Jeffrey Energy Center
Fly Ash Landfill
Run-on and Run-Off Control System Plan

Jeffrey Energy Center
25905 Jeffrey Rd.
St. Marys, Kansas

Prepared for:

evergy

Evergy Kansas Central, Inc.

SCS ENGINEERS

25221157.00 | October 2021

40 Shuman Blvd, Ste 216
Naperville, IL 60563

Table of Contents

Figures

Appendices

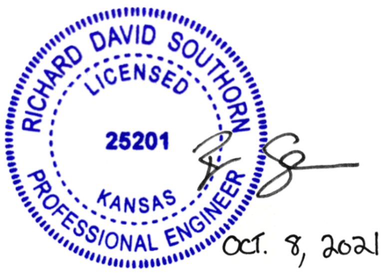
PLAN REVIEW/AMENDMENT LOG

Date of Review	Reviewer Name	Amendment Required (YES/NO)	Sections Amended and Reason
October 2016 (Revision 0)	CB&I Environmental & Infrastructure, Inc.	N/A	Initial Plan
October 2021 (Revision 1)	SCS Engineers	YES	All sections revised / updated as part of the 5-year periodic review process.

PROFESSIONAL ENGINEER CERTIFICATION

I, Richard D. Southorn, hereby certify that this Run-On and Run-Off Control System Plan meets the requirements of 40 CFR §257.81, was prepared by me or under my direct supervision, and that I am a duly licensed Professional Engineer under the laws of the State of Kansas.

This plan has been prepared as a periodic update to the initial Run-On and Run-Off Control System Plan that was certified on October 17, 2016.



Richard D. Southorn, PE

License No. PE 25201

Expires 4/30/2023

1.0 INTRODUCTION

The Fly Ash Landfill (Landfill) is an existing coal combustion residual (CCR) landfill located at Evergy's Jeffrey Energy Center near St. Marys, Kansas. This Run-on and Run-off Control System Plan (RORO Plan) documents that the Landfill's run-on and run-off control systems have been designed and constructed to meet the applicable requirements of Title 40 Code of Federal Regulations (CFR) §257.81[1] of the CCR Rule.

2.0 REGULATORY REQUIREMENTS

<u>40 CFR §257.81 Run-on and run-off controls for CCR landfills.</u>

(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must design, construct, operate, and maintain:

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR §257.3-3[1].

(c) Run-on and run-off control system plan

(1) Content of the plan. The owner or operator must prepare initial and periodic run-on and run-off 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 run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility's operating record as required by 40 CFR §257.105(g)(3).

With reference to 40 CFR §257.81(c) above, the initial RORO Plan was required to be developed no later than October 17, 2016 for existing landfills (40 CFR §257.81(c)(3)(i))[1]. Updates to the RORO Plan are required whenever there is a change in conditions that would substantially affect the written plan in effect (40 CFR §257.81(2))[1], or within five years of the previous plan (40 CFR §257.81(c)(4))[1].

The owner or operator must obtain a certification from a qualified professional engineer or approval from the Participating State Director or EPA, where EPA is the permitting authority, stating that the initial and periodic RORO Plans meet the requirements of 40 CFR §257.81[1].

3.0 2021 RUN-ON AND RUN-OFF CONTROL SYSTEM PLAN UPDATE

This document has been prepared as the periodic update to the initial RORO Plan. This plan has been developed to reflect run-on and run-off controls that are being used at the facility at the time of this report. As such, this plan replaces the previous RORO Plan. The current run-on and run-off control systems at the Landfill have been reviewed as part of this 2021 Periodic RORO Plan update and have been found to meet the requirements of 40 CFR §257.81(a)[1], as outlined in Section 2.0.

Conveyance features that comprise the run-on and run-off control systems at the Landfill are depicted in Figure 1. Storm water calculations supporting the below discussion are included in Appendices A through C.

3.1 RUN-ON CONTROL SYSTEM

Non-contact storm water flowing towards the active portion of the Landfill is controlled by a perimeter berm system constructed to direct storm water around the Landfill boundary. The perimeter berm crest is approximately 2-ft. above the elevation of grades outside of the Landfill and directs run-on around the Landfill toward natural ravines situated on the east and west periphery of the Landfill that convey stormwater to Tower Hill Lake, which is immediately adjacent to the Landfill. The run-on control system is depicted in Figure 1.

Non-contact storm water is directed around the Landfill flows toward Tower Hill Lake. Tower Hill Lake is located immediately to the southwest of the Landfill and is permitted to receive non-contact water, contact water, and leachate from the JEC, including multiple landfills and surface impoundments under the facility's National Pollutant Discharge Elimination System (NPDES) Permit. In accordance with 40 CFR §257.81(b)[1], this is consistent with the surface water requirements under 40 CFR §257.3-3[1].

3.2 RUN-OFF CONTROL SYSTEM

Contact water is permitted to discharge directly into Tower Hill Lake per the NPDES Permit. As such, run-off control systems have not been established at the Landfill. Direct precipitation falling on a majority of the active portion of the Landfill collects in depressional areas within the Landfill. Remaining portions of the active area flow along the surface of the landfill across slopes graded toward the south into Tower Hill Lake. As Landfill build-out continues, areas achieving final grades will be vegetated and closed from active filing. These closed areas will be directed to drain storm water toward Tower Hill Lake and away from the majority of the active portion of the Landfill.

3.3 HYDROLOGIC AND HYDRAULIC ANALYSIS

Engineering calculations to evaluate the run-on control system at the Landfill consist of a hydrologic and hydraulic storm water model prepared using HydroCAD storm water modeling software. The run-on control system model for the Landfill is provided in Appendix B. A run-off control evaluation for the landfill was not completed because contact water is permitted to discharge directly into Tower Hill Lake and run-off control systems are therefore not required. A regional model evaluating the capacity within Tower Hill Lake is provided in Appendix C. Information used to prepare the HydroCAD storm water model is summarized below.

3.3.1 Rainfall Data

Rainfall amounts for the 25-year, 24-hour storm were obtained from the Rainfall Intensity Tables for Counties in Kansas (2014) prepared by Kansas Department of Transportation. This document provides rainfall intensities for various durations and recurrence intervals, displayed in rainfall intensity tables for each county in Kansas. The rainfall intensity table applicable to the Landfill is the table prepared for Pottawatomie County (Appendix A). The 25-year, 24-hour rainfall amount for the Landfill was determined to be 6.00-inches, based on a rainfall rate of 0.25 inches/hour for 24 hours.

The Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (SCS), Technical Release 55 (TR-55) was consulted to determine the appropriate storm water distribution pattern to model the rainfall depth in HydroCAD. According to TR-55[2], the Type-II 24-hour storm distribution is appropriate for all counties located in Kansas.

3.3.2 Model Input Parameters

Subcatchment areas (also known as watersheds) were delineated using AutoCAD Civil3D 2020 (AutoCAD) based on topographic divides within the analyzed area. For the Landfill run-on control system model, all areas flowing toward the Landfill and the active portion of the Landfill are delineated and modeled in HydroCAD. These areas are depicted in Figure 1.

For the regional Tower Hill Lake model, the subcatchment area was delineated using the United States Geological Survey (USGS) 7.5-minutre topographic quadrangle map. This subcatchment area is depicted in Figure 2.

The Curve number (CN) is a parameter used to determine the amount of runoff that will occur from a surface. High CN values indicate that the majority of rainfall will run off with minimal losses. Lower values correspond to an increased ability of rainfall to infiltrate the ground surface, leading to lower run off rates.

Runoff from each subcatchment area was calculated using the NRCS-SCS Technical Release 20 (TR-20) method that utilizes soil types, land covers, and flow length parameters to calculate storm water run-off. According to the NRCS Web Soil Survey for Pottawatomie County[3], the predominant soil type within the Jeffrey Energy Center footprint is Hydrologic Soil Group D (HSG-D). All subcatchment areas have been modeled with the soil type designation. The land cover designations were selected from defined CN tables published in the NRCS-SCS TR-55. The land cover applicable for both models consists of open space with good grass cover (CN=80) and water surface (CN=98).

The time of concentration, defined as the longest amount of time a waterdrop would take to travel from the headwater of a subcatchment area to its downstream edge was delineated in AutoCAD and entered for each subcatchment in HydroCAD.

3.3.3 Conveyance Features

Run-on control is provided by a perimeter berm system that intercepts run-on flowing towards the active portion of the Landfill and directs non-contact water around the Landfill boundary. The perimeter berm crest is approximately 2-ft. above the elevation of grades outside of the Landfill and is sloped at a 4H:1V sideslope. The perimeter berm system creates a conveyance path for non-contact water along the toe of the berm slope that directs run-on toward natural ravines situated on the east and west periphery of the Landfill. These conveyance paths are modeled in HydroCAD to demonstrate the run-on control system is appropriately sized to accommodate the 25-year, 24-hour storm event.

Tower Hill Lake is designed to serve as the run-off control system for the Landfill and other portions of the Jeffrey Energy Center. Tower Hill Lake was modeled with incremental detention volume defined by contour intervals from the normal water elevation at approximate elevation 1,146.0 ft. MSL the lowest elevation of the perimeter berm at approximate elevation 1,166.0 ft. MSL. Tower Hill Lake is modeled to demonstrate the run-off control system is appropriately sized to accommodate total discharge rate from the Landfill for 25-year, 24-hour storm event.

3.4 RESULTS AND CONCLUSIONS

The HydroCAD storm water model of the Landfill was developed to evaluate whether the peak flow from the 25-year, 24-hour storm event could be accommodated without overtopping the run-on control systems.

