Exhibit E: Preliminary Stormwater Management Memo

Hillcrest Planned Development Master Plan Update Mcminnville, Oregon

Preliminary Stormwater Report

Date: March 13, 2017

Client: West Hills Properties, LLC
P.O. Box 731
McMinnville, OR 97128

Engineering Contact: Paul Sellke, PE, GE
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Engineering Firm: AKS Engineering & Forestry, LLC

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Preliminary Stormwater Report

HILLCREST PLANNED DEVELOPMENT
MASTER PLAN UPDATE
MCMINNVILLE, OREGON

1.0 Purpose of Report

This report evaluates the effects of the master plan update on the existing seasonal drainage swales and downstream system. We will document the criteria, methodology, and informational sources used to evaluate the anticipated stormwater runoff due to the modified subdivision, and present the results and comparison of our analyses to the original stormwater report.

2.0 Project Location/Description

The proposed residential subdivision is planned for north of W 2nd Street, west of NW Mt. Mazama Street, and south of NW Fox Ridge Road in the City of McMinnville, Oregon (City). The property proposed for development encompasses 132.2 acres (Tax Lot 801, Tax Map 4S-5-24).

The phased planned development will create a 647-lot residential subdivision for single-family detached and attached homes and multi-family apartment units. The proposed modification to the master plan proposes a maximum total of 488 new single-family units to be constructed with future phases (91 single-family homes and 68 multi-family apartments have already been constructed/platted). The site improvements will include the construction of public streets, underground utilities, and new stormwater facilities. Additional stormwater facilities will be incorporated into the subdivision to meet state and federal requirements for wetland fill permits.

3.0 Regulatory Design Criteria

3.1 STORMWATER QUANTITY

Stormwater quantity management for this project currently uses the existing regional stormwater facility, which was designed to detain the stormwater runoff from the 10-year storm event (see the West Hills Properties Stormwater Report included in Appendix B for additional information). Additional stormwater facilities (vegetated swales and/or extended dry basins) will be incorporated into the future phases of the subdivision to meet stormwater quantity requirements for state and federal wetland fill permit requirements (SLOPES V).

The existing regional stormwater facility, built in 2007, and the Valley's Edge Subdivision storm conveyance system (stormwater master plan for all subdivision phases) were designed using the 1991 City of McMinnville Storm Drainage Master Plan. This report will evaluate the proposed stormwater runoff quantities utilizing the 2009 Storm Drainage Master Plan standards.

3.2 STORMWATER QUALITY

The City currently does not require stormwater quality treatment for stormwater runoff. Stormwater facilities (which will include water quality treatment) will be incorporated where necessary, as each phase develops, to meet the stormwater quality requirements to obtain state and federal wetland fill permits. The modifications will preserve the open channel waterways, which are recommended for water quality measures within Section 9.6.3 of the 2009 Storm Drainage Master Plan.

4.0 Design Parameters

4.1 DESIGN METHODOLOGY

The stormwater runoff analysis was completed using the Santa Barbara Urban Hydrograph (SBUH) Method. This method uses the Soil Conservation Service (SCS) Type 1A 24-hour design storm. HydroCAD 10.0 computer software aided in the analysis. The Natural Resources Conservation Service (NCRS) *Technical Release 55* (TR-55*)* provided representative curve numbers (CNs) and selected values are identified in Appendix D.

4.2 DESIGN STORM

Per City of McMinnville 2009 Master Plan requirements, the stormwater analysis utilized the 24-hour storm event for the evaluation of the pre- and post-developed stormwater runoff. The following 24-hour rainfall intensity was used as the design storm for the recurrence interval:

Table 4-1: Rainfall Intensity

Recurrence Interval (years)	Total Precipitation Depth (inches)
10	3.8*

*The original stormwater report by Westech used a 24-hour, 10-year rainfall intensity of 3.6 inches as required at the time of subdivision approval.

4.3 PRE-DEVELOPED SITE CONDITIONS

4.3.1 Site Topography

Existing on-site grades vary from ± 1% to ± 30%, with open seasonal swales running throughout the western side of the property and draining towards the south (existing W 2nd Street). The site has a high point of ± 440 feet in the northwest corner and a low point of ±195 feet near the southern boundary along SW Redmond Hill Road.

4.3.2 Land Use

The pre-developed site is vacant land and currently comprises pasture land and/or wooded areas.

4.4 SOIL TYPE

Per the 2009 McMinnville Storm Drainage Master Plan, the soils found in the City of McMinnville area are generally silt loams with low to moderate permeability. The soils were grouped into NRCS Hydrologic Groups A, B, C, or D. By overlaying the City's Hydrological Soil Groups Map on the site, the underlying soils were determined to range from Groups A to D soils. The off-site basins were assumed to be Group C soils since most of the property is comprised of the same. Appendix C includes a map with the location of the hydrologic soil groups and an overlay of the site.

4.5 POST-DEVELOPED SITE CONDITIONS

4.5.1 Site Topography

The on-site slopes will be modified with cuts and fills to accommodate the construction of public streets and associated utilities. Additionally, sloped residential building pads will be constructed adjacent to the public right-of-way. Significant grading (cuts/fills) will be required to develop the site due to the site's topography.

4.5.2 Land Use

The post-developed site land use will consist of a multi-phase 647-lot, single- and multi-family residential subdivision with associated streets, sidewalks, and underground utilities.

4.5.3 Post-Developed Input Parameters

Appendix A of this report includes the HydroCAD Report generated for the analyzed storm event. The report includes the parameters (e.g., impervious/pervious areas, time of concentration, etc.) applied to model the post-developed hydrology.

4.5.4 Description of Off-Site Contributing Basins

Off-site basins (Basins 160X, 170X, 180X, 190X, 200X, 210X, 220X, 230X, 240X, 250X, 260X, 270X and 280X) currently convey flow through the project site by a system of seasonal swales running north to south. To accommodate the flow coming from these off-site basins, the seasonal swales will maintain their current alignment (when possible) and road crossing culverts will be designed to convey the 10-year storm event.

5.0 Stormwater Analysis

5.1 POST-DEVELOPED STORMWATER PEAK FLOW COMPARISON

The City requires all proposed developments to provide stormwater detention of the post-developed 10-year storm event peak runoff to the pre-developed 10-year storm event peak runoff. Stormwater quantity management will be satisfied with an existing regional stormwater pond located west of SW Valley's Edge Street and north of SW Redmond Hill Road. The West Hills Properties Stormwater Report, dated September 2007, states that the existing regional facility has been sized to provide stormwater detention for the full development of Tax Lot 801.

The following table presents the results for the total peak flow for the post-developed total drainage basin and the comparative results with respect to the West Hills Properties Stormwater Report prepared by Westech Engineering.

Table 5-1: Post-Developed Total Drainage Basin Peak Flow Comparison

Report	10-year, 24-Hour Developed Flows (cfs)
Westech Engineering	199.1
AKS Engineering & Forestry, LLC	191.4

As shown above, the increase in the number of lots does not result in an increase in the overall stormwater runoff volumes due to the conservative assumptions used in the original stormwater analysis. (i.e., impervious area based on density vs actual lot area).

As outlined in the Westech Stormwater Report, the existing regional stormwater facility in the West Hills Neighborhood Park was designed to detain stormwater runoff during the 10-year storm event. However, due to jurisdictional water/wetland impacts, new stormwater facilities are required within the subdivision to meet the state and federal permit requirements due to wetland impacts. These facilities will further detain stormwater runoff for lower storm events and be incorporated into the subdivision as needed for future development phases of the site, likely requiring reductions in the number of lots to provide space for the facilities.

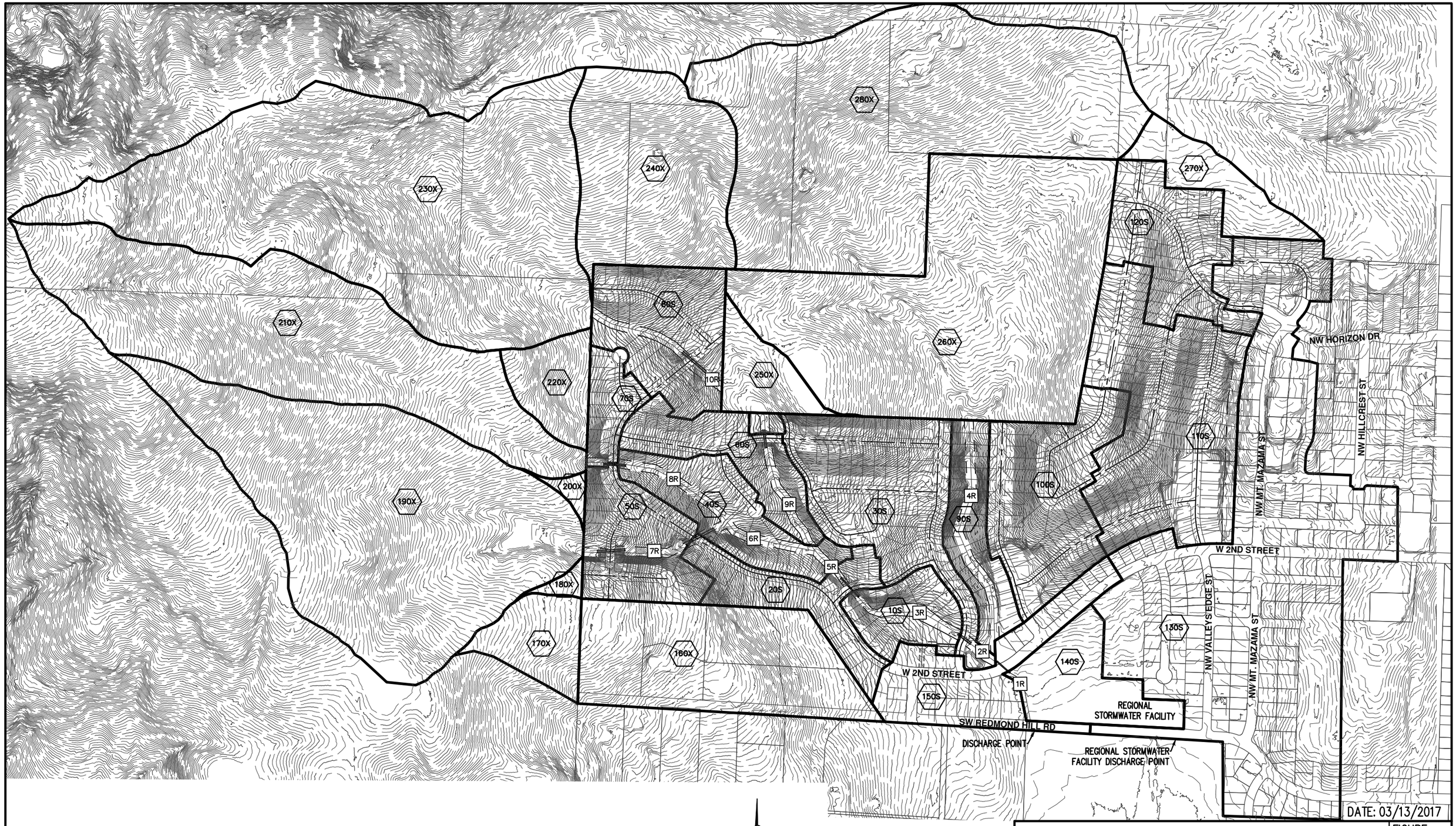
SCALE 1" = 500 FEET

500 0 200 300 400 500

DATE: 03/09/2017

VICINITY MAP	FIGURE 1
HILLCREST MASTER PLAN	
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD, STE 100 TUALATIN, OR 97062 P: 503.563.6151 F: 503.563.6152 aks-eng.com	DRWN: CTS CHKD: PAS AKS JOB: 5147

DWG: MASTER PLAN VICINITY | MAP



SCALE 1" = 500 FEET

500 0 200 300 400 500

DATE: 03/13/2017

POST-DEVELOPED BASIN DELINEATION

FIGURE 2

HILLCREST MASTER PLAN

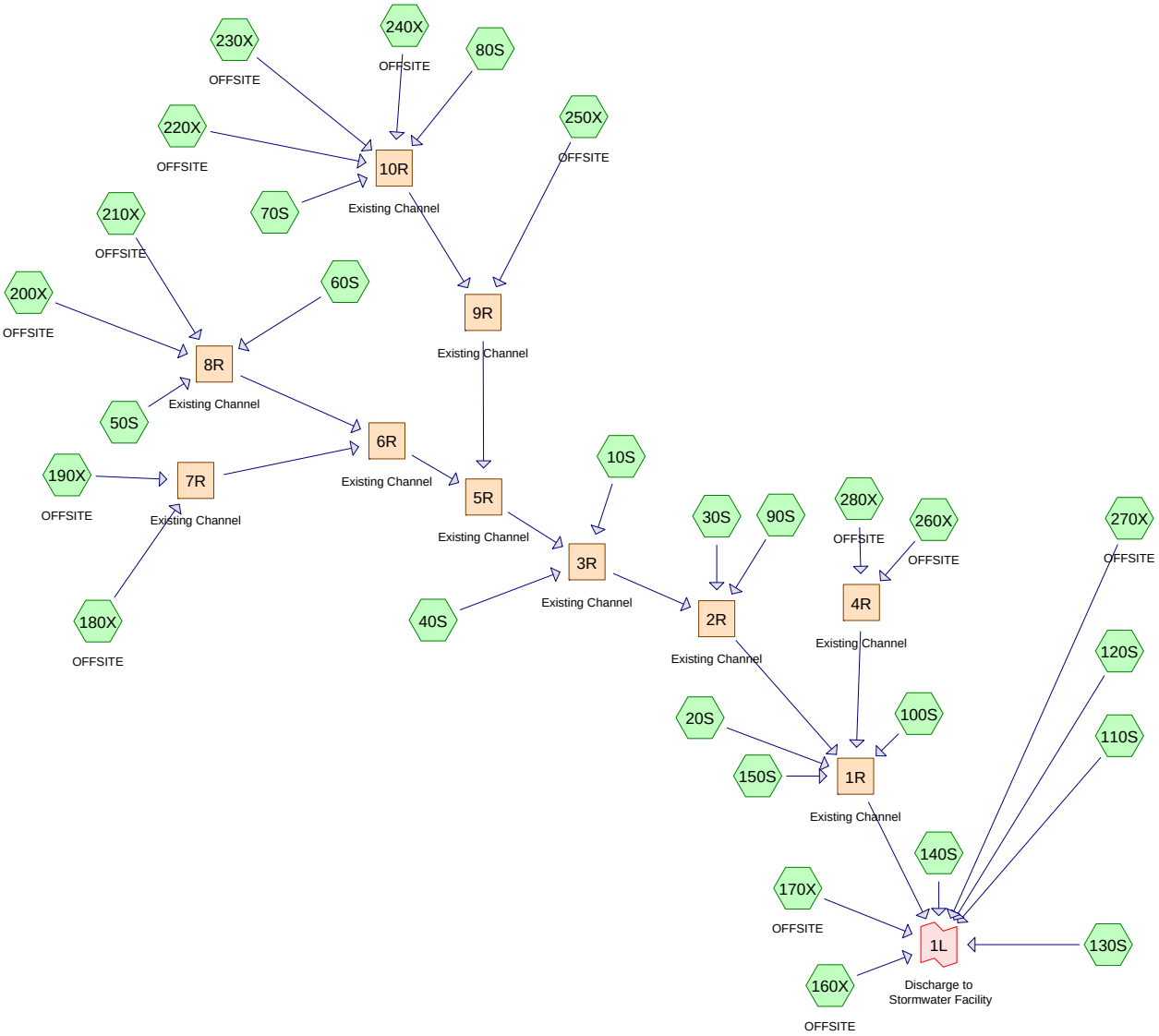
AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
P: 503.563.6151 F: 503.563.6152 aks-eng.com

DRWN: CTS
CHKD: PAS
AKS JOB: 5147

DWG: MASTER PLAN TOTAL DRAINAGE BASIN DELINEATION | LAYOUT1

APPENDIX A

POST-DEVELOPED SITE WITH OFFSITE BASINS
10-YEAR STORM EVENT ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 5147 MASTER PLAN POST-DEV - ALL DEV
Prepared by AKS Engineering & Forestry, LLC, Printed 3/14/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
28.537	61	1/4 acre lots, 38% imp, HSG A (160X, 260X)
354.160	83	1/4 acre lots, 38% imp, HSG C (130S, 160X, 170X, 180X, 190X, 200X, 210X, 220X, 230X, 240X, 250X, 260X, 270X, 280X)
3.833	87	1/4 acre lots, 38% imp, HSG D (250X, 260X)
2.032	98	28% Impervious Area on Lots (150S)
17.007	39	>75% Grass cover, Good, HSG A (lots) (20S, 30S, 50S, 60S, 80S, 90S, 100S, 110S)
7.808	74	>75% Grass cover, Good, HSG C (140S)
5.758	74	>75% Grass cover, Good, HSG C (ROW) (20S, 30S, 40S, 50S, 60S, 70S, 80S, 100S, 110S, 120S, 150S)
54.522	74	>75% Grass cover, Good, HSG C (lots) (10S, 20S, 30S, 40S, 50S, 60S, 70S, 80S, 100S, 110S, 120S, 150S)
2.453	80	>75% Grass cover, Good, HSG D (lots) (110S, 120S)
19.901	98	Impervious Area in ROW (20S, 30S, 40S, 50S, 60S, 70S, 80S, 100S, 110S, 120S, 150S)
6.485	98	Impervious Area on Lots (2640 sf x 107 lots) (110S)
1.273	98	Impervious Area on Lots (2640 sf x 21 lots) (10S)
4.727	98	Impervious Area on Lots (2640 sf x 26 lots) (20S, 50S, 60S)
1.948	98	Impervious Area on Lots (2640 sf x 31 lots) (40S)
2.242	98	Impervious Area on Lots (2640 sf x 37 lots) (80S)
2.303	98	Impervious Area on Lots (2640 sf x 38 lots) (90S)
2.424	98	Impervious Area on Lots (2640 sf x 40 lots) (120S)
3.091	98	Impervious Area on Lots (2640 sf x 51 lots) (30S)
3.273	98	Impervious Area on Lots (2640 sf x 54 lots) (100S)
0.545	98	Impervious Area on Lots (2640 sf x 9 lots) (70S)
1.933	30	Woods, Good, HSG A (natural resource easement) (50S, 90S)
6.041	70	Woods, Good, HSG C (natural resource easement) (10S, 40S, 50S, 60S, 80S, 110S)
532.296	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
47.477	HSG A	20S, 30S, 50S, 60S, 80S, 90S, 100S, 110S, 160X, 260X
0.000	HSG B	
428.289	HSG C	10S, 20S, 30S, 40S, 50S, 60S, 70S, 80S, 100S, 110S, 120S, 130S, 140S, 150S, 160X, 170X, 180X, 190X, 200X, 210X, 220X, 230X, 240X, 250X, 260X, 270X, 280X
6.286	HSG D	110S, 120S, 250X, 260X
50.244	Other	10S, 20S, 30S, 40S, 50S, 60S, 70S, 80S, 90S, 100S, 110S, 120S, 150S
532.296		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment10S: Runoff Area=229,654 sf 24.14% Impervious Runoff Depth>1.91"
Tc=5.0 min CN=73/98 Runoff=2.25 cfs 0.838 af

Subcatchment20S: Runoff Area=332,852 sf 40.71% Impervious Runoff Depth>2.12"
Flow Length=2,080' Tc=5.8 min CN=69/98 Runoff=3.61 cfs 1.351 af

Subcatchment30S: Runoff Area=734,581 sf 41.15% Impervious Runoff Depth>2.10"
Flow Length=2,042' Tc=5.3 min CN=68/98 Runoff=7.86 cfs 2.949 af

Subcatchment40S: Runoff Area=387,551 sf 25.74% Impervious Runoff Depth>1.94"
Flow Length=1,462' Tc=7.7 min CN=73/98 Runoff=3.76 cfs 1.438 af

Subcatchment50S: Runoff Area=406,337 sf 33.01% Impervious Runoff Depth>1.71"
Flow Length=1,565' Tc=8.3 min CN=63/98 Runoff=3.17 cfs 1.332 af

Subcatchment60S: Runoff Area=335,735 sf 31.22% Impervious Runoff Depth>2.02"
Flow Length=1,528' Tc=7.5 min CN=72/98 Runoff=3.41 cfs 1.294 af

Subcatchment70S: Runoff Area=151,887 sf 34.18% Impervious Runoff Depth>2.17"
Flow Length=885' Tc=6.7 min CN=74/98 Runoff=1.72 cfs 0.630 af

Subcatchment80S: Runoff Area=531,993 sf 28.01% Impervious Runoff Depth>1.73"
Flow Length=2,297' Tc=11.0 min CN=67/98 Runoff=4.09 cfs 1.757 af

Subcatchment90S: Runoff Area=285,400 sf 35.15% Impervious Runoff Depth>1.25"
Flow Length=1,350' Tc=8.6 min CN=36/98 Runoff=1.98 cfs 0.683 af

Subcatchment100S: Runoff Area=632,182 sf 39.90% Impervious Runoff Depth>1.49"
Flow Length=2,165' Tc=7.6 min CN=44/98 Runoff=5.03 cfs 1.797 af

Subcatchment110S: Runoff Area=1,048,600 sf 40.00% Impervious Runoff Depth>2.20"
Flow Length=3,711' Tc=15.5 min CN=72/98 Runoff=10.62 cfs 4.421 af

Subcatchment120S: Runoff Area=475,503 sf 37.76% Impervious Runoff Depth>2.27"
Flow Length=3,926' Tc=17.7 min CN=75/98 Runoff=4.89 cfs 2.068 af

Subcatchment130S: Runoff Area=2,606,901 sf 38.00% Impervious Runoff Depth>2.25"
Flow Length=3,735' Tc=9.2 min CN=74/98 Runoff=29.87 cfs 11.199 af

Subcatchment140S: Runoff Area=340,109 sf 0.00% Impervious Runoff Depth>1.44"
Flow Length=640' Slope=0.0600 '/' Tc=9.7 min CN=74/0 Runoff=2.18 cfs 0.939 af

Subcatchment150S: Runoff Area=457,197 sf 44.66% Impervious Runoff Depth>2.39"
Flow Length=693' Tc=8.3 min CN=74/98 Runoff=5.71 cfs 2.088 af

Subcatchment160X: OFFSITE Runoff Area=896,268 sf 38.00% Impervious Runoff Depth>1.74"
Tc=5.0 min CN=59/98 Runoff=7.23 cfs 2.976 af

Subcatchment170X: OFFSITE Runoff Area=239,159 sf 38.00% Impervious Runoff Depth>2.24"
Flow Length=2,530' Tc=17.0 min CN=74/98 Runoff=2.43 cfs 1.024 af

Subcatchment180X: OFFSITE Runoff Area=30,593 sf 38.00% Impervious Runoff Depth>2.24"
Flow Length=665' Tc=13.9 min CN=74/98 Runoff=0.33 cfs 0.131 af

Subcatchment190X: OFFSITE Runoff Area=2,202,039 sf 38.00% Impervious Runoff Depth>2.23"
Flow Length=2,997' Tc=29.1 min CN=74/98 Runoff=18.81 cfs 9.373 af

Subcatchment200X: OFFSITE Runoff Area=32,333 sf 38.00% Impervious Runoff Depth>2.24"
Flow Length=1,070' Tc=12.8 min CN=74/98 Runoff=0.35 cfs 0.139 af

Subcatchment210X: OFFSITE Runoff Area=1,802,806 sf 38.00% Impervious Runoff Depth>2.22"
Flow Length=3,796' Tc=31.6 min CN=74/98 Runoff=14.93 cfs 7.665 af

Subcatchment220X: OFFSITE Runoff Area=228,043 sf 38.00% Impervious Runoff Depth>2.24"
Flow Length=1,152' Tc=14.9 min CN=74/98 Runoff=2.39 cfs 0.977 af

Subcatchment230X: OFFSITE Runoff Area=2,806,985 sf 38.00% Impervious Runoff Depth>2.23"
Flow Length=4,118' Tc=28.5 min CN=74/98 Runoff=24.17 cfs 11.952 af

Subcatchment240X: OFFSITE Runoff Area=921,256 sf 38.00% Impervious Runoff Depth>2.23"
Flow Length=2,410' Tc=23.6 min CN=74/98 Runoff=8.47 cfs 3.932 af

Subcatchment250X: OFFSITE Runoff Area=210,435 sf 38.00% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=74/98 Runoff=2.51 cfs 0.906 af

Subcatchment260X: OFFSITE Runoff Area=2,138,570 sf 38.00% Impervious Runoff Depth>1.76"
Flow Length=1,790' Tc=9.7 min CN=60/98 Runoff=16.91 cfs 7.201 af

Subcatchment270X: OFFSITE Runoff Area=255,803 sf 38.00% Impervious Runoff Depth>2.23"
Flow Length=3,690' Tc=26.8 min CN=74/98 Runoff=2.25 cfs 1.090 af

Subcatchment280X: OFFSITE Runoff Area=2,466,021 sf 38.00% Impervious Runoff Depth>2.23"
Flow Length=3,163' Tc=25.8 min CN=74/98 Runoff=22.00 cfs 10.513 af

Reach 1R: Existing Channel Avg. Flow Depth=3.10' Max Vel=3.52 fps Inflow=138.13 cfs 68.330 af
n=0.080 L=310.0' S=0.0226 '/' Capacity=248.44 cfs Outflow=138.05 cfs 68.264 af

Reach 2R: Existing Channel Avg. Flow Depth=1.24' Max Vel=2.64 fps Inflow=91.29 cfs 45.535 af
n=0.080 L=264.0' S=0.0347 '/' Capacity=596.25 cfs Outflow=91.21 cfs 45.477 af

Reach 3R: Existing Channel Avg. Flow Depth=1.16' Max Vel=2.77 fps Inflow=85.51 cfs 42.050 af
n=0.080 L=768.0' S=0.0428 '/' Capacity=662.85 cfs Outflow=84.68 cfs 41.903 af

Reach 4R: Existing Channel Avg. Flow Depth=1.61' Max Vel=2.97 fps Inflow=38.69 cfs 17.715 af
n=0.080 L=1,340.0' S=0.0351 '/' Capacity=2,366.15 cfs Outflow=37.02 cfs 17.618 af

Reach 5R: Existing Channel Avg. Flow Depth=1.06' Max Vel=3.18 fps Inflow=80.99 cfs 39.807 af
n=0.080 L=212.0' S=0.0665 '/' Capacity=825.92 cfs Outflow=80.97 cfs 39.774 af

Reach 6R: Existing Channel Avg. Flow Depth=0.80' Max Vel=2.74 fps Inflow=40.01 cfs 19.855 af
n=0.080 L=537.0' S=0.0739 '/' Capacity=870.78 cfs Outflow=39.72 cfs 19.808 af

Reach 7R: Existing Channel Avg. Flow Depth=0.53' Max Vel=2.83 fps Inflow=19.13 cfs 9.505 af
n=0.080 L=846.0' S=0.1162 '/' Capacity=3,539.93 cfs Outflow=18.85 cfs 9.468 af

Reach 8R: Existing Channel Avg. Flow Depth=0.42' Max Vel=3.19 fps Inflow=21.64 cfs 10.430 af
n=0.080 L=905.0' S=0.1197 '/' Capacity=670.49 cfs Outflow=21.27 cfs 10.387 af

Reach 9R: Existing Channel Avg. Flow Depth=1.02' Max Vel=3.19 fps Inflow=42.30 cfs 20.085 af
n=0.080 L=1,126.0' S=0.0728 '/' Capacity=1,290.64 cfs Outflow=41.27 cfs 19.998 af

Reach 10R: Existing Channel Avg. Flow Depth=0.61' Max Vel=3.43 fps Inflow=40.66 cfs 19.247 af
n=0.080 L=857.0' S=0.0881 '/' Capacity=551.68 cfs Outflow=40.10 cfs 19.179 af

Link 1L: Discharge to Stormwater Facility Inflow=191.37 cfs 91.980 af
Primary=191.37 cfs 91.980 af

Total Runoff Area = 532.296 ac Runoff Volume = 92.662 af Average Runoff Depth = 2.09"
62.97% Pervious = 335.170 ac 37.03% Impervious = 197.125 ac

Summary for Subcatchment 10S:

