 24.778 af

Pond C2W: Cell 2 West Peak Elev=712.80' Storage=8.542 af Inflow=136.37 cfs 8.544 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Tertiary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond C3: Cell 3 Peak Elev=714.49' Storage=52.114 af Inflow=570.27 cfs 592.354 af
Primary=158.50 cfs 573.067 af Secondary=0.00 cfs 0.000 af Outflow=158.50 cfs 573.067 af

Link 100-Yr Primary Imported from AECI_Thomas Hill_Cell 1_Stormwater Link~Pond C1.csv Inflow=33.68 cfs 226.297 af
Primary=33.68 cfs 226.281 af

Total Runoff Area = 146.357 ac Runoff Volume = 81.833 af Average Runoff Depth = 6.71"
54.77% Pervious = 80.166 ac 45.23% Impervious = 66.191 ac

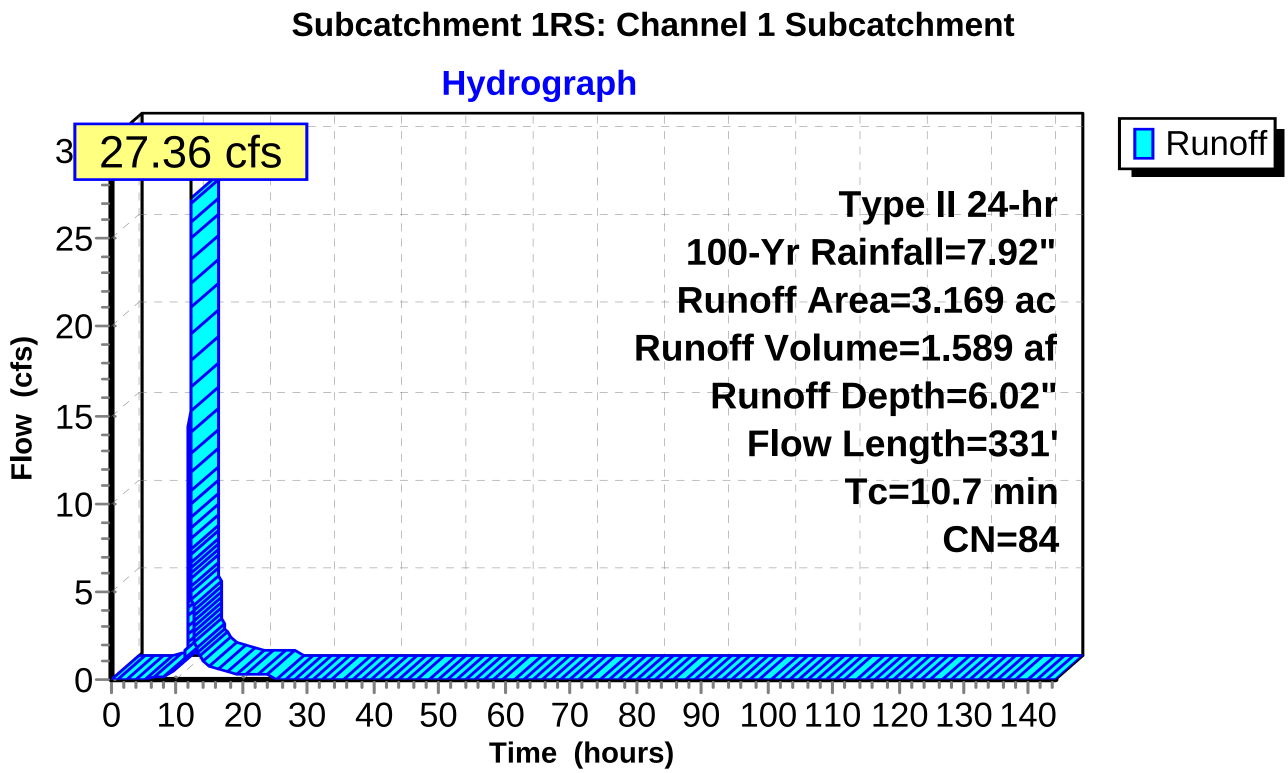
Summary for Subcatchment 1RS: Channel 1 Subcatchment

Runoff = 27.36 cfs @ 12.02 hrs, Volume= 1.589 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
3.169	84	50-75% Grass cover, Fair, HSG D
3.169		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	100	0.0360	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
2.0	231	0.0753	1.92		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.7	331	Total			



Summary for Subcatchment 2RS: Channel 2 Subcatchment

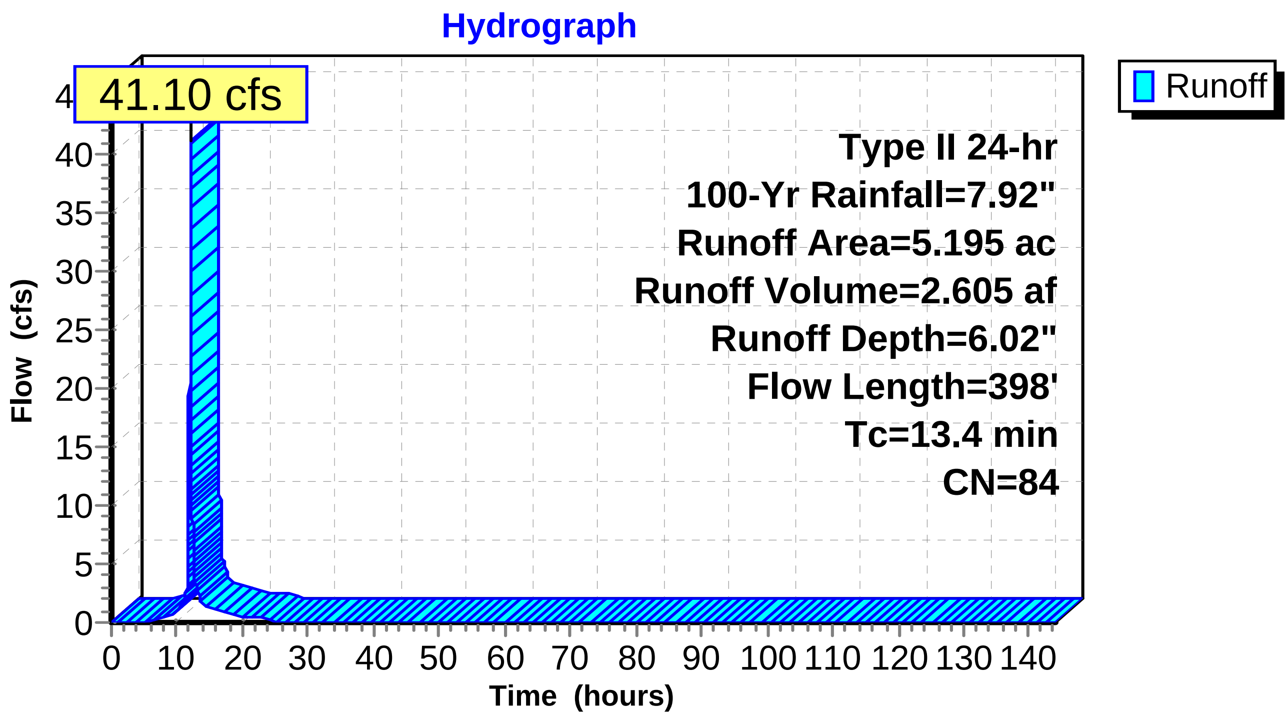
Runoff = 41.10 cfs @ 12.05 hrs, Volume= 2.605 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
5.195	84	50-75% Grass cover, Fair, HSG D
5.195		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	100	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
2.4	298	0.0872	2.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
13.4	398	Total			

Subcatchment 2RS: Channel 2 Subcatchment



Summary for Subcatchment C2ES: Cell 2 East Subcatchment

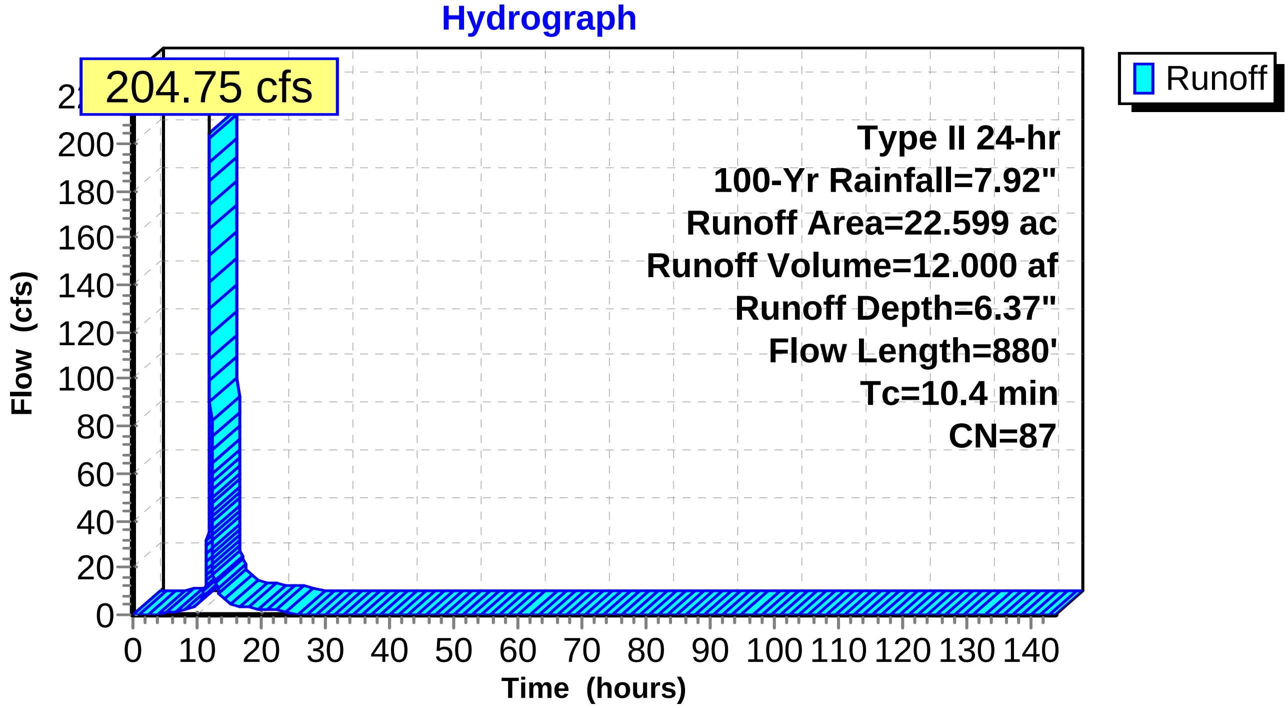
Runoff = 204.75 cfs @ 12.01 hrs, Volume= 12.000 af, Depth= 6.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
4.491	98	Water Surface, HSG A
18.108	84	50-75% Grass cover, Fair, HSG D
22.599	87	Weighted Average
18.108		80.13% Pervious Area
4.491		19.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	100	0.0930	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
2.6	215	0.0377	1.36		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.9	565	0.0265	5.05	57.03	**Channel Flow,** Area= 11.3 sf Perim= 30.0' r= 0.38' n= 0.025 Earth, clean & winding
10.4	880	Total			