Run-On Control System

The run-on control system is designed and constructed to divert storm water away from the active portions of the Landfill and into Tower Hill Lake. Based on the results of the HydroCAD storm water model, the run-on control system was determined to accommodate the 25-year, 24-hour storm event without overtopping and meets the requirements of 40 CFR §257.81(a)(1)[1]. The peak depth and freeboard remaining within each conveyance feature is summarized below:

Table 1 – Conveyance Feature Sizing		
Conveyance Feature Designation	Peak Depth (feet)	Freeboard (feet)
East Berm 1	0.96	1.04
West Berm 1	1.27	0.73
West Berm 2	1.33	0.67
West Berm 3	1.07	0.93

Run-Off Control System

Tower Hill Lake is immediately adjacent to the landfill and is permitted to receive contact water runoff. No engineered run-off controls are required to directly discharge run-off to Tower Hill Lake. Therefore, the landfill design is compliant with 40 CFR §257.81(a)(2)[1].

Based on the results from the regional HydroCAD model, Tower Hill Lake is designed to collect and control the water volume resulting from the 25-year, 24-hour storm event for the Landfill and other portions of the Jeffrey Energy Center without overtopping. The peak depth and freeboard remaining within Tower Hill Lake is summarized below:

Table 2 – Tower Hill Lake Capacity		
Peak Rise in Water Elevation (feet)	Remaining Freeboard (feet)	Remaining Capacity (acre-feet)
2.70	17.30	2,804,237.85

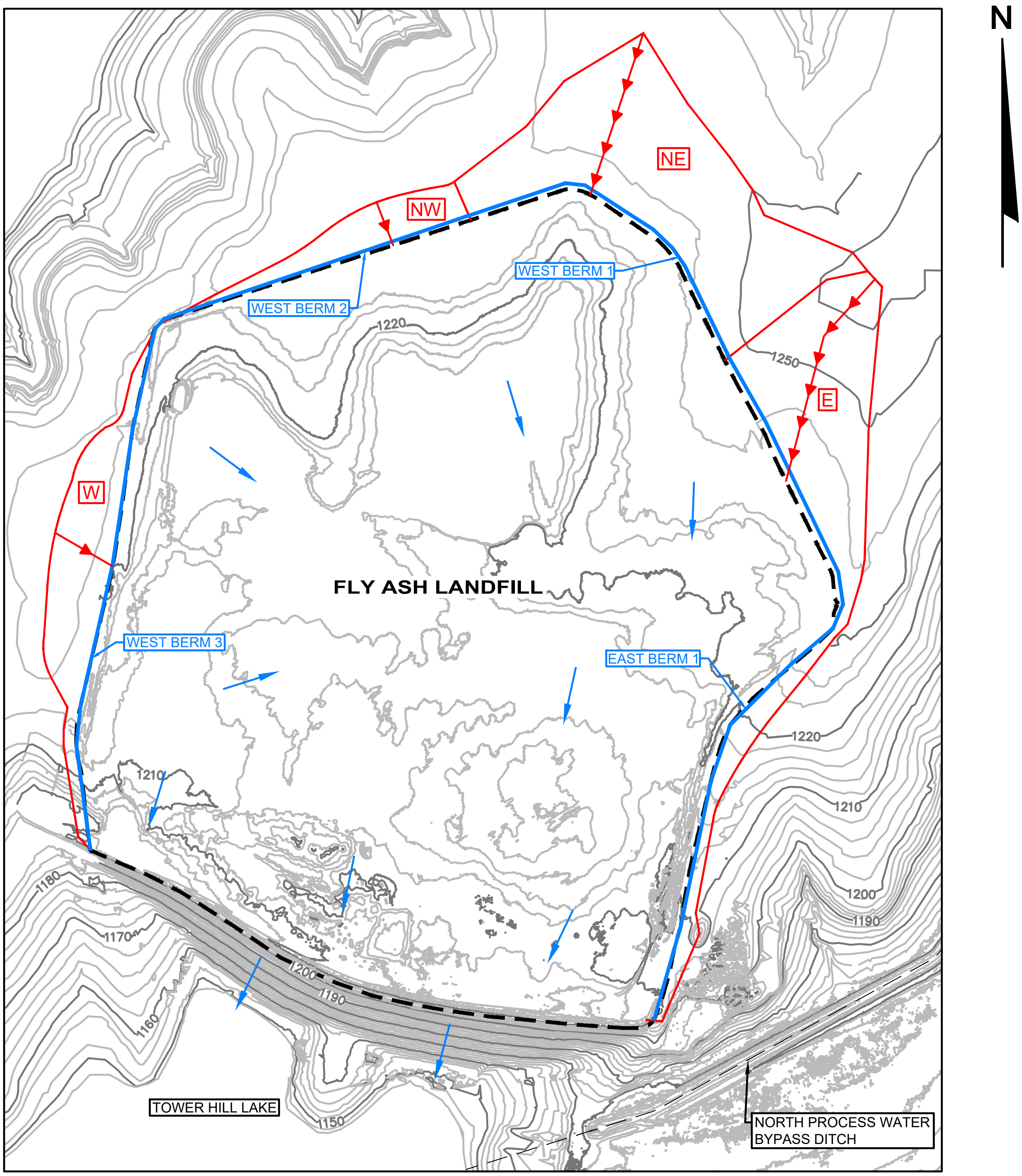
4.0 CERTIFICATIONS

Richard D. Southorn, a licensed Professional Engineer in the State of Kansas, has overseen the preparation of this Run-On and Run-Off Control System Plan. A certification statement in accordance with 40 CFR §257.81(c)(5)[1] is provided on **Page iii** of this plan.

5.0 REFERENCES

1. U.S. Environmental Protection Agency, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, Title 40 Code of Federal Regulations Part §257. Federal Register 80, Subpart D, dated April 17, 2015, as revised.
2. USDA Natural Resources Conservation Service, Technical Release 55, dated June 1986.
3. USDA Natural Resources Conservation Service, Web Soil Survey for Pottawatomie County https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm, dated 2021.

Figures



EXISTING SITE TOPOGRAPHY DEVELOPED BY PROFESSIONAL ENGINEERING CONSULTANTS (PEC) IN DECEMBER 2020

LEGEND

- RUN–ON SUBCATCHMENT BOUNDARY
- APPROXIMATE ACTIVE AREA BOUNDARY
- WATER CONVEYANCE FEATURE LOCATION
- TIME OF CONCENTRATION FLOW PATH
- FLOW DIRECTION

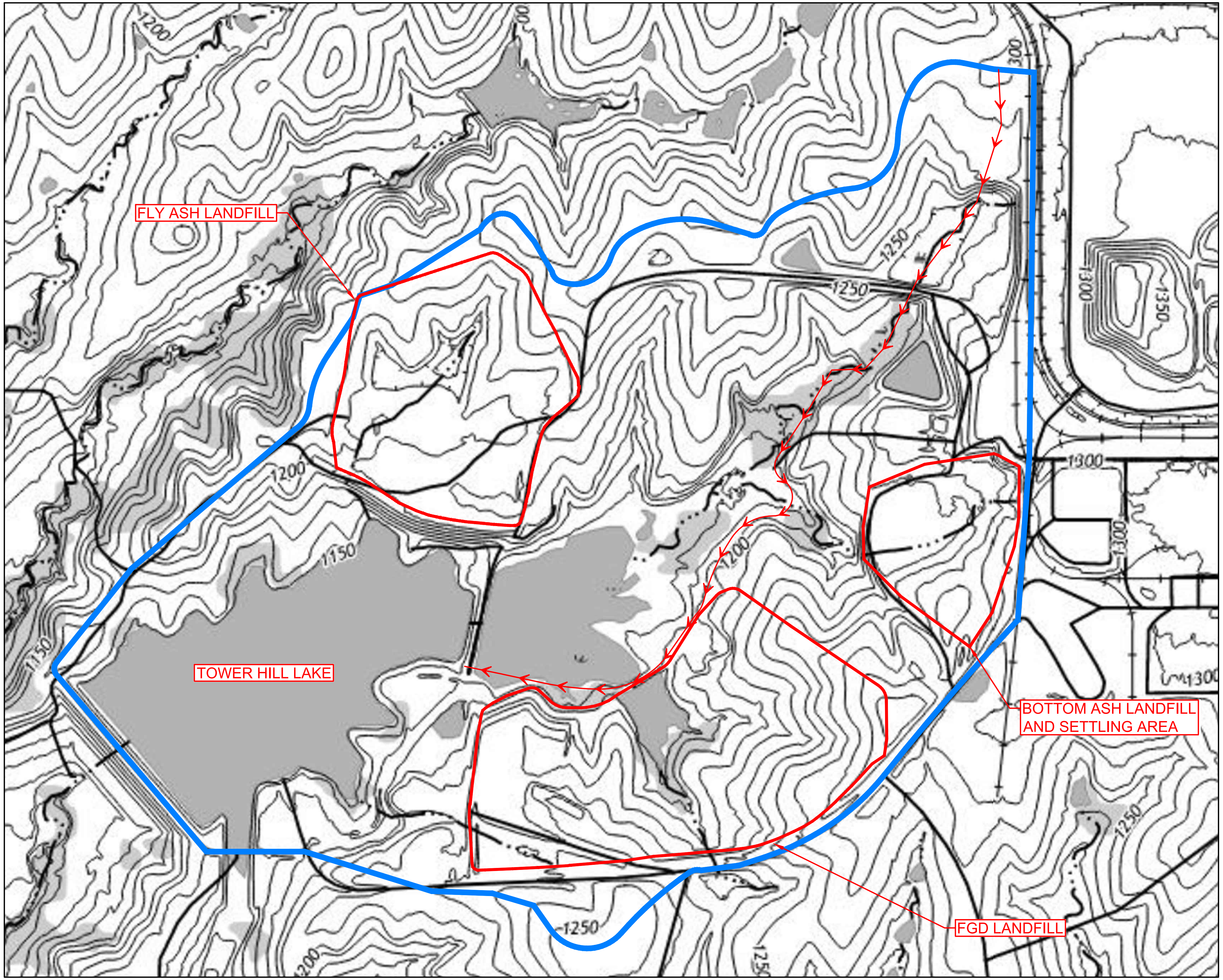
500 0 500

SCALE: 1" = 500'

CLIENT	evergy	SITE	JEFFREY ENERGY CENTER ST. MARYS, KS	RUN–ON RUN–OFF PLAN SUBCATCHMENT DELINEATION

PROJECT NO.	25221157	DRAWN BY:	NV	ENGINEER	SCS ENGINEERS 2830 DAIRY DRIVE MADISON, WI 53718–6751 PHONE: (608) 224–2830	FIGURE
DRAWN:	08/26/2021	CHECKED BY:	SJL			1 OF 2
REVISED:	09/21/2021	APPROVED BY:	RDS			

I:\25221157.00\Drawings\Site Layout-HydroCAD (JEC RORO).dwg, 9/24/2021 8:17:22 AM



LEGEND

- CCR UNIT BOUNDARY
- WATERSHED BOUNDARY
- TIME OF CONCENTRATION

NOTES:

1. FIGURE ADAPTED FROM USGS 7.5–MINUTE TOPOGRAPHIC QUADRANGLE FROM EMMETT AND LECLEDE, KS (2018).
2. ALL BOUNDARIES ARE APPROXIMATE.