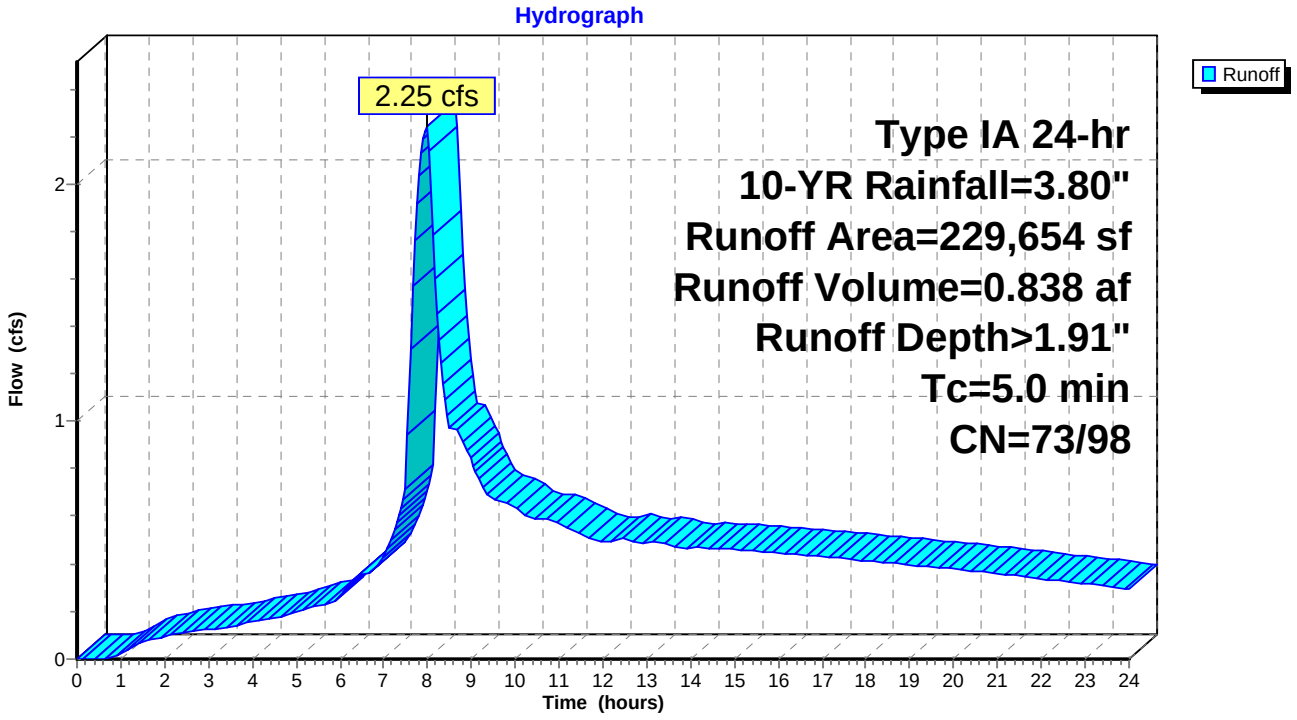
Runoff = 2.25 cfs @ 7.98 hrs, Volume= 0.838 af, Depth> 1.91"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	55,440	98	Impervious Area on Lots (2640 sf x 21 lots)
*	136,901	74	>75% Grass cover, Good, HSG C (lots)
*	37,313	70	Woods, Good, HSG C (natural resource easement)
	229,654	79	Weighted Average
	174,214		75.86% Pervious Area
	55,440		24.14% Impervious Area

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

Subcatchment 10S:



Summary for Subcatchment 20S:

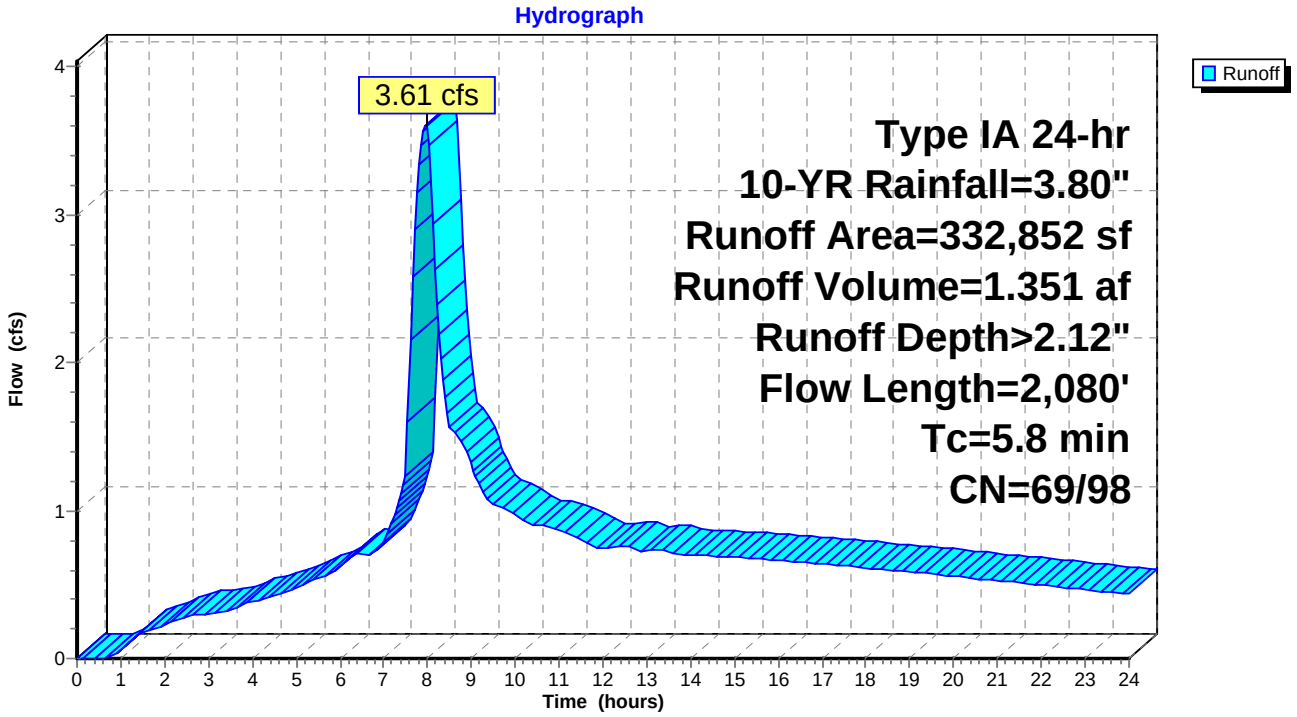
Runoff = 3.61 cfs @ 7.97 hrs, Volume= 1.351 af, Depth> 2.12"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	66,868	98	Impervious Area in ROW
*	23,520	74	>75% Grass cover, Good, HSG C (ROW)
*	68,640	98	Impervious Area on Lots (2640 sf x 26 lots)
*	145,720	74	>75% Grass cover, Good, HSG C (lots)
*	28,104	39	>75% Grass cover, Good, HSG A (lots)
	332,852	81	Weighted Average
	197,344		59.29% Pervious Area
	135,508		40.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.9	180	0.2100	3.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.6	1,850	0.0700	12.00	9.43	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
5.8	2,080	Total			

Subcatchment 20S:



Summary for Subcatchment 30S:

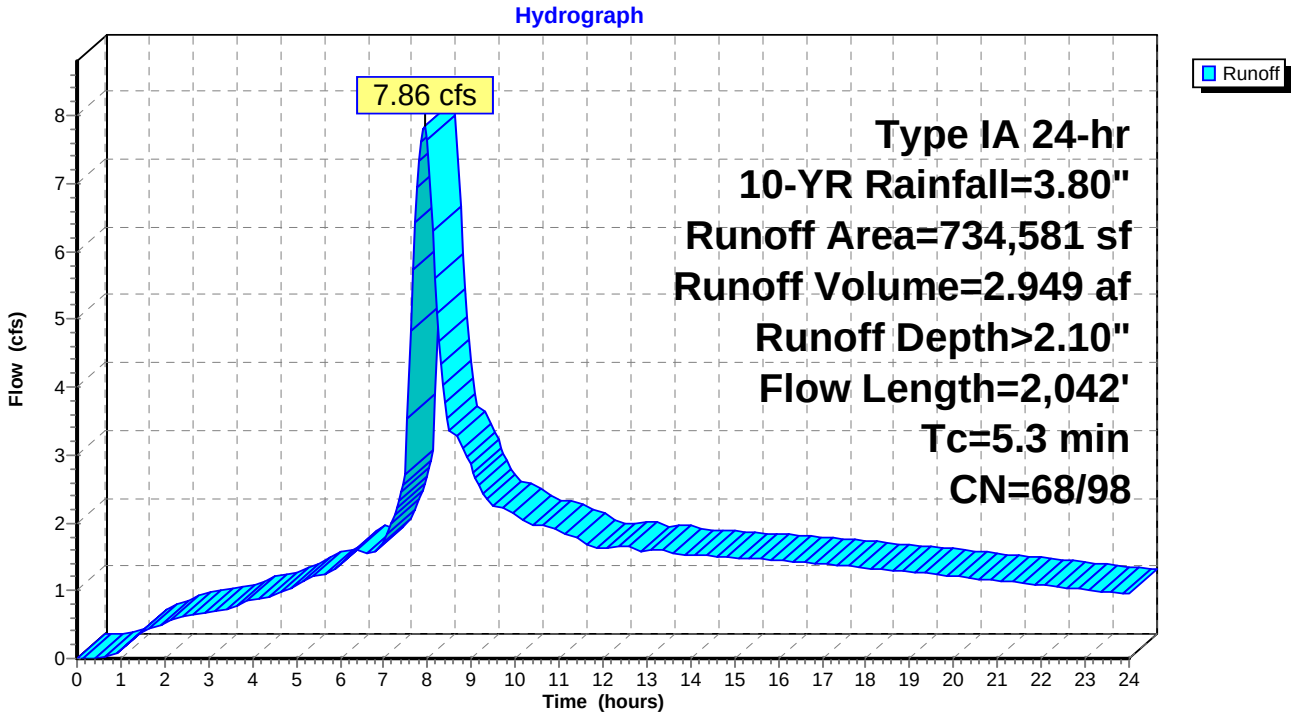
Runoff = 7.86 cfs @ 7.96 hrs, Volume= 2.949 af, Depth> 2.10"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	167,661	98	Impervious Area in ROW
*	47,289	74	>75% Grass cover, Good, HSG C (ROW)
*	134,640	98	Impervious Area on Lots (2640 sf x 51 lots)
*	313,028	74	>75% Grass cover, Good, HSG C (lots)
*	71,963	39	>75% Grass cover, Good, HSG A (lots)
	734,581	80	Weighted Average
	432,280		58.85% Pervious Area
	302,301		41.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	50	0.5000	0.48		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.0	62	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	90	0.0300	3.52		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.2	1,840	0.0700	13.93	17.09	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.3	2,042	Total			

Subcatchment 30S:



Summary for Subcatchment 40S:

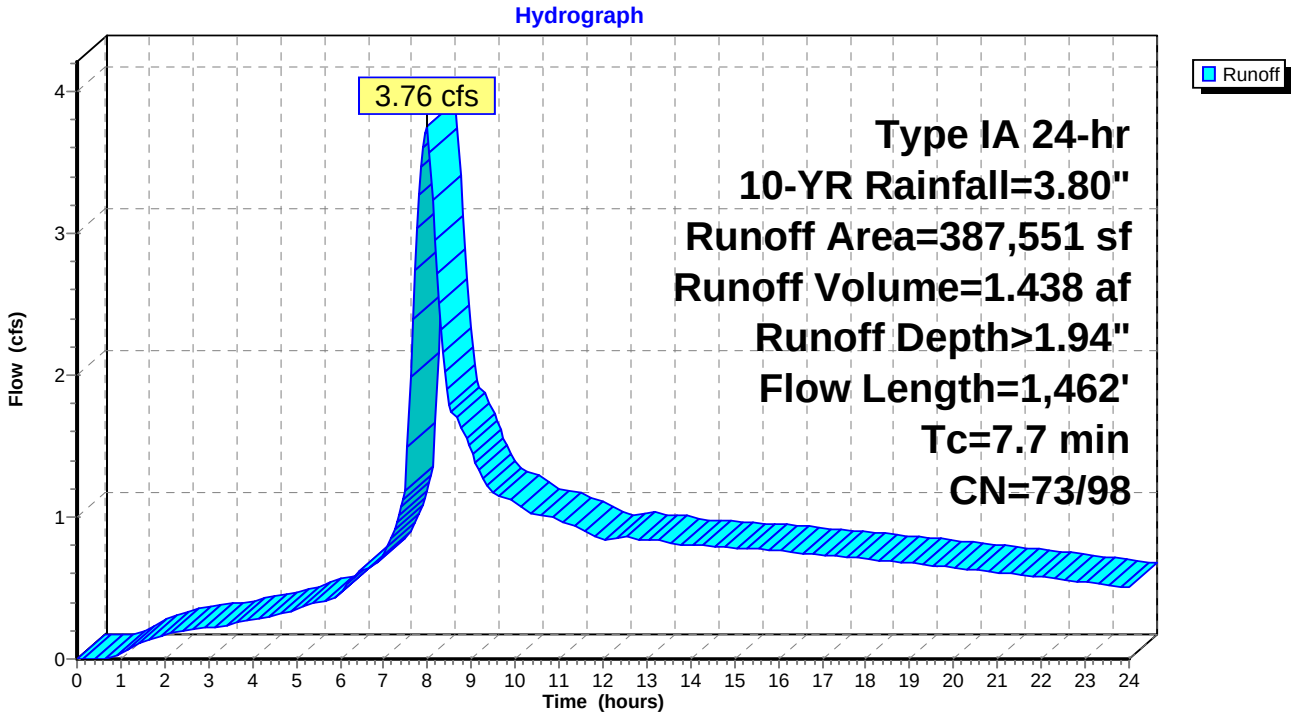
Runoff = 3.76 cfs @ 7.99 hrs, Volume= 1.438 af, Depth> 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	14,935	98	Impervious Area in ROW
*	4,215	74	>75% Grass cover, Good, HSG C (ROW)
*	84,840	98	Impervious Area on Lots (2640 sf x 31 lots)
*	210,847	74	>75% Grass cover, Good, HSG C (lots)
*	72,714	70	Woods, Good, HSG C (natural resource easement)
	387,551	79	Weighted Average
	287,776		74.26% Pervious Area
	99,775		25.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
5.4	1,412	0.0800	4.38	80.53	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
7.7	1,462	Total			

Subcatchment 40S:



Summary for Subcatchment 50S:

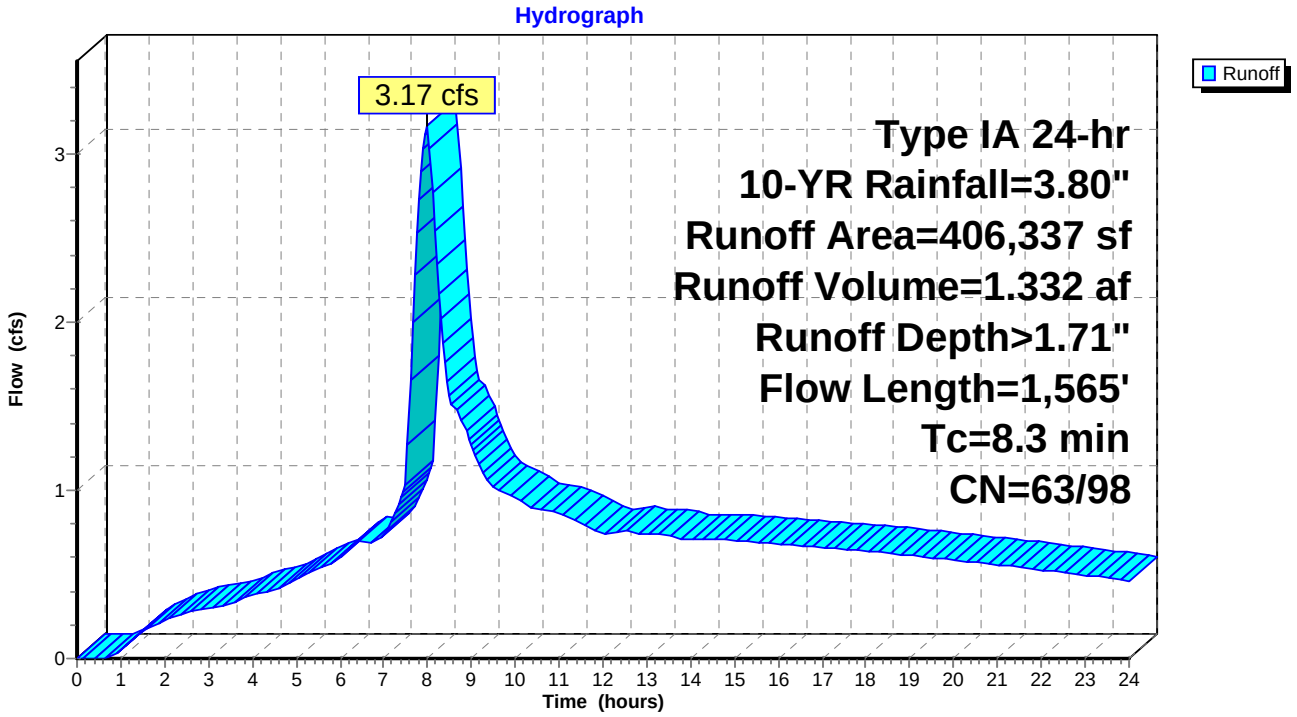
Runoff = 3.17 cfs @ 7.99 hrs, Volume= 1.332 af, Depth> 1.71"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	65,484	98	Impervious Area in ROW
*	20,686	74	>75% Grass cover, Good, HSG C (ROW)
*	68,640	98	Impervious Area on Lots (2640 sf x 26 lots)
*	159,568	74	>75% Grass cover, Good, HSG C (lots)
*	69,733	39	>75% Grass cover, Good, HSG A (lots)
*	9,661	70	Woods, Good, HSG C (natural resource easement)
*	12,565	30	Woods, Good, HSG A (natural resource easement)
	406,337	74	Weighted Average
	272,213		66.99% Pervious Area
	134,124		33.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.0800	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.1	65	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	300	0.1500	7.86		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	150	0.2500	22.68	17.81	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
2.9	1,000	0.1400	5.79	106.53	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
8.3	1,565	Total			

Subcatchment 50S:



Summary for Subcatchment 60S:

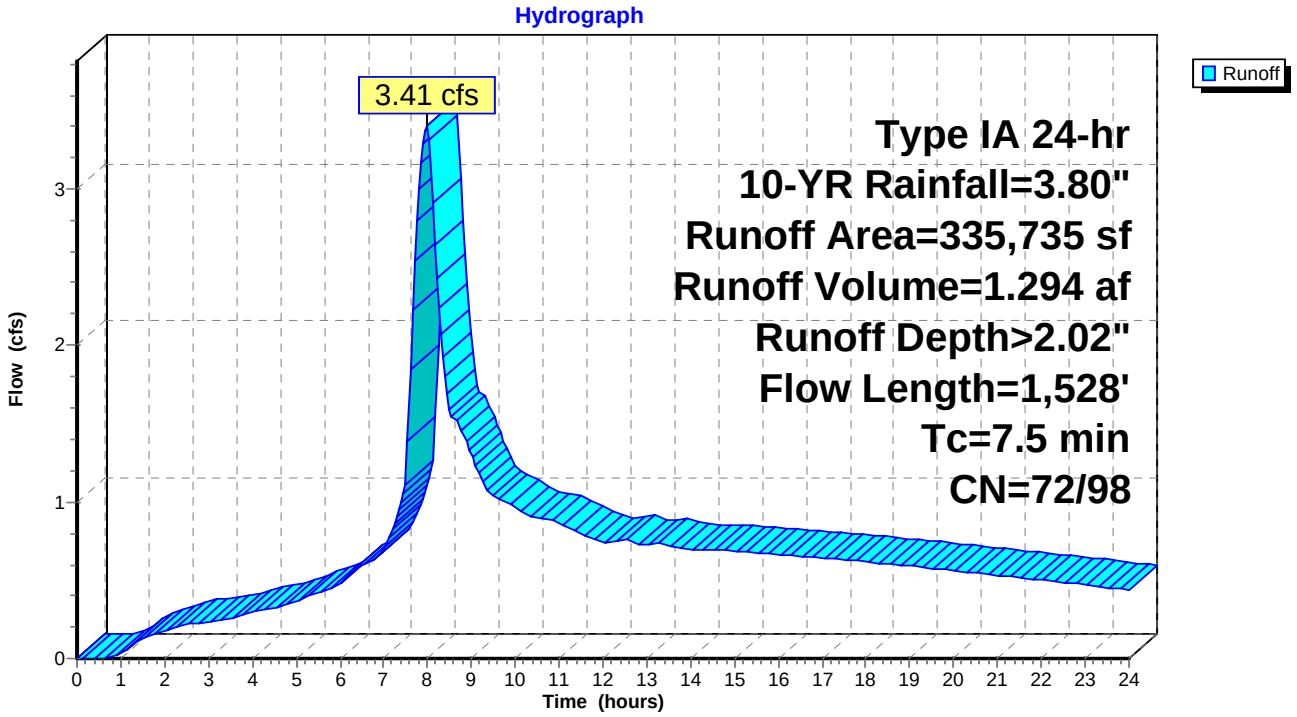
Runoff = 3.41 cfs @ 7.98 hrs, Volume= 1.294 af, Depth> 2.02"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	36,192	98	Impervious Area in ROW
*	10,208	74	>75% Grass cover, Good, HSG C (ROW)
*	68,640	98	Impervious Area on Lots (2640 sf x 26 lots)
*	180,014	74	>75% Grass cover, Good, HSG C (lots)
*	10,081	39	>75% Grass cover, Good, HSG A (lots)
*	30,600	70	Woods, Good, HSG C (natural resource easement)
	335,735	80	Weighted Average
	230,903		68.78% Pervious Area
	104,832		31.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.8	104	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	170	0.1200	7.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.8	620	0.0800	12.83	10.08	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
2.2	584	0.0800	4.38	80.53	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
7.5	1,528	Total			

Subcatchment 60S:



Summary for Subcatchment 70S:

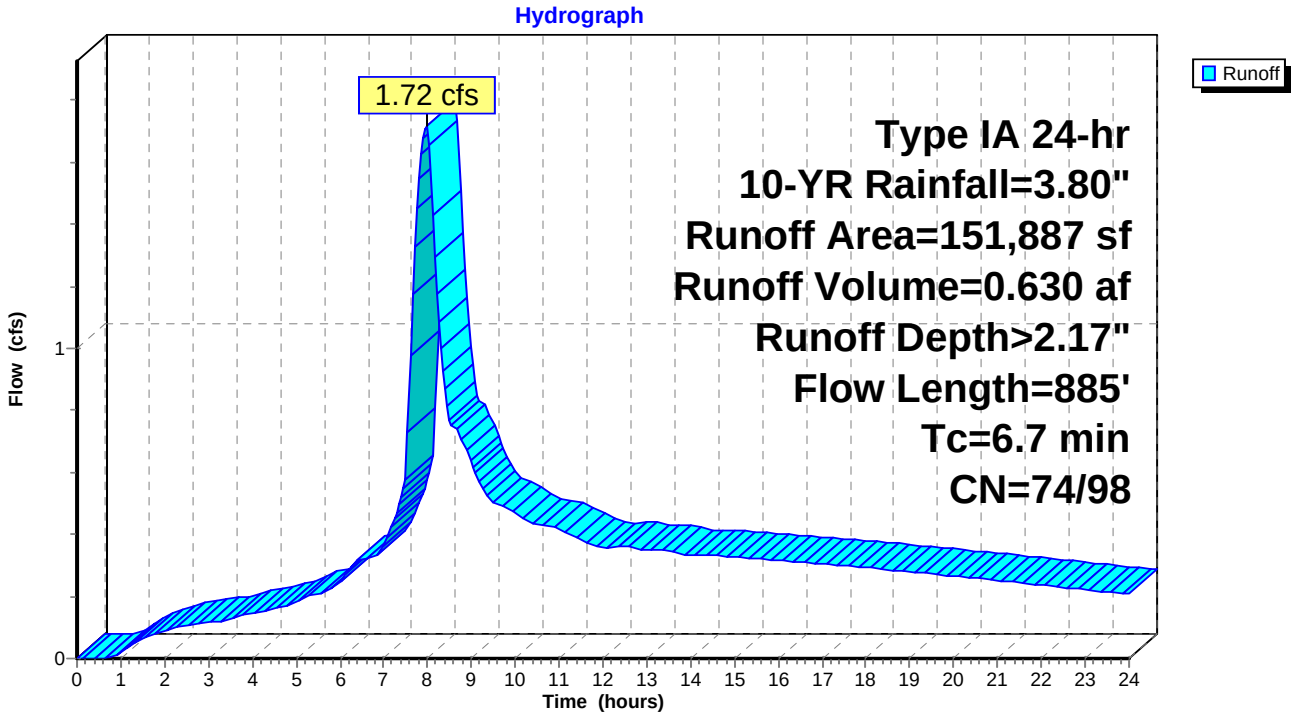
Runoff = 1.72 cfs @ 7.98 hrs, Volume= 0.630 af, Depth> 2.17"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	28,156	98	Impervious Area in ROW
*	9,526	74	>75% Grass cover, Good, HSG C (ROW)
*	23,760	98	Impervious Area on Lots (2640 sf x 9 lots)
*	90,445	74	>75% Grass cover, Good, HSG C (lots)
	151,887	82	Weighted Average
	99,971		65.82% Pervious Area
	51,916		34.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	50	0.0700	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.3	75	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	295	0.1100	6.73		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	465	0.0400	9.07	7.13	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
6.7	885	Total			

Subcatchment 70S:



Summary for Subcatchment 80S:

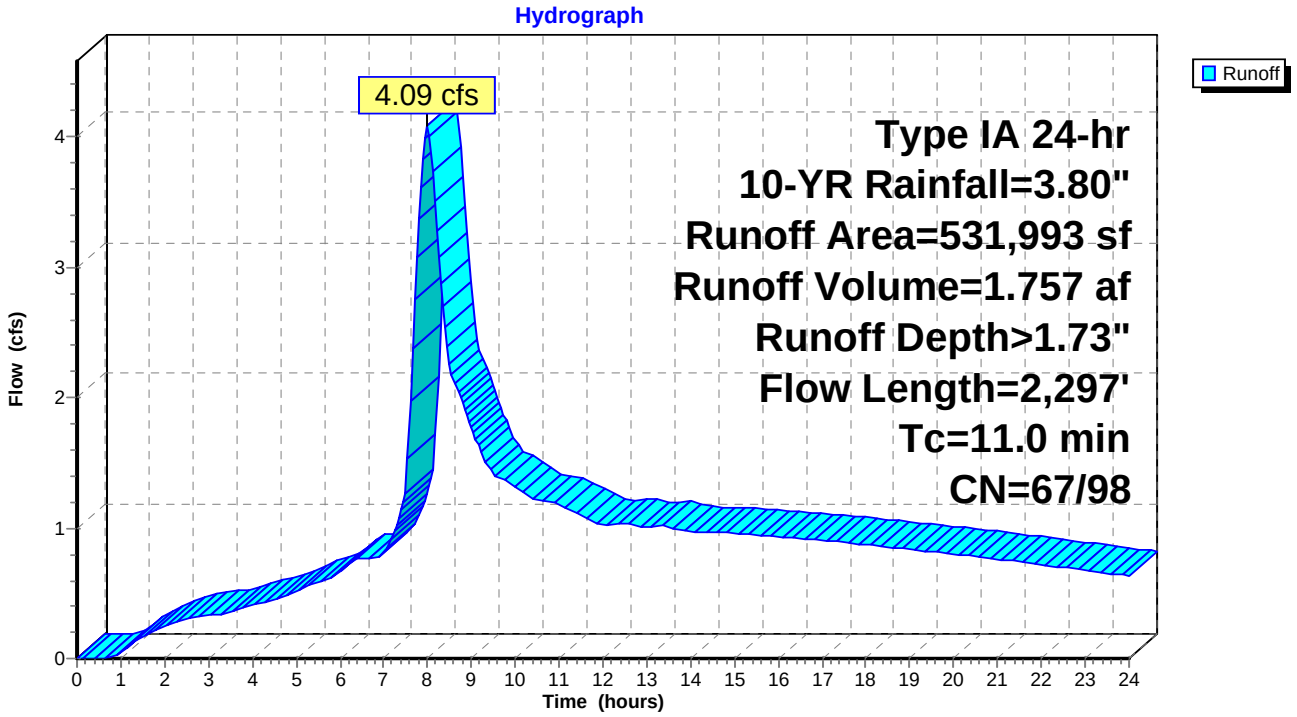
Runoff = 4.09 cfs @ 8.00 hrs, Volume= 1.757 af, Depth> 1.73"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	51,310	98	Impervious Area in ROW
*	16,338	74	>75% Grass cover, Good, HSG C (ROW)
*	97,680	98	Impervious Area on Lots (2640 sf x 37 lots)
*	75,707	39	>75% Grass cover, Good, HSG A (lots)
*	250,308	74	>75% Grass cover, Good, HSG C (lots)
*	40,650	70	Woods, Good, HSG C (natural resource easement)
	531,993	75	Weighted Average
	383,003		71.99% Pervious Area
	148,990		28.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.5	88	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	114	0.0650	5.18		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.0	845	0.1000	14.35	11.27	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
5.8	1,200	0.0500	3.46	63.66	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
11.0	2,297	Total			

Subcatchment 80S:



Summary for Subcatchment 90S:

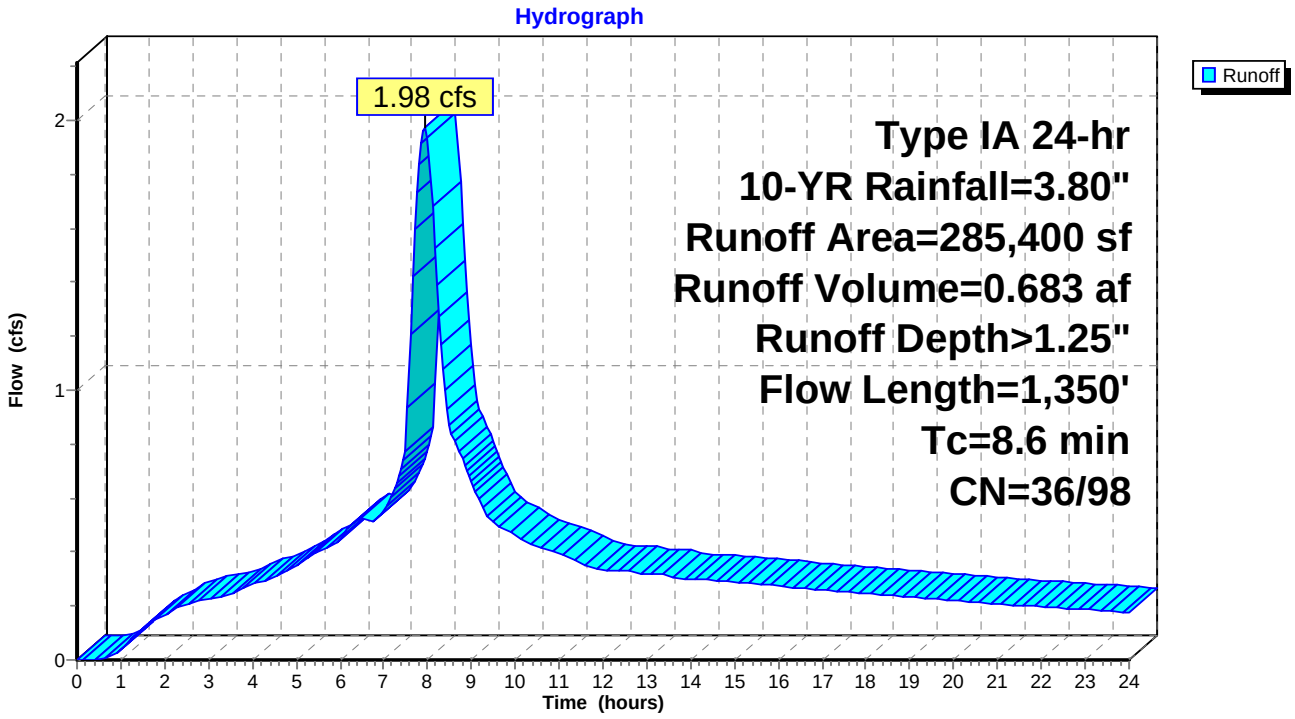
Runoff = 1.98 cfs @ 7.96 hrs, Volume= 0.683 af, Depth> 1.25"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	100,320	98	Impervious Area on Lots (2640 sf x 38 lots)
*	113,460	39	>75% Grass cover, Good, HSG A (lots)
*	71,620	30	Woods, Good, HSG A (natural resource easement)
	285,400	57	Weighted Average
	185,080		64.85% Pervious Area
	100,320		35.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
6.3	1,300	0.0500	3.46	63.66	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
8.6	1,350	Total			

Subcatchment 90S:



Summary for Subcatchment 100S:

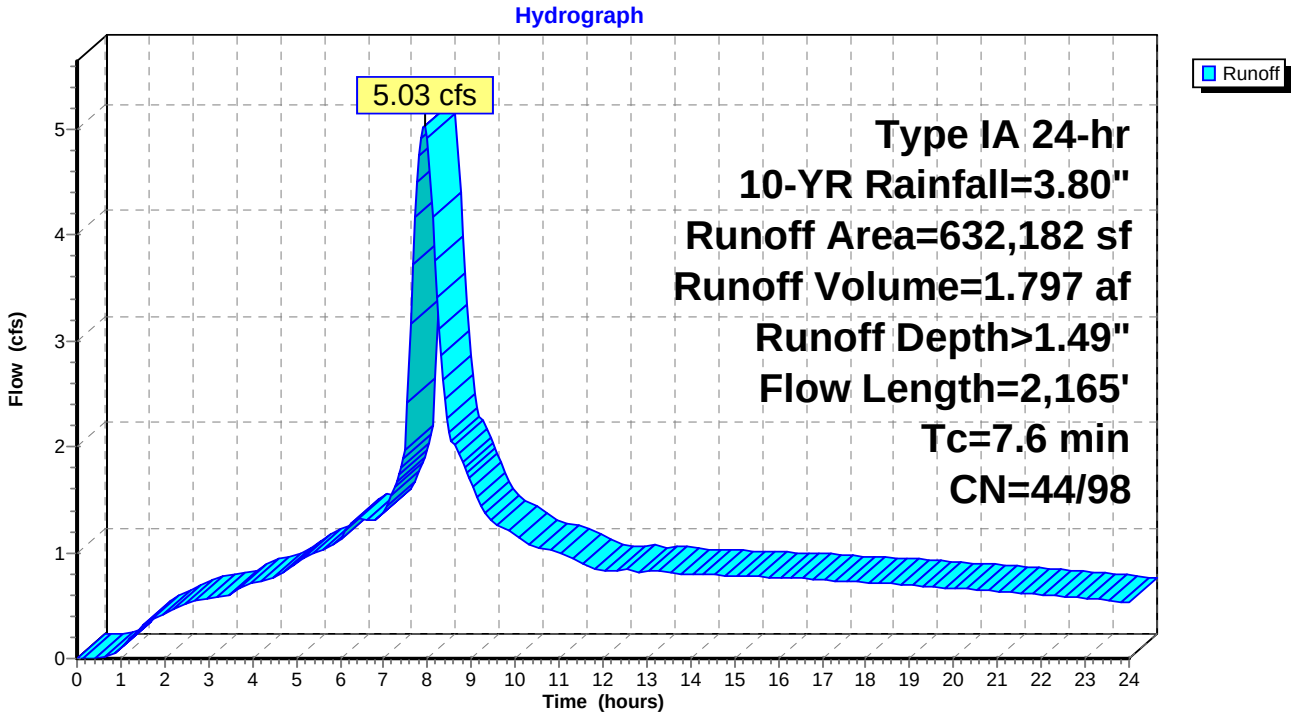
Runoff = 5.03 cfs @ 7.94 hrs, Volume= 1.797 af, Depth> 1.49"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	109,707	98	Impervious Area in ROW
*	30,943	74	>75% Grass cover, Good, HSG C (ROW)
*	142,560	98	Impervious Area on Lots (2640 sf x 54 lots)
*	330,383	39	>75% Grass cover, Good, HSG A (lots)
*	18,589	74	>75% Grass cover, Good, HSG C (lots)
	632,182	65	Weighted Average
	379,915		60.10% Pervious Area
	252,267		39.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0420	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.7	55	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.3	2,060	0.0800	14.89	18.27	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
7.6	2,165	Total			

Subcatchment 100S:



Summary for Subcatchment 110S:

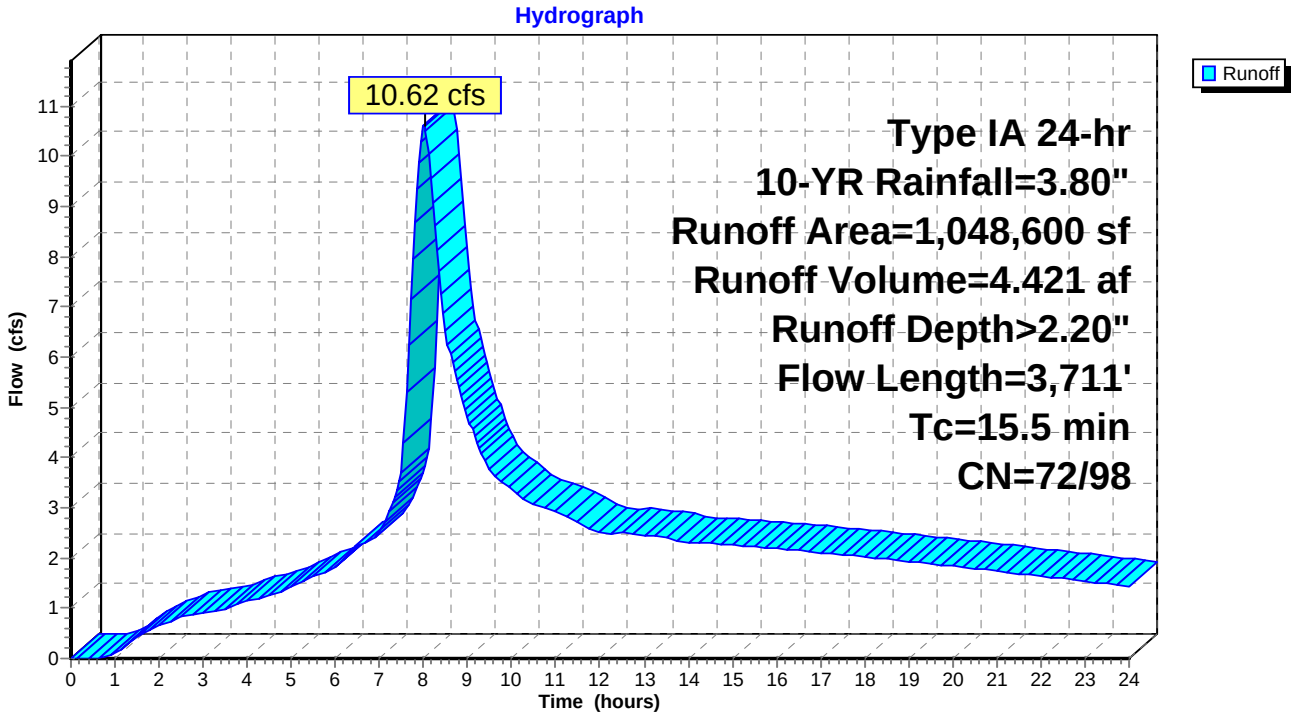
Runoff = 10.62 cfs @ 8.01 hrs, Volume= 4.421 af, Depth> 2.20"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	136,929	98	Impervious Area in ROW
*	38,621	74	>75% Grass cover, Good, HSG C (ROW)
*	282,480	98	Impervious Area on Lots (2640 sf x 107 lots)
*	412,510	74	>75% Grass cover, Good, HSG C (lots)
*	41,388	39	>75% Grass cover, Good, HSG A (lots)
*	64,446	80	>75% Grass cover, Good, HSG D (lots)
*	72,226	70	Woods, Good, HSG C (natural resource easement)
	1,048,600	82	Weighted Average
	629,191		60.00% Pervious Area
	419,409		40.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0200	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.9	56	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	200	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.5	1,378	0.0800	14.89	18.27	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
3.1	581	0.0400	3.09	56.94	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
3.1	1,446	0.0300	7.86	6.17	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
15.5	3,711	Total			

Subcatchment 110S:



Summary for Subcatchment 120S:

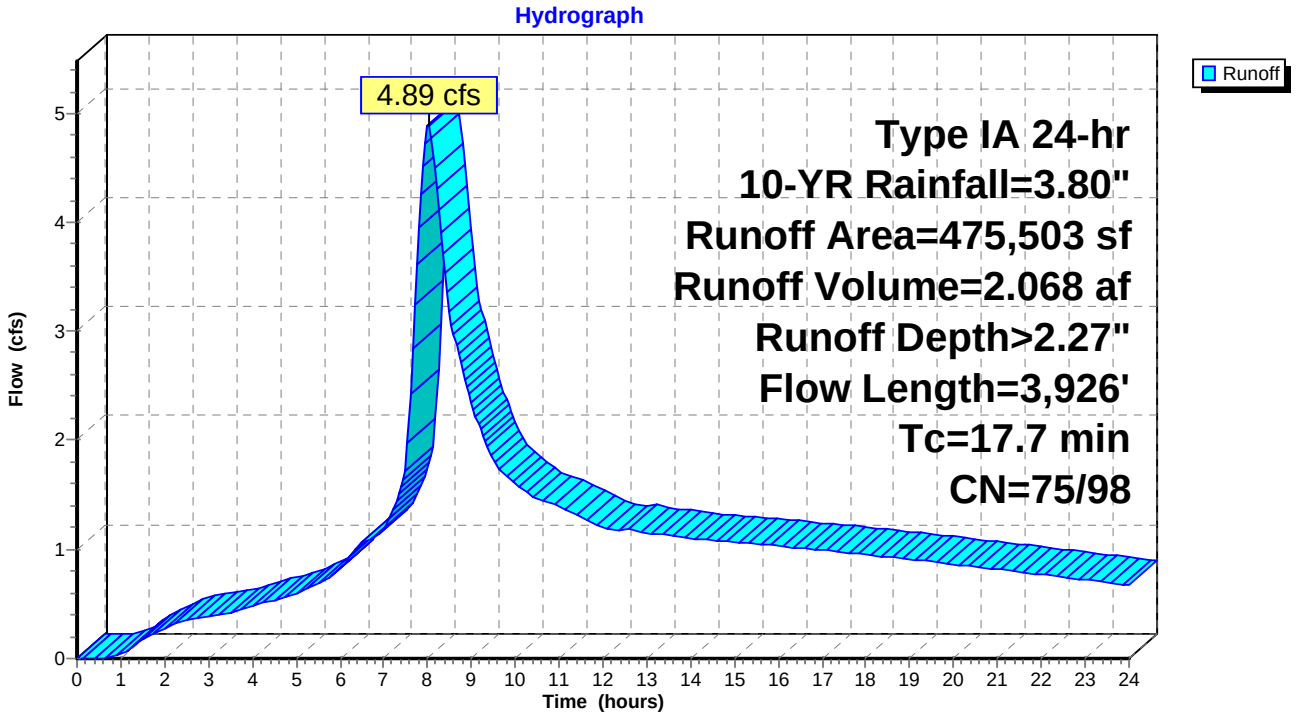
Runoff = 4.89 cfs @ 8.02 hrs, Volume= 2.068 af, Depth> 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	73,954	98	Impervious Area in ROW
*	24,092	74	>75% Grass cover, Good, HSG C (ROW)
*	105,600	98	Impervious Area on Lots (2640 sf x 40 lots)
*	229,430	74	>75% Grass cover, Good, HSG C (lots)
*	42,427	80	>75% Grass cover, Good, HSG D (lots)
	475,503	84	Weighted Average
	295,949		62.24% Pervious Area
	179,554		37.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0200	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.7	60	0.0400	1.40		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	111	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.8	1,175	0.0600	11.11	8.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
5.9	1,100	0.0400	3.09	56.94	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
2.6	1,430	0.0400	9.07	7.13	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
17.7	3,926	Total			

Subcatchment 120S:



Summary for Subcatchment 130S:

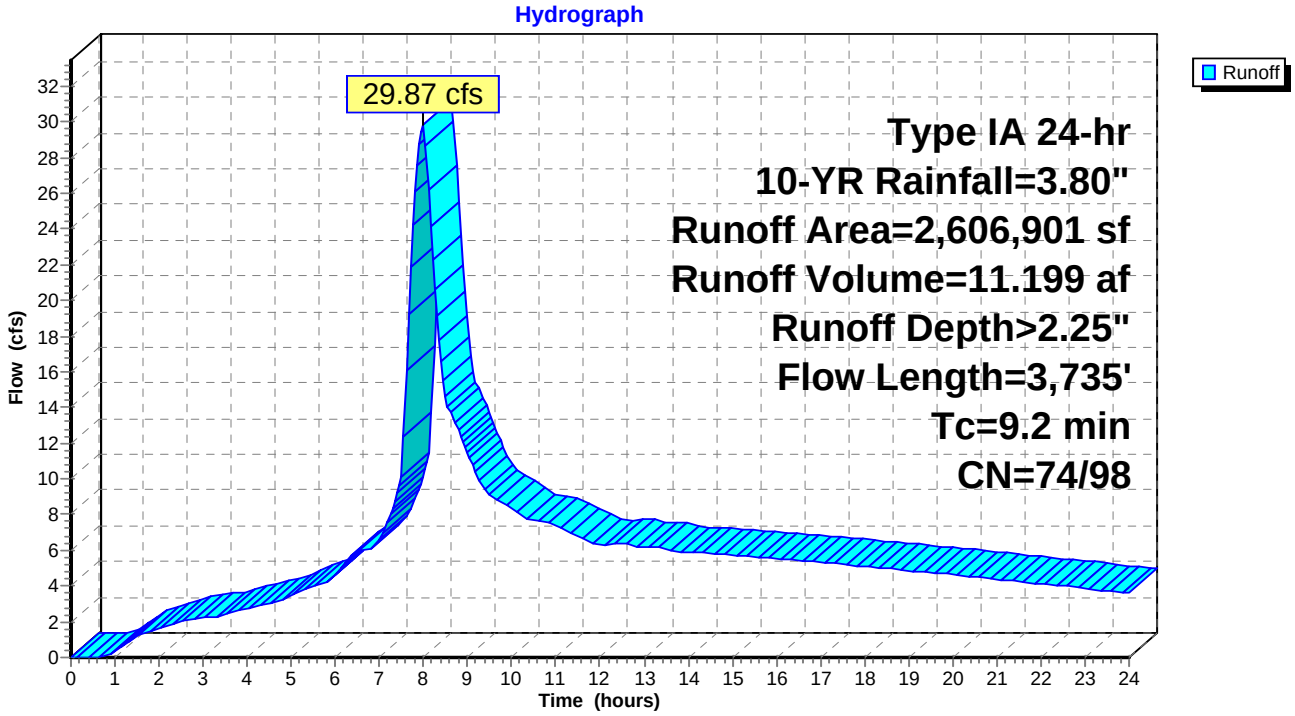
Runoff = 29.87 cfs @ 7.99 hrs, Volume= 11.199 af, Depth> 2.25"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
2,606,901	83	1/4 acre lots, 38% imp, HSG C
1,616,279		62.00% Pervious Area
990,622		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	50	0.1600	0.31		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.0	60	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	150	0.0500	4.54		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.9	3,475	0.0500	11.77	14.44	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
9.2	3,735	Total			

Subcatchment 130S:



Summary for Subcatchment 140S:

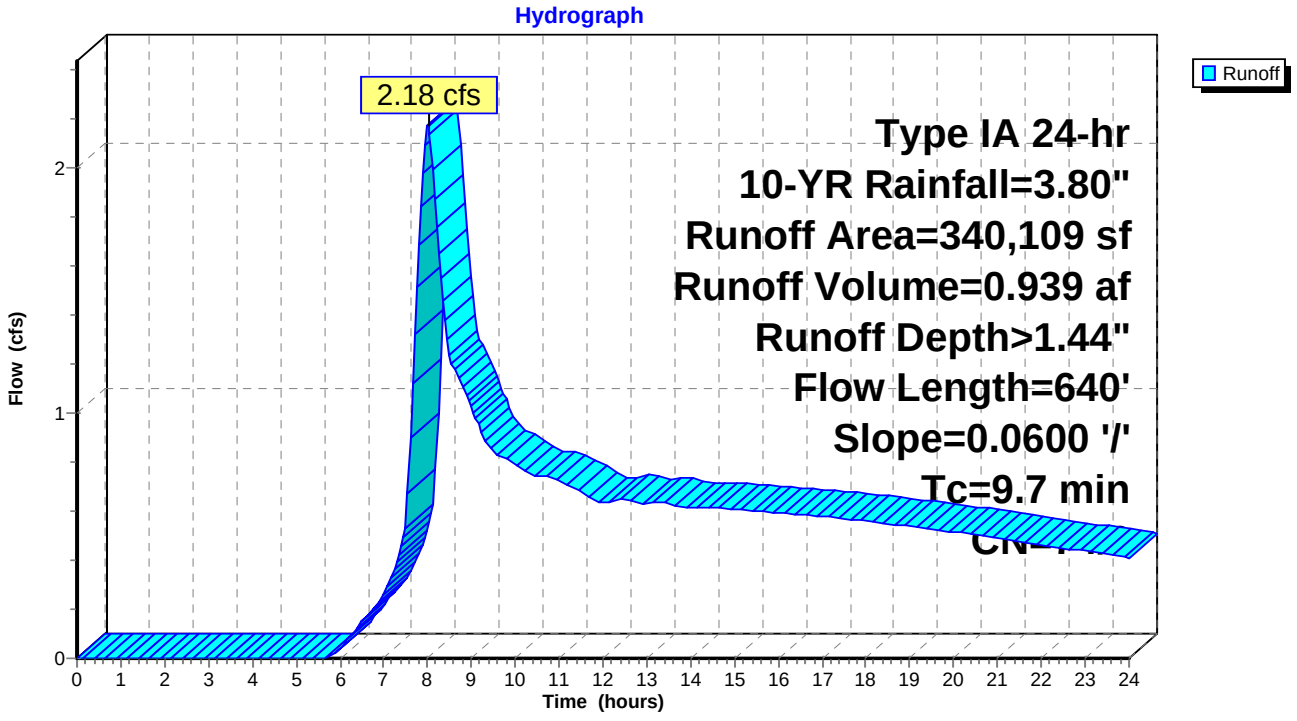
Runoff = 2.18 cfs @ 8.01 hrs, Volume= 0.939 af, Depth> 1.44"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
340,109	74	>75% Grass cover, Good, HSG C
340,109		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	50	0.0600	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
5.7	590	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.7	640	Total			

Subcatchment 140S:



Summary for Subcatchment 150S:

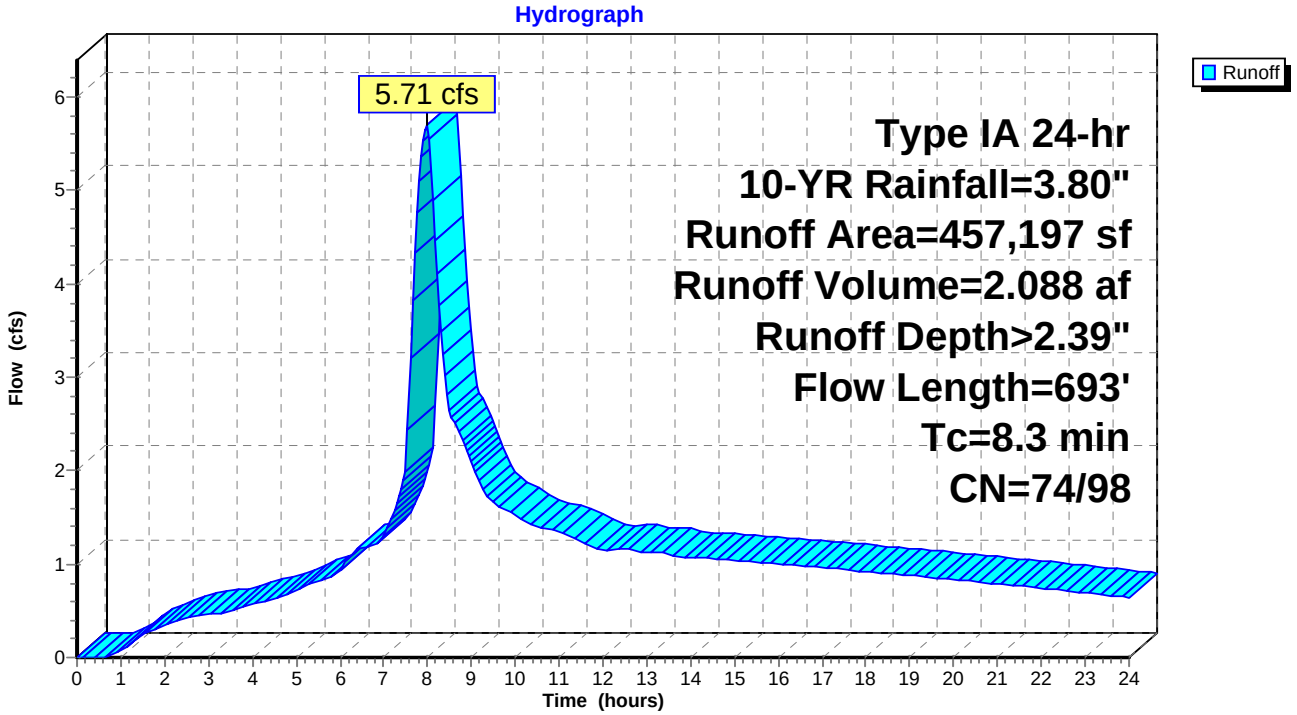
Runoff = 5.71 cfs @ 7.98 hrs, Volume= 2.088 af, Depth> 2.39"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

	Area (sf)	CN	Description
*	115,682	98	Impervious Area in ROW
*	25,393	74	>75% Grass cover, Good, HSG C (ROW)
*	88,514	98	28% Impervious Area on Lots
*	227,608	74	>75% Grass cover, Good, HSG C (lots)
	457,197	85	Weighted Average
	253,001		55.34% Pervious Area
	204,196		44.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0200	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
1.2	73	0.0200	0.99		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	570	0.0600	11.11	8.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
8.3	693	Total			

Subcatchment 150S:



Summary for Subcatchment 160X: OFFSITE

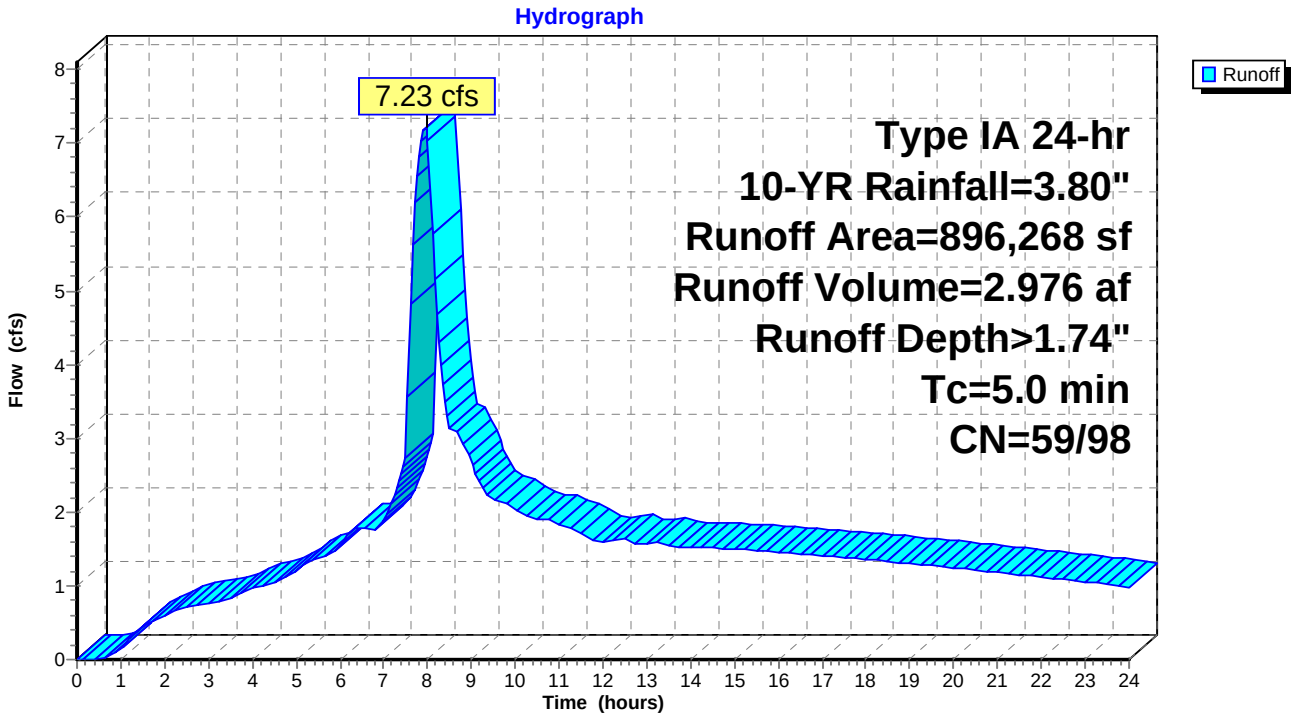
Runoff = 7.23 cfs @ 7.96 hrs, Volume= 2.976 af, Depth> 1.74"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
512,606	83	1/4 acre lots, 38% imp, HSG C
383,662	61	1/4 acre lots, 38% imp, HSG A
896,268	74	Weighted Average
555,686		62.00% Pervious Area
340,582		38.00% Impervious Area