Subcatchment C2ES: Cell 2 East Subcatchment



Summary for Subcatchment C2WS: Cell 2 West Subcatchment

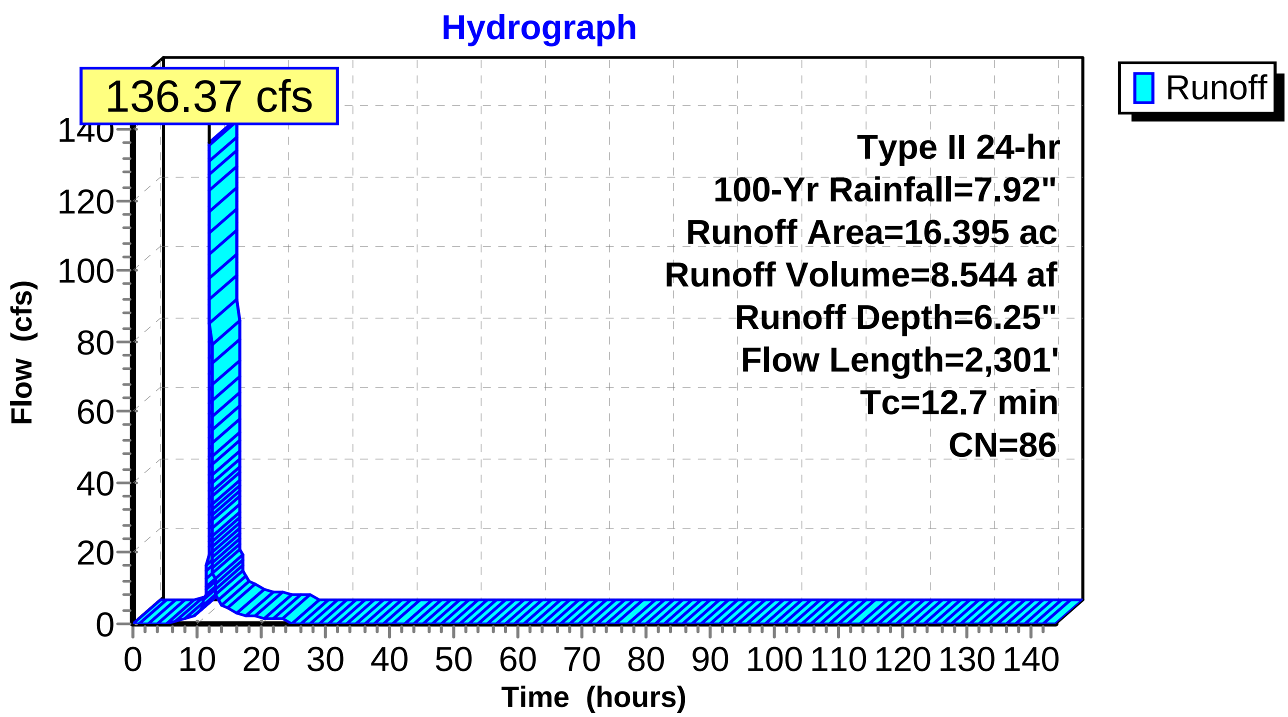
Runoff = 136.37 cfs @ 12.04 hrs, Volume= 8.544 af, Depth= 6.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
2.687	98	Water Surface, HSG A
13.708	84	50-75% Grass cover, Fair, HSG D
16.395	86	Weighted Average
13.708		83.61% Pervious Area
2.687		16.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	100	0.2830	0.44		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"
1.8	158	0.0424	1.44		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.1	2,043	0.0020	4.80	240.05	**Channel Flow,** Area= 50.0 sf Perim= 20.6' r= 2.43' n= 0.025 Earth, clean & winding
12.7	2,301	Total			

Subcatchment C2WS: Cell 2 West Subcatchment



Summary for Subcatchment C3S: Cell 3 Subcatchment

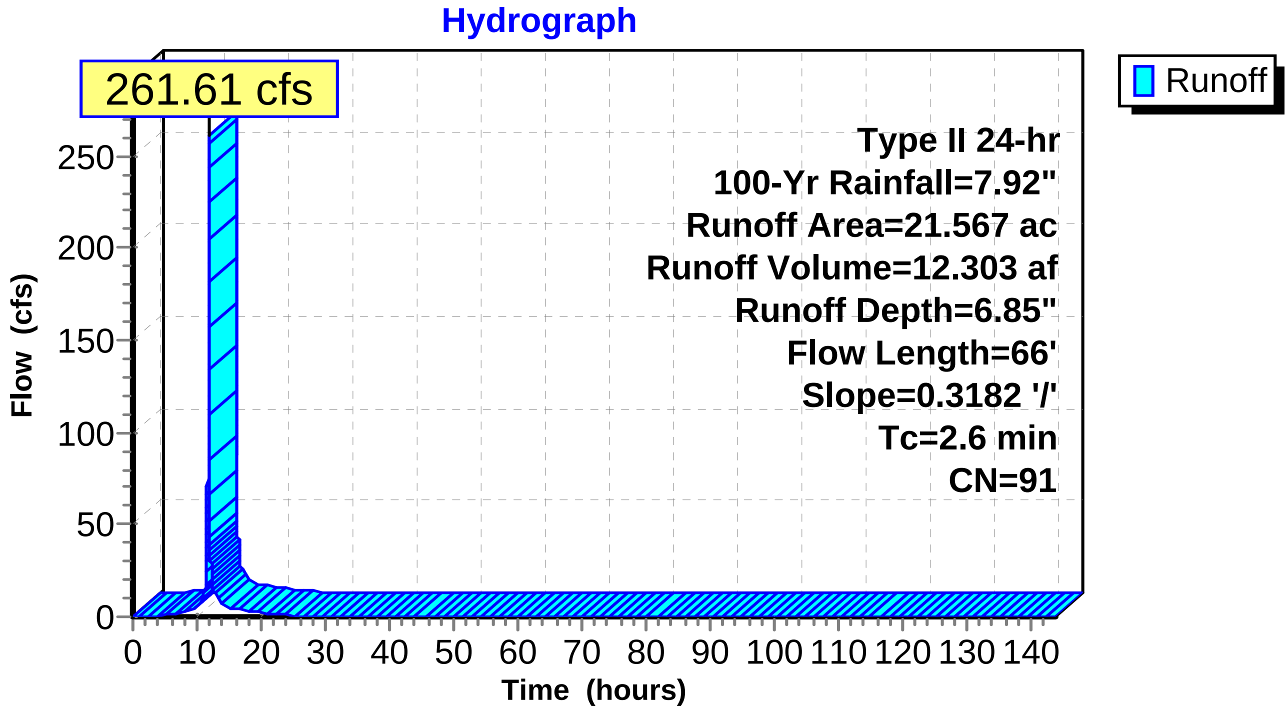
Runoff = 261.61 cfs @ 11.93 hrs, Volume= 12.303 af, Depth= 6.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
10.685	98	Water Surface, HSG A
10.882	84	50-75% Grass cover, Fair, HSG D
21.567	91	Weighted Average
10.882		50.46% Pervious Area
10.685		49.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	66	0.3182	0.42		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.56"

Subcatchment C3S: Cell 3 Subcatchment



Summary for Subcatchment CPS: Coal Pile Subcatchment

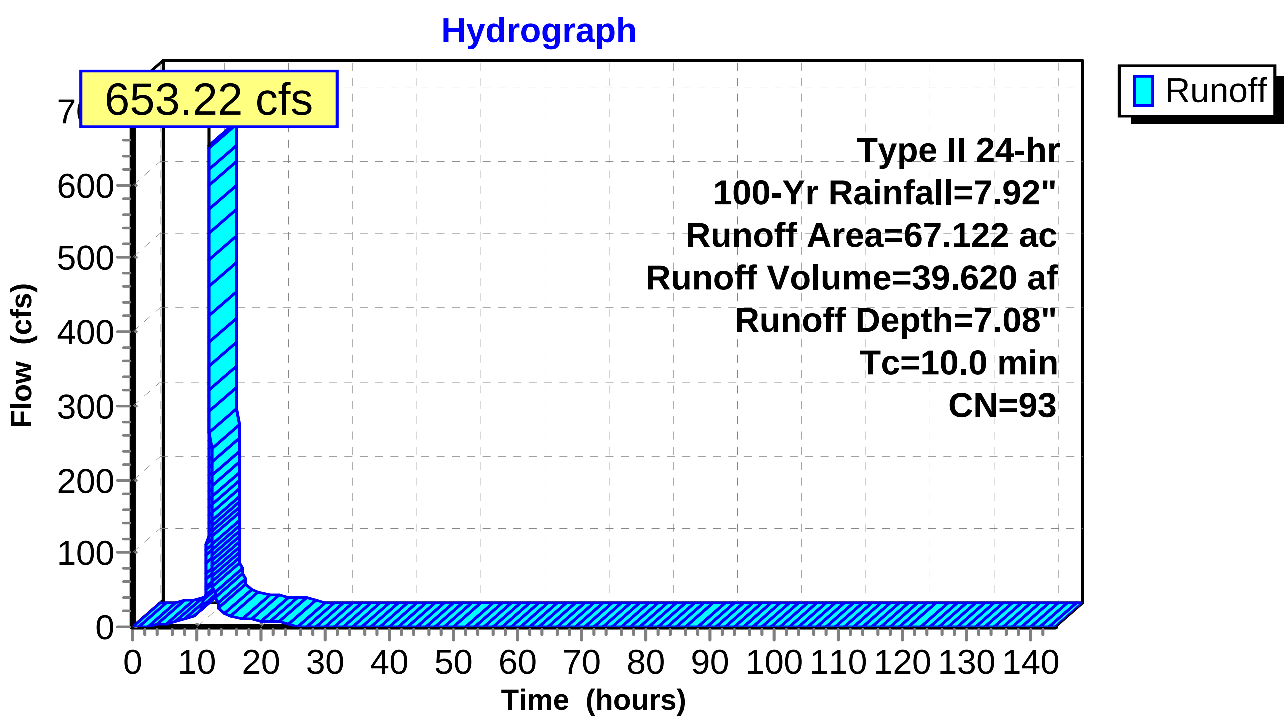
Runoff = 653.22 cfs @ 12.01 hrs, Volume= 39.620 af, Depth= 7.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
67.122	93	Urban industrial, 72% imp, HSG D
18.794		28.00% Pervious Area
48.328		72.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					**Direct Entry,**

