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January 12, 2026

Kepley Wetland Design Report
Site No. STO842436B
Story County, Iowa

Project Overview

This constructed wetland is planned to provide nutrient reduction benefits to a part of the watershed of Drainage District 39 in Story County, Iowa. Nitrates will be converted to nitrogen gas through natural processes as the water passes through the wetland.

The project location is on the property of Danny Kepley and Susan Kepley, near the northeast corner of Ames, Iowa. A wetland pool will be created through excavation. To fill the pool, a partial-capture gravity inlet pipe will convey water from the existing ditch to the proposed inlet channel, and water from the existing Drainage District 39 tile will be pumped into the wetland. From the inlet channel, water will flow through the wetland pool, where nutrient concentrations will be reduced through natural processes. Water will be released from the pool through the rectangular wetland outlet structure, with four-foot openings on all sides, and be carried through an outlet pipe. The existing 16-inch-diameter Drainage District 39 tile will be re-laid with a larger 18-inch-diameter tile. The wetland outlet pipe and re-laid tile will connect at a manhole downstream of the wetland, where water will be conveyed to the South Skunk River by the existing Drainage District 39 tile. During large storm events, the wetland pool will rise, and water will flow overland to the south of the wetland. Constructing the wetland will not have adverse effects on the hydrology of the neighboring properties.

Site Selection & Analysis

This site was deemed viable because of the size of its watershed (1,101 acres) and its topography. Initial payment information was presented to the landowner, who wished to proceed with the project.

Bolton & Menk reviewed the soil survey data for the location and found the soils to be primarily loam. After this review, it was determined that soil borings were unnecessary unless deep excavation work was determined to be needed. The wetland watersheds were analyzed using LiDAR data, with land uses delineated and existing ponds and culverts accounted for. A map of the contributing watersheds is included with this report. Curve number calculations are provided in the attached hydrology report, and a runoff analysis are provided in the attached Autodesk Storm and Sanitary Analysis (SSA) output.

The site was surveyed with survey-grade GPS equipment, and additional topographic information was provided from a publicly available LiDAR database. LiDAR was verified with survey data. Elevations are referenced to NAVD88, and the Iowa State Plane North (Survey Foot) coordinate system was used for horizontal coordinates. Survey data was collected electronically and is available in .csv files.

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Design Standards

Iowa NRCS Conservation Practice Standard (CPS) 656, dated December 2023, was used to develop this project. CPS 587 (Structure for Water Control) was used for the water control structure. The project is NRCS Job Class IV under CPS 656 because the direct surface watershed is between 300 and 1000 acres.

Project Layout

The permanent pool and excavation elevations were selected based on the ability to maximize pool area while minimizing excavation. The pool was also sited to minimize impacts to the South Skunk River. The project lies within the FEMA 0.2% annual chance flood hazard. The wetland pool partially encroaches upon the FEMA regulatory floodway for the South Skunk River but does not adversely affect the stream as no earthfill is required to construct the wetland.

The watershed information and rainfall data were used to develop hydrographs in SSA. The storm distribution used was MSE 3, with rainfall depths from the National Engineering Handbook. These hydrographs and the proposed stage-storage information were used to size the primary outlet of the wetland. The SSA output is provided in the appendix.

Existing Tiles & Ditch

There is one known tile on-site. The portion of the tile that runs underneath the wetland pool will be removed and re-laid around the pool. Water from the tile will be partially captured and pumped to the wetland. A profile is provided in the plans for the re-laid tile, as well as all new pipe installations. Pipe sizing calculations are provided in the appendix.

Water will also be conveyed to the wetland from a ditch on the east side of the site. This ditch is a private drainage ditch that terminates to the southeast of the site. At the end of the ditch there is an existing tile intake that conveys flows from the ditch to the drainage district main. There is also a berm built up around the end of the ditch, with a culvert passing through the berm. It was considered that directing water from the ditch, into the wetland, and then into the drainage district tile could have an adverse impact on the capacity of the district tile. However, the water from the ditch is already directed to the tile so this project does not change the hydraulics of the system except that the intercepted ditch water will enter the tile slightly upstream of where it does currently. The district tile is the same size (18” diameter) at the south end of the site as it is where the ditch water is directed to the tile.

Land Rights & Permits

The permanent easement for this project will be on the Kepley property. IDALS-DSWQ is currently in the process of updating the abstracts and will have a signed easement recorded for the area as shown in the plans. No additional land rights are needed.

The project will be permitted under USACE Regional Permit 39. The permit was obtained by the Iowa Department of Agriculture and Land Stewardship (IDALS). The project is located within the floodplain of the South Skunk River, and a portion of the project lies within the FEMA regulatory floodway. Plans for the project will be provided to the Iowa Department of Natural Resources for review, and a floodplain permit will be obtained if necessary.

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This project is located in Drainage District 39 in Franklin Township. Plans for the project will be provided to the drainage district for review and approval prior to bidding of the project. A City of Ames well is located adjacent to the project. The city and Iowa DNR have reviewed the plans and determined that the project will not affect the well.

Sincerely,

Bolton & Menk, Inc.

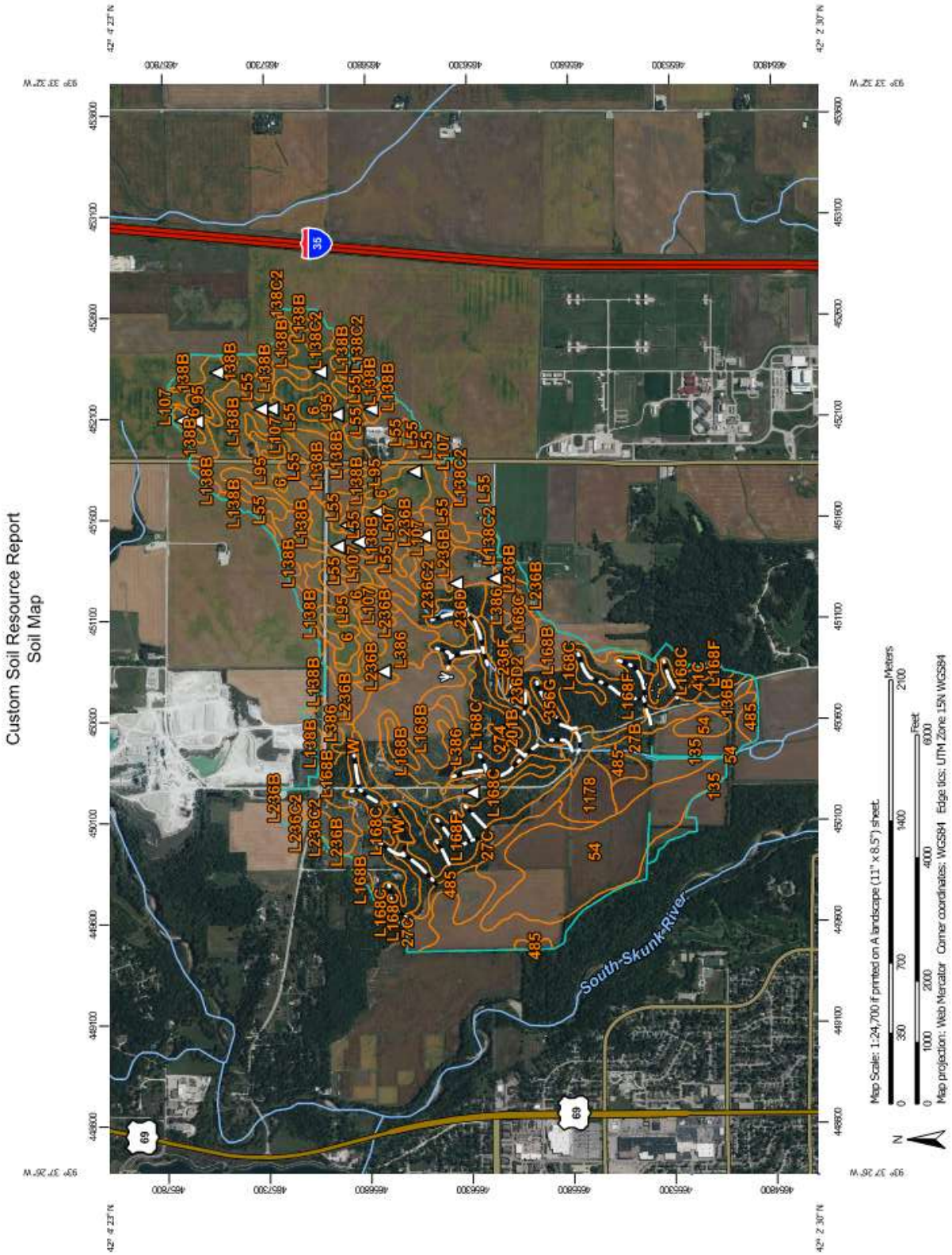
Brandon C. Short, PE
Water Resources Project Engineer

Appendices:

A. Soil Survey Map
B. Watershed and Land Use
C. Hydrology Report
D. SSA Output
E. Pump Curve and Sump Design
F. Pipe Capacity Calculations

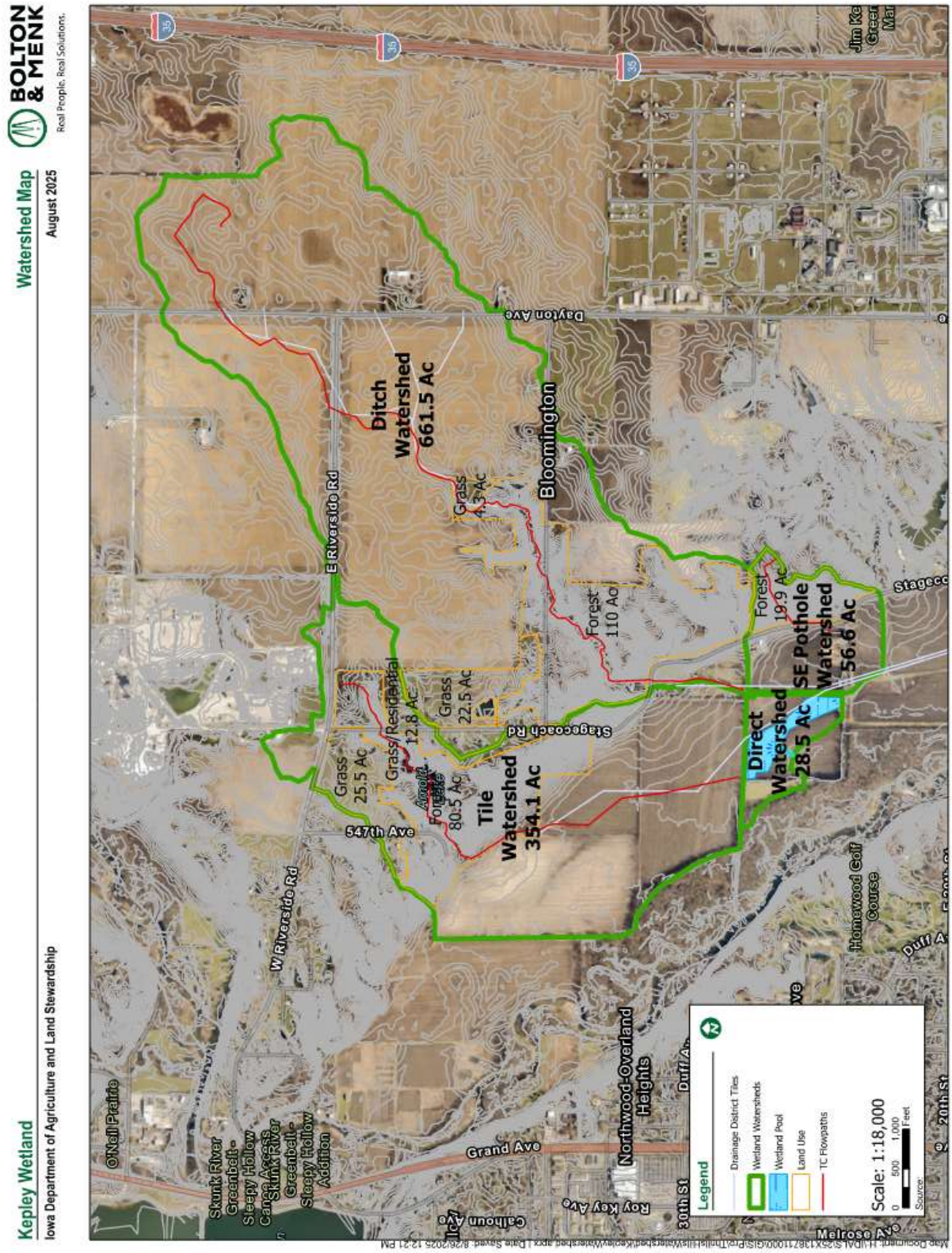
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Appendix A: Soil Survey Map



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Appendix B: Watershed Map



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Appendix C: Hydrology Report

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Report Summary

Design Parameters and Procedures:

Design hydrology and hydraulic study of this site was completed. The drainage area was determined and a stage-area-storage curve was developed based on the topographic survey, lidar data available from the Iowa Department of Natural Resources, and grading design for the wetland. Land use and treatment were determined through a site visit and aerial photo review. Hydrologic data was compiled, sediment calculations were made, the structure was flood routed using the SCS method in Autodesk Storm and Sanitary Analysis (SSA) Software, and all the output was reviewed.

Rainfall events used for this site were MSE 3 distribution, 24-hour, 5-, 10-, 25-, and 100-year events. The primary spillway is an outlet structure with four rectangular 4-foot wide openings that discharges to the existing Drainage District 39 tile main. The secondary spillway is a the natural overflow of the existing pothole. Values shown below for Q_{max} Out include overland flow and tile flow.

Hydrology Analysis Summary

25-year Event: 5.40'' **100-year Event: 7.00''**

* Hydrologic Soil Groups: A, B, C
* Runoff Curve Number: 81.2 (based on Land use shown in this report)
* Primary Spillway Weir Coefficent = 3.0
* Tc = 2.9 hours determined by the sum of sheet, shallow concentrated and channel flow times.
* Normal pool area is 4.95 acres.
* Surface watershed area is approximately 1044.1 acres or 1.63 square miles.

Summary Table:

Overflow Elevation: 893.07 (Data for Surface Overflow)

24-Hour Storm Event	Q_{max} In (cfs)	Q_{max} Out (cfs)	Max Elev (ft)	Duration - Hours at elevation		
				893.00	893.25	893.50
5-year	214.84	190.79	893.53	25.2	7.1	0.5
10-year	272.99	252.94	893.60	25.5	8.4	1.3
25-year	356.92	347.08	893.69	26.6	9.6	1.9
100-year	512.39	504.93	893.82	27.4	11.6	2.0

Rainfall Data

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi.

The following rainfall data was used for the hydrology analysis of the site. Rainfall depths from the NEH Title 210 Figure IA2-25 were used, and two additional sources are shown for reference only.

County: Story
Storm Distribution: MSE 3
Iowa Climactic Section (SUDAS): Central

24-Hour Rainfall Depths (in)

Return Period (Years)	Data Source		
	NEH Title 210 (Figure IA2-25)	SUDAS Design Manual 2025 Edition	NOAA Atlas 14
2	3.20	3.08	3.16
5	3.90	3.81	3.88
10	4.50	4.46	4.52
25	5.40	5.44	5.46
50	6.20	6.26	6.23
100	7.00	7.12	7.04

Tributary Watershed Data

Watershed	Area (ac)	Area (sq. mi.)	Tile/Surface Drained	Time of Concentration (min)
Direct	28.5	0.04	Surface	10
SE Pothole	56.6	0.09	None - For modeling only	31
Tile	354.1	0.55	Surface & Tile	118
Ditch	661.5	1.03	Surface & Tile (Treated)	212

Surface Total	1044.1	1.63
Tile/Treated Total	1015.6	1.59
Pump Total	354.1	0.55

Average Tc = 176.3 min.
Average Tc = 2.94 min.

Runoff Curve Number

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi.

Soil Name[1]	HSG[1]	Cover Type and Hyd. Condition	% of Watershed	CN[2]	Product
Hayden Loam, Bemis moraine, 22-40% slopes	C	Varies	10.5%	Varies	-
Webster clay loam, Bemis moraine, 0-2% slopes	C/D	Varies	10.4%	Varies	-
Hayden Loam, Bemis moraine, 6-10% slopes	C	Varies	9.2%	Varies	-
Zook silty clay loam, 0-2% slopes	C/D	Varies	8.8%	Varies	-
Clarion loam, Bemis moraine 2-6% slopes	B	Varies	7.9%	Varies	-
		Total	46.8%		81.2

Cover types and hydrologic conditions vary throughout the watersheds. For full curve number calculations, see the Autodesk SSA outputs that are part of this report.

Watershed	**Weighted CN**
Direct	71.0
SE Pothole	82.1
Tile	79.7
Ditch	80.5
Total Weighted CN =	**81.2**

References:

[1] USDA - NRCS Soil Survey of Story Co., Iowa.
[2] USDA - NRCS Technical Release 55, Chapter 2, June 1986.

Sediment Calculations

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi.

DA[1]		1,044	acres	1.631	sqmi
Trap efficiency, very short storage time[2]				44	percent
Average annual sheet and rill erosion[3]				0.8	tons/ac/yr
Area of depressions not subject to sediment delivery				5	acres
Area subject to sheet and rill erosion				1,039	acres
Average annual sheet and rill erosion				827	tons
Delivery ratio[5]				5.5	percent
Sheet and rill erosion delivered to site				45.5	tons/yr
Adjustment for LRA 103[2]				0.3	factor
Adjusted sheet and rill erosion delivered				13.6	tons/yr
Average annual gully erosion rate[4]				0.2	cuft/ft
Length of gully erosion				3,500	ft
In place density of gully material				80	lb/cuft
Average annual gully erosion (100% delivered)				28.0	t/yr
Total sediment delivered				41.6	t/yr
Weight of sediment retained in resevoir at		44.0	percent trapped[2]	18	t/yr
Sediment accumulation during		150	-year period	2,700	tons
Estimate	80	percent of delivered sediment will not be submerged[2]		2,160	tons
Volume of submerged sediment at		1,307	t/acft[2]	1.65	acft
Normal pool volume		3.6	acft, will not be full		
Estimate	20	percent of delivered sediment will be aerated[2]		540	tons
Volume of aerated sediment at		1,742	t/acft[2]	0.31	acft

References:

[1] Determined by Engineer - Includes Tile and Ditch Watersheds

[2] USDA-NRCS, Engr. Field Man., Chap. 11, Amend. IA 27, Fig.2, May 1986,. Adjusted. See notes.

[3] Estimated by preparer.

[4] Estimated by preparer.

[5] Delivery curve for Des Moines lobe. Source: Iowa Geological Survey.

Stage-Storage

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi

Contour Elev.	Area	Area	Average Area	Incremental Volume	Cumulative Volume	Volume Above Weir
	(Sq ft)	(Acres)	(Acres)	(Ac-ft)	(Ac-ft)	(Ac-ft)
891.25	203400	4.67	4.67	0.00	0.00	
892.00	212400	4.88	4.77	3.58	3.58	
892.25	**215500**	**4.95**	**4.91**	**1.23**	**4.81**	**0.00**
893.00	391026	8.98	6.96	5.22	10.03	5.22
893.07	434251	9.97	9.47	0.66	10.69	5.88
893.25	577078	13.25	11.61	2.09	12.78	7.97
893.50	758252	17.41	15.33	3.83	16.61	11.81

Storage at Normal Pool =	**4.81**	**Acre-feet**
Elevation of Weir =	**892.25**	
Storage at Overflow =	**10.69**	**Acre-feet**
Elevation =	**893.07**	

$$\text{Average Depth} = \frac{\text{Storage at Normal Pool}}{\text{Area at Normal Pool}}$$

Average Depth = 0.97 Feet

Notes:
Contour data is compiled from LiDAR, topographic survey, and proposed grading.

Gravity Inlet Calculations

Proposed gravity inlet does not capture all ditch flow. QFC (full capture flow rate) represents the full-flowing capacity of the proposed inlet pipe.

Intercept Capacities				
Watershed Name	Watershed Area (ac)	[1]Q_{FC} (cfs)	[2]Average Ditch Flow (cfs)	Annual Flow Captured (%)
Ditch	661.5	1.95	0.43	92.7%

Notes:

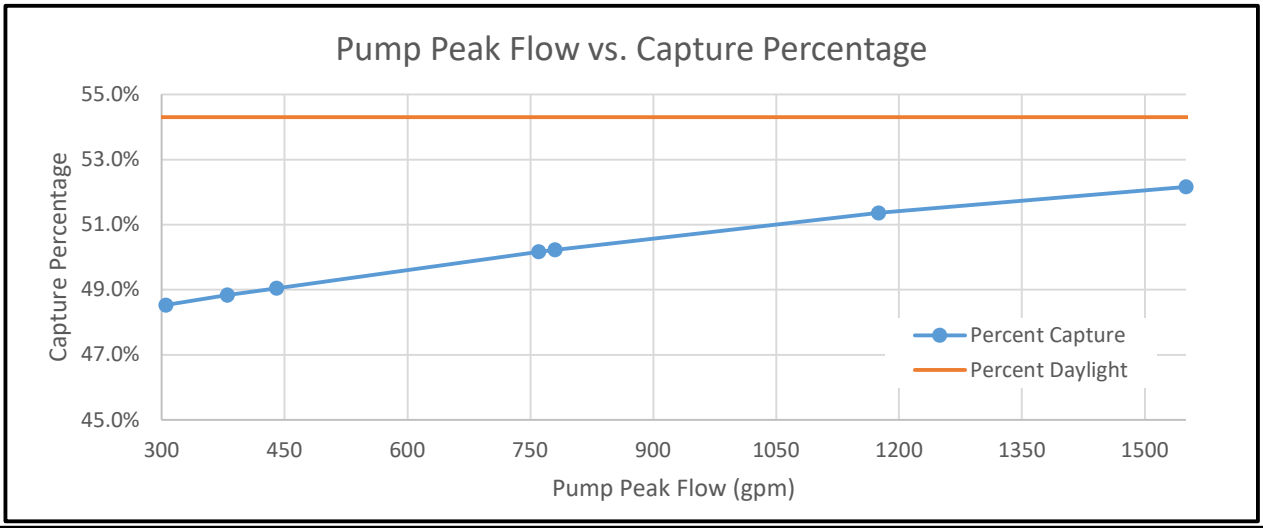
[1] Calculated using Manning's Equation assuming pipes flowing full. Manning's n from Chow, 1959

[2] Average flow calculated from flow-duration data from the USGS StreamStats Application

Solar Pump Capture Calculations

Average Daylight Hours: 54.3%

	Pump Comparison							
	Pump	Outlet Dia. (in)	TDH (ft)	Peak Pumping Rate (gpm)	Peak Pumping Rate (cfs)	9-Month Percent Capture	Capture with Storage	Effective Pumped Watershed (ac)
	1.5 HP	6	7.50	305	0.68	48.5%	48.5%	172
	2 HP	6	7.50	380	0.85	48.8%	48.8%	173
Selected:	**3 HP**	**6**	**7.75**	**440**	**0.98**	**49.0%**	**49.0%**	**174**
	2 HP Duplex	6	7.50	760	1.69	50.2%	50.2%	178
Not Practicable with Solar	5 HP	6	9.00	780	1.74	50.2%	50.2%	178
	10 HP	8	8.25	1175	2.62	51.4%	51.4%	182
	15 HP	8	9.00	1550	3.45	52.2%	52.2%	185



Pump Analysis (Selected Pump)								
Watershed	Drainage Area (ac)	[1] 9-Month Mean Tile Flow (cfs)	[2] Peak Pumping Rate (cfs)	[3] Adjusted Pumping Capacity (cfs)	% of Tile Capacity	% of 1/2" Dc	% of 9-Month Mean Tile Flow	[4] Total 9-Month Percent Capture
Tile	354.1	0.68	0.98	0.30	8.9%	4.1%	44.3%	48.7%

Notes:

[1] Calculated from USGS StreamStats flow-duration data. Estimates flows from March through November.

[2] Maximum capacity of 3 HP pump assuming 7.75 ft total dynamic head.

[3] Adjusts for average daylight hours and cloud cover for March through November.

[4] Average capture was calculated for each month based on expected tile flow, daylight hours, and cloud cover. This percentage is the average of months March through November.