N

1000 0 1000

SCALE: 1" = 1000'

PROJECT NO.	25221157	DRAWN BY:	SJL
DRAWN:	08/26/2021	CHECKED BY:	RDS
REVISED:		APPROVED BY:	

ENGINEER: SCS ENGINEERS, 2830 DAIRY DRIVE MADISON, WI 53718–6751, PHONE: (608) 224–2830

CLIENT: evergy

SITE: JEFFREY ENERGY CENTER, ST. MARYS, KS

JEFFREY ENERGY CENTER
REGIONAL CONTROL SYSTEM
TOWER HILL LAKE

FIGURE
2 OF 2

Appendices

Appendix A	Rainfall Intensity Table for Kansas Counties
Appendix B	Fly Ash Landfill Run-On Control System – HydroCAD Output Files
Appendix C	Regional Control System Tower Hill Lake – HydroCAD Output Files

Appendix A Rainfall Intensity Table for Kansas Counties

MEMO

Kansas
Department of Transportation
Bureau of Road Design

ROAD MEMORANDUM NO. 16-03

DATE: September 2, 2016

SUBJECT: *Rainfall Intensity Tables*

The publication, *Rainfall Intensity Tables for Counties in Kansas*, dated June 1997, has recently be updated and replaced by *Rainfall Intensity Tables for Counties in Kansas (2014)*.

The new tables were developed from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Volume 8 (Perica et al. 2013) which was recently released by the National Weather Service (NWS) Hydro Meteorological Design Studies Center. The new tables provide rainfall intensities for durations from 5 minutes to 24 hours and various recurrence intervals from 1-500 years.

The *Rainfall Intensity Tables for Counties in Kansas (2014)* supersede the previous rainfall tables based on TP-40 and HYDRO-35 (McEnroe 1997). The new rainfall tables are available on the Kansas Department of Transportation's (KDOT) website at http://kart.ksdot.org.

If you have any questions, please contact John Hobelman at (785) 368-8791.

Scott W. King, P.E., Chief
Bureau of Road Design

SWK:js
By e-mail: American Council of Engineering Companies
Federal Highway Administration
Kansas Contractors Association (kca@ink.org)
Active Consultants
Director of Engineering & Design
Director of Operations
District Engineers
Area Engineers
Chief, Bureau of Local Projects
Chief, Bureau of Right of Way
Chief, Bureau of Transportation Safety & Technology
Chief, Bureau of Construction & Materials
Chief, Bureau of Maintenance
Chief, Bureau of Structures and Geotechnical Services
Road Design/Squad Leaders
Coordinating Section

Rainfall Intensity
Tables
for
Counties in Kansas

Kansas
Department of Transportation

(December, 2014 Edition)

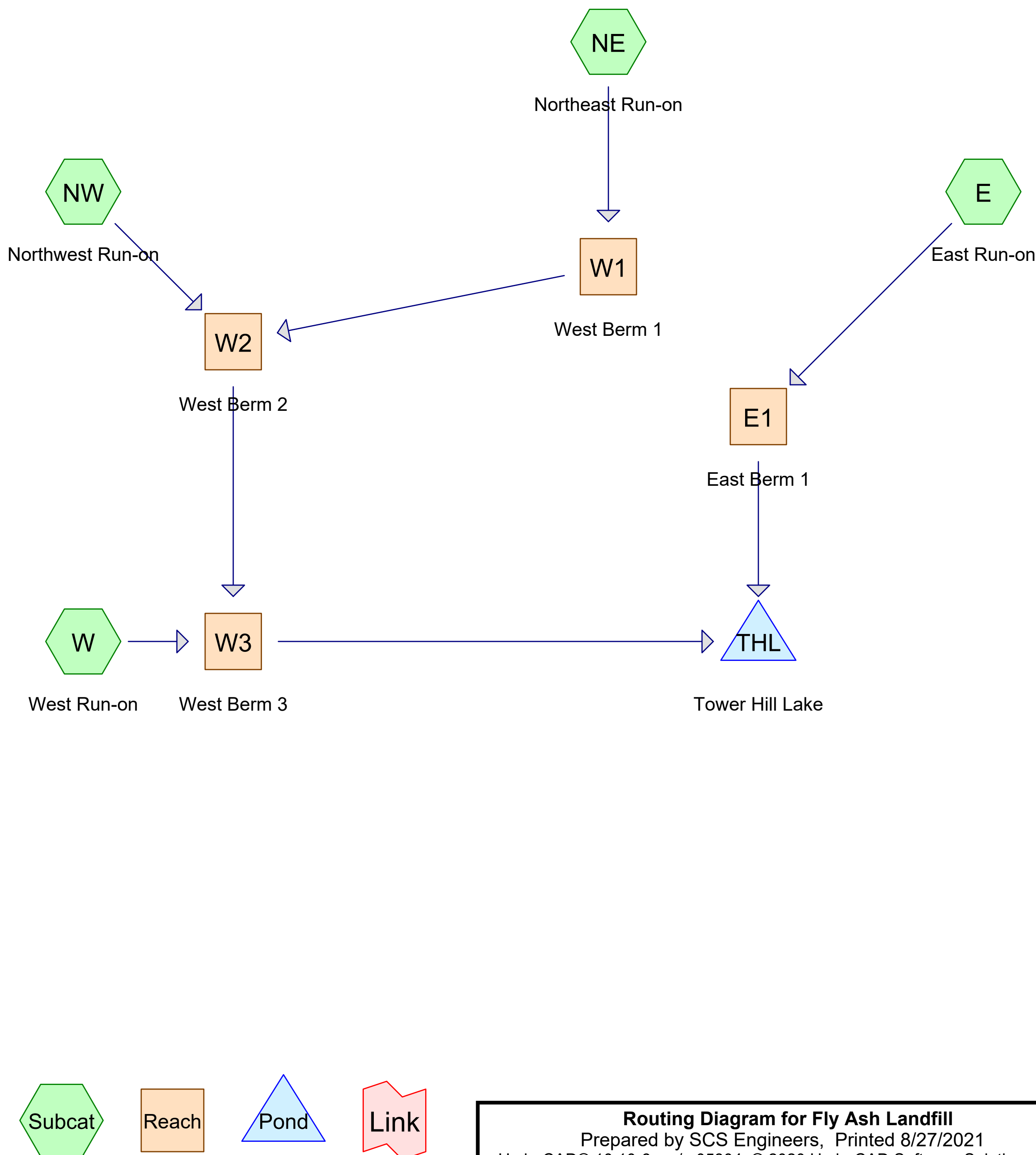
RAINFALL INTENSITY TABLE

POTTAWATOMIE COUNTY, KANSAS

This table contains average rainfall intensities in inches per hour.

DURATION	AVERAGE RECURRENCE INTERVAL								
(H:M)	1 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr	200 yr	500 yr
3:15	0.58	0.68	0.87	1.03	1.27	1.47	1.68	1.91	2.22
3:30	0.55	0.65	0.82	0.98	1.21	1.40	1.59	1.81	2.11
3:45	0.52	0.61	0.78	0.93	1.15	1.33	1.52	1.72	2.00
4:00	0.49	0.58	0.74	0.88	1.09	1.26	1.44	1.64	1.91
4:15	0.47	0.56	0.71	0.84	1.04	1.21	1.38	1.56	1.82
4:30	0.45	0.53	0.68	0.81	1.00	1.16	1.32	1.50	1.74
4:45	0.43	0.51	0.65	0.78	0.96	1.11	1.27	1.44	1.67
5:00	0.42	0.49	0.63	0.74	0.92	1.06	1.22	1.38	1.61
5:15	0.40	0.47	0.60	0.72	0.89	1.02	1.17	1.33	1.54
5:30	0.39	0.46	0.58	0.69	0.85	0.99	1.13	1.28	1.49
5:45	0.37	0.44	0.56	0.67	0.82	0.95	1.09	1.23	1.43
6:00	0.36	0.43	0.54	0.64	0.80	0.92	1.05	1.19	1.38
6:30	0.34	0.40	0.51	0.61	0.75	0.86	0.99	1.12	1.30
7:00	0.32	0.38	0.48	0.57	0.70	0.81	0.93	1.05	1.22
7:30	0.30	0.36	0.46	0.54	0.67	0.77	0.88	0.99	1.15
8:00	0.29	0.34	0.43	0.51	0.63	0.73	0.83	0.94	1.09
8:30	0.27	0.32	0.41	0.49	0.60	0.70	0.79	0.90	1.04
9:00	0.26	0.31	0.39	0.47	0.57	0.66	0.76	0.85	0.99
9:30	0.25	0.30	0.38	0.45	0.55	0.63	0.72	0.81	0.94
10:00	0.24	0.28	0.36	0.43	0.53	0.61	0.69	0.78	0.90
10:30	0.23	0.27	0.35	0.41	0.50	0.58	0.66	0.75	0.86
11:00	0.22	0.26	0.33	0.40	0.49	0.56	0.64	0.72	0.83
11:30	0.21	0.25	0.32	0.38	0.47	0.54	0.61	0.69	0.80
12:00	0.21	0.24	0.31	0.37	0.45	0.52	0.59	0.66	0.77
13:00	0.19	0.23	0.29	0.34	0.42	0.48	0.55	0.62	0.72
14:00	0.18	0.22	0.27	0.32	0.39	0.45	0.51	0.58	0.67
15:00	0.17	0.20	0.26	0.30	0.37	0.43	0.48	0.55	0.63
16:00	0.16	0.19	0.24	0.29	0.35	0.40	0.46	0.52	0.59
17:00	0.16	0.18	0.23	0.27	0.33	0.38	0.43	0.49	0.56
18:00	0.15	0.18	0.22	0.26	0.32	0.36	0.41	0.46	0.53
19:00	0.14	0.17	0.21	0.25	0.30	0.35	0.39	0.44	0.51
20:00	0.14	0.16	0.20	0.24	0.29	0.33	0.37	0.42	0.49
21:00	0.13	0.15	0.19	0.23	0.28	0.32	0.36	0.40	0.46
22:00	0.13	0.15	0.19	0.22	0.27	0.30	0.34	0.39	0.45
23:00	0.12	0.14	0.18	0.21	0.26	0.29	0.33	0.37	0.43
24:00	0.12	0.14	0.17	0.20	0.25	0.28	0.32	0.36	0.41

