CONSTRUCTION TESTING & ENGINEERING, INC.
1441 MONTIEL ROAD, SUITE 115 | ESCONDIDO, CA 92026 | 760.746.4955 | FAX 760.746.9806

PRELIMINARY HYDROLOGY STUDY FOR:
GROVER BEACH LODGE
CITY OF GROVER BEACH, CALIFORNIA

Prepared For:

PACIFICA COMPANIES
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Prepared By:

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CTE Job No. 10-10460C

January 19, 2012

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INTRODUCTION

The purpose of this study is to determine storm water runoff and storm water runoff treatment required for the proposed development Grover Beach Lodge in Grover Beach California.

A hydrologic and hydraulic analysis for a 2, 10, 25, and 100 year storm event will be conducted for existing and proposed conditions. The proposed stormwater management plan will incorporate Low Impact Development (LID) techniques along with post construction best management practices (BMPs) to mitigate any post development water quality impacts.

SITE LOCATION AND SITE DESCRIPTION

The subject property is located within Pismo State Beach and the City of Grover Beach west of Highway 1 between Grand Avenue and Le Sage Drive in San Luis Obispo County. North of the site is the golf course owned by the Department of Parks and Recreation and south of the project is State Parks recreational area. East of the project site running from north to south is Meadow Creek and west of the site is the beach dunes and the Pacific Ocean. East of Meadow Creek is a privately owned property. See Attachment 1 for a site vicinity map and site location map.

The project area is approximately 10.41 acres and is partially developed including Finns restaurant and public parking for the restaurant, beach, and golf course. The site located in a 100 year flood plain per the Flood Insurance Rate Map Number 06079C1582F (See Attachment 2). The flood elevation is 10.0 for the NGVD29 datum and 8.0 City of Grover Beach datum. The hydrology maps and elevations in this report are utilizing City of Grover Beach Elevations.

The development will consist of three (3) hotel buildings, landscaping, dune restoration areas, parking areas, and associated hardscape improvements.

DESIGN CRITERIA

The following is a summary of the design criteria used for this analysis:

- City of Grover Beach Standard Drawings D.1 Rainfall Intensity Chart
- City of Grover Beach Standard Drawings D.2 Table of Coefficient Runoff (C) Chart. Impervious area C=1.0 and Moderate Vegetation C=0.2
- City of Grover Beach Standard Drawings D.3 Nomograph for time of concentration
- From the USDA Natural Resources Conservation Service Web Soil Survey the site soil is Group "A" See Web Soil Survey Map (Attachment 2).

HYDROLOGY

EXISTING CONDITIONS

The existing runoff drains from the improved project limits to the west easterly into Meadow Creek. The existing site was divided into two (2) hydrologic basins and a weighted coefficient of runoff (C) was calculated. The weighted C value was obtained by averaging the impervious area versus the pervious areas. A C value of 1.0 was used for the impervious areas and a C value of 0.2 was used for the pervious areas.

The calculations incorporate the effects of site inundation to elevation 8' (Grover Beach Datum, 10' NGVD '29) for a 100-year storm event based on the flood elevation identified on FEMA's Flood Insurance Rate Map Panel 1582. For a 100-year storm, portions of basins EX-1 and PR-8 will be affected by the 100-year flood elevation calculated by FEMA.

The existing total impervious percentage is 55.52 percent based on affected areas of the 100 year inundation. The following is a summary of pre-development conditions:

TABLE 1: PRE-DEVELOPMENT SUMMARY

Basin	Area (acre)	Impervious Percentage	Q2 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
EX-1	7.075	47.32% for 100yr; 25.24% all other storm events	3.98	6.54	7.39	13.51
EX-2	3.427	72.46	3.74	6.14	6.95	8.82
TOTAL	**10.502**	**55.52% for 100yr; 40.65% all other storm events**	**7.72**	**12.69**	**14.34**	**22.33**

TABLE 2: PRE-DEVELOPMENT 100 YEAR VOLUME SUMMARY

Basin	Q100 (Acre-ft)
EX	2.760

See Attachment 3 for a summary of the area, C calculations, and hydrologic calculations.
See Attachment 7 for the existing hydrology map.

PROPOSED CONDITIONS

The proposed drainage plan is to maintain the existing runoff and limit diversion and to provide a storm water management plan to treat the storm runoff. The proposed drainage plan is divided into ten (10) basins which all basins drain easterly to Meadow Creek. The weighted C value comprises of impervious areas (C=1.0), pervious areas (C=0.2), and pervious pavement (C=0.6). The proposed horse staging relocation area south of Grand Avenue will be developed with sand dunes and a dirt base. The hydrologic conditions will remain unchanged and considered not to increase the pre-development hydrologic conditions. The following is a summary of post-development conditions:

TABLE 3: POST-DEVELOPMENT SUMMARY W/ NO DETENTION

Basin	Area (acre)	Impervious Percentage	Q2 (cfs)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
PR-1A	0.831	49.56	0.69	1.14	1.29	1.64
PR-1B	0.398	60.89	0.38	0.63	0.71	0.90
PR-1C	0.518	61.06	0.86	1.18	1.28	1.18
PR-2	0.725	45.68	0.57	0.94	1.07	1.35
PR-3	0.476	46.01	0.38	0.62	0.70	0.89
PR-4	0.974	13.31	0.42	0.69	0.78	0.98
PR-5	1.309	32.32	1.05	1.73	1.95	2.48
PR-6	1.150	57.03	1.19	1.95	2.20	2.80
PR-7	1.199	54.76	1.3	2.02	2.28	2.90
PR-8	2.922	85.86% for 100yr; 83.39% all other storm events	3.55	5.83	6.59	8.55
TOTAL	**10.502**	**56.13% for 100yr; 55.44% all other storm events**	**10.32**	**16.72**	**18.86**	**23.67**

See Attachment 4 for a summary of the area, C calculations, and hydrologic calculations.
See Attachment 8 for the existing hydrology map.

The proposed impervious percentage is 58.83 and has increased 0.61 percent based on affected areas of the 100 year inundation. The difference in post construction runoff and volume is indicated in the tables below. The following is a comparison summary of pre- and post-development (no detention) conditions:

TABLE 4: PRE- AND POST-DEVELOPMENT COMPARISON W/ NO DETENTION				
Basin	**Q2 (cfs)**	**Q10 (cfs)**	**Q25 (cfs)**	**Q100 (cfs)**
EXISTING	**7.72**	**12.69**	**14.34**	**22.33**
PROPOSED	**10.32**	**16.72**	**18.86**	**23.67**
DIFFERENCE	**2.60**	**4.03**	**4.52**	**1.34**

TABLE 5: PRE- AND POST-DEVELOPMENT 100 YEAR VOLUME COMPARISON W/ NO DETENTION	
Basin	**Q100 (Acre-ft)**
EXISTING	2.760
PROPOSED	2.873
DIFFERENCE	**0.113**

Based on the post development flows, the project will be utilizing the detention basins to decrease the post peak discharge and volume to the pre-development conditions.

Detention Calculations

The detention basin will be designed and evaluated utilizing an inflow hydrograph, stage-storage relationships, and the stage-discharge relationships for the outlet structures. HydroCAD Version 9.10 was utilized for the analysis. Curve Numbers were adjusted for each basin to reflect the runoff from the rational method fro the Grover Beach requirements. Below is a table of the post runoff with detention (See Attachment 5):

TABLE 6: POST-DEVELOPMENT SUMMARY WITH DETENTION						
Basin	**Area (acre)**	**Impervious Percentage**	**Q2 (cfs)**	**Q10 (cfs)**	**Q25 (cfs)**	**Q100 (cfs)**
PR-1A	0.831	49.56	*0.14*	*0.18*	*0.18*	*0.21*
PR-1B	0.398	60.89	*0.16*	*0.20*	*0.21*	*0.24*
PR-1C	0.518	61.06	*0.24*	*0.34*	*0.35*	*0.33*
PR-2	0.725	45.68	*0.58*	*0.20*	*0.21*	*0.24*
PR-3	0.476	46.01	*0.11*	*0.15*	*0.16*	*0.18*
PR-4	0.974	13.31	*0.08*	*0.13*	*0.14*	*0.16*
PR-5	1.309	32.32	*0.17*	*0.22*	*0.24*	*0.27*
PR-6	1.150	57.03	1.19	1.95	2.20	2.80
PR-7	1.199	78.47	1.23	2.02	2.28	2.90
PR-8	2.922	85.86% for 100yr; 83.39% all other storm events	3.55	5.83	6.59	8.55
TOTAL	**10.502**	**56.13% for 100yr; 55.44% all other storm events**	**7.45**	**11.22**	**12.56**	**15.88**

TABLE 7: PRE- AND POST-DEVELOPMENT COMPARISON WITH DETENTION				
Basin	**Q2 (cfs)**	**Q10 (cfs)**	**Q25 (cfs)**	**Q100 (cfs)**
EXISTING	7.72	12.69	14.34	22.33
PROPOSED	7.45	11.22	12.56	15.88
DIFFERENCE	**0.27**	**1.47**	**1.78**	**6.45**

TABLE 8: PRE- AND POST-DEVELOPMENT 100 YEAR VOLUME COMPARISON WITH DETENTION	
Basin	**Q100 (Acre-ft)**
EXISTING	2.760
PROPOSED	2.761
DIFFERENCE	**-0.001**

Ponding Requirements

Per the City of Grover Beach Standards and Specifications Section 505 G 12.1., proposed developments are subject to volume capacity requirements. Below is a summary of the capacity requirements for each proposed basin:

Basin Number	Total Area SF	% Coverage	Pond Capacity Req.* CF
PR-1A	36,210.497	49.56%	5,832
PR-1B	17,326.633	60.89%	3,429
PR-1C	22,559.270	61.06%	4,477
PR-2	31,602.330	45.68%	4,691
PR-3	20,753.345	46.01%	3,103
PR-4	42,421.926	13.31%	1,835
PR-5	57,034.000	32.32%	5,991
PR-6	50,093.100	57.03%	9,284
PR-7	52,225.806	78.47%	13,319
PR-8	127,269.985	85.86%	35,514
TOTAL	457,496.892	5.302	788,312

*The capacity requirement is assumed to be for the 100 year storm interval.
**Basins will be designed for water quality only.

It is interpreted that the city's ponding requirements is intended to compensate for the 100 year increase in runoff from pre- to post development conditions and to provide water quality treatment. The preliminary grading plan proposes storage ponds that satisfy the city requirement for basins PR-1A, 1B, 1C, 2, 3, 4, and 5 above the 100 year flood elevation. However, due to site constraints including the 100 year flood elevation of 8.0 (CGB), providing ponding basins (above or below ground) for the remaining hydrological basins would not be physically achievable.

In order to satisfy the city's storage requirements, it is proposed to utilize the proposed ponds in basins PR-1A, 2, 3, and 5 for detention. The ponds will be designed as detention basins which will decrease the post-development runoff to pre-existing runoff rates for the entire project. The detention basins will also act as volume-based treatment control BMPs for basins PR-1A, 1B, 1C, 2, 3, and 5. The detention basins will drain easterly into Meadow Creek and will not co-mingle with

any untreated runoff.

Basins PR-6, 7, and 8 will not include a dedicated storage but will be designed to treat the 24-hours, 85th percentile rainfall depth. Post BMPs will include pervious pavement, vegetated swales, and bio-infiltration basins.

STORM WATER MANAGEMENT

The project will comprise of Low Impact Development (LID) techniques, along with volume and flow based treatment control BMPs.

Low Impact Design (LID) uses site based planning and design strategies to manage the quantity and quality of stormwater runoff. The proposed LID design will reduce the amount of runoff by mimicking the natural hydraulic function of the existing development site. The design will promote infiltration and using landscape features, and detention basins to filter, slow, and infiltrate surface runoff at the source.

All basins will drain into landscape areas, detention basins, and bio-infiltration basins. Onsite impervious areas will be directed into pervious landscaping and promote infiltration to maximum extent possible. Runoff from parking lots will be directed to landscape areas and then into bio-infiltration basins.

The project will utilize the proposed detention basins and bio-infiltration basins for water quality purposes and will be design according to the Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87, ASCE 1998. See Attachment 6 for the water quality calculations.

The detention basins will incorporate a storm drain control structure which will control the proposed runoff for the 100 year flood, 85th percentile (first flush), and the LEED storm water quality and quantity requirements.

Maintenance of BMPS and Storm Water Structures

The proposed bmps and storm drain structures that will require maintenance are as follows:

1. Detention basins and bio-infiltration basins
2. Vegetated Swales
3. Rip Rap energy dissipators
4. Storm drain systems including catch basins and cleanouts.

Maintenance will be required and monitoring will be implemented in order to maintain the performance of the drainage system. The detention structures will have to be maintained on a quarterly basis and after every storm event.

SUMMARY AND CONCLUSIONS

The proposed site drainage will mimic the existing conditions and will discharge into Meadow Creek. Due to the project being within the 100 year flood plain, the project will propose detention basins satisfying the City of Grover Beach's ponding requirements to the maximum extent feasible. Detention basins will be proposed on the western area of the project above the 100 year flood elevation. The eastern area of the project is within the 100 year flood elevation and providing detention basins would not be possible. In order to satisfy the City of Grover Beach's ponding requirement for the entire project, the detention basins on the western side of the project is designed to reduce the peak runoff and volume to pre-existing conditions. The eastern side of the project will propose a combination of pervious pavement, bio-infiltration, and vegetated swales to treat the 85th percentile (first flush) storm events.

Impervious areas will be directed into pervious landscaping and promote infiltration to maximum extent possible. The velocity of the proposed runoff will be calculated and the drainage system will be designed to minimize scouring. Onsite runoff will be separated, treated, and then discharged into the natural drainage course.

DECLARATION OF RESPONSIBLE CHARGE

I, hereby declare that I am the Engineer of Work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the business and professions code, and that the design is consistent with current standards.

I understand that the check of project drawings and specifications by the City of the City of Grover Beach is confined to a review only and does not relieve me, as Engineer of Work of my responsibility for project design.

ENGINEER OF WORK:

Construction Testing and Engineering, Inc.
1441 Montiel Road, Suite 115
Escondido, CA 92026

1/19/12

David V. Caron
R.C.E. 70066 Exp.9-30-12

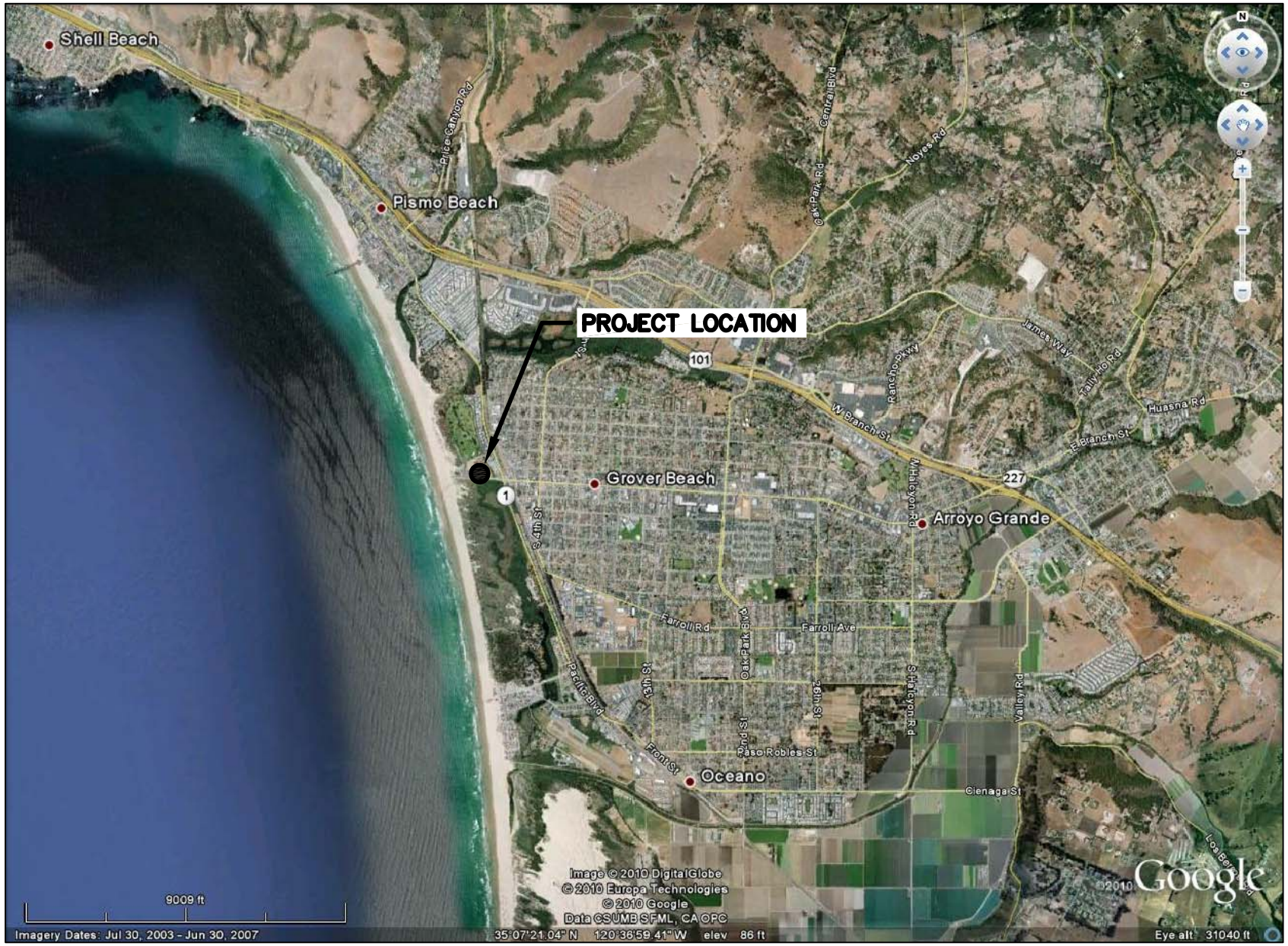
Date

REFERENCES

1. Standard and Specifications, City of Grover Beach Community Development Department, 2007.
2. Stormwater Management Program, City of Grover Beach, September 2008 Draft.
3. Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) USDA. Rational method for basins less than 1 square mile.
4. Hydraulic Engineering Circular No. 22, Second Edition, Publication FHWA-NHI-01-021, August 2001.
5. HydroCAD, Version 9.10. 2010 HydroCAD Software Solutions LLC.
6. United States Department of Agriculture, Natural Resource Conservation Service (NRCS).
7. USDA Natural Resources Conservation Service Web Soil Survey.
8. Bentley FLOWMASTER, Version 8.11.01.03, 2009.
9. Urban Stormwater Hydrology, A Guide to Engineering Calculations, A. Osman Akan, 1988.
10. Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual and Report on Engineering Practice No. 87, ASCE 1998.

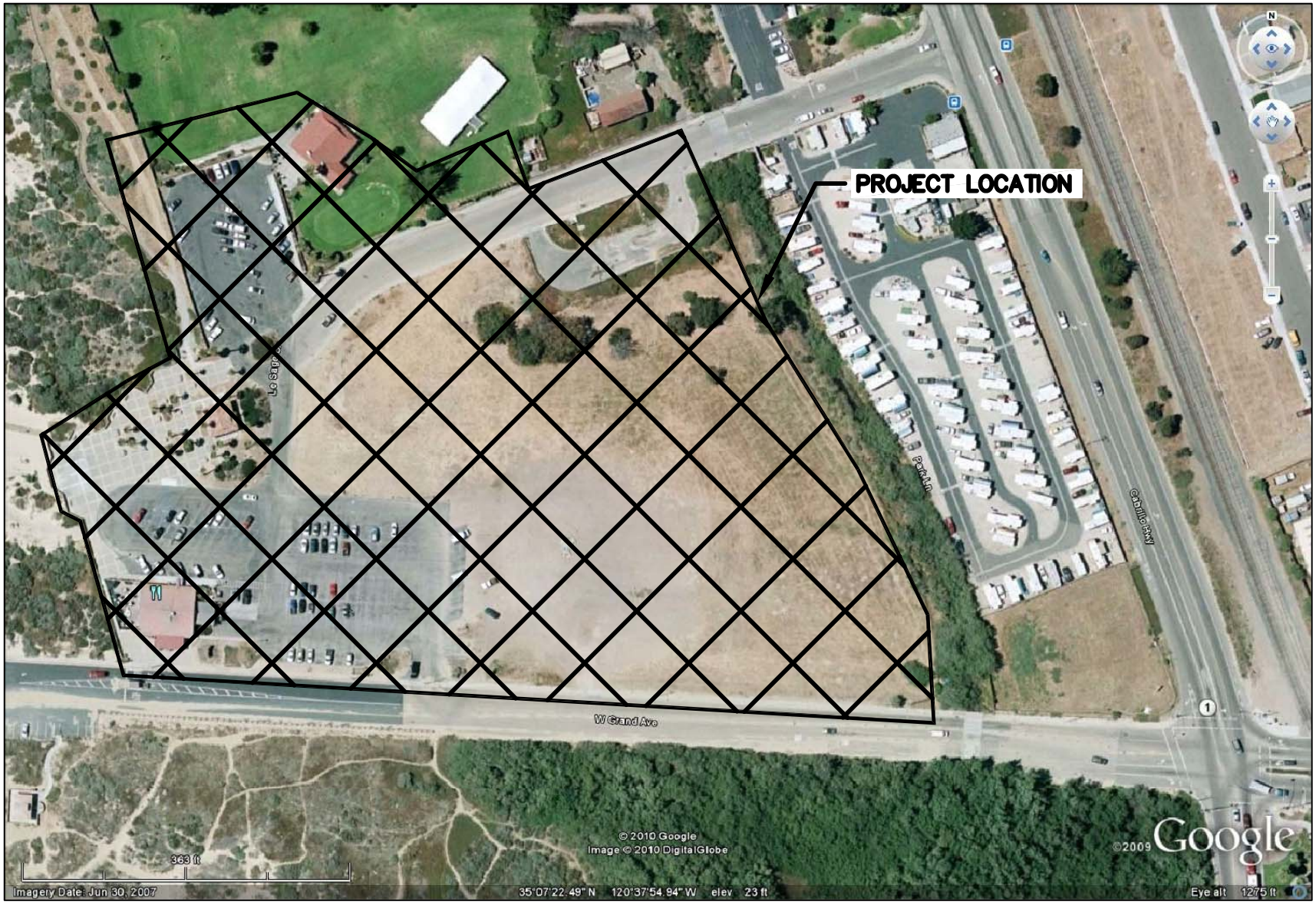
ATTACHMENT 1

VICINITY AND SITE LOCATION MAP



SITE VICILINTY MAP

DATE: 10-4-10	GROVER BEACH LODGE GROVER BEACH, CALIFORNIA	
SCALE: AS SHOWN		DRAWN BY: D.CARON



SITE MAP

DATE: 10-4-10

SCALE: AS SHOWN

GROVER BEACH LODGE

GROVER BEACH, CALIFORNIA

DRAWN BY: D.CARON

ATTACHMENT 2

100 YEAR FLOOD MAP
SOIL MAP
CITY STANDARD DRAWINGS

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations tables in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations tables should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 10. The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1994 or later.