Subcatchment CPS: Coal Pile Subcatchment



Summary for Subcatchment TPS: Triangular Pond Subcatchment

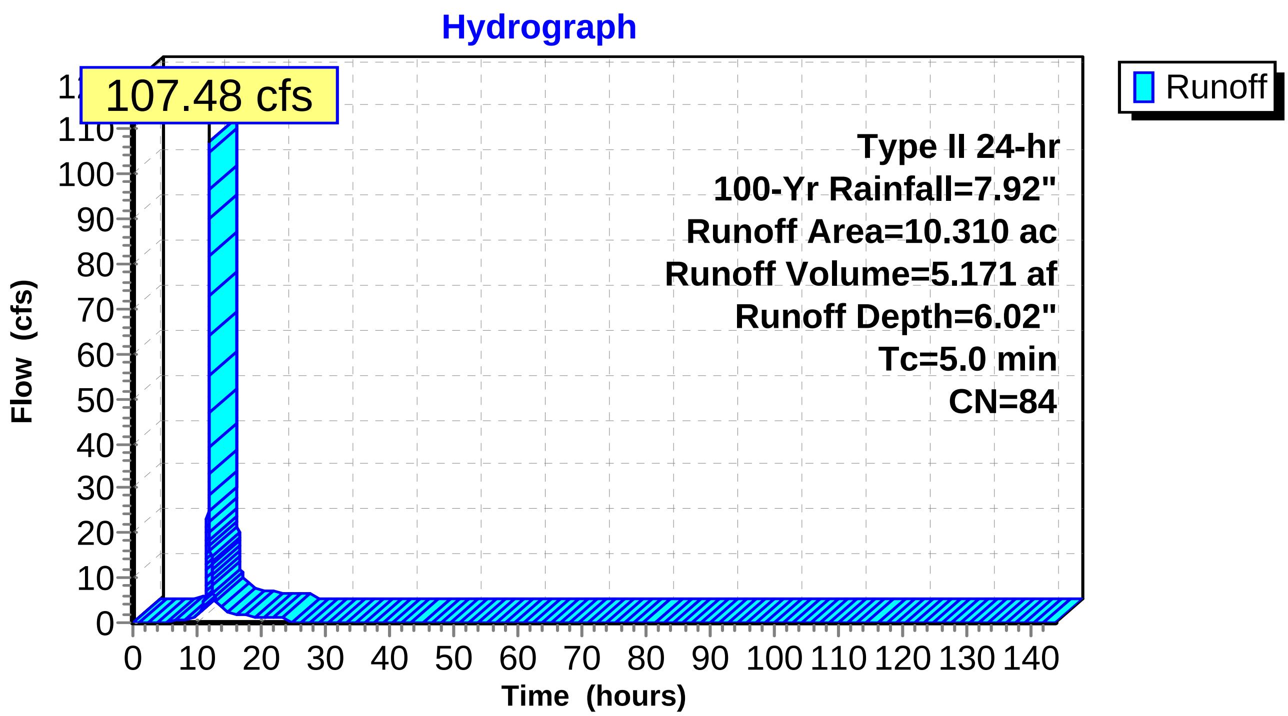
Runoff = 107.48 cfs @ 11.96 hrs, Volume= 5.171 af, Depth= 6.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-Yr Rainfall=7.92"

Area (ac)	CN	Description
10.310	84	50-75% Grass cover, Fair, HSG D
10.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment TPS: Triangular Pond Subcatchment



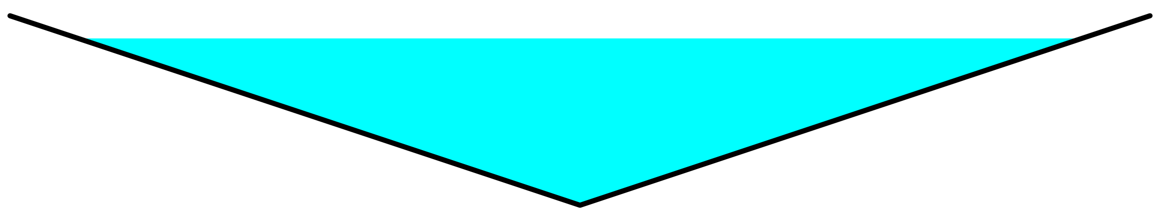
Summary for Reach 1R: Channel 1

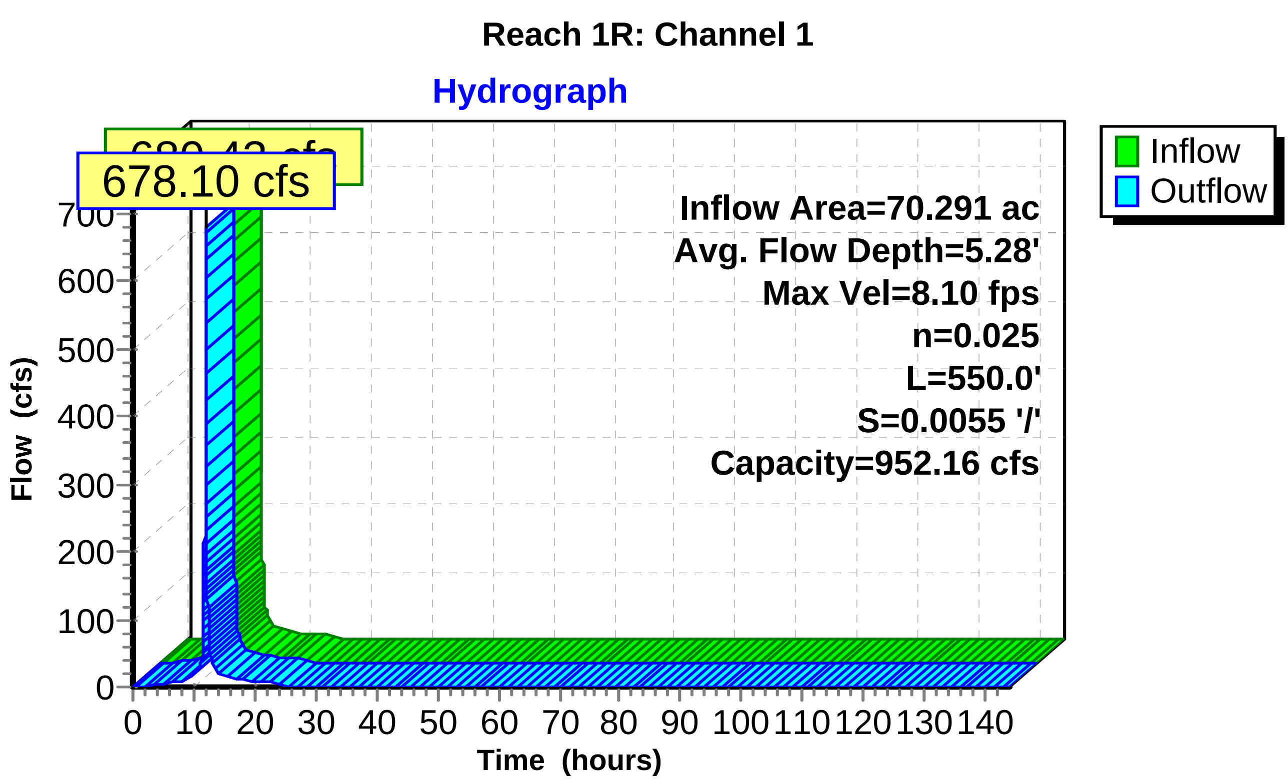
Inflow Area = 70.291 ac, 68.75% Impervious, Inflow Depth = 7.04" for 100-Yr event
Inflow = 680.43 cfs @ 12.01 hrs, Volume= 41.210 af
Outflow = 678.10 cfs @ 12.02 hrs, Volume= 41.210 af, Atten= 0%, Lag= 0.8 min

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.10 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 4.7 min

Peak Storage= 46,049 cf @ 12.02 hrs
Average Depth at Peak Storage= 5.28'
Bank-Full Depth= 6.00' Flow Area= 108.0 sf, Capacity= 952.16 cfs

0.00' x 6.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 3.0 '/' Top Width= 36.00'
Length= 550.0' Slope= 0.0055 '/'
Inlet Invert= 737.00', Outlet Invert= 734.00'





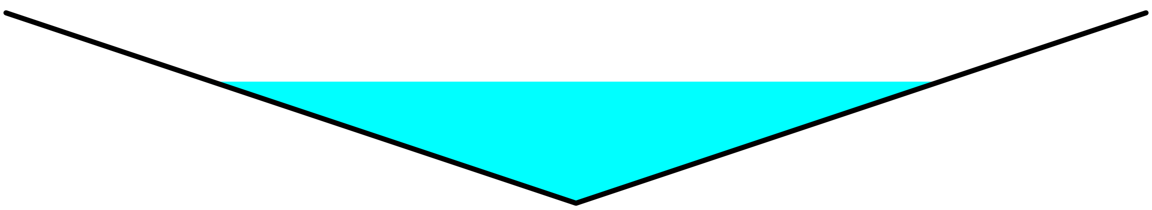
Summary for Reach 2R: Channel 2

Inflow Area = 75.486 ac, 64.02% Impervious, Inflow Depth > 88.31" for 100-Yr event
Inflow = 439.43 cfs @ 12.11 hrs, Volume= 555.512 af
Outflow = 437.42 cfs @ 12.14 hrs, Volume= 555.308 af, Atten= 0%, Lag= 1.9 min

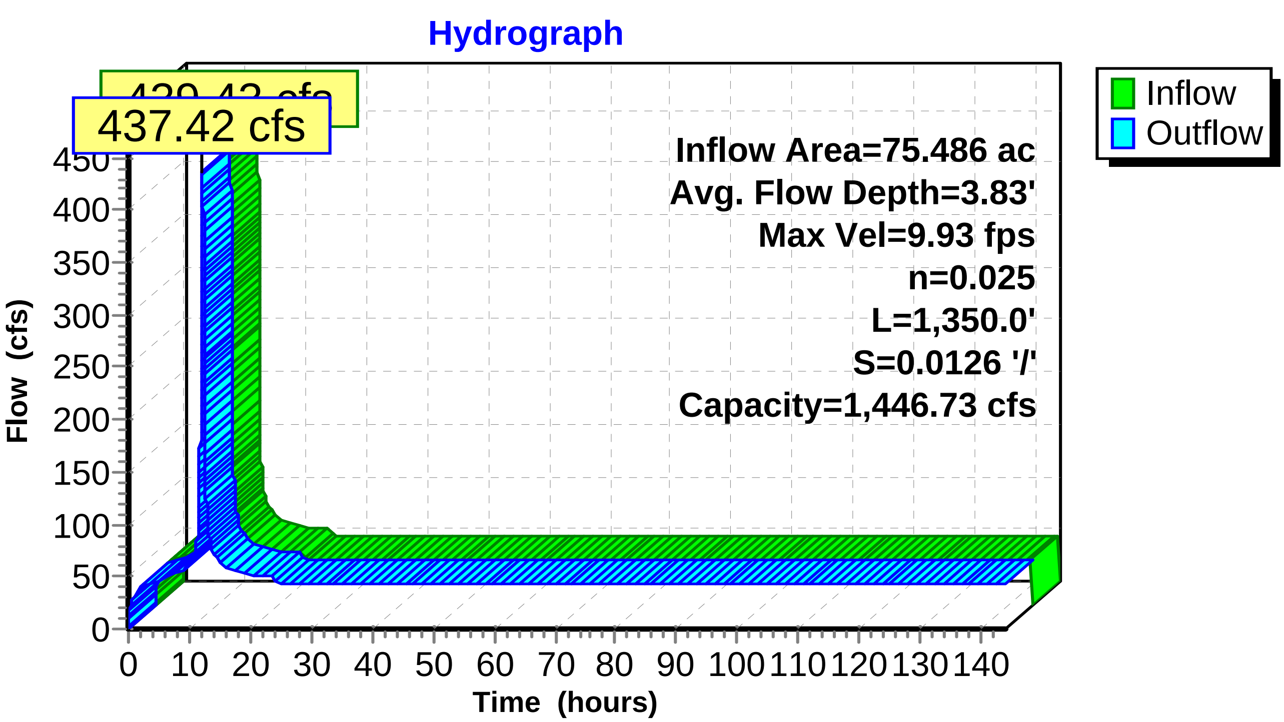
Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.93 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 5.63 fps, Avg. Travel Time= 4.0 min

Peak Storage= 59,451 cf @ 12.14 hrs
Average Depth at Peak Storage= 3.83'
Bank-Full Depth= 6.00' Flow Area= 108.0 sf, Capacity= 1,446.73 cfs

0.00' x 6.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 3.0 '/' Top Width= 36.00'
Length= 1,350.0' Slope= 0.0126 '/'
Inlet Invert= 733.00', Outlet Invert= 716.00'



Reach 2R: Channel 2



Summary for Pond 1P: 48" Culverts

Dual 48" culverts per Gredell Engineering Cell 2 West Basin drawing (11/2015). Invert elevations per topo.