Appendix B Fly Ash Landfill Run-On Control System – HydroCAD Output Files



Routing Diagram for Fly Ash Landfill
Prepared by SCS Engineers, Printed 8/27/2021
HydroCAD® 10.10-6a s/n 05804 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-year,24-hour	Type II 24-hr		Default	24.00	1	6.00	2

Summary for Subcatchment E: East Run-on

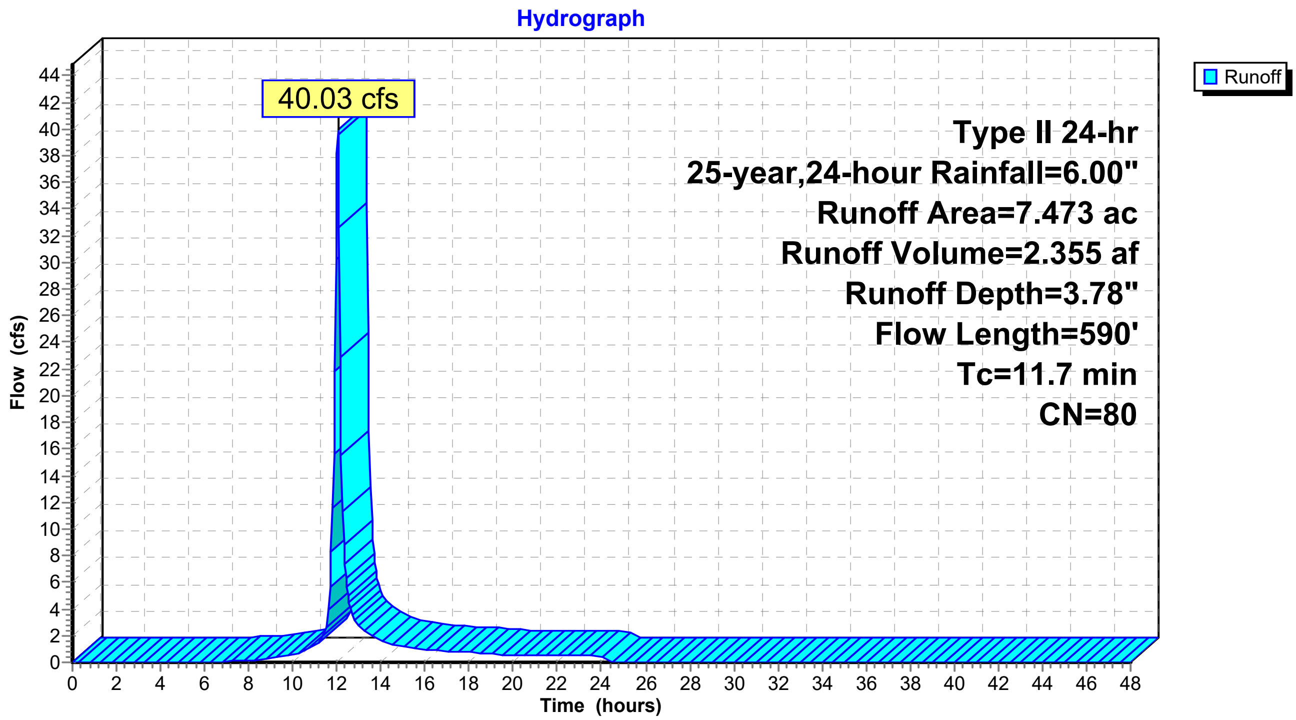
Runoff = 40.03 cfs @ 12.03 hrs, Volume= 2.355 af, Depth= 3.78"
Routed to Reach E1 : East Berm 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year,24-hour Rainfall=6.00"

Area (ac)	CN	Description
7.473	80	>75% Grass cover, Good, HSG D
7.473		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
4.5	490	0.0670	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
11.7	590	Total			

Subcatchment E: East Run-on



Summary for Subcatchment NE: Northeast Run-on

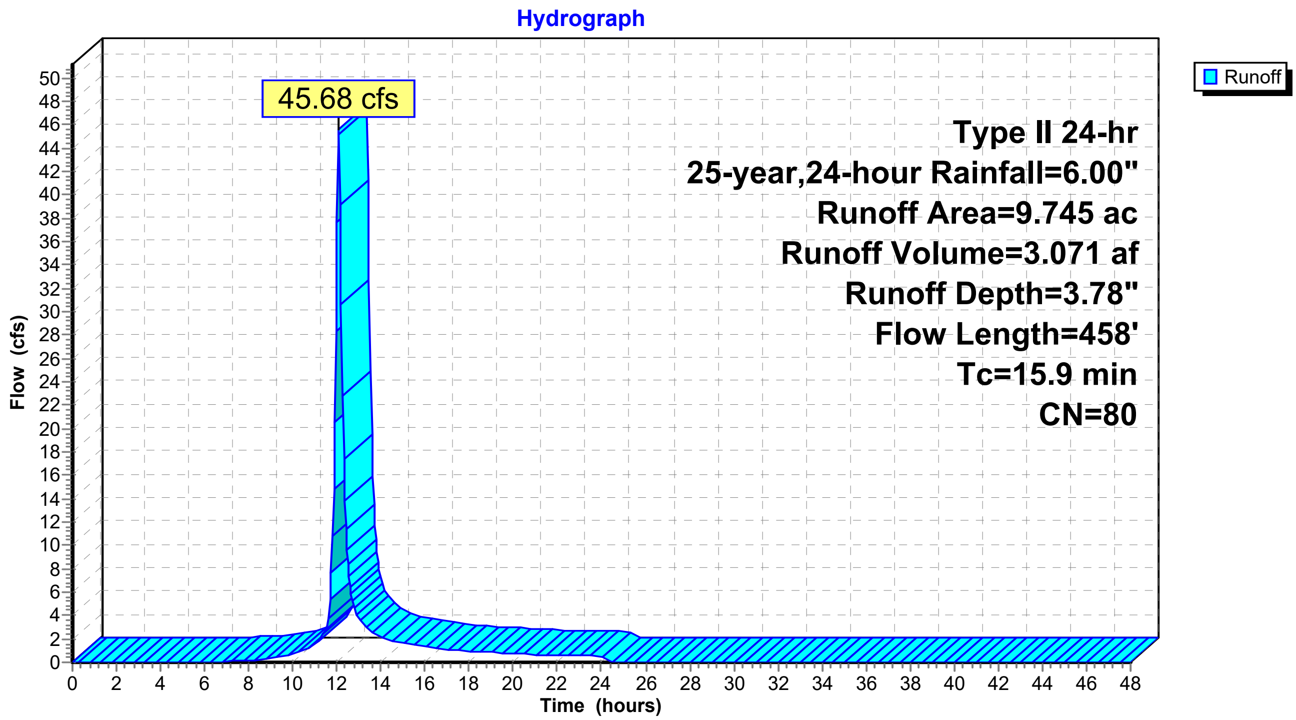
Runoff = 45.68 cfs @ 12.08 hrs, Volume= 3.071 af, Depth= 3.78"
Routed to Reach W1 : West Berm 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year,24-hour Rainfall=6.00"

Area (ac)	CN	Description
9.745	80	>75% Grass cover, Good, HSG D
9.745		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
3.3	358	0.0670	1.81		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.9	458	Total			