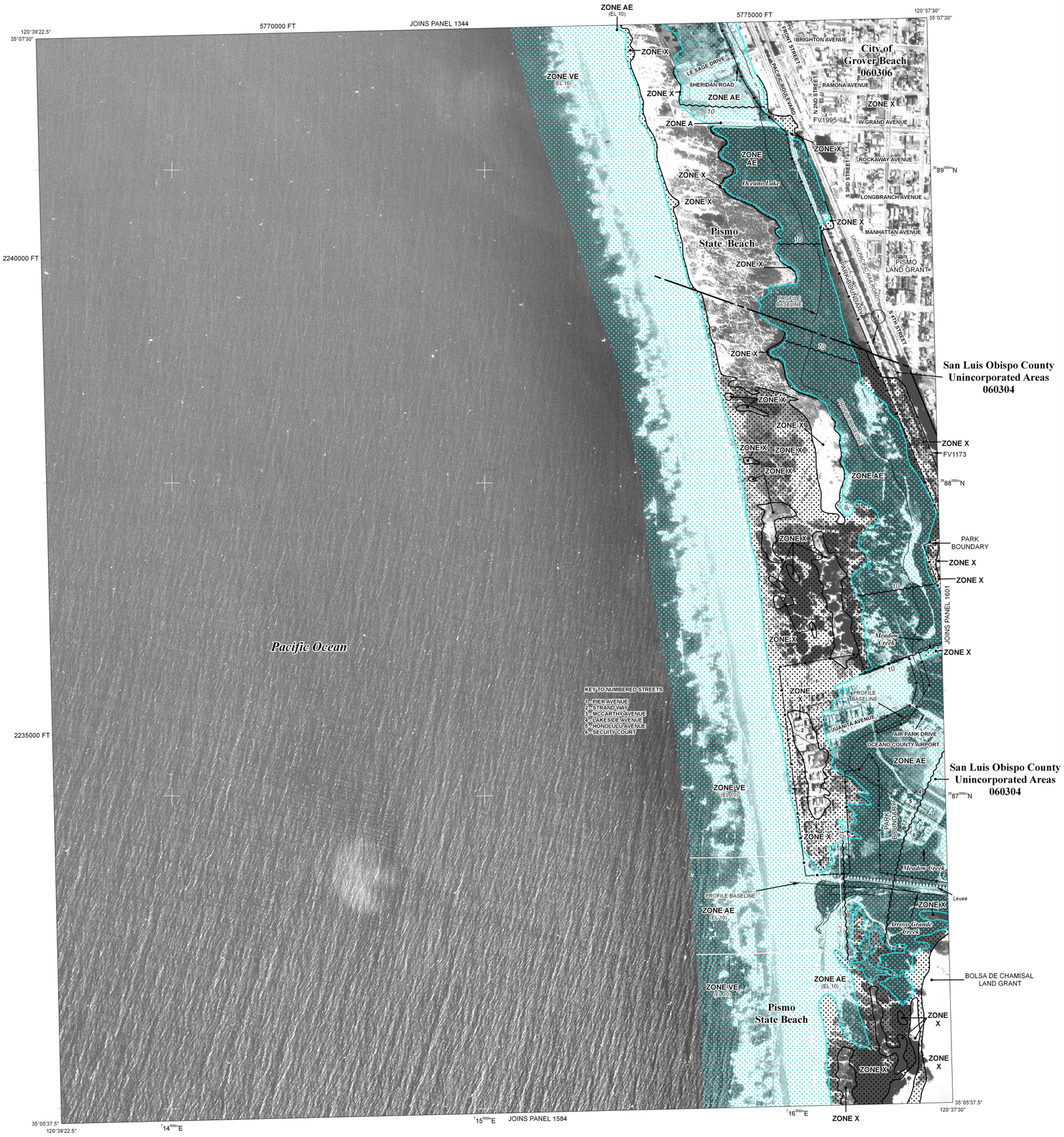
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary

0.2% annual chance floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the National Geodetic Vertical Datum of 1929

A — A	Cross section line
23 - - - - 23	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
$^{24}76^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 10
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone V (FIPSZONE 0405), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 28, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

N

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1582F

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 1582 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GROVER BEACH, CITY OF	060306	1582	F
SAN LUIS OBISPO COUNTY	060304	1582	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
06079C1582F

EFFECTIVE DATE
AUGUST 28, 2008

Federal Emergency Management Agency

Map Scale: 1:1,670 if printed on A size (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Oceans

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:1,680 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 4, Jan 2, 2008

Date(s) aerial images were photographed: 6/26/2005

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — San Luis Obispo County, California, Coastal Part				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
124	Corralitos sand, 0 to 2 percent slopes	A	7.4	65.5%
125	Corralitos sand, 2 to 15 percent slopes	A	0.8	6.9%
134	Dune land	A	3.1	27.6%
Totals for Area of Interest			**11.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

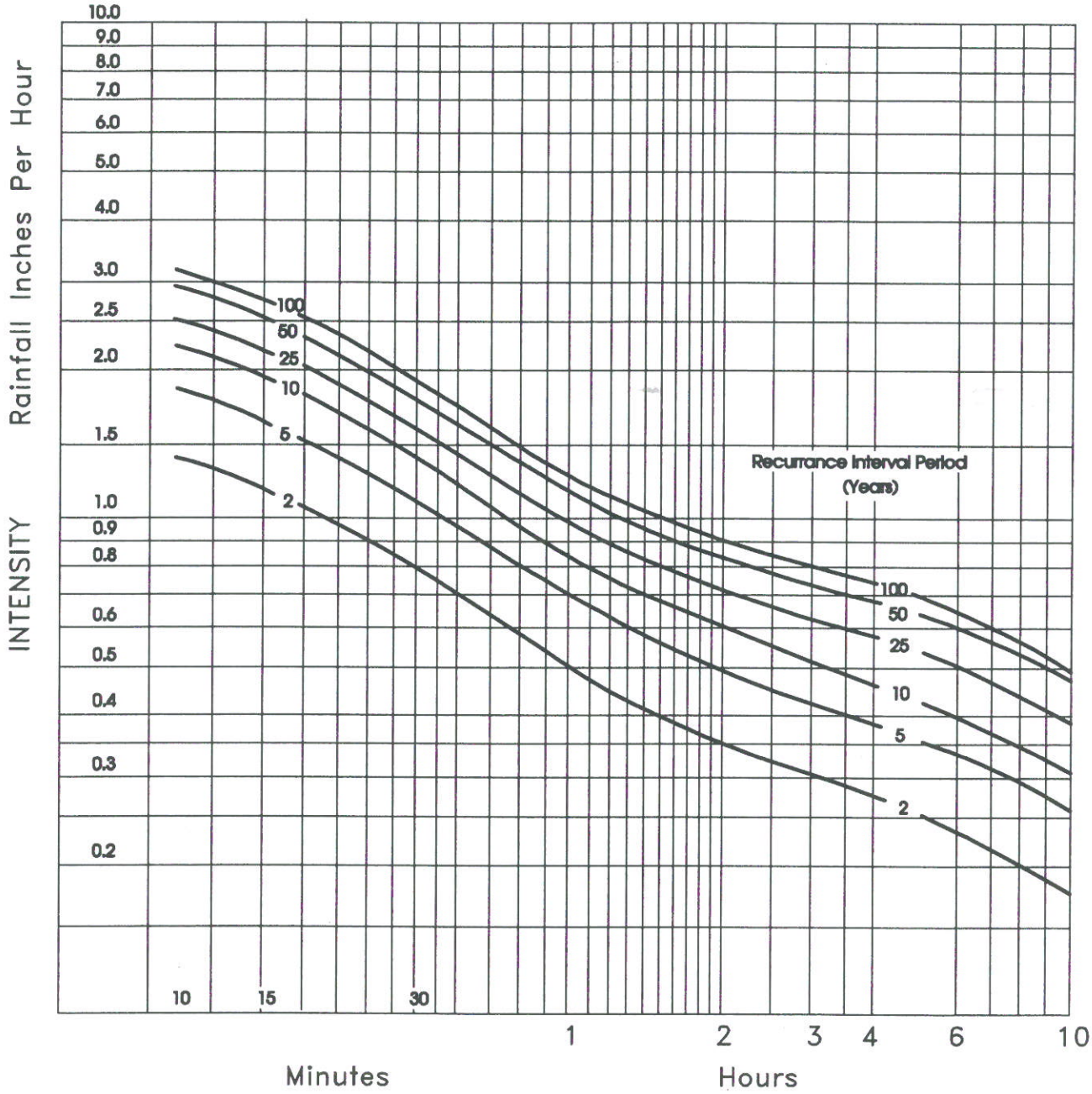
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Lower

City of Grover Beach: 16 inches Annual Average Rainfall



See Drawings D.2 and D.3

Approved:

7 Nov 07

Director of Public Works/ Designee

7 Nov 07

R. James Garing, RCE 26993
City Engineer

REGISTERED PROFESSIONAL ENGINEER
R. JAMES GARING
No. 26993
Exp. 3-31-09
CIVIL
STATE OF CALIFORNIA

City of Grover Beach

Rainfall Intensity Duration Curve

D.1

corrected 7 Nov 07

New Development in areas of sand shall use the total percentage of coverage of the site or lot as the runoff factor or coefficient of runoff. Coverage is to include roofs of all structures, all paved areas, pools and other water features, infiltration basins, and all other non-pervious coverage of the lot.

Use the following coefficients when studying large areas—not for new development.

Type of Development	Type of Soil**	Coefficient of runoff for Slope* <2%	2% to 10%	>10%
20,000 Sq. Ft.	c	.35	.40	.45
	s	.25	.35	.40
10,000 Sq. Ft.	c	.40	.45	.55
	s	.30	.40	.45
6,000 Sq. Ft.	c	.45	.55	.65
	s	.35	.40	.50
Apartments	c	.50	.60	.70
	s	.40	.50	.60
Industrial	c	.55	.65	.75
	s	.45	.55	.65
Commercial	c	.75	.80	.85
	s	.70	.75	.80
Dense Vegetation	c	.15	.25	.35
	s	.10	.15	.20
Moderate Vegetation	c	.20	.30	.40
	s	.15	.20	.25
Sparse Vegetation	c	.25	.35	.45
	s	.20	.25	.30
Impervious: paved, etc.	–	1.0	1.0	1.0

*Note: These values are intended to be a minimum. Higher values may be required by the City Engineer and/or Community Development Director.

**Note: Soil Type
C = Clay, Adobe, Rock Material
S = Sand, Gravel, Loam, or Pervious Material

See Drawings D.1 and D.3

Approved:

29 JUNE 07
Director of Public Works/
Designee

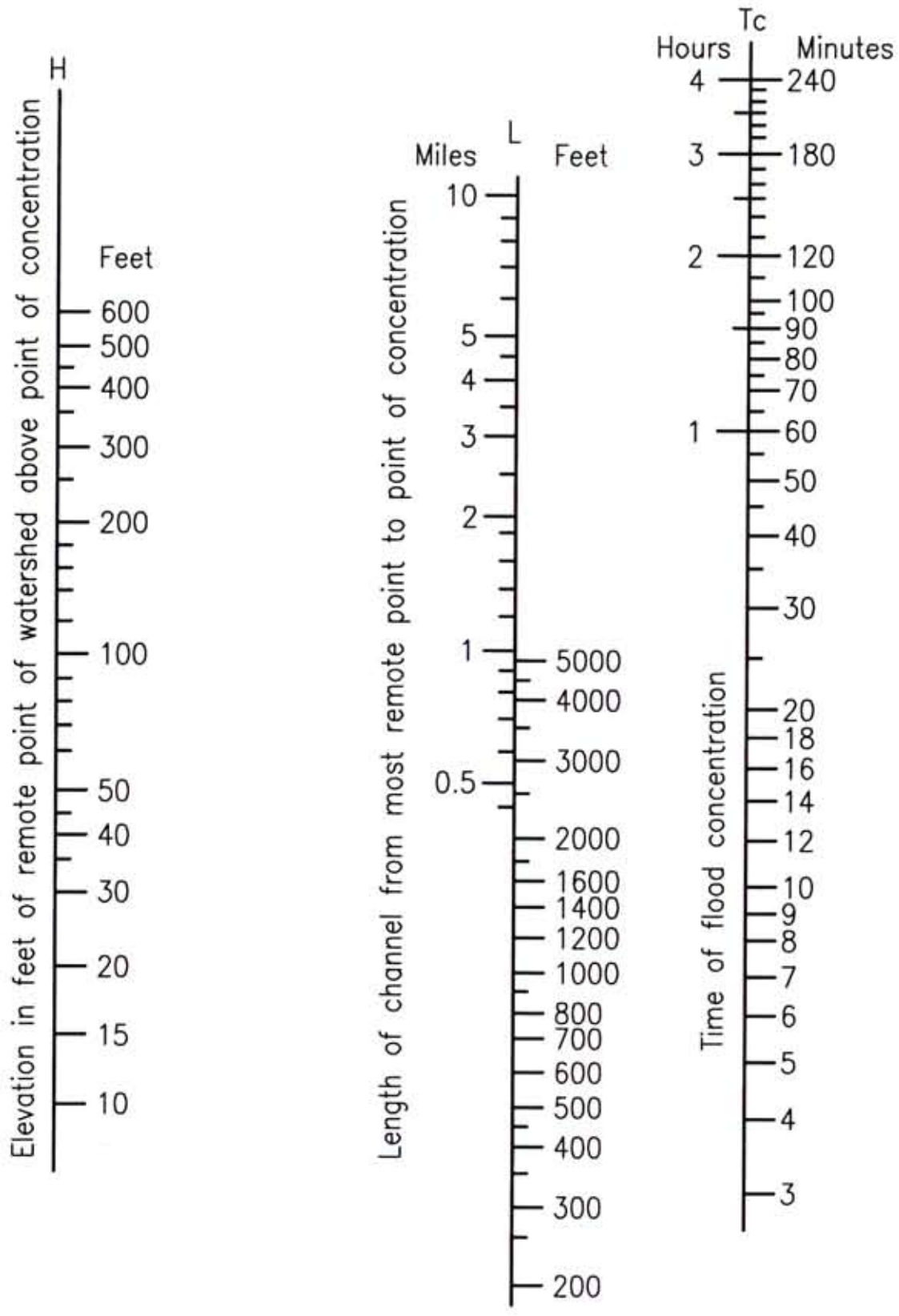
29 June 07
R. James Garing, RCE 26993
City Engineer

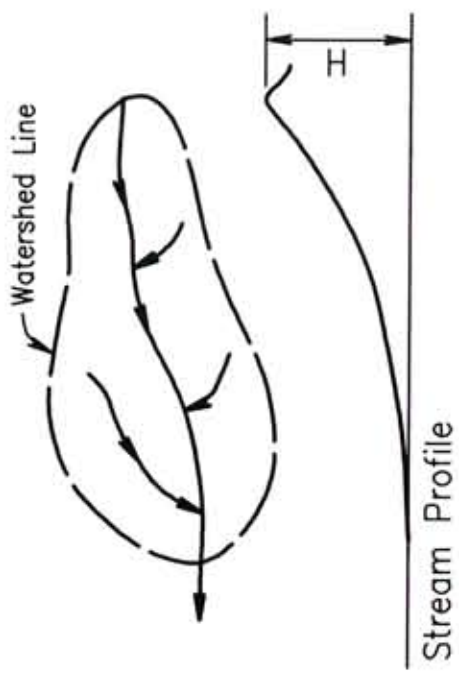
REGISTERED PROFESSIONAL ENGINEER
R. JAMES GARING
No. 26993
Exp. 3-31-09
CIVIL
STATE OF CALIFORNIA

City of Grover Beach

Table of Coefficient Runoff Chart

D.2





Equations for estimated "Time of Concentration"

$$Tc = \left(\frac{11.9L^3}{H}\right) 0.385$$

Tc = Time of Concentration in hours.

L = Length of Channel in miles.

H = Difference in elevation between most remote point & point of concentration.

This nomograph is to be limited to areas of 200 acres or less.

See Drawings D.1 and D.2

Approved:

29 JUNE 07

Director of Public Works/ Designee

29 June 07

R. James Garing, RCE 26993
City Engineer

REGISTERED PROFESSIONAL ENGINEER
R. JAMES GARING
No. 26993
Exp. 3-31-09
CIVIL
STATE OF CALIFORNIA

City of Grover Beach Nomograph

For Determining "Time of Concentration" of Small Drainage Basins

D.3

ATTACHMENT 3

EXISTING HYDROLOGIC CALCULATIONS

AREA CALCULATIONS

EXISTING HYDROLOGIC BASINS FOR 100 YEAR STORM

Basin Number	Total Area SF	Total Area Acres	Impervious Area SF	Impervious Area Acres	Percent Impervious	C Value Weighted
EX-1	308,187.000	7.075	145,831.300	3.348	47.32%	0.58
EX-2	149,265.350	3.427	108,151.420	2.483	72.46%	0.78
TOTAL	457,452.350	10.502	253,982.720	5.831	55.52%	0.64

*C values per City of Grover Beach Standards Table of Coefficient Runoff Chart D.2.

EXISTING HYDROLOGY TABLE

100 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
EX-1	17.00	10.00	7.00	400.00	0.08	1.75%	3.50	3.30	0.58	7.075	13.51
EX-2	18.50	7.00	11.50	785.00	0.15	1.46%	6.00	3.30	0.78	3.427	8.82
TOTAL											**22.33**

25 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
EX-1	17.00	10.00	7.00	400.00	0.08	1.75%	3.50	2.60	0.40	7.075	7.39
EX-2	18.50	7.00	11.50	785.00	0.15	1.46%	6.00	2.60	0.78	3.427	6.95
TOTAL											**14.34**

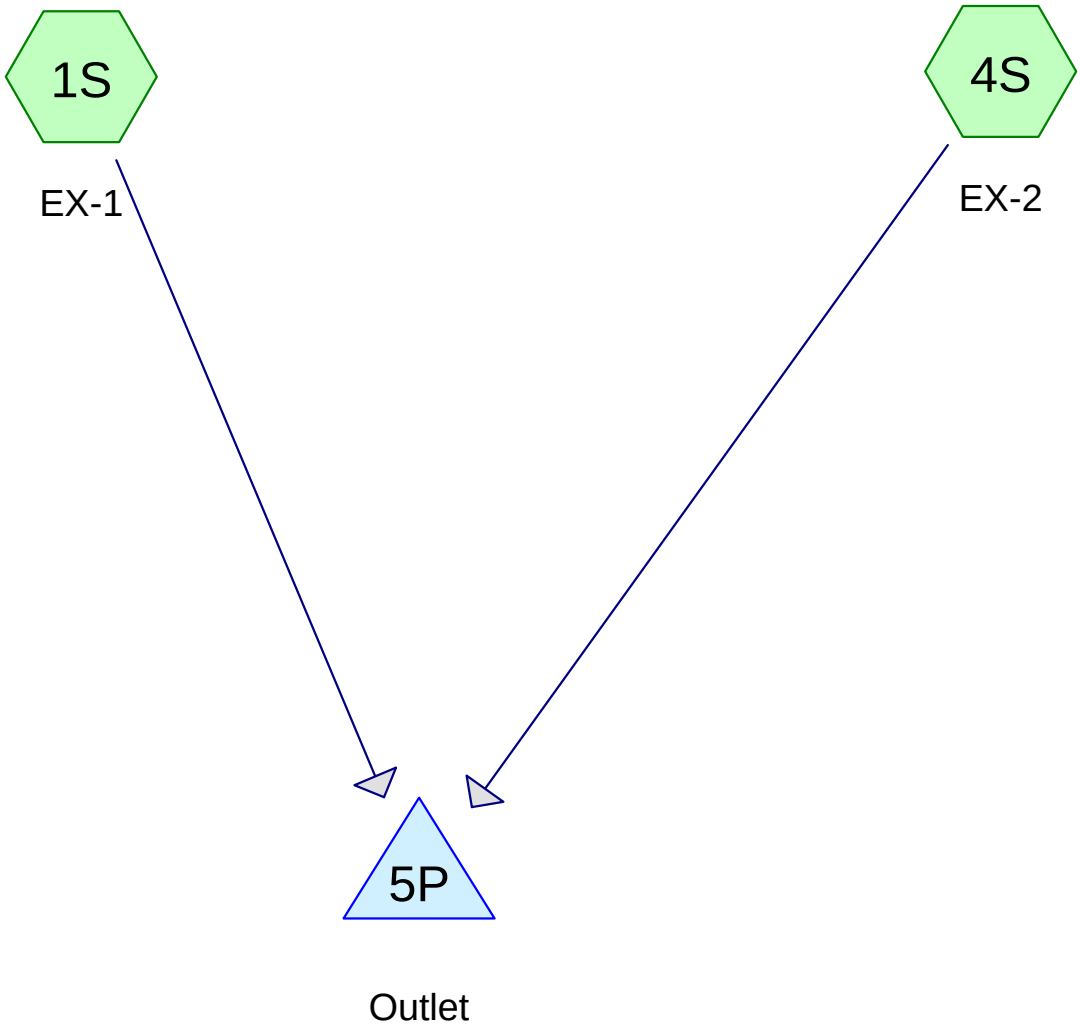
10 YEAR STORM

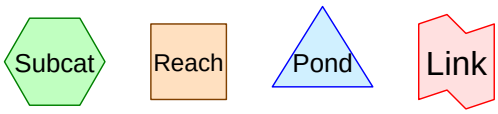
Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
EX-1	17.00	10.00	7.00	400.00	0.08	1.75%	3.50	2.30	0.40	7.075	6.54
EX-2	18.50	7.00	11.50	785.00	0.15	1.46%	6.00	2.30	0.78	3.427	6.14
TOTAL											**12.69**

2 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
EX-1	17.00	10.00	7.00	400.00	0.08	1.75%	3.50	1.40	0.40	7.075	3.98
EX-2	18.50	7.00	11.50	785.00	0.15	1.46%	6.00	1.40	0.78	3.427	3.74
TOTAL											**7.72**

*Time of concentration is per City of Grover Beach Nomograph Drawing No. D.3
*Intensity is per City of Grover Beach Nomograph Drawing No. D.1





Drainage Diagram for Grover Beach
Prepared by {enter your company name here}, Printed 11/22/2011
HydroCAD® 9.10 s/n 06659 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
7.075	71	(1S)
3.427	79	(4S)
10.502	74	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
10.502	Other	1S, 4S
10.502		**TOTAL AREA**

Time span=5.00-30.00 hrs, dt=0.03 hrs, 834 points
Runoff by SBUH method
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: EX-1 Runoff Area=7.075 ac Runoff Depth=2.90"
Tc=6.0 min CN=71 Runoff=13.97 cfs 1.709 af

Subcatchment 4S: EX-2 Runoff Area=3.427 ac Runoff Depth>3.68"
Tc=6.0 min CN=79 Runoff=8.96 cfs 1.051 af

Pond 5P: Outlet Inflow=22.93 cfs 2.760 af
Primary=22.93 cfs 2.760 af

Total Runoff Area = 10.502 ac Runoff Volume = 2.760 af Average Runoff Depth = 3.15"

Summary for Subcatchment 1S: EX-1

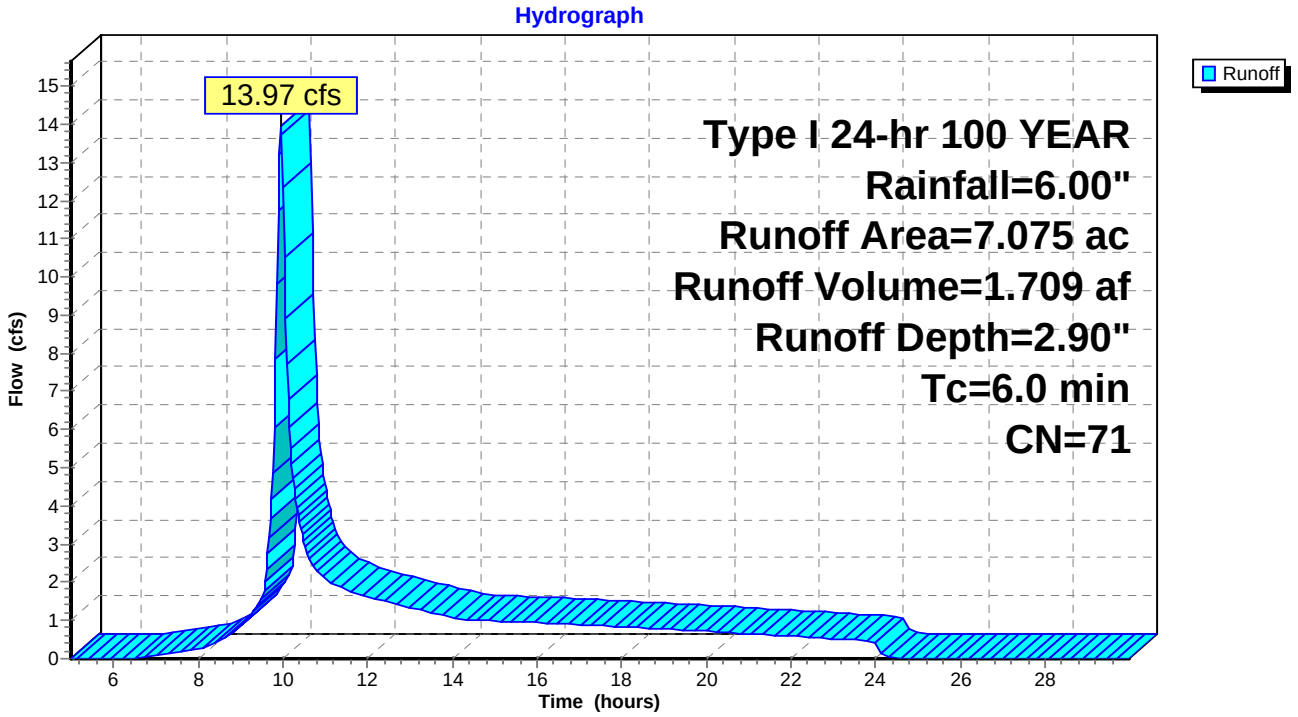
Runoff = 13.97 cfs @ 9.96 hrs, Volume= 1.709 af, Depth= 2.90"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (ac)	CN	Description
*	7.075	71	

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

Subcatchment 1S: EX-1



Summary for Subcatchment 4S: EX-2

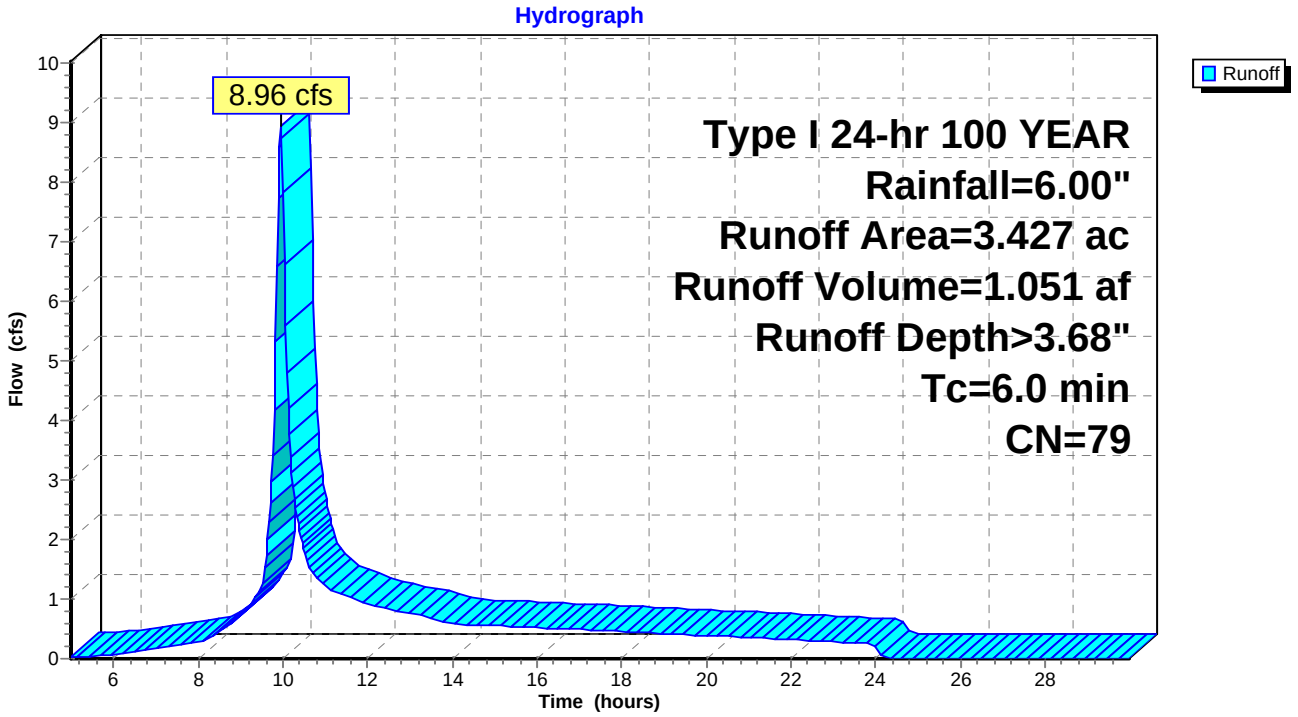
Runoff = 8.96 cfs @ 9.95 hrs, Volume= 1.051 af, Depth> 3.68"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (ac)	CN	Description
*	3.427	79	

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

Subcatchment 4S: EX-2



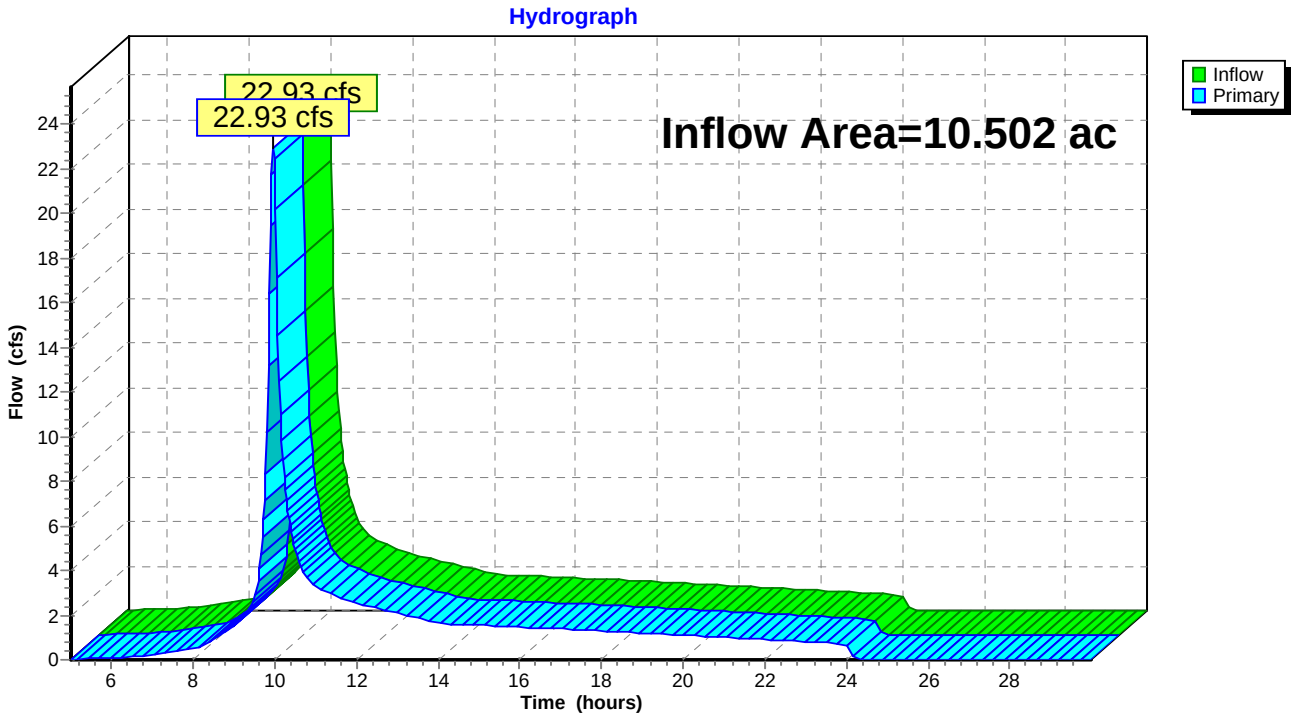
Summary for Pond 5P: Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.502 ac, Inflow Depth > 3.15" for 100 YEAR event
Inflow = 22.93 cfs @ 9.96 hrs, Volume= 2.760 af
Primary = 22.93 cfs @ 9.96 hrs, Volume= 2.760 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs

Pond 5P: Outlet



ATTACHMENT 4

PROPOSED HYDROLOGIC CALCULATIONS

AREA CALCULATIONS

PROPOSED HYDROLOGIC BASINS FOR 100 YEAR STORM EVENTS

Basin Number	Total Area SF	Total Area Acres	Impervious Area SF	Landscape Area SF	Pervious Pavement SF	Percent Impervious	C Value* Weighted
PR-1A	36,210.497	0.831	17,945.920	18,264.577	0.000	49.56%	0.60
PR-1B	17,326.633	0.398	10,550.244	6,776.389	0.000	60.89%	0.69
PR-1C	22,559.270	0.518	13,774.680	8,784.590	0.000	61.06%	0.69
PR-2	31,602.330	0.725	14,435.100	17,167.230	0.000	45.68%	0.57
PR-3	20,753.345	0.476	9,549.000	11,204.345	0.000	46.01%	0.57
PR-4	42,421.926	0.974	5,645.039	36,776.888	0.000	13.31%	0.31
PR-5	57,034.000	1.309	18,435.240	22,238.930	16,359.831	32.32%	0.57
PR-6	50,093.100	1.150	28,566.062	11,424.011	10,103.027	57.03%	0.74
PR-7	52,225.806	1.199	28,600.321	11,244.478	12,381.007	54.76%	0.73
PR-8	127,269.985	2.922	109,272.630	17,997.355	0.000	85.86%	0.89
TOTAL	457,496.892	10.502	256,774.235	161,878.793	38,843.864	56.13%	0.793

*C values per City of Grover Beach Standards Table of Coefficient Runoff Chart D.2.