[63] Warning: Exceeded Reach 1R INLET depth by 3.47' @ 12.22 hrs

Inflow Area = 70.291 ac, 68.75% Impervious, Inflow Depth > 94.42" for 100-Yr event
Inflow = 731.83 cfs @ 12.02 hrs, Volume= 553.095 af, Incl. 24.00 cfs Base Flow
Outflow = 407.32 cfs @ 12.15 hrs, Volume= 552.942 af, Atten= 44%, Lag= 7.3 min
Primary = 407.32 cfs @ 12.15 hrs, Volume= 552.942 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 744.08' @ 12.15 hrs Surf.Area= 1.463 ac Storage= 6.981 af

Plug-Flow detention time= 3.4 min calculated for 552.942 af (100% of inflow)
Center-of-Mass det. time= 2.1 min (4,054.6 - 4,052.4)

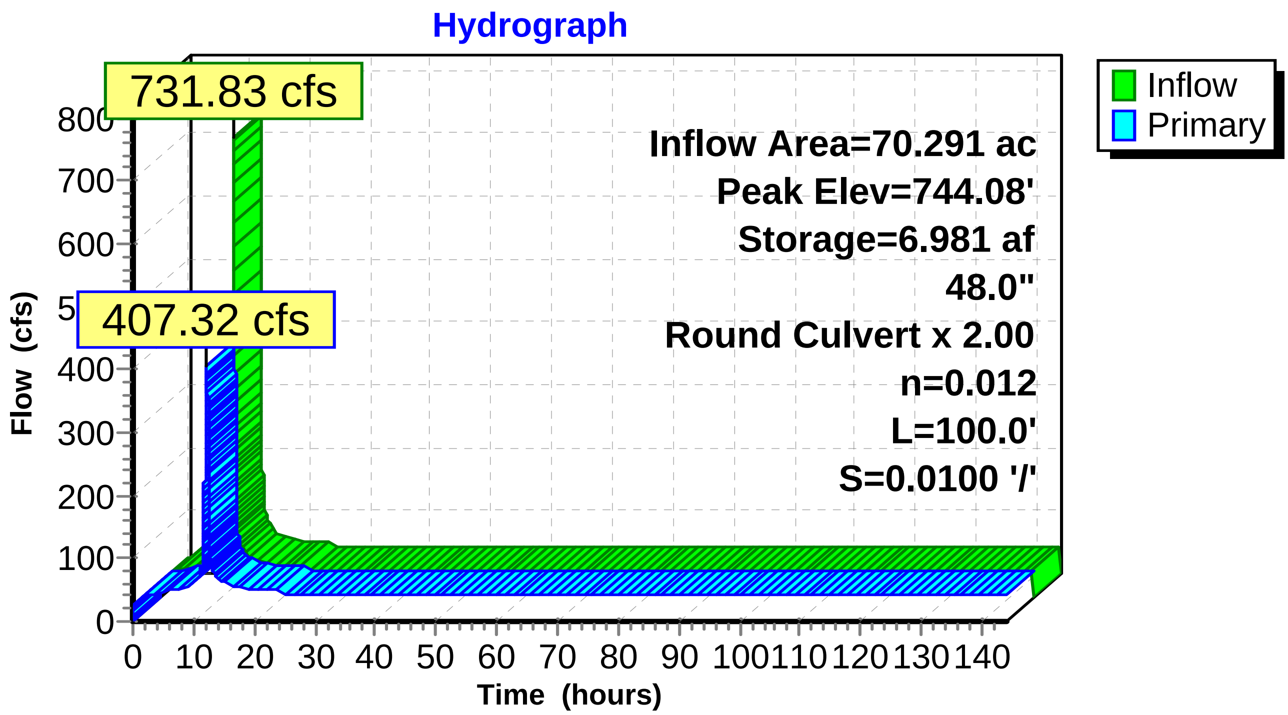
Volume	Invert	Avail.Storage	Storage Description
#1	732.00'	7.008 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
732.00	0.002	0.000	0.000
733.00	0.008	0.005	0.005
734.00	0.041	0.024	0.029
735.00	0.098	0.069	0.099
736.00	0.179	0.138	0.237
737.00	0.308	0.244	0.481
738.00	0.427	0.367	0.849
739.00	0.657	0.542	1.391
740.00	0.865	0.761	2.152
741.00	1.037	0.951	3.103
742.00	1.183	1.110	4.213
743.00	1.326	1.255	5.467
744.00	1.463	1.395	6.861
744.10	1.463	0.146	7.008

Device	Routing	Invert	Outlet Devices
#1	Primary	734.00'	**48.0" Round Culvert X 2.00** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 734.00' / 733.00' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf

Primary OutFlow Max=407.25 cfs @ 12.15 hrs HW=744.08' TW=736.83' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 407.25 cfs @ 16.20 fps)

Pond 1P: 48" Culverts



Summary for Pond C2E: Cell 2 East

Cell 2 East and Cell 2 West combined into one unit at El. 721'.

Primary outlet weir per Gredell Engineering Inc. Cell 2 Outfall Modification (9/2015). Outfall pipe diameter assumed based on Cell 3 and Cell 4. Upstream invert of culvert provided by Gredell Engineering. Length of culvert approximated using Google Earth Pro.

Emergency spillway elevation per Burns & McDonnell Ash Pond Modifications Drawing Y12 (10/17/1985). Dimensions assumed similar to Cell 3.

Inflow = 295.26 cfs @ 11.99 hrs, Volume= 19.908 af, Incl. 0.23 cfs Base Flow
Outflow = 48.39 cfs @ 12.30 hrs, Volume= 24.778 af, Atten= 84%, Lag= 18.7 min
Primary = 48.39 cfs @ 12.30 hrs, Volume= 24.778 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Starting Elev= 718.00' Surf.Area= 5.225 ac Storage= 19.174 af
Peak Elev= 718.70' @ 12.30 hrs Surf.Area= 5.418 ac Storage= 22.914 af (3.740 af above start)

Plug-Flow detention time= 2,306.9 min calculated for 5.604 af (28% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	714.00'	36.274 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

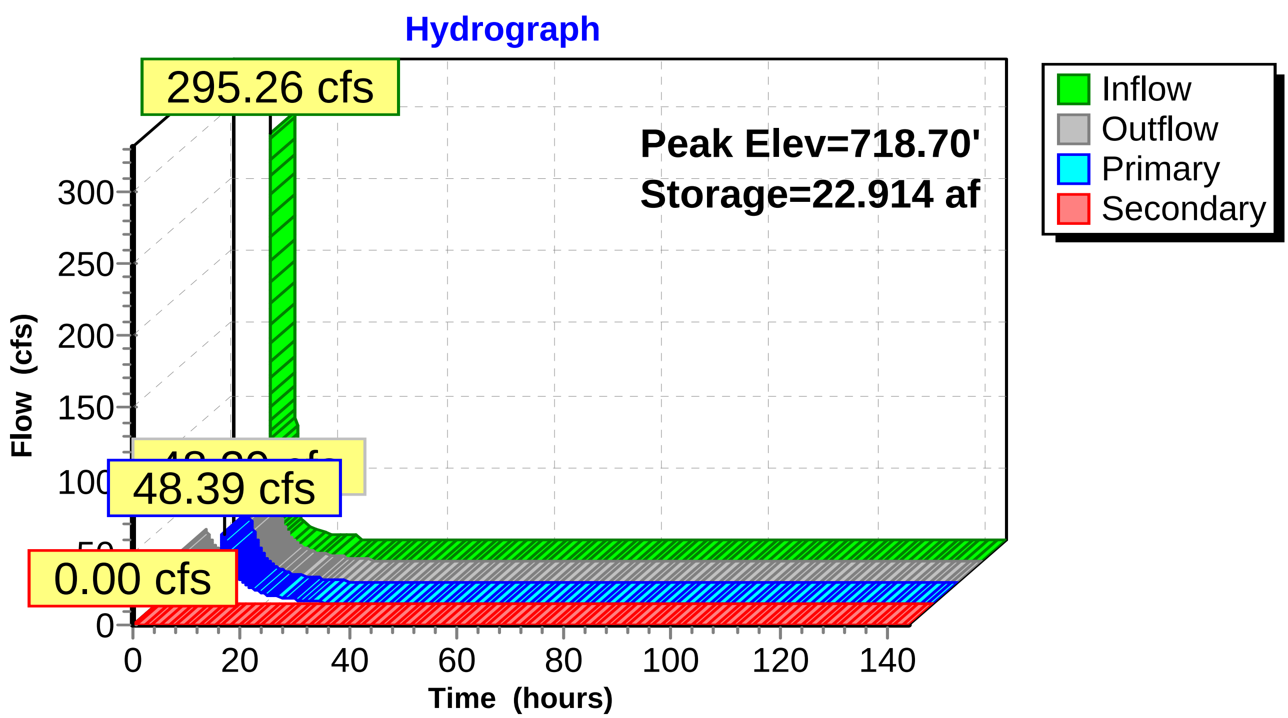
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
714.00	4.491	0.000	0.000
715.00	4.599	4.545	4.545
716.00	4.736	4.667	9.212
717.00	4.981	4.859	14.071
718.00	5.225	5.103	19.174
719.00	5.499	5.362	24.536
720.00	5.841	5.670	30.206
721.00	6.295	6.068	36.274

Device	Routing	Invert	Outlet Devices
#1	Primary	705.00'	**48.0" Round Culvert** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 705.00' / 704.00' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf
#2	Device 1	717.00'	**7.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	720.00'	**700.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=48.39 cfs @ 12.30 hrs HW=718.70' TW=713.89' (Dynamic Tailwater)
└─**1=Culvert** (Passes 48.39 cfs of 165.88 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 48.39 cfs @ 4.27 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=718.00' TW=710.00' (Dynamic Tailwater)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C2E: Cell 2 East



Summary for Pond C2W: Cell 2 West

Cell 2 East and Cell 2 West combined into one unit at El. 721'.