Subcatchment NE: Northeast Run-on



Summary for Subcatchment NW: Northwest Run-on

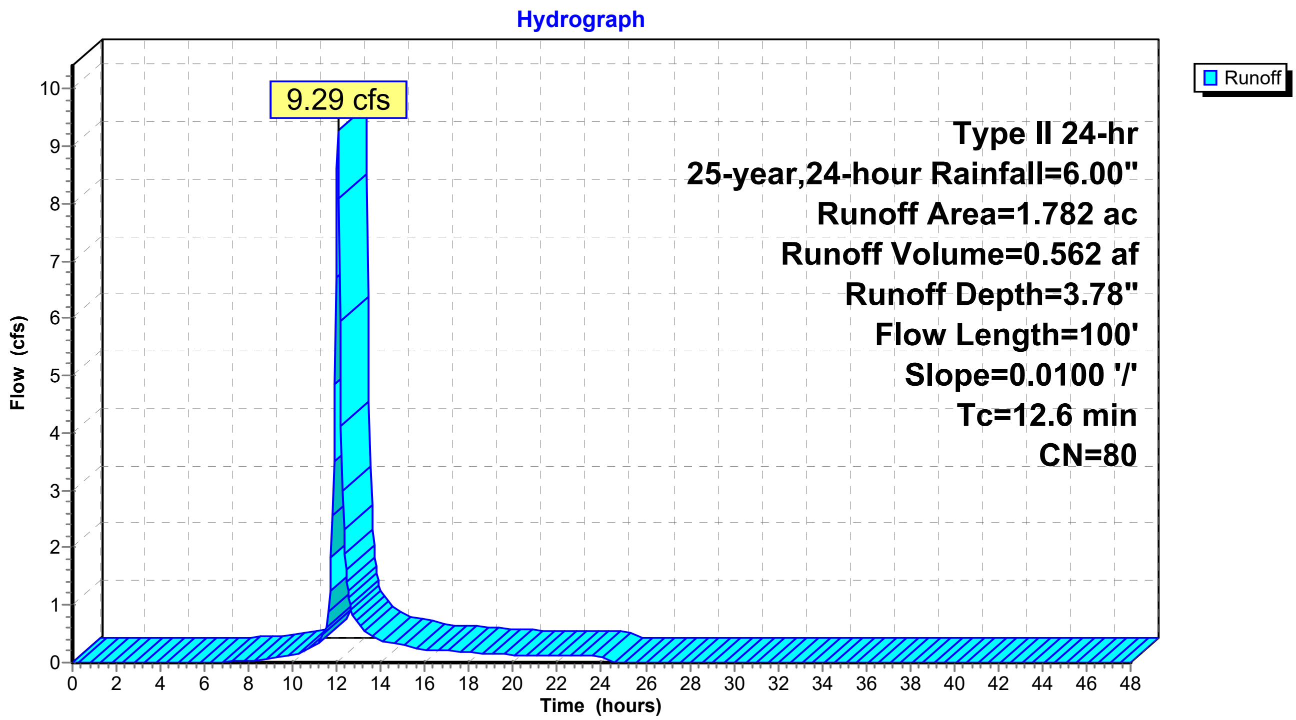
Runoff = 9.29 cfs @ 12.04 hrs, Volume= 0.562 af, Depth= 3.78"
Routed to Reach W2 : West Berm 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year,24-hour Rainfall=6.00"

Area (ac)	CN	Description
1.782	80	>75% Grass cover, Good, HSG D
1.782		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"

Subcatchment NW: Northwest Run-on



Summary for Subcatchment W: West Run-on

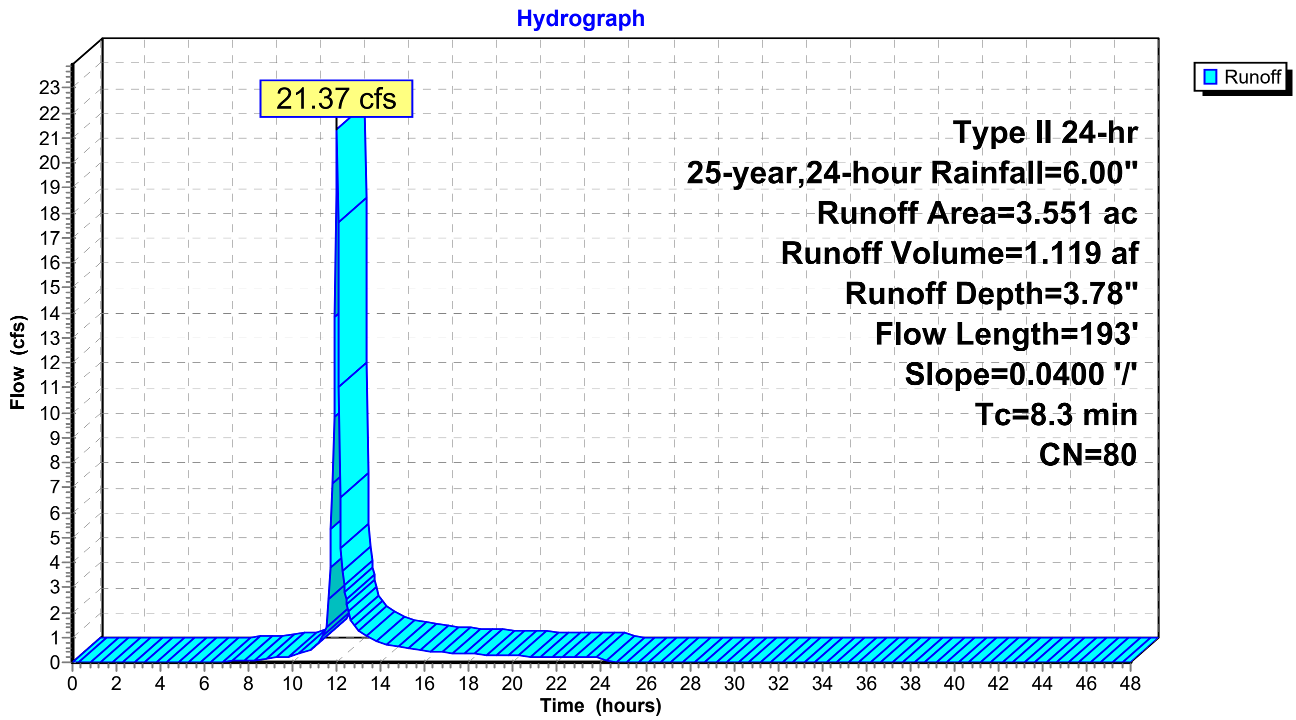
Runoff = 21.37 cfs @ 12.00 hrs, Volume= 1.119 af, Depth= 3.78"
Routed to Reach W3 : West Berm 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year,24-hour Rainfall=6.00"

Area (ac)	CN	Description
3.551	80	>75% Grass cover, Good, HSG D
3.551		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
1.1	93	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
8.3	193	Total			

Subcatchment W: West Run-on



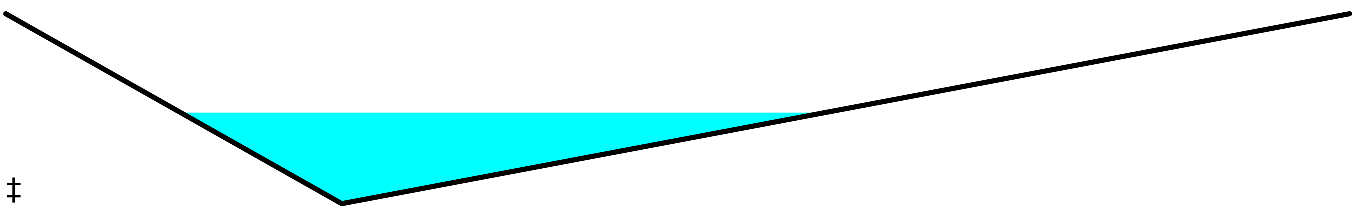
Summary for Reach E1: East Berm 1

Inflow Area = 7.473 ac, 0.00% Impervious, Inflow Depth = 3.78" for 25-year,24-hour event
Inflow = 40.03 cfs @ 12.03 hrs, Volume= 2.355 af
Outflow = 31.05 cfs @ 12.25 hrs, Volume= 2.355 af, Atten= 22%, Lag= 13.0 min
Routed to Pond THL : Tower Hill Lake

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.27 fps, Min. Travel Time= 8.4 min
Avg. Velocity = 1.23 fps, Avg. Travel Time= 29.0 min

Peak Storage= 15,740 cf @ 12.11 hrs
Average Depth at Peak Storage= 0.96' , Surface Width= 15.34'
Bank-Full Depth= 2.00' Flow Area= 32.0 sf, Capacity= 223.16 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 12.0 '/' Top Width= 32.00'
Length= 2,140.0' Slope= 0.0201 '/'
Inlet Invert= 1,247.00', Outlet Invert= 1,204.00'



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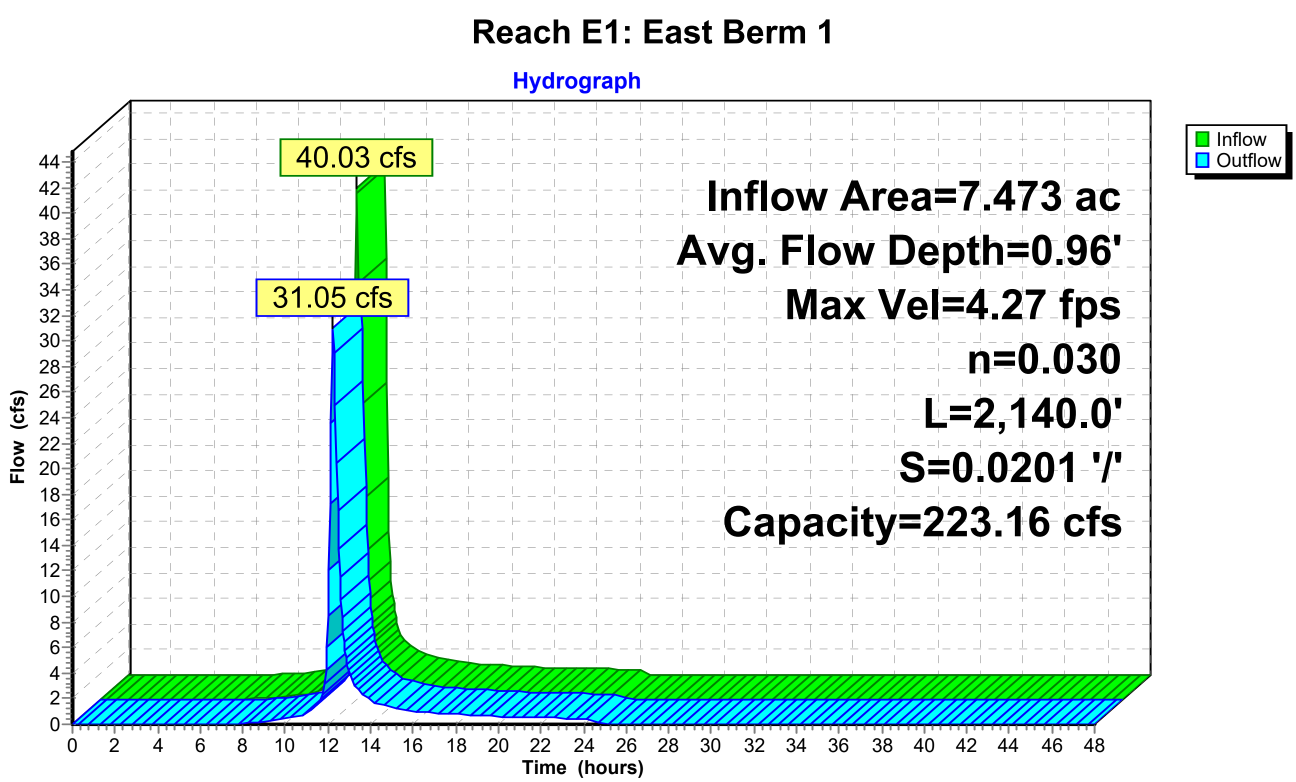