Total Capture Calculations

Wetland Normal Pool Volume = 209413 CF

Watershed	Area (ac)	Percent Capture	Effective Capture Area (ac)	Average Flow Captured (cf/d)[1]	Full Flow Captured (cf/d)[2]	Average Residence Time (d)[3]	Full Flow Residence Time (d)[4]
Tile	354.1	48.7%	172	8826	45973		
Ditch	661.5	92.7%	613	37535	168480		
Wetland Total	1015.6	77.3%	785	46361	214453	4.5	1.0

Notes:

[1] 9-month average capture for pumped inlets; average capture for gravity inlets.

[2] Average full-sun day for pumped inlets; Q_{FC} or 1 csm for gravity inlets.

[3] Based on normal pool volume and average flow capture.

[4] Based on normal pool volume and full flow capture.

Weir Flow Hydraulics

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi.

Input

$Q = CLH^{1.5}$ Use C = 3.1

Output

Normal Pool Elevation = 892.25

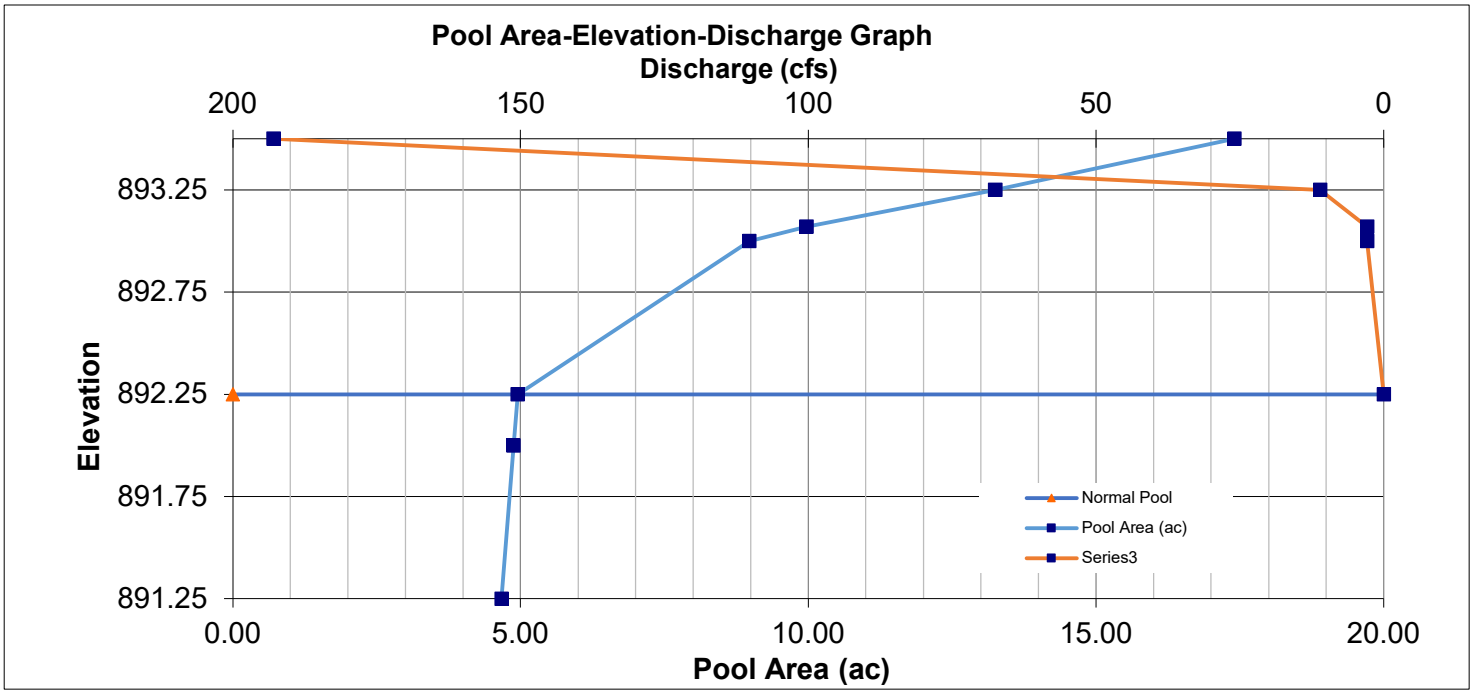
	Weir Length (ft)	8	12	16	20	24
	W.S. Elev.	Q - cfs	Q - cfs	Q - cfs	Q - cfs	Q - cfs
	892.25	0.0	0.0	0.0	0.0	0.0
	892.30	0.3	0.4	0.5	0.6	0.8
	892.34	0.7	1.1	1.4	1.8	2.1
	892.39	1.3	2.0	2.6	3.3	3.9
	892.44	2.0	3.0	4.0	5.0	6.0
	892.48	2.8	4.2	5.6	7.0	8.4
	892.53	3.7	5.5	7.4	9.2	11.1
	892.58	4.7	7.0	9.3	11.7	14.0
	892.63	5.7	8.5	11.4	14.2	17.1
	892.67	6.8	10.2	13.6	17.0	20.4
	892.72	8.0	11.9	15.9	19.9	23.9
	892.77	9.2	13.8	18.4	23.0	27.5
	892.81	10.5	15.7	20.9	26.2	31.4
	892.86	11.8	17.7	23.6	29.5	35.4
	892.91	13.2	19.8	26.4	33.0	39.6
	892.95	14.6	21.9	29.2	36.6	43.9
MAX POOL	893.00	16.1	24.2	32.2	40.3	48.3

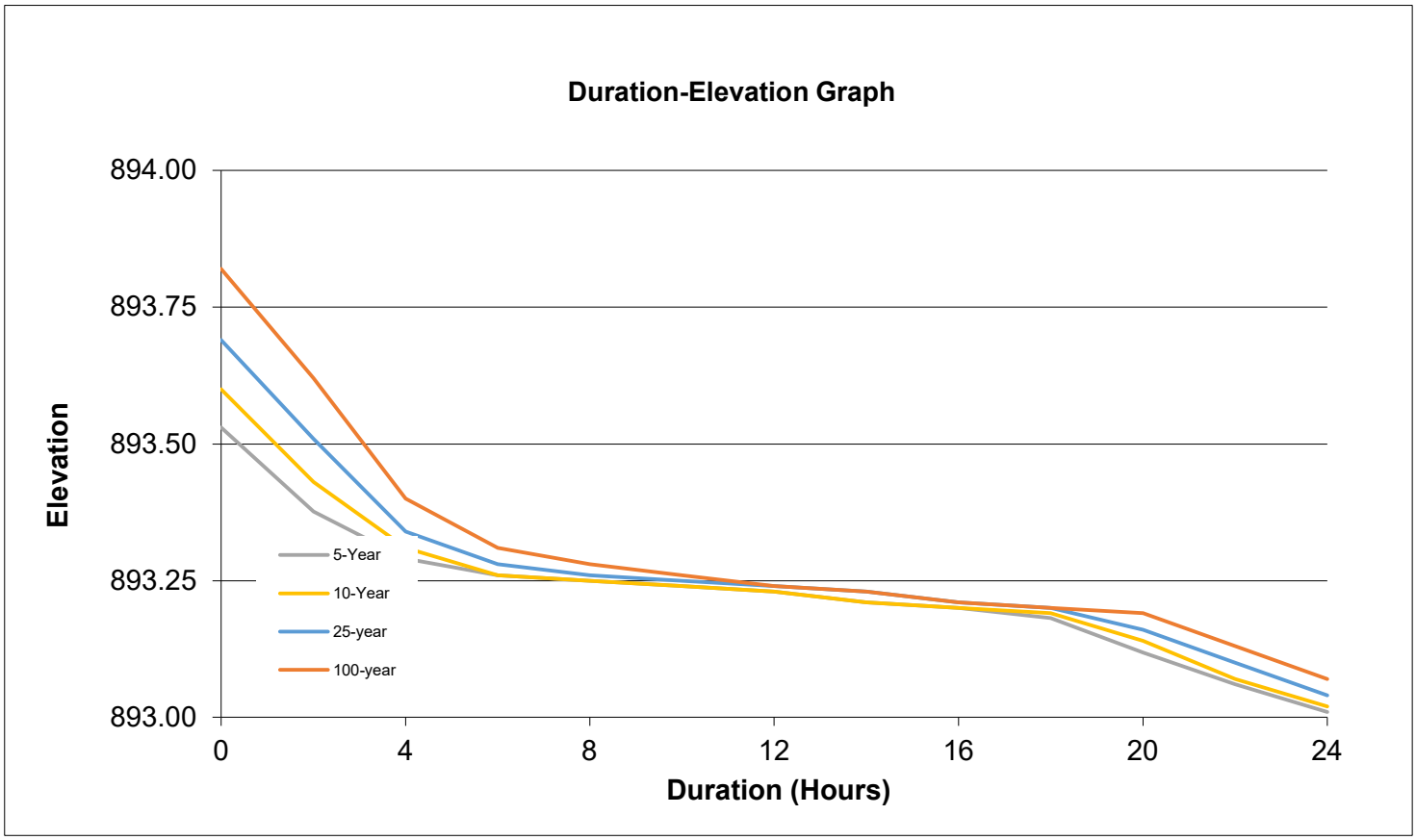
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Results

Surface-Drained DA = 1044.1 ac. = 1.63 sq. mi.

The following are based on surface flows and storm response. Discharge includes tile flow and overland flow.





Results

Suface-Drained DA = 1044.1 ac.
= 1.63 sq. mi.

The Elevation-Discharge table below shows tile and surface outflows from the wetland for various elevations. The tile discharge is very small compared to the surface discharge at higher elevations.

Elevation	Pool Area (ac)	Tile Discharge (cfs)	Surface Discharge (cfs)	Total Discharge
891.25	4.67			
892.00	4.88			
892.25	4.95			
893.00	8.98	2.88	0	2.88
893.07	9.97	2.88	0	2.88
893.25	13.25	2.88	8.17	11.05
893.50	17.41	2.88	190.00	192.88

The Duration-Elevation table below shows the duration that the pool is at each listed elevation during the design storms. This is based on surface inflows during the design storms listed. The design for the wetland is based on tile flows, but the entire watershed is analyzed, including surface flows, to show that the proposed wetland does not have adverse impacts on surrounding properties during rainfall events.

Duration-Elevation Table

5-year		10-year		25-year		100-year	
Duration	Elevation	Duration	Elevation	Duration	Elevation	Duration	Elevation
0	893.53	0	893.60	0	893.69	0	893.82
2	893.38	2	893.43	2	893.51	2	893.62
4	893.29	4	893.31	4	893.34	4	893.40
6	893.26	6	893.26	6	893.28	6	893.31
8	893.25	8	893.25	8	893.26	8	893.28
10	893.24	10	893.24	10	893.25	10	893.26
12	893.23	12	893.23	12	893.24	12	893.24
14	893.21	14	893.21	14	893.23	14	893.23
16	893.20	16	893.20	16	893.21	16	893.21
18	893.18	18	893.19	18	893.20	18	893.20
20	893.12	20	893.14	20	893.16	20	893.19
22	893.06	22	893.07	22	893.10	22	893.13
24	893.01	24	893.02	24	893.04	24	893.07

Appendix D: SSA Output

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Project Description

File Name ..... Story Kepley Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	NO
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
Nodes	19
Junctions	6
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	7
Links	21
Channels	8
Pipes	9
Pumps	1
Orifices	1
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	StoryCounty	Time Series	5-Year	Cumulative	inches				0.00	

Subbasin Summary

Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
DirectWatershed	28.50	71.00	3.90	1.33	37.79	59.27	0 00:10:00
DitchWatershed	661.50	82.06	3.90	2.12	1404.36	335.18	0 03:32:16
SE PotholeWatershed	56.60	79.73	3.90	1.94	109.69	99.29	0 00:31:03
TileWatershed	354.10	80.51	3.90	2.00	707.85	263.47	0 01:58:09

Node Summary

Element ID	Element Type	Invert Elevation (ft)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
InletPipeUp	Junction	894.00	4.92	898.03	0.00	0 00:00	0.00	0.00
ManholeDownstream	Junction	889.00	6.21	900.13	0.00	0 00:00	0.00	0.00
OutletStructure	Junction	889.50	17.09	894.03	0.00	0 00:00	0.00	0.00
StreamAboveCulverts	Junction	892.00	80.84	894.76	0.00	0 00:00	0.00	0.00
StreamBelowCulverts	Junction	891.50	80.69	894.06	0.00	0 00:00	0.00	0.00
TileAtIntake	Junction	888.00	6.06	893.12	0.00	0 00:00	0.00	0.00
SurfaceOutfall	Outfall	891.00	63.26	891.00				
SurfaceOutfall2	Outfall	891.00	174.41	891.00				
SurfaceOutfall3	Outfall	890.90	232.46	893.33				
SurfaceOutfall4	Outfall	891.00	15.04	891.00				
TileOutfall	Outfall	884.00	4.55	885.50				
WestChannelToRiver	Outfall	892.50	42.96	893.77				
DitchEnd	Storage Node	890.00	80.69	893.88			0.00	0.00
ManholeUpstream	Storage Node	880.00	5.76	894.03			0.00	0.00
NorthPothole	Storage Node	893.00	262.81	894.30			0.00	0.00
PotholeAboveAccessRoad	Storage Node	899.00	335.16	900.52			0.00	0.00
SEPothole	Storage Node	891.00	255.66	893.44			0.00	0.00
StreamAtInlet	Storage Node	896.00	85.70	898.14			0.00	0.00
WetlandPool	Storage Node	891.50	211.77	893.52			0.00	0.00

Link Summary

Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)
CrossingCulverts	Pipe	PotholeAboveAccessRoad	StreamAtInlet	32.00	895.10	895.00	0.3100	36.000	0.0150	85.70	353.98
CulvertsDownstream	Pipe	StreamAboveCulverts	StreamBelowCulverts	15.00	892.00	891.50	3.3300	30.000	0.0250	80.69	116.82
PipeThruBerm	Pipe	DitchEnd	SurfaceOutfall4	15.00	891.57	891.17	2.6700	18.000	0.0130	15.04	17.15
TileDSofWetland	Pipe	ManholeDownstream	TileAtIntake	685.09	889.00	888.00	0.1500	18.000	0.0150	3.92	3.48
TileOutfall	Pipe	TileAtIntake	TileOutfall	3000.00	888.00	884.00	0.1300	18.000	0.0150	4.55	3.32
TileRelay	Pipe	ManholeUpstream	ManholeDownstream	1150.00	887.46	886.39	0.0900	18.000	0.0150	3.36	3.33
TileUpstream	Pipe	NorthPothole	ManholeUpstream	100.00	887.56	887.46	0.1000	16.000	0.0150	3.11	15.65
WetlandInletPipe	Pipe	InletPipeUp	WetlandPool	168.00	894.00	893.50	0.3000	12.000	0.0130	4.83	1.94
WLOutletPipe	Pipe	OutletStructure	ManholeDownstream	151.00	888.00	887.00	0.6600	18.000	0.0130	5.72	6.04
ChannelToRiver	Channel	NorthPothole	WestChannelToRiver	486.51	893.00	892.50	0.1000	48.000	0.0300	42.96	385.61
DitchEndOverflow	Channel	DitchEnd	SurfaceOutfall	10.00	892.41	892.40	0.1000	91.080	0.0320	63.26	3838.47
EastSurfaceOverflow	Channel	PotholeAboveAccessRoad	SEPothole	10.00	900.00	899.00	10.0000	120.000	0.0500	249.16	38630.29
SEPotOverflow	Channel	SEPothole	SurfaceOutfall3	208.36	891.00	-0.10	427.6700	80.400	0.0320	232.46	4342.77
StreamChannel	Channel	StreamAtInlet	StreamAboveCulverts	1240.00	896.50	892.00	0.3600	72.000	0.0270	80.84	1021.92
StreamDown	Channel	StreamBelowCulverts	DitchEnd	290.00	891.50	890.90	0.2100	72.000	0.0270	80.69	775.17
SurfaceOverflowPothole	Channel	NorthPothole	WetlandPool	557.73	893.80	893.00	0.1400	120.000	0.0320	203.37	31608.38
WLSurfaceOverflow	Channel	WetlandPool	SurfaceOutfall2	10.00	893.20	893.10	1.0000	120.000	0.0320	174.41	61939.96
IntakeToTile	Orifice	DitchEnd	TileAtIntake		890.00	888.00		10.000		4.10	
InletFromStream	Weir	StreamAtInlet	InletPipeUp		896.00	894.00				4.92	
WetlandOutlet	Weir	WetlandPool	OutletStructure		891.50	889.50				17.09	
Pump-01	Pump	ManholeUpstream	WetlandPool		880.00	891.50				0.98	

Subbasin Hydrology

Subbasin : DirectWatershed

Input Data

Area (ac) 28.5
Peak Rate Factor 484
Weighted Curve Number 71
Rain Gage ID ..... StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Meadow, non-grazed	28.5	C	71
Composite Area & Weighted CN	28.5		71

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

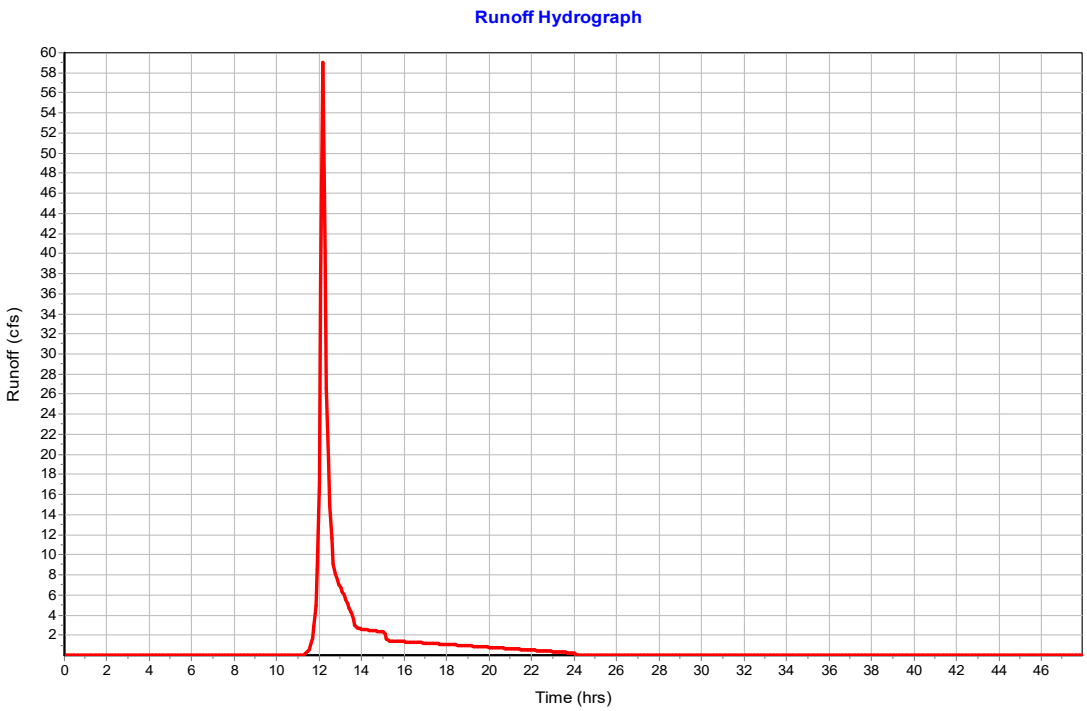
User-Defined TOC override (minutes): 10

Subbasin Runoff Results

Total Rainfall (in) 3.9
Total Runoff (in) 1.33
Peak Runoff (cfs) 59.27

Weighted Curve Number	71
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : DirectWatershed



Subbasin : DitchWatershed

Input Data

Area (ac)	661.5
Peak Rate Factor	484
Weighted Curve Number	82.06
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
> 75% grass cover, Good	26.8	C	74
Woods, Good	110	C	70
Row crops, straight row, Good	524.7	C	85
Composite Area & Weighted CN	661.5		82.06

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.19	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	10.07	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	2389	4387	0
Slope (%) :	0.42	0.55	0
Surface Type :	Straight rows	Straight rows	Unpaved
Velocity (ft/sec) :	0.58	0.67	0
Computed Flow Time (min) :	68.65	109.13	0

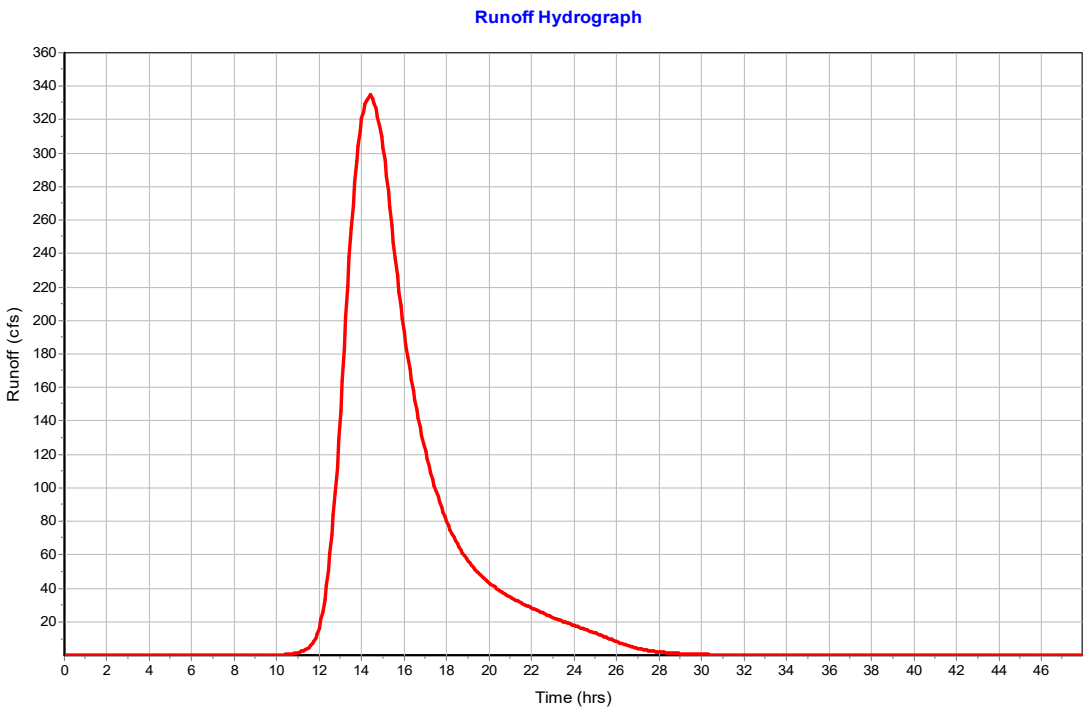
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.045	0	0
Flow Length (ft) :	6117	0	0
Channel Slope (%) :	1.73	0	0
Cross Section Area (ft^2) :	30	0	0
Wetted Perimeter (ft) :	32	0	0
Velocity (ft/sec) :	4.17	0	0
Computed Flow Time (min) :	24.44	0	0

Total TOC (min) 212.28

Subbasin Runoff Results

Total Rainfall (in)	3.9
Total Runoff (in)	2.12
Peak Runoff (cfs)	335.18
Weighted Curve Number	82.06
Time of Concentration (days hh:mm:ss)	0 03:32:17

Subbasin : DitchWatershed



Subbasin : SE PotholeWatershed

Input Data

Area (ac)	56.6
Peak Rate Factor	484
Weighted Curve Number	79.73
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	19.9	C	70
Row crops, straight row, Good	36.7	C	85
Composite Area & Weighted CN	56.6		79.73