Primary and secondary outlets per Gerdell Engineering Resources, Inc. Figure 1 (9/2015). Length estimated per Google Earth Pro.

Inflow	=	136.37 cfs @	12.04 hrs,	Volume=	8.544 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 100%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Tertiary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 712.80' @ 24.73 hrs Surf.Area= 3.719 ac Storage= 8.542 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	710.00'	156.546 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
710.00	2.687	0.000	0.000
711.00	2.822	2.754	2.754
712.00	3.207	3.014	5.769
713.00	3.846	3.527	9.296
714.00	4.397	4.122	13.417
715.00	4.743	4.570	17.987
716.00	5.459	5.101	23.088
717.00	6.021	5.740	28.828
718.00	7.423	6.722	35.550
719.00	8.443	7.933	43.483
720.00	10.187	9.315	52.798
721.00	10.662	10.424	63.223
722.00	17.910	14.286	77.509
723.00	18.925	18.418	95.926
724.00	19.796	19.360	115.287
725.00	20.629	20.212	135.499
726.00	21.464	21.047	156.546

Device	Routing	Invert	Outlet Devices
#1	Primary	718.00'	**15.0" Round Culvert** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 718.00' / 716.50' S= 0.0150 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.23 sf
#2	Secondary	719.00'	**15.0" Round Culvert** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 719.00' / 716.50' S= 0.0250 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 1.23 sf
#3	Tertiary	720.00'	**700.0' long x 10.0' breadth Broad-Crested Rectangular Weir**

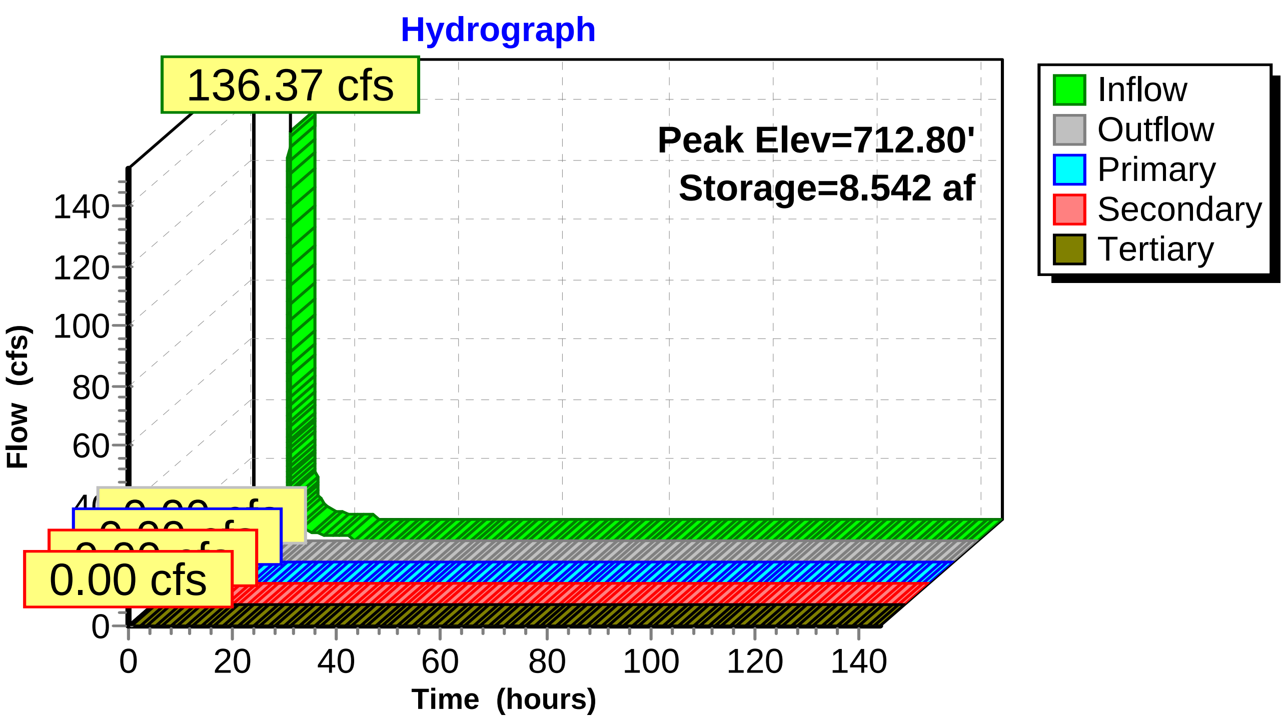
Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' TW=710.00' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' TW=710.00' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Tertiary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' TW=718.00' (Dynamic Tailwater)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond C2W: Cell 2 West



Summary for Pond C3: Cell 3

Weir length, pipe size, slope, material, and upstream invert elevation per Burns & McDonnell Ash Pond Modifications Drawing Y8 (6/4/1984).

Weir overflow elevation based on water level at time of survey.

Emergency spillway - Ash Pond #001 Specs provided by AECI. Dimensions out spillway per GEI Specific Site Assessment for CCW Impoundments at THEC (6/2011).

Inflow = 570.27 cfs @ 11.94 hrs, Volume= 592.354 af
Outflow = 158.50 cfs @ 12.89 hrs, Volume= 573.067 af, Atten= 72%, Lag= 56.7 min
Primary = 158.50 cfs @ 12.89 hrs, Volume= 573.067 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs
Peak Elev= 714.49' @ 12.89 hrs Surf.Area= 12.866 ac Storage= 52.114 af

Plug-Flow detention time= 306.4 min calculated for 573.067 af (97% of inflow)
Center-of-Mass det. time= 150.8 min (4,004.6 - 3,853.8)

Volume	Invert	Avail.Storage	Storage Description
#1	710.00'	72.090 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

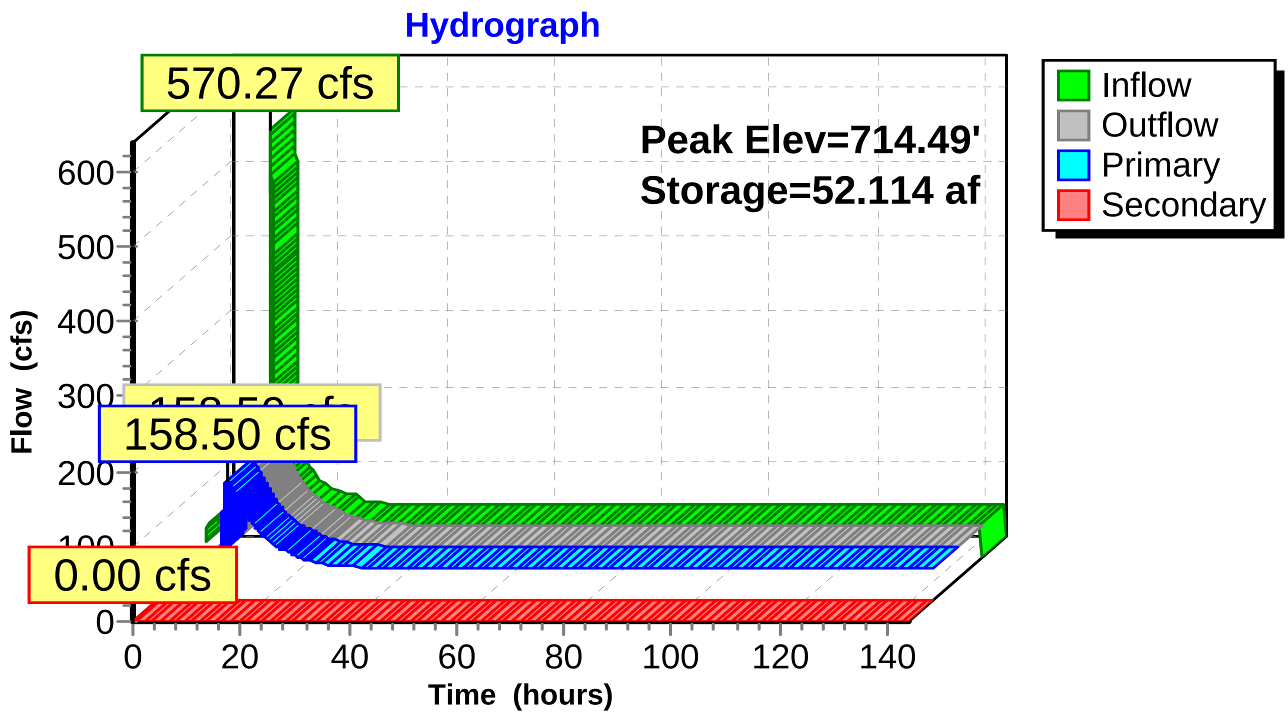
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
710.00	10.685	0.000	0.000
711.00	11.024	10.855	10.855
712.00	11.282	11.153	22.007
713.00	11.968	11.625	33.632
714.00	12.627	12.297	45.930
715.00	13.119	12.873	58.803
716.00	13.456	13.287	72.090

Device	Routing	Invert	Outlet Devices
#1	Primary	695.00'	**48.0" Round Culvert** L= 125.0' RCP, rounded edge headwall, Ke= 0.100 Inlet / Outlet Invert= 695.00' / 693.75' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 12.57 sf
#2	Device 1	710.00'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Secondary	715.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 2.00 Width (feet) 12.00 18.00

Primary OutFlow Max=158.50 cfs @ 12.89 hrs HW=714.49' (Free Discharge)
└─**1=Culvert** (Passes 158.50 cfs of 323.43 cfs potential flow)
  └─**2=Sharp-Crested Rectangular Weir** (Weir Controls 158.50 cfs @ 6.93 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=710.00' (Free Discharge)
└─**3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond C3: Cell 3