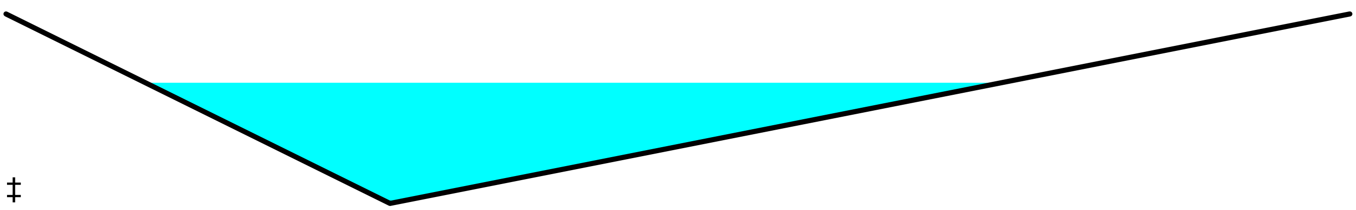
Summary for Reach W1: West Berm 1

Inflow Area = 9.745 ac, 0.00% Impervious, Inflow Depth = 3.78" for 25-year,24-hour event
Inflow = 45.68 cfs @ 12.08 hrs, Volume= 3.071 af
Outflow = 40.95 cfs @ 12.22 hrs, Volume= 3.071 af, Atten= 10%, Lag= 8.4 min
Routed to Reach W2 : West Berm 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.65 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 1.11 fps, Avg. Travel Time= 16.3 min

Peak Storage= 12,332 cf @ 12.14 hrs
Average Depth at Peak Storage= 1.27' , Surface Width= 17.82'
Bank-Full Depth= 2.00' Flow Area= 28.0 sf, Capacity= 138.38 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 10.0 '/' Top Width= 28.00'
Length= 1,087.0' Slope= 0.0101 '/'
Inlet Invert= 1,247.00', Outlet Invert= 1,236.00'



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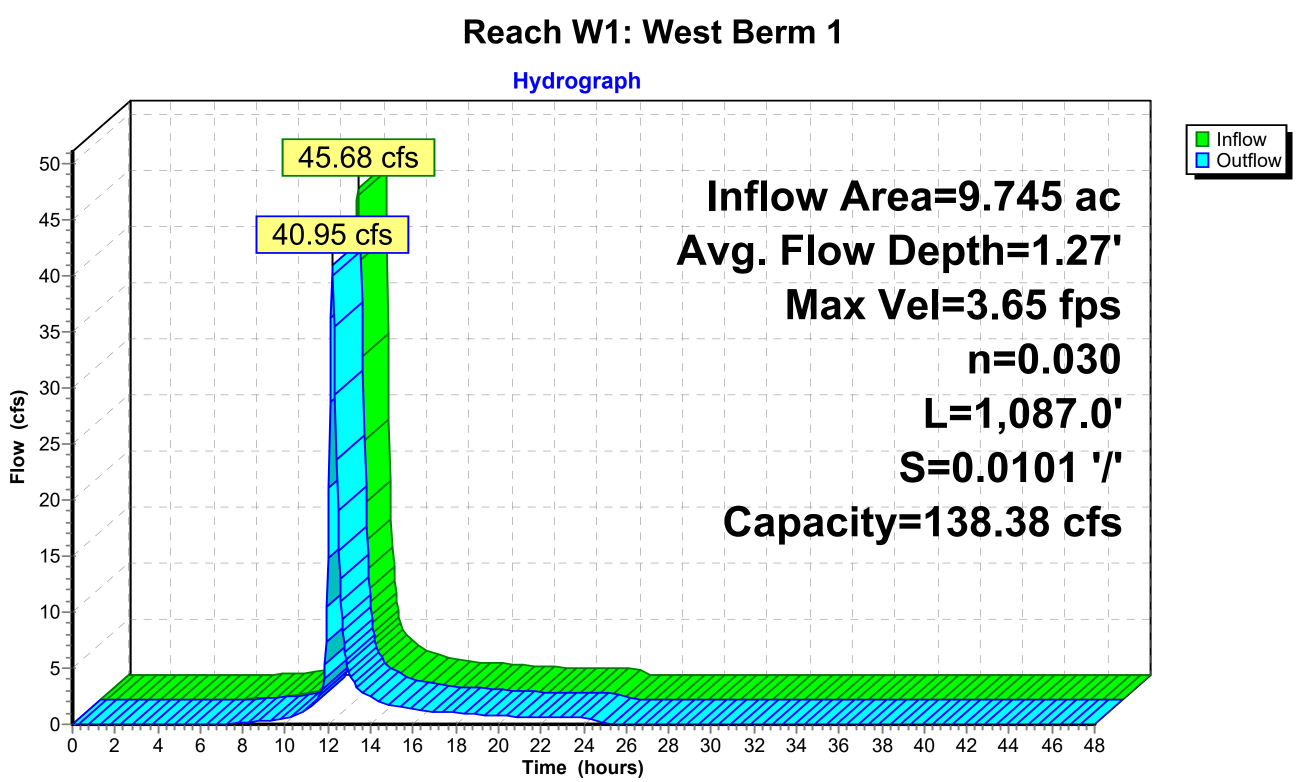


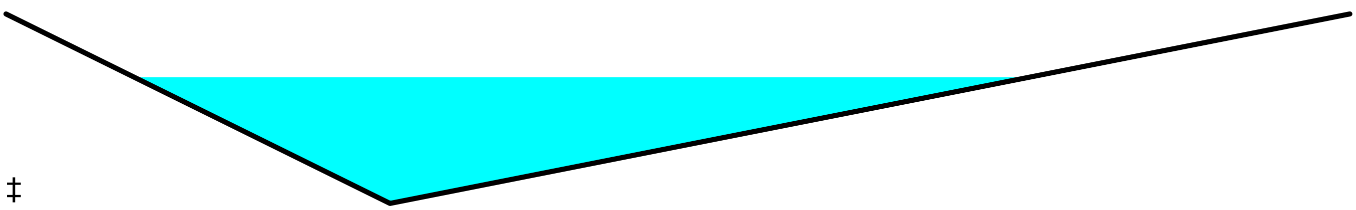
Summary for Reach W2: West Berm 2

Inflow Area = 11.527 ac, 0.00% Impervious, Inflow Depth = 3.78" for 25-year,24-hour event
Inflow = 44.74 cfs @ 12.20 hrs, Volume= 3.632 af
Outflow = 32.26 cfs @ 12.61 hrs, Volume= 3.632 af, Atten= 28%, Lag= 24.2 min
Routed to Reach W3 : West Berm 3

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.61 fps, Min. Travel Time= 15.8 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 65.2 min

Peak Storage= 30,651 cf @ 12.35 hrs
Average Depth at Peak Storage= 1.33' , Surface Width= 18.64'
Bank-Full Depth= 2.00' Flow Area= 28.0 sf, Capacity= 95.88 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 10.0 '/' Top Width= 28.00'
Length= 2,470.0' Slope= 0.0049 '/'
Inlet Invert= 1,236.00', Outlet Invert= 1,224.00'