PROPOSED HYDROLOGIC BASINS FOR OTHER STORM EVENTS

Basin Number	Total Area SF	Total Area Acres	Impervious Area SF	Landscape Area SF	Pervious Pavement SF	Percent Impervious	C Value* Weighted
PR-1A	36,210.497	0.831	17,945.920	18,264.577	0.000	49.56%	0.60
PR-1B	17,326.633	0.398	10,550.244	6,776.389	0.000	60.89%	0.69
PR-1C	22,559.270	0.518	13,774.680	8,784.590	0.000	61.06%	0.69
PR-2	31,602.330	0.725	14,435.100	17,167.230	0.000	45.68%	0.57
PR-3	20,753.345	0.476	9,549.000	11,204.345	0.000	46.01%	0.57
PR-4	42,421.926	0.974	5,645.039	36,776.888	0.000	13.31%	0.31
PR-5	57,034.000	1.309	18,435.240	22,238.930	16,359.831	32.32%	0.57
PR-6	50,093.100	1.150	28,566.062	11,424.011	10,103.027	57.03%	0.74
PR-7	52,225.806	1.199	28,600.321	11,244.478	12,381.007	54.76%	0.73
PR-8	127,269.985	2.922	106,126.760	21,143.225	0.000	83.39%	0.87
TOTAL	457,496.892	10.502	253,628.365	165,024.663	38,843.864	55.44%	0.790

*C values per City of Grover Beach Standards Table of Coefficient Runoff Chart D.2.

PROPOSED HYDROLOGY TABLE (no detention)

100 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
PR-1A	12.50	10.00	2.50	222.00	0.04	1.13%	2.00	3.30	0.60	0.831	1.64
PR-1B	12.50	9.00	3.50	170.00	0.03	2.06%	2.00	3.30	0.69	0.398	0.90
PR-1C	12.50	9.00	3.50	188.00	0.04	1.86%	2.00	3.30	0.69	0.518	1.18
PR-2	14.50	10.50	4.00	202.00	0.04	1.98%	2.00	3.30	0.57	0.725	1.35
PR-3	12.00	9.00	3.00	157.00	0.03	1.91%	2.00	3.30	0.57	0.476	0.89
PR-4	17.00	10.50	6.50	234.00	0.04	2.78%	2.00	3.30	0.31	0.974	0.98
PR-5	19.00	13.60	5.40	225.00	0.04	2.40%	2.80	3.30	0.57	1.309	2.48
PR-6	13.00	10.33	2.67	300.00	0.06	0.89%	3.00	3.30	0.74	1.150	2.80
PR-7	11.45	8.00	3.45	355.00	0.07	0.97%	2.80	3.30	0.73	1.199	2.90
PR-8	11.90	7.00	4.90	380.00	0.07	1.29%	4.00	3.30	0.89	2.922	8.55
TOTAL											**23.67**

25 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
PR-1A	12.50	10.00	2.50	222.00	0.04	1.13%	2.00	2.60	0.60	0.831	1.29
PR-1B	12.50	9.00	3.50	170.00	0.03	2.06%	2.00	2.60	0.69	0.398	0.71
PR-1C	12.50	9.00	3.50	188.00	0.04	1.86%	2.00	3.60	0.69	0.518	1.28
PR-2	14.50	10.50	4.00	202.00	0.04	1.98%	2.00	2.60	0.57	0.725	1.07
PR-3	12.00	9.00	3.00	157.00	0.03	1.91%	2.00	2.60	0.57	0.476	0.70
PR-4	17.00	10.50	6.50	234.00	0.04	2.78%	2.00	2.60	0.31	0.974	0.78
PR-5	19.00	13.60	5.40	225.00	0.04	2.40%	2.80	2.60	0.57	1.309	1.95
PR-6	13.00	10.33	2.67	300.00	0.06	0.89%	3.00	2.60	0.74	1.150	2.20
PR-7	11.45	8.00	3.45	355.00	0.07	0.97%	2.80	2.60	0.73	1.199	2.28
PR-8	11.90	7.00	4.90	380.00	0.07	1.29%	4.00	2.60	0.87	2.922	6.59
TOTAL											**18.86**

PROPOSED HYDROLOGY TABLE (no detention)

10 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
PR-1A	12.50	10.00	2.50	222.00	0.04	1.13%	2.00	2.30	0.60	0.831	1.14
PR-1B	12.50	9.00	3.50	170.00	0.03	2.06%	2.00	2.30	0.69	0.398	0.63
PR-1C	12.50	9.00	3.50	188.00	0.04	1.86%	2.00	3.30	0.69	0.518	1.18
PR-2	14.50	10.50	4.00	202.00	0.04	1.98%	2.00	2.30	0.57	0.725	0.94
PR-3	12.00	9.00	3.00	157.00	0.03	1.91%	2.00	2.30	0.57	0.476	0.62
PR-4	17.00	10.50	6.50	234.00	0.04	2.78%	2.00	2.30	0.31	0.974	0.69
PR-5	19.00	13.60	5.40	225.00	0.04	2.40%	2.80	2.30	0.57	1.309	1.73
PR-6	13.00	10.33	2.67	300.00	0.06	0.89%	3.00	2.30	0.74	1.150	1.95
PR-7	11.45	8.00	3.45	355.00	0.07	0.97%	2.80	2.30	0.73	1.199	2.02
PR-8	11.90	7.00	4.90	380.00	0.07	1.29%	4.00	2.30	0.87	2.922	5.83
TOTAL											**16.72**

2 YEAR STORM

Basin Number	High Elev feet	Low Elev feet	H Elev. Diff. feet	Flow Length Feet	Flow Length Miles	Slope Percent	Tc* Minutes	Intensity (I)** Inches/hour	C Value Weighted	Total Area Acres	Flow (Q) cfs
PR-1A	12.50	10.00	2.50	222.00	0.04	1.13%	2.00	1.40	0.60	0.831	0.69
PR-1B	12.50	9.00	3.50	170.00	0.03	2.06%	2.00	1.40	0.69	0.398	0.38
PR-1C	12.50	9.00	3.50	188.00	0.04	1.86%	2.00	2.40	0.69	0.518	0.86
PR-2	14.50	10.50	4.00	202.00	0.04	1.98%	2.00	1.40	0.57	0.725	0.57
PR-3	12.00	9.00	3.00	157.00	0.03	1.91%	2.00	1.40	0.57	0.476	0.38
PR-4	17.00	10.50	6.50	234.00	0.04	2.78%	2.00	1.40	0.31	0.974	0.42
PR-5	19.00	13.60	5.40	225.00	0.04	2.40%	2.80	1.40	0.57	1.309	1.05
PR-6	13.00	10.33	2.67	300.00	0.06	0.89%	3.00	1.40	0.74	1.150	1.19
PR-7	11.45	8.00	3.45	355.00	0.07	0.97%	2.80	1.40	0.73	1.199	1.23
PR-8	11.90	7.00	4.90	380.00	0.07	1.29%	4.00	1.40	0.87	2.922	3.55
TOTAL											**10.32**

*Time of concentration is per City of Grover Beach Nomograph Drawing No. D.3
*Intensity is per City of Grover Beach Nomograph Drawing No. D.1

Summary for Subcatchment 2S: PR_NO DETENTION

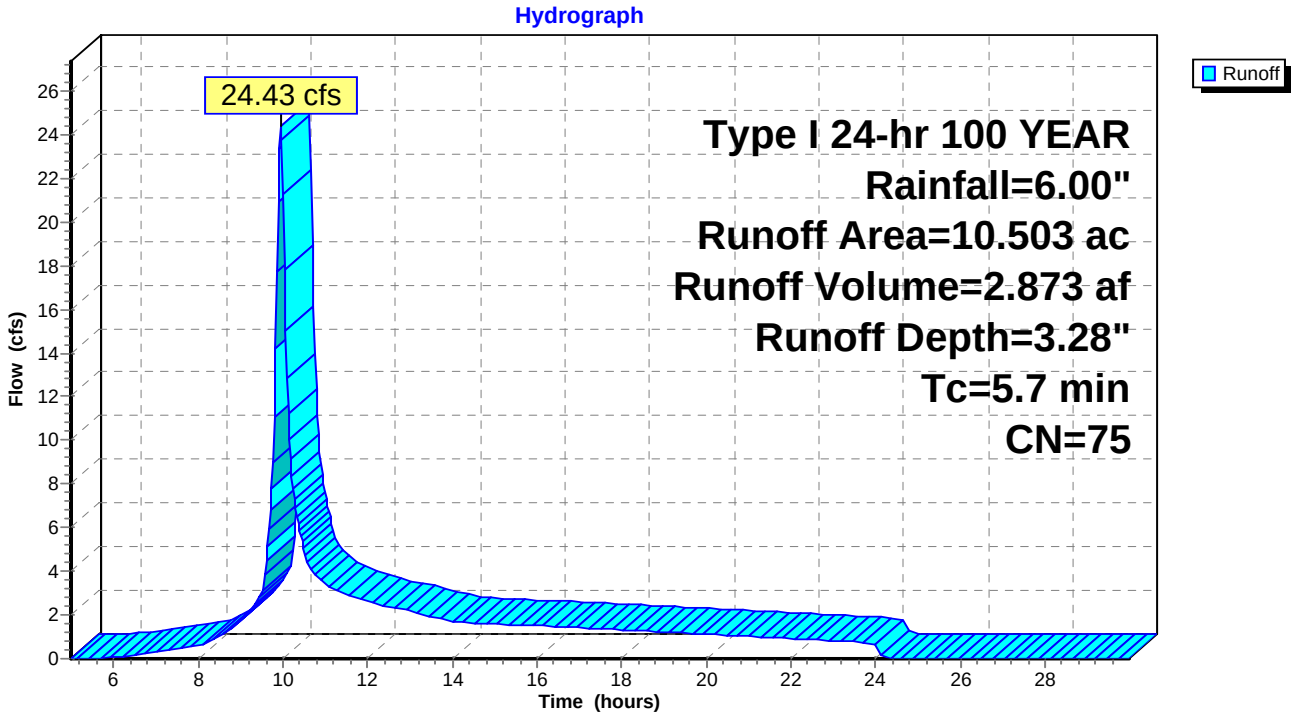
Runoff = 24.43 cfs @ 9.95 hrs, Volume= 2.873 af, Depth= 3.28"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (ac)	CN	Description
*	10.503	75	

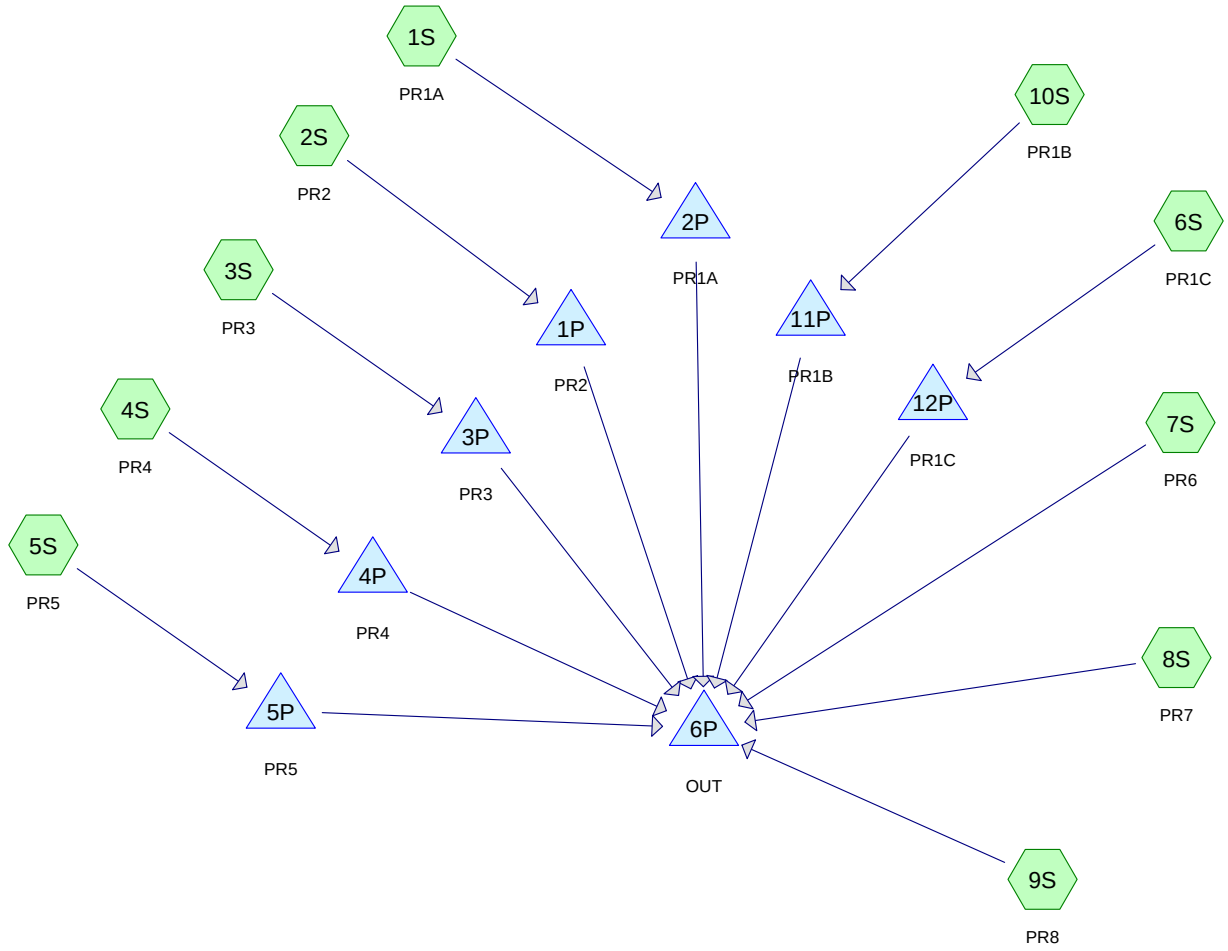
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7					**Direct Entry,**

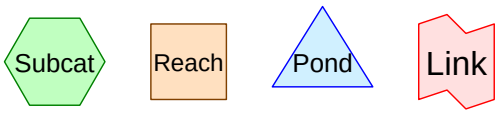
Subcatchment 2S: PR_NO DETENTION



ATTACHMENT 5

DETENTION CALCULATIONS





Drainage Diagram for Grover Proposed_det_11-22-11
Prepared by {enter your company name here}, Printed 11/23/2011
HydroCAD® 9.10 s/n 06659 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.974	57	(4S)
2.511	69	(2S, 3S, 5S)
0.831	70	(1S)
0.916	74	(6S, 10S)
1.199	75	(8S)
1.150	76	(7S)
2.922	82	(9S)
10.503	73	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
10.503	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S
10.503		**TOTAL AREA**

Time span=5.00-30.00 hrs, dt=0.03 hrs, 834 points
Runoff by SBUH method
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1S: PR1A Runoff Area=36,211 sf Runoff Depth=2.81"
Tc=5.0 min CN=70 Runoff=1.65 cfs 0.194 af

Subcatchment2S: PR2 Runoff Area=31,602 sf Runoff Depth=2.71"
Tc=5.0 min CN=69 Runoff=1.38 cfs 0.164 af

Subcatchment3S: PR3 Runoff Area=20,753 sf Runoff Depth=2.71"
Tc=5.0 min CN=69 Runoff=0.91 cfs 0.108 af

Subcatchment4S: PR4 Runoff Area=42,422 sf Runoff Depth=1.68"
Tc=5.0 min CN=57 Runoff=0.95 cfs 0.136 af

Subcatchment5S: PR5 Runoff Area=57,034 sf Runoff Depth=2.71"
Tc=5.0 min CN=69 Runoff=2.50 cfs 0.296 af

Subcatchment6S: PR1C Runoff Area=22,559 sf Runoff Depth=3.18"
Tc=5.0 min CN=74 Runoff=1.20 cfs 0.137 af

Subcatchment7S: PR6 Runoff Area=50,093 sf Runoff Depth=3.38"
Tc=5.0 min CN=76 Runoff=2.86 cfs 0.324 af

Subcatchment8S: PR7 Runoff Area=52,226 sf Runoff Depth=3.28"
Tc=5.0 min CN=75 Runoff=2.88 cfs 0.328 af

Subcatchment9S: PR8 Runoff Area=127,270 sf Runoff Depth>3.98"
Tc=5.0 min CN=82 Runoff=8.72 cfs 0.969 af

Subcatchment10S: PR1B Runoff Area=17,327 sf Runoff Depth=3.18"
Tc=5.0 min CN=74 Runoff=0.92 cfs 0.106 af

Pond 1P: PR2 Peak Elev=11.62' Storage=1,700 cf Inflow=1.38 cfs 0.164 af
Outflow=0.24 cfs 0.163 af

Pond 2P: PR1A Peak Elev=9.89' Storage=2,434 cf Inflow=1.65 cfs 0.194 af
Outflow=0.21 cfs 0.193 af

Pond 3P: PR3 Peak Elev=9.70' Storage=1,081 cf Inflow=0.91 cfs 0.108 af
Outflow=0.18 cfs 0.107 af

Pond 4P: PR4 Peak Elev=10.84' Storage=1,178 cf Inflow=0.95 cfs 0.136 af
Outflow=0.16 cfs 0.134 af

Pond 5P: PR5 Peak Elev=10.42' Storage=4,036 cf Inflow=2.50 cfs 0.296 af
Outflow=0.27 cfs 0.293 af

Pond 6P: OUT Inflow=15.65 cfs 2.753 af
Primary=15.65 cfs 2.753 af

Pond 11P: PR1B Peak Elev=10.17' Storage=859 cf Inflow=0.92 cfs 0.106 af
Outflow=0.24 cfs 0.106 af

Pond 12P: PR1C Peak Elev=9.60' Storage=1,269 cf Inflow=1.20 cfs 0.137 af
Outflow=0.33 cfs 0.137 af

Total Runoff Area = 10.503 ac Runoff Volume = 2.761 af Average Runoff Depth = 3.16"

Summary for Subcatchment 1S: PR1A

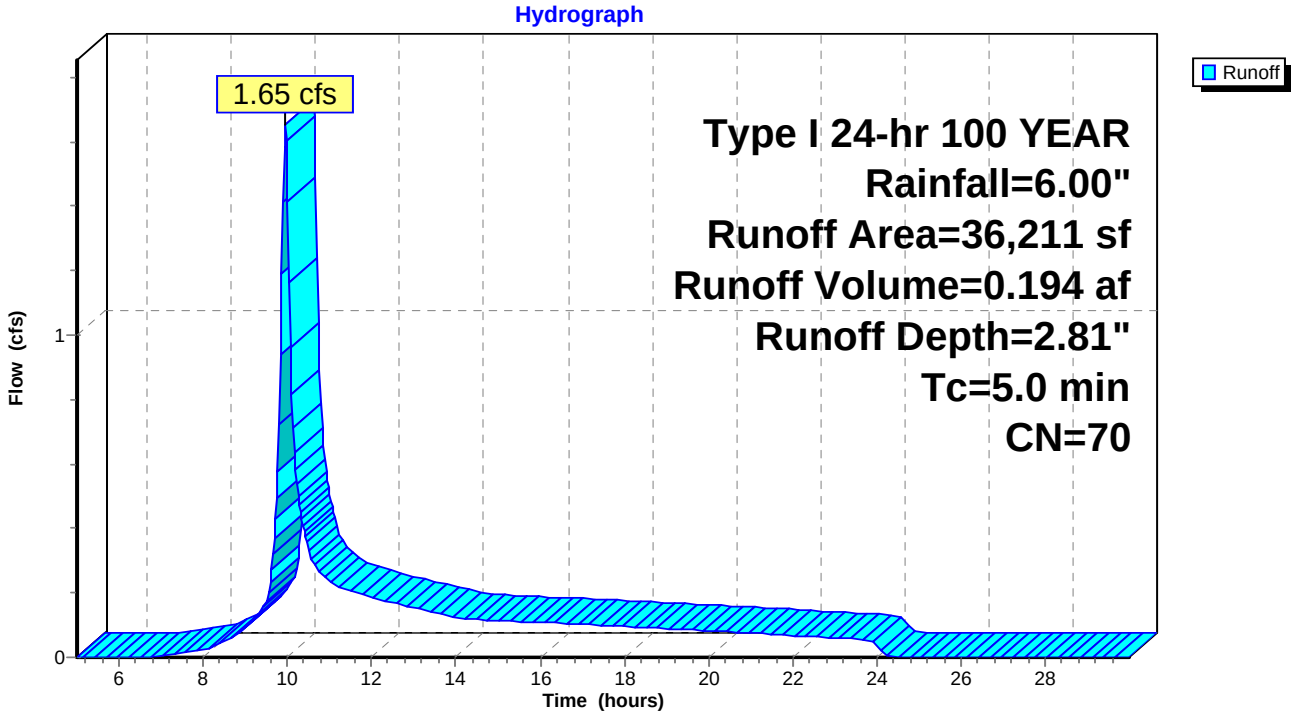
Runoff = 1.65 cfs @ 9.95 hrs, Volume= 0.194 af, Depth= 2.81"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	36,211	70	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1S: PR1A



Summary for Subcatchment 2S: PR2

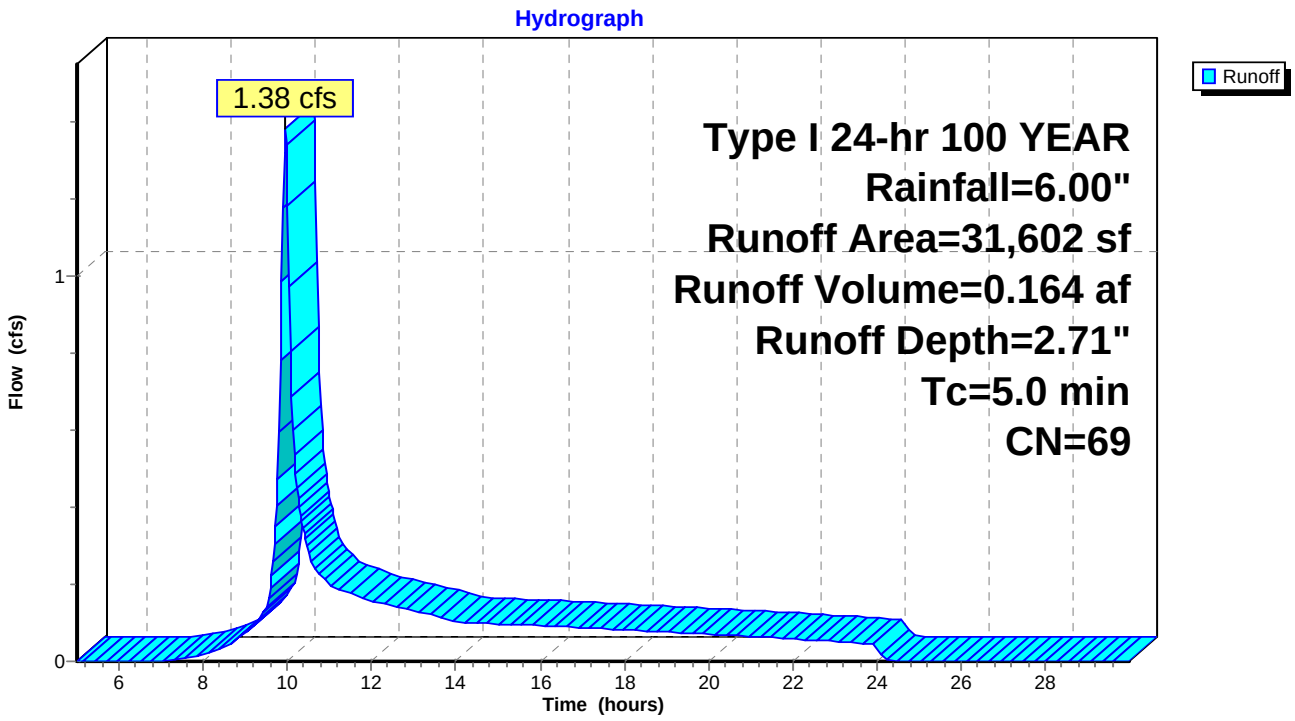
Runoff = 1.38 cfs @ 9.95 hrs, Volume= 0.164 af, Depth= 2.71"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	31,602	69	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2S: PR2