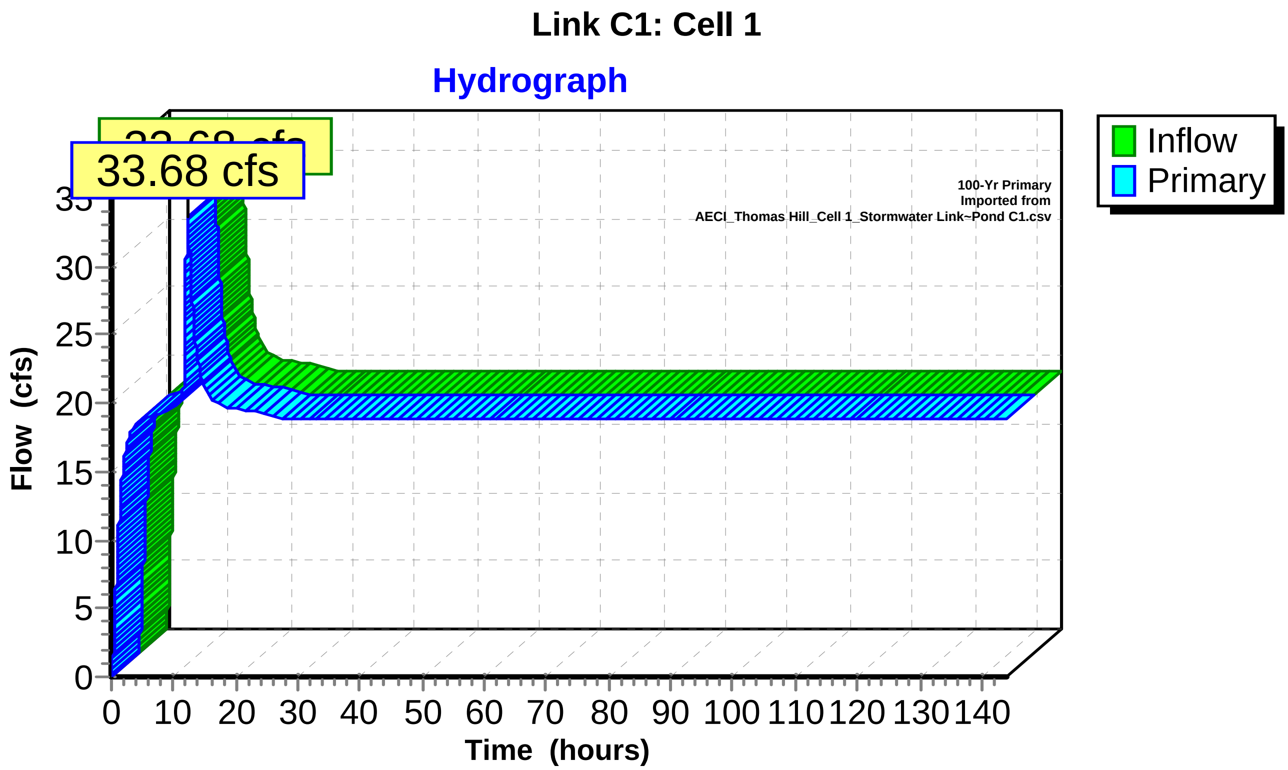
Summary for Link C1: Cell 1

Cell 001 Outflow

Inflow	=	33.68 cfs @	12.18 hrs,	Volume=	226.297 af
Primary	=	33.68 cfs @	12.19 hrs,	Volume=	226.281 af, Atten= 0%, Lag= 0.6 min

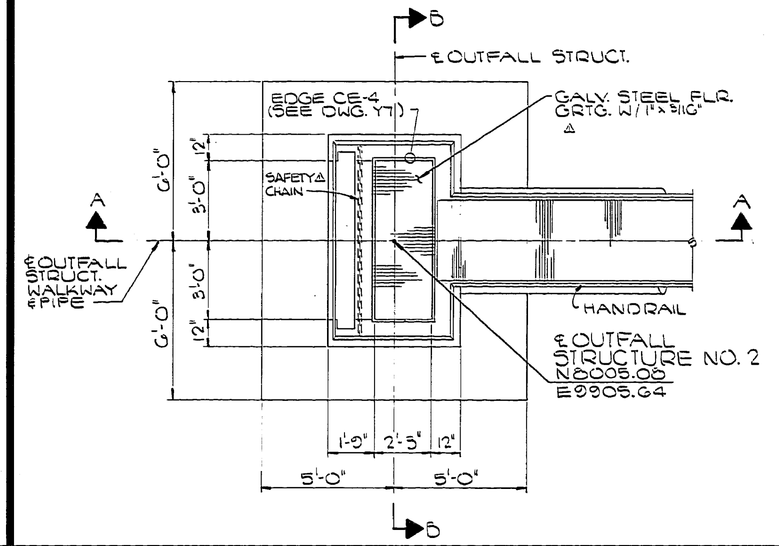
Primary outflow = Inflow, Time Span= 0.00-144.00 hrs, dt= 0.01 hrs

100-Yr Primary Imported from AECI_Thomas Hill_Cell 1_Stormwater Link~Pond C1.csv

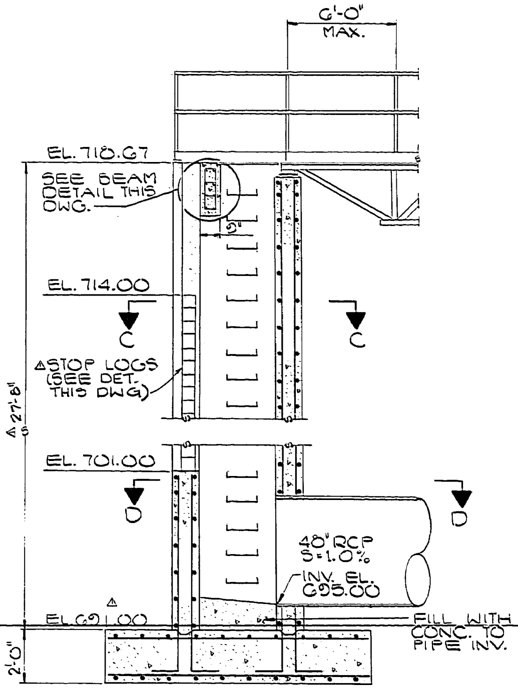


Appendix 2

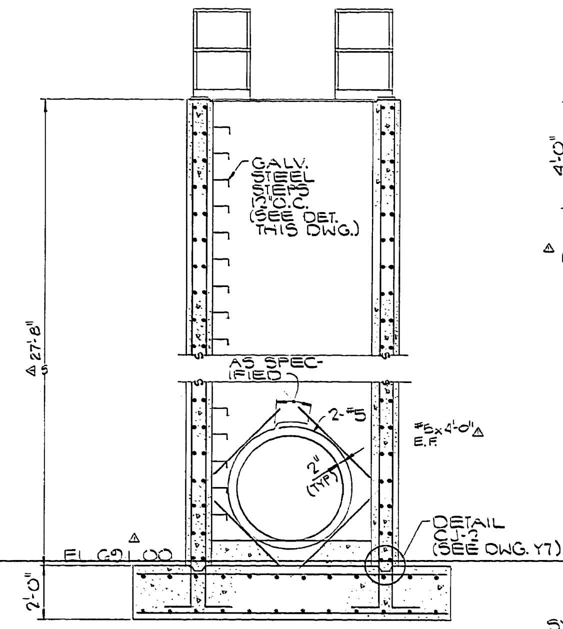
no.	date	by	revision
△	6-26-84	AFF	REVISED PER ADDENDUM NO. 1
	6-29-84	UAK	ISSUED W/ADD NO. 1
	8-6-84	UAK	ISSUED FOR CONSTRUCTION
△	10-17-85	DLM	CONFORMING TO CONSTRUCTION RECORDS



OUTFALL STRUCTURE NO. 2
NOT TO SCALE



SECTION A
NOT TO SCALE



SECTION B
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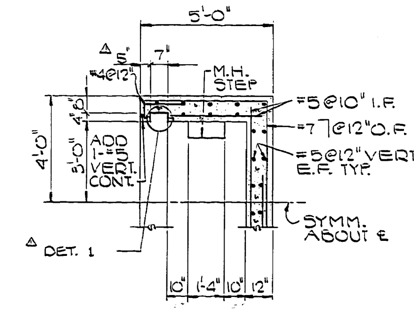
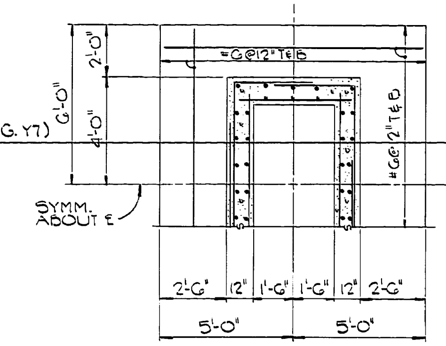
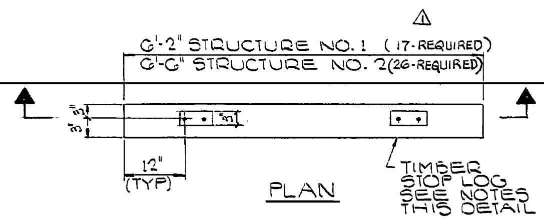


SECTION C
NOT TO SCALE

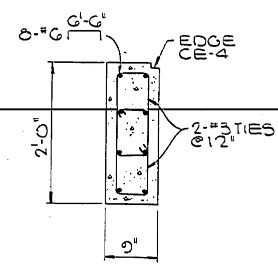


SECTION D
NOT TO SCALE

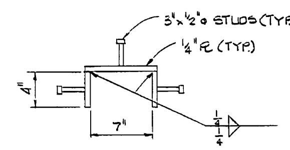
NOTE: 48" RCP SHALL BE CLASS IV CONFORMING TO ASTM C76. JOINTS SHALL BE RUBBER CONFORMING TO ASTM C443 & CONCRETE. RUBBER GASKETS SHALL BE O-RING CROSS SECTION.



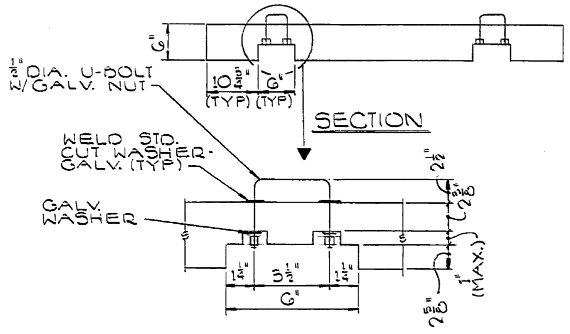
PLAN



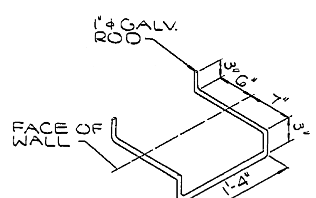
BEAM DETAIL
NOT TO SCALE



△ DETAIL 1
NOT TO SCALE



STOP LOG DETAIL
NOT TO SCALE



TYPICAL MANHOLE STEP
NOT TO SCALE

NOTES:

1. STOP LOGS SHALL BE DENSE STRUCTURAL SOUTHERN PINE OR DENSE SELECT DOUGLAS FIR TIMBER WITHOUT ANY DEFECTS.
2. TREAT ALL STOP LOGS W/60/40 CREOSOTE-COAL TAR SOLUTION IN ACCORDANCE WITH AWPA STANDARD C-6.
3. ALLOWABLE UNIT STRESS FOR TIMBER STOP LOG SHALL BE MINIMUM 2000 PSI. BENDING, 135 P.S.I. SHEAR △
4. SUBMIT TIMBER TREATMENT & PRESERVATION RECORDS

date JUNE 4, 1984
designed SEYB
detailed MADDOCK
checked

Burns & McDonnell
Engineers • Architects • Consultants
Kansas City, Missouri

THOMAS HILL POWER PLANT
ASSOCIATED ELECTRIC COOPERATIVE
MISSOURI 73

ASH POND MODIFICATIONS

OUTFALL STRUCTURE NO. 2

project 85-210-1
contract EP. TO. 8501
drawing Y8
rev. -2

EP. TO 8501

GEI Consultants

Geotechnical
Environmental
Resources
Ecological

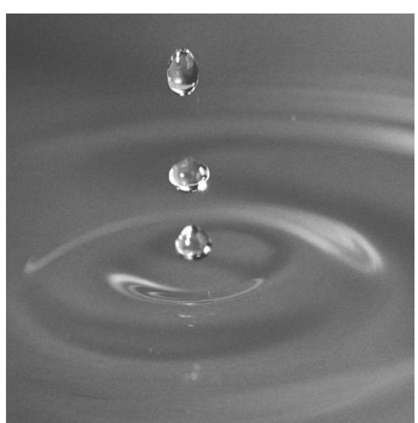
Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center