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	19.14	0	0

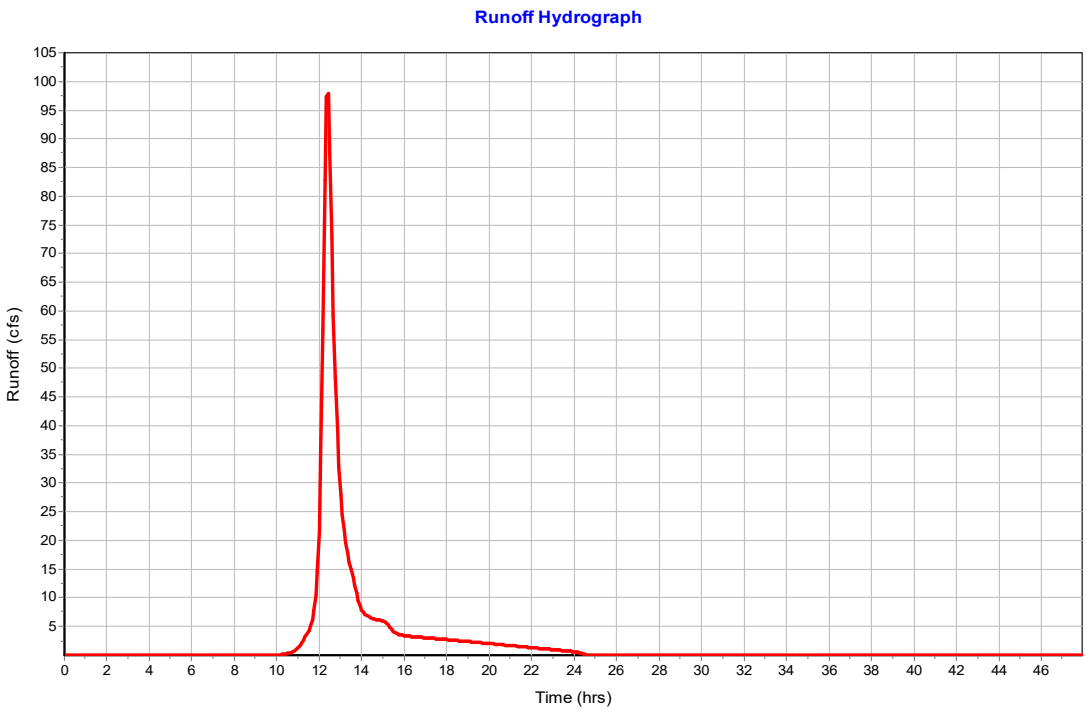
	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	1015	0	0
Slope (%) :	8.1	0	0
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0	0
Computed Flow Time (min) :	11.91	0	0

Total TOC (min) 31.05

Subbasin Runoff Results

Total Rainfall (in)	3.9
Total Runoff (in)	1.94
Peak Runoff (cfs)	99.29
Weighted Curve Number	79.73
Time of Concentration (days hh:mm:ss)	0 00:31:03

Subbasin : SE PotholeWatershed



Subbasin : TileWatershed

Input Data

Area (ac)	354.1
Peak Rate Factor	484
Weighted Curve Number	80.51
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	80.5	C	70
2 acre lots, 12% impervious	12.8	C	77
Pasture, grassland, or range, Good	25.5	C	74
Row crops, straight row, Good	235.3	C	85
Composite Area & Weighted CN	354.1		80.51

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	22.51	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	300	3650	0
Slope (%) :	5.3	0.6	0
Surface Type :	Woodland	Straight rows	Unpaved
Velocity (ft/sec) :	1.15	0.7	0
Computed Flow Time (min) :	4.35	86.9	0

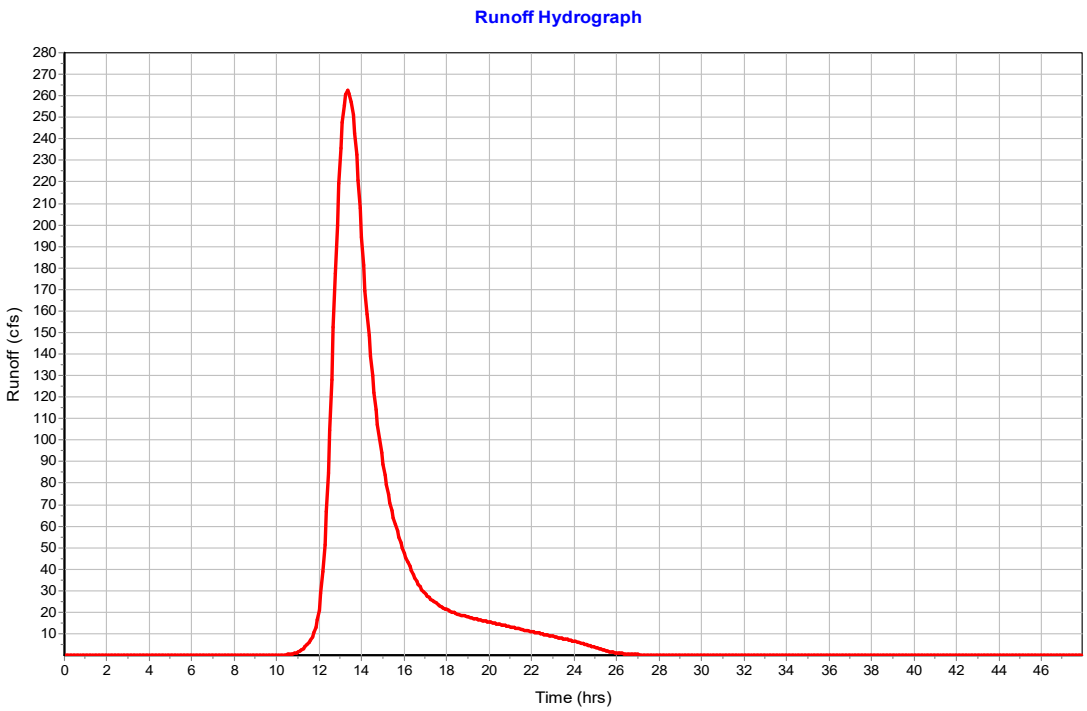
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.035	0.035	0
Flow Length (ft) :	890	865	0
Channel Slope (%) :	2	2.1	0
Cross Section Area (ft^2) :	30	25	0
Wetted Perimeter (ft) :	22	26	0
Velocity (ft/sec) :	7.4	6.01	0
Computed Flow Time (min) :	2	2.4	0

Total TOC (min) 118.16

Subbasin Runoff Results

Total Rainfall (in)	3.9
Total Runoff (in)	2
Peak Runoff (cfs)	263.47
Weighted Curve Number	80.51
Time of Concentration (days hh:mm:ss)	0 01:58:10

Subbasin : TileWatershed



Storage Nodes

Storage Node : DitchEnd

Input Data

Invert Elevation (ft)	890.00
Max (Rim) Elevation (ft)	1000.00
Max (Rim) Offset (ft)	110.00
Initial Water Elevation (ft)	890.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	2500.00
Evaporation Loss	0.00

Outflow Orifices

Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
IntakeToTile	Bottom	CIRCULAR	No	10.00			890.23	0.61

Output Summary Results

Peak Inflow (cfs)	80.69
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	80.7
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.88
Max HGL Depth Attained (ft)	3.88
Average HGL Elevation Attained (ft)	893.16
Average HGL Depth Attained (ft)	3.16
Time of Max HGL Occurrence (days hh:mm)	0 14:37
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : ManholeUpstream

Input Data

Invert Elevation (ft)	880.00
Max (Rim) Elevation (ft)	910.00
Max (Rim) Offset (ft)	30.00
Initial Water Elevation (ft)	880.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	5.76
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	3.09
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.03
Max HGL Depth Attained (ft)	14.03
Average HGL Elevation Attained (ft)	893.19
Average HGL Depth Attained (ft)	13.19
Time of Max HGL Occurrence (days hh:mm)	0 14:02
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NorthPothole

Input Data

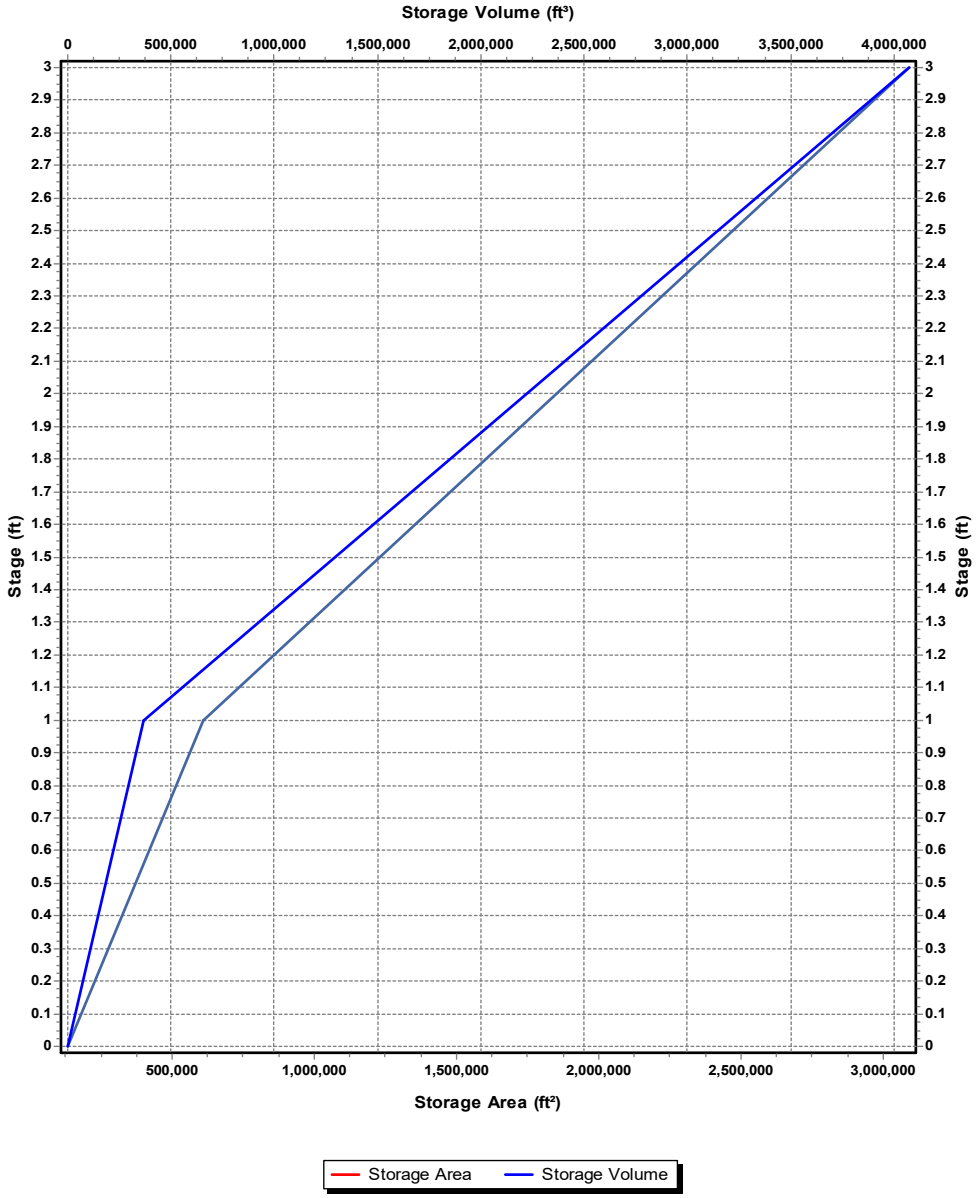
Invert Elevation (ft)	893.00
Max (Rim) Elevation (ft)	896.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	893.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : NorthPothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	131000	0
1	609800	370400
3	3092800	4073000

Storage Area Volume Curves



Storage Node : NorthPothole (continued)

Output Summary Results

Peak Inflow (cfs)	262.81
Peak Lateral Inflow (cfs)	262.81
Peak Outflow (cfs)	248.32
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.3
Max HGL Depth Attained (ft)	1.3
Average HGL Elevation Attained (ft)	893.75
Average HGL Depth Attained (ft)	0.75
Time of Max HGL Occurrence (days hh:mm)	0 13:50
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : PotholeAboveAccessRoad

Input Data

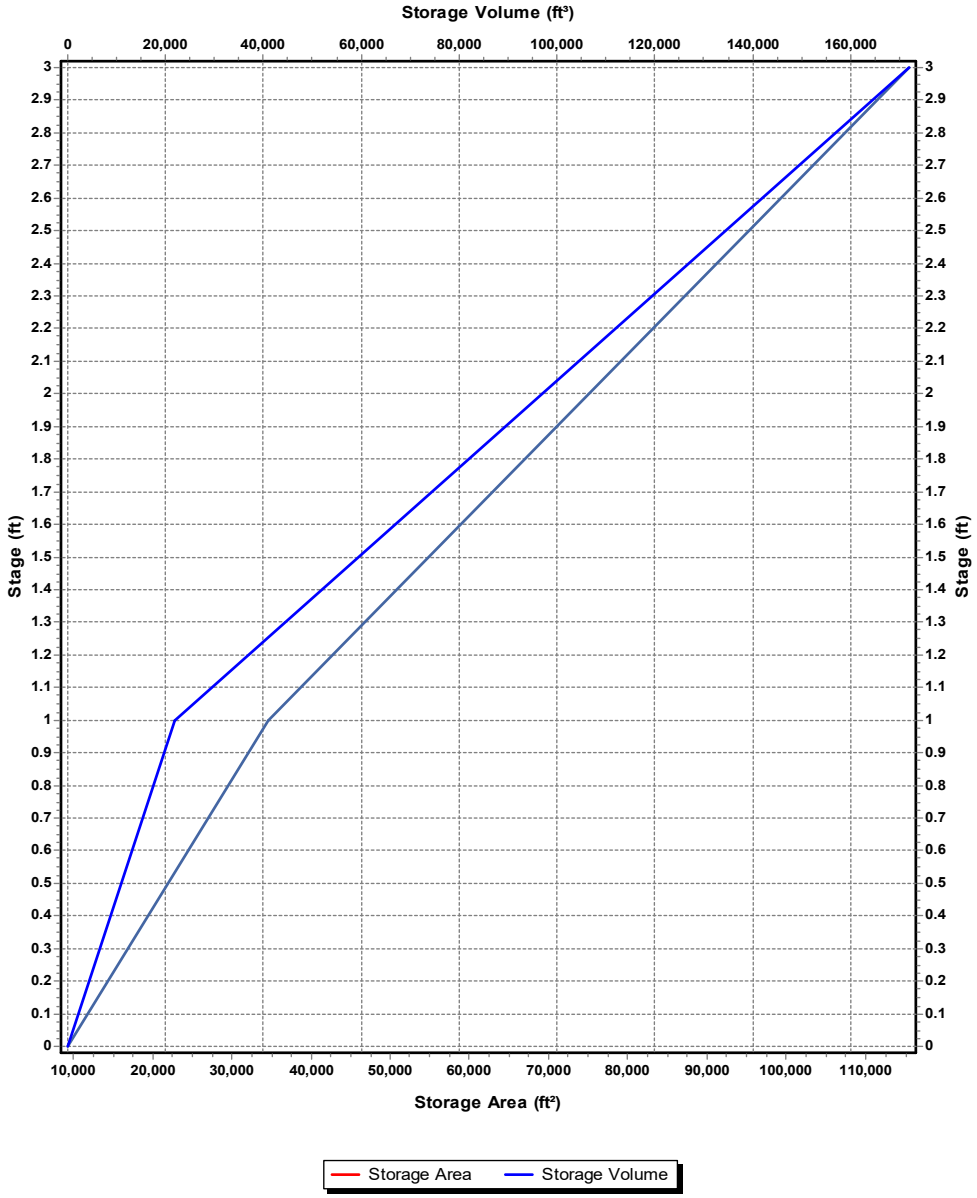
Invert Elevation (ft)	899.00
Max (Rim) Elevation (ft)	902.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	899.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : PotholeAboveAccess

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	9300	0
1	34531	21915.5
3	115500	171946.5

Storage Area Volume Curves



Storage Node : PotholeAboveAccessRoad (continued)

Output Summary Results

Peak Inflow (cfs)	335.16
Peak Lateral Inflow (cfs)	335.16
Peak Outflow (cfs)	334.86
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	900.52
Max HGL Depth Attained (ft)	1.52
Average HGL Elevation Attained (ft)	899.87
Average HGL Depth Attained (ft)	0.87
Time of Max HGL Occurrence (days hh:mm)	0 14:30
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SEPothole

Input Data

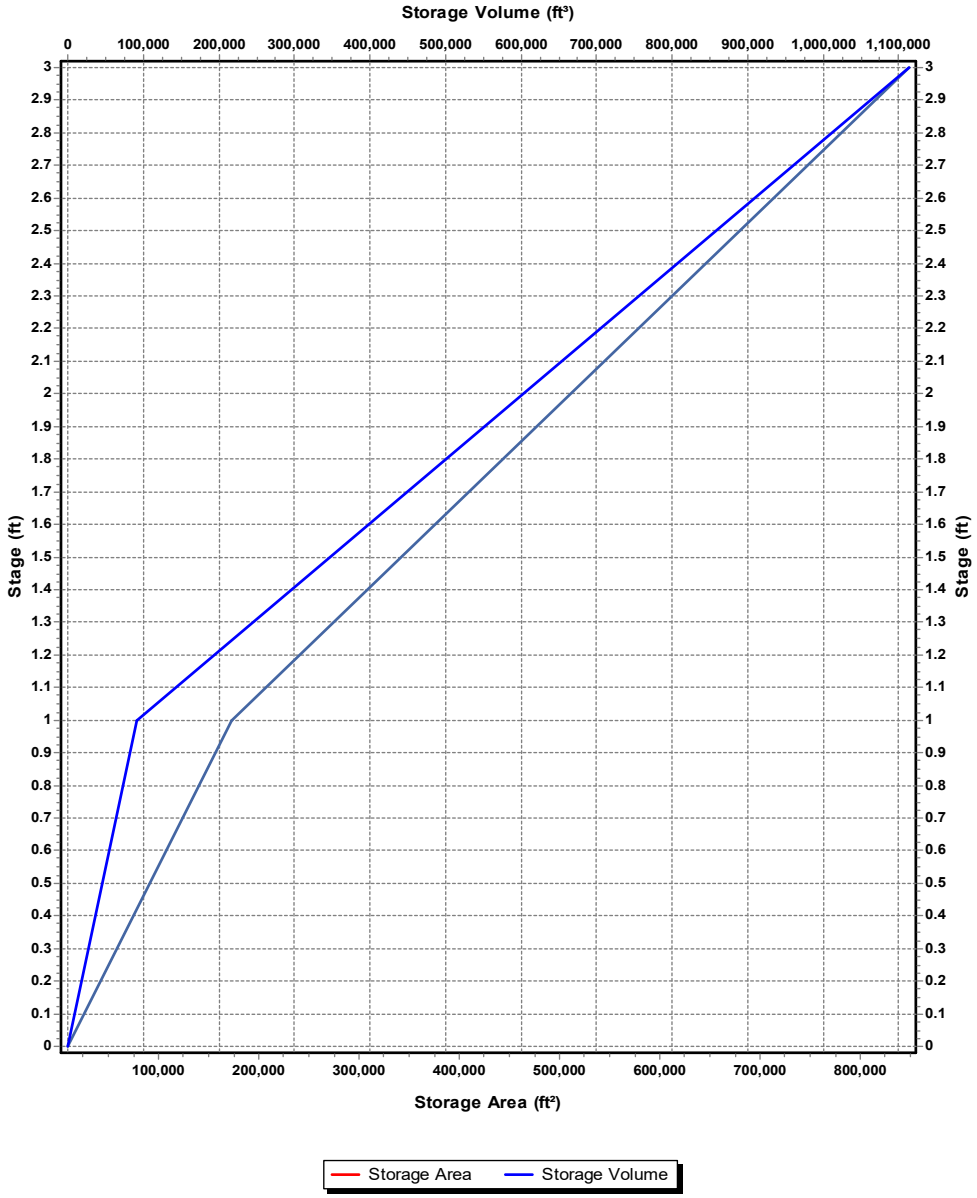
Invert Elevation (ft)	891.00
Max (Rim) Elevation (ft)	894.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-891.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : SE Pothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	10000	0
1	173600	91800
3	848300	1113700

Storage Area Volume Curves



Storage Node : SEPothole (continued)

Output Summary Results

Peak Inflow (cfs)	255.66
Peak Lateral Inflow (cfs)	97.91
Peak Outflow (cfs)	232.46
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.44
Max HGL Depth Attained (ft)	2.44
Average HGL Elevation Attained (ft)	892.39
Average HGL Depth Attained (ft)	1.39
Time of Max HGL Occurrence (days hh:mm)	0 15:01
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : StreamAtInlet

Input Data

Invert Elevation (ft)	896.00
Max (Rim) Elevation (ft)	906.00
Max (Rim) Offset (ft)	10.00
Initial Water Elevation (ft)	896.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
InletFromStream	Rectangular	No	896.50	0.50	4.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	85.7
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	85.75
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	898.14
Max HGL Depth Attained (ft)	2.14
Average HGL Elevation Attained (ft)	897.48
Average HGL Depth Attained (ft)	1.48
Time of Max HGL Occurrence (days hh:mm)	0 14:32
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : WetlandPool

Input Data

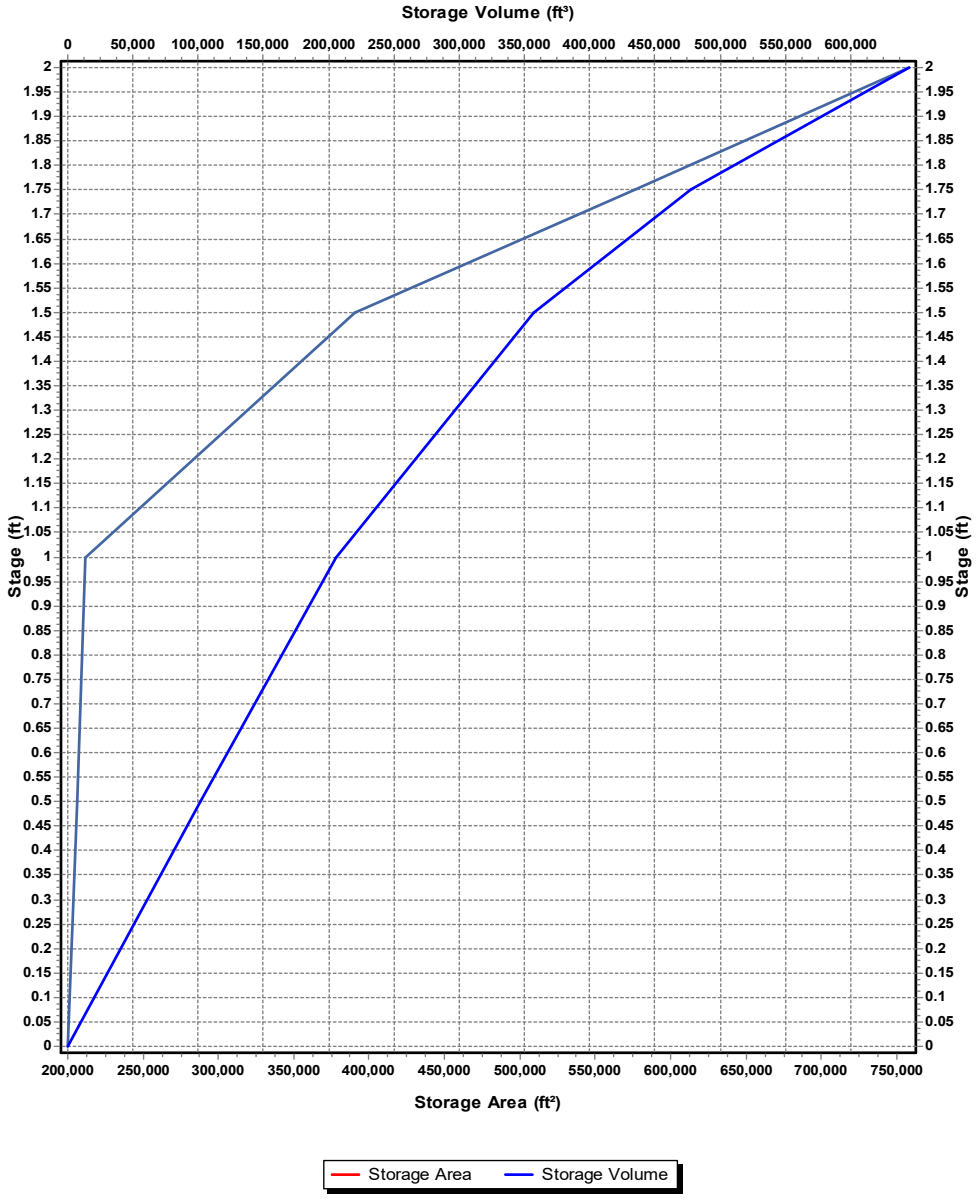
Invert Elevation (ft)	891.50
Max (Rim) Elevation (ft)	900.00
Max (Rim) Offset (ft)	8.50
Initial Water Elevation (ft)	892.50
Initial Water Depth (ft)	1.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Wetland Pool

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	200000	0
0.5	206000	101500
1	212000	206000
1.5	391000	356750
1.75	577000	477750
2	758250	644656.25