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

Subcatchment 160X: OFFSITE



Summary for Subcatchment 170X: OFFSITE

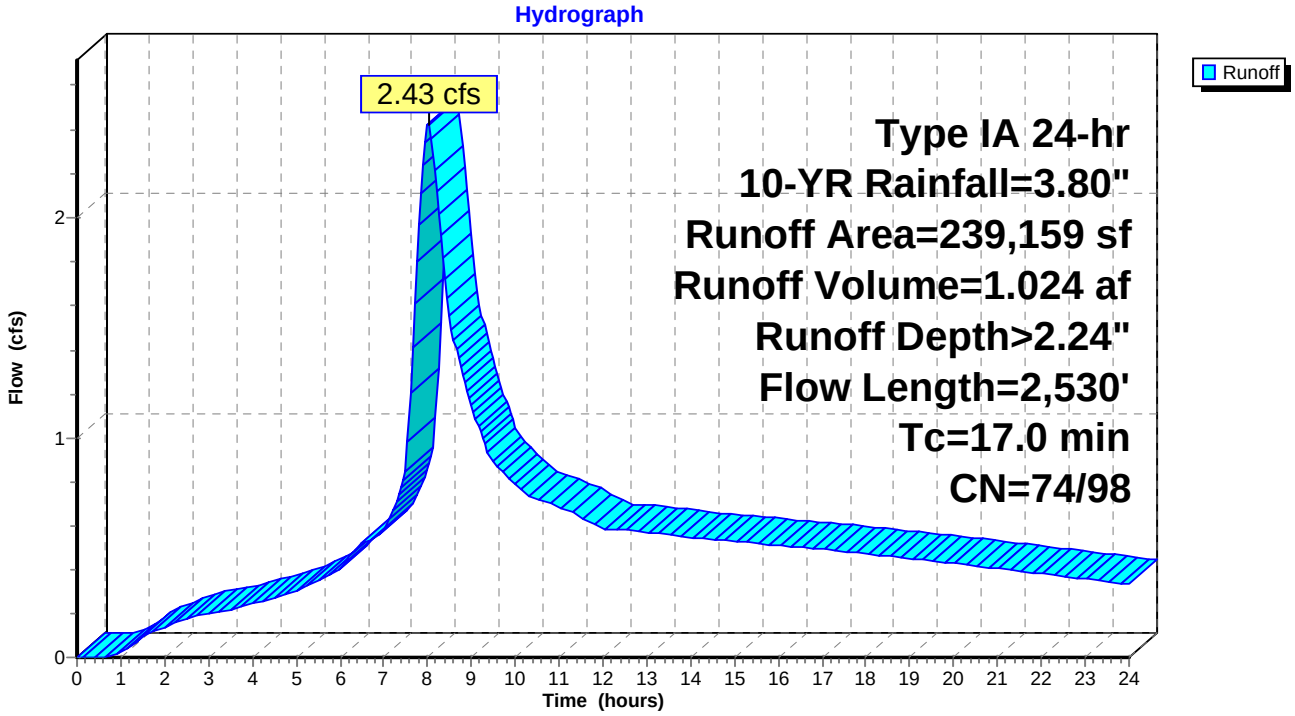
Runoff = 2.43 cfs @ 8.02 hrs, Volume= 1.024 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
239,159	83	1/4 acre lots, 38% imp, HSG C
148,279		62.00% Pervious Area
90,880		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0800	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
7.0	730	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.1	1,750	0.0900	13.61	10.69	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
17.0	2,530	Total			

Subcatchment 170X: OFFSITE



Summary for Subcatchment 180X: OFFSITE

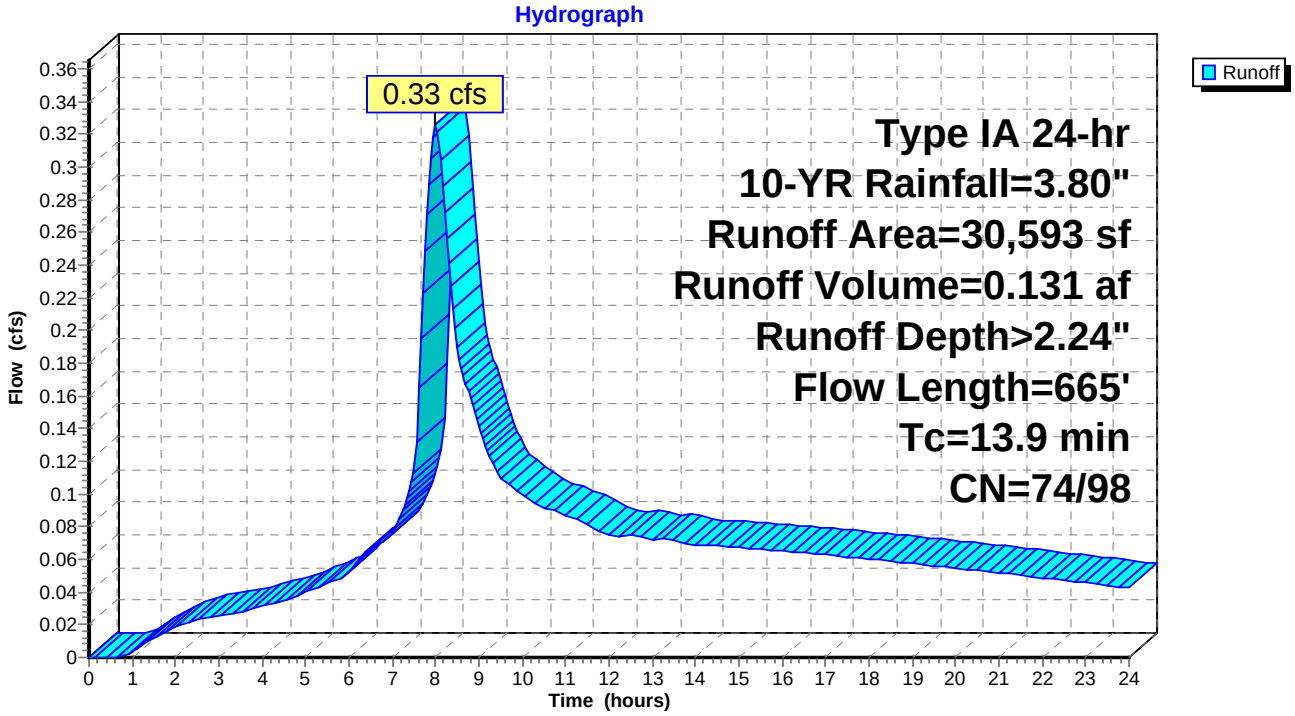
Runoff = 0.33 cfs @ 8.01 hrs, Volume= 0.131 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
30,593	83	1/4 acre lots, 38% imp, HSG C
18,968		62.00% Pervious Area
11,625		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0600	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
4.1	300	0.0600	1.22		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.6	100	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.4	215	0.0400	9.07	7.13	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
13.9	665	Total			

Subcatchment 180X: OFFSITE



Summary for Subcatchment 190X: OFFSITE

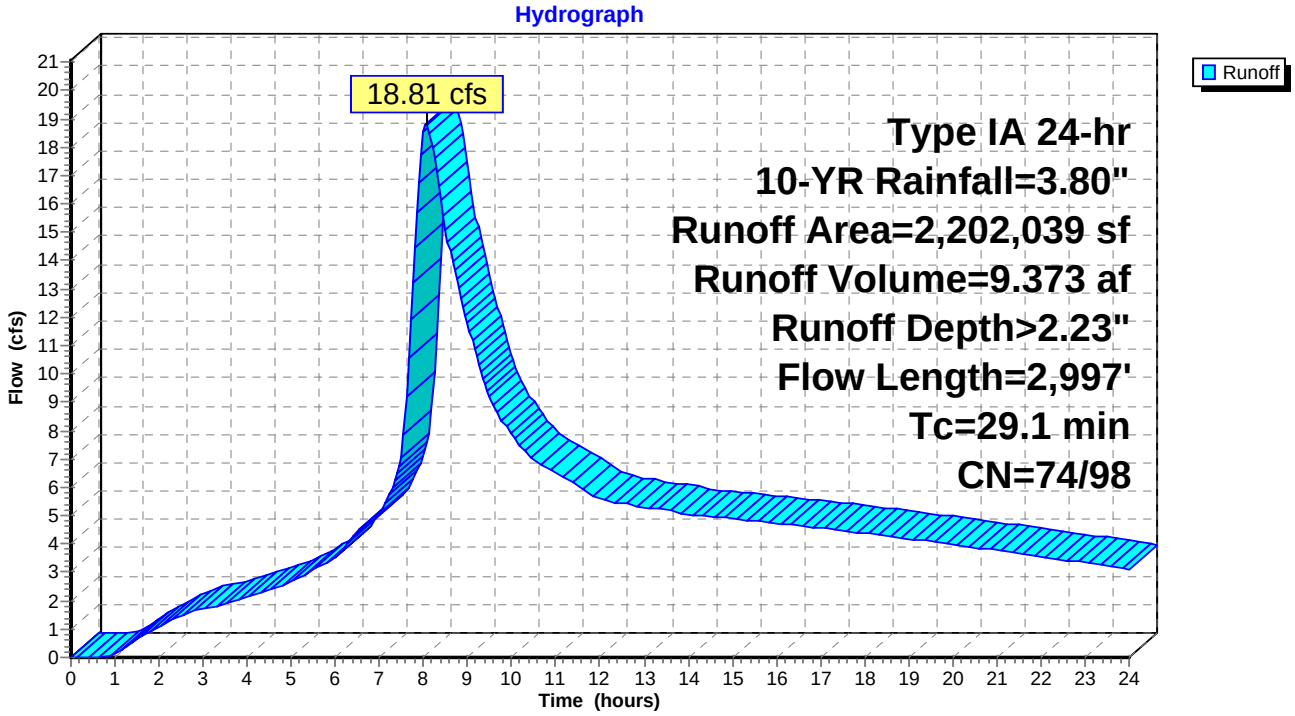
Runoff = 18.81 cfs @ 8.06 hrs, Volume= 9.373 af, Depth> 2.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
2,202,039	83	1/4 acre lots, 38% imp, HSG C
1,365,264		62.00% Pervious Area
836,775		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0800	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
18.3	2,192	0.1600	2.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.9	755	0.0800	4.32	78.64	**Channel Flow,** Area= 18.2 sf Perim= 24.4' r= 0.75' n= 0.080 Earth, long dense weeds
29.1	2,997	Total			

Subcatchment 190X: OFFSITE



Summary for Subcatchment 200X: OFFSITE

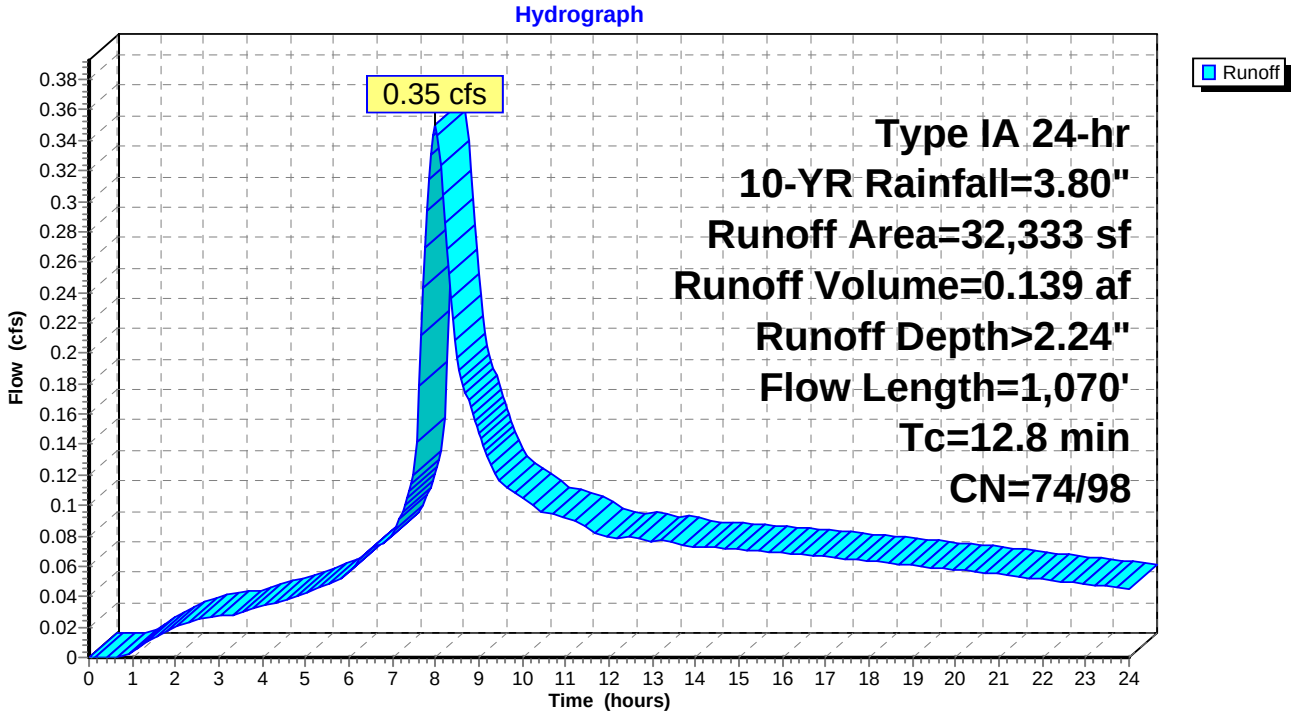
Runoff = 0.35 cfs @ 8.00 hrs, Volume= 0.139 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
32,333	83	1/4 acre lots, 38% imp, HSG C
20,046		62.00% Pervious Area
12,287		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0700	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
3.0	280	0.1000	1.58		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
0.8	170	0.2500	3.50		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	570	0.0800	12.83	10.08	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.8	1,070	Total			

Subcatchment 200X: OFFSITE



Summary for Subcatchment 210X: OFFSITE

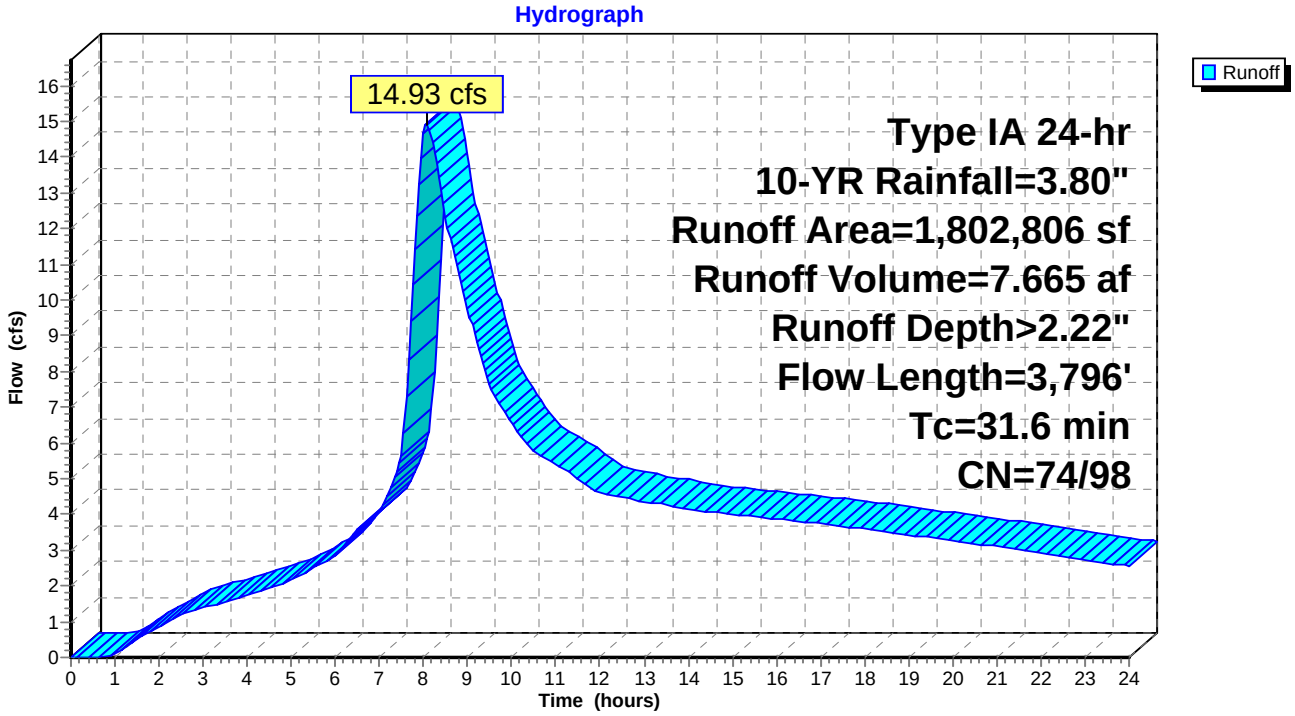
Runoff = 14.93 cfs @ 8.06 hrs, Volume= 7.665 af, Depth> 2.22"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
1,802,806	83	1/4 acre lots, 38% imp, HSG C
1,117,740		62.00% Pervious Area
685,066		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0600	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
15.8	1,706	0.1300	1.80		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.0	2,040	0.1000	4.83	87.93	**Channel Flow,** Area= 18.2 sf Perim= 24.4' r= 0.75' n= 0.080 Earth, long dense weeds
31.6	3,796	Total			

Subcatchment 210X: OFFSITE



Summary for Subcatchment 220X: OFFSITE

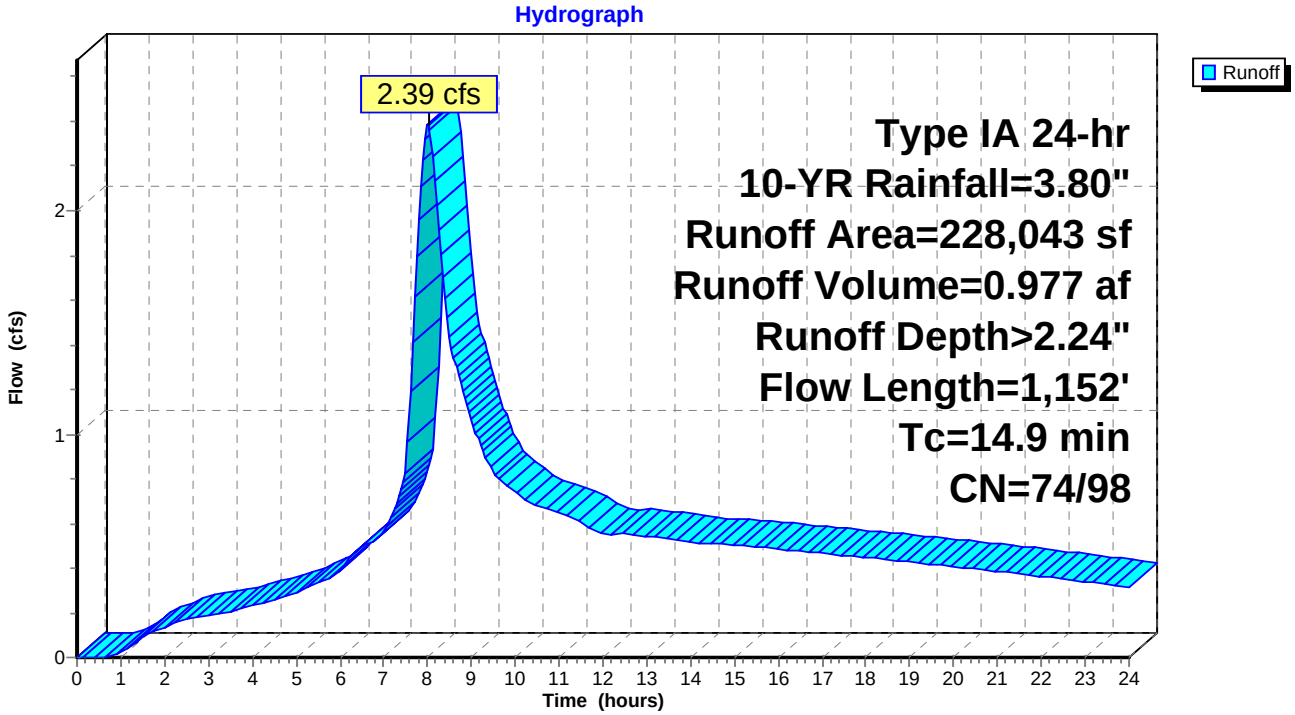
Runoff = 2.39 cfs @ 8.01 hrs, Volume= 0.977 af, Depth> 2.24"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
228,043	83	1/4 acre lots, 38% imp, HSG C
141,387		62.00% Pervious Area
86,656		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0700	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
4.6	540	0.1500	1.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.3	200	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.7	362	0.0400	9.07	7.13	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
14.9	1,152	Total			

Subcatchment 220X: OFFSITE



Summary for Subcatchment 230X: OFFSITE

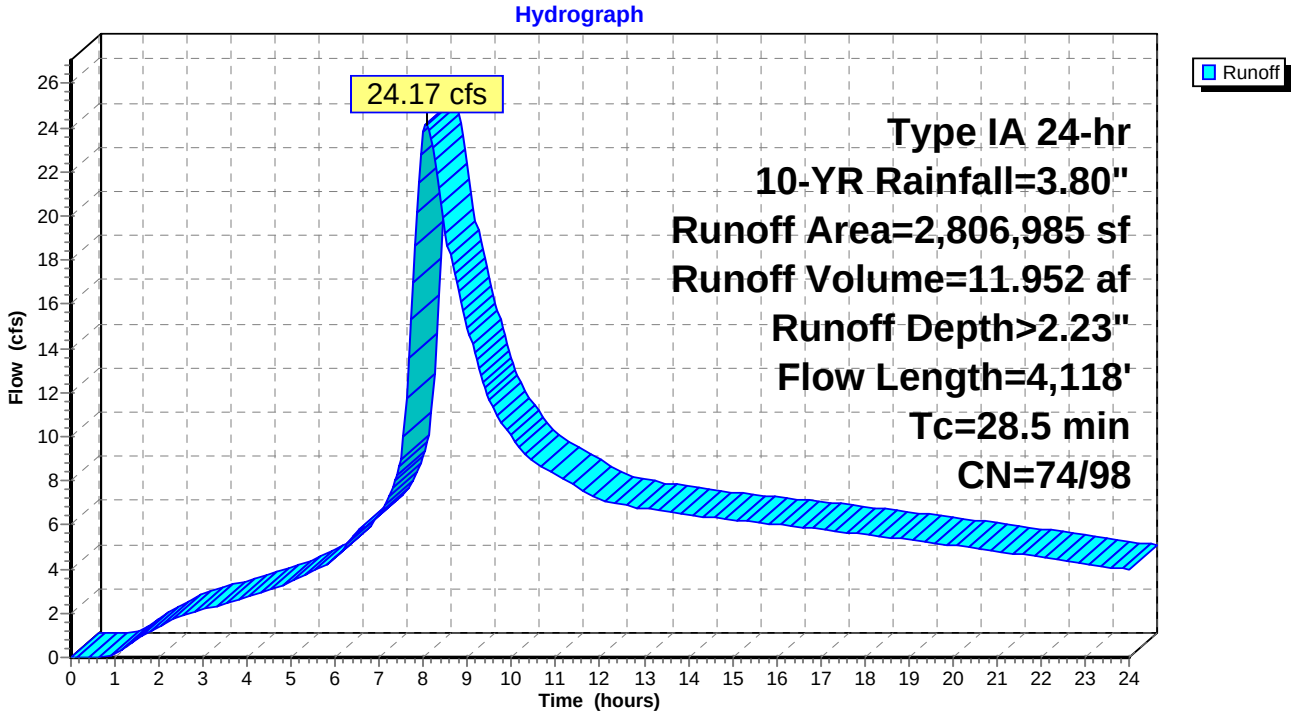
Runoff = 24.17 cfs @ 8.05 hrs, Volume= 11.952 af, Depth> 2.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
2,806,985	83	1/4 acre lots, 38% imp, HSG C
1,740,331		62.00% Pervious Area
1,066,654		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0800	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
13.5	1,718	0.1800	2.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
7.1	2,350	0.1300	5.51	100.25	**Channel Flow,** Area= 18.2 sf Perim= 24.4' r= 0.75' n= 0.080 Earth, long dense weeds
28.5	4,118	Total			

Subcatchment 230X: OFFSITE



Summary for Subcatchment 240X: OFFSITE

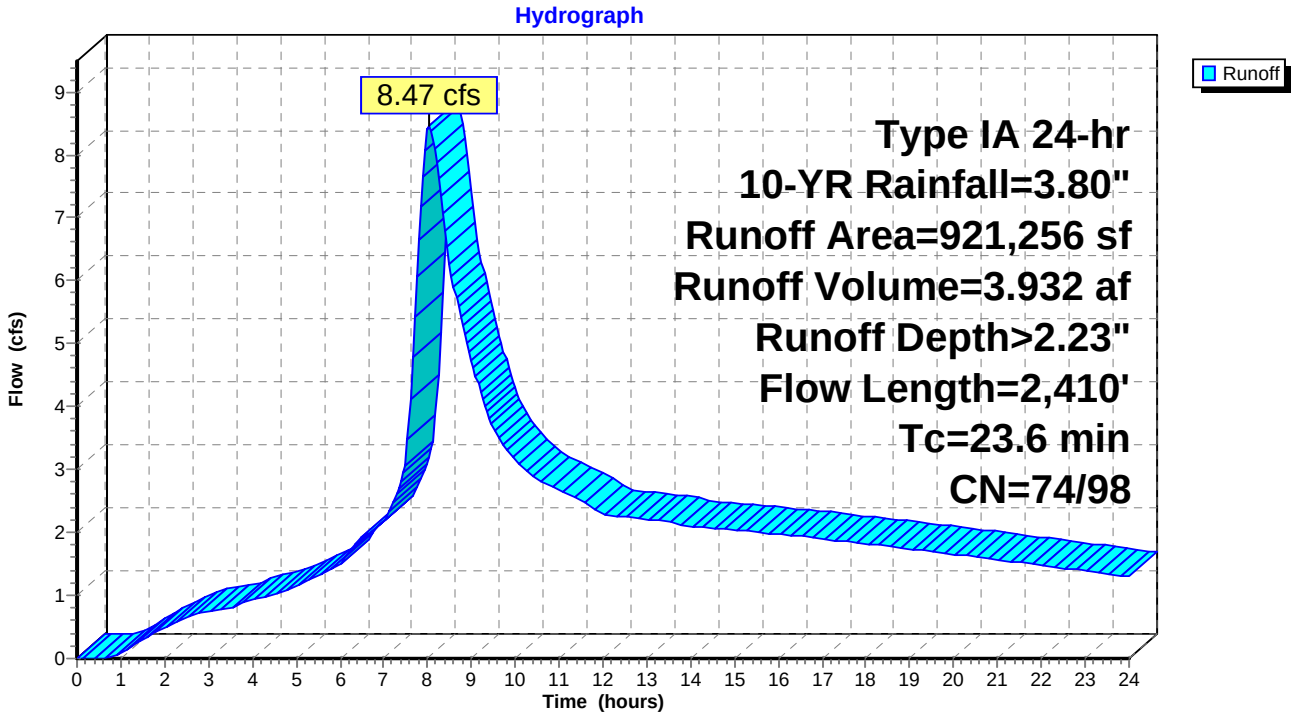
Runoff = 8.47 cfs @ 8.04 hrs, Volume= 3.932 af, Depth> 2.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
921,256	83	1/4 acre lots, 38% imp, HSG C
571,179		62.00% Pervious Area
350,077		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	50	0.1100	0.12		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
11.7	1,215	0.1200	1.73		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
2.4	375	0.1400	2.62		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	300	0.0500	10.14	7.97	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
2.1	470	0.0600	3.79	69.74	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
23.6	2,410	Total			

Subcatchment 240X: OFFSITE



Summary for Subcatchment 250X: OFFSITE

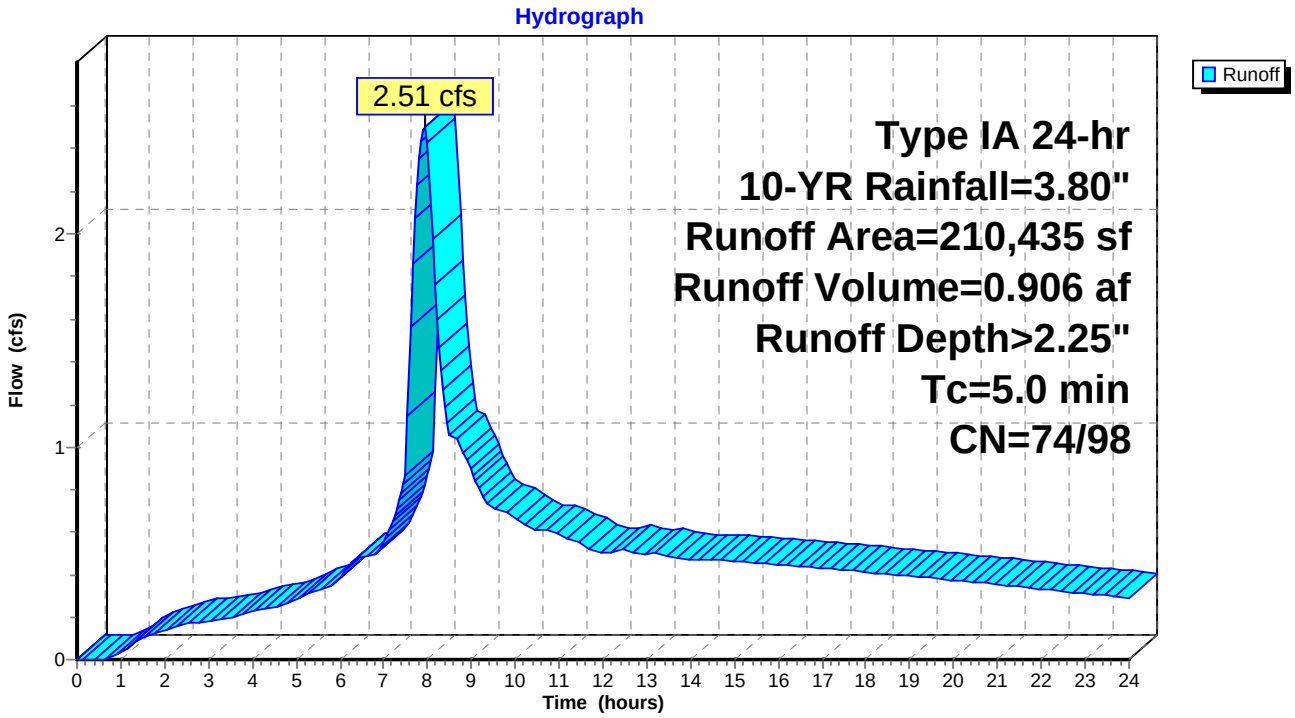
Runoff = 2.51 cfs @ 7.95 hrs, Volume= 0.906 af, Depth> 2.25"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
16,973	87	1/4 acre lots, 38% imp, HSG D
193,462	83	1/4 acre lots, 38% imp, HSG C
210,435	83	Weighted Average
130,470		62.00% Pervious Area
79,965		38.00% Impervious Area