Clifton Hill, Missouri

Submitted to:
U.S. Environmental Protection Agency
Office of Resource Conservation and Recovery
5304P
1200 Pennsylvania Avenue NW
Washington, DC 20460

Submitted by:
GEI Consultants, Inc.
4601 DTC Blvd, Suite 900
Denver, CO 80237

June 2011
Project Number: 092884



Steven R. Townsley, P.E.
Senior Project Engineer

The materials stored in each of the CCW impoundment dikes are summarized below:

- Slag Dewatering Basin – This basin is a wet storage area that is used to contain both bottom ash and boiler slag. The ash and slag is continuously dredged and is sold to a private contractor who uses the material as roofing granules.
- Ash Pond – Cell No. 2 – This cell is a wet storage that is used to contain fly ash, bottom ash, boiler slag, and sediments from the coal pile runoff. The fly ash is collected and used as part of the mine reclamation activities on the power plant property.

Based on our observation and the soil boring information presented in the Global Stability Evaluation report prepared by Geotechnology, Inc. in May of 2010, the CCW impoundment dikes appear to have homogeneous construction using silty clayey fill soils. The dikes were designed without internal drains from the collection of seepage.

The dike for the Slag Dewatering Basin has an approximate crest width of 10 feet and design upstream and downstream side slopes of 3H:1V and 2H:1V, respectively. The perimeter dike for Ash Pond – Cell No. 2 has an approximate crest width of 18 feet and design upstream and downstream side slopes of 3H:1V.

The basic dimensions and geometry of each impoundment is summarized in Table 2-1.

Table 2-1: Summary Information for Impoundment Dike Parameters

Parameter	Value	
Dam	Slag Dewatering Basin	Ash Pond – Cell No. 2
Maximum Height (ft)	Approximately 10	25
Approximate Length (ft)	1,500	830
Approximate Crest Width (ft)	15	18
Lowest Crest Elevation (ft)	735	717
Design Side Slopes (H:V)	3:1 US/2:1 DS	3:1 US/3:1 DS
Estimated Freeboard (ft) at time of site visit	2.7	4
Total Storage Capacity (cubic yards)*	16,000	50,000
Approximate Surface Area (acres)*	3	12

*Storage capacity and area values provided by Associated Electric Cooperative, Inc.

2.3 Spillways

The Ash Pond – Cell No. 2 Impoundment has an emergency spillway (Photo 16) which, if utilized, would flow into Ash Pond – Cell No. 3. The emergency spillway is an Open Channel Spillway, trapezoidal in shape, with a top width of approximately 18 feet, an average bottom width of 12 feet, and a depth of 2 feet below the top of the dike crest. The emergency spillway crest is lined with 3- to 6-inch crushed rock.

The Slag Dewatering Pond does not have a spillway associated with the impoundment.

2.4 Intakes and Outlet Works

2.4.1 Slag Dewatering Basin

The coal ash slurry line at the Slag Dewatering Basin consists of an 18-inch steel pipe from the power plant. Photos 1 and 2 in Appendix B show the inlet structure to the Slag Dewatering Basin.

The outlet structure (Photos 3 and 7) consists of a 30-inch diameter concrete outlet pipe from the concrete decant tower with 60-inch wide, 6-inch square concrete stop logs. The outlet structure releases the decant water into a bypass channel (Photo 4) which bypasses Ash Pond – Cell No. 1 and discharges into the Ash Pond – Cell No. 2 (Photos 8 and 9). At the time of our visit to the site, there was active flow through the outlet structure.

2.4.2 Ash Pond – Cell No. 2

Decant water is received from the Slag Dewatering Basin through a bypass channel (Photos 8 and 9) and from a concrete decant tower with 60-inch wide, 6-inch square concrete stop logs in the Ash Pond – Cell No. 1. This decant water is collected from natural runoff around Ash Pond – Cell No. 1.

The outlet structure (Photo 12) consists of a 36-inch diameter concrete outlet pipe from the concrete decant tower with 72-inch wide, 6-inch square concrete stop logs. At the time of our visit to the site, there was active flow through the outlet structure into Ash Pond – Cell No. 3. Ash Pond – Cell No. 3 contains only decant water prior to its release to the Middle Fork of the Little Chariton River.

2.5 Vicinity Map

Thomas Hill Energy Center is located in the town of Clifton Hill in Randolph County, Missouri, as shown on Figure 1. The specific latitude and longitude of the ponds is provided below:

Longitude: 92 Degrees, 38 Minutes, 17 Seconds
Latitude: 39 Degrees, 32 Minutes, 34 Seconds

2.6 Plan and Sectional Drawings

GEI was provided with two partial sets of design documents for this project and a geotechnical engineering report. These documents included:

- Engineering drawings for the “Ash Pond Facilities” project in 1978-79. These plans were prepared by Burns and McDonnell dated December 1, 1978 and March 23, 1979.

invert elevation is at about El. 731 feet. Based on the 24-hour 100-year precipitation event of 7.2 inches, the Slag Dewatering Basin would receive about 8.4 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Slag Dewatering Basin, however the available storage volume and discharge capacity of the decant structure is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Slag Dewatering Basin meets the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.

5.2.2 Ash Pond – Cell No. 2

The contributing drainage area to the Ash Pond – Cell No. 2 includes the impoundment's surface area (Table 2-1) and a considerable amount of surrounding surface drainage. Additionally, decant water from the Slag Dewatering Basin and Ash Pond – Cell No. 1 can be routed to Ash Pond – Cell No. 2 through the decant structures, producing a total contributing drainage area of about 148 acres. However, currently Ash Pond – Cell No. 1 does not store any water and has considerable available storage capacity to store the design storm precipitation that falls over the reservoir surface. Therefore, based on the current configuration, Ash Pond – Cell No. 1 does not contribute storm water runoff to Ash Pond – Cell No. 2, resulting in a total contributing drainage area to Ash Pond – Cell No. 2 of about 136 acres.

The water surface in Ash Pond – Cell No. 2 is regulated by a decant structure located through the south dike that discharges water into Ash Pond – Cell No. 3. Additionally, Ash Pond – Cell No. 2 has an 18-foot wide by 2-foot deep emergency spillway located over the south dike that can also discharge water into Ash Pond – Cell No. 3. Currently, the Ash Pond – Cell No. 2 water level is maintained at about El. 713 feet, providing about 4.0 feet of freeboard. Based on the current configuration and the 24-hour 100-year precipitation event of 7.2 inches, the Ash Pond – Cell No. 2 would receive about 83 acre-feet of storm water. Without detailed hydraulic routing simulations, it is difficult to determine the resulting water surface elevation in Ash Pond – Cell No. 2, however the combined discharge capacity of the decant structure and emergency spillway is likely enough to maintain at least 1 foot of residual freeboard during the design event. Based on these results, the Ash Pond – Cell No. 2 will likely meet the regulatory requirements for storing and passing the 24-hour 100-year inflow design flood without overtopping the dam.

8.3 Ash Pond – Cell No. 2

8.3.1 Impoundment Dike

8.3.1.1 Dike Crest

The crest of the dike at the Ash Pond – Cell No. 2 appeared to be in good condition. No signs of cracking, settlement, movement, erosion or deterioration were observed during the assessment. The crest appears to be well-drained and no standing water was observed. The dike crest surface is generally composed of gravel road base material that traverses the length of the dike for vehicle access.

8.3.1.2 Upstream Slope

The upstream slope (Photos 10, 14, 15 and 18) of the dike at the Ash Pond – Cell No. 2 is partially covered with small riprap near the toe and well established grass growth near the crest of the embankment. The remaining slope is unprotected. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the impoundment.

8.3.1.3 Downstream Slope

The downstream slope (Photos 11 and 17) of the dike at the Ash Pond – Cell No. 2 (which is also the upstream slope of Ash Pond – Cell No. 3) has well-established grass growth, which provides some erosion protection. At the toe of the slope is Ash Pond – No. 3. The lower 10 feet of the slope is rip rap with small to medium size rock. No scarps, sloughs, depressions or other indications of slope instability or signs of erosion were observed during the inspection of the impoundment.

8.3.2 Seepage and Stability

We observed no signs of seepage or slope instability in the dike during our inspection of Ash Pond – Cell No. 2.

8.3.3 Appurtenant Structures

8.3.3.1 Outlet Structure

The outlet structure (Photo 12) consists of a 36-inch diameter concrete outlet pipe and a concrete decant tower with 72-inch wide, 6-inch square concrete stop logs. The outlet structure releases decant water into Ash Pond – Cell No. 3. At the time of our visit to the site, there was active flow through the outlet structure.

8.3.3.2 Pump Structures

No pumps are present at Ash Pond – Cell No. 2.

8.3.3.3 Emergency Spillway

Just west of the Ash Pond – Cell No. 2 spillway (decant outlet) is the emergency spillway (Photo 16). The emergency spillway is an Open Channel Spillway, trapezoidal in shape, with a top width of approximately 18 feet, an average bottom width of 12 feet, and a depth of 2 feet below the top of the dike crest. The emergency spillway crest is lined with 3- to 6-inch crushed rock.

8.3.3.4 Drains

No internal or toe drains are present in the dike at Ash Pond – Cell No. 2.

8.3.3.5 Water Surface Elevations and Reservoir Discharge

At the time of our inspection on November 9, 2010, the Ash Pond – Cell No. 2 water level was observed to be at an approximate elevation of 713 feet (Photo 13). The water surface of Ash Pond – Cell No. 2 is controlled by the outlet structure that discharges into the Ash Pond – Cell No. 3.