Summary for Subcatchment 3S: PR3

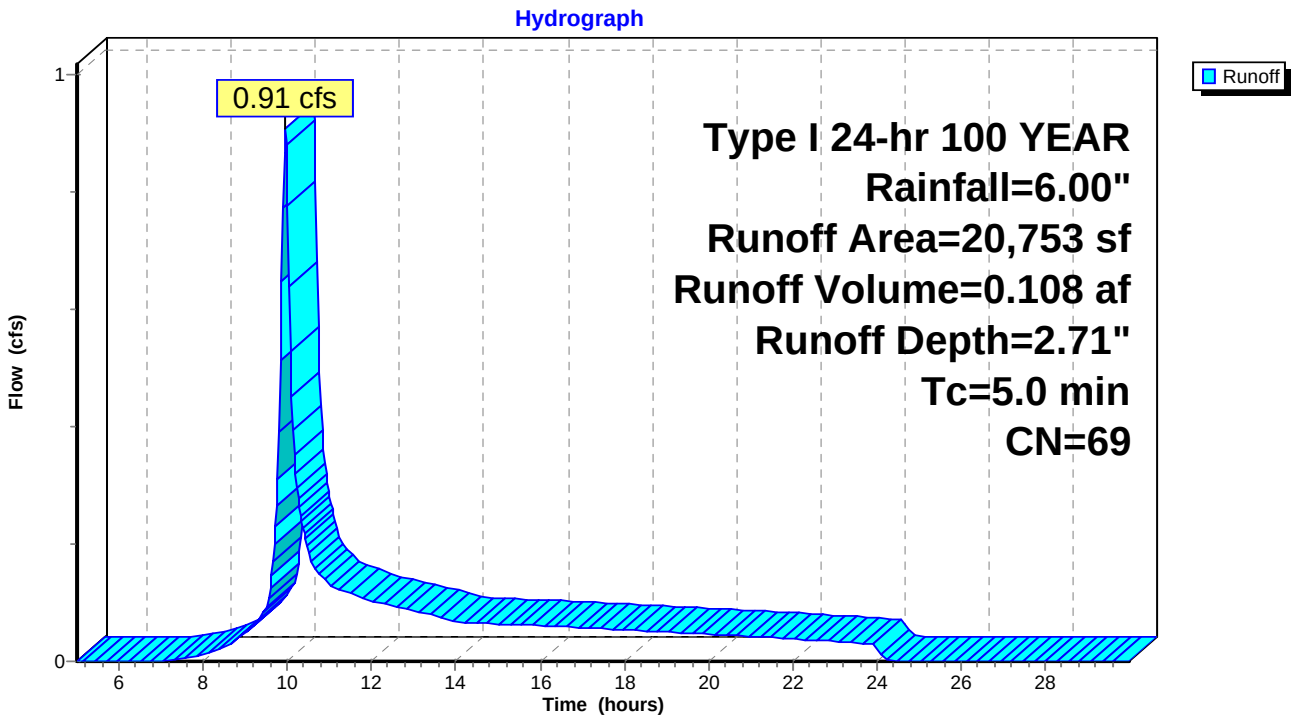
Runoff = 0.91 cfs @ 9.95 hrs, Volume= 0.108 af, Depth= 2.71"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	20,753	69	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3S: PR3



Summary for Subcatchment 4S: PR4

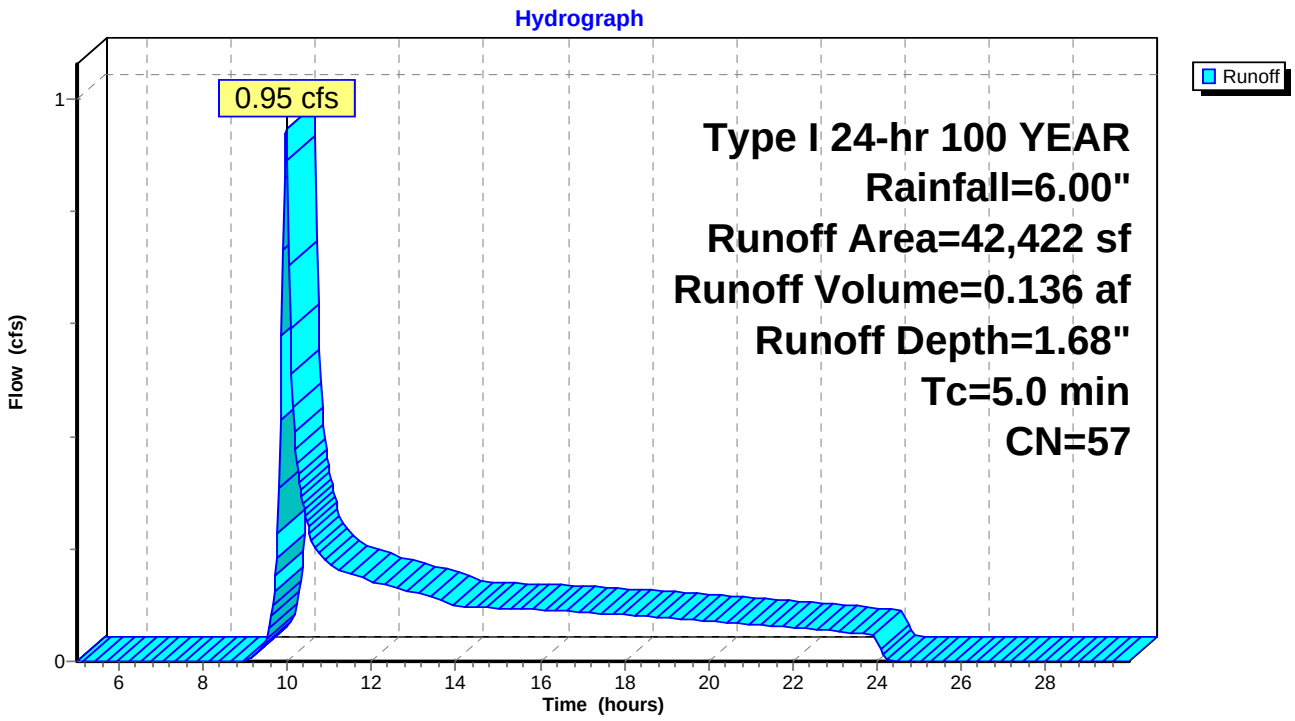
Runoff = 0.95 cfs @ 9.96 hrs, Volume= 0.136 af, Depth= 1.68"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	42,422	57	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: PR4



Summary for Subcatchment 5S: PR5

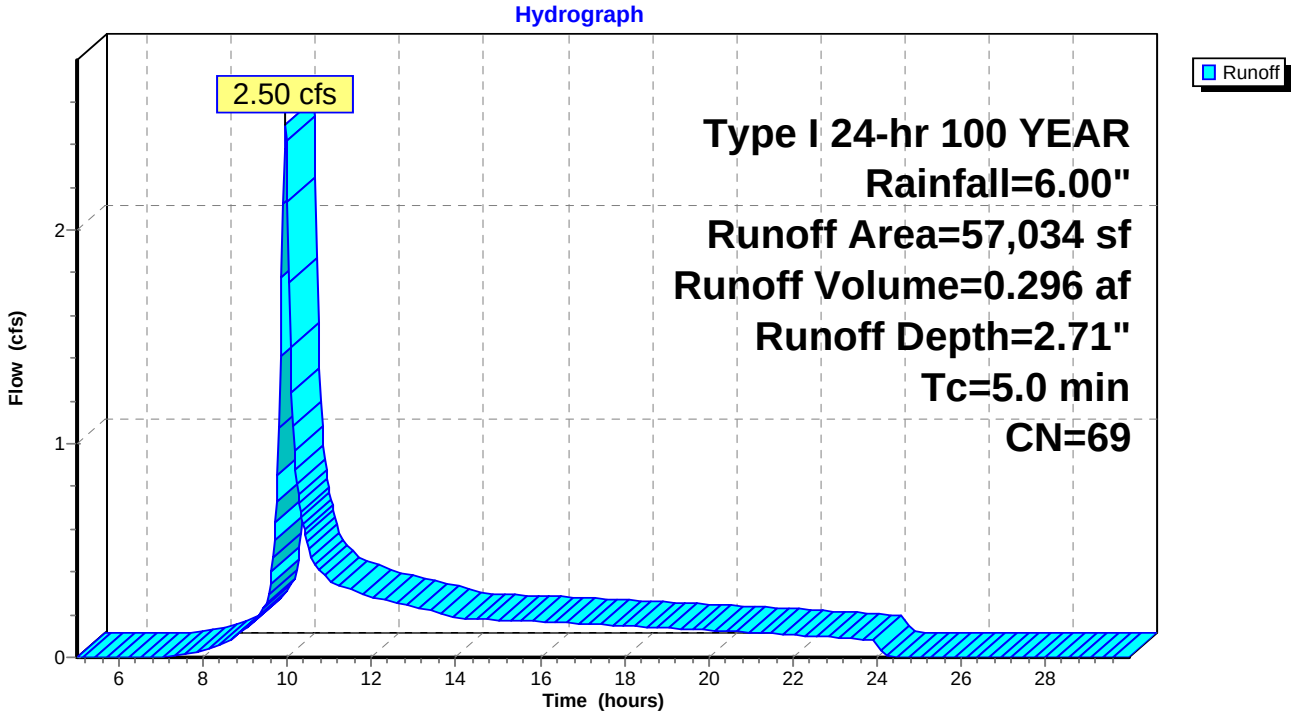
Runoff = 2.50 cfs @ 9.95 hrs, Volume= 0.296 af, Depth= 2.71"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	57,034	69	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 5S: PR5



Summary for Subcatchment 6S: PR1C

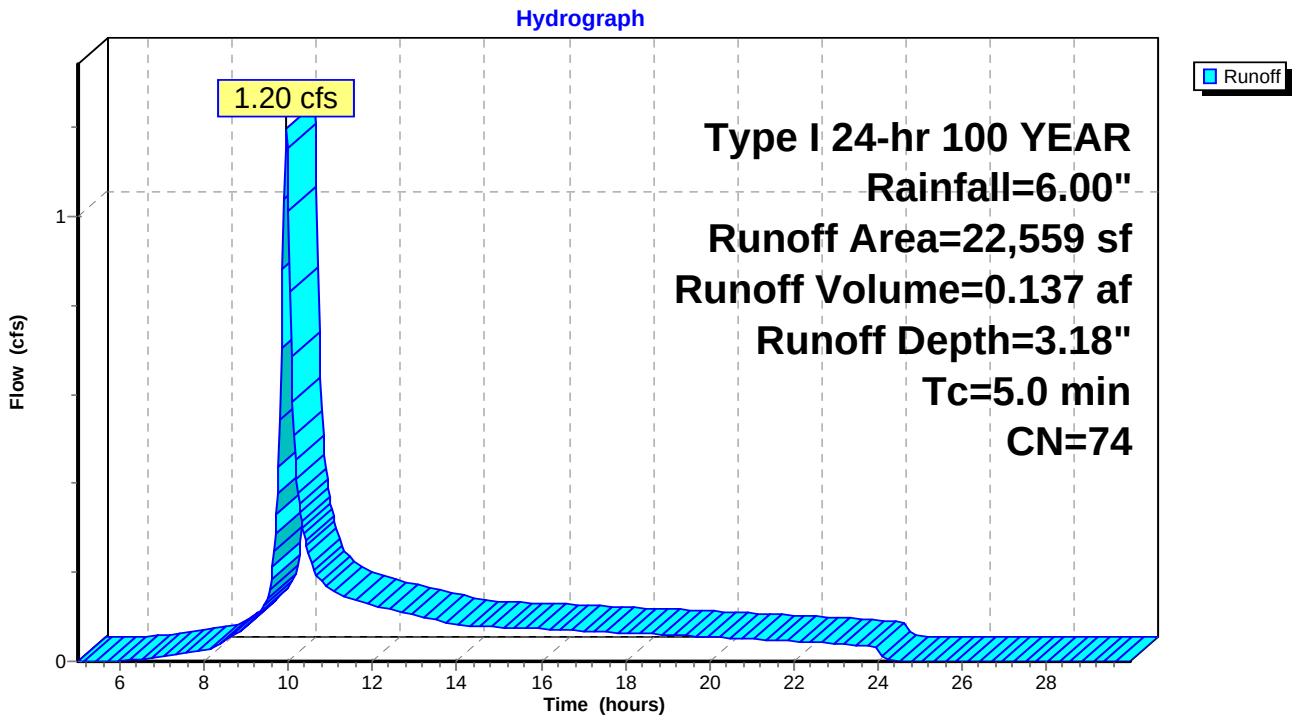
Runoff = 1.20 cfs @ 9.95 hrs, Volume= 0.137 af, Depth= 3.18"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	22,559	74	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 6S: PR1C



Summary for Subcatchment 7S: PR6

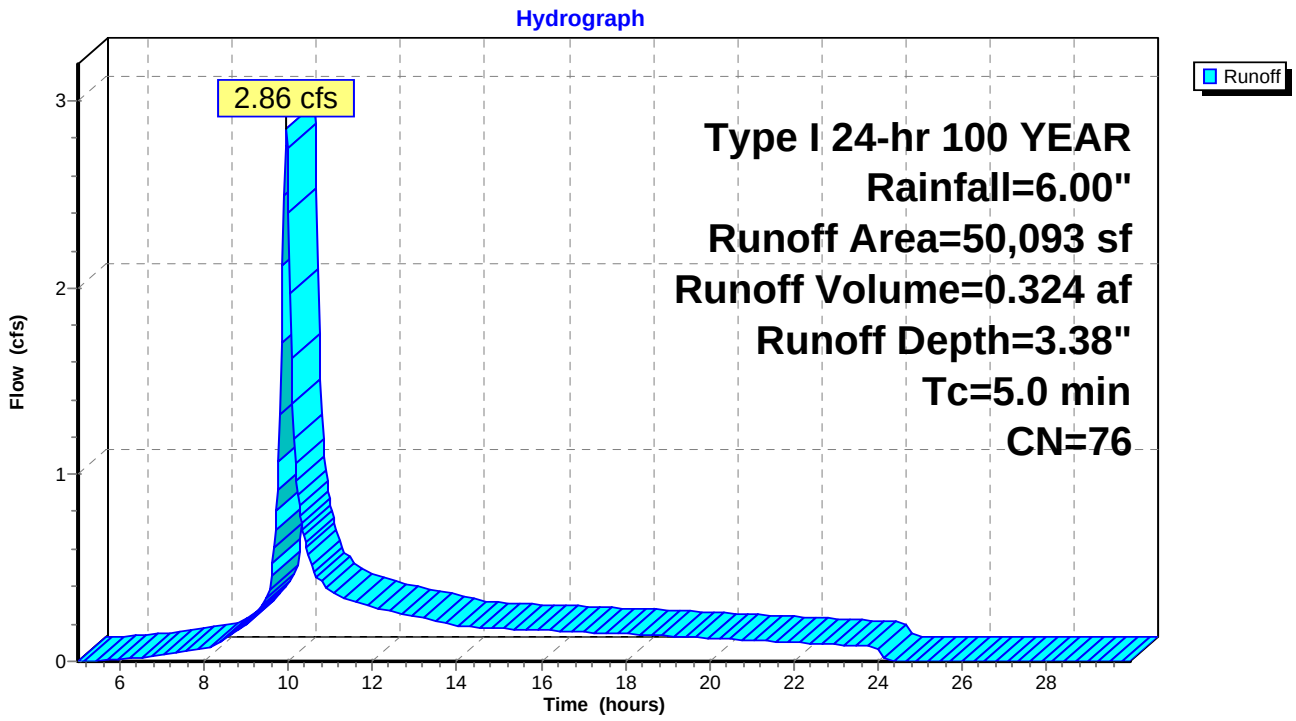
Runoff = 2.86 cfs @ 9.95 hrs, Volume= 0.324 af, Depth= 3.38"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	50,093	76	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: PR6



Summary for Subcatchment 8S: PR7

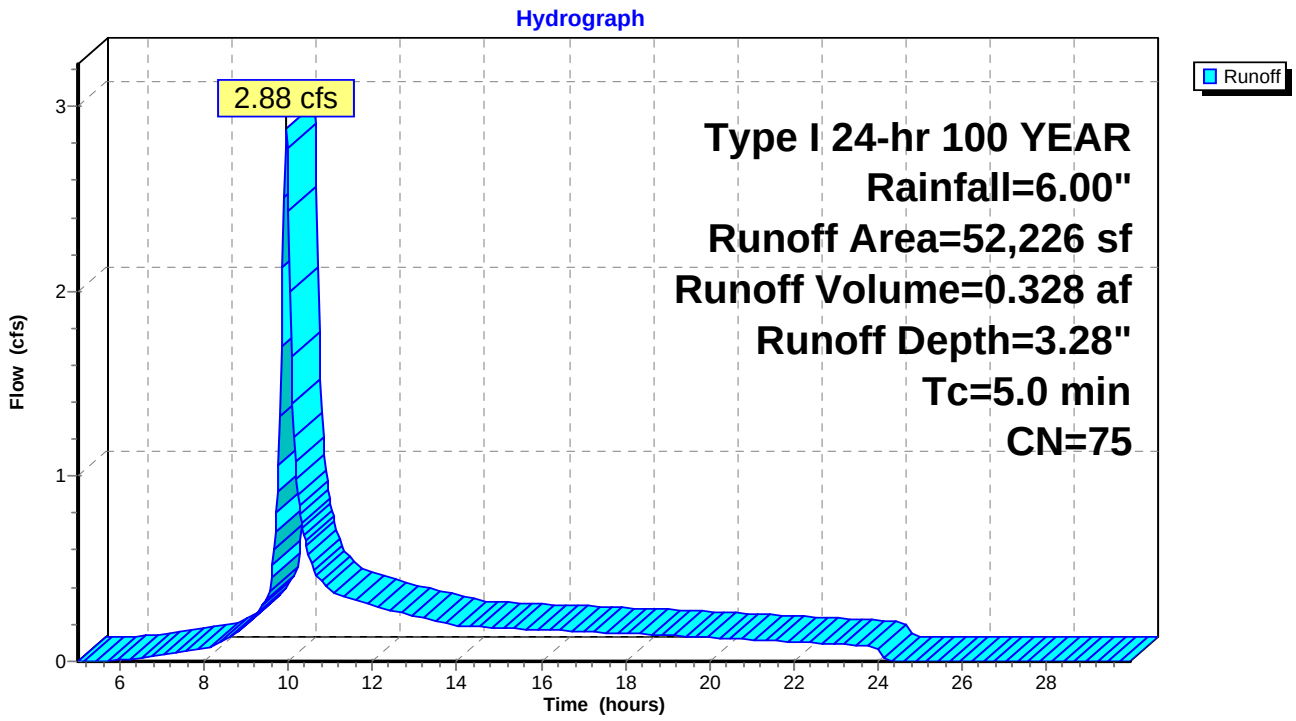
Runoff = 2.88 cfs @ 9.95 hrs, Volume= 0.328 af, Depth= 3.28"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	52,226	75	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 8S: PR7



Summary for Subcatchment 9S: PR8

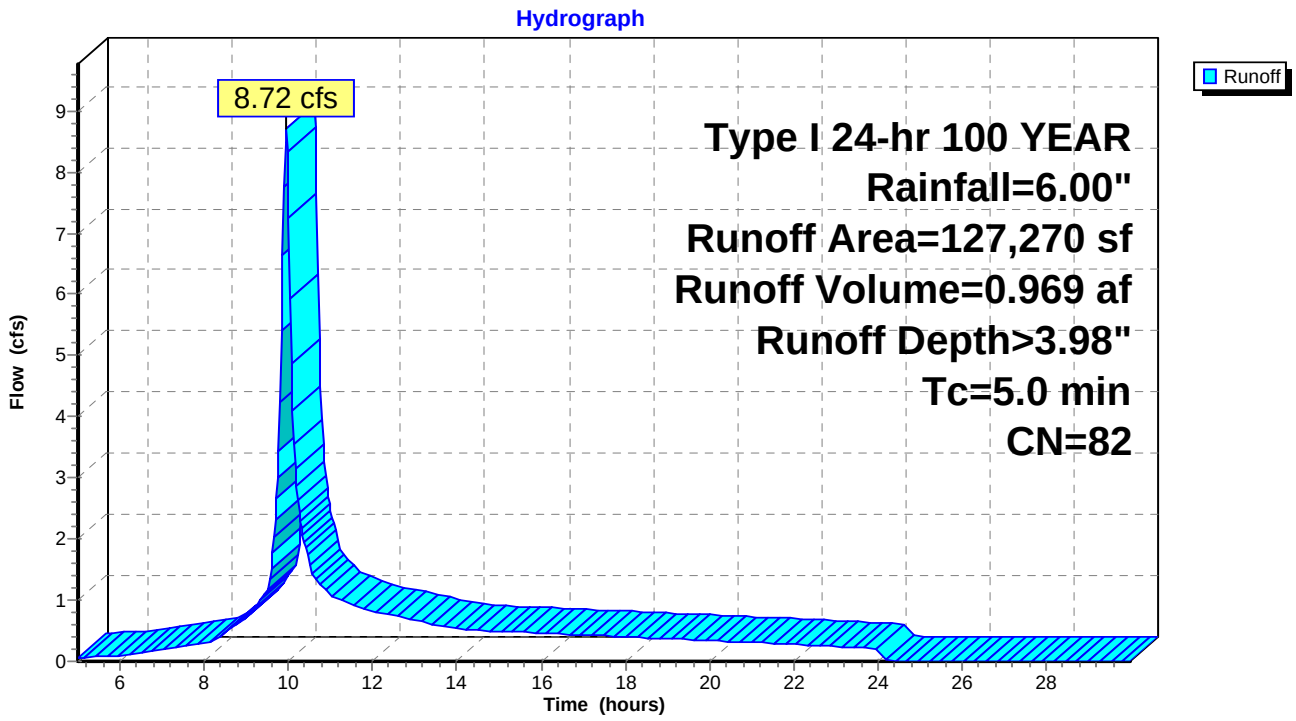
Runoff = 8.72 cfs @ 9.95 hrs, Volume= 0.969 af, Depth> 3.98"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	127,270	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0					**Direct Entry,**
4.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 9S: PR8



Summary for Subcatchment 10S: PR1B

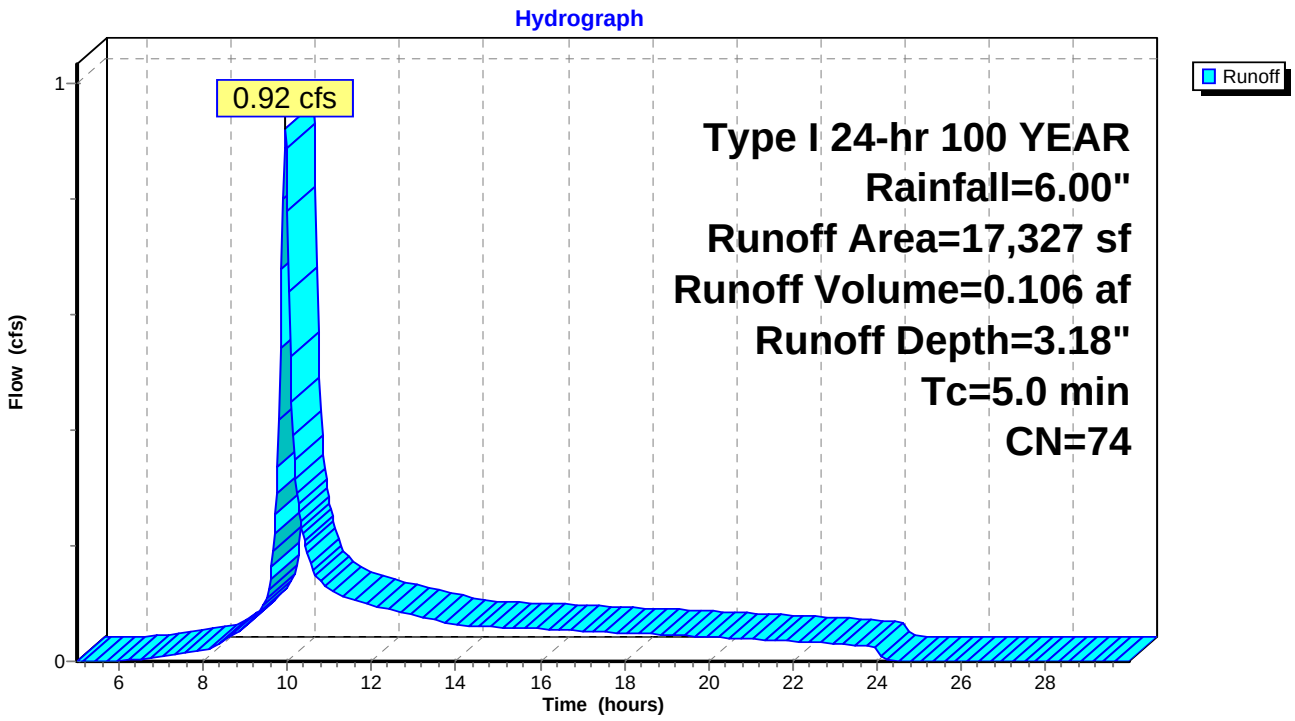
Runoff = 0.92 cfs @ 9.95 hrs, Volume= 0.106 af, Depth= 3.18"

Runoff by SBUH method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Type I 24-hr 100 YEAR Rainfall=6.00"

	Area (sf)	CN	Description
*	17,327	74	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 10S: PR1B



Summary for Pond 1P: PR2

Inflow Area = 0.725 ac, Inflow Depth = 2.71" for 100 YEAR event
Inflow = 1.38 cfs @ 9.95 hrs, Volume= 0.164 af
Outflow = 0.24 cfs @ 10.68 hrs, Volume= 0.163 af, Atten= 83%, Lag= 43.5 min
Primary = 0.24 cfs @ 10.68 hrs, Volume= 0.163 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 11.62' @ 10.68 hrs Surf.Area= 0 sf Storage= 1,700 cf

Plug-Flow detention time= 87.5 min calculated for 0.163 af (100% of inflow)
Center-of-Mass det. time= 85.0 min (908.7 - 823.7)