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

Subcatchment 250X: OFFSITE



Summary for Subcatchment 260X: OFFSITE

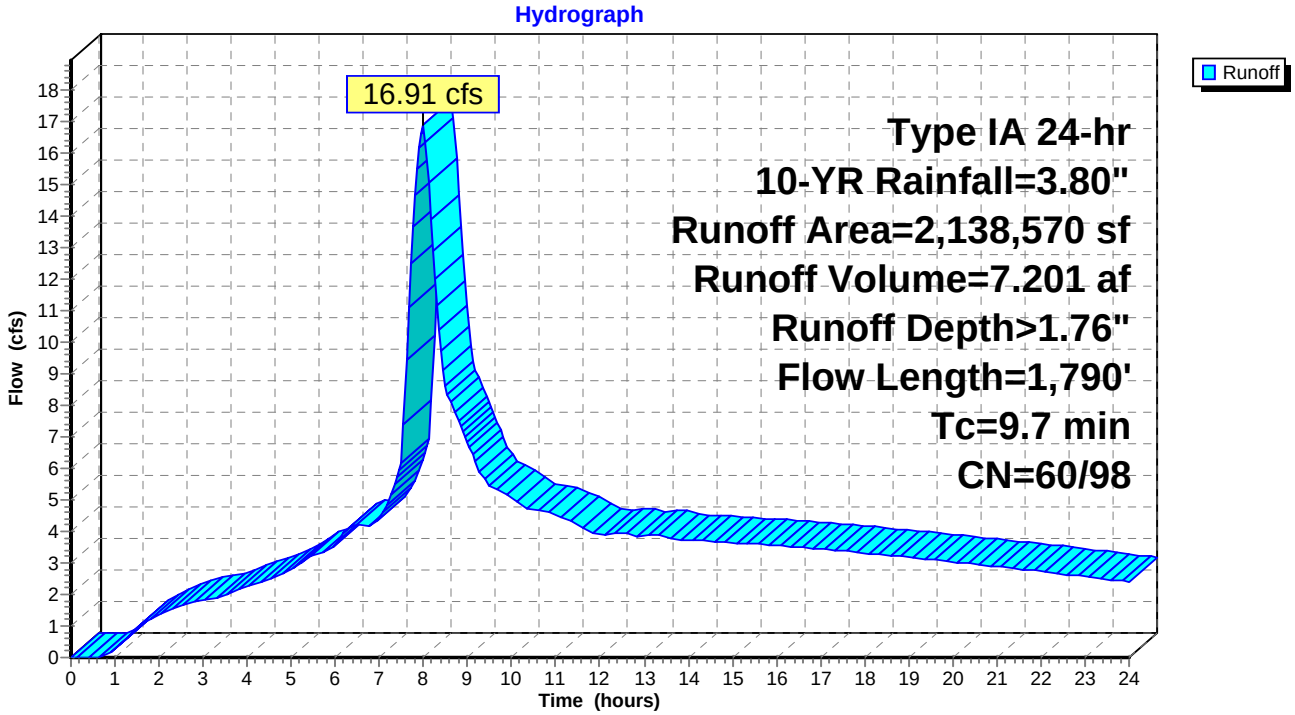
Runoff = 16.91 cfs @ 7.99 hrs, Volume= 7.201 af, Depth> 1.76"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
149,971	87	1/4 acre lots, 38% imp, HSG D
1,129,187	83	1/4 acre lots, 38% imp, HSG C
859,412	61	1/4 acre lots, 38% imp, HSG A
2,138,570	74	Weighted Average
1,325,913		62.00% Pervious Area
812,657		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.3	50	0.2500	0.37		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.60"
0.1	100	0.0800	12.83	10.08	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
7.3	1,640	0.0600	3.74	68.11	**Channel Flow,** Area= 18.2 sf Perim= 24.4' r= 0.75' n= 0.080 Earth, long dense weeds
9.7	1,790	Total			

Subcatchment 260X: OFFSITE



Summary for Subcatchment 270X: OFFSITE

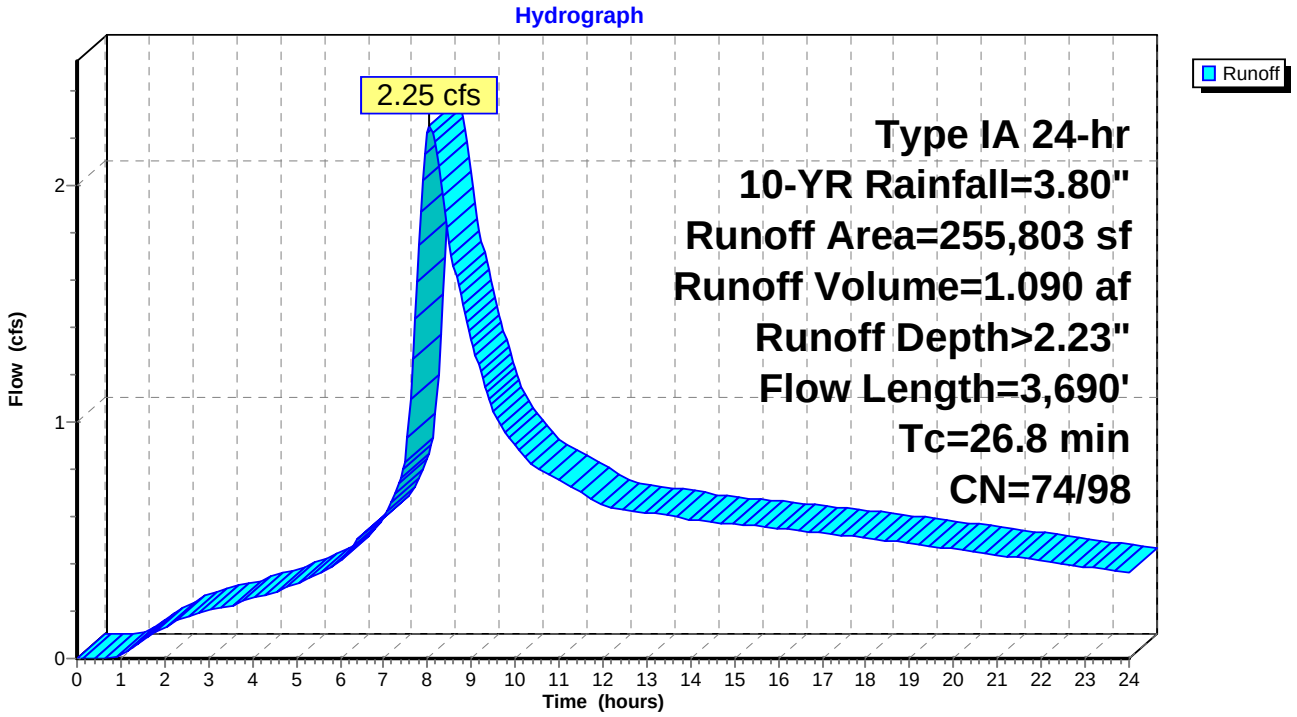
Runoff = 2.25 cfs @ 8.05 hrs, Volume= 1.090 af, Depth> 2.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
255,803	83	1/4 acre lots, 38% imp, HSG C
158,598		62.00% Pervious Area
97,205		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	50	0.0200	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
2.7	180	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.7	190	0.0700	1.85		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	730	0.0500	10.14	7.97	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
4.9	1,100	0.0400	3.74	68.86	**Channel Flow,** Area= 18.4 sf Perim= 18.2' r= 1.01' n= 0.080 Earth, long dense weeds
2.6	1,440	0.0400	9.07	7.13	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
26.8	3,690	Total			

Subcatchment 270X: OFFSITE



Summary for Subcatchment 280X: OFFSITE

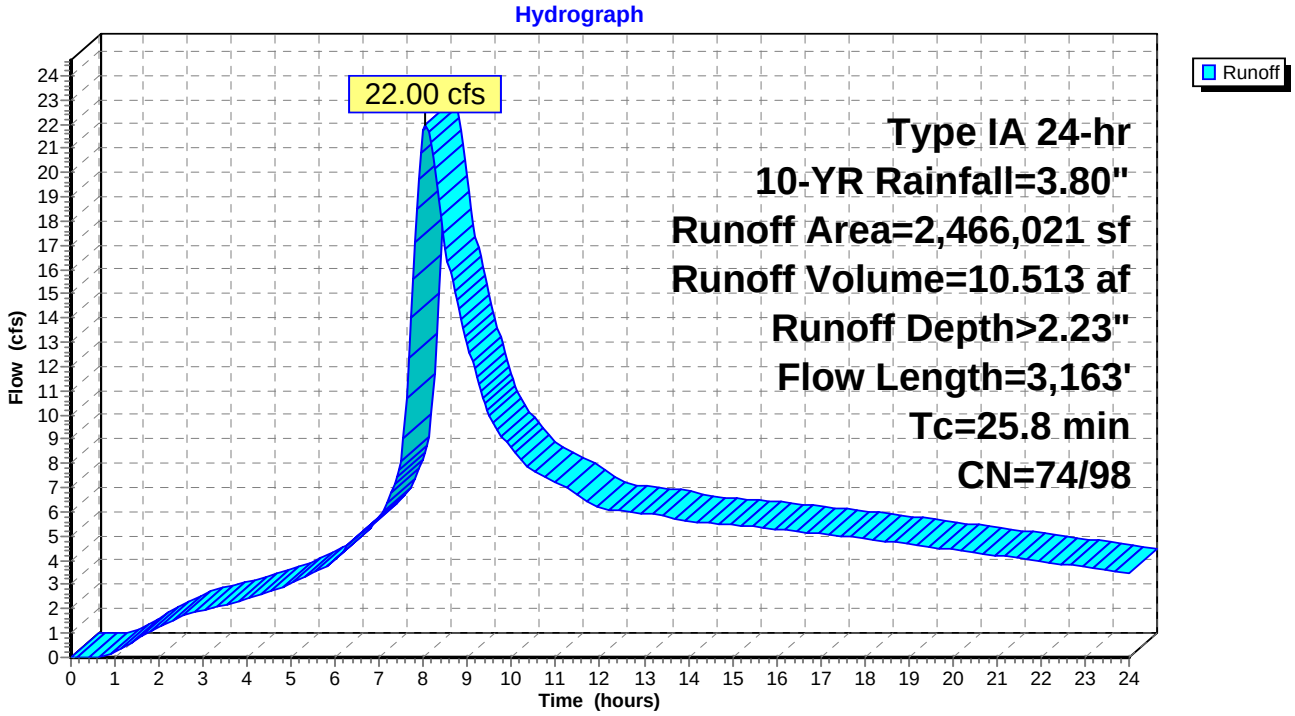
Runoff = 22.00 cfs @ 8.05 hrs, Volume= 10.513 af, Depth> 2.23"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-YR Rainfall=3.80"

Area (sf)	CN	Description
2,466,021	83	1/4 acre lots, 38% imp, HSG C
1,528,933		62.00% Pervious Area
937,088		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0500	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.60"
9.1	1,473	0.1500	2.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
7.2	1,640	0.0600	3.79	69.74	**Channel Flow,** Area= 18.4 sf Perim= 24.2' r= 0.76' n= 0.080 Earth, long dense weeds
25.8	3,163	Total			

Subcatchment 280X: OFFSITE



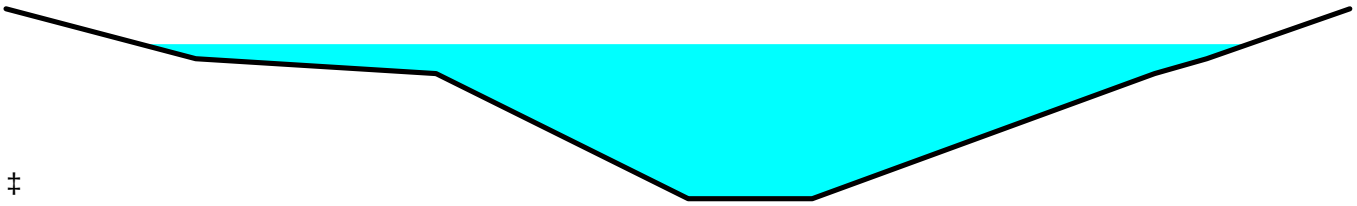
Summary for Reach 1R: Existing Channel

Inflow Area = 397.715 ac, 37.34% Impervious, Inflow Depth > 2.06" for 10-YR event
Inflow = 138.13 cfs @ 8.13 hrs, Volume= 68.330 af
Outflow = 138.05 cfs @ 8.15 hrs, Volume= 68.264 af, Atten= 0%, Lag= 1.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.52 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.60 fps, Avg. Travel Time= 2.0 min

Peak Storage= 12,169 cf @ 8.15 hrs
Average Depth at Peak Storage= 3.10'
Defined Flood Depth= 3.50' Flow Area= 50.6 sf, Capacity= 195.68 cfs
Bank-Full Depth= 3.81' Flow Area= 60.3 sf, Capacity= 248.44 cfs

Custom cross-section, Length= 310.0' Slope= 0.0226 '/' (101 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 189.00', Outlet Invert= 182.00'

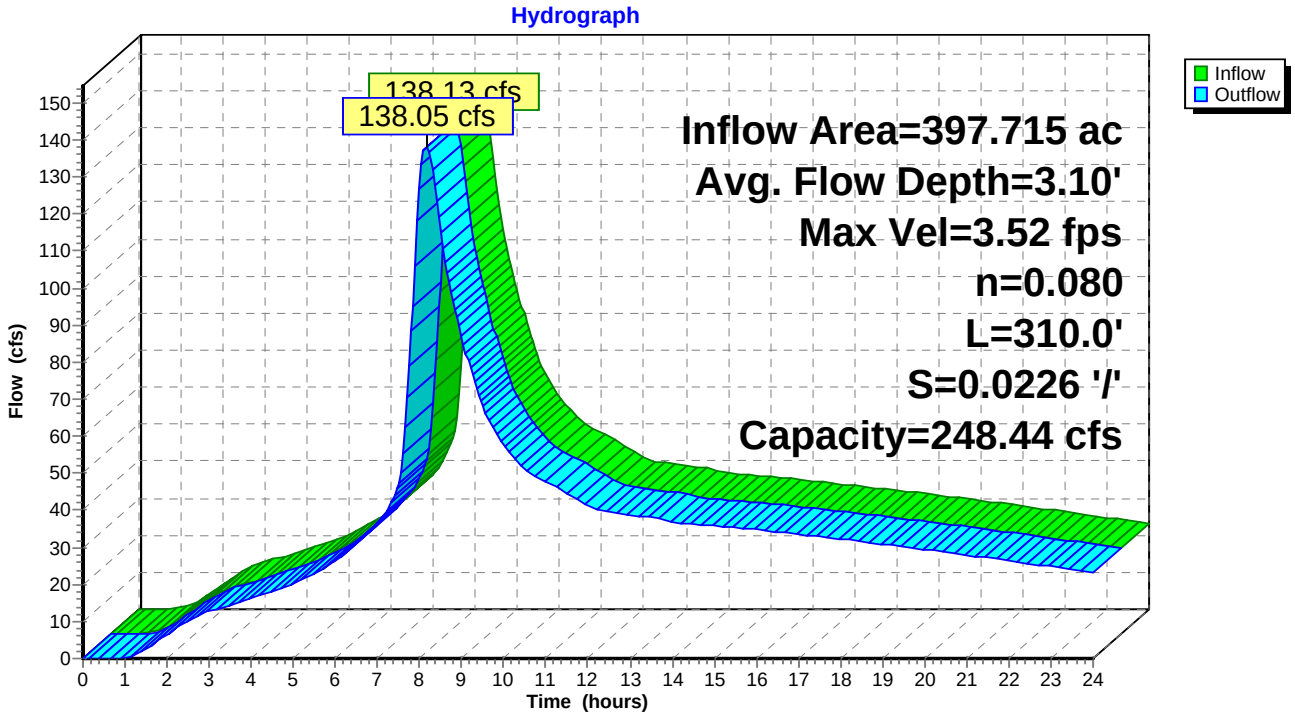


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-18.00	3.81	0.00
-13.41	2.81	1.00
-7.60	2.51	1.30
-1.50	0.00	3.81
1.50	0.00	3.81
9.78	2.51	1.30
11.04	2.81	1.00
14.50	3.81	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
2.51	25.6	18.2	7,929	89.18
2.81	31.9	25.4	9,874	103.49
3.81	60.3	33.7	18,701	248.44

Reach 1R: Existing Channel



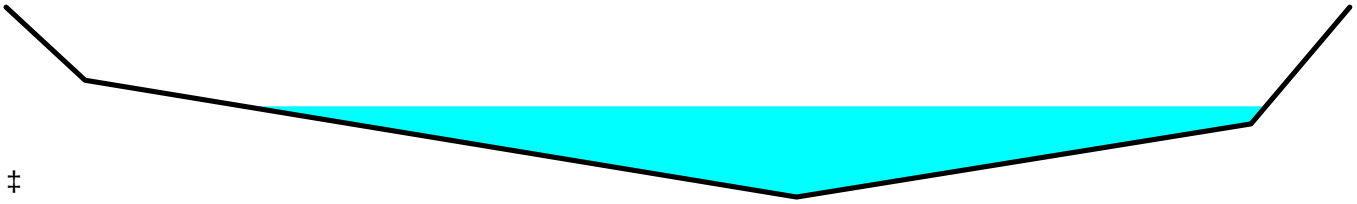
Summary for Reach 2R: Existing Channel

Inflow Area = 259.358 ac, 36.53% Impervious, Inflow Depth > 2.11" for 10-YR event
Inflow = 91.29 cfs @ 8.18 hrs, Volume= 45.535 af
Outflow = 91.21 cfs @ 8.20 hrs, Volume= 45.477 af, Atten= 0%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.64 fps, Min. Travel Time= 1.7 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 2.6 min

Peak Storage= 9,118 cf @ 8.20 hrs
Average Depth at Peak Storage= 1.24'
Bank-Full Depth= 2.60' Flow Area= 119.1 sf, Capacity= 596.25 cfs

Custom cross-section, Length= 264.0' Slope= 0.0347 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 200.00', Outlet Invert= 190.84'

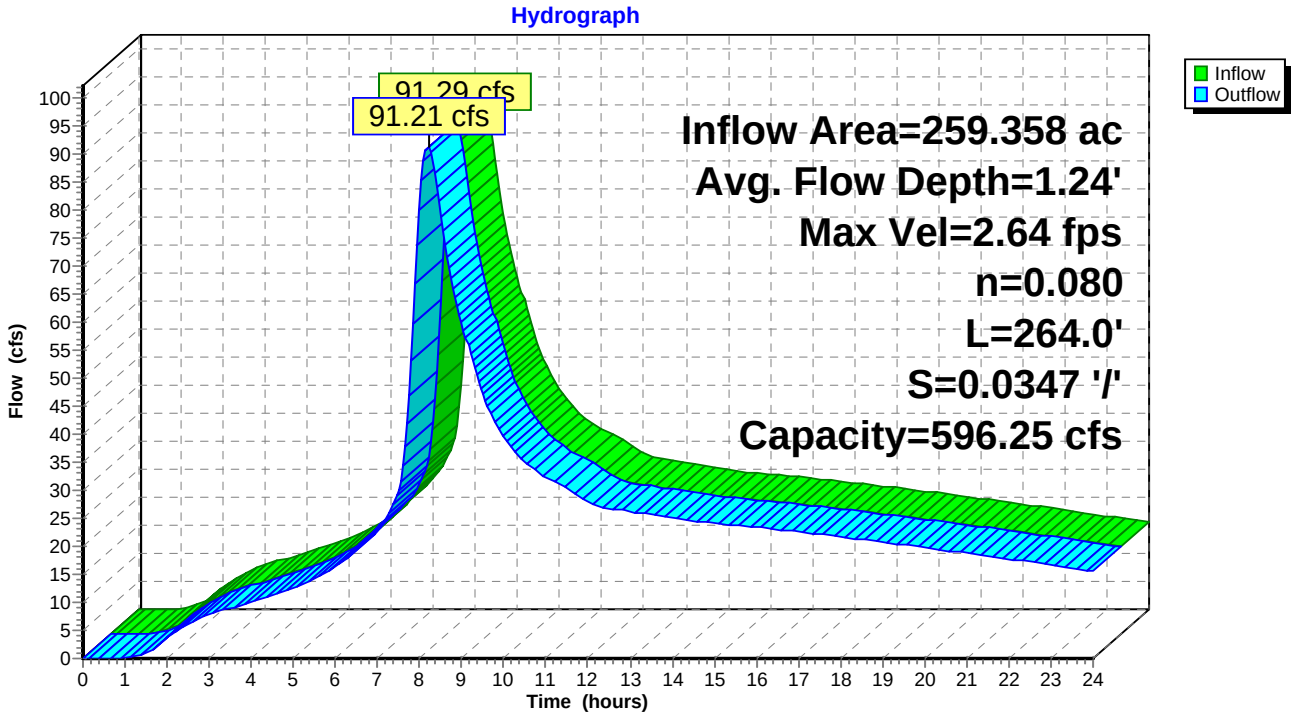


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-40.00	2.60	0.00
-36.00	1.60	1.00
0.00	0.00	2.60
23.00	1.00	1.60
28.00	2.60	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.00	22.8	45.5	6,006	49.56
1.60	54.7	61.0	14,431	175.74
2.60	119.1	68.4	31,442	596.25

Reach 2R: Existing Channel



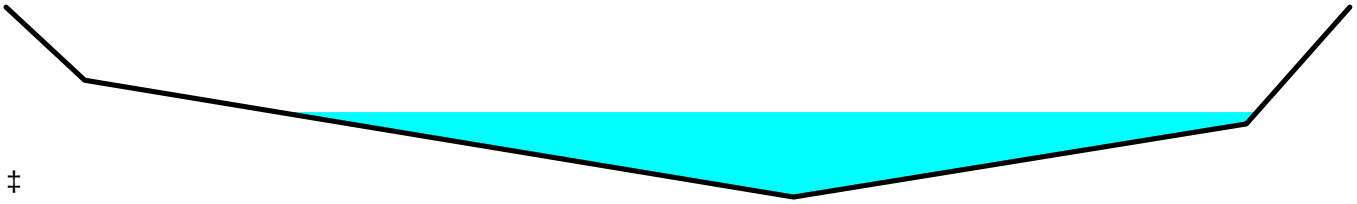
Summary for Reach 3R: Existing Channel

Inflow Area = 235.942 ac, 36.24% Impervious, Inflow Depth > 2.14" for 10-YR event
Inflow = 85.51 cfs @ 8.14 hrs, Volume= 42.050 af
Outflow = 84.68 cfs @ 8.20 hrs, Volume= 41.903 af, Atten= 1%, Lag= 3.6 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.77 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 7.1 min

Peak Storage= 23,438 cf @ 8.20 hrs
Average Depth at Peak Storage= 1.16'
Bank-Full Depth= 2.60' Flow Area= 119.3 sf, Capacity= 662.85 cfs

Custom cross-section, Length= 768.0' Slope= 0.0428 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 232.90', Outlet Invert= 200.00'

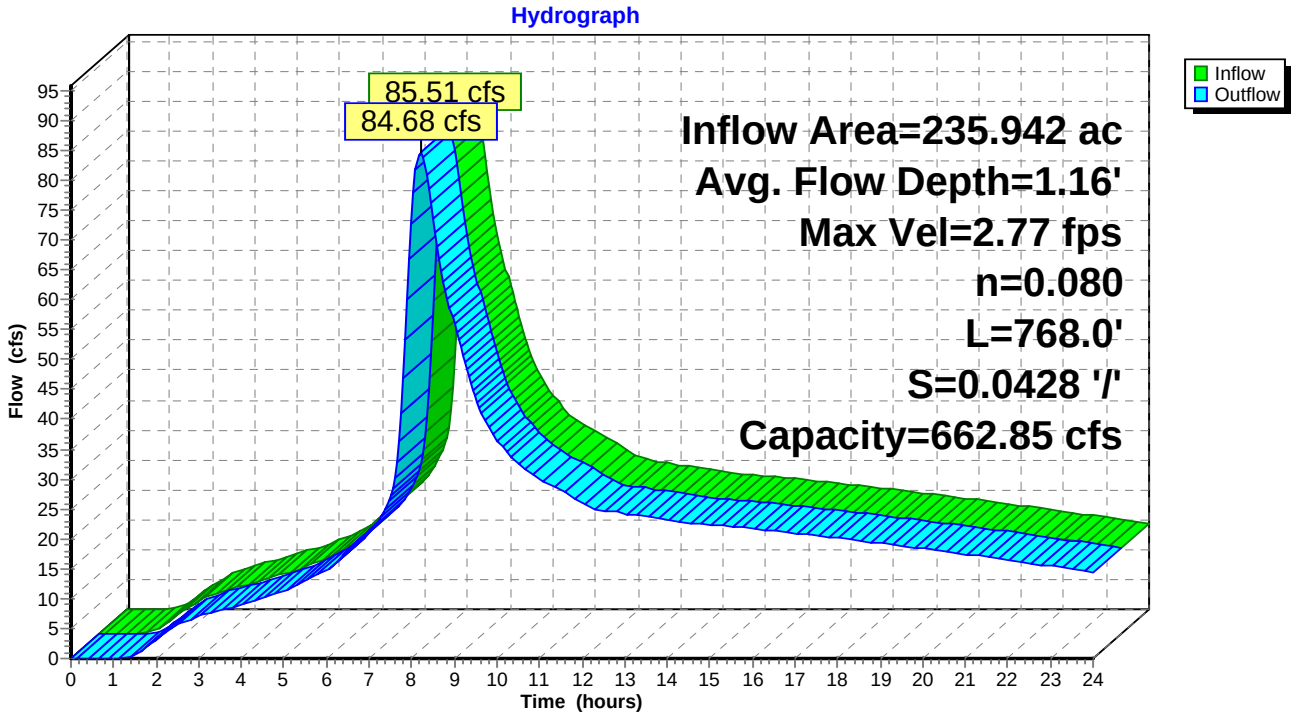


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-40.00	2.60	0.00
-36.00	1.60	1.00
0.00	0.00	2.60
23.00	1.00	1.60
28.26	2.60	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.00	22.8	45.5	17,472	55.06
1.60	54.7	61.1	42,003	195.25
2.60	119.3	68.7	91,629	662.85

Reach 3R: Existing Channel



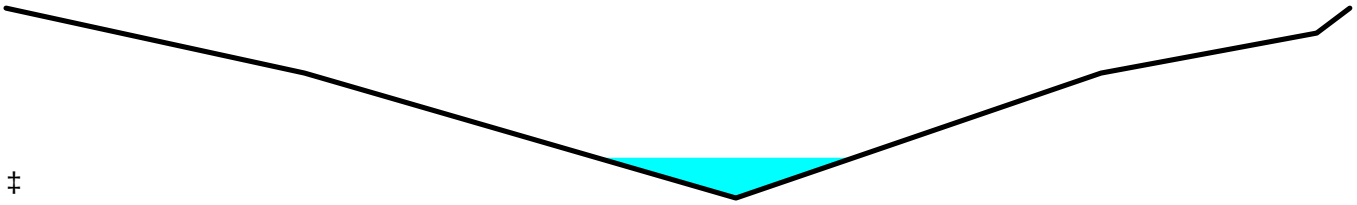
Summary for Reach 4R: Existing Channel

Inflow Area = 105.707 ac, 38.00% Impervious, Inflow Depth > 2.01" for 10-YR event
Inflow = 38.69 cfs @ 8.01 hrs, Volume= 17.715 af
Outflow = 37.02 cfs @ 8.10 hrs, Volume= 17.618 af, Atten= 4%, Lag= 5.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.97 fps, Min. Travel Time= 7.5 min
Avg. Velocity = 2.01 fps, Avg. Travel Time= 11.1 min

Peak Storage= 16,702 cf @ 8.10 hrs
Average Depth at Peak Storage= 1.61'
Bank-Full Depth= 7.60' Flow Area= 292.6 sf, Capacity= 2,366.15 cfs

Custom cross-section, Length= 1,340.0' Slope= 0.0351 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 236.00', Outlet Invert= 189.00'