Storage Area Volume Curves



Storage Node : WetlandPool (continued)

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
WetlandOutlet	Rectangular	No	892.50	1.00	16.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	211.77
Peak Lateral Inflow (cfs)	59.03
Peak Outflow (cfs)	181.59
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.52
Max HGL Depth Attained (ft)	2.02
Average HGL Elevation Attained (ft)	893.23
Average HGL Depth Attained (ft)	1.73
Time of Max HGL Occurrence (days hh:mm)	0 14:21
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	Story Kepley Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	NO
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
Nodes	19
Junctions	6
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	7
Links	21
Channels	8
Pipes	9
Pumps	1
Orifices	1
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	StoryCounty	Time Series	10-Year	Cumulative	inches				0.00	

Subbasin Summary

Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
DirectWatershed	28.50	71.00	4.50	1.75	49.76	79.01	0 00:10:00
DitchWatershed	661.50	82.06	4.50	2.64	1747.02	417.86	0 03:32:16
SE PotholeWatershed	56.60	79.73	4.50	2.44	137.99	125.34	0 00:31:03
TileWatershed	354.10	80.51	4.50	2.51	887.02	331.77	0 01:58:09

Node Summary

Element ID	Element Type	Invert Elevation (ft)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
InletPipeUp	Junction	894.00	4.97	898.11	0.00	0 00:00	0.00	0.00
ManholeDownstream	Junction	889.00	6.10	901.45	0.00	0 00:00	0.00	0.00
OutletStructure	Junction	889.50	17.61	894.11	0.00	0 00:00	0.00	0.00
StreamAboveCulverts	Junction	892.00	88.31	894.98	0.00	0 00:00	0.00	0.00
StreamBelowCulverts	Junction	891.50	88.18	894.14	0.00	0 00:00	0.00	0.00
TileAtIntake	Junction	888.00	4.77	893.18	0.00	0 00:00	0.00	0.00
SurfaceOutfall	Outfall	891.00	70.44	891.00				
SurfaceOutfall2	Outfall	891.00	241.45	891.00				
SurfaceOutfall3	Outfall	890.90	307.94	893.51				
SurfaceOutfall4	Outfall	891.00	15.34	891.00				
TileOutfall	Outfall	884.00	4.57	885.50				
WestChannelToRiver	Outfall	892.50	47.34	893.84				
DitchEnd	Storage Node	890.00	88.18	893.95			0.00	0.00
ManholeUpstream	Storage Node	880.00	5.80	894.10			0.00	0.00
NorthPothole	Storage Node	893.00	331.10	894.37			0.00	0.00
PotholeAboveAccessRoad	Storage Node	899.00	417.29	900.62			0.00	0.00
SEPothole	Storage Node	891.00	331.86	893.62			0.00	0.00
StreamAtInlet	Storage Node	896.00	93.22	898.22			0.00	0.00
WetlandPool	Storage Node	891.50	272.32	893.59			0.00	0.00

Link Summary

Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)
CrossingCulverts	Pipe	PotholeAboveAccessRoad	StreamAtInlet	32.00	895.10	895.00	0.3100	36.000	0.0150	93.22	353.98
CulvertsDownstream	Pipe	StreamAboveCulverts	StreamBelowCulverts	15.00	892.00	891.50	3.3300	30.000	0.0250	88.18	116.82
PipeThruBerm	Pipe	DitchEnd	SurfaceOutfall4	15.00	891.57	891.17	2.6700	18.000	0.0130	15.34	17.15
TileDSofWetland	Pipe	ManholeDownstream	TileAtIntake	685.09	889.00	888.00	0.1500	18.000	0.0150	3.92	3.48
TileOutfall	Pipe	TileAtIntake	TileOutfall	3000.00	888.00	884.00	0.1300	18.000	0.0150	4.57	3.32
TileRelay	Pipe	ManholeUpstream	ManholeDownstream	1150.00	887.46	886.39	0.0900	18.000	0.0150	3.37	3.33
TileUpstream	Pipe	NorthPothole	ManholeUpstream	100.00	887.56	887.46	0.1000	16.000	0.0150	3.14	15.65
WetlandInletPipe	Pipe	InletPipeUp	WetlandPool	168.00	894.00	893.50	0.3000	12.000	0.0130	4.89	1.94
WLOutletPipe	Pipe	OutletStructure	ManholeDownstream	151.00	888.00	887.00	0.6600	18.000	0.0130	5.58	6.04
ChannelToRiver	Channel	NorthPothole	WestChannelToRiver	486.51	893.00	892.50	0.1000	48.000	0.0300	47.34	385.61
DitchEndOverflow	Channel	DitchEnd	SurfaceOutfall	10.00	892.41	892.40	0.1000	91.080	0.0320	70.44	3838.47
EastSurfaceOverflow	Channel	PotholeAboveAccessRoad	SEPothole	10.00	900.00	899.00	10.0000	120.000	0.0500	323.85	38630.29
SEPotOverflow	Channel	SEPothole	SurfaceOutfall3	208.36	891.00	-0.10	427.6700	80.400	0.0320	307.94	4342.77
StreamChannel	Channel	StreamAtInlet	StreamAboveCulverts	1240.00	896.50	892.00	0.3600	72.000	0.0270	88.31	1021.92
StreamDown	Channel	StreamBelowCulverts	DitchEnd	290.00	891.50	890.90	0.2100	72.000	0.0270	88.18	775.17
SurfaceOverflowPothole	Channel	NorthPothole	WetlandPool	557.73	893.80	893.00	0.1400	120.000	0.0320	263.13	31608.38
WLSurfaceOverflow	Channel	WetlandPool	SurfaceOutfall2	10.00	893.20	893.10	1.0000	120.000	0.0320	241.45	61939.96
IntakeToTile	Orifice	DitchEnd	TileAtIntake		890.00	888.00		10.000		4.23	
InletFromStream	Weir	StreamAtInlet	InletPipeUp		896.00	894.00				4.97	
WetlandOutlet	Weir	WetlandPool	OutletStructure		891.50	889.50				17.61	
Pump-01	Pump	ManholeUpstream	WetlandPool		880.00	891.50				0.98	

Subbasin Hydrology

Subbasin : DirectWatershed

Input Data

Area (ac) 28.5
Peak Rate Factor 484
Weighted Curve Number 71
Rain Gage ID ..... StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Meadow, non-grazed	28.5	C	71
Composite Area & Weighted CN	28.5		71

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

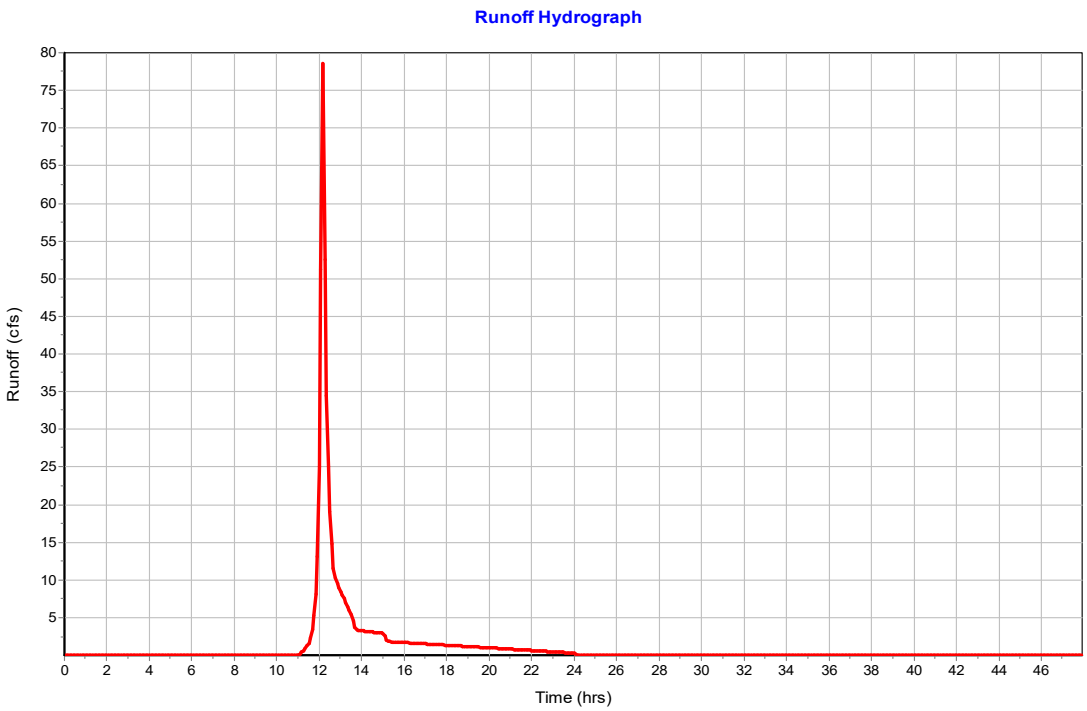
User-Defined TOC override (minutes): 10

Subbasin Runoff Results

Total Rainfall (in) 4.5
Total Runoff (in) 1.75
Peak Runoff (cfs) 79.01

Weighted Curve Number	71
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : DirectWatershed



Subbasin : DitchWatershed

Input Data

Area (ac)	661.5
Peak Rate Factor	484
Weighted Curve Number	82.06
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
> 75% grass cover, Good	26.8	C	74
Woods, Good	110	C	70
Row crops, straight row, Good	524.7	C	85
Composite Area & Weighted CN	661.5		82.06

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.19	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	10.07	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	2389	4387	0
Slope (%) :	0.42	0.55	0
Surface Type :	Straight rows	Straight rows	Unpaved
Velocity (ft/sec) :	0.58	0.67	0
Computed Flow Time (min) :	68.65	109.13	0

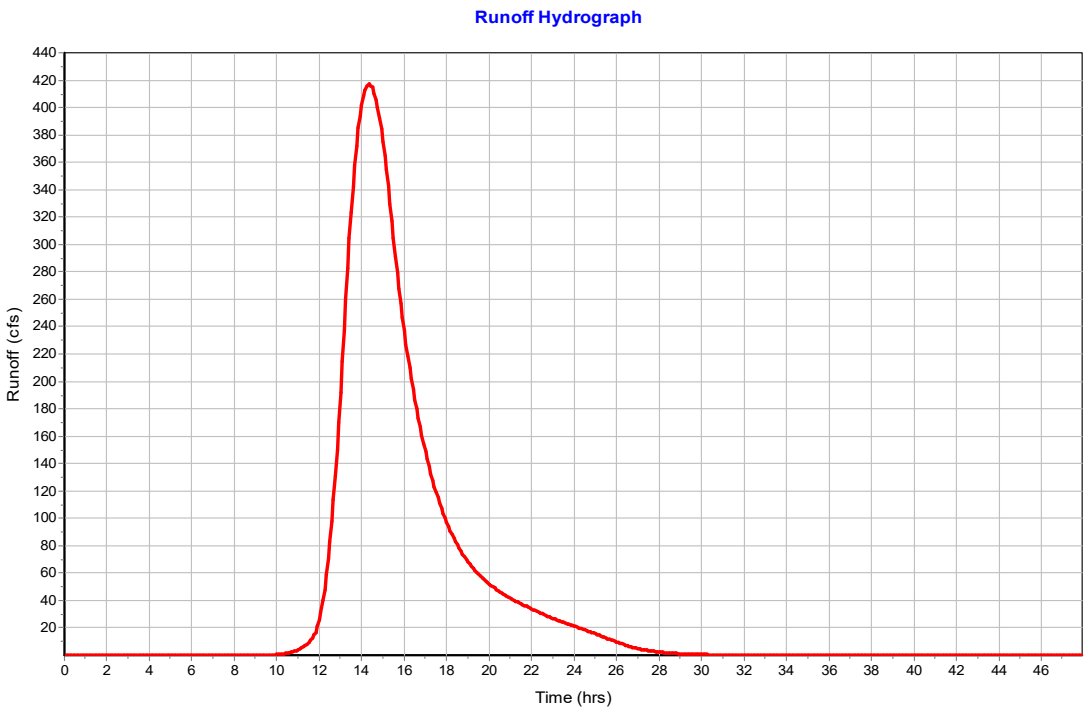
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.045	0	0
Flow Length (ft) :	6117	0	0
Channel Slope (%) :	1.73	0	0
Cross Section Area (ft^2) :	30	0	0
Wetted Perimeter (ft) :	32	0	0
Velocity (ft/sec) :	4.17	0	0
Computed Flow Time (min) :	24.44	0	0

Total TOC (min) 212.28

Subbasin Runoff Results

Total Rainfall (in)	4.5
Total Runoff (in)	2.64
Peak Runoff (cfs)	417.86
Weighted Curve Number	82.06
Time of Concentration (days hh:mm:ss)	0 03:32:17

Subbasin : DitchWatershed



Subbasin : SE PotholeWatershed

Input Data

Area (ac)	56.6
Peak Rate Factor	484
Weighted Curve Number	79.73
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	19.9	C	70
Row crops, straight row, Good	36.7	C	85
Composite Area & Weighted CN	56.6		79.73

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	19.14	0	0

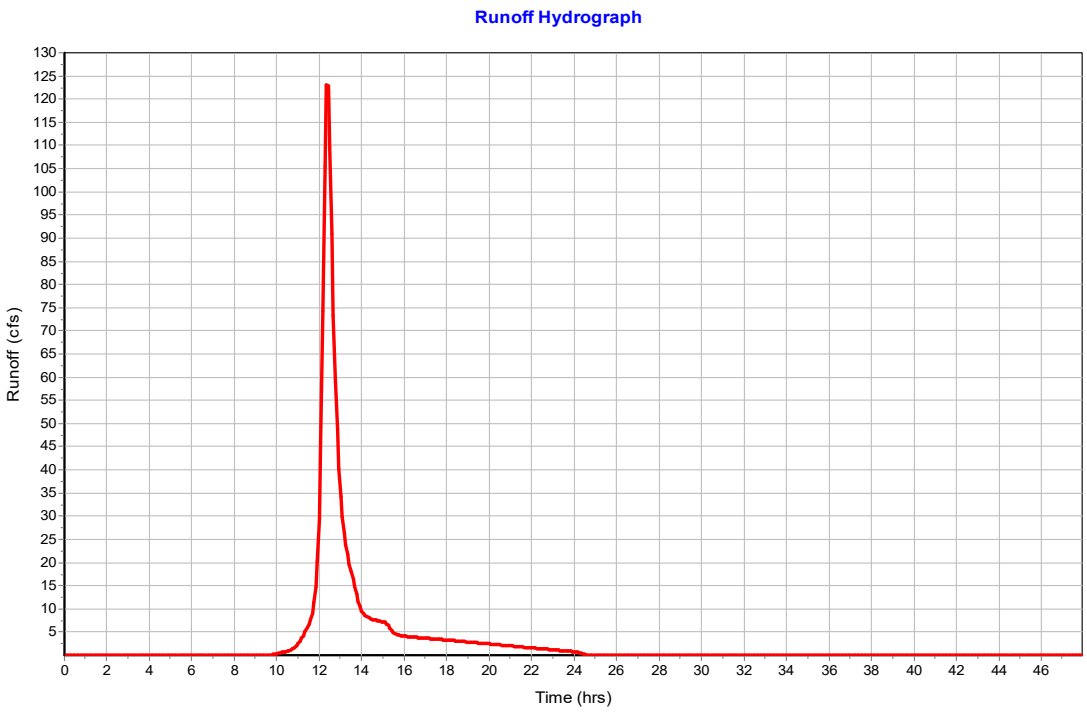
	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	1015	0	0
Slope (%) :	8.1	0	0
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0	0
Computed Flow Time (min) :	11.91	0	0

Total TOC (min) 31.05

Subbasin Runoff Results

Total Rainfall (in)	4.5
Total Runoff (in)	2.44
Peak Runoff (cfs)	125.34
Weighted Curve Number	79.73
Time of Concentration (days hh:mm:ss)	0 00:31:03

Subbasin : SE PotholeWatershed



Subbasin : TileWatershed

Input Data

Area (ac)	354.1
Peak Rate Factor	484
Weighted Curve Number	80.51
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	80.5	C	70
2 acre lots, 12% impervious	12.8	C	77
Pasture, grassland, or range, Good	25.5	C	74
Row crops, straight row, Good	235.3	C	85
Composite Area & Weighted CN	354.1		80.51

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	22.51	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	300	3650	0
Slope (%) :	5.3	0.6	0
Surface Type :	Woodland	Straight rows	Unpaved
Velocity (ft/sec) :	1.15	0.7	0
Computed Flow Time (min) :	4.35	86.9	0

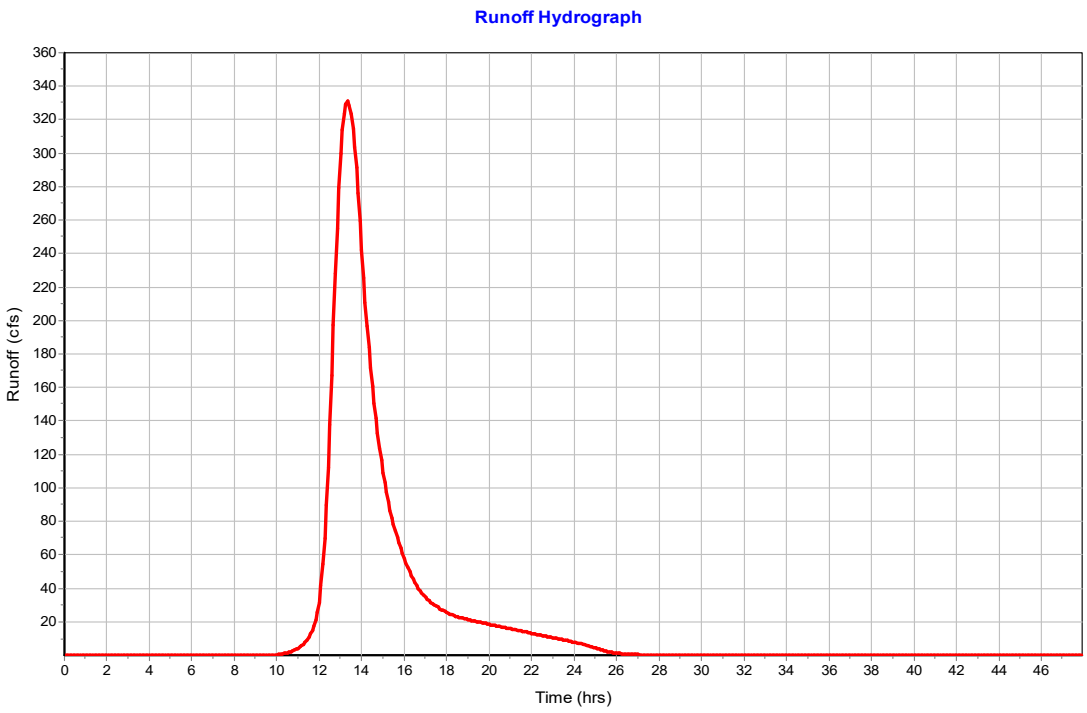
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.035	0.035	0
Flow Length (ft) :	890	865	0
Channel Slope (%) :	2	2.1	0
Cross Section Area (ft^2) :	30	25	0
Wetted Perimeter (ft) :	22	26	0
Velocity (ft/sec) :	7.4	6.01	0
Computed Flow Time (min) :	2	2.4	0

Total TOC (min) 118.16

Subbasin Runoff Results

Total Rainfall (in)	4.5
Total Runoff (in)	2.51
Peak Runoff (cfs)	331.77
Weighted Curve Number	80.51
Time of Concentration (days hh:mm:ss)	0 01:58:10

Subbasin : TileWatershed



Storage Nodes

Storage Node : DitchEnd

Input Data

Invert Elevation (ft)	890.00
Max (Rim) Elevation (ft)	1000.00
Max (Rim) Offset (ft)	110.00
Initial Water Elevation (ft)	890.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	2500.00
Evaporation Loss	0.00

Outflow Orifices

Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
IntakeToTile	Bottom	CIRCULAR	No	10.00			890.23	0.61

Output Summary Results

Peak Inflow (cfs)	88.18
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	88.19
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.95
Max HGL Depth Attained (ft)	3.95
Average HGL Elevation Attained (ft)	893.21
Average HGL Depth Attained (ft)	3.21
Time of Max HGL Occurrence (days hh:mm)	0 14:37
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : ManholeUpstream

Input Data

Invert Elevation (ft)	880.00
Max (Rim) Elevation (ft)	910.00
Max (Rim) Offset (ft)	30.00
Initial Water Elevation (ft)	880.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	5.8
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	3.1
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.1
Max HGL Depth Attained (ft)	14.1
Average HGL Elevation Attained (ft)	893.18
Average HGL Depth Attained (ft)	13.18
Time of Max HGL Occurrence (days hh:mm)	0 13:53
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NorthPothole

Input Data

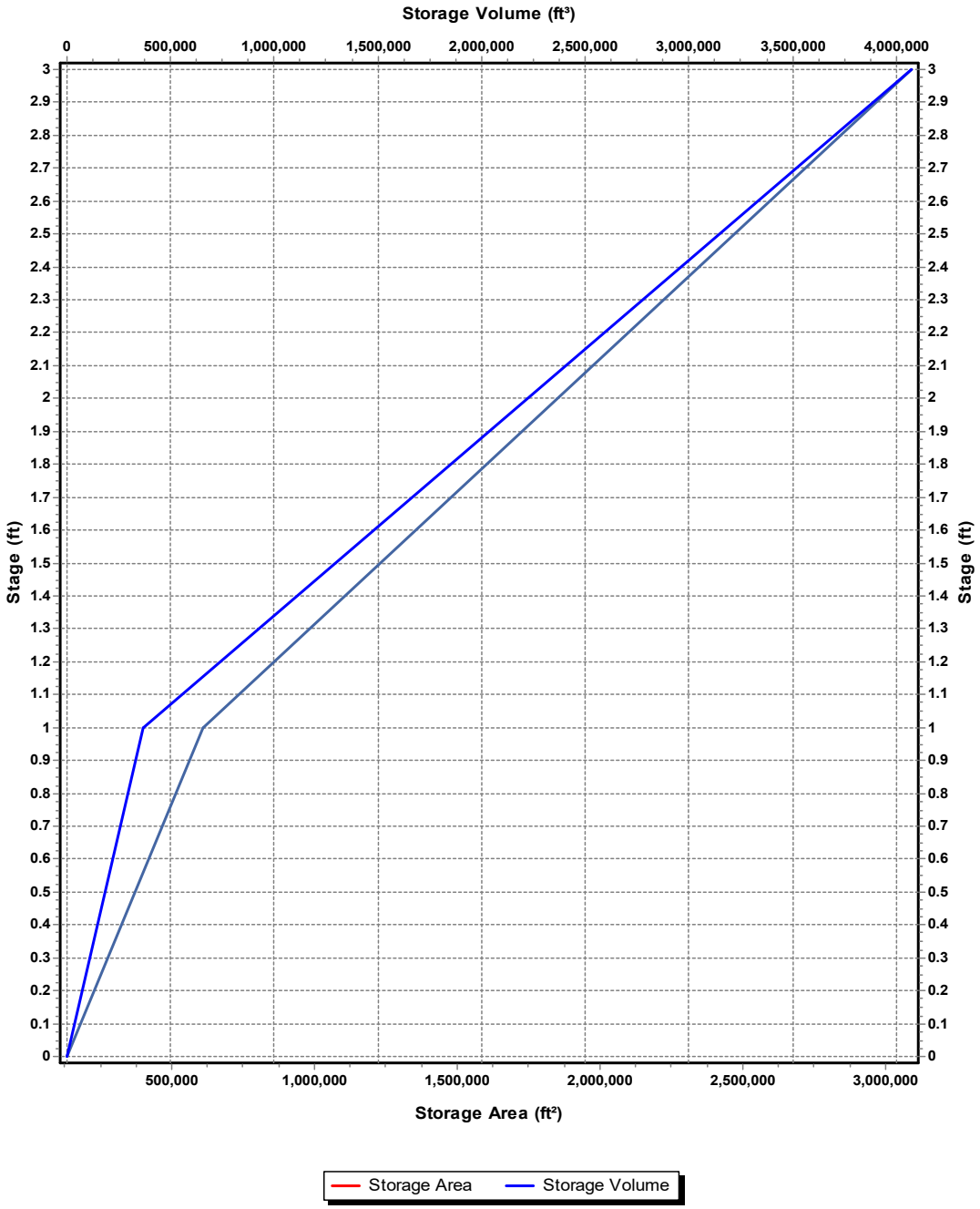
Invert Elevation (ft)	893.00
Max (Rim) Elevation (ft)	896.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	893.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : NorthPothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	131000	0
1	609800	370400
3	3092800	4073000