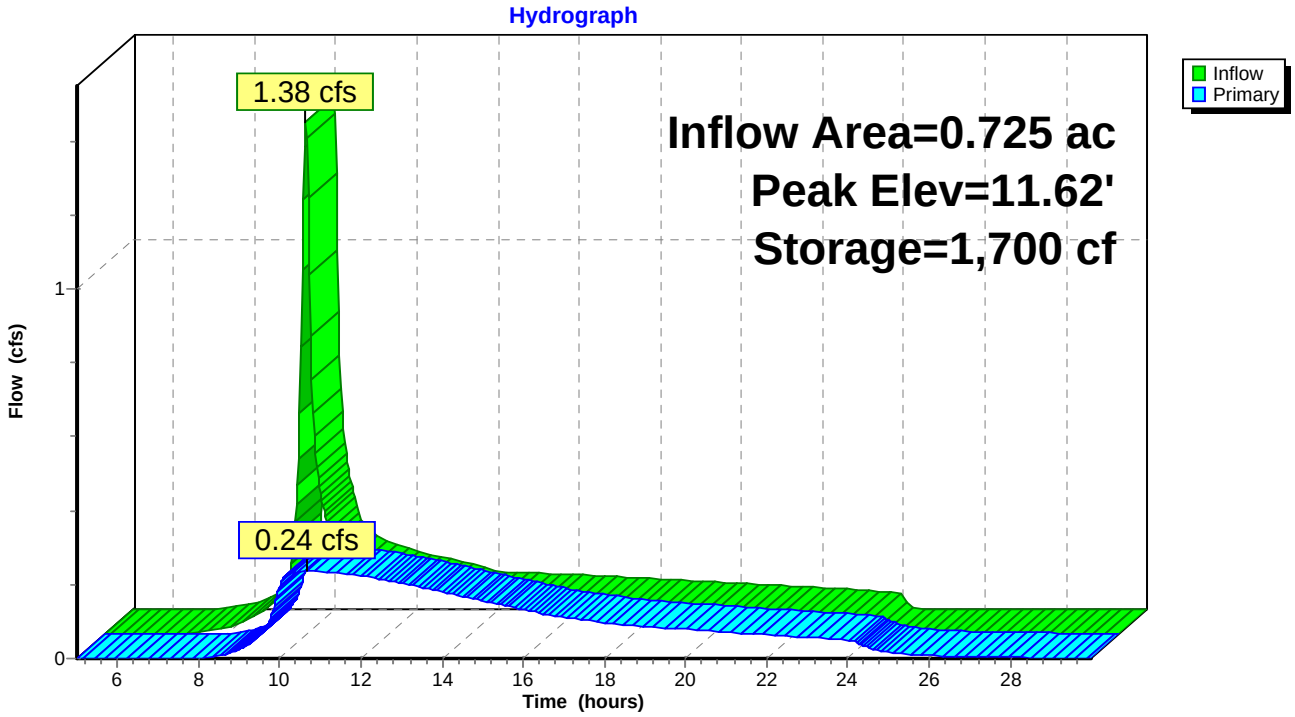
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	5,225 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	628
11.50	1,447
12.00	2,476
12.50	3,730
13.00	5,225

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.24 cfs @ 10.68 hrs HW=11.62' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.81 fps)

Pond 1P: PR2


Hydrograph
1.38 cfs
0.24 cfs
Inflow Area=0.725 ac
Peak Elev=11.62'
Storage=1,700 cf
Inflow
Primary
Flow (cfs)
0
1
6
8
10
12
14
16
18
20
22
24
26
28
Time (hours)

Summary for Pond 2P: PR1A

Inflow Area = 0.831 ac, Inflow Depth = 2.81" for 100 YEAR event
Inflow = 1.65 cfs @ 9.95 hrs, Volume= 0.194 af
Outflow = 0.21 cfs @ 11.51 hrs, Volume= 0.193 af, Atten= 87%, Lag= 93.2 min
Primary = 0.21 cfs @ 11.51 hrs, Volume= 0.193 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 9.89' @ 11.51 hrs Surf.Area= 0 sf Storage= 2,434 cf

Plug-Flow detention time= 149.4 min calculated for 0.193 af (99% of inflow)
Center-of-Mass det. time= 144.1 min (964.0 - 819.9)

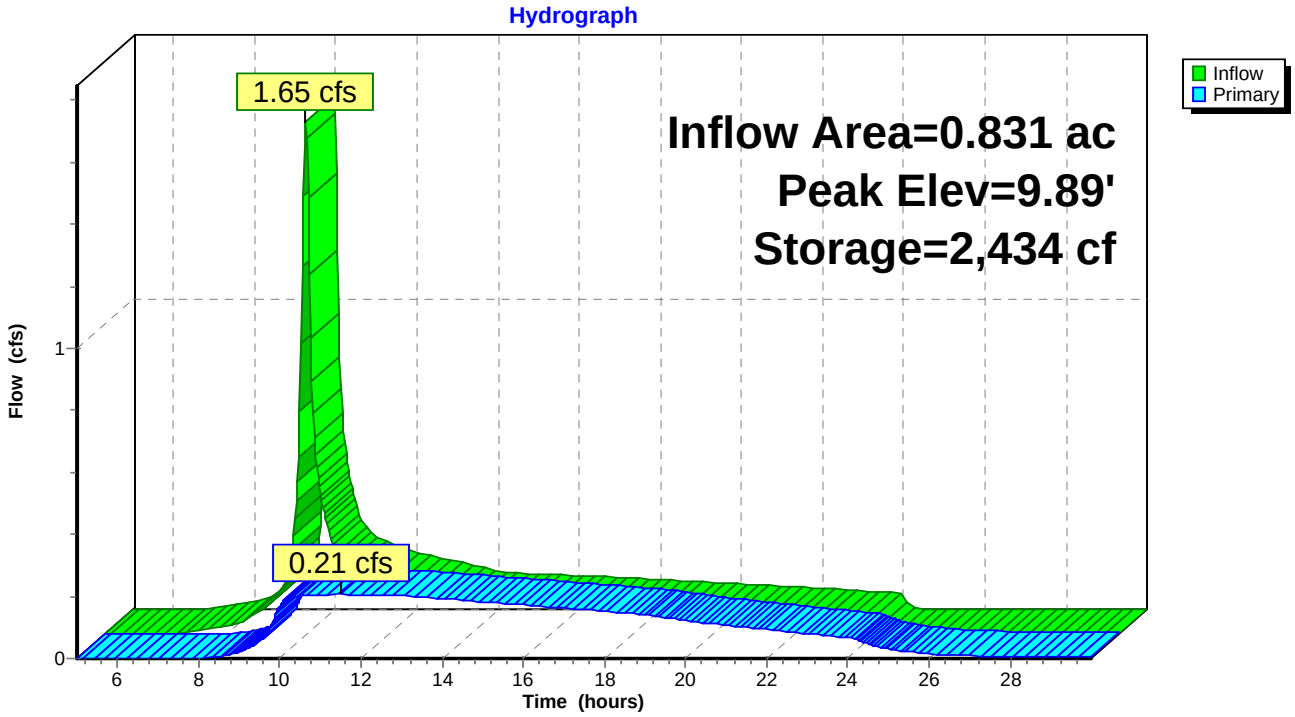
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	7,451 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	989
10.00	2,843
10.50	4,993
11.00	7,451

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.21 cfs @ 11.51 hrs HW=9.89' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.21 cfs @ 4.21 fps)

Pond 2P: PR1A


Hydrograph
1.65 cfs
0.21 cfs
Inflow Area=0.831 ac
Peak Elev=9.89'
Storage=2,434 cf
Inflow
Primary
Flow (cfs)
0
1
6
8
10
12
14
16
18
20
22
24
26
28
Time (hours)

Summary for Pond 3P: PR3

Inflow Area = 0.476 ac, Inflow Depth = 2.71" for 100 YEAR event
Inflow = 0.91 cfs @ 9.95 hrs, Volume= 0.108 af
Outflow = 0.18 cfs @ 10.53 hrs, Volume= 0.107 af, Atten= 80%, Lag= 34.4 min
Primary = 0.18 cfs @ 10.53 hrs, Volume= 0.107 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 9.70' @ 10.53 hrs Surf.Area= 0 sf Storage= 1,081 cf

Plug-Flow detention time= 83.2 min calculated for 0.107 af (99% of inflow)
Center-of-Mass det. time= 78.8 min (902.5 - 823.7)

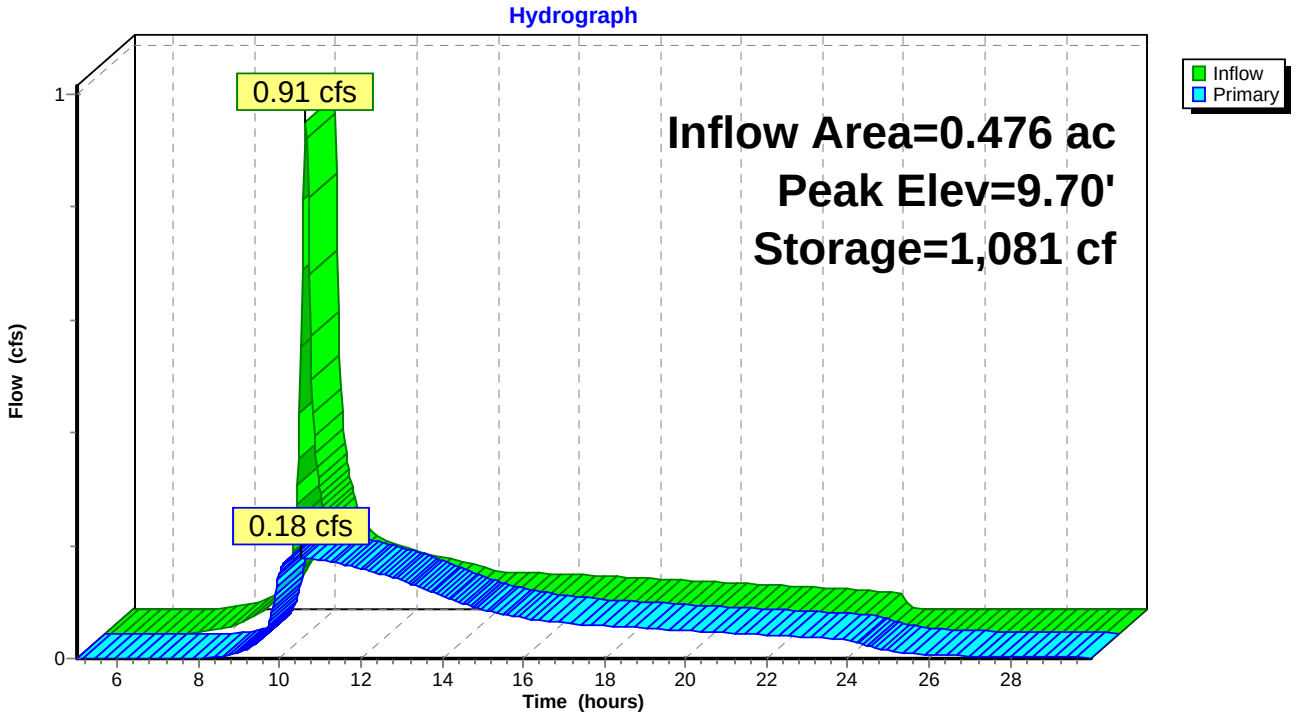
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,409 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	692
10.00	1,672
10.50	2,904
11.00	4,409

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.18 cfs @ 10.53 hrs HW=9.70' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.18 cfs @ 3.65 fps)

Pond 3P: PR3


Hydrograph
Inflow
Primary
0.91 cfs
0.18 cfs
Inflow Area=0.476 ac
Peak Elev=9.70'
Storage=1,081 cf
Flow (cfs)
1
0
6
8
10
12
14
16
18
20
22
24
26
28
Time (hours)

Summary for Pond 4P: PR4

Inflow Area = 0.974 ac, Inflow Depth = 1.68" for 100 YEAR event
Inflow = 0.95 cfs @ 9.96 hrs, Volume= 0.136 af
Outflow = 0.16 cfs @ 11.35 hrs, Volume= 0.134 af, Atten= 83%, Lag= 83.3 min
Primary = 0.16 cfs @ 11.35 hrs, Volume= 0.134 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 10.84' @ 11.35 hrs Surf.Area= 0 sf Storage= 1,178 cf

Plug-Flow detention time= 112.8 min calculated for 0.134 af (98% of inflow)
Center-of-Mass det. time= 105.1 min (978.5 - 873.5)

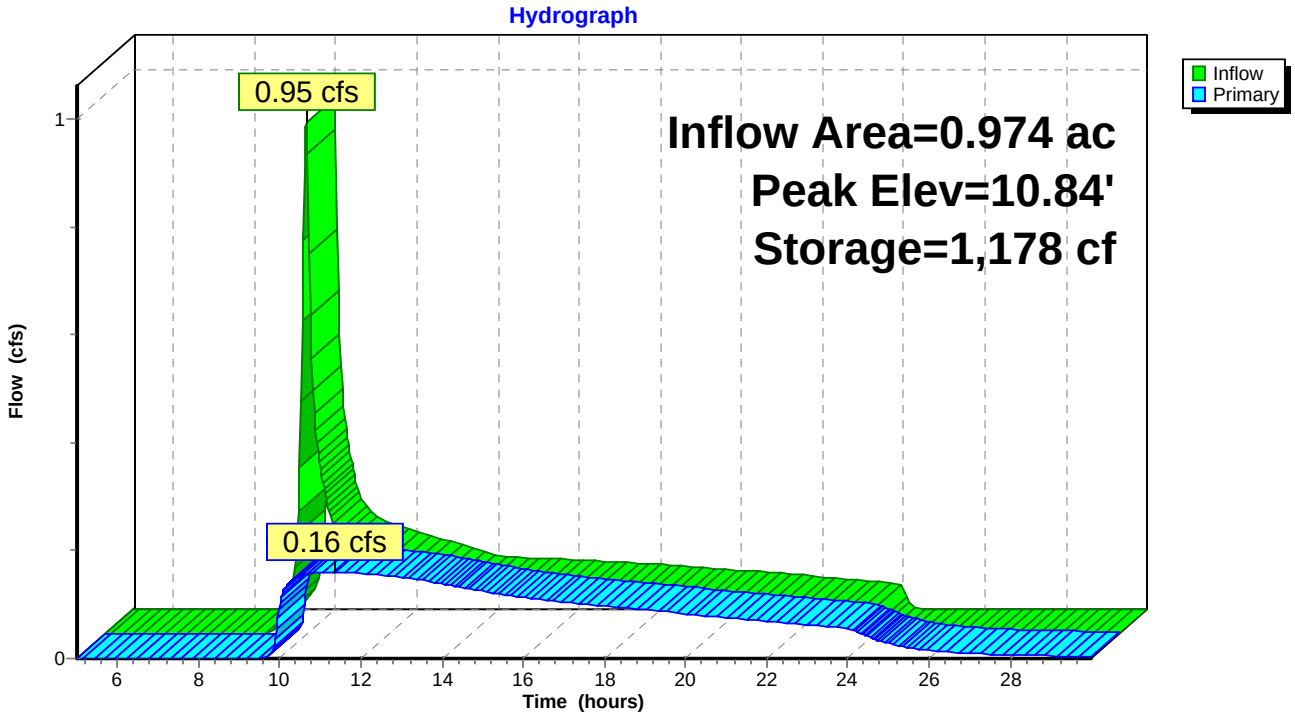
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	8,606 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	1,737
11.50	3,743
12.00	6,029
12.50	8,606

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**2.0" Vert. Orifice/Grate X 3.00** C= 0.600

Primary OutFlow Max=0.16 cfs @ 11.35 hrs HW=10.84' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.16 cfs @ 2.43 fps)

Pond 4P: PR4


Hydrograph
0.95 cfs
0.16 cfs
Inflow Area=0.974 ac
Peak Elev=10.84'
Storage=1,178 cf
Inflow
Primary
Flow (cfs)
1
0
6
8
10
12
14
16
18
20
22
24
26
28
Time (hours)

Summary for Pond 5P: PR5

Inflow Area =	1.309 ac,	Inflow Depth =	2.71"	for	100 YEAR event
Inflow =	2.50 cfs @	9.95 hrs,	Volume=	0.296 af	
Outflow =	0.27 cfs @	12.29 hrs,	Volume=	0.293 af,	Atten= 89%, Lag= 140.3 min
Primary =	0.27 cfs @	12.29 hrs,	Volume=	0.293 af	

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 10.42' @ 12.29 hrs Surf.Area= 0 sf Storage= 4,036 cf

Plug-Flow detention time= 198.7 min calculated for 0.293 af (99% of inflow)
Center-of-Mass det. time= 192.7 min (1,016.4 - 823.7)

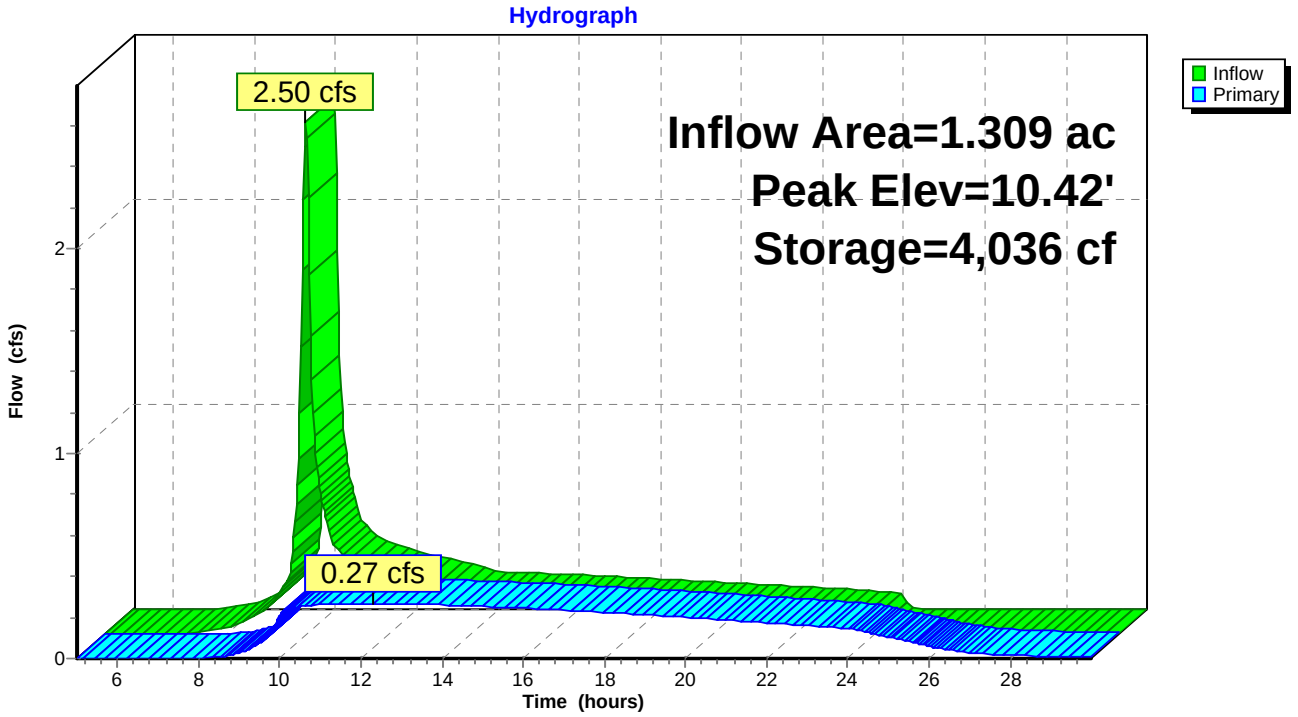
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	6,358 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,145
10.00	2,579
10.50	4,313
11.00	6,358

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.27 cfs @ 12.29 hrs HW=10.42' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.27 cfs @ 5.48 fps)

Pond 5P: PR5


Hydrograph
2.50 cfs
0.27 cfs
Inflow Area=1.309 ac
Peak Elev=10.42'
Storage=4,036 cf
Inflow
Primary
Flow (cfs)
0
1
2
6
8
10
12
14
16
18
20
22
24
26
28
Time (hours)

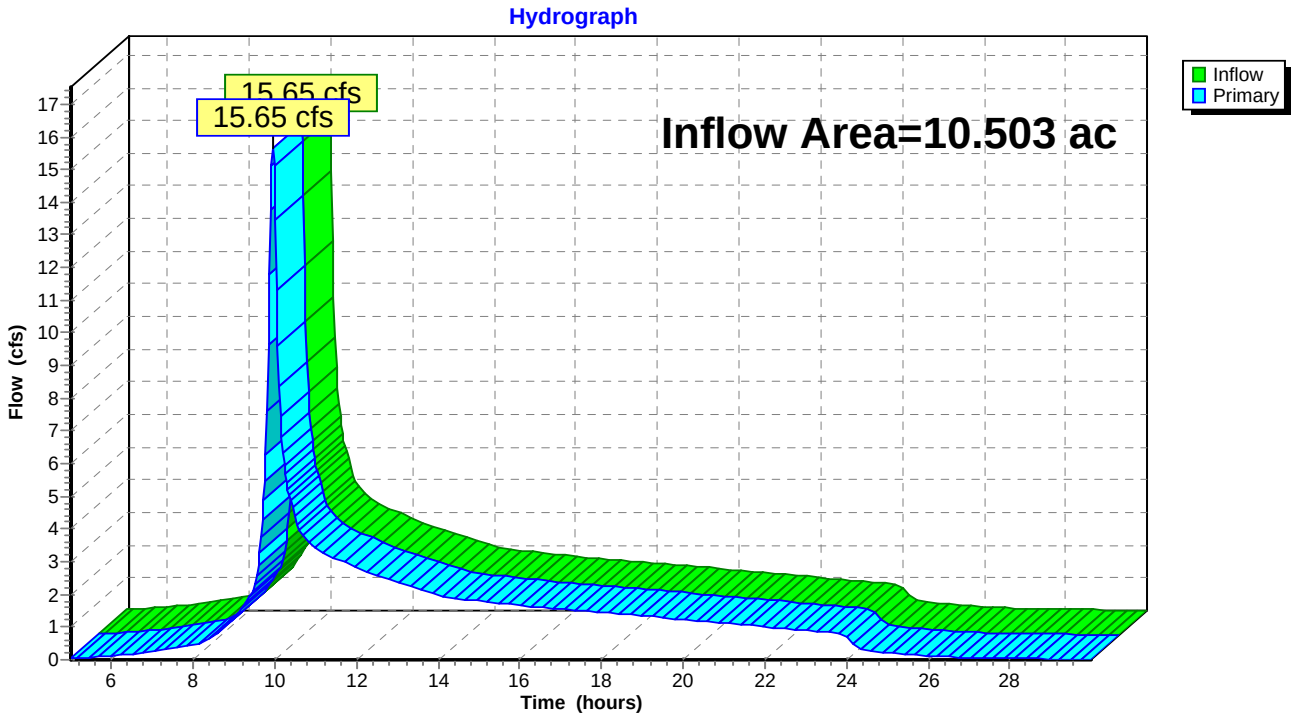
Summary for Pond 6P: OUT

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.503 ac, Inflow Depth > 3.14" for 100 YEAR event
Inflow = 15.65 cfs @ 9.95 hrs, Volume= 2.753 af
Primary = 15.65 cfs @ 9.95 hrs, Volume= 2.753 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs

Pond 6P: OUT



Summary for Pond 11P: PR1B

Inflow Area = 0.398 ac, Inflow Depth = 3.18" for 100 YEAR event
Inflow = 0.92 cfs @ 9.95 hrs, Volume= 0.106 af
Outflow = 0.24 cfs @ 10.31 hrs, Volume= 0.106 af, Atten= 74%, Lag= 21.8 min
Primary = 0.24 cfs @ 10.31 hrs, Volume= 0.106 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 10.17' @ 10.31 hrs Surf.Area= 0 sf Storage= 859 cf

Plug-Flow detention time= 38.3 min calculated for 0.105 af (100% of inflow)
Center-of-Mass det. time= 38.2 min (843.3 - 805.0)

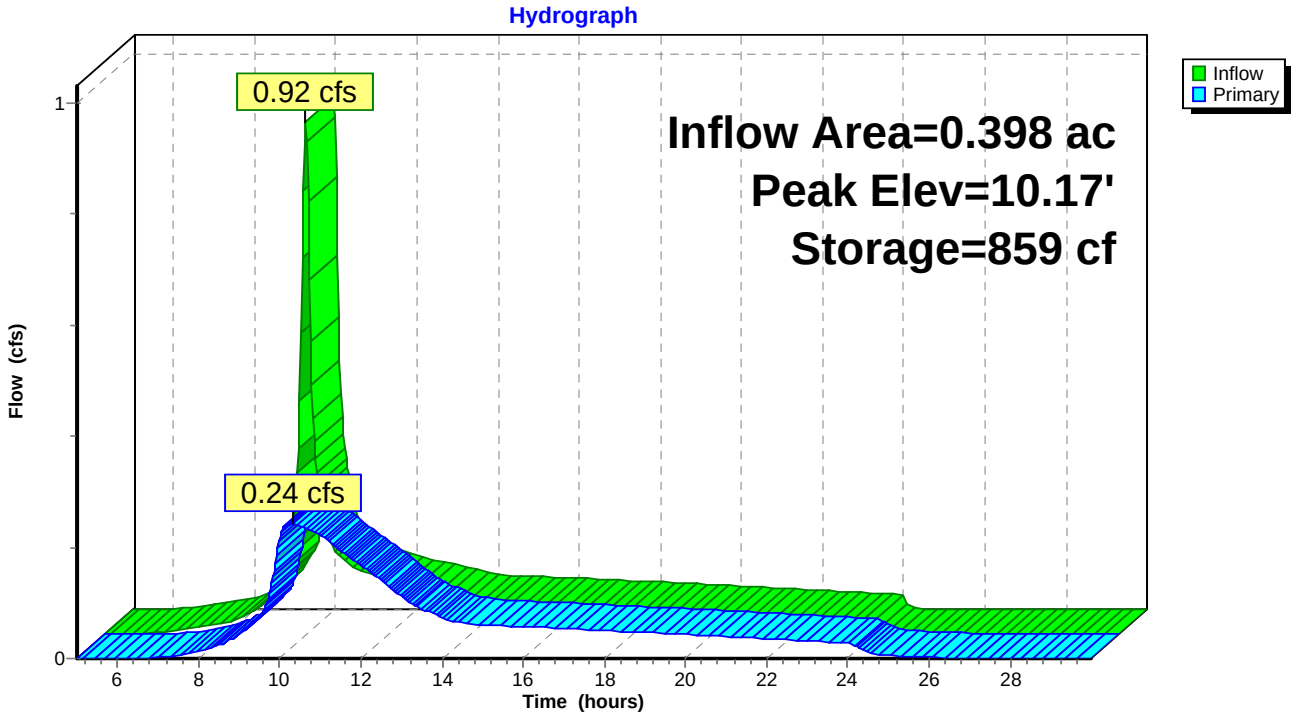
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	3,863 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	268
10.00	671
10.50	1,220
11.00	1,930
11.50	2,814
12.00	3,863

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.24 cfs @ 10.31 hrs HW=10.17' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.92 fps)