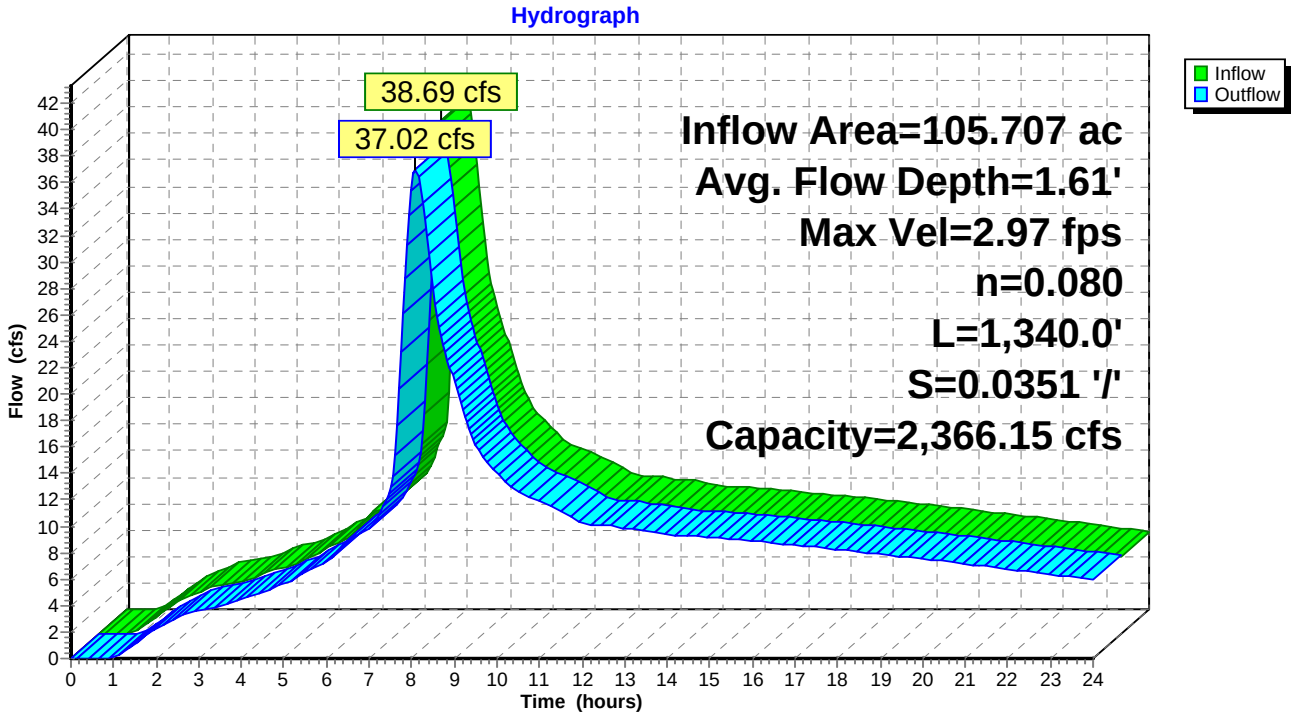


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-44.00	7.60	0.00
-26.00	5.00	2.60
0.00	0.00	7.60
22.00	5.00	2.60
35.00	6.60	1.00
37.00	7.60	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
5.00	120.0	49.0	160,800	758.07
6.60	216.1	73.3	289,522	1,544.82
7.60	292.6	82.6	392,084	2,366.15

Reach 4R: Existing Channel



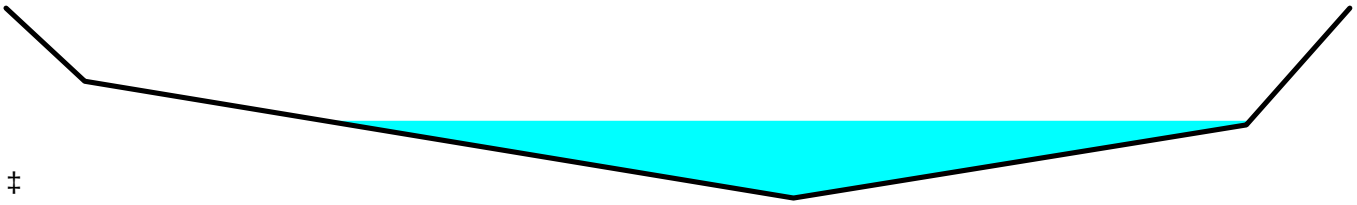
Summary for Reach 5R: Existing Channel

Inflow Area = 221.773 ac, 36.94% Impervious, Inflow Depth > 2.15" for 10-YR event
Inflow = 80.99 cfs @ 8.15 hrs, Volume= 39.807 af
Outflow = 80.97 cfs @ 8.16 hrs, Volume= 39.774 af, Atten= 0%, Lag= 0.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 2.12 fps, Avg. Travel Time= 1.7 min

Peak Storage= 5,397 cf @ 8.16 hrs
Average Depth at Peak Storage= 1.06'
Bank-Full Depth= 2.60' Flow Area= 119.3 sf, Capacity= 825.92 cfs

Custom cross-section, Length= 212.0' Slope= 0.0665 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 247.00', Outlet Invert= 232.90'

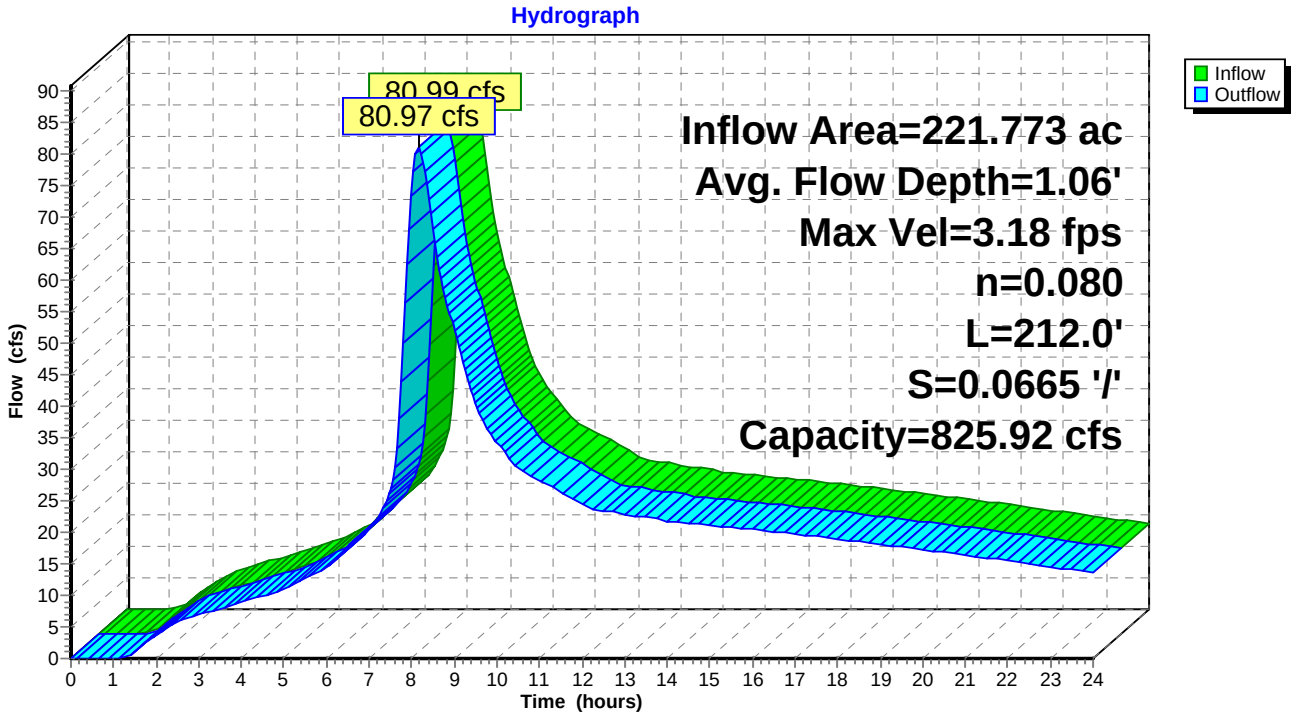


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-40.00	2.60	0.00
-36.00	1.60	1.00
0.00	0.00	2.60
23.00	1.00	1.60
28.26	2.60	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.00	22.8	45.5	4,823	68.61
1.60	54.7	61.1	11,595	243.29
2.60	119.3	68.7	25,293	825.92

Reach 5R: Existing Channel



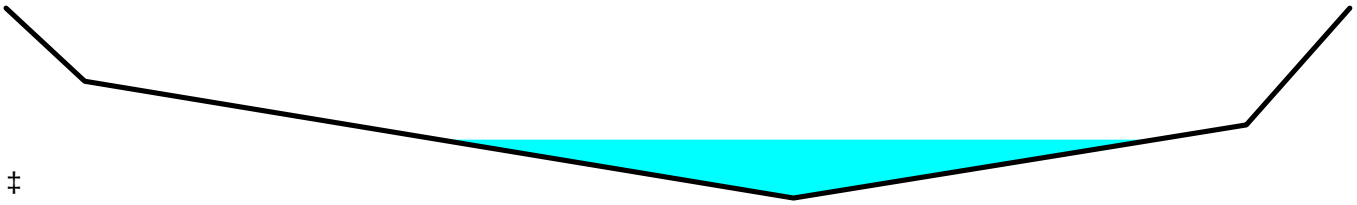
Summary for Reach 6R: Existing Channel

Inflow Area = 110.419 ac, 37.11% Impervious, Inflow Depth > 2.16" for 10-YR event
Inflow = 40.01 cfs @ 8.09 hrs, Volume= 19.855 af
Outflow = 39.72 cfs @ 8.14 hrs, Volume= 19.808 af, Atten= 1%, Lag= 2.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.74 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.86 fps, Avg. Travel Time= 4.8 min

Peak Storage= 7,792 cf @ 8.14 hrs
Average Depth at Peak Storage= 0.80'
Bank-Full Depth= 2.60' Flow Area= 119.3 sf, Capacity= 870.78 cfs

Custom cross-section, Length= 537.0' Slope= 0.0739 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 286.70', Outlet Invert= 247.00'

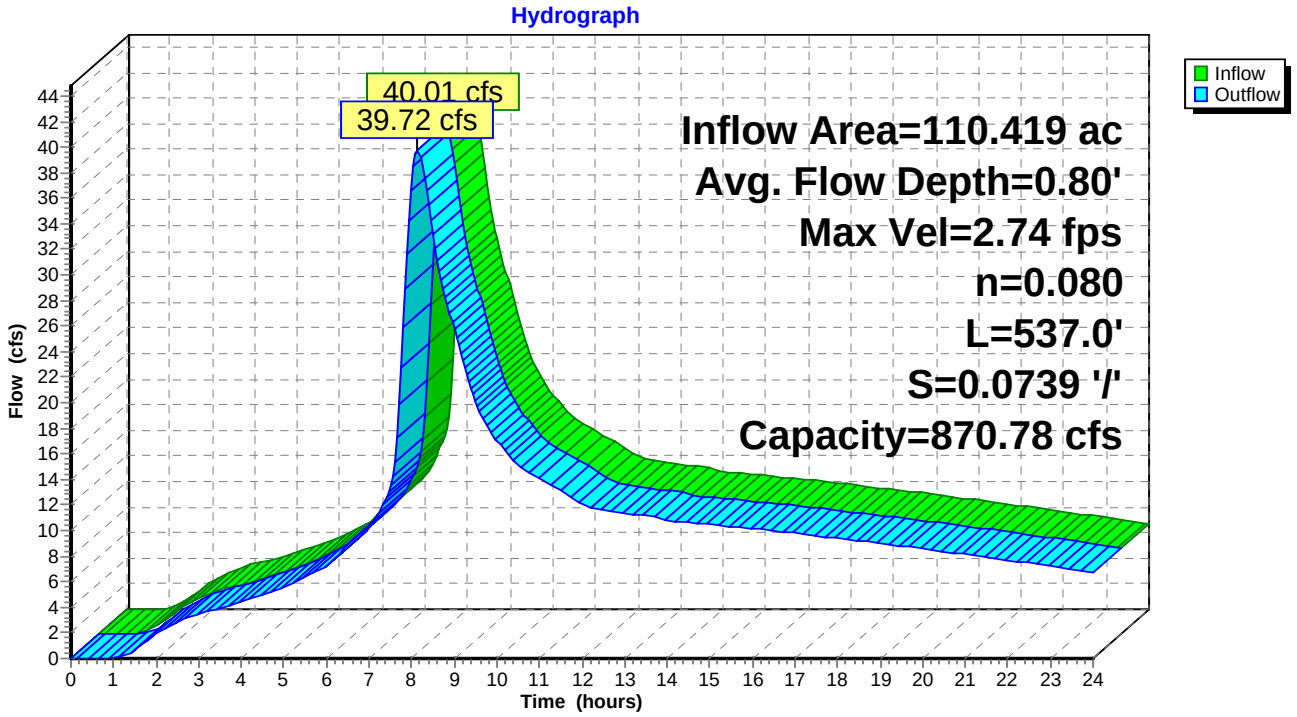


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-40.00	2.60	0.00
-36.00	1.60	1.00
0.00	0.00	2.60
23.00	1.00	1.60
28.26	2.60	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.00	22.8	45.5	12,217	72.34
1.60	54.7	61.1	29,369	256.50
2.60	119.3	68.7	64,068	870.78

Reach 6R: Existing Channel



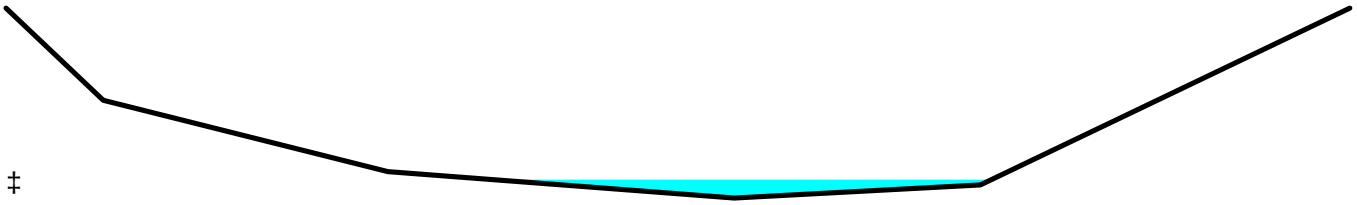
Summary for Reach 7R: Existing Channel

Inflow Area = 51.254 ac, 38.00% Impervious, Inflow Depth > 2.23" for 10-YR event
Inflow = 19.13 cfs @ 8.05 hrs, Volume= 9.505 af
Outflow = 18.85 cfs @ 8.12 hrs, Volume= 9.468 af, Atten= 1%, Lag= 4.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.83 fps, Min. Travel Time= 5.0 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 7.8 min

Peak Storage= 5,630 cf @ 8.12 hrs
Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 5.48' Flow Area= 231.4 sf, Capacity= 3,539.93 cfs

Custom cross-section, Length= 846.0' Slope= 0.1162 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 385.00', Outlet Invert= 286.70'

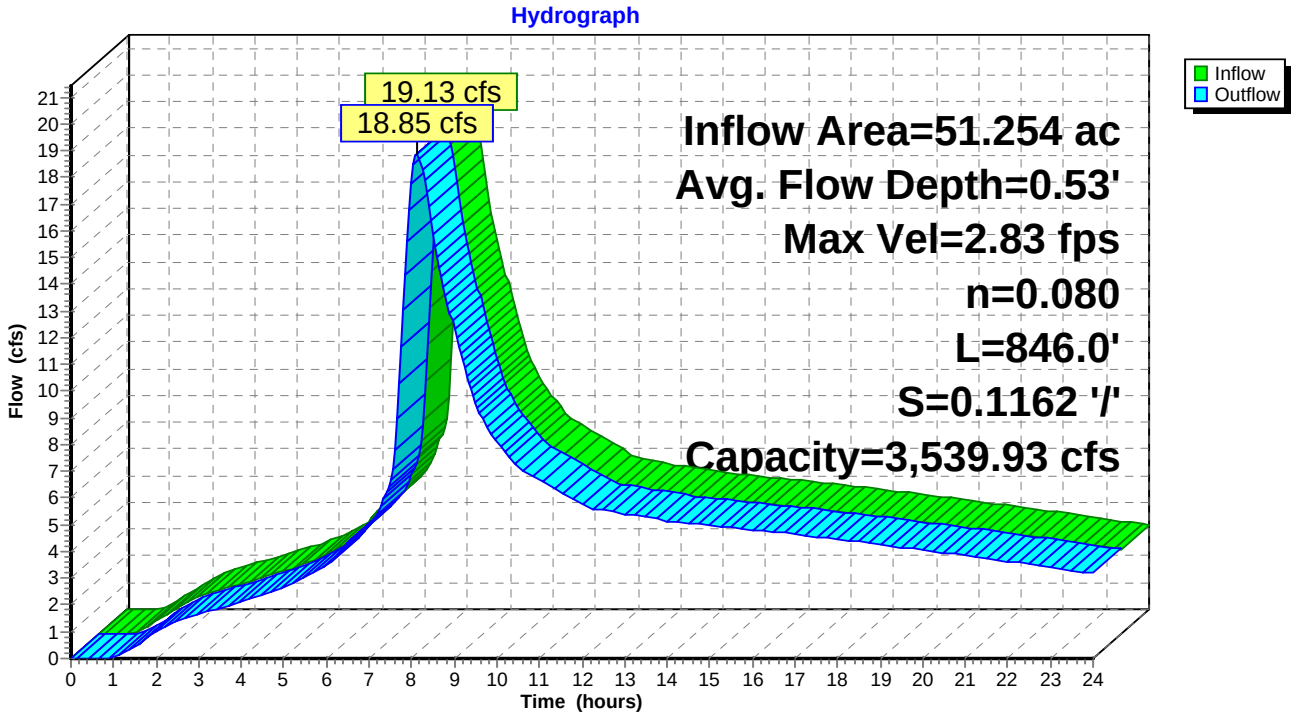


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-32.47	5.48	0.00
-28.13	2.82	2.66
-15.44	0.76	4.72
0.00	0.00	5.48
10.98	0.38	5.10
27.45	5.48	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
0.38	3.6	18.7	3,010	7.47
0.76	12.4	27.7	10,456	45.66
2.82	89.2	47.6	75,493	859.63
5.48	231.4	61.6	195,786	3,539.93

Reach 7R: Existing Channel



Summary for Reach 8R: Existing Channel

Inflow Area = 59.165 ac, 36.33% Impervious, Inflow Depth > 2.12" for 10-YR event
Inflow = 21.64 cfs @ 8.02 hrs, Volume= 10.430 af
Outflow = 21.27 cfs @ 8.07 hrs, Volume= 10.387 af, Atten= 2%, Lag= 3.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.19 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 1.89 fps, Avg. Travel Time= 8.0 min

Peak Storage= 6,020 cf @ 8.07 hrs
Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 2.50' Flow Area= 77.4 sf, Capacity= 670.49 cfs

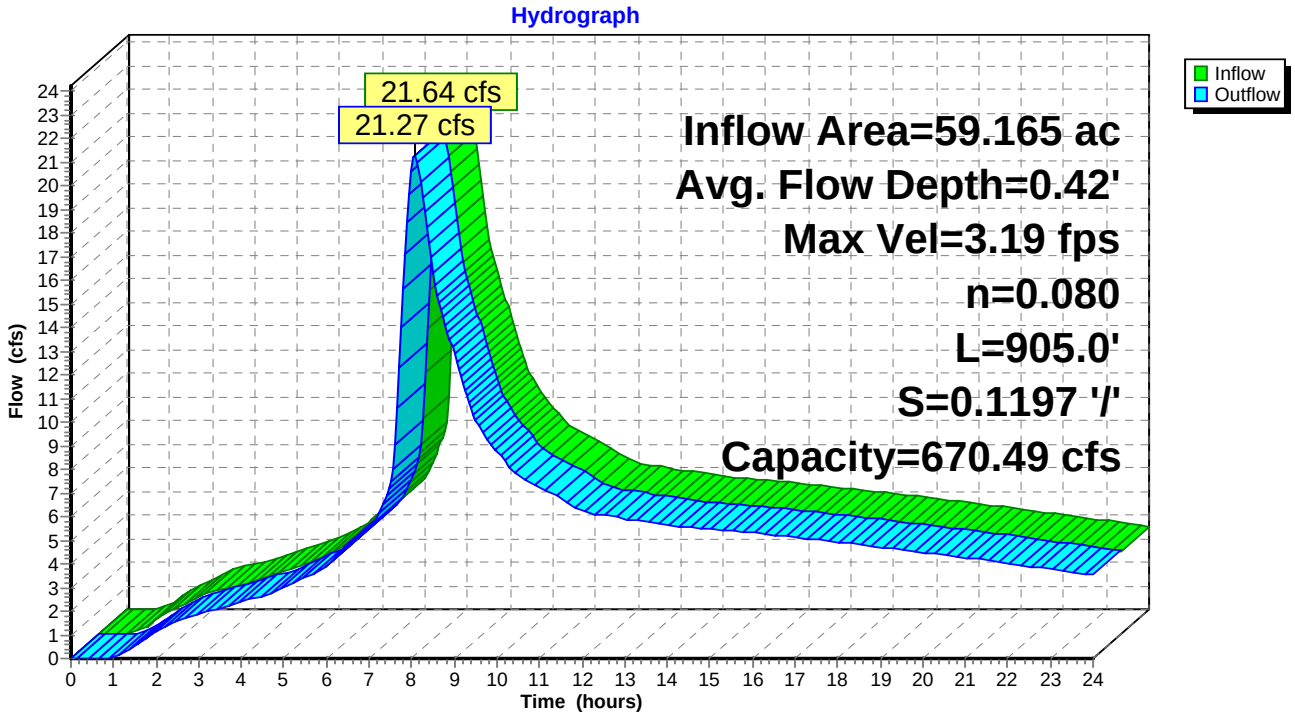
Custom cross-section, Length= 905.0' Slope= 0.1197 '/'
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 395.00', Outlet Invert= 286.70'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-22.22	2.50	0.00
-6.14	0.00	2.50
6.65	0.00	2.50
26.94	2.50	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	12.8	0	0.00
2.50	77.4	49.5	70,081	670.49

Reach 8R: Existing Channel



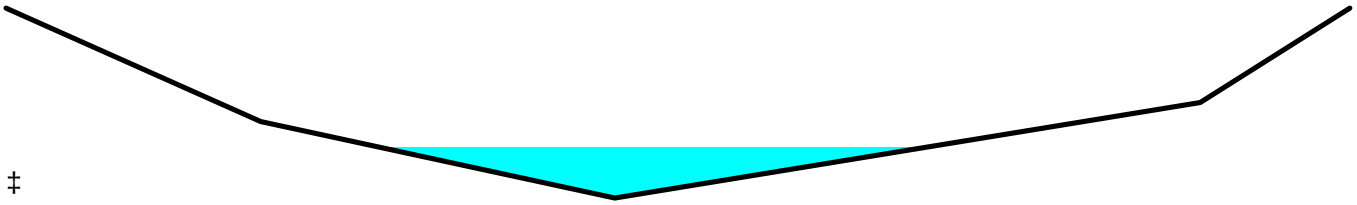
Summary for Reach 9R: Existing Channel

Inflow Area = 111.354 ac, 36.78% Impervious, Inflow Depth > 2.16" for 10-YR event
Inflow = 42.30 cfs @ 8.07 hrs, Volume= 20.085 af
Outflow = 41.27 cfs @ 8.15 hrs, Volume= 19.998 af, Atten= 2%, Lag= 5.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.19 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 2.15 fps, Avg. Travel Time= 8.7 min

Peak Storage= 14,549 cf @ 8.15 hrs
Average Depth at Peak Storage= 1.02'
Bank-Full Depth= 3.80' Flow Area= 146.2 sf, Capacity= 1,290.64 cfs

Custom cross-section, Length= 1,126.0' Slope= 0.0728 '/' (102 Elevation Intervals)
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 329.00', Outlet Invert= 247.00'

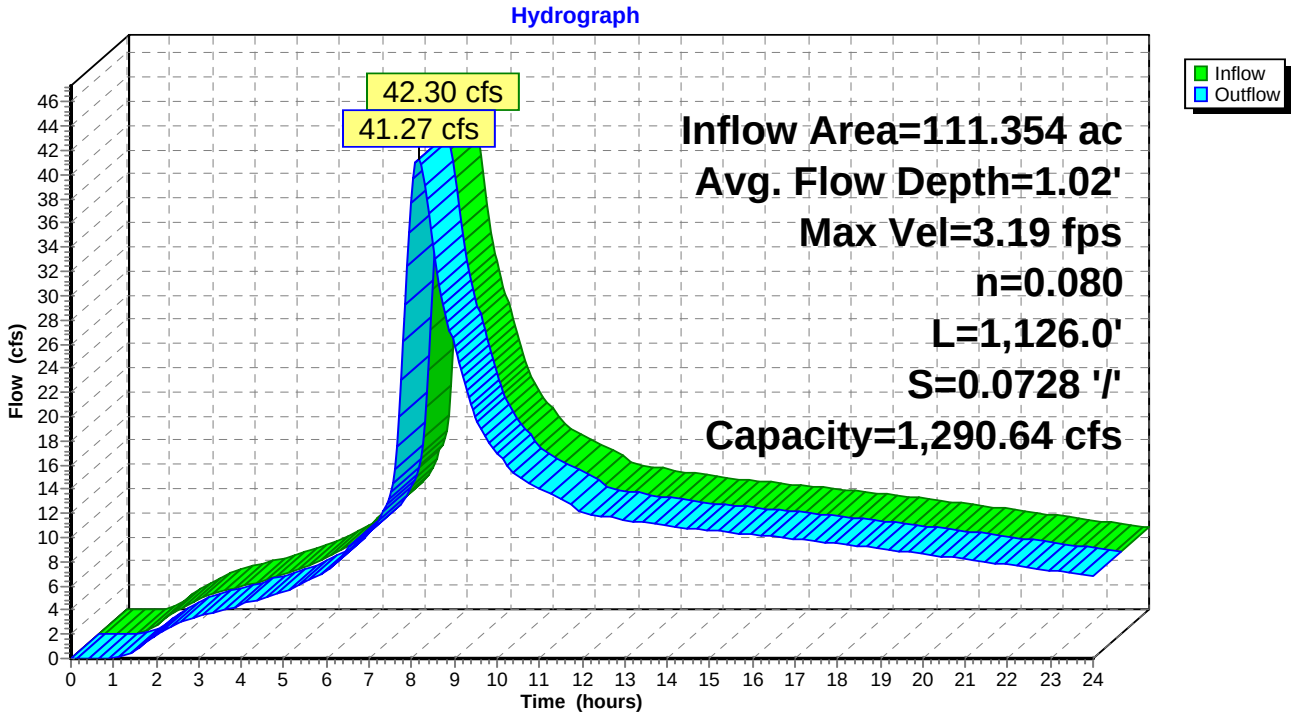


‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-28.08	3.80	0.00
-16.33	1.53	2.27
0.00	0.00	3.80
27.00	1.91	1.89
33.90	3.80	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	0.0	0	0.00
1.53	29.0	38.1	32,697	121.48
1.91	44.9	45.5	50,509	222.82
3.80	146.2	62.6	164,659	1,290.64

Reach 9R: Existing Channel



Summary for Reach 10R: Existing Channel

Inflow Area = 106.524 ac, 36.73% Impervious, Inflow Depth > 2.17" for 10-YR event
Inflow = 40.66 cfs @ 8.03 hrs, Volume= 19.247 af
Outflow = 40.10 cfs @ 8.08 hrs, Volume= 19.179 af, Atten= 1%, Lag= 2.9 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.43 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 2.05 fps, Avg. Travel Time= 7.0 min

Peak Storage= 10,006 cf @ 8.08 hrs
Average Depth at Peak Storage= 0.61'
Bank-Full Depth= 2.36' Flow Area= 76.0 sf, Capacity= 551.68 cfs

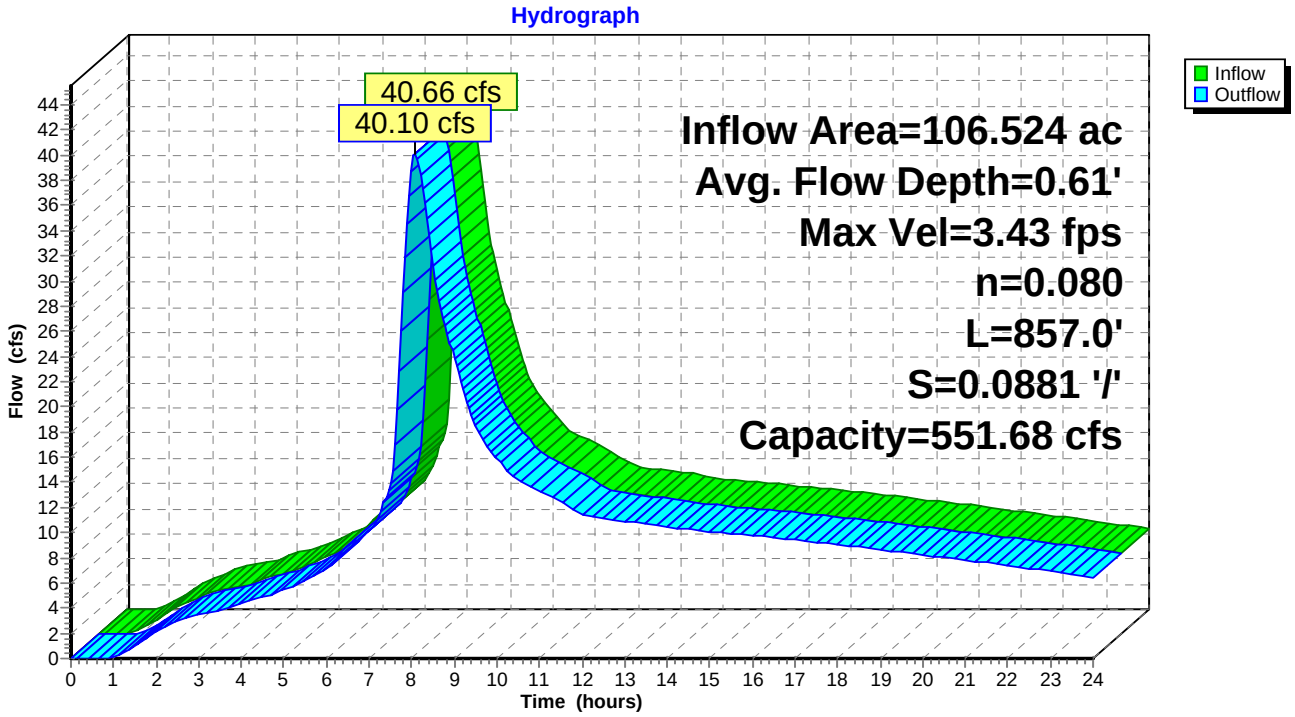
Custom cross-section, Length= 857.0' Slope= 0.0881 '/'
Constant n= 0.080 Earth, long dense weeds
Inlet Invert= 404.50', Outlet Invert= 329.00'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
-21.83	2.36	0.00
-7.20	0.00	2.36
7.20	0.00	2.36
28.20	2.36	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	14.4	0	0.00
2.36	76.0	50.4	65,155	551.68