Storage Area Volume Curves



Storage Node : NorthPothole (continued)

Output Summary Results

Peak Inflow (cfs)	331.1
Peak Lateral Inflow (cfs)	331.1
Peak Outflow (cfs)	312.91
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.37
Max HGL Depth Attained (ft)	1.37
Average HGL Elevation Attained (ft)	893.78
Average HGL Depth Attained (ft)	0.78
Time of Max HGL Occurrence (days hh:mm)	0 13:44
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : PotholeAboveAccessRoad

Input Data

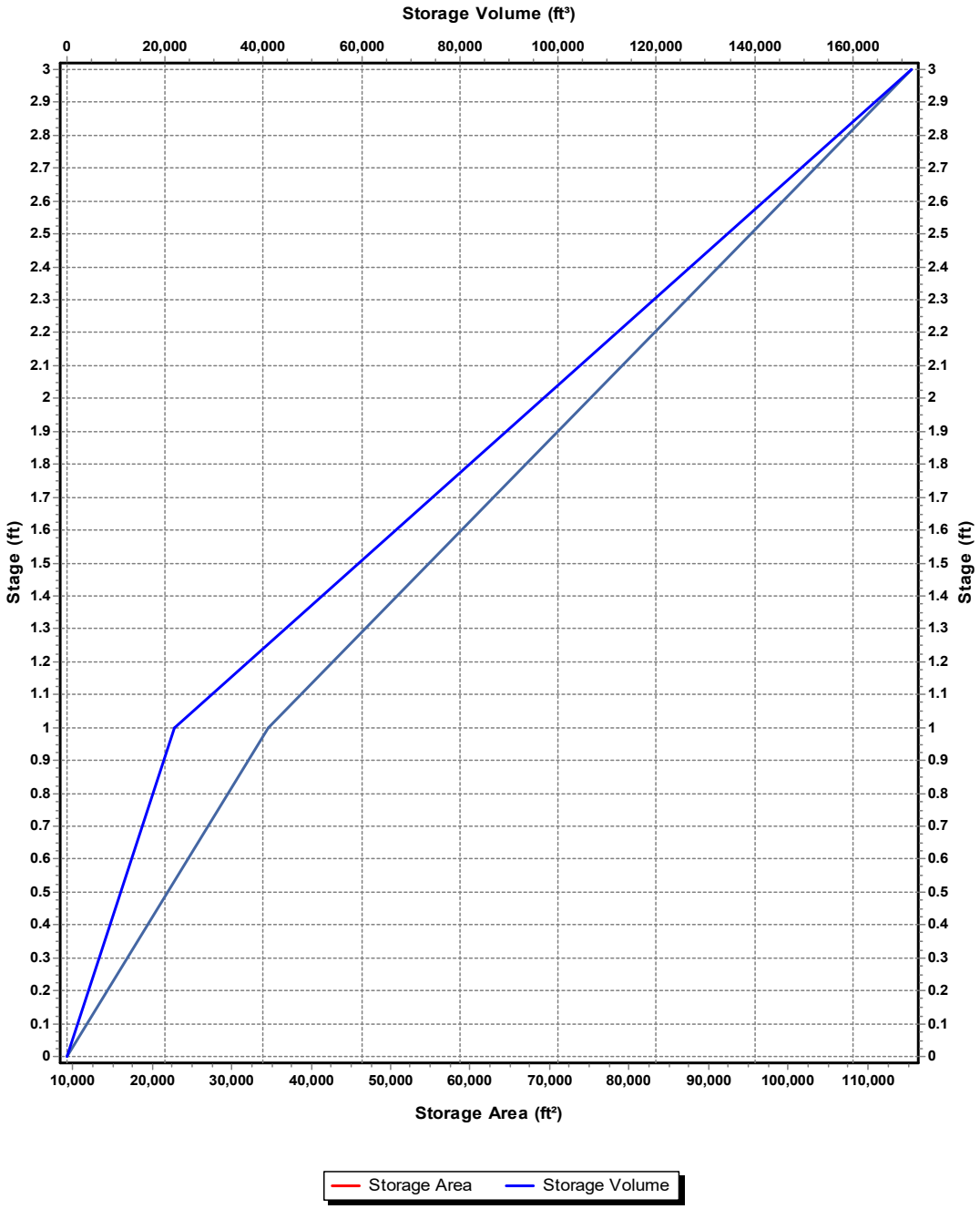
Invert Elevation (ft)	899.00
Max (Rim) Elevation (ft)	902.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	899.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : PotholeAboveAccess

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	9300	0
1	34531	21915.5
3	115500	171946.5

Storage Area Volume Curves



Storage Node : PotholeAboveAccessRoad (continued)

Output Summary Results

Peak Inflow (cfs)	417.29
Peak Lateral Inflow (cfs)	417.29
Peak Outflow (cfs)	417.07
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	900.62
Max HGL Depth Attained (ft)	1.62
Average HGL Elevation Attained (ft)	899.92
Average HGL Depth Attained (ft)	0.92
Time of Max HGL Occurrence (days hh:mm)	0 14:25
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SEPothole

Input Data

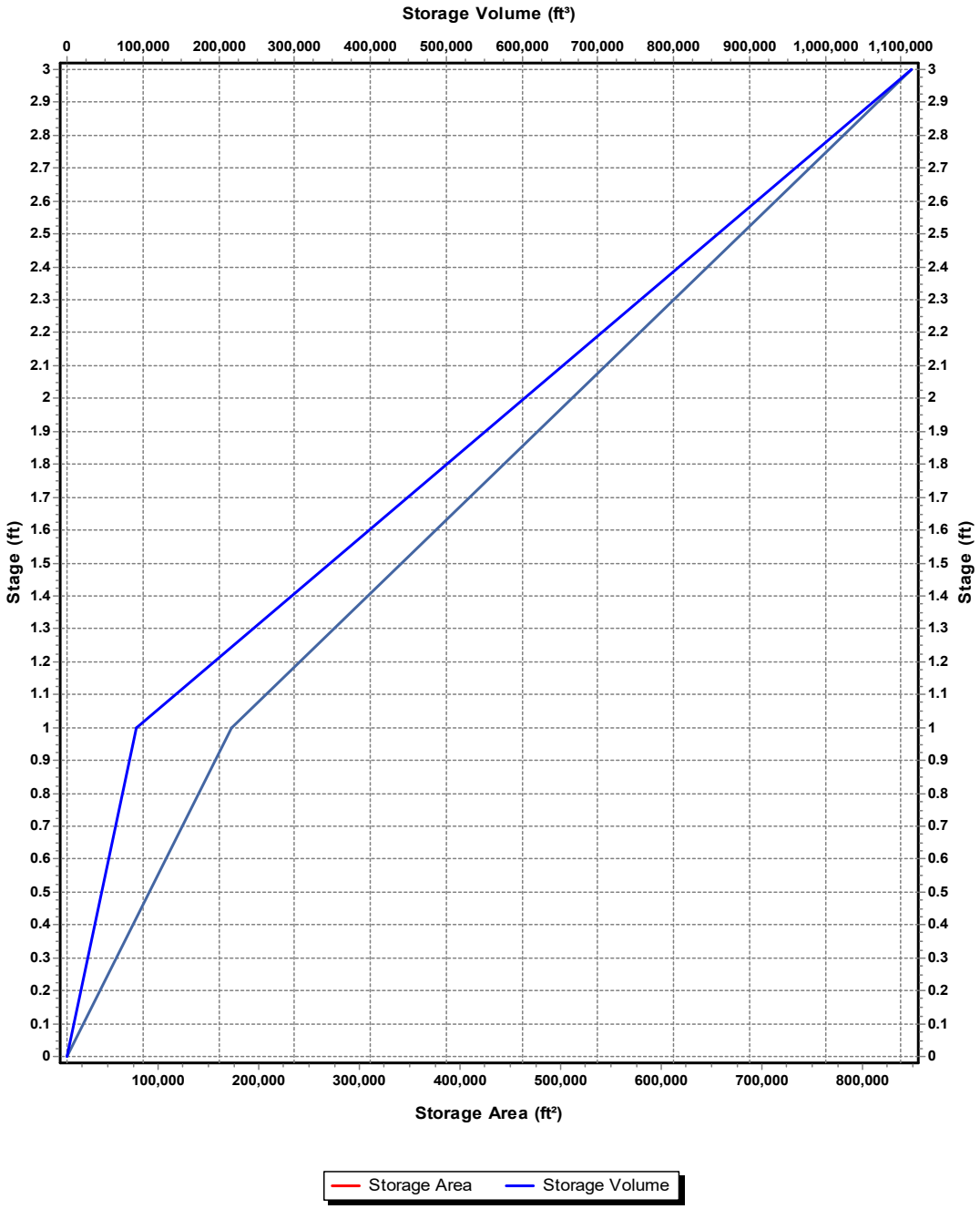
Invert Elevation (ft)	891.00
Max (Rim) Elevation (ft)	894.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-891.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : SE Pothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	10000	0
1	173600	91800
3	848300	1113700

Storage Area Volume Curves



Storage Node : SEPothole (continued)

Output Summary Results

Peak Inflow (cfs)	331.86
Peak Lateral Inflow (cfs)	123.14
Peak Outflow (cfs)	307.94
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.62
Max HGL Depth Attained (ft)	2.62
Average HGL Elevation Attained (ft)	892.46
Average HGL Depth Attained (ft)	1.46
Time of Max HGL Occurrence (days hh:mm)	0 14:56
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : StreamAtInlet

Input Data

Invert Elevation (ft)	896.00
Max (Rim) Elevation (ft)	906.00
Max (Rim) Offset (ft)	10.00
Initial Water Elevation (ft)	896.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
InletFromStream	Rectangular	No	896.50	0.50	4.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	93.22
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	93.28
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	898.22
Max HGL Depth Attained (ft)	2.22
Average HGL Elevation Attained (ft)	897.53
Average HGL Depth Attained (ft)	1.53
Time of Max HGL Occurrence (days hh:mm)	0 14:27
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : WetlandPool

Input Data

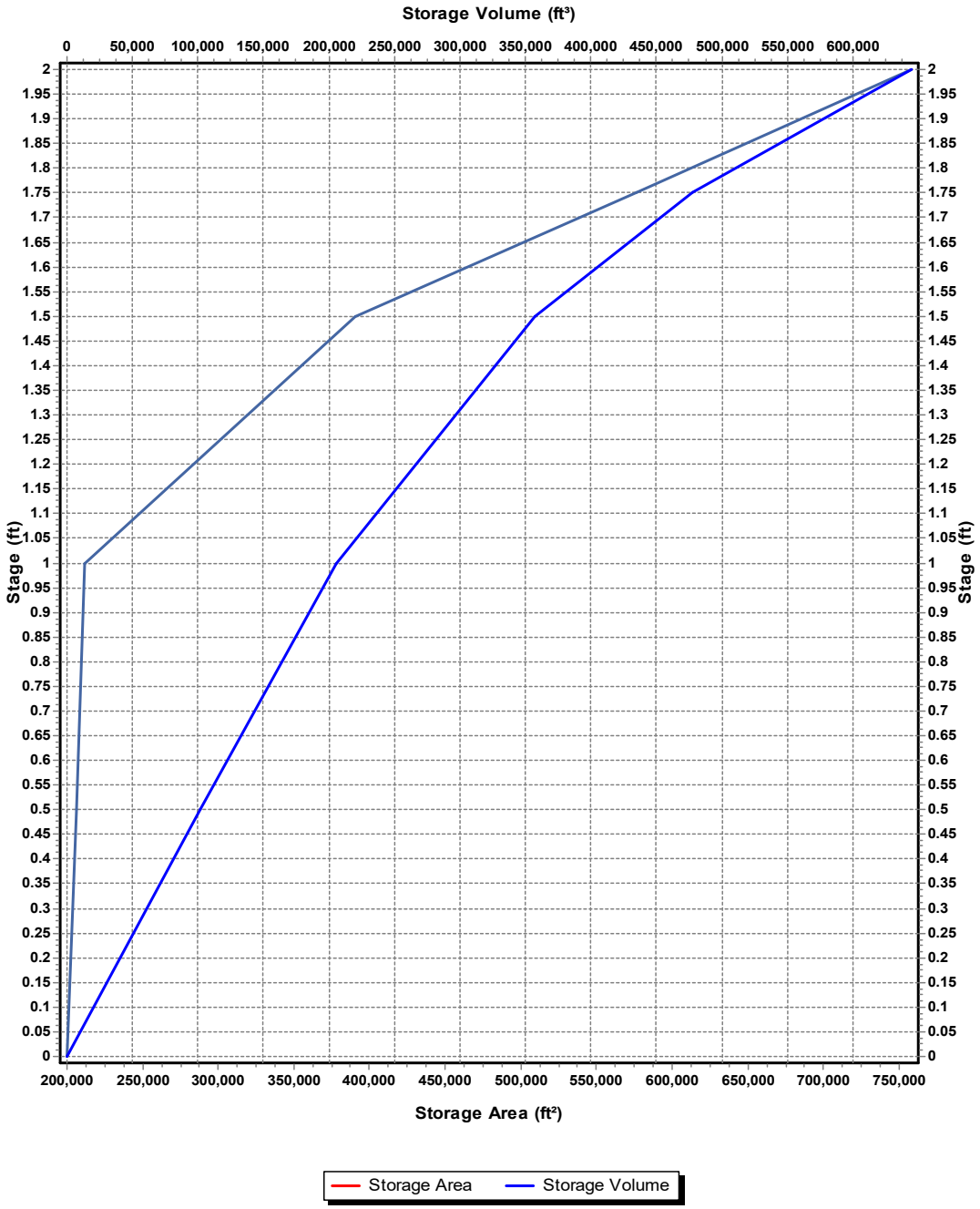
Invert Elevation (ft)	891.50
Max (Rim) Elevation (ft)	900.00
Max (Rim) Offset (ft)	8.50
Initial Water Elevation (ft)	892.50
Initial Water Depth (ft)	1.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Wetland Pool

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	200000	0
0.5	206000	101500
1	212000	206000
1.5	391000	356750
1.75	577000	477750
2	758250	644656.25

Storage Area Volume Curves



Storage Node : WetlandPool (continued)

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
WetlandOutlet	Rectangular	No	892.50	1.00	16.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	272.32
Peak Lateral Inflow (cfs)	78.53
Peak Outflow (cfs)	248.38
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.59
Max HGL Depth Attained (ft)	2.09
Average HGL Elevation Attained (ft)	893.25
Average HGL Depth Attained (ft)	1.75
Time of Max HGL Occurrence (days hh:mm)	0 14:11
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	Story Kepley Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	NO
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
Nodes	19
Junctions	6
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	7
Links	21
Channels	8
Pipes	9
Pumps	1
Orifices	1
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	StoryCounty	Time Series	25-Year	Cumulative	inches				0.00	

Subbasin Summary

Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
DirectWatershed	28.50	71.00	5.40	2.42	69.06	110.48	0 00:10:00
DitchWatershed	661.50	82.06	5.40	3.45	2278.87	547.72	0 03:32:16
SE PotholeWatershed	56.60	79.73	5.40	3.22	182.20	165.26	0 00:31:03
TileWatershed	354.10	80.51	5.40	3.29	1166.41	437.26	0 01:58:09

Node Summary

Element ID	Element Type	Invert Elevation (ft)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
InletPipeUp	Junction	894.00	5.04	898.22	0.00	0 00:00	0.00	0.00
ManholeDownstream	Junction	889.00	4.82	900.90	0.00	0 00:00	0.00	0.00
OutletStructure	Junction	889.50	15.39	894.14	0.00	0 00:00	0.00	0.00
StreamAboveCulverts	Junction	892.00	99.34	895.29	0.00	0 00:00	0.00	0.00
StreamBelowCulverts	Junction	891.50	99.13	894.23	0.00	0 00:00	0.00	0.00
TileAtIntake	Junction	888.00	4.60	893.25	0.00	0 00:00	0.00	0.00
SurfaceOutfall	Outfall	891.00	81.18	891.00				
SurfaceOutfall2	Outfall	891.00	338.01	891.00				
SurfaceOutfall3	Outfall	890.90	424.41	893.75				
SurfaceOutfall4	Outfall	891.00	15.56	891.00				
TileOutfall	Outfall	884.00	4.59	885.50				
WestChannelToRiver	Outfall	892.50	53.69	893.94				
DitchEnd	Storage Node	890.00	99.13	894.00			0.00	0.00
ManholeUpstream	Storage Node	880.00	4.33	894.20			0.00	0.00
NorthPothole	Storage Node	893.00	435.98	894.47			0.00	0.00
PotholeAboveAccessRoad	Storage Node	899.00	547.57	900.78			0.00	0.00
SEPothole	Storage Node	891.00	452.77	893.86			0.00	0.00
StreamAtInlet	Storage Node	896.00	104.35	898.33			0.00	0.00
WetlandPool	Storage Node	891.50	359.43	893.68			0.00	0.00

Link Summary

Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)
CrossingCulverts	Pipe	PotholeAboveAccessRoad	StreamAtInlet	32.00	895.10	895.00	0.3100	36.000	0.0150	104.35	353.98
CulvertsDownstream	Pipe	StreamAboveCulverts	StreamBelowCulverts	15.00	892.00	891.50	3.3300	30.000	0.0250	99.13	116.82
PipeThruBerm	Pipe	DitchEnd	SurfaceOutfall4	15.00	891.57	891.17	2.6700	18.000	0.0130	15.56	17.15
TileDSofWetland	Pipe	ManholeDownstream	TileAtIntake	685.09	889.00	888.00	0.1500	18.000	0.0150	3.93	3.48
TileOutfall	Pipe	TileAtIntake	TileOutfall	3000.00	888.00	884.00	0.1300	18.000	0.0150	4.59	3.32
TileRelay	Pipe	ManholeUpstream	ManholeDownstream	1150.00	887.46	886.39	0.0900	18.000	0.0150	2.13	3.33
TileUpstream	Pipe	NorthPothole	ManholeUpstream	100.00	887.56	887.46	0.1000	16.000	0.0150	3.15	15.65
WetlandInletPipe	Pipe	InletPipeUp	WetlandPool	168.00	894.00	893.50	0.3000	12.000	0.0130	4.96	1.94
WLOutletPipe	Pipe	OutletStructure	ManholeDownstream	151.00	888.00	887.00	0.6600	18.000	0.0130	4.82	6.04
ChannelToRiver	Channel	NorthPothole	WestChannelToRiver	486.51	893.00	892.50	0.1000	48.000	0.0300	53.69	385.61
DitchEndOverflow	Channel	DitchEnd	SurfaceOutfall	10.00	892.41	892.40	0.1000	91.080	0.0320	81.18	3838.47
EastSurfaceOverflow	Channel	PotholeAboveAccessRoad	SEPothole	10.00	900.00	899.00	10.0000	120.000	0.0500	442.67	38630.29
SEPotOverflow	Channel	SEPothole	SurfaceOutfall3	208.36	891.00	-0.10	427.6700	80.400	0.0320	424.41	4342.77
StreamChannel	Channel	StreamAtInlet	StreamAboveCulverts	1240.00	896.50	892.00	0.3600	72.000	0.0270	99.34	1021.92
StreamDown	Channel	StreamBelowCulverts	DitchEnd	290.00	891.50	890.90	0.2100	72.000	0.0270	99.13	775.17
SurfaceOverflowPothole	Channel	NorthPothole	WetlandPool	557.73	893.80	893.00	0.1400	120.000	0.0320	348.90	31608.38
WLSurfaceOverflow	Channel	WetlandPool	SurfaceOutfall2	10.00	893.20	893.10	1.0000	120.000	0.0320	338.01	61939.96
IntakeToTile	Orifice	DitchEnd	TileAtIntake		890.00	888.00		10.000		4.29	
InletFromStream	Weir	StreamAtInlet	InletPipeUp		896.00	894.00				5.04	
WetlandOutlet	Weir	WetlandPool	OutletStructure		891.50	889.50				15.39	
Pump-01	Pump	ManholeUpstream	WetlandPool		880.00	891.50				0.98	

Subbasin Hydrology

Subbasin : DirectWatershed

Input Data

Area (ac) 28.5
Peak Rate Factor 484
Weighted Curve Number 71
Rain Gage ID ..... StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Meadow, non-grazed	28.5	C	71
Composite Area & Weighted CN	28.5		71

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

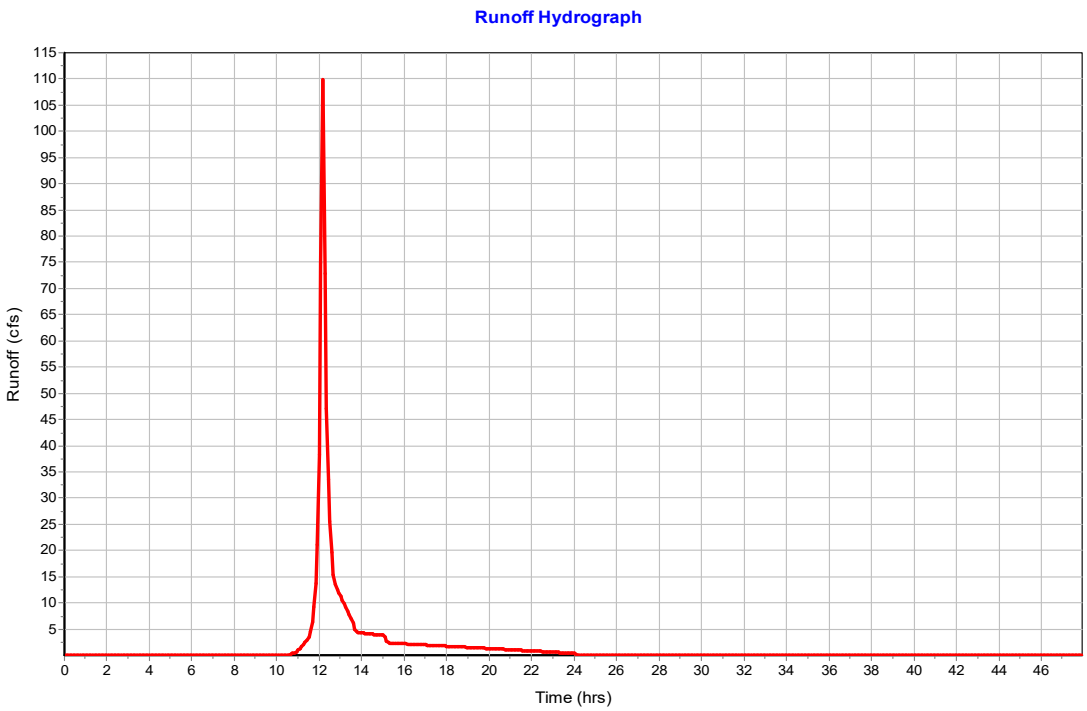
User-Defined TOC override (minutes): 10

Subbasin Runoff Results

Total Rainfall (in) 5.4
Total Runoff (in) 2.42
Peak Runoff (cfs) 110.48

Weighted Curve Number	71
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : DirectWatershed



Subbasin : DitchWatershed

Input Data

Area (ac)	661.5
Peak Rate Factor	484
Weighted Curve Number	82.06
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
> 75% grass cover, Good	26.8	C	74
Woods, Good	110	C	70
Row crops, straight row, Good	524.7	C	85
Composite Area & Weighted CN	661.5		82.06

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.19	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	10.07	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	2389	4387	0
Slope (%) :	0.42	0.55	0
Surface Type :	Straight rows	Straight rows	Unpaved
Velocity (ft/sec) :	0.58	0.67	0
Computed Flow Time (min) :	68.65	109.13	0