Pond 11P: PR1B



Summary for Pond 12P: PR1C

Inflow Area = 0.518 ac, Inflow Depth = 3.18" for 100 YEAR event
Inflow = 1.20 cfs @ 9.95 hrs, Volume= 0.137 af
Outflow = 0.33 cfs @ 10.29 hrs, Volume= 0.137 af, Atten= 73%, Lag= 20.6 min
Primary = 0.33 cfs @ 10.29 hrs, Volume= 0.137 af

Routing by Stor-Ind method, Time Span= 5.00-29.99 hrs, dt= 0.03 hrs
Peak Elev= 9.60' @ 10.29 hrs Surf.Area= 0 sf Storage= 1,269 cf

Plug-Flow detention time= 63.9 min calculated for 0.136 af (99% of inflow)
Center-of-Mass det. time= 60.4 min (865.5 - 805.0)

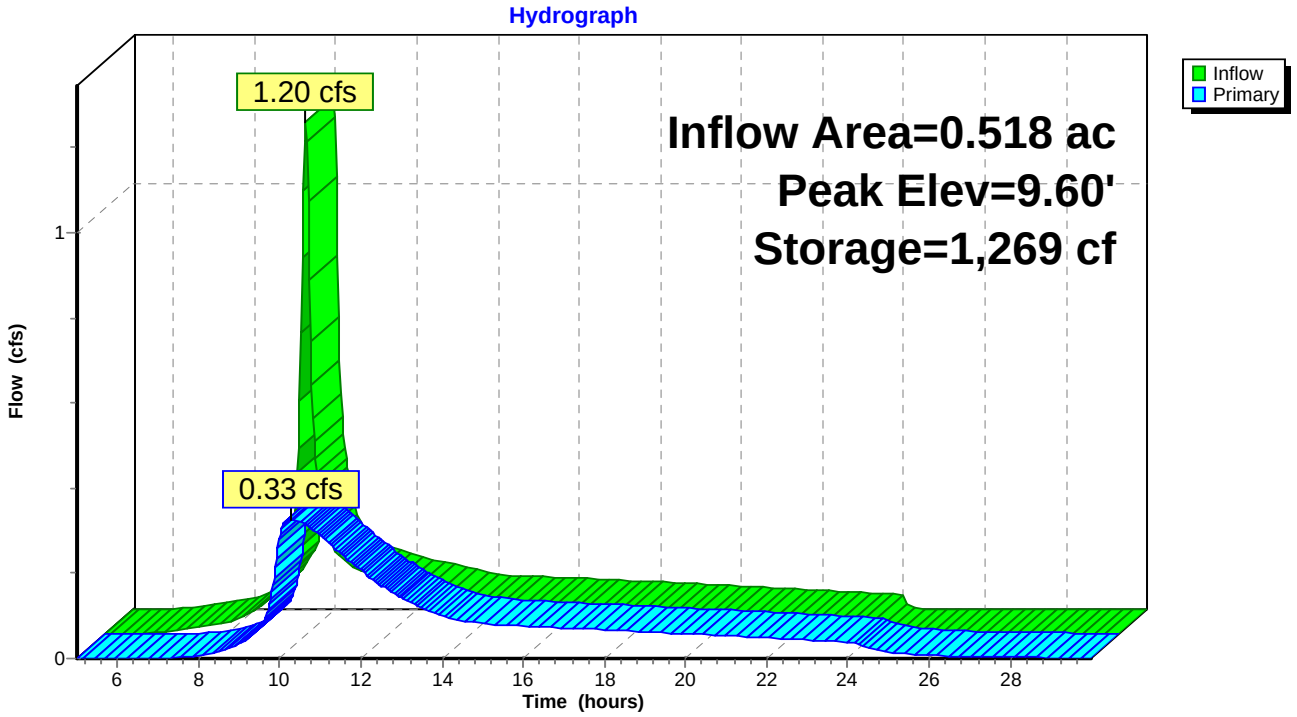
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	5,366 cf	**Custom Stage Data** Listed below

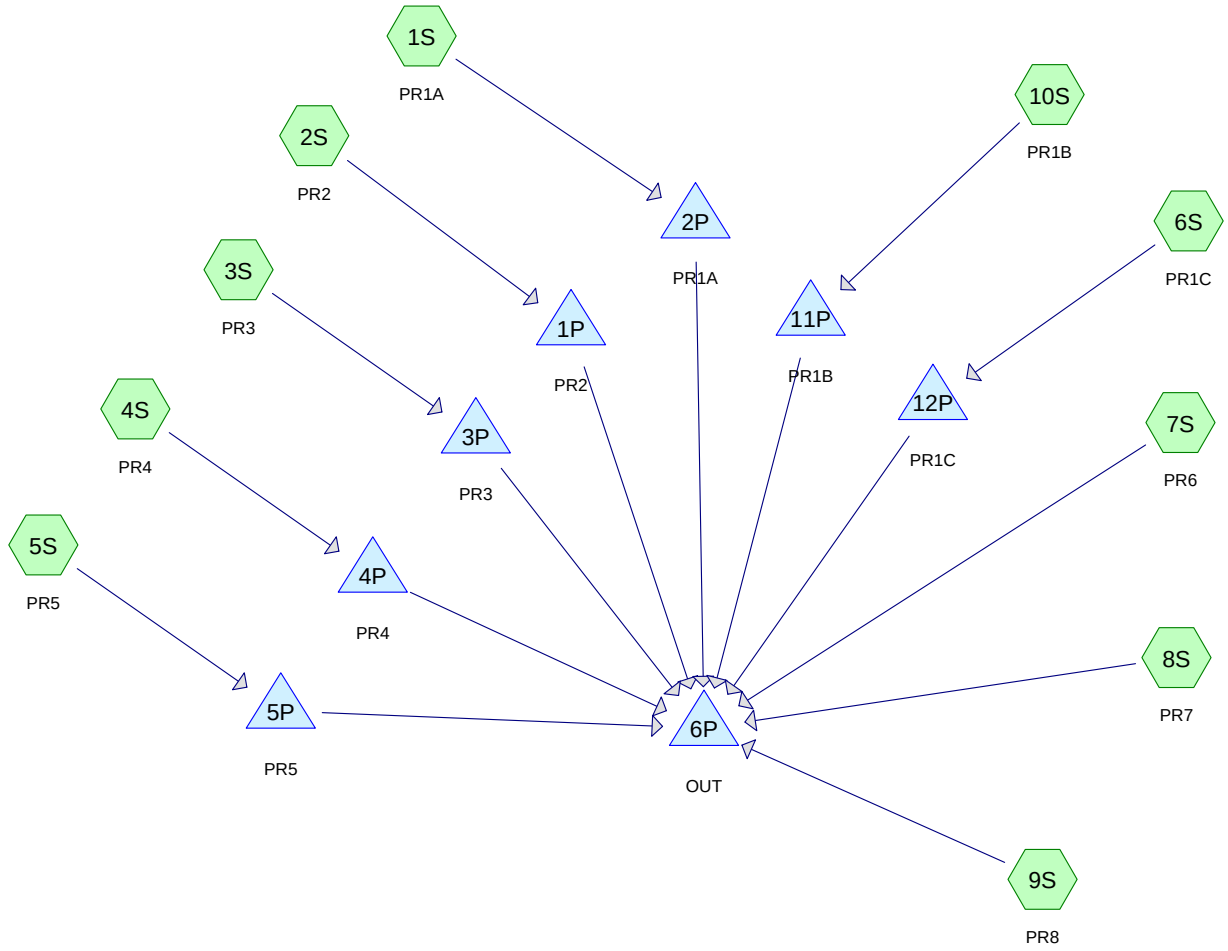
Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,023
10.00	2,248
10.50	3,690
11.00	5,366

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.33 cfs @ 10.29 hrs HW=9.60' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.33 cfs @ 3.32 fps)

Pond 12P: PR1C





Subcat Reach Pond Link

Drainage Diagram for Grover Proposed_25yr_det_1-19-12
Prepared by {enter your company name here}, Printed 1/20/2012
HydroCAD® 9.10 s/n 06659 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.974	65	(4S)
2.511	76	(2S, 3S, 5S)
0.831	77	(1S)
0.398	80	(10S)
2.349	82	(7S, 8S)
2.922	87	(9S)
0.518	89	(6S)
10.503	80	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
10.503	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S
10.503		**TOTAL AREA**

Time span=1.00-30.00 hrs, dt=0.03 hrs, 968 points
Runoff by SBUH method
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: PR1A Runoff Area=36,211 sf Runoff Depth=2.21"
Tc=5.0 min CN=77 Runoff=1.32 cfs 0.153 af

Subcatchment 2S: PR2 Runoff Area=31,602 sf Runoff Depth=2.13"
Tc=5.0 min CN=76 Runoff=1.10 cfs 0.129 af

Subcatchment 3S: PR3 Runoff Area=20,753 sf Runoff Depth=2.13"
Tc=5.0 min CN=76 Runoff=0.72 cfs 0.085 af

Subcatchment 4S: PR4 Runoff Area=42,422 sf Runoff Depth=1.33"
Tc=5.0 min CN=65 Runoff=0.78 cfs 0.108 af

Subcatchment 5S: PR5 Runoff Area=57,034 sf Runoff Depth=2.13"
Tc=5.0 min CN=76 Runoff=1.98 cfs 0.232 af

Subcatchment 6S: PR1C Runoff Area=22,559 sf Runoff Depth=3.30"
Tc=5.0 min CN=89 Runoff=1.28 cfs 0.142 af

Subcatchment 7S: PR6 Runoff Area=50,093 sf Runoff Depth=2.64"
Tc=5.0 min CN=82 Runoff=2.24 cfs 0.253 af

Subcatchment 8S: PR7 Runoff Area=52,226 sf Runoff Depth=2.64"
Tc=5.0 min CN=82 Runoff=2.34 cfs 0.263 af

Subcatchment 9S: PR8 Runoff Area=127,270 sf Runoff Depth=3.10"
Tc=5.0 min CN=87 Runoff=6.78 cfs 0.755 af

Subcatchment 10S: PR1B Runoff Area=17,327 sf Runoff Depth=2.46"
Tc=5.0 min CN=80 Runoff=0.72 cfs 0.082 af

Pond 1P: PR2 Peak Elev=11.42' Storage=1,309 cf Inflow=1.10 cfs 0.129 af
Outflow=0.21 cfs 0.128 af

Pond 2P: PR1A Peak Elev=9.74' Storage=1,861 cf Inflow=1.32 cfs 0.153 af
Outflow=0.18 cfs 0.152 af

Pond 3P: PR3 Peak Elev=9.58' Storage=841 cf Inflow=0.72 cfs 0.085 af
Outflow=0.16 cfs 0.084 af

Pond 4P: PR4 Peak Elev=10.77' Storage=942 cf Inflow=0.78 cfs 0.108 af
Outflow=0.14 cfs 0.106 af

Pond 5P: PR5 Peak Elev=10.13' Storage=3,028 cf Inflow=1.98 cfs 0.232 af
Outflow=0.24 cfs 0.230 af

Pond 6P: OUT Inflow=12.48 cfs 2.193 af
Primary=12.48 cfs 2.193 af

Pond 11P: PR1B Peak Elev=9.95' Storage=632 cf Inflow=0.72 cfs 0.082 af
Outflow=0.21 cfs 0.082 af

Pond 12P: PR1C Peak Elev=9.66' Storage=1,420 cf Inflow=1.28 cfs 0.142 af
Outflow=0.35 cfs 0.141 af

Total Runoff Area = 10.503 ac Runoff Volume = 2.201 af Average Runoff Depth = 2.51"

Summary for Subcatchment 1S: PR1A

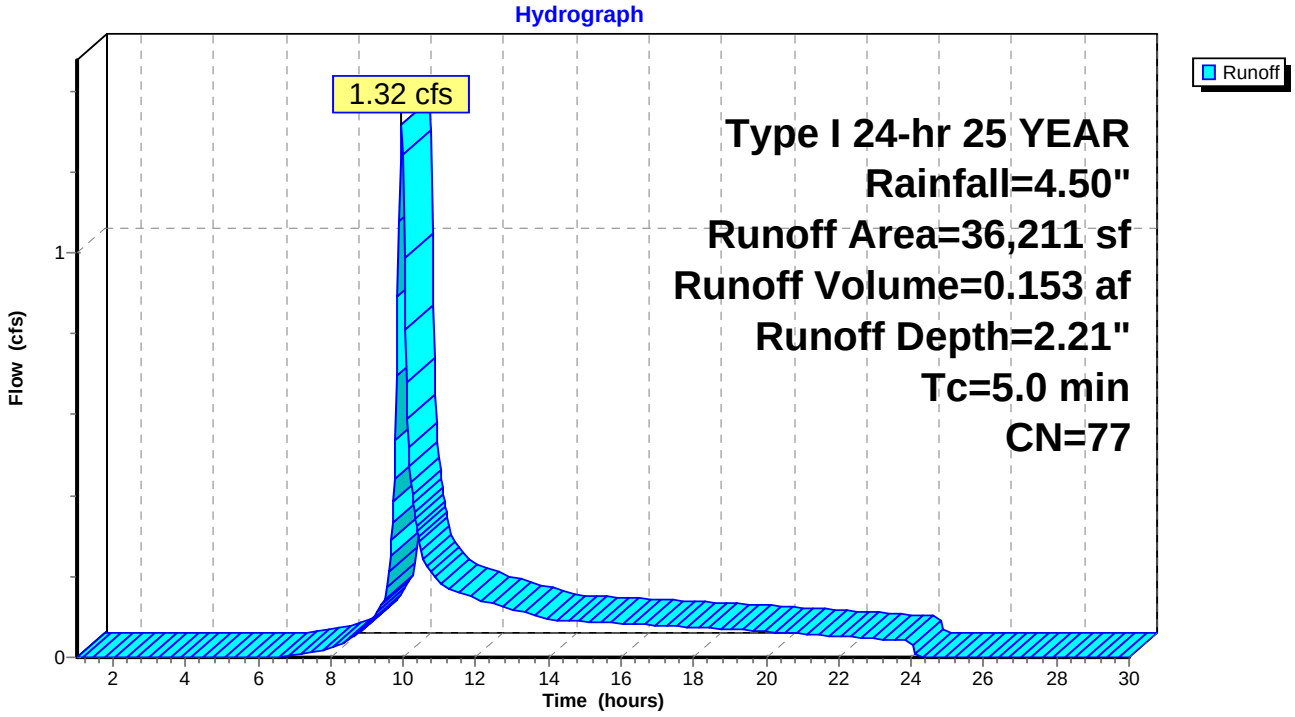
Runoff = 1.32 cfs @ 9.95 hrs, Volume= 0.153 af, Depth= 2.21"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	36,211	77	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1S: PR1A



Summary for Subcatchment 2S: PR2

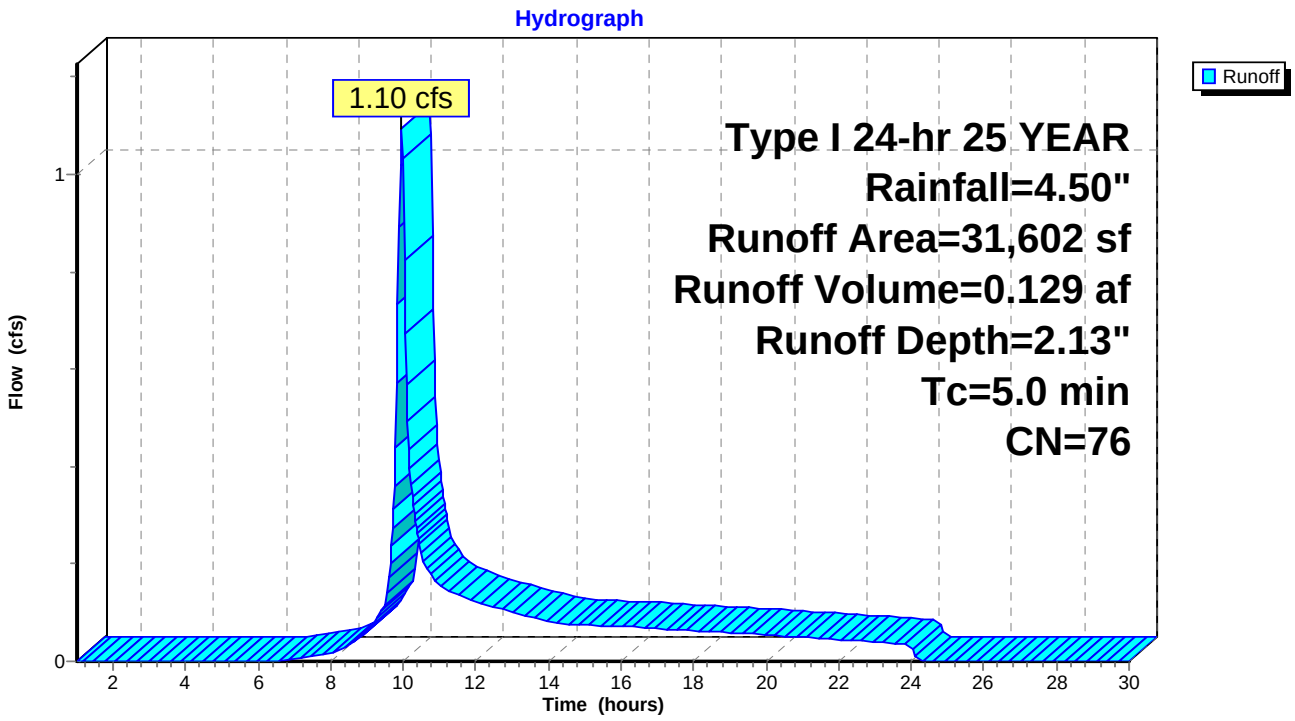
Runoff = 1.10 cfs @ 9.95 hrs, Volume= 0.129 af, Depth= 2.13"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	31,602	76	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2S: PR2



Summary for Subcatchment 3S: PR3

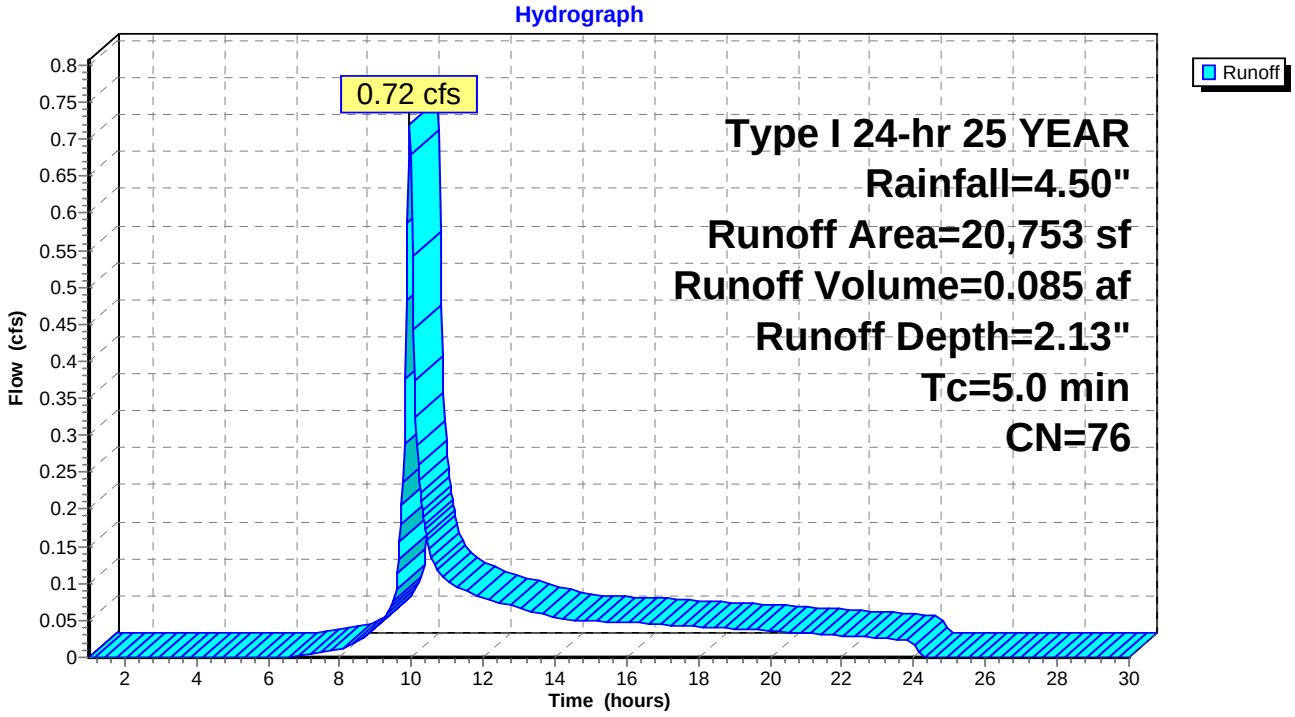
Runoff = 0.72 cfs @ 9.95 hrs, Volume= 0.085 af, Depth= 2.13"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	20,753	76	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3S: PR3



Summary for Subcatchment 4S: PR4

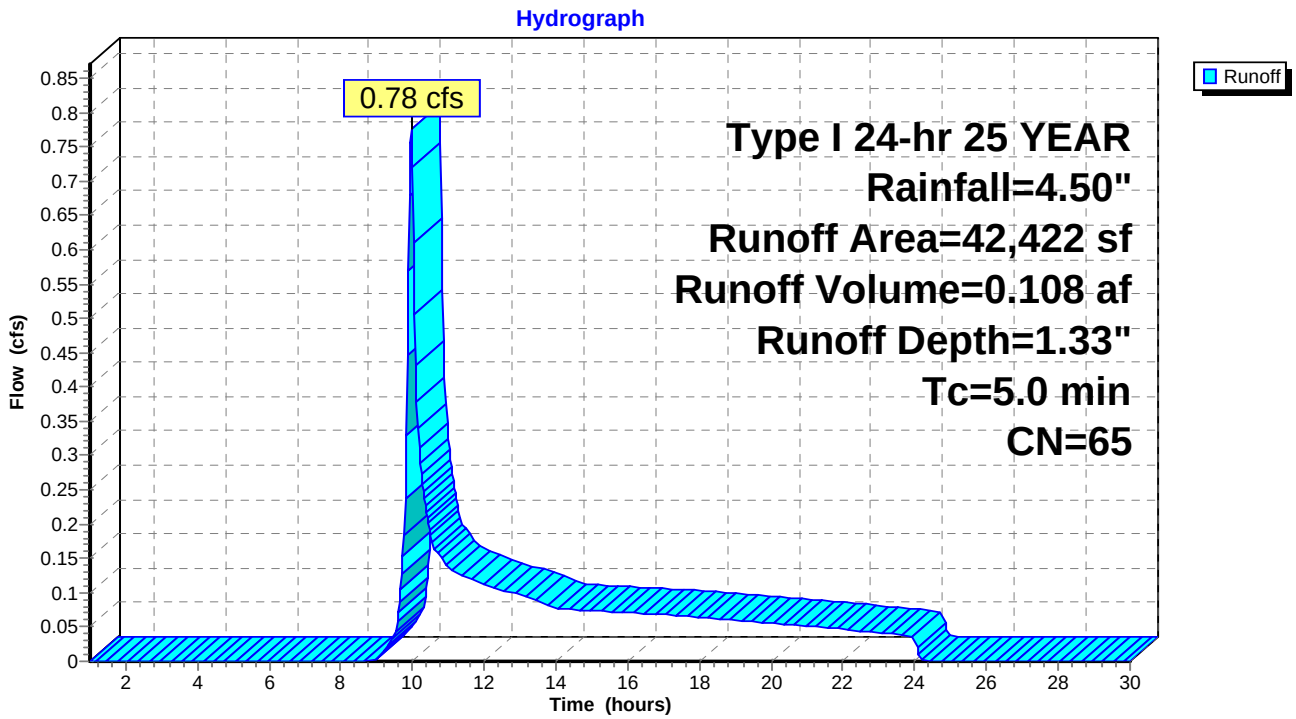
Runoff = 0.78 cfs @ 9.96 hrs, Volume= 0.108 af, Depth= 1.33"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	42,422	65	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: PR4



Summary for Subcatchment 5S: PR5

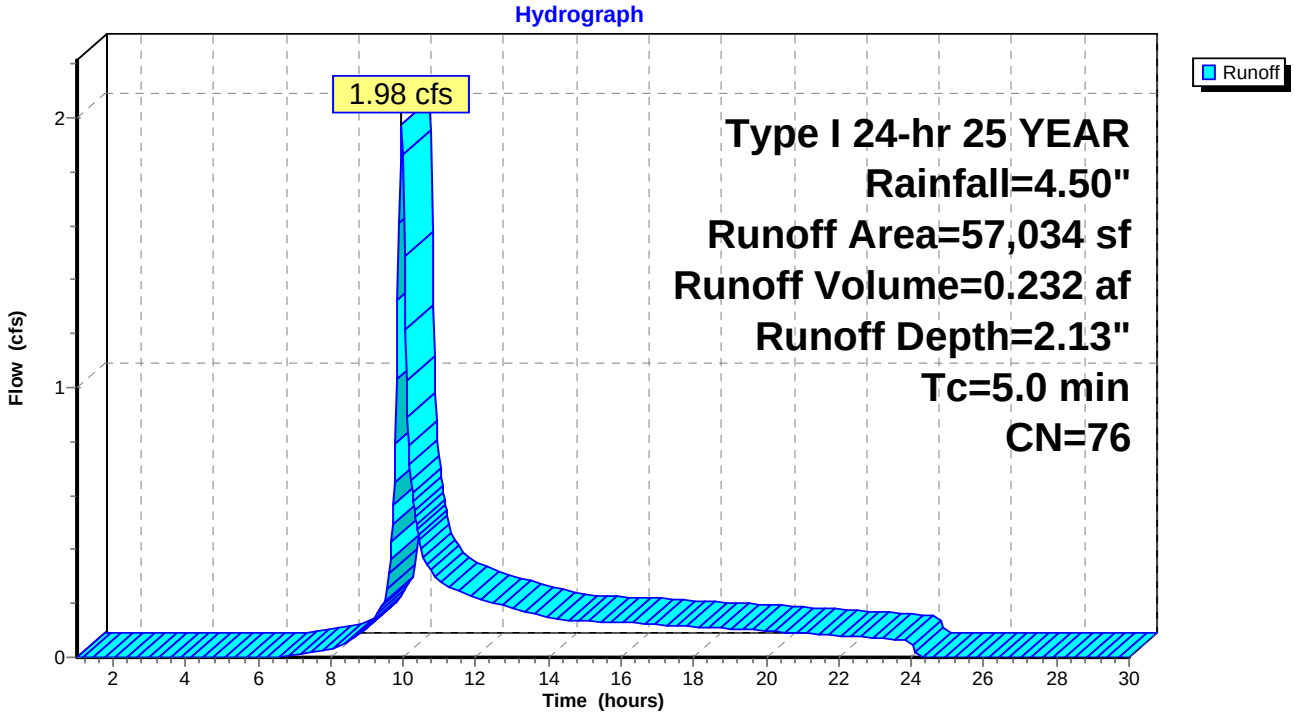
Runoff = 1.98 cfs @ 9.95 hrs, Volume= 0.232 af, Depth= 2.13"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	57,034	76	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 5S: PR5