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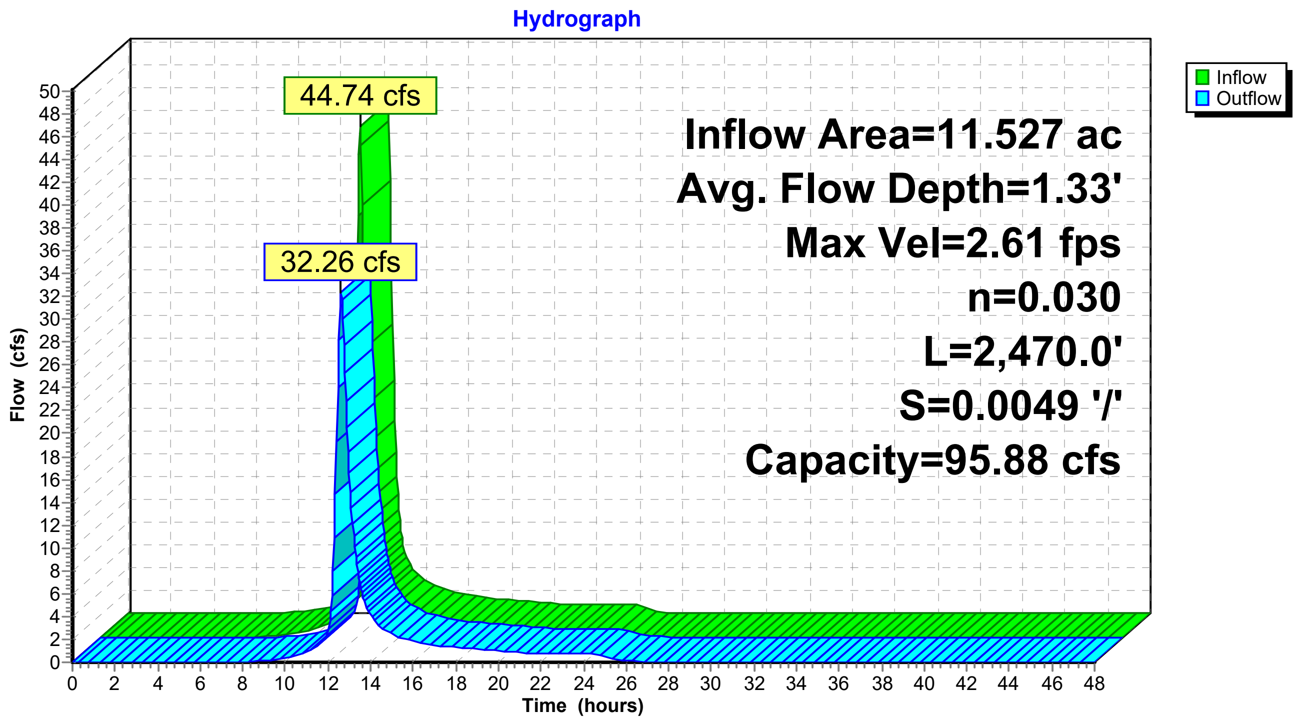
Reach W2: West Berm 2



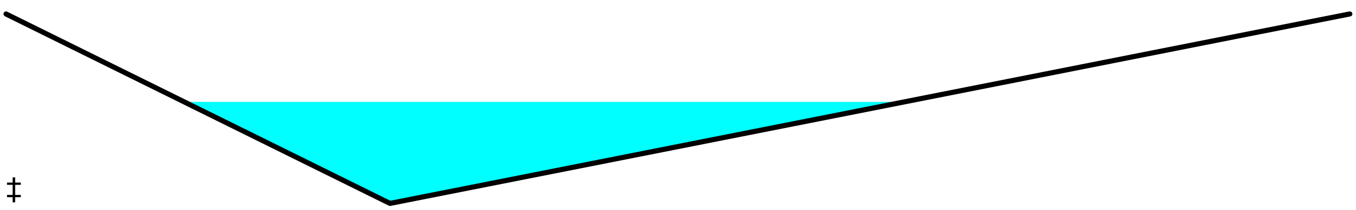
Summary for Reach W3: West Berm 3

Inflow Area = 15.078 ac, 0.00% Impervious, Inflow Depth = 3.78" for 25-year,24-hour event
Inflow = 33.97 cfs @ 12.60 hrs, Volume= 4.751 af
Outflow = 32.32 cfs @ 12.78 hrs, Volume= 4.751 af, Atten= 5%, Lag= 10.7 min
Routed to Pond THL : Tower Hill Lake

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.02 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 1.06 fps, Avg. Travel Time= 22.5 min

Peak Storage= 11,533 cf @ 12.68 hrs
Average Depth at Peak Storage= 1.07' , Surface Width= 15.01'
Bank-Full Depth= 2.00' Flow Area= 28.0 sf, Capacity= 170.45 cfs

0.00' x 2.00' deep channel, n= 0.030
Side Slope Z-value= 4.0 10.0 '/' Top Width= 28.00'
Length= 1,433.0' Slope= 0.0154 '/'
Inlet Invert= 1,224.00', Outlet Invert= 1,202.00'



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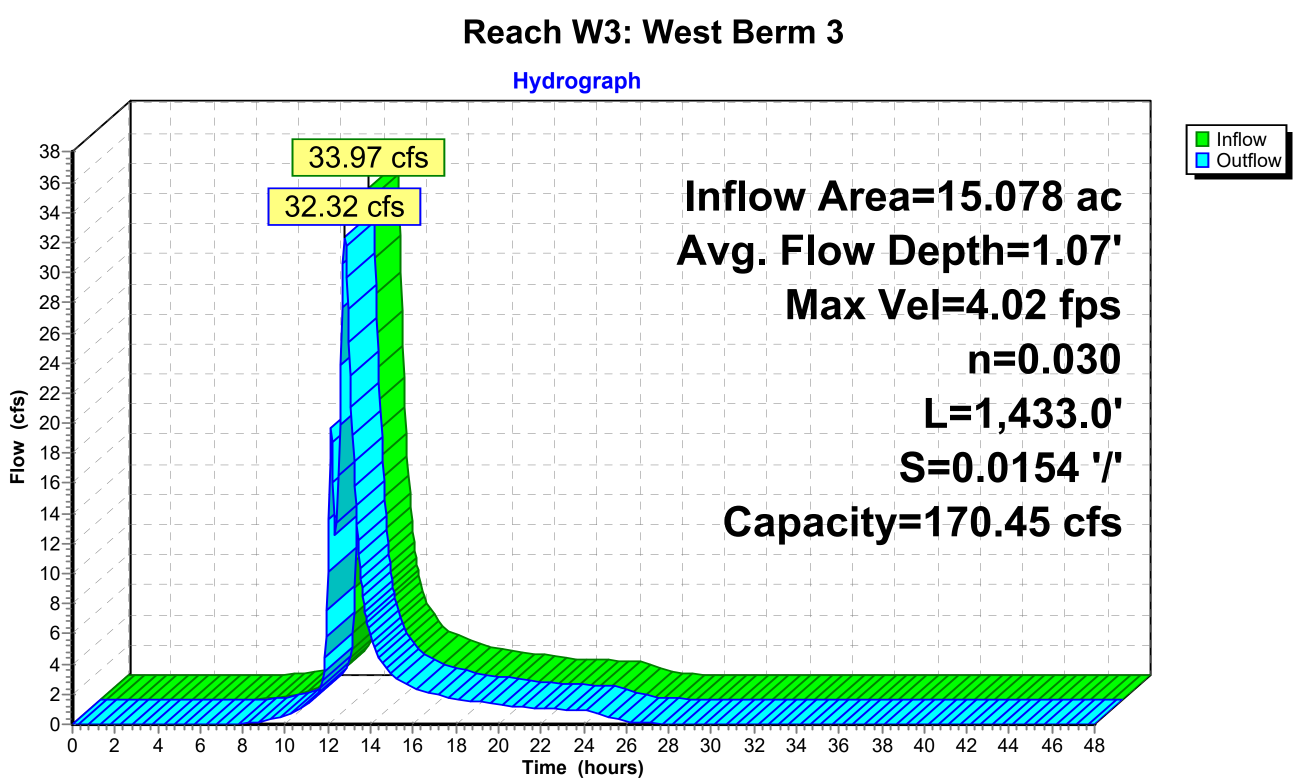


Summary for Pond THL: Tower Hill Lake

Inflow Area = 22.551 ac, 0.00% Impervious, Inflow Depth = 3.78" for 25-year,24-hour event
Inflow = 48.13 cfs @ 12.22 hrs, Volume= 7.106 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

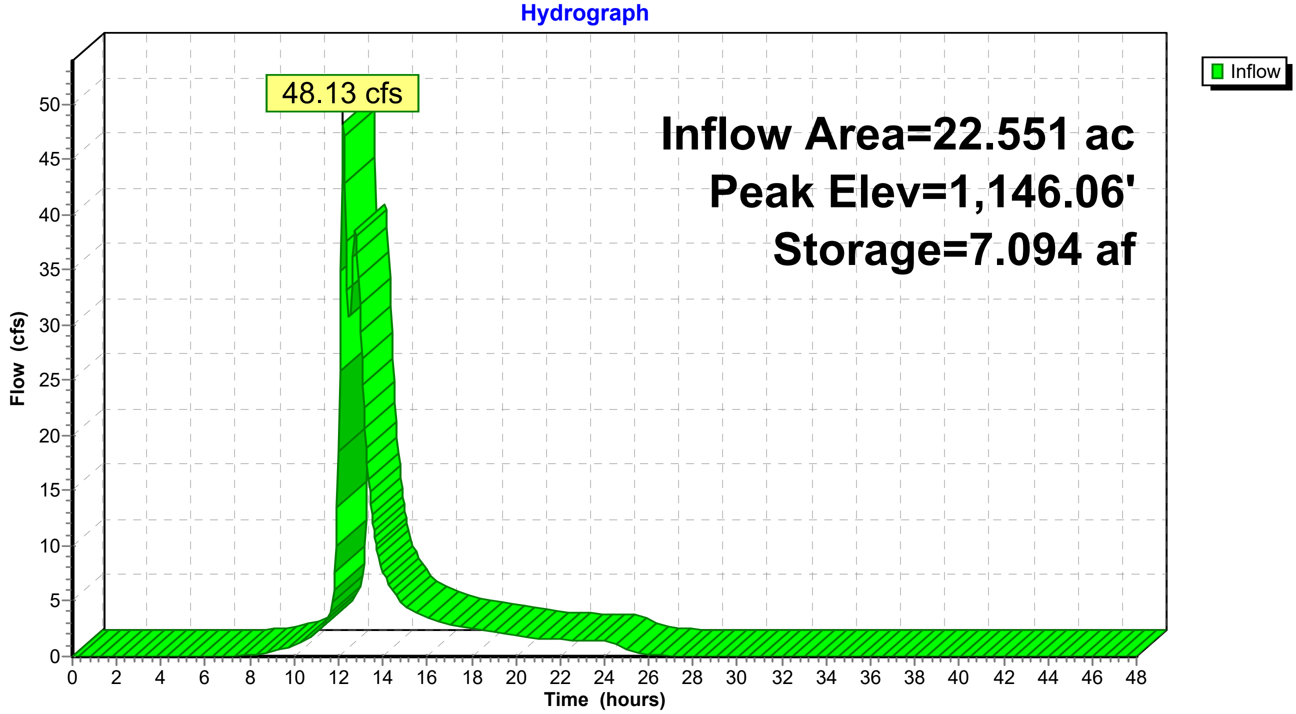
Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,146.06' @ 48.00 hrs Surf.Area= 117.354 ac Storage= 7.094 af