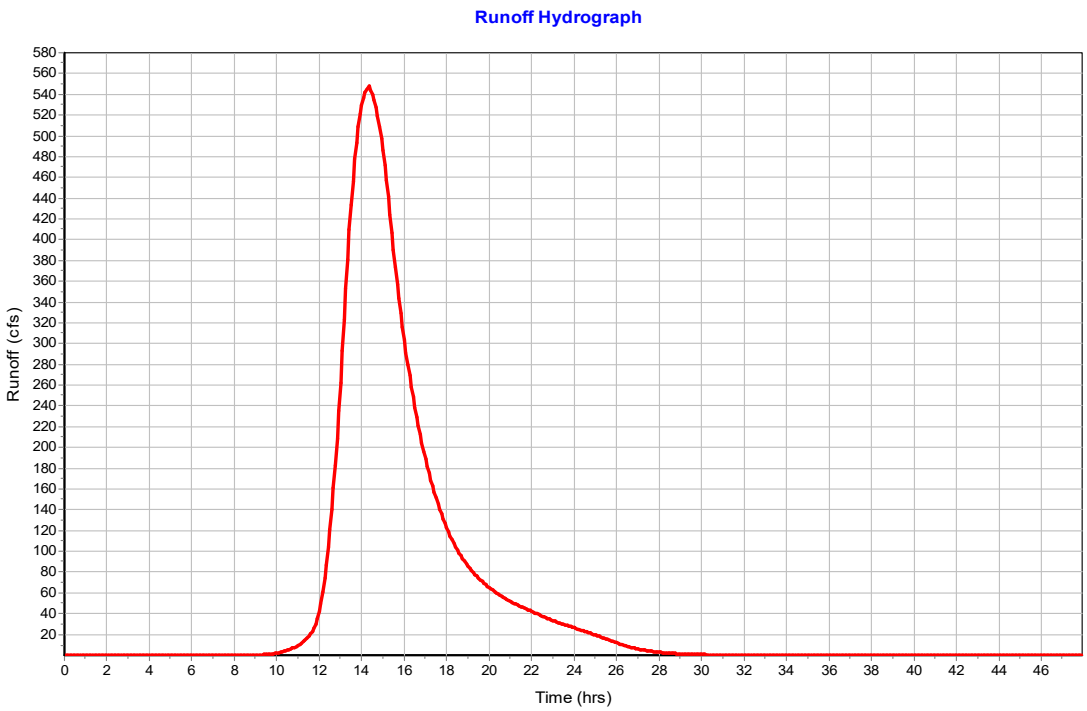
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.045	0	0
Flow Length (ft) :	6117	0	0
Channel Slope (%) :	1.73	0	0
Cross Section Area (ft^2) :	30	0	0
Wetted Perimeter (ft) :	32	0	0
Velocity (ft/sec) :	4.17	0	0
Computed Flow Time (min) :	24.44	0	0

Total TOC (min) 212.28

Subbasin Runoff Results

Total Rainfall (in)	5.4
Total Runoff (in)	3.45
Peak Runoff (cfs)	547.72
Weighted Curve Number	82.06
Time of Concentration (days hh:mm:ss)	0 03:32:17

Subbasin : DitchWatershed



Subbasin : SE PotholeWatershed

Input Data

Area (ac)	56.6
Peak Rate Factor	484
Weighted Curve Number	79.73
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	19.9	C	70
Row crops, straight row, Good	36.7	C	85
Composite Area & Weighted CN	56.6		79.73

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	19.14	0	0

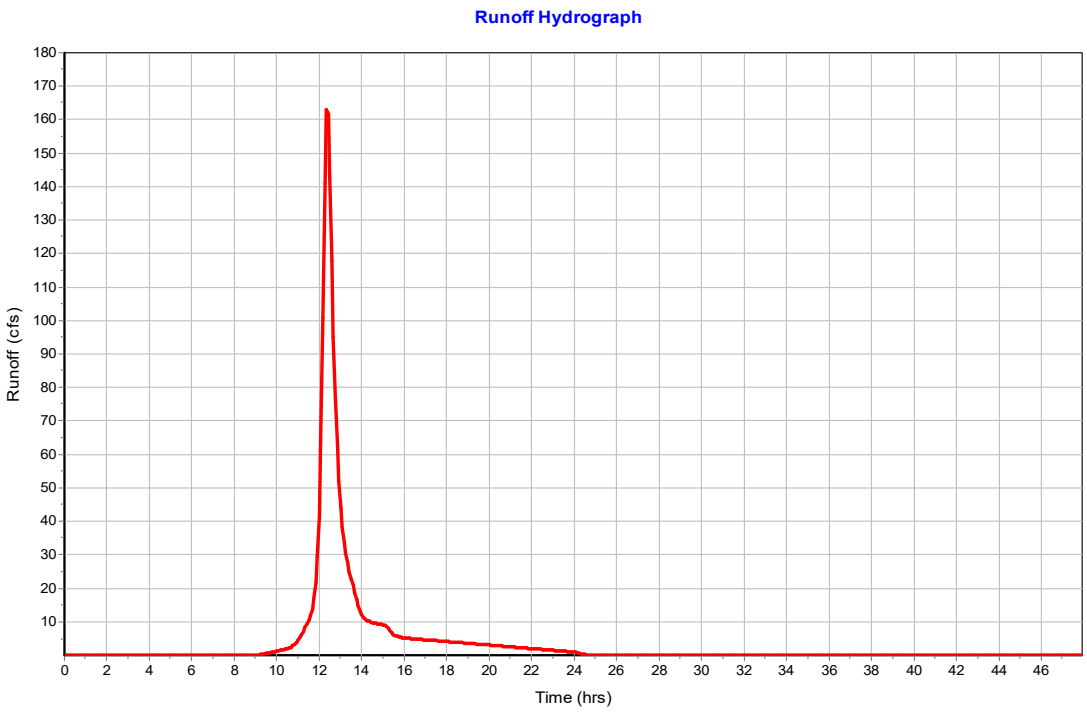
	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	1015	0	0
Slope (%) :	8.1	0	0
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0	0
Computed Flow Time (min) :	11.91	0	0

Total TOC (min) 31.05

Subbasin Runoff Results

Total Rainfall (in)	5.4
Total Runoff (in)	3.22
Peak Runoff (cfs)	165.26
Weighted Curve Number	79.73
Time of Concentration (days hh:mm:ss)	0 00:31:03

Subbasin : SE PotholeWatershed



Subbasin : TileWatershed

Input Data

Area (ac)	354.1
Peak Rate Factor	484
Weighted Curve Number	80.51
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	80.5	C	70
2 acre lots, 12% impervious	12.8	C	77
Pasture, grassland, or range, Good	25.5	C	74
Row crops, straight row, Good	235.3	C	85
Composite Area & Weighted CN	354.1		80.51

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	22.51	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	300	3650	0
Slope (%) :	5.3	0.6	0
Surface Type :	Woodland	Straight rows	Unpaved
Velocity (ft/sec) :	1.15	0.7	0
Computed Flow Time (min) :	4.35	86.9	0

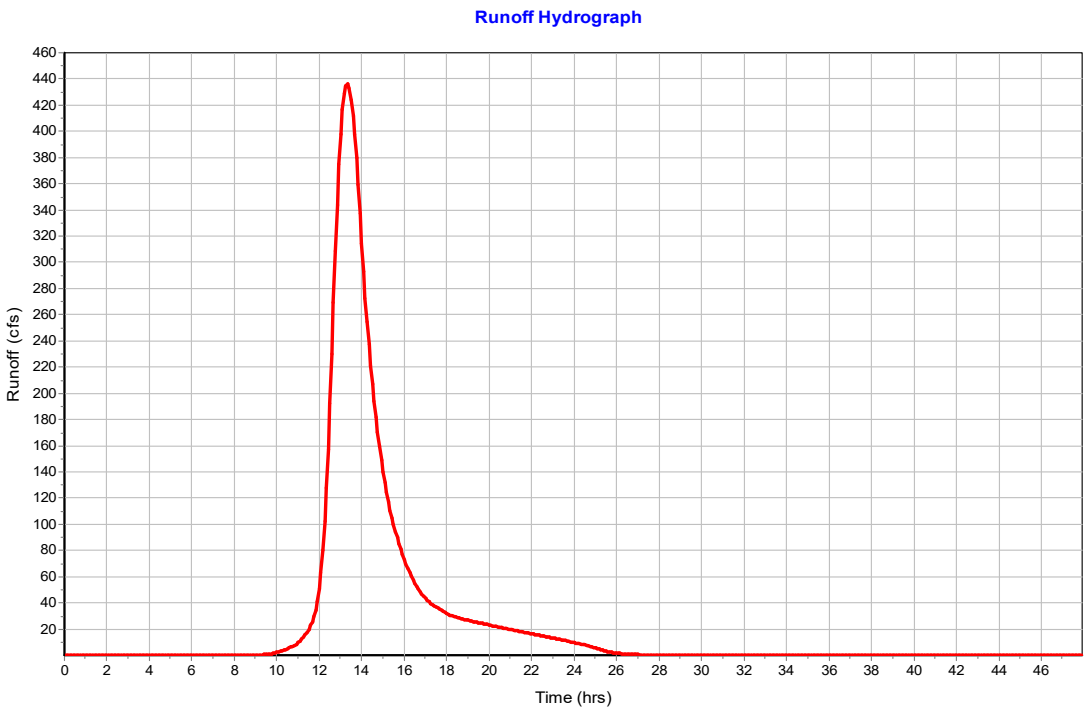
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.035	0.035	0
Flow Length (ft) :	890	865	0
Channel Slope (%) :	2	2.1	0
Cross Section Area (ft^2) :	30	25	0
Wetted Perimeter (ft) :	22	26	0
Velocity (ft/sec) :	7.4	6.01	0
Computed Flow Time (min) :	2	2.4	0

Total TOC (min) 118.16

Subbasin Runoff Results

Total Rainfall (in)	5.4
Total Runoff (in)	3.29
Peak Runoff (cfs)	437.26
Weighted Curve Number	80.51
Time of Concentration (days hh:mm:ss)	0 01:58:10

Subbasin : TileWatershed



Storage Nodes

Storage Node : DitchEnd

Input Data

Invert Elevation (ft)	890.00
Max (Rim) Elevation (ft)	1000.00
Max (Rim) Offset (ft)	110.00
Initial Water Elevation (ft)	890.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	2500.00
Evaporation Loss	0.00

Outflow Orifices

Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
IntakeToTile	Bottom	CIRCULAR	No	10.00			890.23	0.61

Output Summary Results

Peak Inflow (cfs)	99.13
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	99.14
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894
Max HGL Depth Attained (ft)	4
Average HGL Elevation Attained (ft)	893.27
Average HGL Depth Attained (ft)	3.27
Time of Max HGL Occurrence (days hh:mm)	0 14:33
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : ManholeUpstream

Input Data

Invert Elevation (ft)	880.00
Max (Rim) Elevation (ft)	910.00
Max (Rim) Offset (ft)	30.00
Initial Water Elevation (ft)	880.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	4.33
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	3.11
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.2
Max HGL Depth Attained (ft)	14.2
Average HGL Elevation Attained (ft)	893.18
Average HGL Depth Attained (ft)	13.18
Time of Max HGL Occurrence (days hh:mm)	0 13:48
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NorthPothole

Input Data

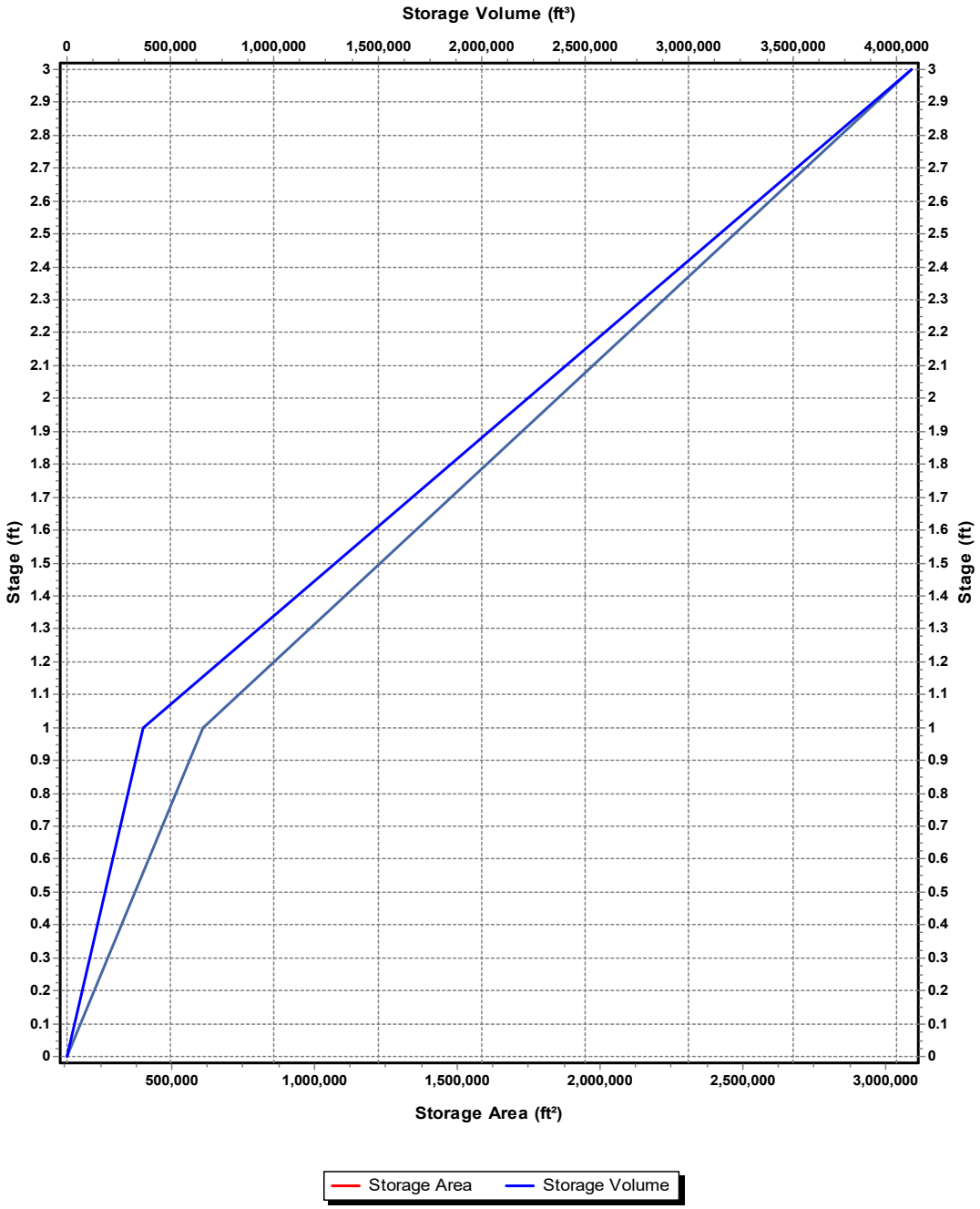
Invert Elevation (ft)	893.00
Max (Rim) Elevation (ft)	896.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	893.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : NorthPothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	131000	0
1	609800	370400
3	3092800	4073000

Storage Area Volume Curves



Storage Node : NorthPothole (continued)

Output Summary Results

Peak Inflow (cfs)	435.98
Peak Lateral Inflow (cfs)	435.98
Peak Outflow (cfs)	405.35
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.47
Max HGL Depth Attained (ft)	1.47
Average HGL Elevation Attained (ft)	893.81
Average HGL Depth Attained (ft)	0.81
Time of Max HGL Occurrence (days hh:mm)	0 13:43
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : PotholeAboveAccessRoad

Input Data

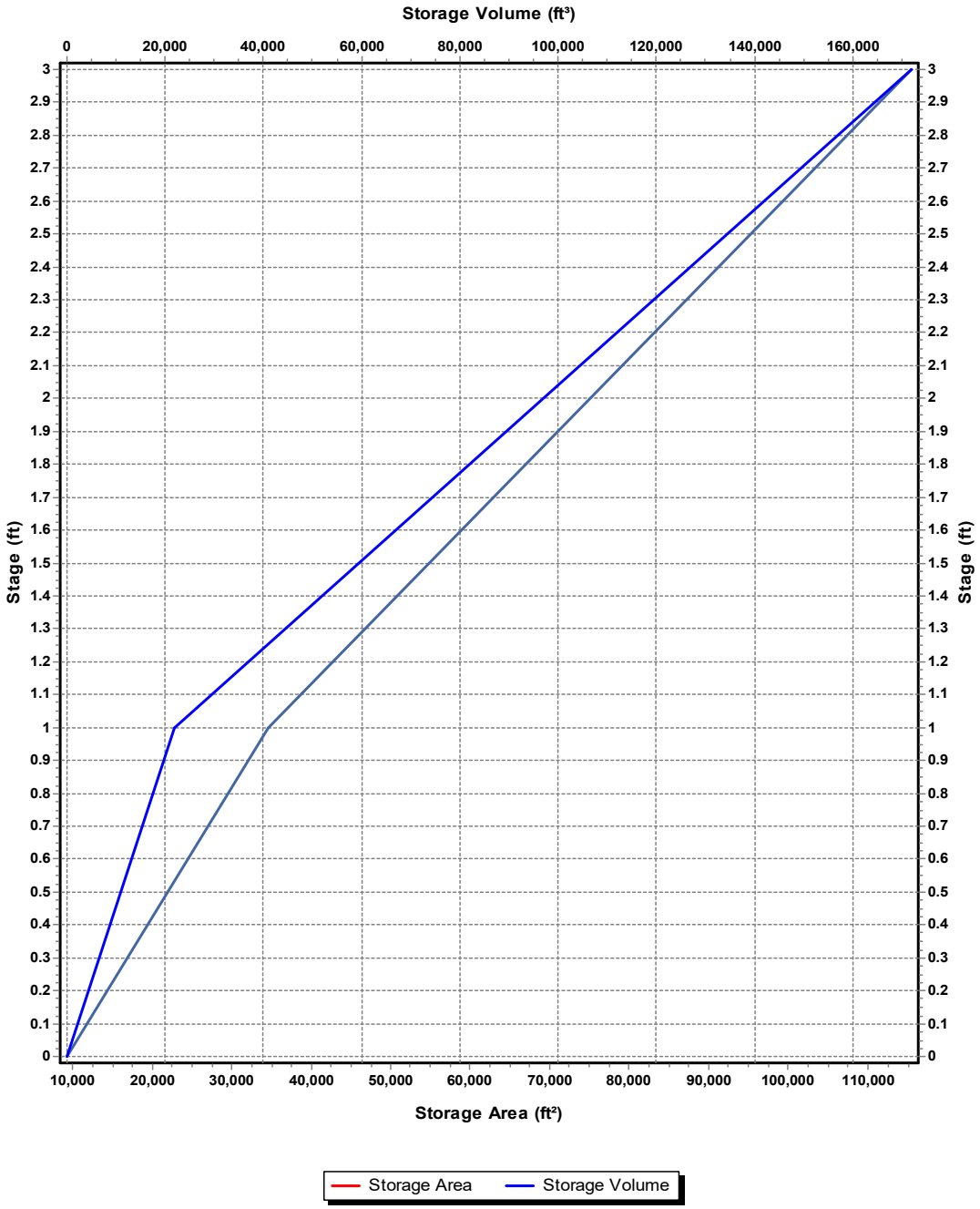
Invert Elevation (ft)	899.00
Max (Rim) Elevation (ft)	902.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	899.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : PotholeAboveAccess

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	9300	0
1	34531	21915.5
3	115500	171946.5

Storage Area Volume Curves



Storage Node : PotholeAboveAccessRoad (continued)

Output Summary Results

Peak Inflow (cfs)	547.57
Peak Lateral Inflow (cfs)	547.57
Peak Outflow (cfs)	547.02
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	900.78
Max HGL Depth Attained (ft)	1.78
Average HGL Elevation Attained (ft)	899.98
Average HGL Depth Attained (ft)	0.98
Time of Max HGL Occurrence (days hh:mm)	0 14:25
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SEPothole

Input Data

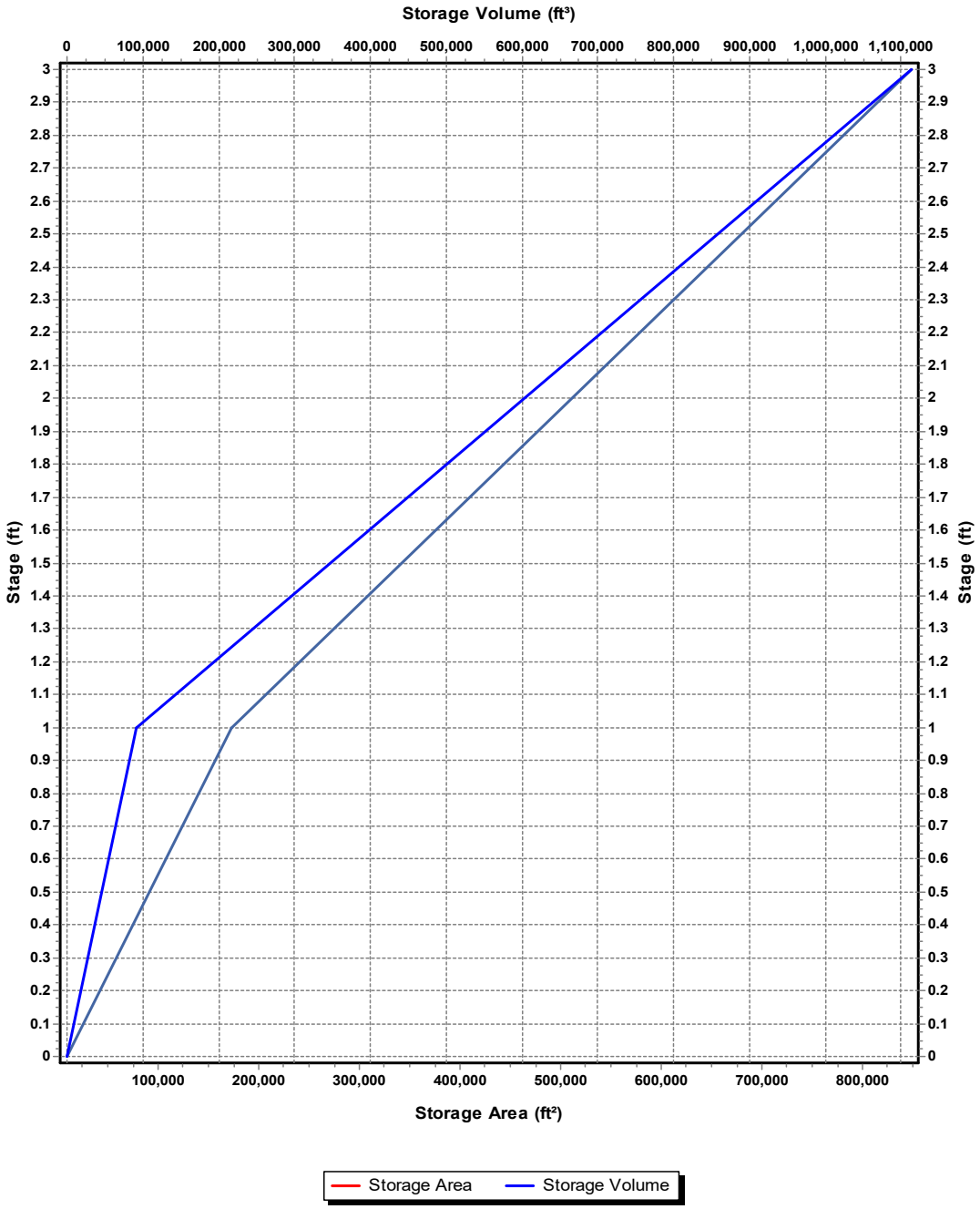
Invert Elevation (ft)	891.00
Max (Rim) Elevation (ft)	894.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-891.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : SE Pothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	10000	0
1	173600	91800
3	848300	1113700

Storage Area Volume Curves



Storage Node : SEPothole (continued)

Output Summary Results

Peak Inflow (cfs)	452.77
Peak Lateral Inflow (cfs)	163
Peak Outflow (cfs)	424.41
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.86
Max HGL Depth Attained (ft)	2.86
Average HGL Elevation Attained (ft)	892.56
Average HGL Depth Attained (ft)	1.56
Time of Max HGL Occurrence (days hh:mm)	0 14:52
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : StreamAtInlet

Input Data

Invert Elevation (ft)	896.00
Max (Rim) Elevation (ft)	906.00
Max (Rim) Offset (ft)	10.00
Initial Water Elevation (ft)	896.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
InletFromStream	Rectangular	No	896.50	0.50	4.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	104.35
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	104.37
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	898.33
Max HGL Depth Attained (ft)	2.33
Average HGL Elevation Attained (ft)	897.59
Average HGL Depth Attained (ft)	1.59
Time of Max HGL Occurrence (days hh:mm)	0 14:27
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : WetlandPool