Summary for Subcatchment 6S: PR1C

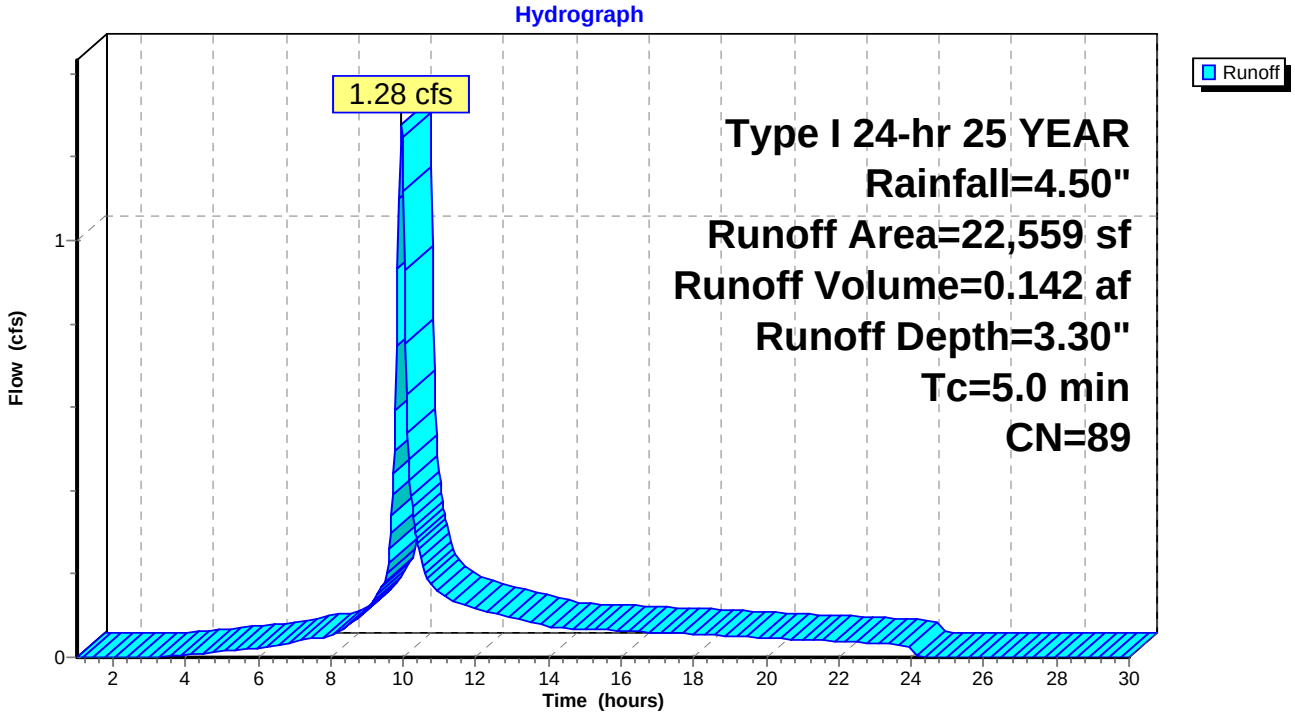
Runoff = 1.28 cfs @ 9.94 hrs, Volume= 0.142 af, Depth= 3.30"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	22,559	89	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 6S: PR1C



Summary for Subcatchment 7S: PR6

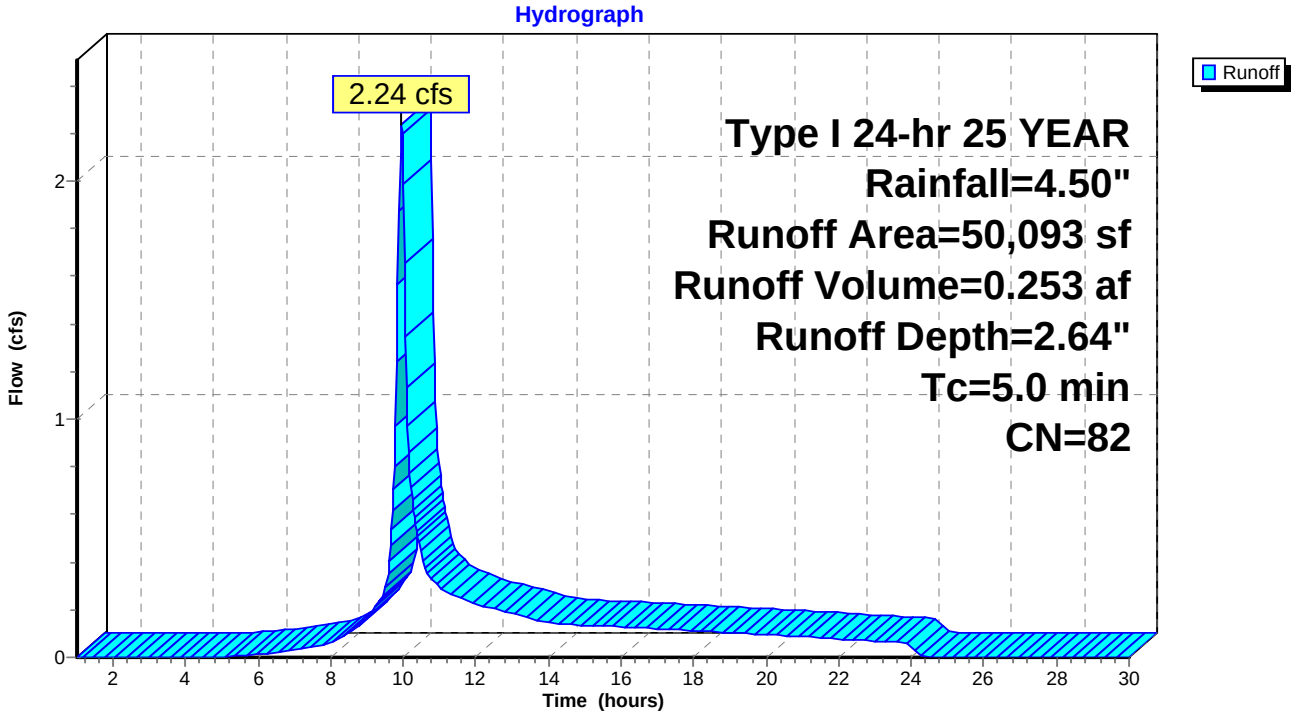
Runoff = 2.24 cfs @ 9.95 hrs, Volume= 0.253 af, Depth= 2.64"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	50,093	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: PR6



Summary for Subcatchment 8S: PR7

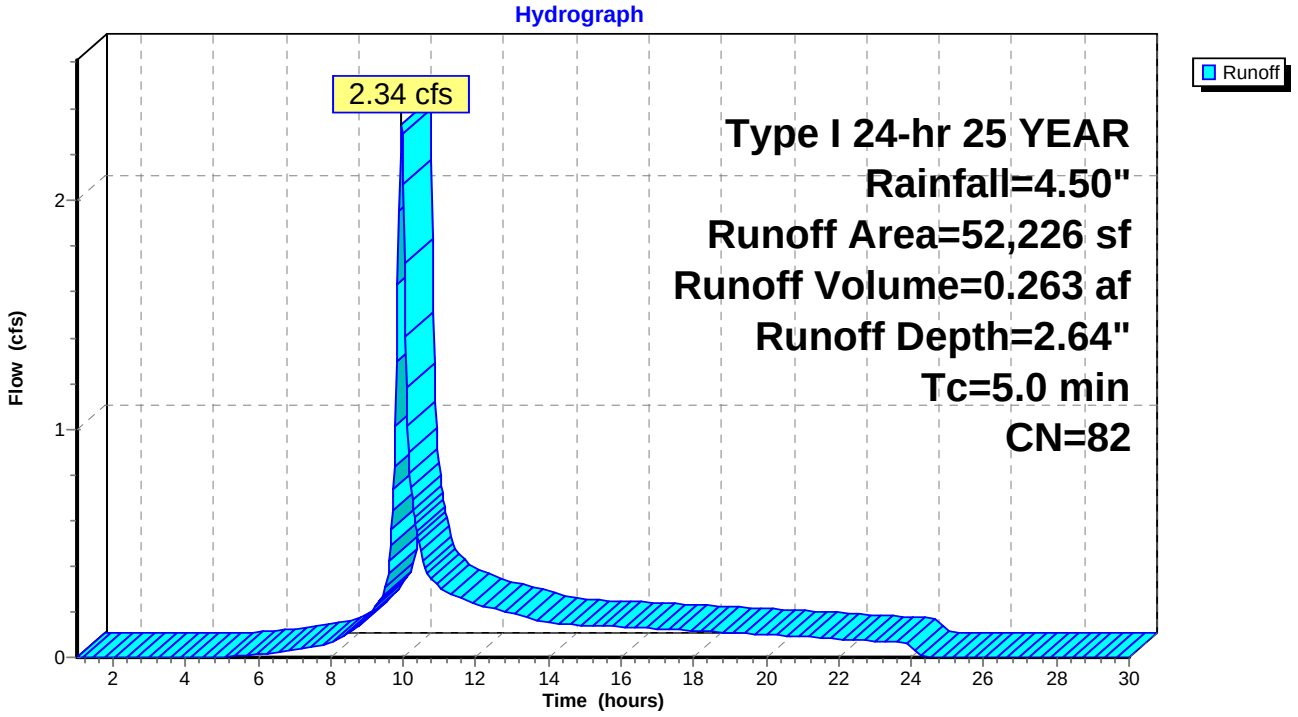
Runoff = 2.34 cfs @ 9.95 hrs, Volume= 0.263 af, Depth= 2.64"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	52,226	82	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 8S: PR7



Summary for Subcatchment 9S: PR8

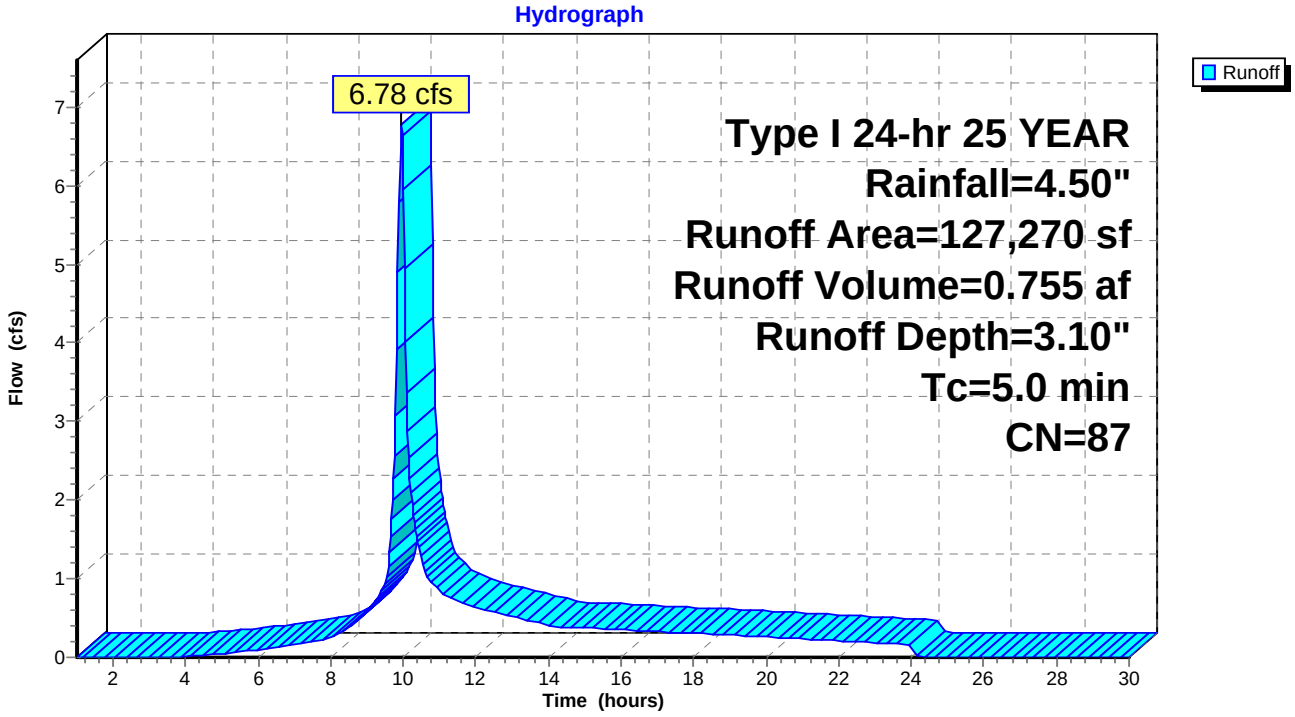
Runoff = 6.78 cfs @ 9.95 hrs, Volume= 0.755 af, Depth= 3.10"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	127,270	87	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0					**Direct Entry,**
4.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 9S: PR8



Summary for Subcatchment 10S: PR1B

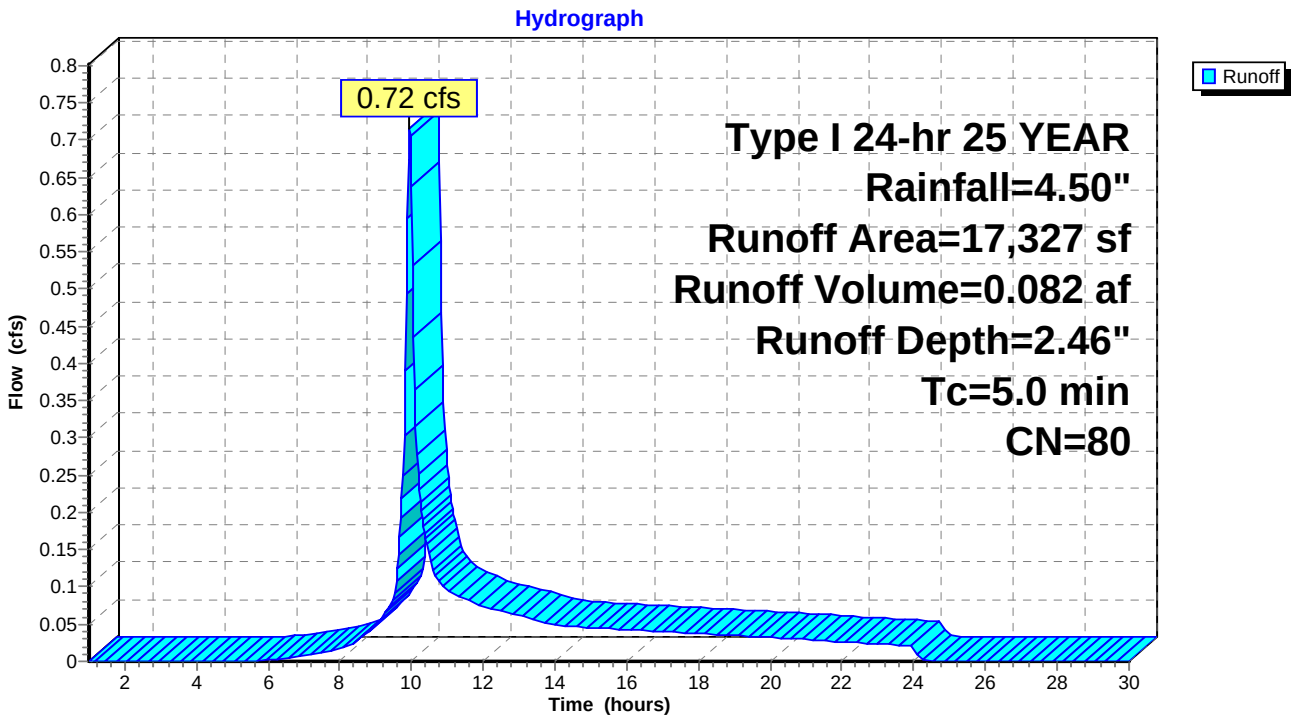
Runoff = 0.72 cfs @ 9.95 hrs, Volume= 0.082 af, Depth= 2.46"

Runoff by SBUH method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Type I 24-hr 25 YEAR Rainfall=4.50"

	Area (sf)	CN	Description
*	17,327	80	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 10S: PR1B



Summary for Pond 1P: PR2

Inflow Area = 0.725 ac, Inflow Depth = 2.13" for 25 YEAR event
Inflow = 1.10 cfs @ 9.95 hrs, Volume= 0.129 af
Outflow = 0.21 cfs @ 10.54 hrs, Volume= 0.128 af, Atten= 81%, Lag= 35.1 min
Primary = 0.21 cfs @ 10.54 hrs, Volume= 0.128 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 11.42' @ 10.54 hrs Surf.Area= 0 sf Storage= 1,309 cf

Plug-Flow detention time= 80.0 min calculated for 0.128 af (99% of inflow)
Center-of-Mass det. time= 76.9 min (895.4 - 818.5)

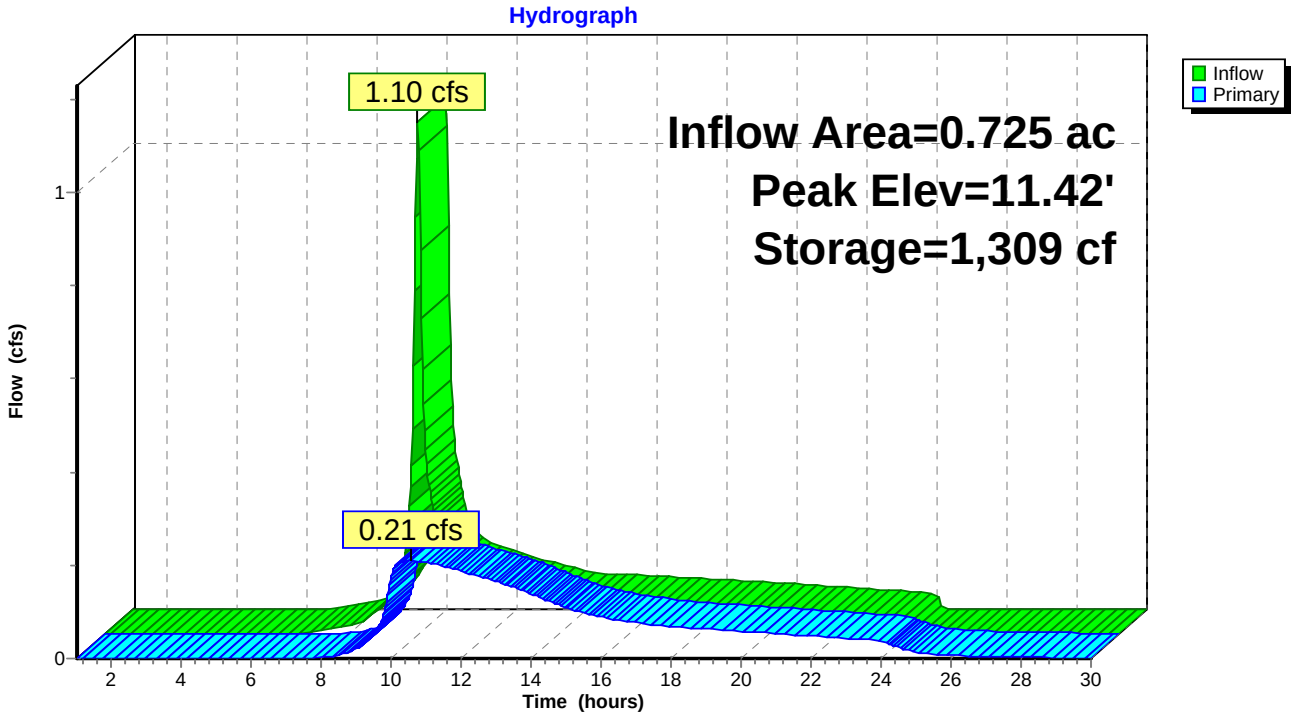
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	5,225 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	628
11.50	1,447
12.00	2,476
12.50	3,730
13.00	5,225

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.21 cfs @ 10.54 hrs HW=11.42' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.21 cfs @ 4.28 fps)

Pond 1P: PR2


Hydrograph
1.10 cfs
0.21 cfs
Inflow Area=0.725 ac
Peak Elev=11.42'
Storage=1,309 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

Summary for Pond 2P: PR1A

Inflow Area = 0.831 ac, Inflow Depth = 2.21" for 25 YEAR event
Inflow = 1.32 cfs @ 9.95 hrs, Volume= 0.153 af
Outflow = 0.18 cfs @ 10.99 hrs, Volume= 0.152 af, Atten= 86%, Lag= 62.5 min
Primary = 0.18 cfs @ 10.99 hrs, Volume= 0.152 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 9.74' @ 10.99 hrs Surf.Area= 0 sf Storage= 1,861 cf

Plug-Flow detention time= 129.4 min calculated for 0.151 af (99% of inflow)
Center-of-Mass det. time= 123.2 min (937.5 - 814.3)

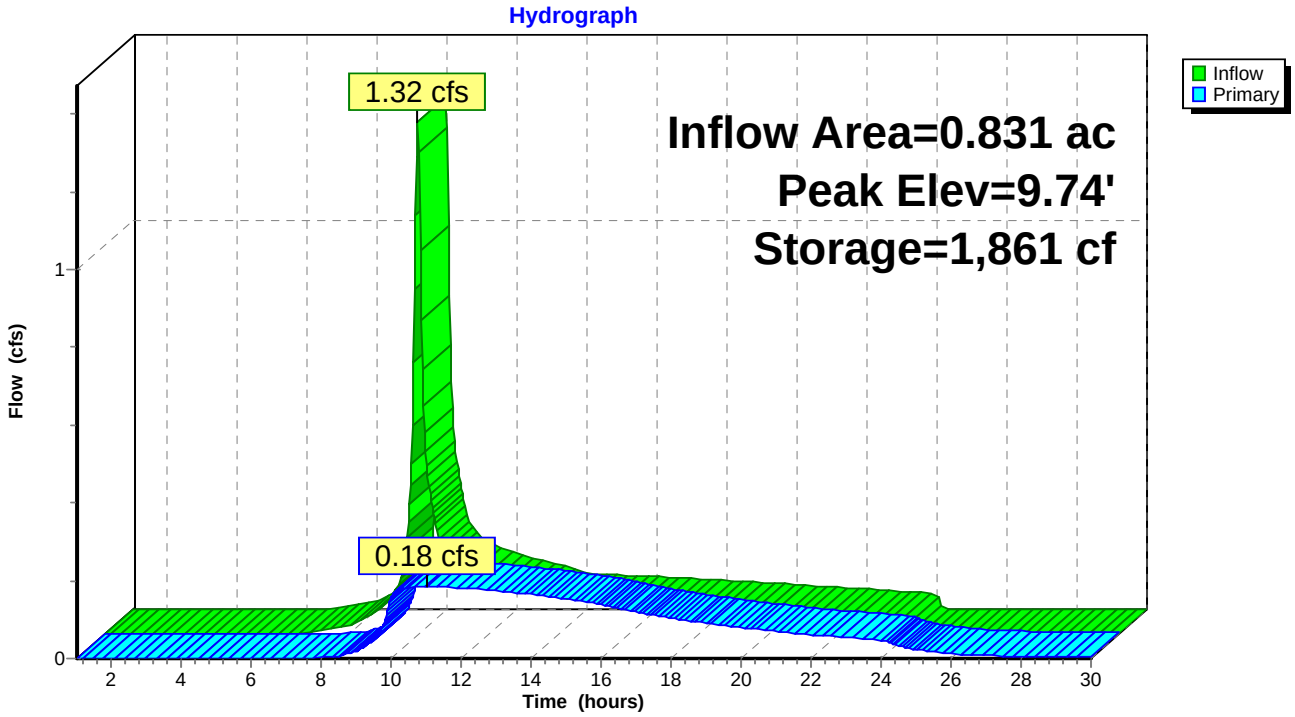
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	7,451 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	989
10.00	2,843
10.50	4,993
11.00	7,451

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.18 cfs @ 10.99 hrs HW=9.74' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.18 cfs @ 3.76 fps)

Pond 2P: PR1A


Hydrograph
1.32 cfs
0.18 cfs
Inflow Area=0.831 ac
Peak Elev=9.74'
Storage=1,861 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

Summary for Pond 3P: PR3

Inflow Area = 0.476 ac, Inflow Depth = 2.13" for 25 YEAR event
Inflow = 0.72 cfs @ 9.95 hrs, Volume= 0.085 af
Outflow = 0.16 cfs @ 10.45 hrs, Volume= 0.084 af, Atten= 78%, Lag= 29.6 min
Primary = 0.16 cfs @ 10.45 hrs, Volume= 0.084 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 9.58' @ 10.45 hrs Surf.Area= 0 sf Storage= 841 cf

Plug-Flow detention time= 81.7 min calculated for 0.084 af (99% of inflow)
Center-of-Mass det. time= 76.6 min (895.1 - 818.5)

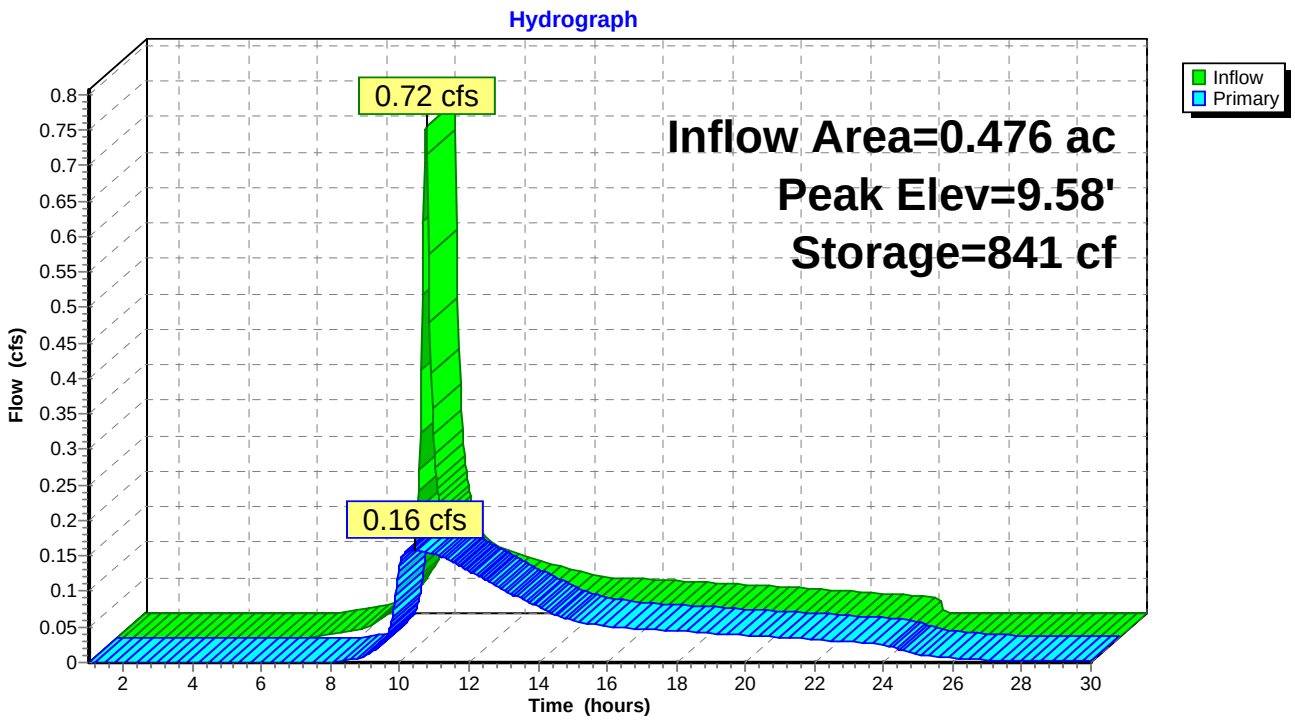
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,409 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	692
10.00	1,672
10.50	2,904
11.00	4,409