Reach 10R: Existing Channel

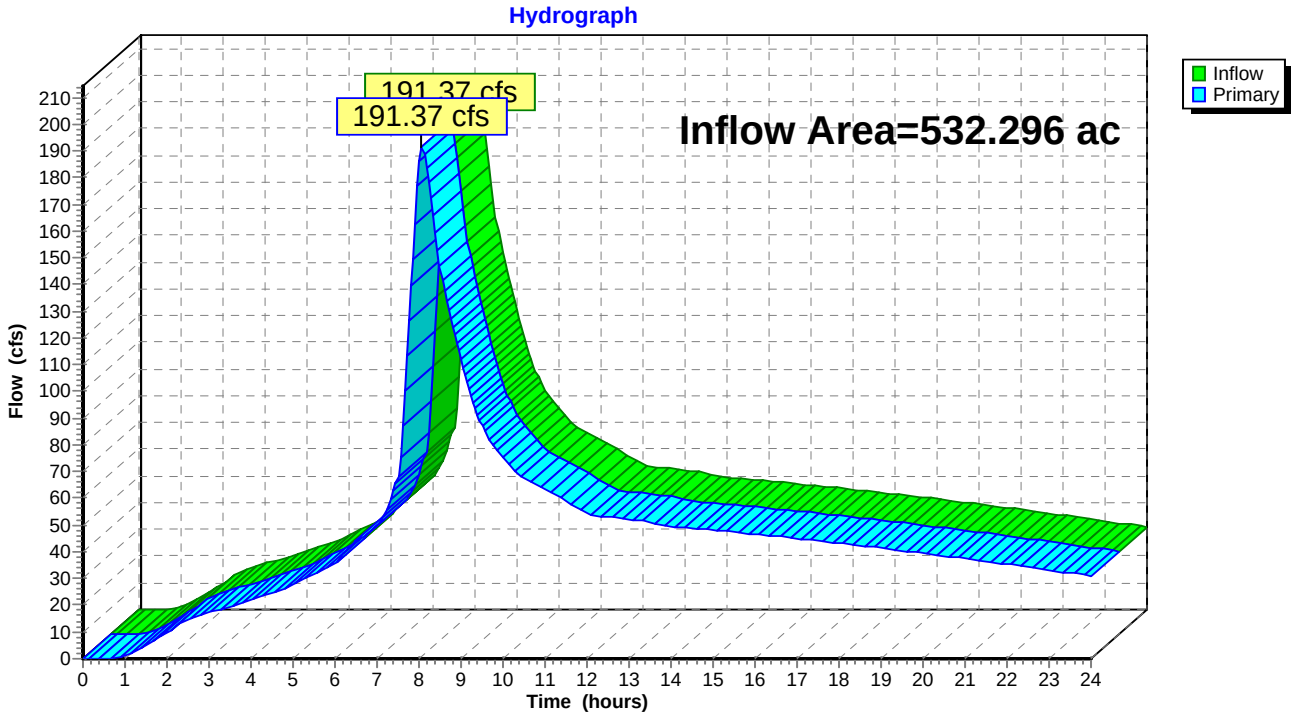


Summary for Link 1L: Discharge to Stormwater Facility

Inflow Area = 532.296 ac, 37.03% Impervious, Inflow Depth > 2.07" for 10-YR event
Inflow = 191.37 cfs @ 8.07 hrs, Volume= 91.980 af
Primary = 191.37 cfs @ 8.07 hrs, Volume= 91.980 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: Discharge to Stormwater Facility



APPENDIX B

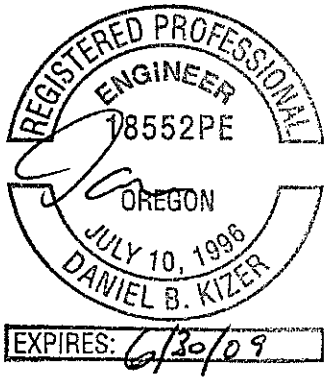
WEST HILLS PROPERTIES STORMWATER REPORT

STORMWATER PLAN & CALCULATIONS

FOR

WEST HILLS PROPERTIES LLC

McMINNVILLE, OREGON



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September 2007

WESTECH ENGINEERING, INC.
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Salem, OR 97302
(503) 585-2474

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1.1 Project Overview

The West Hills Properties LLC property encompasses just over 200 acres and is made up of many different subdivisions including, West Hills Phases 1 – 5, Valley's Edge Phases 2 – 5, Hillcrest Phases 6 – 8, and Northridge subdivision (Refer to Figure 1). These residential subdivisions will create approximately 690 lots. In order to maximize developable area and minimize construction costs a regional detention basin has been constructed based on the City of McMinnville detention requirements

1.2 McMinnville Stormwater Requirements

The City of McMinnville requires the detention on all developments that create a significant portion of impervious area. New developments are required to detain the difference between the post-developed 10-year 24-hour and the pre-developed 10-year 24-hour storm event, with a maximum release rate equal to the pre-developed 10-year 24-hour storm event.

1.3 Stormwater Detention Methodology and Criteria

The proposed residential subdivision will take up a significant portion of the drainage basin made up of forests and pasture, which upon development will require a significant amount of detention due to the addition of impervious area. In order to determine the size of the detention facility, maximum flow release rate from the detention facility, and bypass flow rate, and overflow rates must be determined. To determine the maximum flow release rate from the detention facility the 10-year, 24-hour pre-developed flow rates were determined for the land occupying the buildout development area (a significant portion of the entire drainage basin). These flow rates will later be used to help size the outlet orifice of our detention facility. The bypass flow rate for the detention facility can be sized by determining the peak 10-year, 24-hour runoff event for the entire upstream drainage basin and subtracting off the 10-year, 24-hour runoff event for the buildout development area. The developed 10-year, 24-hour runoff event for the entire drainage was used to determine the total overflow capacity of the detention pond.

The 10-year 24-hour runoff events for the development and the entire drainage basin were determined with the aid of the "PondPack" computer simulation program created by Haested Methods using the Santa Barbara Urban Hydrograph methodology. The Type 1A, 24-hour rainfall distribution was utilized to convert selected rainfall depths listed in Table 1 of a particular recurrence interval into a hyetograph.

Table 1: McMinnville 24-Hour Rainfall Events

Recurrance Interval (years)	Rainfall Depth (inches)
2	2.4
5	3.1
10	3.6
25	4.2
50	4.7
100	5.3

The total drainage basin was modeled as 11 sub-basins, while the subdivision was modeled as 9 sub-basins for both the predeveloped and developed conditions as illustrated in Figure 2 and Figure 3. The predeveloped curve numbers were determined for each sub-basin based on either a wooded or pasture land use. The area of woods vs. pasture was determined by using a scaled aerial photographs (Refer to Appendix 5 for full size sheets). Wooded and pasture land areas were assigned Curve Numbers (CN) equal to 70 and 74, respectively. The curve numbers were then weighted based on areas (refer to Appendix 1 through 4 for calculations). The curve numbers are associated with a type C and D soil per the City of McMinnville Storm Drainage Master Plan. However, for this project a type C soil was used though out the basin. Supporting soils maps CN selection tables can be found in Appendix 7.

Developed runoff conditions were determined by assigning curve numbers to each of the drainage basins based upon residential density. The subdivision had a residential density that ranged from 2.4 residential units per acre to 3.8 residential units per acre as shown in Table 2 and Table 3 and illustrated in Figure 2. If a sub-basin had a residential density less than 3 units per acre it was rounded up to 3 units per acre. If a sub-basin had a residential density between 3 and 4 units per acre the density was rounded up to 4 units per acre. Sub-basins with assigned residential density of 3 units per acre and 4 units per acre were assigned curve numbers of 83 and 81, respectively, and in accordance with TR-55 Curve Numbers.

Table 2: Subdivision Area Predeveloped and Developed Land-Use

BASIN	AREA	PREDEVELOPED LAND-USE		DEVELOPED LAND-USE (DU/Acre)		
		Woods Area	Pasture Area	DU	Calculated	Assigned
C1.0.A	58.9	0.0	58.9	189	3.2	4
C1.0.B	7.4	0.2	7.2	18	2.4	3
C1.1.A	44.5	0.0	44.5	162	3.6	4
C2.0.A	18.2	13.2	6.0	69	3.8	4
C3.0.A	23.2	8.4	14.8	78	3.4	4
C3.1.A	36.8	36.6	0.2	96	2.6	3
C3.2.A	8	8.0	0.0	20	2.5	3
C4.0.A	10.2	3.3	6.9	37	3.6	4
TOTAL	**207.2**	**69.7**	**138.5**	**669**	**N/A**	**N/A**

Table 3: Total Drainage Basin Predeveloped and Developed Land-Use

BASIN	AREA	PREDEVELOPED LAND-USE		DEVELOPED LAND-USE
		Woods Area	Pasture Area	Assigned DU/Acre
C1.0.A	54	0.0	54.0	4
C1.0.B	7.4	0.2	7.2	3
C1.1.A	43.3	0.0	43.3	4
C2.0.A	39.7	33.1	6.6	4
C2.1.A	11.5	8.2	3.3	4
C3.0.A	23.8	9.0	14.8	4
C3.1.1.A	95	45.6	49.4	4
C3.1.A	42.4	39.6	2.8	3
C3.2.A	78.4	61.5	16.9	4
C3.2.B	15.1	2.8	12.3	4
C4.0.A	49.1	18.6	30.5	4
C5.0.A	73.3	17.5	55.8	4
TOTAL	**533**	**236.1**	**296.9**	**N/A**

1.4 Calculations Summary

Refer to Appendix 1 through 4 for the runoff calculations, Tc calculations, and pond volume calculations. Table 4 and Table 5 provide a summary of all the peak runoff values for each sub-basin.

Table 4: Subdivision Pre and Post Developed Peak Flows

BASIN	10-Year, 24-Hour Predeveloped Flows (CFS)	10-Year, 24-Hour Developed Flows (CFS)
C1.0.A	10.78	23.88
C1.0.B	1.54	2.74
C1.1.A	7.43	17.03
C2.0.A	2.52	6.63
C3.0.A	3.54	0.87
C3.1.A	3.63	15.57
C3.2.A	0.78	2.32
C4.0.A	1.79	3.39
PEAK	**31.64**	**70.17**

Table 5: Total Drainage Basin Pre and Post Developed Peak Flows

BASIN	10-Year, 24-Hour Predeveloped Flows (CFS)	10-Year, 24-Hour Developed Flows (CFS)
C1.0.A	9.88	22.28
C1.0.B	1.54	2.8
C1.1.A	7.23	17.02
C2.0.A	4.32	16.02
C2.1.A	1.21	4.48
C3.0.A	2.52	9.33
C3.1.1.A	10.63	33.95
C3.1.A	10.92	14.36
C3.2.A	7.97	27.86
C3.2.B	2.42	5.65
C4.0.A	6.72	18.56
C5.0.A	9.93	27.27
PEAK	**73.96**	**199.1**

1.5 Detention Volume Determination

Please refer to Appendix 2 for the detention calculations and Figure 4. The detention volume was determined in compliance with McMinnville's required maximum release rate equal to the basins peak 10-year runoff event, while capturing the 10-year post-developed runoff event. Based on preliminary calculations we determined the approximate amount of storage required. The detention basins grading plan, i.e., the area as a function of height was entered into the "Pond Pack" computer program, which determines volume as a function of height. By iteration, the orifice size was adjusted until the maximum release rate was equal to the 10-year predeveloped runoff event. The maximum amount of water stored in the pond was equal to the required detention volume. The total detention required is 3.567 ac-ft or 155,379 cubic-feet. The detention pond as shown on sheet C8 of the Civil drawings and Figure 4 have a total detention capacity of approximately 190,000 cubic-feet.

The detention basin was sized to provide the volume necessary to limit the stormwater discharge rate to the release rate that is equivalent to the 10-year, 24-hour pre-developed runoff event for the total drainage basin (74 cfs).

The 10-year, 24-hour pre-developed runoff event for the total basin was calculated to be 74 cfs. Three pipe discharges on Redmond Hill Road are shown on construction drawing sheets St-2 and St-3. These 3 discharges are as follows:

1. Detention Pond 24-inch discharge pipe with 16.5-inch orifice, restricted the release rate to 14 cfs with the pond at water surface elevation 184.0

2. A 12-inch discharge pipe from a slope inlet set at elevation 180.0, which restricts the release rate at 7 cfs with the pond at water surface elevation 184.0.

3. A 48-inch cross culvert at Redmond Hill Road Station 38+25. At the ditch water surface elevation of 185.00 the water begins to flow overland east to the detention pond. At elevation 185.0, the 48-inch culvert can convey 54 cfs across Redmond Hill Road to the open ditch on the south side.

   At elevation 185.50, the 48-inch culvert can convey 65 cfs across Redmond Hill Road to the open ditch on the south side. The overflow for the north-south ditch can convey 51 cfs at a depth of flow of 6-inches (Manning's value of 0.030 for the overland flow across the park grass.)

Refer to the Detention Pond Grading Plan on Sheet G9 for the surface overflow route for the north-south ditch.

1.6 Over Flow Routing Summary

The detention pond was sized with a total overflow capacity equal to the post developed 10-year storm for the entire drainage basin or 199.1 cfs. As indicated on the Civil Drawings and in Figure 4 once the detention pond begins to fill until the stormwater reaches the overflow elevation of 184. At this elevation the orifice will release 21 cfs (the predeveloped 10-year flow for the total basin). Above this elevation (between 185 and 184) water will back up to the culvert west of the pond and a second Type III inlet. The capacity of the 125-foot long spillway at a flow depth of 3" is approximately 109 cfs.

The detention pond can overflow via 4 routes:

1. Water can flow into the two overflow catchbasins set at elevation 184.0 along the side of the south berm in the detention pond.

2. Water can overflow the flow control manhole riser piping inside the manhole at Redmond Hill Road Station 31+43.

3. Water can overflow the north, curbside sidewalk at elevation 184.98 at Redmond Hill Road Station 32+50. The sidewalk serves as the overland flow route for water to flow across Redmond Hill Road.

Above elevation 185.5, water can overflow through the remainder of the capacity of the 48-inch culvert crossing Redmond Hill Road at Station 38+25. Capacity is available between flow depth of 34-inches (elevation 185) flow depth of 48-inches (elevation 186.2).

0 100 200 400
(Feet)

UGB AND CITY LIMITS

GRAVITY WATER SERVICE LEVEL BOUNDARY

URBAN GROWTH BOUNDARY (UGB)

DUNCKEL PROPERTY BOUNDARY

WEST HILLS PHASE 5 (R-2 PD) 11.99 ACRES

WEST HILLS PHASE 4 (R-2 PD) 13.38 ACRES

WEST HILLS PHASE 3 (R-2 PD) 7.01 ACRES

WEST HILLS PHASE 2 (R-2 PD) 12.46 ACRES

WEST HILLS PHASE 1 (R-2 PD) 10.73 ACRES

COMMERCIAL TREE PARKING BOUNDARY

VALLEY'S EDGE PHASE 5 (R-2 PD) 5.08 ACRES

VALLEY'S EDGE PHASE 4 (R-2 PD) 14.82 ACRES

VALLEY'S EDGE PHASE 3 (R-2 PD) 17.54 ACRES

HILLCREST PHASE 7 (R-2 PD) 10.98 ACRES

NORTHRIDGE (R-2 PD) 8.64 ACRES

HILLCREST PHASE 8 (R-2 PD) 7.81 ACRES

HILLCREST PHASE 6 (R-2 PD) 12.12 ACRES

MF 3.00 ACRES

VALLEY'S EDGE PHASE 2 (R-2 PD) 18.65 ACRES

PARK 5.00 ACRES

DETENTION POND 2.77 ACRES

YAMHILL COUNTY GIS TAX LOT BOUNDARY

DUNCKEL PROPERTY BOUNDARY

CEMETERY

HILLSDALE

WEST VALLEY ESTATES (96)

HILLSDALE SUB.

HILLSDALE FIRST ADD.

WEST HILLS ESTATES

275

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VERIFY SCALE
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY
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DSN. DBK
DRN. SSM
CKD. DBK
DATE: JUN 07

REGISTERED PROFESSIONAL ENGINEER
OREGON JULY 10, 1987
DANIEL B. KAUER
EXPIRES: JUNE 30, 2007

REVIEW

WESTECH ENGINEERING, INC.
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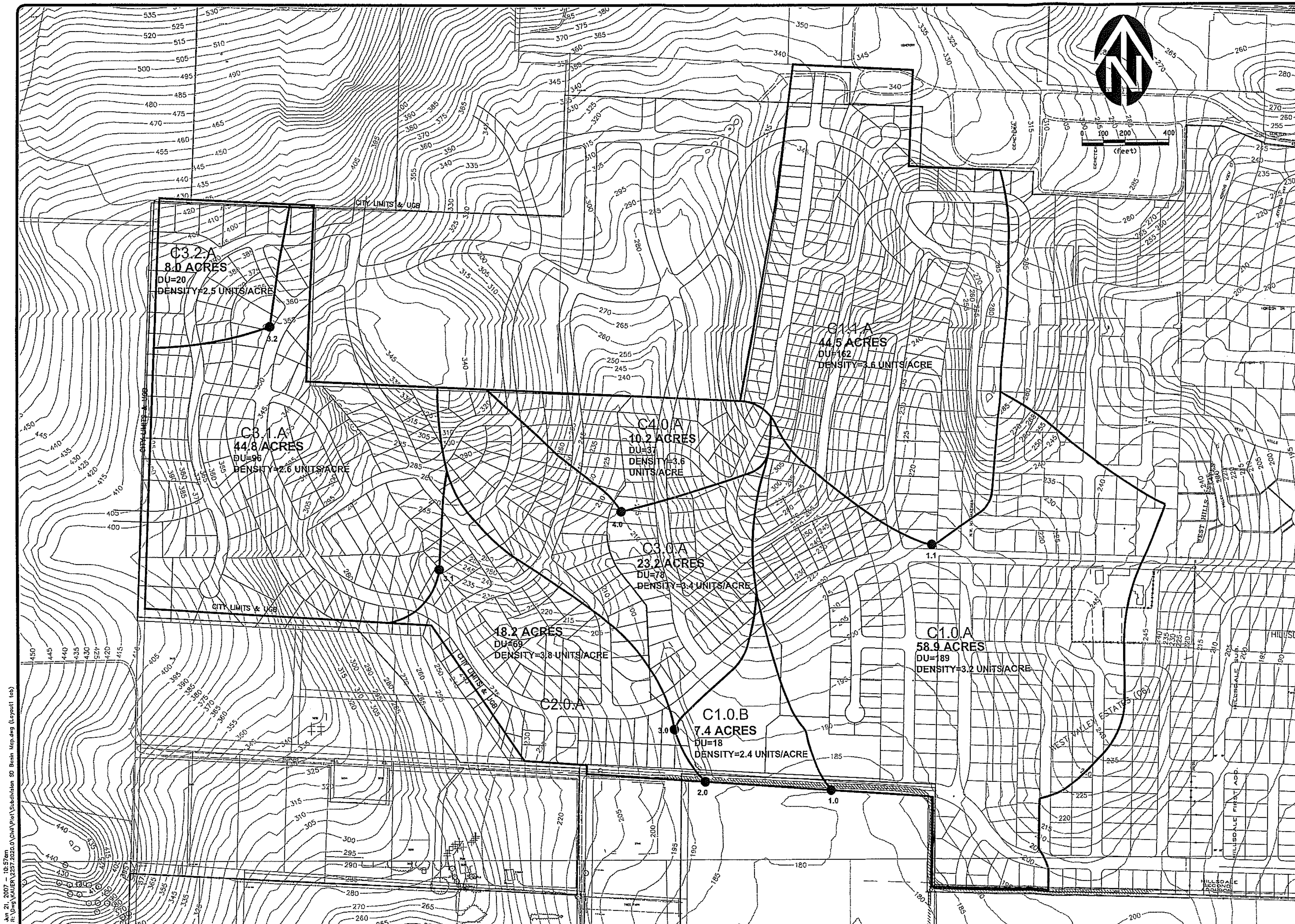
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

KHA PROPERTIES LLC McMINNVILLE, OREGON

FIGURE 1.
OVERALL SUBDIVISION MASTER PLAN

SHEET
X OF X

JOB NUMBER
2257.2020.0



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KHA PROPERTIES LLC McMINNVILLE, OREGON

FIGURE 2

SUBDIVISION SD BASIN MAP

SHEET X OF X

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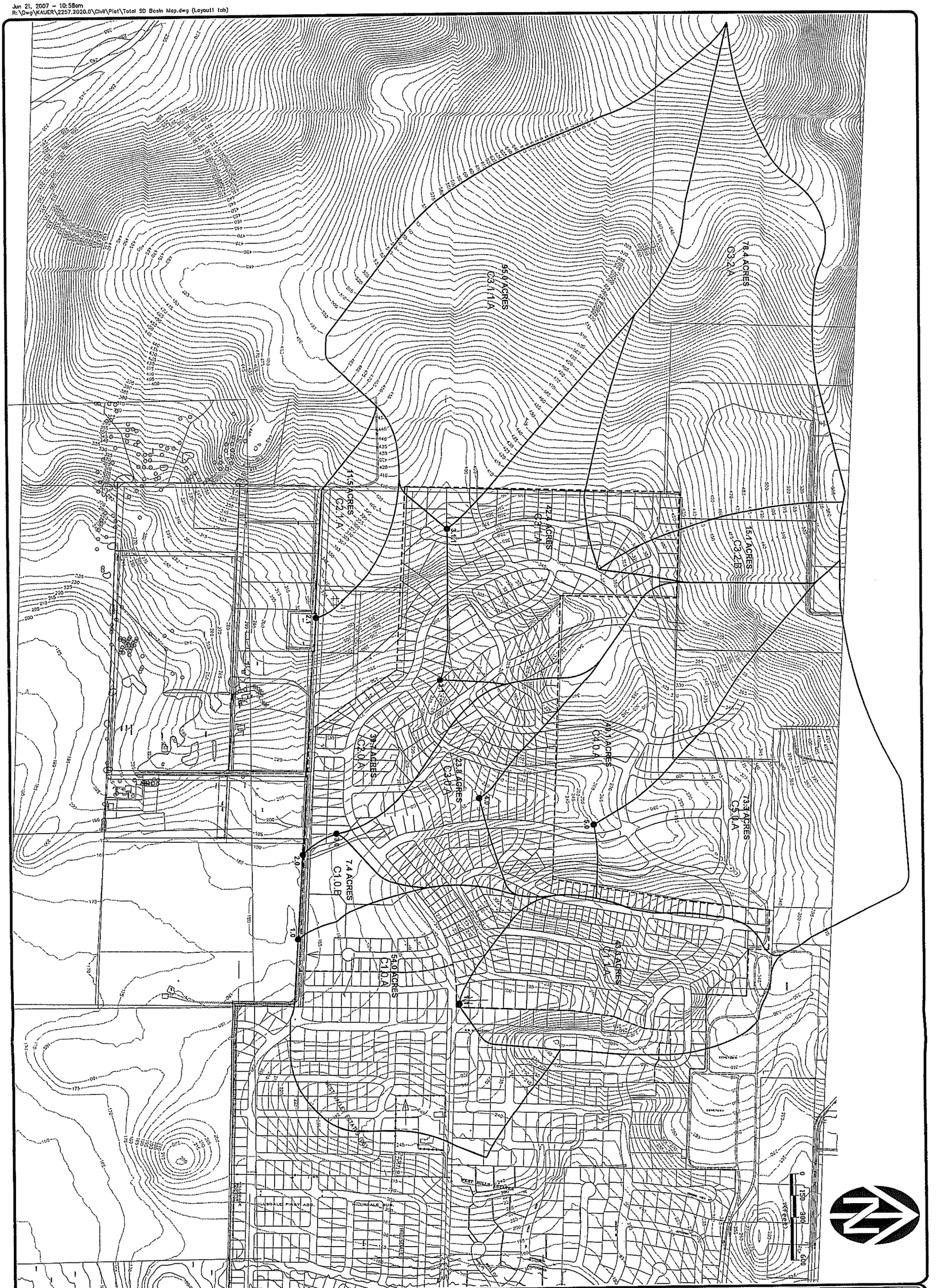

KHA PROPERTIES LLC McMINNVILLE, OREGON

FIGURE 3

TOTAL SD BASIN MAP

SHEET X OF X

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DANIEL B. KUCZA
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CKD. DBK
DATE: JUN 07

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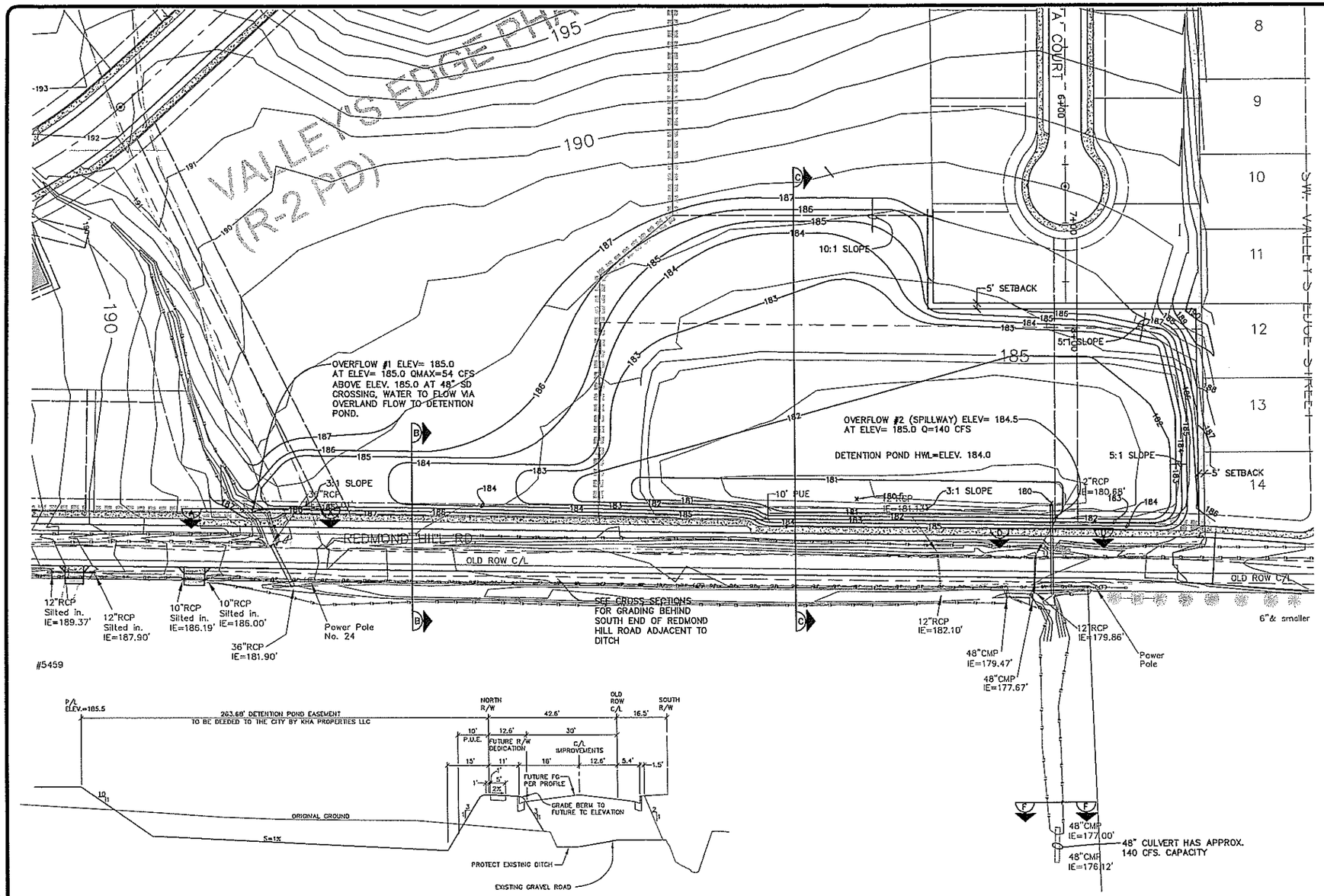

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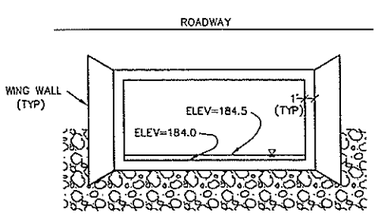

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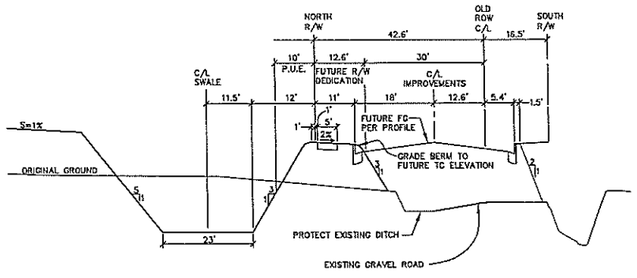

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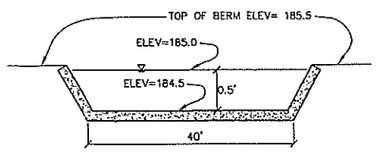

TYPICAL SECTION D-D
N.T.S.