Input Data

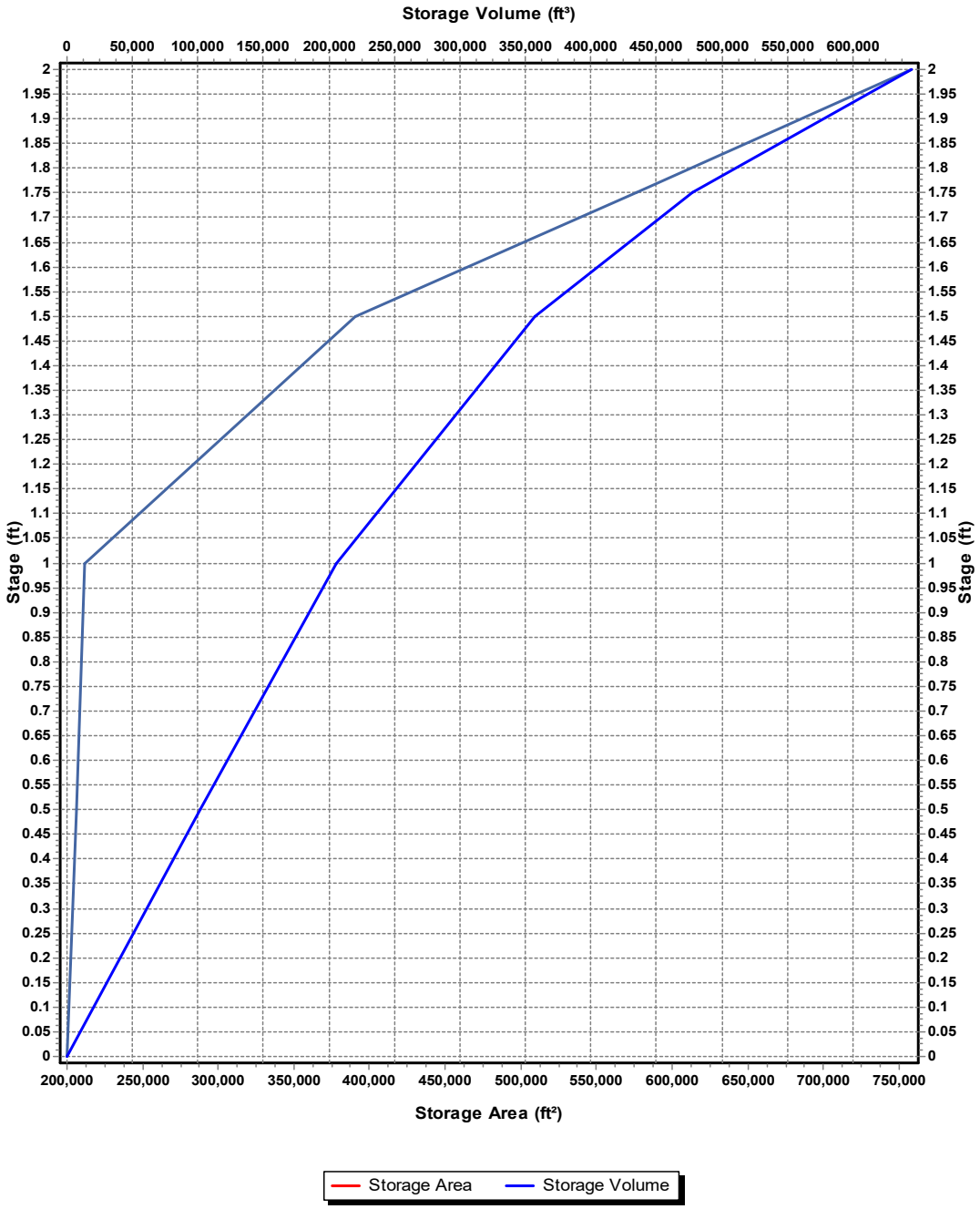
Invert Elevation (ft)	891.50
Max (Rim) Elevation (ft)	900.00
Max (Rim) Offset (ft)	8.50
Initial Water Elevation (ft)	892.50
Initial Water Depth (ft)	1.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Wetland Pool

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	200000	0
0.5	206000	101500
1	212000	206000
1.5	391000	356750
1.75	577000	477750
2	758250	644656.25

Storage Area Volume Curves



Storage Node : WetlandPool (continued)

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
WetlandOutlet	Rectangular	No	892.50	1.00	16.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	359.43
Peak Lateral Inflow (cfs)	109.84
Peak Outflow (cfs)	344.17
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.68
Max HGL Depth Attained (ft)	2.18
Average HGL Elevation Attained (ft)	893.27
Average HGL Depth Attained (ft)	1.77
Time of Max HGL Occurrence (days hh:mm)	0 14:03
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name	Story Kepley Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-20
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Hydrodynamic
Enable Overflow Ponding at Nodes	NO
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
Nodes	19
Junctions	6
Outfalls	6
Flow Diversions	0
Inlets	0
Storage Nodes	7
Links	21
Channels	8
Pipes	9
Pumps	1
Orifices	1
Weirs	2
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1	StoryCounty	Time Series	100-Year	Cumulative	inches				0.00	

Subbasin Summary

Subbasin ID	Area (ac)	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
DirectWatershed	28.50	71.00	7.00	3.72	106.11	169.45	0 00:10:00
DitchWatershed	661.50	82.06	7.00	4.92	3256.56	782.80	0 03:32:16
SE PotholeWatershed	56.60	79.73	7.00	4.67	264.04	238.06	0 00:31:03
TileWatershed	354.10	80.51	7.00	4.75	1682.33	630.00	0 01:58:09

Node Summary

Element ID	Element Type	Invert Elevation (ft)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
InletPipeUp	Junction	894.00	5.15	898.38	0.00	0 00:00	0.00	0.00
ManholeDownstream	Junction	889.00	4.82	895.90	0.00	0 00:00	0.00	0.00
OutletStructure	Junction	889.50	17.46	894.10	0.00	0 00:00	0.00	0.00
StreamAboveCulverts	Junction	892.00	117.58	895.85	0.00	0 00:00	0.00	0.00
StreamBelowCulverts	Junction	891.50	117.25	894.36	0.00	0 00:00	0.00	0.00
TileAtIntake	Junction	888.00	4.63	893.36	0.00	0 00:00	0.00	0.00
SurfaceOutfall	Outfall	891.00	99.03	891.00				
SurfaceOutfall2	Outfall	891.00	496.17	891.00				
SurfaceOutfall3	Outfall	890.90	498.93	893.89				
SurfaceOutfall4	Outfall	891.00	15.86	891.00				
TileOutfall	Outfall	884.00	4.62	885.50				
WestChannelToRiver	Outfall	892.50	65.53	894.10				
DitchEnd	Storage Node	890.00	117.25	894.07			0.00	0.00
ManholeUpstream	Storage Node	880.00	3.51	894.37			0.00	0.00
NorthPothole	Storage Node	893.00	628.86	894.64			0.00	0.00
PotholeAboveAccessRoad	Storage Node	899.00	782.11	901.03			0.00	0.00
SEPothole	Storage Node	891.00	672.60	894.00			188.09	91.00
StreamAtInlet	Storage Node	896.00	122.68	898.51			0.00	0.00
WetlandPool	Storage Node	891.50	514.74	893.82			0.00	0.00

Link Summary

Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)
CrossingCulverts	Pipe	PotholeAboveAccessRoad	StreamAtInlet	32.00	895.10	895.00	0.3100	36.000	0.0150	122.68	353.98
CulvertsDownstream	Pipe	StreamAboveCulverts	StreamBelowCulverts	15.00	892.00	891.50	3.3300	30.000	0.0250	117.25	116.82
PipeThruBerm	Pipe	DitchEnd	SurfaceOutfall4	15.00	891.57	891.17	2.6700	18.000	0.0130	15.86	17.15
TileDSofWetland	Pipe	ManholeDownstream	TileAtIntake	685.09	889.00	888.00	0.1500	18.000	0.0150	3.93	3.48
TileOutfall	Pipe	TileAtIntake	TileOutfall	3000.00	888.00	884.00	0.1300	18.000	0.0150	4.62	3.32
TileRelay	Pipe	ManholeUpstream	ManholeDownstream	1150.00	887.46	886.39	0.0900	18.000	0.0150	2.07	3.33
TileUpstream	Pipe	NorthPothole	ManholeUpstream	100.00	887.56	887.46	0.1000	16.000	0.0150	3.10	15.65
WetlandInletPipe	Pipe	InletPipeUp	WetlandPool	168.00	894.00	893.50	0.3000	12.000	0.0130	5.07	1.94
WLOutletPipe	Pipe	OutletStructure	ManholeDownstream	151.00	888.00	887.00	0.6600	18.000	0.0130	4.82	6.04
ChannelToRiver	Channel	NorthPothole	WestChannelToRiver	486.51	893.00	892.50	0.1000	48.000	0.0300	65.53	385.61
DitchEndOverflow	Channel	DitchEnd	SurfaceOutfall	10.00	892.41	892.40	0.1000	91.080	0.0320	99.03	3838.47
EastSurfaceOverflow	Channel	PotholeAboveAccessRoad	SEPothole	10.00	900.00	899.00	10.0000	120.000	0.0500	658.81	38630.29
SEPotOverflow	Channel	SEPothole	SurfaceOutfall3	208.36	891.00	-0.10	427.6700	80.400	0.0320	498.93	4342.77
StreamChannel	Channel	StreamAtInlet	StreamAboveCulverts	1240.00	896.50	892.00	0.3600	72.000	0.0270	117.58	1021.92
StreamDown	Channel	StreamBelowCulverts	DitchEnd	290.00	891.50	890.90	0.2100	72.000	0.0270	117.25	775.17
SurfaceOverflowPothole	Channel	NorthPothole	WetlandPool	557.73	893.80	893.00	0.1400	120.000	0.0320	502.02	31608.38
WLSurfaceOverflow	Channel	WetlandPool	SurfaceOutfall2	10.00	893.20	893.10	1.0000	120.000	0.0320	496.17	61939.96
IntakeToTile	Orifice	DitchEnd	TileAtIntake		890.00	888.00		10.000		4.22	
InletFromStream	Weir	StreamAtInlet	InletPipeUp		896.00	894.00				5.15	
WetlandOutlet	Weir	WetlandPool	OutletStructure		891.50	889.50				17.46	
Pump-01	Pump	ManholeUpstream	WetlandPool		880.00	891.50				0.98	

Subbasin Hydrology

Subbasin : DirectWatershed

Input Data

Area (ac) 28.5
Peak Rate Factor 484
Weighted Curve Number 71
Rain Gage ID ..... StoryCounty

Composite Curve Number

32

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Meadow, non-grazed	28.5	C	71
Composite Area & Weighted CN	28.5		71

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

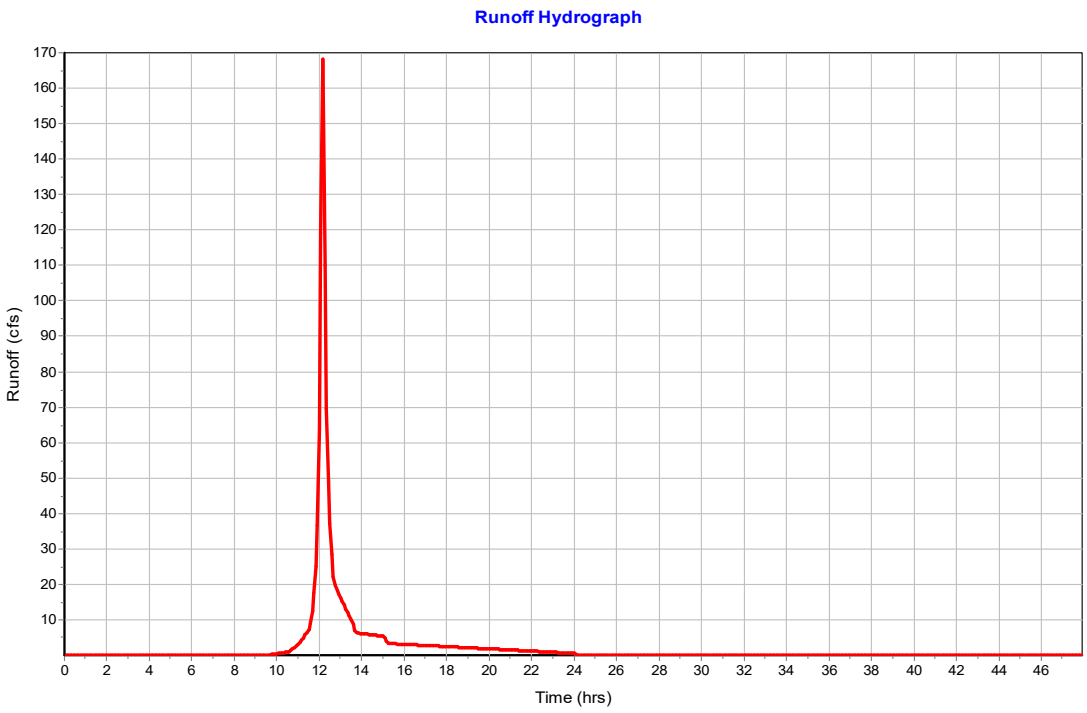
User-Defined TOC override (minutes): 10

Subbasin Runoff Results

Total Rainfall (in) 7
Total Runoff (in) 3.72
Peak Runoff (cfs) 169.45

Weighted Curve Number	71
Time of Concentration (days hh:mm:ss)	0 00:10:00

Subbasin : DirectWatershed



Subbasin : DitchWatershed

Input Data

Area (ac)	661.5
Peak Rate Factor	484
Weighted Curve Number	82.06
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
> 75% grass cover, Good	26.8	C	74
Woods, Good	110	C	70
Row crops, straight row, Good	524.7	C	85
Composite Area & Weighted CN	661.5		82.06

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.19	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	3	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.17	0	0
Computed Flow Time (min) :	10.07	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	2389	4387	0
Slope (%) :	0.42	0.55	0
Surface Type :	Straight rows	Straight rows	Unpaved
Velocity (ft/sec) :	0.58	0.67	0
Computed Flow Time (min) :	68.65	109.13	0

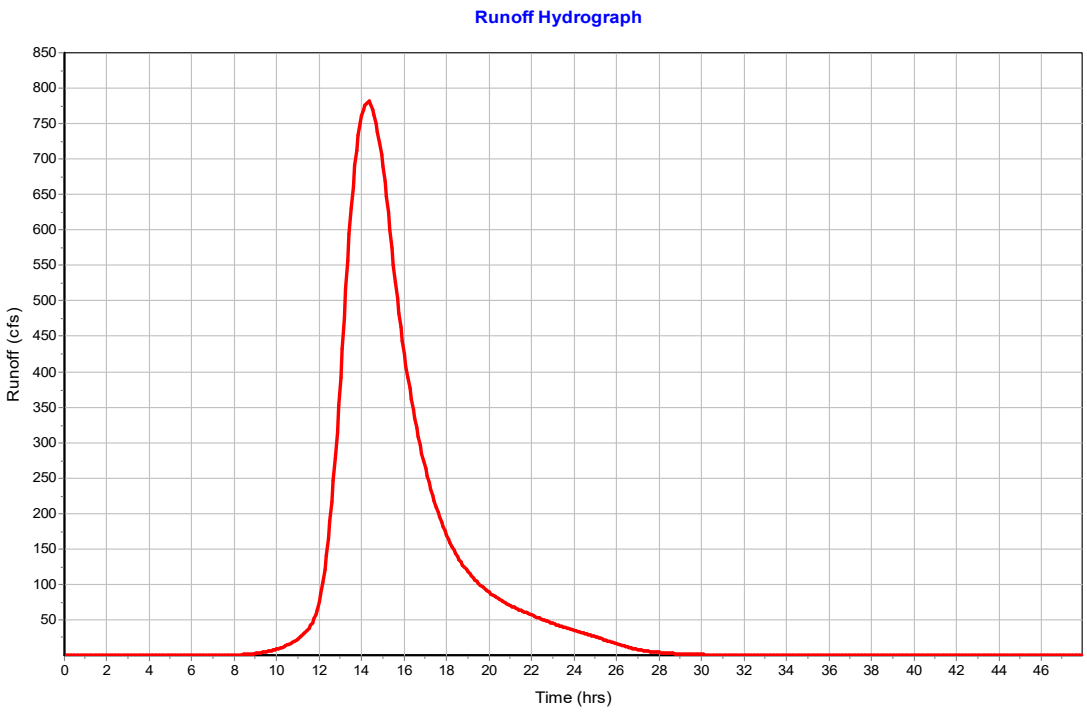
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.045	0	0
Flow Length (ft) :	6117	0	0
Channel Slope (%) :	1.73	0	0
Cross Section Area (ft^2) :	30	0	0
Wetted Perimeter (ft) :	32	0	0
Velocity (ft/sec) :	4.17	0	0
Computed Flow Time (min) :	24.44	0	0

Total TOC (min) 212.28

Subbasin Runoff Results

Total Rainfall (in)	7
Total Runoff (in)	4.92
Peak Runoff (cfs)	782.8
Weighted Curve Number	82.06
Time of Concentration (days hh:mm:ss)	0 03:32:17

Subbasin : DitchWatershed



Subbasin : SE PotholeWatershed

Input Data

Area (ac)	56.6
Peak Rate Factor	484
Weighted Curve Number	79.73
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	19.9	C	70
Row crops, straight row, Good	36.7	C	85
Composite Area & Weighted CN	56.6		79.73

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	6	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.09	0	0
Computed Flow Time (min) :	19.14	0	0

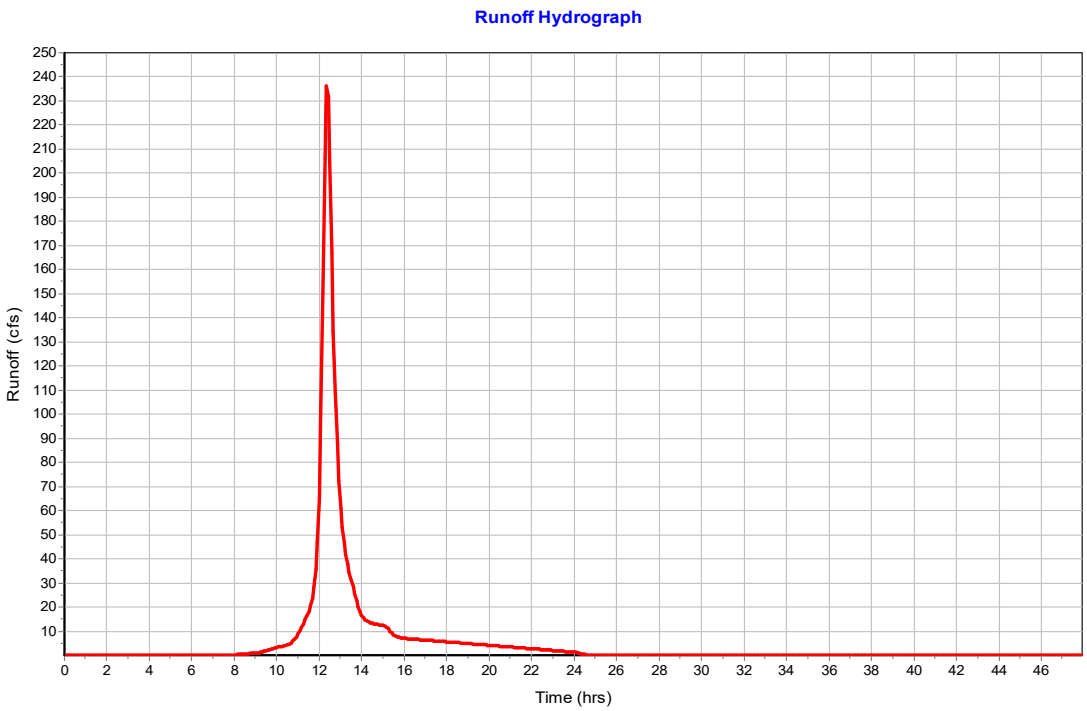
	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	1015	0	0
Slope (%) :	8.1	0	0
Surface Type :	Woodland	Unpaved	Unpaved
Velocity (ft/sec) :	1.42	0	0
Computed Flow Time (min) :	11.91	0	0

Total TOC (min) 31.05

Subbasin Runoff Results

Total Rainfall (in)	7
Total Runoff (in)	4.67
Peak Runoff (cfs)	238.06
Weighted Curve Number	79.73
Time of Concentration (days hh:mm:ss)	0 00:31:03

Subbasin : SE PotholeWatershed



Subbasin : TileWatershed

Input Data

Area (ac)	354.1
Peak Rate Factor	484
Weighted Curve Number	80.51
Rain Gage ID	StoryCounty

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Woods, Good	80.5	C	70
2 acre lots, 12% impervious	12.8	C	77
Pasture, grassland, or range, Good	25.5	C	74
Row crops, straight row, Good	235.3	C	85
Composite Area & Weighted CN	354.1		80.51

Time of Concentration

	Subarea	Subarea	Subarea
Sheet Flow Computations	A	B	C
Manning's Roughness :	0.6	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4	0	0
2 yr, 24 hr Rainfall (in) :	3.2	0	0
Velocity (ft/sec) :	0.07	0	0
Computed Flow Time (min) :	22.51	0	0

	Subarea	Subarea	Subarea
Shallow Concentrated Flow Computations	A	B	C
Flow Length (ft) :	300	3650	0
Slope (%) :	5.3	0.6	0
Surface Type :	Woodland	Straight rows	Unpaved
Velocity (ft/sec) :	1.15	0.7	0
Computed Flow Time (min) :	4.35	86.9	0

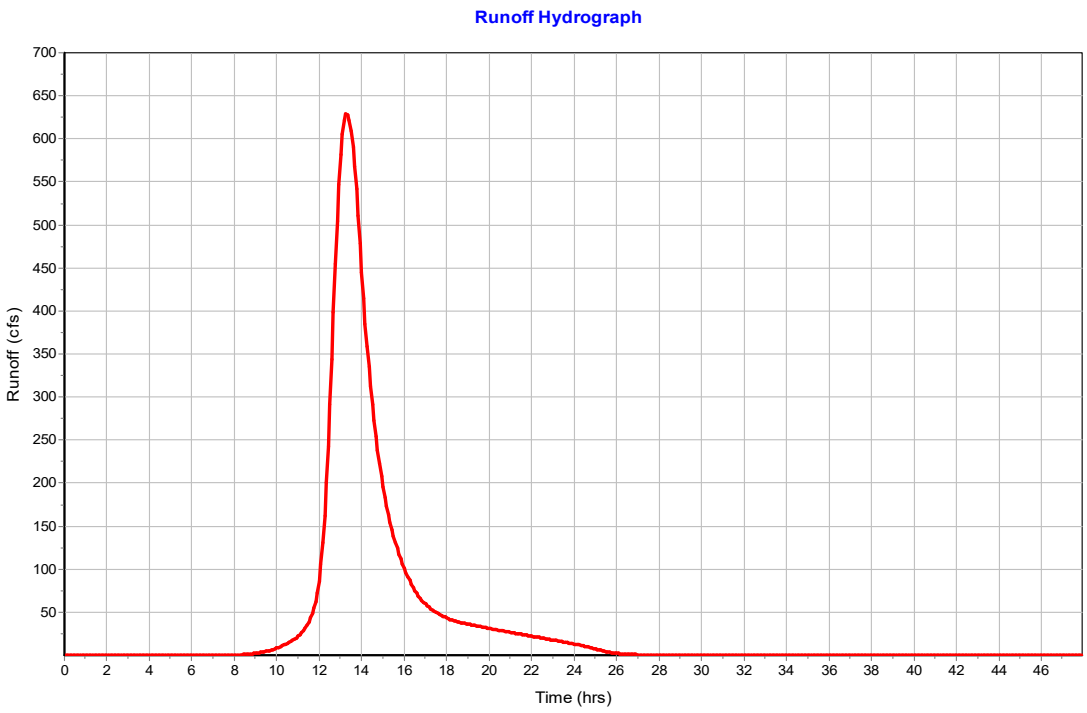
	Subarea	Subarea	Subarea
Channel Flow Computations	A	B	C
Manning's Roughness :	0.035	0.035	0
Flow Length (ft) :	890	865	0
Channel Slope (%) :	2	2.1	0
Cross Section Area (ft^2) :	30	25	0
Wetted Perimeter (ft) :	22	26	0
Velocity (ft/sec) :	7.4	6.01	0
Computed Flow Time (min) :	2	2.4	0