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

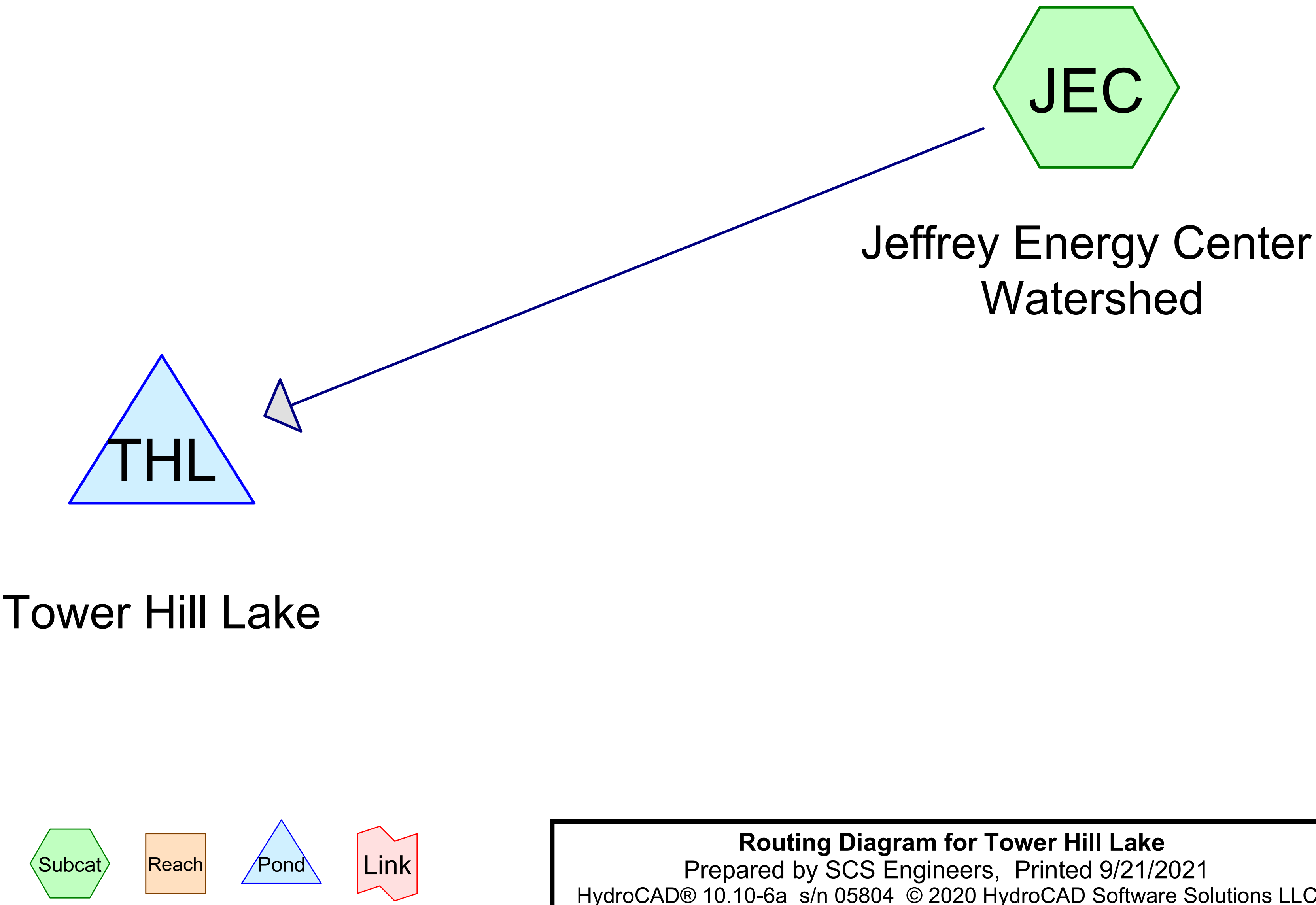
Volume	Invert	Avail.Storage	Storage Description
#1	1,146.00'	2,804.565 af	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,146.00	117.180	0.000	0.000
1,148.00	122.922	240.102	240.102
1,150.00	126.458	249.380	489.482
1,152.00	130.703	257.161	746.643
1,154.00	134.795	265.498	1,012.141
1,156.00	138.961	273.756	1,285.897
1,158.00	143.457	282.418	1,568.315
1,160.00	148.544	292.001	1,860.316
1,162.00	154.180	302.724	2,163.040
1,164.00	160.146	314.326	2,477.366
1,166.00	167.053	327.199	2,804.565

Pond THL: Tower Hill Lake



Appendix C Regional Control System Tower Hill Lake – HydroCAD Output Files



Routing Diagram for Tower Hill Lake
Prepared by SCS Engineers, Printed 9/21/2021

Summary for Subcatchment JEC: Jeffrey Energy Center Watershed

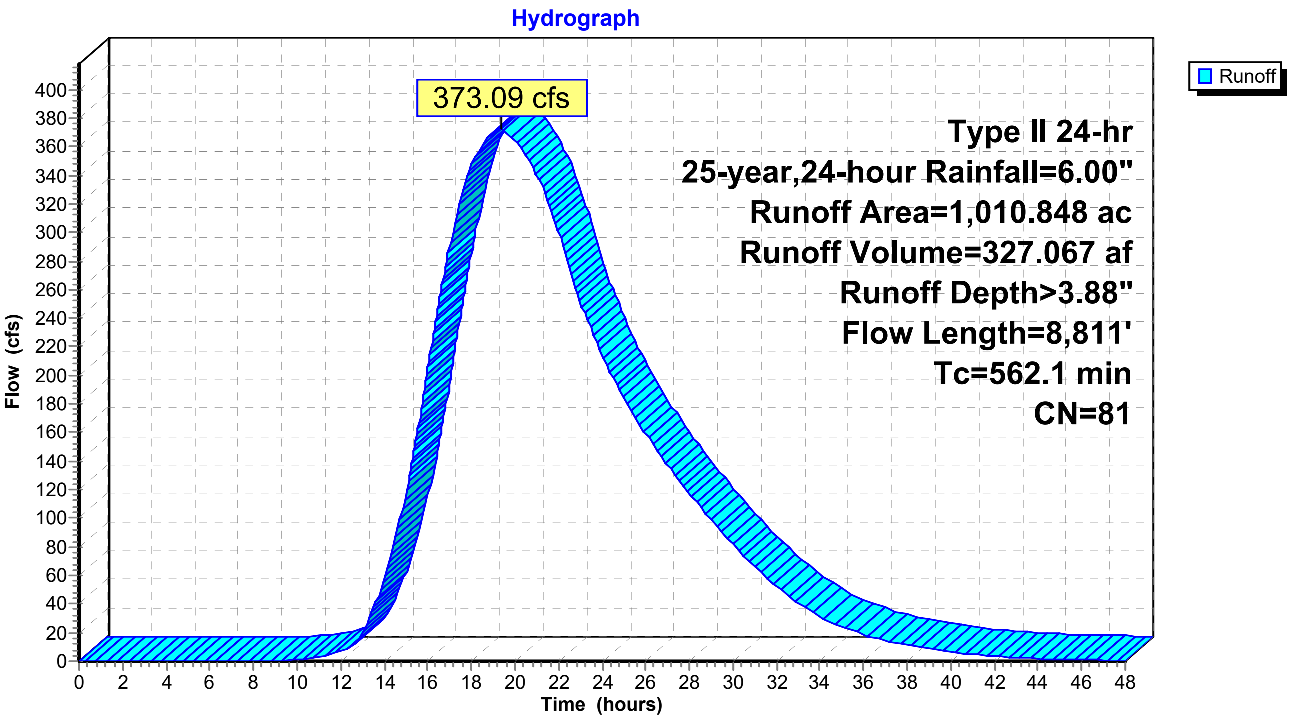
Runoff = 373.09 cfs @ 19.35 hrs, Volume= 327.067 af, Depth> 3.88"
Routed to Pond THL : Tower Hill Lake

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-year,24-hour Rainfall=6.00"

Area (ac)	CN	Description
934.496	80	>75% Grass cover, Good, HSG D
76.352	98	Water Surface, 0% imp, HSG D
1,010.848	81	Weighted Average
1,010.848		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	100	0.0400	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
13.5	1,138	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
541.4	7,573	0.1000	0.23	6.99	**Channel Flow,** Area= 30.0 sf Perim= 4,737.0' r= 0.01' n= 0.069 Riprap, 6-inch
562.1	8,811	Total			

Subcatchment JEC: Jeffrey Energy Center Watershed



Summary for Pond THL: Tower Hill Lake

Inflow Area = 1,010.848 ac, 0.00% Impervious, Inflow Depth > 3.88" for 25-year,24-hour event
Inflow = 373.09 cfs @ 19.35 hrs, Volume= 327.067 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,148.70' @ 48.00 hrs Surf.Area= 124.166 ac Storage= 327.058 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	1,146.00'	2,804.565 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,146.00	117.180	0.000	0.000
1,148.00	122.922	240.102	240.102
1,150.00	126.458	249.380	489.482
1,152.00	130.703	257.161	746.643
1,154.00	134.795	265.498	1,012.141
1,156.00	138.961	273.756	1,285.897
1,158.00	143.457	282.418	1,568.315
1,160.00	148.544	292.001	1,860.316
1,162.00	154.180	302.724	2,163.040
1,164.00	160.146	314.326	2,477.366
1,166.00	167.053	327.199	2,804.565

Pond THL: Tower Hill Lake