Appendix 3

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MO

DATA DESCRIPTION

Data type: precipitation depth **Units:** english **Time series type:** partial duration

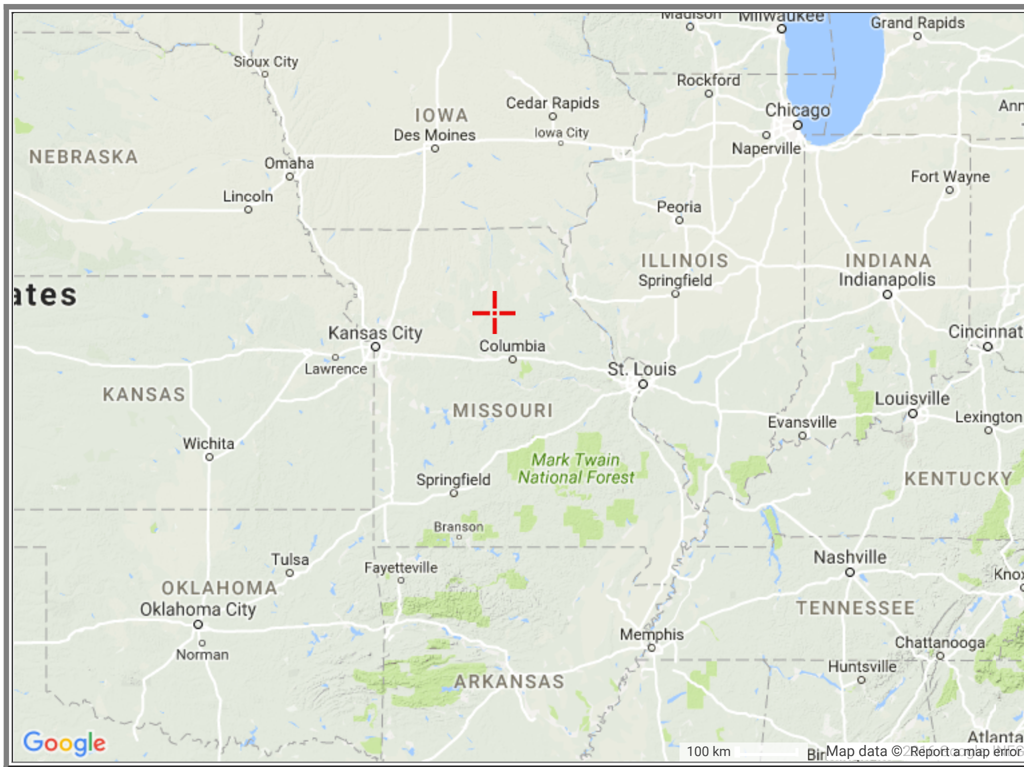
SELECT LOCATION

1. Manually:

a) Enter location (decimal degrees, use "-" for S and W): latitude: 39.544661 longitude: -92.635891 submit

b) Select station (click here for a list of stations used in frequency analysis for MO): select station

2. Use map:



a) Select location
(move crosshair or double click)
b) Click on station icon
(show stations on map)

LOCATION INFORMATION:
Name: Clifton Hill, Missouri, US*
Latitude: 39.5447°
Longitude: -92.6359°
Elevation: 733 ft*

* source: Google Maps

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 8, Version 2

PF tabular PF graphical Supplementary information Print Page

PDS-based 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	0.405 (0.328-0.498)	0.468 (0.378-0.576)	0.570 (0.459-0.703)	0.654 (0.524-0.810)	0.769 (0.594-0.975)	0.857 (0.647-1.10)	0.944 (0.688-1.24)	1.03 (0.721-1.39)	1.15 (0.770-1.58)	1.23 (0.808-1.72)
10-min	0.593 (0.480-0.729)	0.685 (0.554-0.843)	0.834 (0.673-1.03)	0.958 (0.767-1.19)	1.13 (0.870-1.43)	1.25 (0.947-1.61)	1.38 (1.01-1.81)	1.51 (1.05-2.03)	1.68 (1.13-2.31)	1.80 (1.18-2.52)
15-min	0.723 (0.585-0.890)	0.835 (0.676-1.03)	1.02 (0.820-1.26)	1.17 (0.936-1.45)	1.37 (1.06-1.74)	1.53 (1.16-1.96)	1.69 (1.23-2.21)	1.84 (1.29-2.47)	2.05 (1.38-2.81)	2.20 (1.44-3.08)
30-min	1.02 (0.827-1.26)	1.19 (0.965-1.47)	1.47 (1.19-1.81)	1.70 (1.36-2.10)	2.00 (1.54-2.53)	2.23 (1.68-2.86)	2.45 (1.79-3.21)	2.68 (1.87-3.59)	2.97 (1.99-4.08)	3.18 (2.08-4.44)
60-min	1.29 (1.05-1.59)	1.54 (1.25-1.90)	1.96 (1.58-2.41)	2.30 (1.84-2.85)	2.79 (2.16-3.56)	3.17 (2.40-4.09)	3.56 (2.60-4.68)	3.96 (2.77-5.33)	4.49 (3.02-6.20)	4.91 (3.21-6.85)
2-hr	1.57 (1.28-1.92)	1.89 (1.54-2.31)	2.44 (1.98-2.99)	2.91 (2.35-3.58)	3.58 (2.79-4.55)	4.11 (3.13-5.28)	4.66 (3.43-6.11)	5.24 (3.69-7.02)	6.02 (4.08-8.26)	6.63 (4.38-9.20)
3-hr	1.73 (1.41-2.10)	2.10 (1.72-2.56)	2.75 (2.24-3.36)	3.31 (2.68-4.06)	4.14 (3.25-5.26)	4.81 (3.68-6.17)	5.51 (4.08-7.21)	6.25 (4.43-8.37)	7.28 (4.96-9.97)	8.09 (5.36-11.2)
6-hr	2.06 (1.70-2.49)	2.50 (2.06-3.03)	3.27 (2.68-3.97)	3.96 (3.22-4.82)	4.97 (3.95-6.31)	5.81 (4.49-7.43)	6.71 (5.00-8.74)	7.66 (5.48-10.2)	9.00 (6.19-12.3)	10.1 (6.72-13.8)

12-hr	**2.49** (2.06-2.99)	**2.95** (2.44-3.55)	**3.77** (3.11-4.54)	**4.50** (3.69-5.44)	**5.57** (4.45-7.01)	**6.46** (5.03-8.20)	**7.41** (5.57-9.59)	**8.42** (6.06-11.1)	**9.83** (6.81-13.3)	**11.0** (7.38-14.9)
24-hr	**2.95** (2.46-3.52)	**3.42** (2.85-4.08)	**4.24** (3.52-5.08)	**4.97** (4.11-5.98)	**6.06** (4.88-7.57)	**6.97** (5.46-8.77)	**7.92** (6.00-10.2)	**8.95** (6.50-11.8)	**10.4** (7.25-13.9)	**11.5** (7.82-15.6)
2-day	**3.38** (2.84-4.01)	**3.88** (3.25-4.61)	**4.76** (3.98-5.66)	**5.54** (4.61-6.62)	**6.70** (5.43-8.30)	**7.66** (6.05-9.58)	**8.68** (6.61-11.1)	**9.77** (7.14-12.7)	**11.3** (7.94-15.0)	**12.5** (8.54-16.8)
3-day	**3.67** (3.10-4.34)	**4.22** (3.56-4.99)	**5.17** (4.34-6.13)	**6.02** (5.02-7.16)	**7.26** (5.89-8.94)	**8.28** (6.55-10.3)	**9.35** (7.15-11.9)	**10.5** (7.70-13.6)	**12.1** (8.54-16.0)	**13.4** (9.17-17.9)
4-day	**3.94** (3.33-4.64)	**4.52** (3.81-5.33)	**5.52** (4.65-6.53)	**6.41** (5.37-7.61)	**7.72** (6.28-9.47)	**8.79** (6.97-10.9)	**9.91** (7.60-12.5)	**11.1** (8.17-14.4)	**12.8** (9.04-16.9)	**14.1** (9.70-18.8)
7-day	**4.64** (3.94-5.44)	**5.28** (4.48-6.19)	**6.38** (5.40-7.50)	**7.37** (6.20-8.69)	**8.80** (7.21-10.7)	**9.98** (7.97-12.3)	**11.2** (8.66-14.1)	**12.5** (9.29-16.1)	**14.4** (10.2-18.9)	**15.9** (11.0-21.0)
10-day	**5.28** (4.50-6.16)	**5.97** (5.09-6.98)	**7.17** (6.09-8.40)	**8.23** (6.95-9.68)	**9.79** (8.04-11.9)	**11.1** (8.86-13.6)	**12.4** (9.60-15.5)	**13.8** (10.3-17.7)	**15.8** (11.3-20.7)	**17.4** (12.1-22.9)
20-day	**7.11** (6.10-8.24)	**8.02** (6.88-9.31)	**9.57** (8.18-11.1)	**10.9** (9.27-12.7)	**12.8** (10.6-15.4)	**14.3** (11.6-17.4)	**15.9** (12.4-19.7)	**17.6** (13.1-22.3)	**19.8** (14.3-25.7)	**21.6** (15.1-28.3)
30-day	**8.64** (7.45-9.98)	**9.78** (8.42-11.3)	**11.7** (10.0-13.5)	**13.2** (11.3-15.4)	**15.5** (12.8-18.4)	**17.2** (13.9-20.7)	**18.9** (14.8-23.3)	**20.8** (15.6-26.1)	**23.2** (16.7-29.9)	**25.1** (17.6-32.7)
45-day	**10.6** (9.17-12.2)	**12.0** (10.4-13.8)	**14.3** (12.4-16.5)	**16.2** (13.9-18.8)	**18.8** (15.6-22.3)	**20.8** (16.9-24.9)	**22.8** (17.8-27.9)	**24.8** (18.6-30.9)	**27.3** (19.8-35.0)	**29.3** (20.7-38.0)
60-day	**12.3** (10.6-14.1)	**14.0** (12.1-16.0)	**16.6** (14.4-19.2)	**18.8** (16.2-21.7)	**21.7** (18.0-25.6)	**23.9** (19.4-28.5)	**26.1** (20.4-31.7)	**28.1** (21.2-35.0)	**30.8** (22.4-39.2)	**32.8** (23.2-42.5)

[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.

Estimates from the table in csv format: precipitation frequency estimates ▼ Submit

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Appendix 4

NOTES:
1. ALL FLOWS INDICATE MILLION GALLONS PER DAY.
2. NUMBERS IN PARENTHESIS () INDICATE INSTANTANEOUS OR DAILY MAXIMUM FLOWS BECAUSE ALL MAXIMUM FLOWS MAY NOT OCCUR SIMULTANEOUSLY. FLOWS WILL NOT BALANCE UNDER MAXIMUM CONDITIONS.
3. ALL OTHER FLOW RATES ARE INTENDED TO REPRESENT THE AVERAGE MONTHLY DAY.

REV	DATE	DESCRIPTION	APP
3	6/08	REV. AS IS	JRE
2	9/99	REV. AS IS	JRE
1	6/97	REV. AS IS	JRE

aeci
associated electric cooperative, inc.

HEADQUARTERS

PROJECT TITLE

DRAWING TITLE

THOMAS HILL POWER PLANT
N. P. D. E. S. FLOW DIAGRAM

CONTRACTOR NAME:

DWG. NO. EOJEBAC

PROJECT NO.	DESIGN BY: JEB
DATE: 21-JAN-1992	DRAWN BY: DAB
CAD FILE NO. EOJEBAC	APPROVED BY: REV. 3

LEGEND
EXISTING SYSTEM
INTERMITTENT OR ABNORMAL FLOWS

THIS IS A CADD GENERATED DRAWING
MAGNIFICATION FACTOR (1)