Total TOC (min) 118.16

Subbasin Runoff Results

Total Rainfall (in)	7
Total Runoff (in)	4.75
Peak Runoff (cfs)	630
Weighted Curve Number	80.51
Time of Concentration (days hh:mm:ss)	0 01:58:10

Subbasin : TileWatershed



Storage Nodes

Storage Node : DitchEnd

Input Data

Invert Elevation (ft)	890.00
Max (Rim) Elevation (ft)	1000.00
Max (Rim) Offset (ft)	110.00
Initial Water Elevation (ft)	890.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	2500.00
Evaporation Loss	0.00

Outflow Orifices

Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
IntakeToTile	Bottom	CIRCULAR	No	10.00			890.23	0.61

Output Summary Results

Peak Inflow (cfs)	117.25
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	117.25
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.07
Max HGL Depth Attained (ft)	4.07
Average HGL Elevation Attained (ft)	893.34
Average HGL Depth Attained (ft)	3.34
Time of Max HGL Occurrence (days hh:mm)	0 14:33
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : ManholeUpstream

Input Data

Invert Elevation (ft)	880.00
Max (Rim) Elevation (ft)	910.00
Max (Rim) Offset (ft)	30.00
Initial Water Elevation (ft)	880.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Output Summary Results

Peak Inflow (cfs)	3.51
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	3.05
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.37
Max HGL Depth Attained (ft)	14.37
Average HGL Elevation Attained (ft)	893.24
Average HGL Depth Attained (ft)	13.24
Time of Max HGL Occurrence (days hh:mm)	0 13:49
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : NorthPothole

Input Data

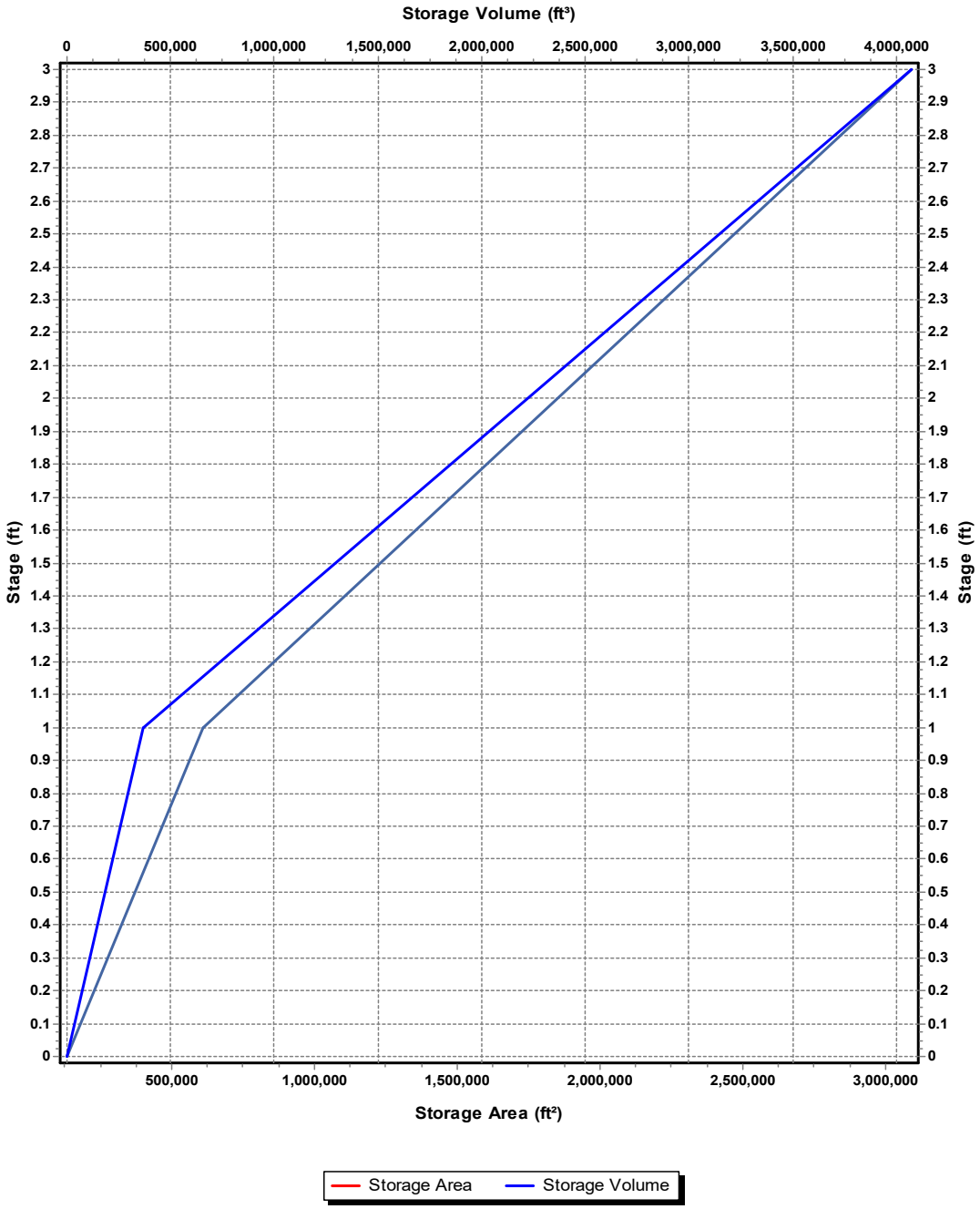
Invert Elevation (ft)	893.00
Max (Rim) Elevation (ft)	896.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	893.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : NorthPothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	131000	0
1	609800	370400
3	3092800	4073000

Storage Area Volume Curves



Storage Node : NorthPothole (continued)

Output Summary Results

Peak Inflow (cfs)	628.86
Peak Lateral Inflow (cfs)	628.86
Peak Outflow (cfs)	570.45
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894.64
Max HGL Depth Attained (ft)	1.64
Average HGL Elevation Attained (ft)	893.85
Average HGL Depth Attained (ft)	0.85
Time of Max HGL Occurrence (days hh:mm)	0 13:44
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : PotholeAboveAccessRoad

Input Data

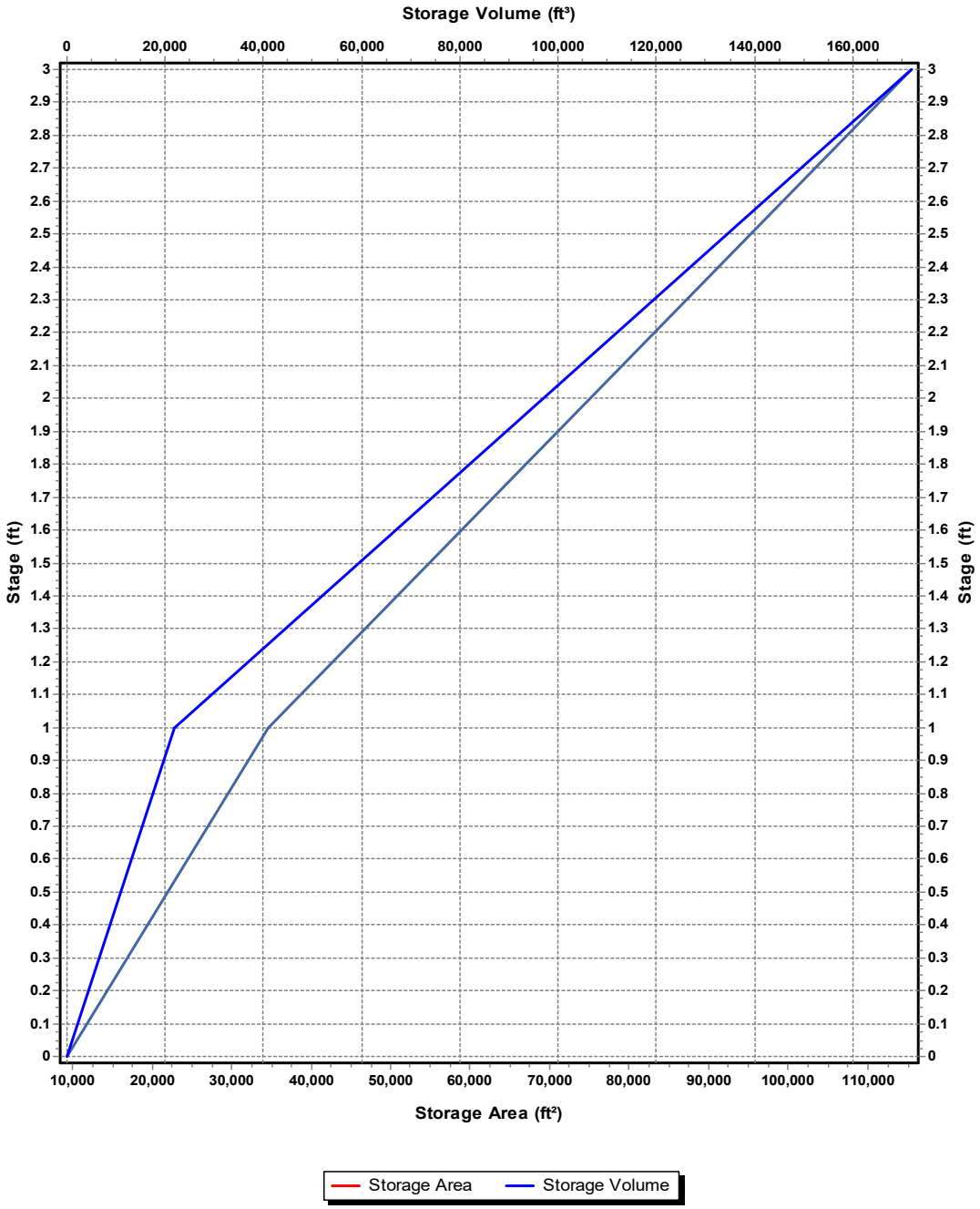
Invert Elevation (ft)	899.00
Max (Rim) Elevation (ft)	902.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	899.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : PotholeAboveAccess

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	9300	0
1	34531	21915.5
3	115500	171946.5

Storage Area Volume Curves



Storage Node : PotholeAboveAccessRoad (continued)

Output Summary Results

Peak Inflow (cfs)	782.11
Peak Lateral Inflow (cfs)	782.11
Peak Outflow (cfs)	781.49
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	901.03
Max HGL Depth Attained (ft)	2.03
Average HGL Elevation Attained (ft)	900.06
Average HGL Depth Attained (ft)	1.06
Time of Max HGL Occurrence (days hh:mm)	0 14:25
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : SEPothole

Input Data

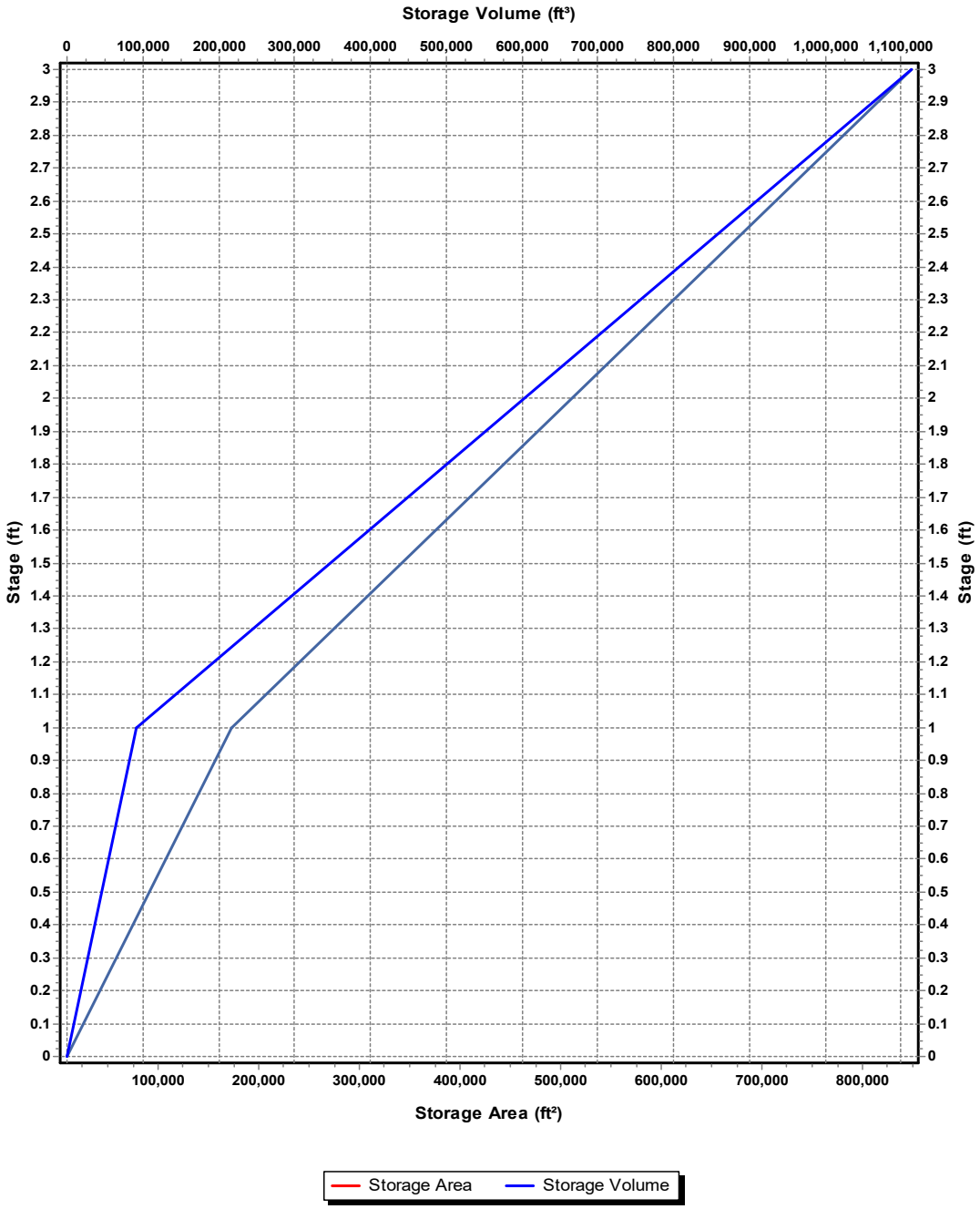
Invert Elevation (ft)	891.00
Max (Rim) Elevation (ft)	894.00
Max (Rim) Offset (ft)	3.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-891.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : SE Pothole

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	10000	0
1	173600	91800
3	848300	1113700

Storage Area Volume Curves



Storage Node : SEPothole (continued)

Output Summary Results

Peak Inflow (cfs)	672.6
Peak Lateral Inflow (cfs)	236.13
Peak Outflow (cfs)	498.93
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	894
Max HGL Depth Attained (ft)	3
Average HGL Elevation Attained (ft)	892.67
Average HGL Depth Attained (ft)	1.67
Time of Max HGL Occurrence (days hh:mm)	0 13:56
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	188.09
Total Time Flooded (min)	91
Total Retention Time (sec)	0

Storage Node : StreamAtInlet

Input Data

Invert Elevation (ft)	896.00
Max (Rim) Elevation (ft)	906.00
Max (Rim) Offset (ft)	10.00
Initial Water Elevation (ft)	896.00
Initial Water Depth (ft)	0.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
InletFromStream	Rectangular	No	896.50	0.50	4.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	122.68
Peak Lateral Inflow (cfs)	0
Peak Outflow (cfs)	122.72
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	898.51
Max HGL Depth Attained (ft)	2.51
Average HGL Elevation Attained (ft)	897.67
Average HGL Depth Attained (ft)	1.67
Time of Max HGL Occurrence (days hh:mm)	0 14:26
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : WetlandPool

Input Data

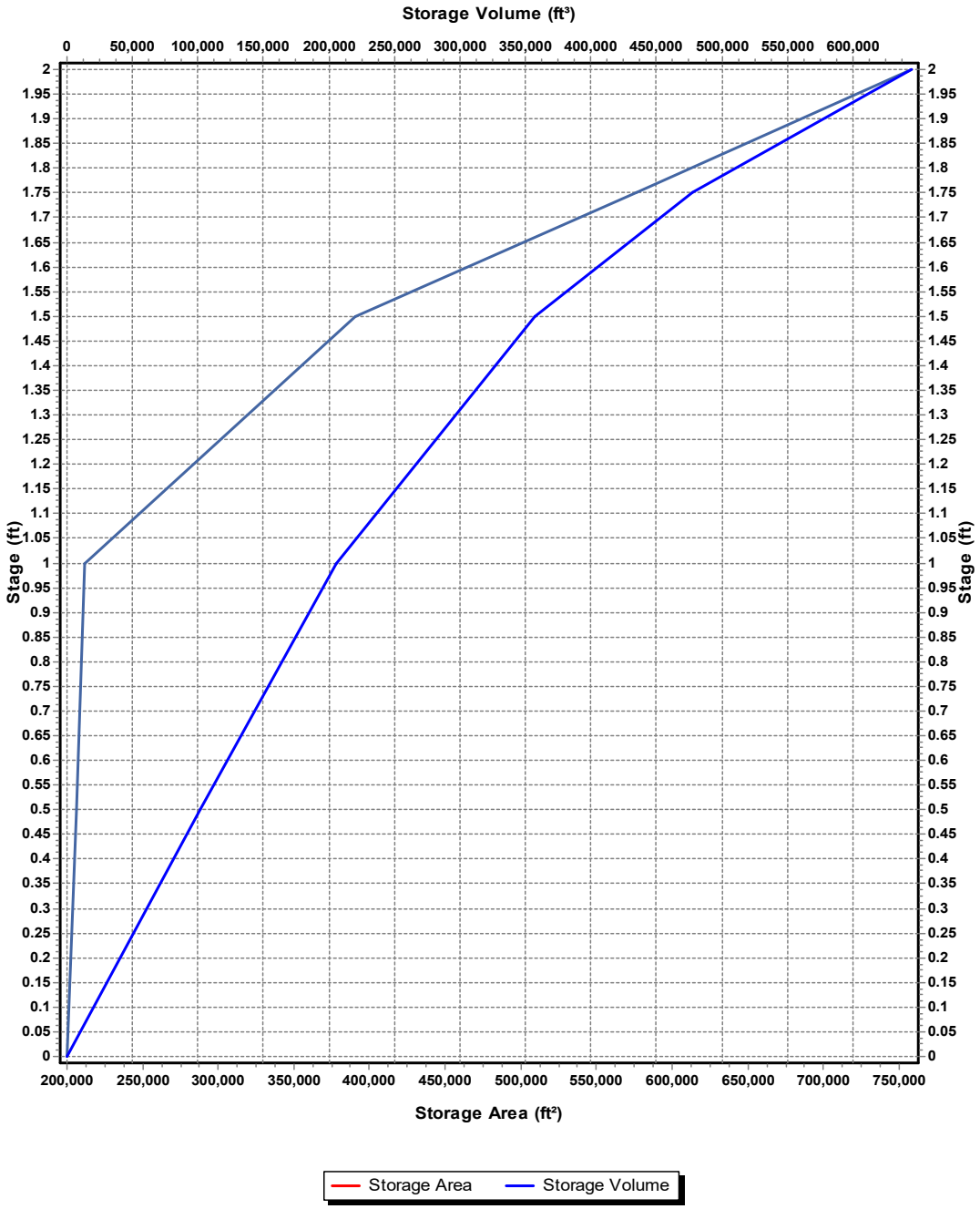
Invert Elevation (ft)	891.50
Max (Rim) Elevation (ft)	900.00
Max (Rim) Offset (ft)	8.50
Initial Water Elevation (ft)	892.50
Initial Water Depth (ft)	1.00
Ponded Area (ft^2)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Wetland Pool

Stage (ft)	Storage Area (ft^2)	Storage Volume (ft^3)
0	200000	0
0.5	206000	101500
1	212000	206000
1.5	391000	356750
1.75	577000	477750
2	758250	644656.25

Storage Area Volume Curves



Storage Node : WetlandPool (continued)

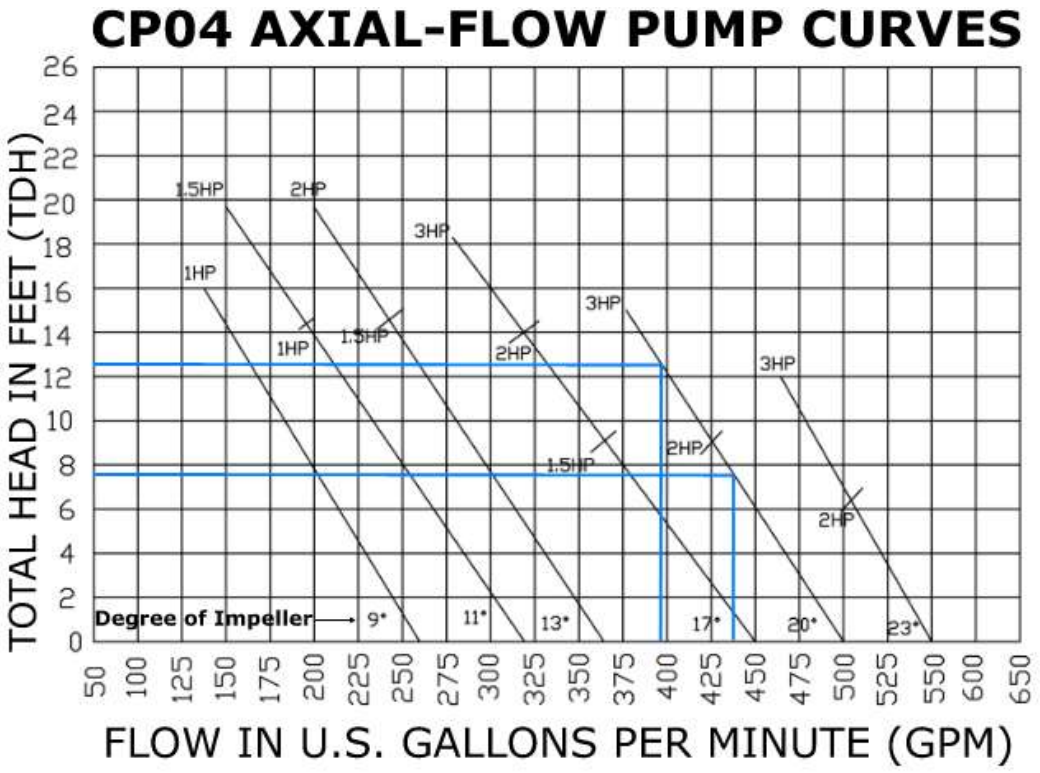
Outflow Weirs

Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
WetlandOutlet	Rectangular	No	892.50	1.00	16.00	0.75	3.00

Output Summary Results

Peak Inflow (cfs)	514.74
Peak Lateral Inflow (cfs)	168.17
Peak Outflow (cfs)	500.49
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	893.82
Max HGL Depth Attained (ft)	2.32
Average HGL Elevation Attained (ft)	893.29
Average HGL Depth Attained (ft)	1.79
Time of Max HGL Occurrence (days hh:mm)	0 14:01
Total Exfiltration Volume (1000-ft^3)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Appendix E: Pump Curve and Sump Design



Pump Basin Sizing Calculations:

Inlet Pipe Elev. = 886.15
Pump Flow Rate = 440 gpm
Minimum Working Volume = 440 gal = 58.8 cu. ft.
Minimum Working Sump Depth = 4.7 ft
On Float Elev. = 886.20
Off Float Elev. = 881.50
Pump Manufacturer Minimum Submergence = 22 in
Bottom of Sump Elev. = 879.50

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Appendix F: Pipe Capacity Calculations

Pipe Capacity Calculations							
Description	Dia (in)	A (sf)	P (ft)	R_h (ft)	s (%)	n	Q_{calc} (cfs)
Ditch Inlet Pipe	12	0.785	3.142	0.250	0.30%	0.013	1.95
DD 39 Existing 16" Tile	16	1.396	4.189	0.333	0.10%	0.02	1.58
DD 39 Existing 18" Tile	18	1.767	4.712	0.375	0.10%	0.02	2.16
Wetland Outlet Pipe	18	1.767	4.712	0.375	0.66%	0.013	8.53
Ring Tile	6	0.196	1.571	0.125	0.27%	0.02	0.19
Pumped Inlet Pipe	15	1.227	3.927	0.313	1.43%	0.013	7.72
DD 39 Tile Relay	18	1.767	4.712	0.375	0.09%	0.012	3.41

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