DETENTION POND DEPTHS:

MAX. DETENTION ELEV.= 184.0

OVERFLOW #1 ELEV.= 184.5

OVERFLOW #2 (SPILLWAY) ELEV.= 185.0

KHA PROPERTIES AND WEST VALLEY ESTATES DETENTION POND CALCULATIONS:

DETENTION VOLUME REQUIRED= 155,379 CF.

DETENTION VOLUME PROVIDED= 190.00 CF.

EXISTING SITE 10-YR Q= 31.64 CFS.

DEVELOPED SITE 10-YR Q= 70.17 CFS.

TOTAL BASIN 10-YR PREDEVELOPED= 73.97 CFS.

TOTAL BASIN 10-YR POST-DEVELOPED= 199.1 CFS.

ORIFICE DIAMETER= 24.53 inches

TOTAL DETAINED RELEASE AT HWL=184.0=75 CFS
(48" SD=54 CFS, EXIST. 24" SD=14 CFS, NEW
12" SD=7 CFS)

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KHA PROPERTIES LLC
VALLEY'S EDGE PHASE 2 AND PHASE 3
McMINNVILLE, OR

Figure 4
DETENTION POND
GRADING PLAN

SHEET
G10 OF X

JOB NUMBER
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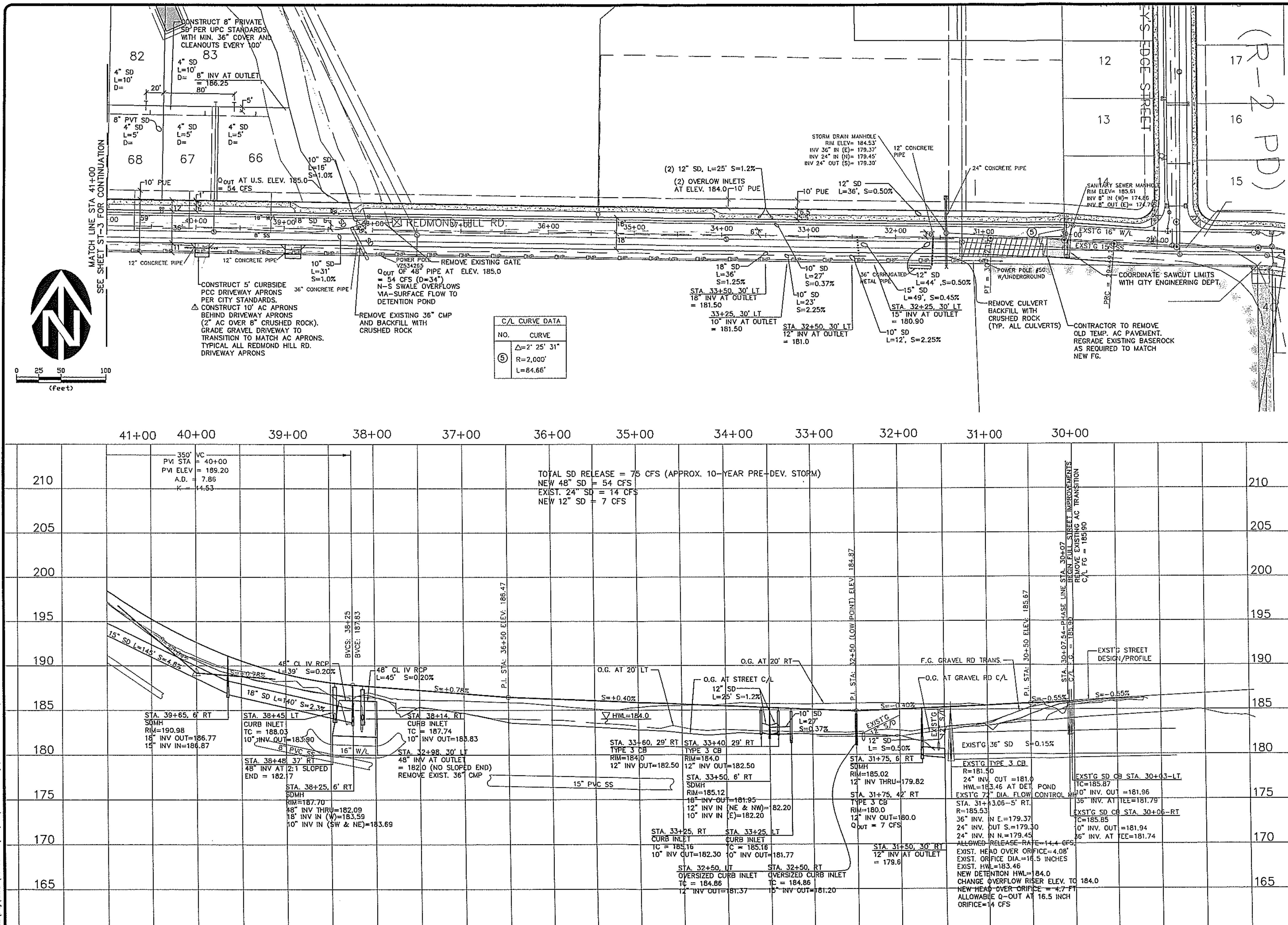

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DRN. SSM
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WEST HILLS PROPERTIES LLC McMINNVILLE, OR
VALLEY'S EDGE PHASE 2 AND PHASE 3
REDMOND HILL ROAD
PLAN & PROFILE
STA. 30+00 TO STA. 41+00

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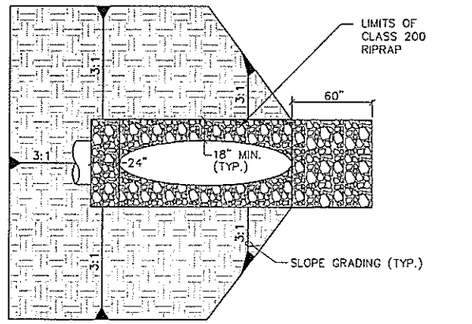
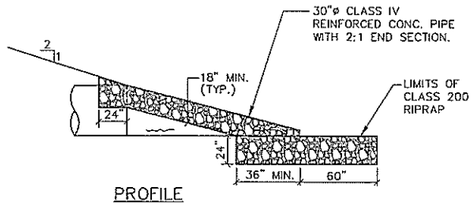


TOP VIEW



PROFILE

30" PIPE OUTFALL DETAIL

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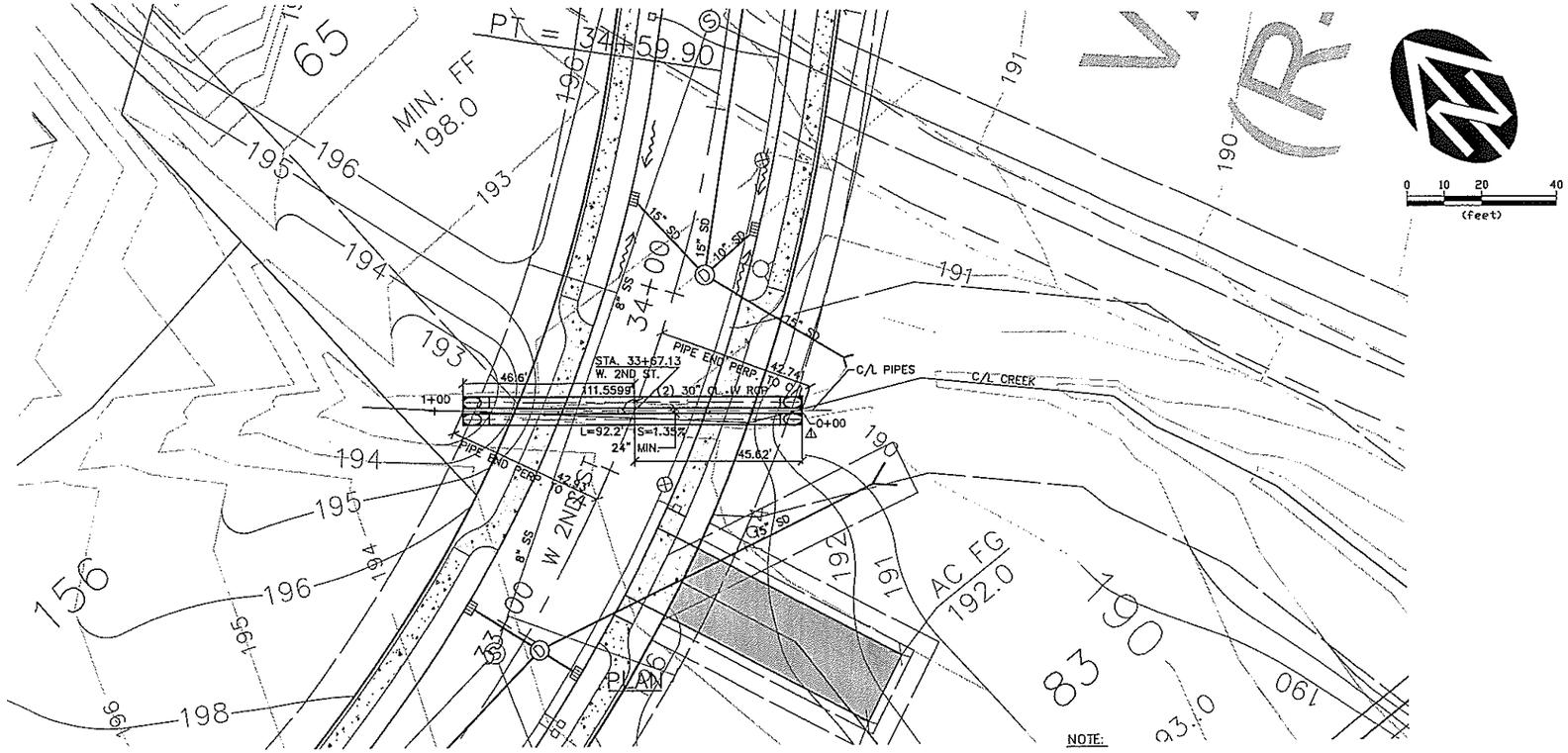
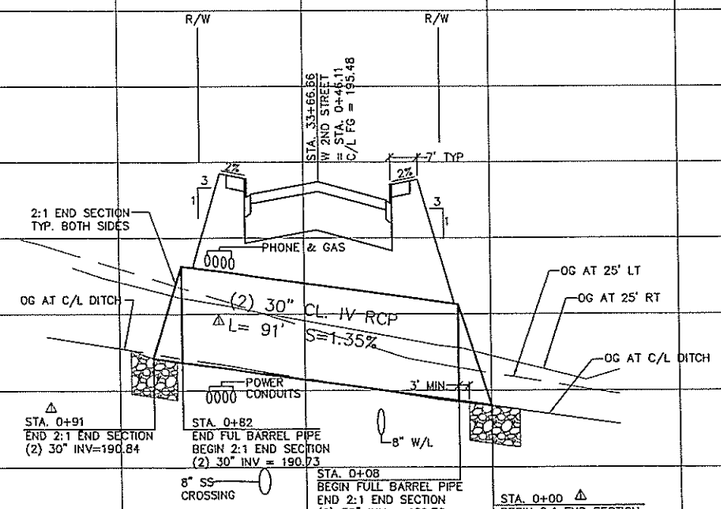


NOTE:
TWIN CULVERT CROSSING HAS 130 CFS CAPACITY WITH ONE-FOOT SURCHARGE ON UPSTREAM END.



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DATE: JULY, 07

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WEST HILLS PROPERTIES LLC McMINNVILLE, OR
VALLEY'S EDGE PHASE 2 AND PHASE 3

(2) 36" CULVERT PLAN & PROFILE STA. 0+00 TO STA. 0+91

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APPENDIX C

MCMINNVILLE STORM DRAINAGE MASETER PLAN HYDROLOGICAL SOIL GROUP MAP

FIGURE 2-3

SOIL INFILITRATION CAPABILITY

City of McMinnville
Stormwater Drainage Master Plan

Project Area

Berry Creek
Panther Creek
Hawn Creek
North Yamhill Rivet
Baker Creek
HWY 99W
Yamhill River
North Branch Cozine Creek
BAKER
ADAMS
3RD
THREE MILE
THREE MILE
THREE MILE
Cozine Creek
HWY 18
BAKER
South Yamhill River

Legend

- Creek\River
- Major Roads
- **Proposed UGB**

Hydrologic Soil Class

- A
- B
- C
- D

N

1 inch equals 3,000 feet

Source:
City of McMinnville
NRCS -
Soil Survey Geographic
(SSURGO) Database

CH2MHILL

Date: 11/01/2007

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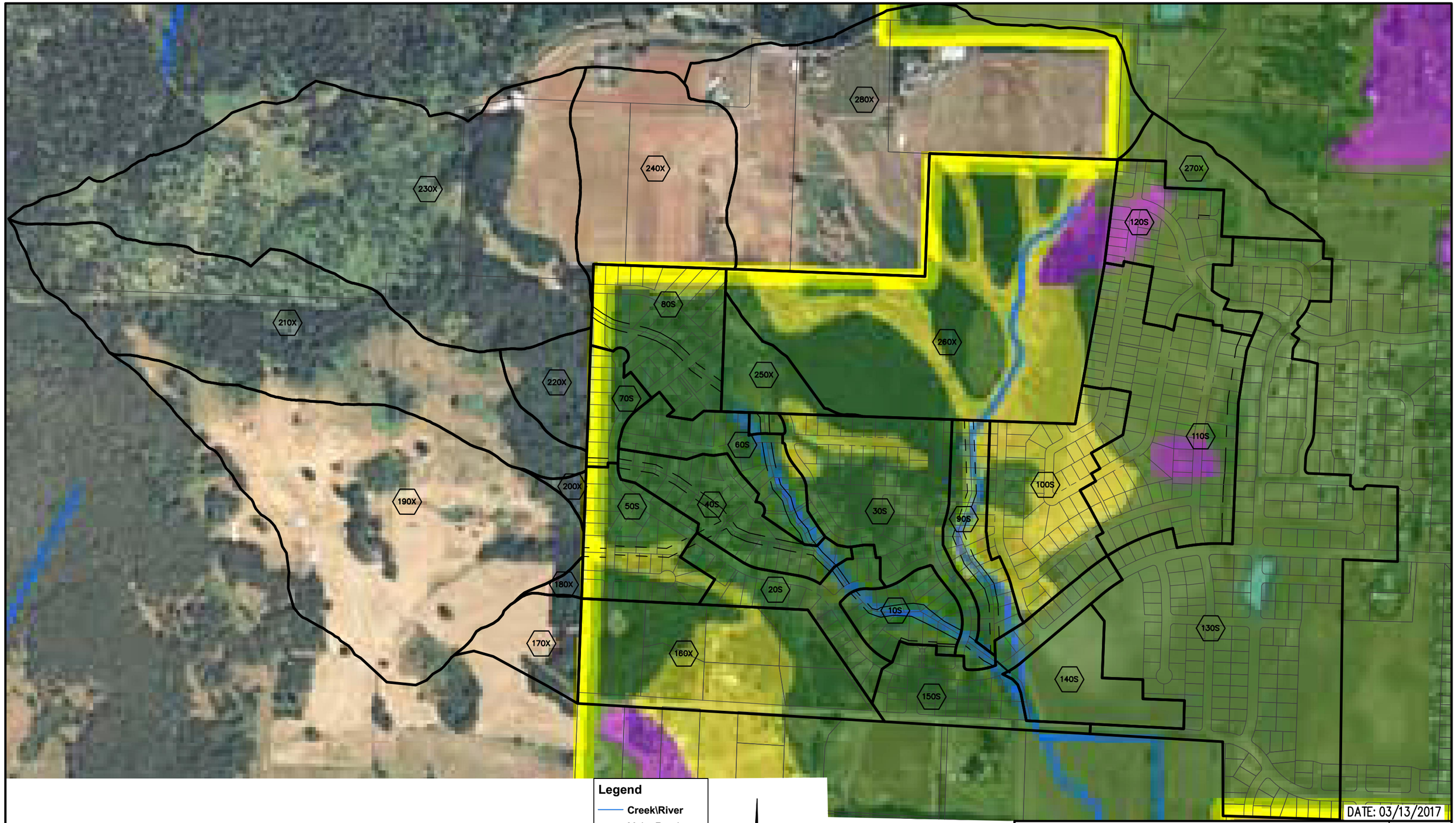

Legend

- Creek\River
- Major Roads
- Proposed UGB

Hydrologic Soil Class

- A
- B
- C
- D

SCALE 1" = 500 FEET

500 0 200 300 400 500

DATE: 03/13/2017

HYDROLOGICAL SOIL GROUP SITE MAP OVERLAY

HILLCREST MASTER PLAN

AKS ENGINEERING & FORESTRY, LLC
12965 SW HERMAN RD, STE 100
TUALATIN, OR 97062
P: 503.563.6151 F: 503.563.6152 aks-eng.com

FIGURE 3

DRWN: CTS
CHKD: PAS
AKS JOB: 5147

DWG: MASTER PLAN BASIN DELINEATION SOIL OVERLAY | LAYOUT1

APPENDIX D

TR55 RUNOFF CURVE NUMBERS

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1/]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2/]	Hydrologic condition [3/]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

[1] Average runoff condition, and I_a=0.2S

[2] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2/]	A [3/]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

Exhibit F: Traffic Analysis Update Memo

Hillcrest Subdivision Analysis Update

3/8/17

REGISTERED PROFESSIONAL ENGINEER
54983PE
OREGON
JULY 10, 2002
MICHAEL T. ARD
EXPIRES: 12/31/17

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To: Paul Sellke, AKS Engineering and Forestry, LLC

From: Michael Ard, PE

Date: March 8, 2017

Subject: Hillcrest Subdivision Analysis Update

Lancaster Engineering prepared a detailed traffic impact study dated January, 2007 for the Hillcrest Subdivision in McMinnville, Oregon. Subsequent to approval of the 580-lot subdivision, changes have been proposed which would result in increased density, with a total development consisting of 579 single-family homes and 68 apartment units. This memorandum is written to provide information regarding the change in site trip generation as well as information regarding whether changes are required to the original mitigation recommendations contained in the January, 2007 analysis.

Trip Generation

The January, 2007 traffic impact study provided trip generation projections for three analysis scenarios. These included the maximum development permitted under the prior R1 Residential zoning (679 homes), the maximum development permitted under the current R2 Residential zoning (873 homes), and the then-proposed actual development scenario (580 homes). These analysis scenarios resulted in 601 trips, 754 trips and 522 trips, respectively during the critical evening peak hour.

If the proposed development plan is modified as proposed to include 579 single-family homes and 68 apartment units, the resulting trip generation during the critical evening peak hour would be 552 trips, which is an increase of 30 trips as compared to the original development scenario analysis and fewer site trips than would have been permitted under the prior R1 Residential zoning. Detailed trip generation worksheets showing the projected site trips for the single-family home and apartment land uses are included in the attached technical appendix.

Mitigation Analysis

Under the January, 2007 traffic impact study, an operational and safety analysis was prepared for the intersections of NW Hill Road at NW Horizon Drive, NW Hill Road at NW 2nd Street, and SW Hill Road at SW Redmond Hill Road. The analysis prepared for each of these intersections was revisited to determine whether the projected small increase in traffic would have resulted in the need for any additional mitigation.

NW Hill Road at NW Horizon Drive

For the intersection of NW Hill Road at NW Horizon Drive, the operational analysis showed that the intersection was projected to operate acceptably without the need for mitigation through year 2026 even with maximum development under the R2 Residential zoning. Since the number of site trips generated under this scenario is far in excess of the number of trips generated under the currently-proposed development scenario, it can be concluded that no mitigation will be needed to support added traffic at this intersection.

NW Hill Road at NW 2nd Street

For the intersection of NW Hill Road at NW 2nd Street, it was projected that the intersection would operate with volumes exceeding intersection capacity during the evening peak hour. It was recommended that the intersection be converted to all-way stop control in order to improve operation. With the conversion to all-way stop control the intersection was projected to operate acceptably through 2026 even with the addition of the maximum development levels permissible under the R-2 Residential zoning. Based on the prior analysis, it can be concluded that the recommended conversion to all-way stop control remains appropriate, and that the added trips from the currently-proposed development will not result in the need for any additional mitigation at this intersection. It should be noted that the conversion to all-way stop control has already been implemented at this intersection.

SW Hill Road at SW Redmond Hill Road

For the intersection of SW Hill Road at SW Redmond Hill Road, the operational analysis again showed that the intersection was projected to operate acceptably without the need for mitigation through year 2026 even with maximum development under the R2 Residential zoning. Since the number of site trips generated under this scenario is far in excess of the number of trips generated under the currently-proposed development scenario, it can be concluded that no additional mitigation will be needed to support added traffic at this intersection.

Turn Lane Warrant Analysis

In addition to the operational analysis of the three study intersections, a safety-based turn-lane warrant analysis was conducted for the study intersections. Based on the analysis, installation of a northbound left-turn lane on NW Hill Road at NW Horizon Drive was projected to be warranted upon development of the 290th home within the proposed subdivision. Similarly, northbound and southbound left-turn lanes were projected to be warranted on NW Hill Road at NW 2nd Street once site development reached 290 or more homes.

For the intersection of SW Hill Road at SW Redmond Hill Road it was determined that left-turn lane warrants would not be met under the maximum development scenario for the prior R1 Residential zoning (679 homes), but that installation of a left-turn lane would be warranted with maximum development under

the current R2 Residential zoning (873 homes). Since the revised development scenario results in fewer trips than the levels allowed under the prior R1 Residential zoning, it can be concluded that installation of a left-turn lane will not be needed upon completion of the revised development plan.

Since completion of the January, 2007 traffic impact study, the intersection of NW Hill Road at NW 2nd Street has been converted to all-way stop control. This change to the traffic control means that the left-turn lane warrant analysis previously prepared for this intersection is no longer applicable. Warrants for left-turn lanes are based on the idea that vehicles stopping within an otherwise free-flowing travel lane can create an unexpected hazard to through traffic and can increase the risk of rear-end collisions, as well as turning-movement collisions that can occur when a stopped vehicle is rear-ended and pushed into the path of oncoming traffic. However, since all vehicles must now stop on all intersection approaches, the turn-lane warrants can no longer be appropriately applied to the intersection. Accordingly, recommendations regarding installation of any new approach lanes at the intersection of NW Hill Road at NW 2nd Street would be based solely on capacity and delay concerns, rather than turn-lane warrants.

Based on the updated operational analysis for the intersection, it is projected that the intersection will operate acceptably during the morning peak hours with the existing lane configuration, but will operate at level of service "F" during the evening peak hours. If the previously-recommended northbound and southbound left-turn lanes are provided, the intersection would be projected to operate at level of service C and with all movements within capacity. Based on this analysis, the prior recommendation for installation of northbound and southbound left turn lanes at NW 2nd Street remains valid under the proposed development plan.

Conclusions

Based on the detailed investigation of the revised development plan, the following improvement recommendations remain valid:

- A northbound left-turn lane should be provided on NW Hill Road at NW Horizon Drive once site development reaches a total of 290 homes.

- Northbound and southbound left-turn lanes should be provided on NW Hill Road at NW 2nd Street once site development reaches a total of 290 homes.

No other operational or safety mitigations are necessary or recommended in conjunction with the modified development proposal.

APPENDIX

TRIP GENERATION CALCULATIONS

Land Use: Single-Family Detached Housing
Land Use Code: 210
Variable: Dwelling Units
Variable Value: 579

AM PEAK HOUR

Trip Equation: T = 0.70(X) + 9.74

	Enter	Exit	Total
Directional Distribution	25%	75%	
Trip Ends	**104**	**311**	**415**

PM PEAK HOUR

Trip Equation: Ln(T)=0.90Ln(X)+0.51

	Enter	Exit	Total
Directional Distribution	63%	37%	
Trip Ends	**321**	**189**	**510**

WEEKDAY

Trip Equation: Ln(T)=0.92Ln(X)+2.72

	Enter	Exit	Total
Directional Distribution	50%	50%	
Trip Ends	**2,642**	**2,642**	**5,284**

SATURDAY

Trip Equation: Ln(T)=0.93Ln(X)+2.64

	Enter	Exit	Total
Directional Distribution	50%	50%	
Trip Ends	**2,599**	**2,599**	**5,198**

Source: TRIP GENERATION, Ninth Edition

TRIP GENERATION CALCULATIONS

Land Use: Apartment
Land Use Code: 220
Variable: Dwelling Units
Variable Value: 68

AM PEAK HOUR

Trip Rate: 0.51

	Enter	Exit	Total
Directional Distribution	20%	80%	
Trip Ends	**7**	**28**	**35**

PM PEAK HOUR

Trip Rate: 0.62

	Enter	Exit	Total
Directional Distribution	65%	35%	
Trip Ends	**27**	**15**	**42**

WEEKDAY

Trip Rate: 6.65

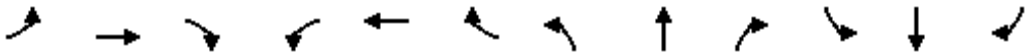
	Enter	Exit	Total
Directional Distribution	50%	50%	
Trip Ends	**226**	**226**	**452**

SATURDAY

Trip Rate: 6.39

	Enter	Exit	Total
Directional Distribution	50%	50%	
Trip Ends	**217**	**217**	**434**

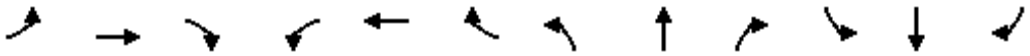
Source: TRIP GENERATION, Ninth Edition



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	51	177	46	41	71	67	28	182	122	149	132	29
Future Volume (vph)	51	177	46	41	71	67	28	182	122	149	132	29
Peak Hour Factor	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Hourly flow rate (vph)	65	227	59	53	91	86	36	233	156	191	169	37

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total (vph)	292	59	230	425	397
Volume Left (vph)	65	0	53	36	191
Volume Right (vph)	0	59	86	156	37
Hadj (s)	0.08	-0.57	-0.13	-0.08	0.13
Departure Headway (s)	7.8	3.2	7.9	7.1	7.4
Degree Utilization, x	0.64	0.05	0.51	0.84	0.82
Capacity (veh/h)	412	1121	399	485	468
Control Delay (s)	23.6	6.4	18.7	37.6	35.4
Approach Delay (s)	20.7		18.7	37.6	35.4
Approach LOS	C		C	E	E

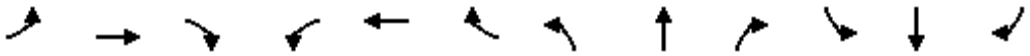
Intersection Summary				
Delay	29.6			
Level of Service	D			
Intersection Capacity Utilization	76.2%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	34	106	31	88	184	174	61	164	76	114	211	63
Future Volume (vph)	34	106	31	88	184	174	61	164	76	114	211	63
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	115	34	96	200	189	66	178	83	124	229	68

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	SB 1
Volume Total (vph)	152	34	485	327	421
Volume Left (vph)	37	0	96	66	124
Volume Right (vph)	0	34	189	83	68
Hadj (s)	0.08	-0.57	-0.16	-0.04	0.03
Departure Headway (s)	8.6	3.2	7.1	7.7	7.5
Degree Utilization, x	0.36	0.03	0.96	0.70	0.87
Capacity (veh/h)	378	1121	500	452	468
Control Delay (s)	16.5	6.3	57.3	26.7	43.2
Approach Delay (s)	14.6		57.3	26.7	43.2
Approach LOS	B		F	D	E

Intersection Summary				
Delay	40.5			
Level of Service	E			
Intersection Capacity Utilization	76.7%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Traffic Volume (vph)	34	106	31	88	184	174	61	164	76	114	211	63
Future Volume (vph)	34	106	31	88	184	174	61	164	76	114	211	63
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	37	115	34	96	200	189	66	178	83	124	229	68

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	152	34	485	66	261	124	297
Volume Left (vph)	37	0	96	66	0	124	0
Volume Right (vph)	0	34	189	0	83	0	68
Hadj (s)	0.08	-0.57	-0.16	0.57	-0.15	0.57	-0.09
Departure Headway (s)	7.8	3.2	6.5	8.4	7.6	8.2	7.5
Degree Utilization, x	0.33	0.03	0.88	0.15	0.55	0.28	0.62
Capacity (veh/h)	429	1121	535	402	438	416	452
Control Delay (s)	14.6	6.3	40.1	11.7	18.5	13.2	20.8
Approach Delay (s)	13.0		40.1	17.1		18.6	
Approach LOS	B		E	C		C	

Intersection Summary				
Delay	24.9			
Level of Service	C			
Intersection Capacity Utilization	65.5%	ICU Level of Service	C	
Analysis Period (min)	15			