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.16 cfs @ 10.45 hrs HW=9.58' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.16 cfs @ 3.23 fps)

Pond 3P: PR3


Hydrograph
0.72 cfs
0.16 cfs
Inflow Area=0.476 ac
Peak Elev=9.58'
Storage=841 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

Summary for Pond 4P: PR4

Inflow Area = 0.974 ac, Inflow Depth = 1.33" for 25 YEAR event
Inflow = 0.78 cfs @ 9.96 hrs, Volume= 0.108 af
Outflow = 0.14 cfs @ 11.00 hrs, Volume= 0.106 af, Atten= 82%, Lag= 62.3 min
Primary = 0.14 cfs @ 11.00 hrs, Volume= 0.106 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 10.77' @ 11.00 hrs Surf.Area= 0 sf Storage= 942 cf

Plug-Flow detention time= 112.2 min calculated for 0.106 af (98% of inflow)
Center-of-Mass det. time= 102.5 min (970.3 - 867.8)

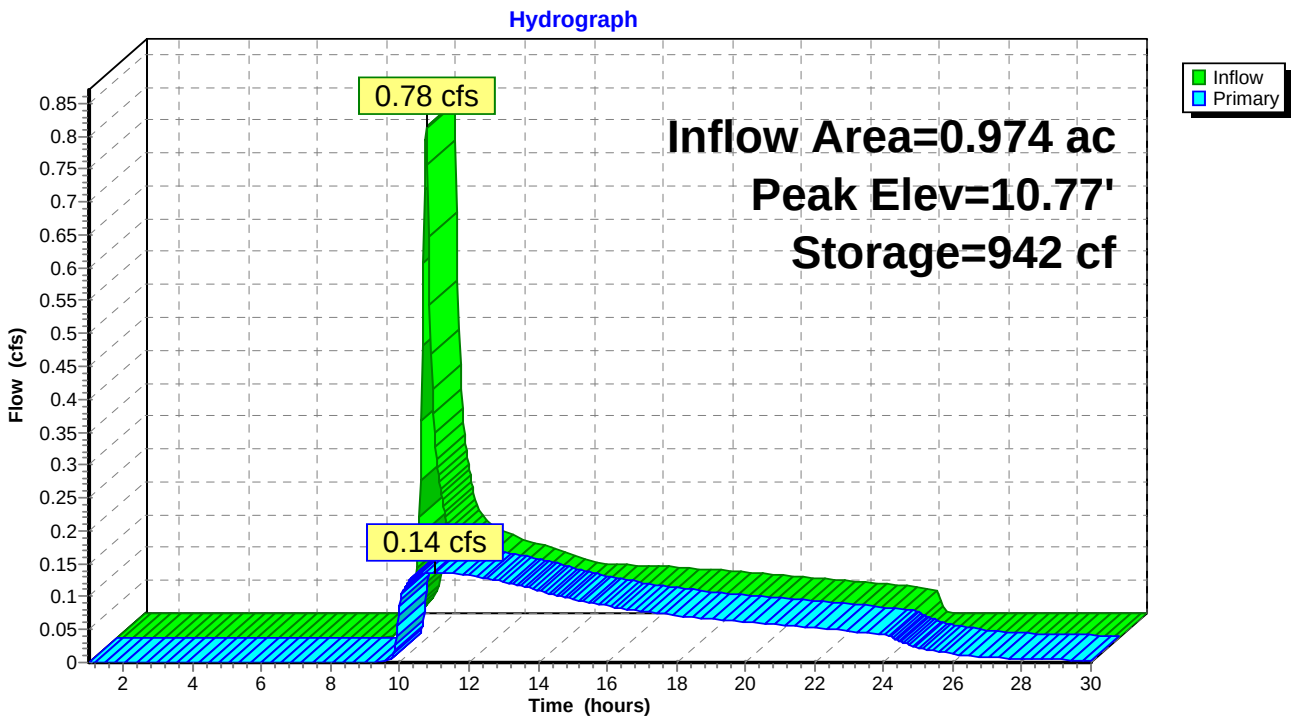
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	8,606 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	1,737
11.50	3,743
12.00	6,029
12.50	8,606

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**2.0" Vert. Orifice/Grate X 3.00** C= 0.600

Primary OutFlow Max=0.14 cfs @ 11.00 hrs HW=10.77' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.14 cfs @ 2.09 fps)

Pond 4P: PR4


Hydrograph
Inflow
Primary
0.78 cfs
0.14 cfs
Inflow Area=0.974 ac
Peak Elev=10.77'
Storage=942 cf
Flow (cfs)
Time (hours)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

Summary for Pond 5P: PR5

Inflow Area = 1.309 ac, Inflow Depth = 2.13" for 25 YEAR event
Inflow = 1.98 cfs @ 9.95 hrs, Volume= 0.232 af
Outflow = 0.24 cfs @ 11.69 hrs, Volume= 0.230 af, Atten= 88%, Lag= 104.5 min
Primary = 0.24 cfs @ 11.69 hrs, Volume= 0.230 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 10.13' @ 11.69 hrs Surf.Area= 0 sf Storage= 3,028 cf

Plug-Flow detention time= 168.8 min calculated for 0.230 af (99% of inflow)
Center-of-Mass det. time= 162.4 min (981.0 - 818.5)

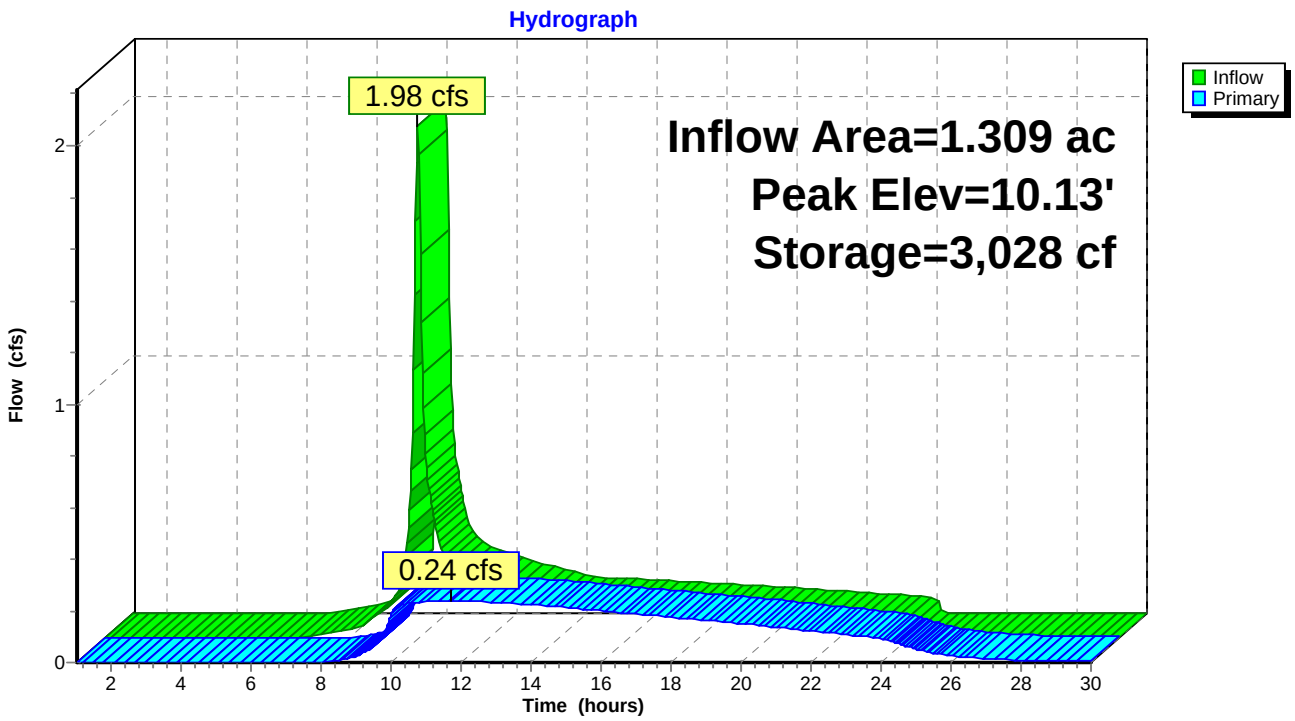
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	6,358 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,145
10.00	2,579
10.50	4,313
11.00	6,358

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.24 cfs @ 11.69 hrs HW=10.13' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.83 fps)

Pond 5P: PR5


Hydrograph
1.98 cfs
0.24 cfs
Inflow Area=1.309 ac
Peak Elev=10.13'
Storage=3,028 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
2
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30

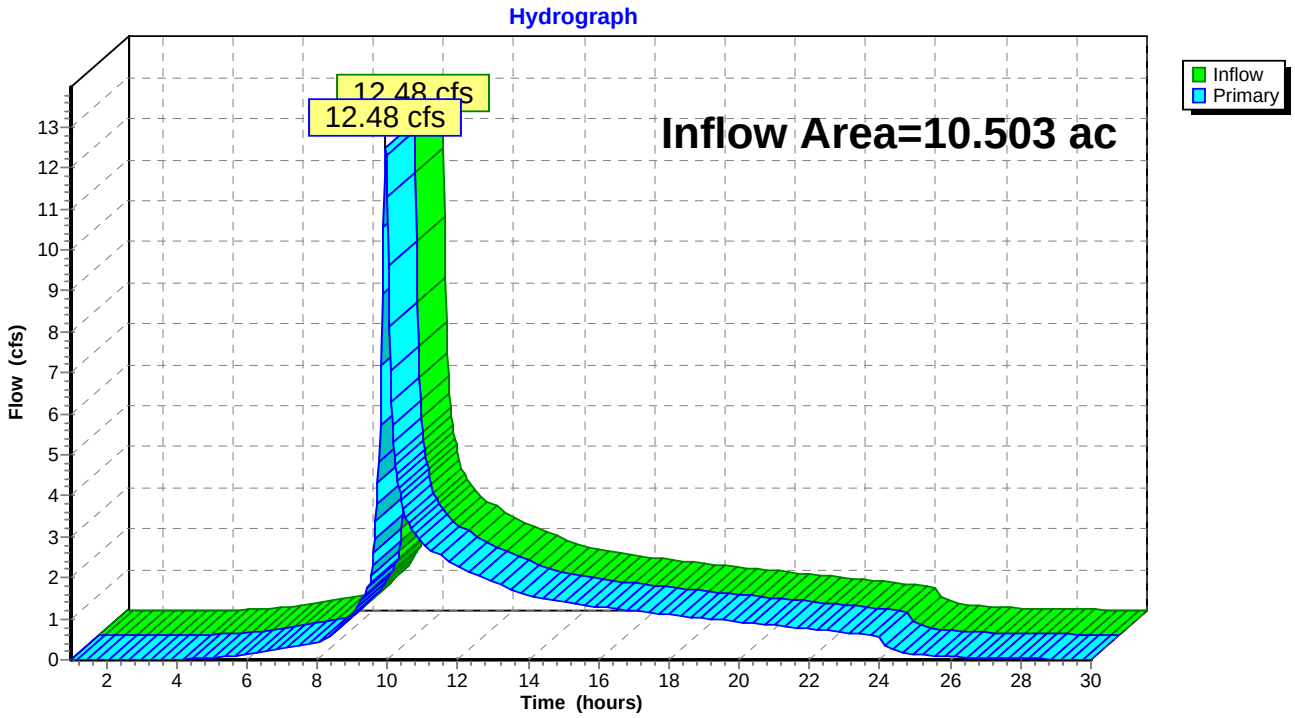
Summary for Pond 6P: OUT

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.503 ac, Inflow Depth > 2.51" for 25 YEAR event
Inflow = 12.48 cfs @ 9.95 hrs, Volume= 2.193 af
Primary = 12.48 cfs @ 9.95 hrs, Volume= 2.193 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs

Pond 6P: OUT



Summary for Pond 11P: PR1B

Inflow Area = 0.398 ac, Inflow Depth = 2.46" for 25 YEAR event
Inflow = 0.72 cfs @ 9.95 hrs, Volume= 0.082 af
Outflow = 0.21 cfs @ 10.24 hrs, Volume= 0.082 af, Atten= 70%, Lag= 17.4 min
Primary = 0.21 cfs @ 10.24 hrs, Volume= 0.082 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 9.95' @ 10.24 hrs Surf.Area= 0 sf Storage= 632 cf

Plug-Flow detention time= 36.7 min calculated for 0.082 af (100% of inflow)
Center-of-Mass det. time= 36.3 min (837.6 - 801.3)

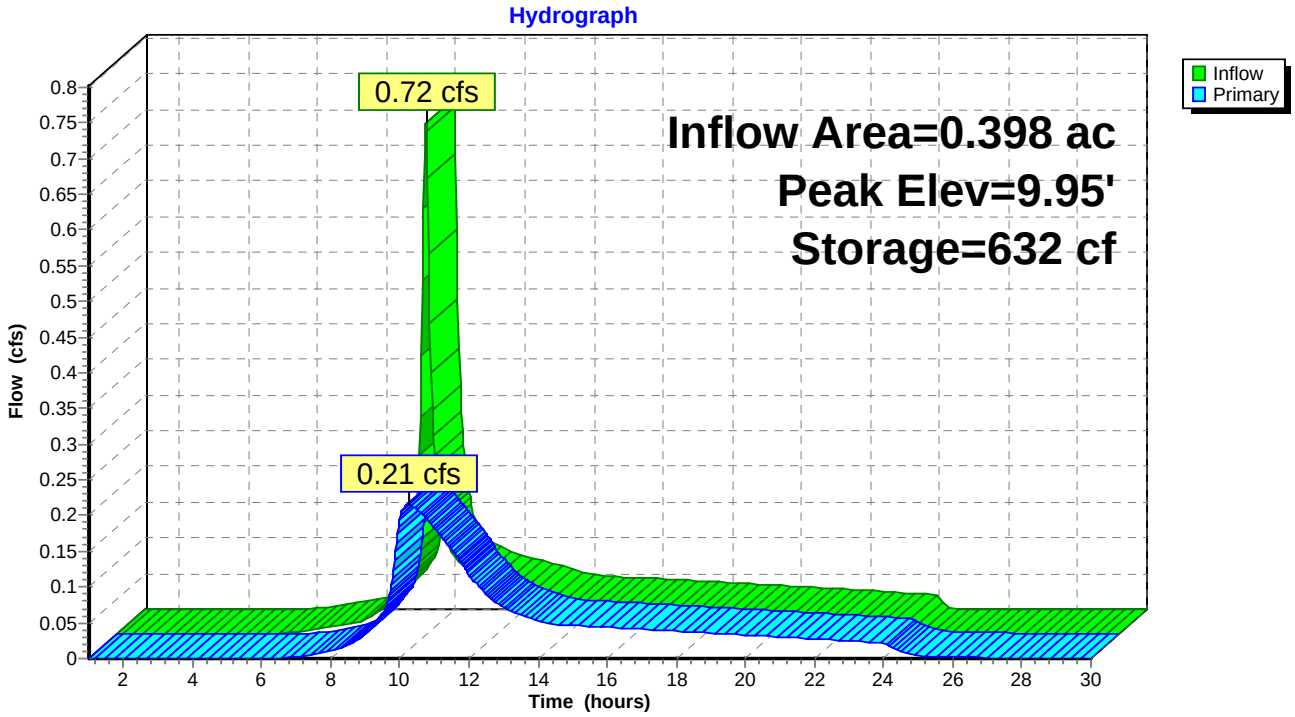
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	3,863 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	268
10.00	671
10.50	1,220
11.00	1,930
11.50	2,814
12.00	3,863

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.21 cfs @ 10.24 hrs HW=9.95' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.21 cfs @ 4.38 fps)

Pond 11P: PR1B



Summary for Pond 12P: PR1C

Inflow Area = 0.518 ac, Inflow Depth = 3.30" for 25 YEAR event
Inflow = 1.28 cfs @ 9.94 hrs, Volume= 0.142 af
Outflow = 0.35 cfs @ 10.26 hrs, Volume= 0.141 af, Atten= 73%, Lag= 18.8 min
Primary = 0.35 cfs @ 10.26 hrs, Volume= 0.141 af

Routing by Stor-Ind method, Time Span= 1.00-30.01 hrs, dt= 0.03 hrs
Peak Elev= 9.66' @ 10.26 hrs Surf.Area= 0 sf Storage= 1,420 cf

Plug-Flow detention time= 66.5 min calculated for 0.141 af (99% of inflow)
Center-of-Mass det. time= 63.0 min (821.8 - 758.8)

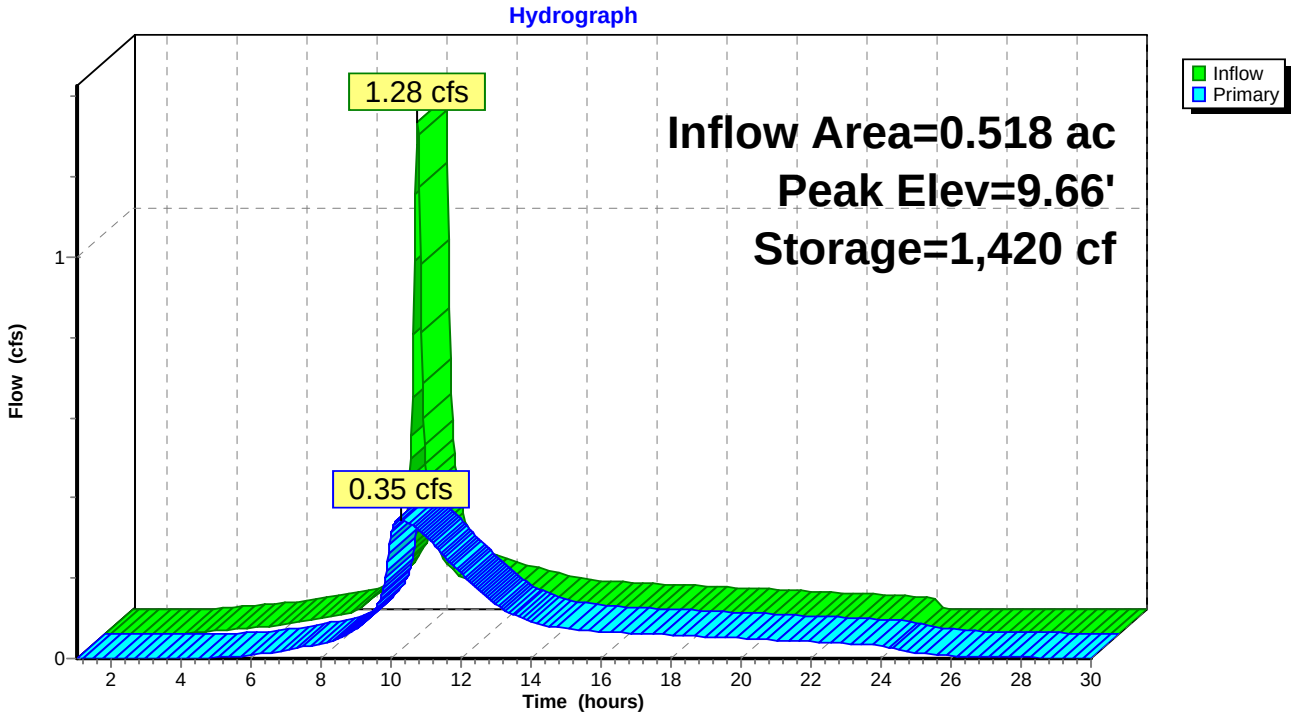
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	5,366 cf	**Custom Stage Data** Listed below

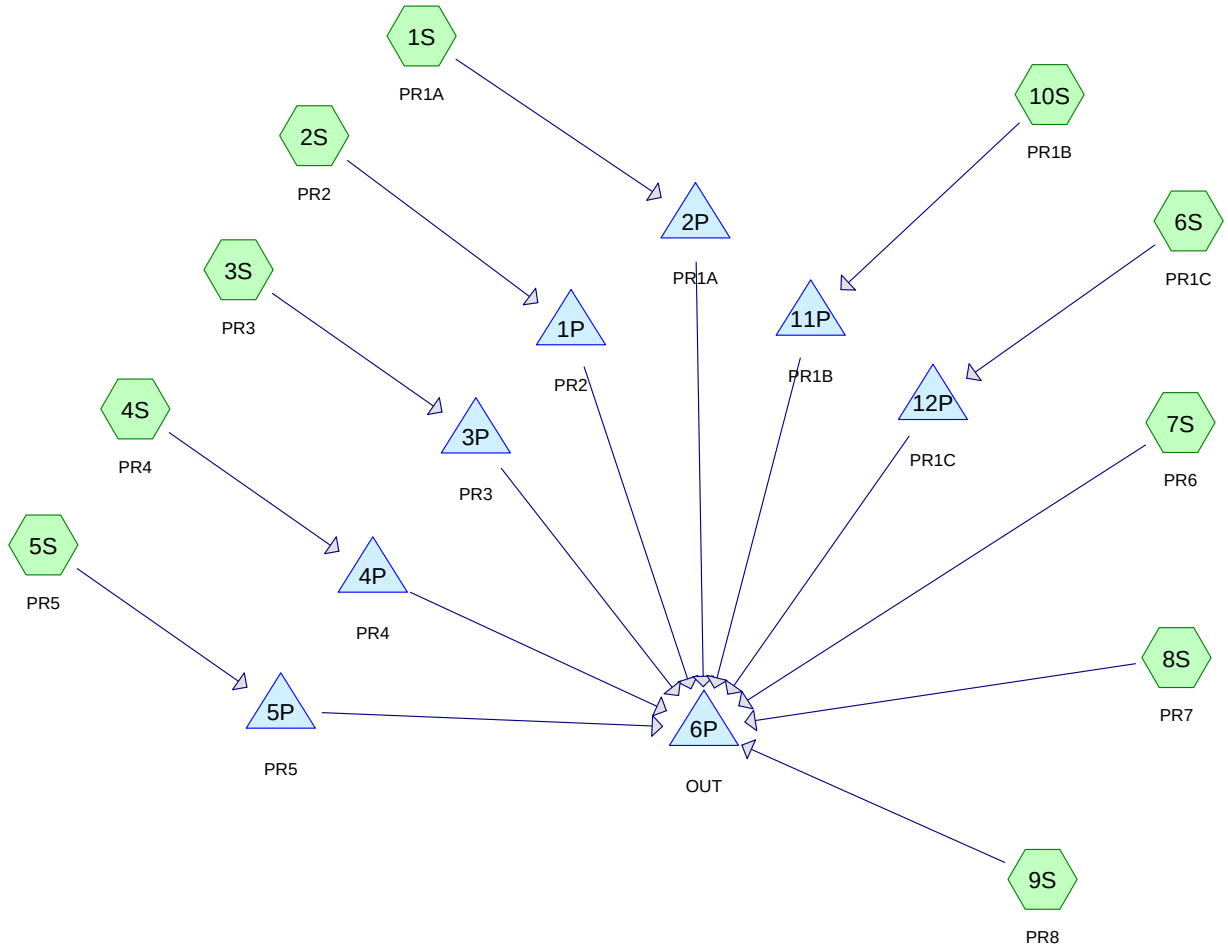
Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,023
10.00	2,248
10.50	3,690
11.00	5,366

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.35 cfs @ 10.26 hrs HW=9.66' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.35 cfs @ 3.53 fps)

Pond 12P: PR1C





Subcat Reach Pond Link

Drainage Diagram for Grover Proposed_10yr_det_1-19-12
Prepared by {enter your company name here}, Printed 1/20/2012
HydroCAD® 9.10 s/n 06659 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.974	73	(4S)
2.511	83	(2S, 3S, 5S)
0.831	84	(1S)
0.398	87	(10S)
2.349	88	(7S, 8S)
2.922	93	(9S)
0.518	98	(6S)
10.503	87	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
10.503	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S
10.503		**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.03 hrs, 1001 points
Runoff by SBUH method
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: PR1A Runoff Area=36,211 sf Runoff Depth=1.94"
Tc=5.0 min CN=84 Runoff=1.18 cfs 0.134 af

Subcatchment 2S: PR2 Runoff Area=31,602 sf Runoff Depth=1.86"
Tc=5.0 min CN=83 Runoff=0.98 cfs 0.112 af

Subcatchment 3S: PR3 Runoff Area=20,753 sf Runoff Depth=1.86"
Tc=5.0 min CN=83 Runoff=0.65 cfs 0.074 af

Subcatchment 4S: PR4 Runoff Area=42,422 sf Runoff Depth=1.18"
Tc=5.0 min CN=73 Runoff=0.73 cfs 0.096 af

Subcatchment 5S: PR5 Runoff Area=57,034 sf Runoff Depth=1.86"
Tc=5.0 min CN=83 Runoff=1.77 cfs 0.203 af

Subcatchment 6S: PR1C Runoff Area=22,559 sf Runoff Depth=3.27"
Tc=5.0 min CN=98 Runoff=1.19 cfs 0.141 af

Subcatchment 7S: PR6 Runoff Area=50,093 sf Runoff Depth=2.27"
Tc=5.0 min CN=88 Runoff=1.95 cfs 0.217 af

Subcatchment 8S: PR7 Runoff Area=52,226 sf Runoff Depth=2.27"
Tc=5.0 min CN=88 Runoff=2.03 cfs 0.227 af

Subcatchment 9S: PR8 Runoff Area=127,270 sf Runoff Depth=2.73"
Tc=5.0 min CN=93 Runoff=5.95 cfs 0.666 af

Subcatchment 10S: PR1B Runoff Area=17,327 sf Runoff Depth=2.18"
Tc=5.0 min CN=87 Runoff=0.65 cfs 0.072 af

Pond 1P: PR2 Peak Elev=11.33' Storage=1,172 cf Inflow=0.98 cfs 0.112 af
Outflow=0.20 cfs 0.112 af

Pond 2P: PR1A Peak Elev=9.68' Storage=1,667 cf Inflow=1.18 cfs 0.134 af
Outflow=0.18 cfs 0.133 af

Pond 3P: PR3 Peak Elev=9.53' Storage=759 cf Inflow=0.65 cfs 0.074 af
Outflow=0.15 cfs 0.073 af

Pond 4P: PR4 Peak Elev=10.76' Storage=895 cf Inflow=0.73 cfs 0.096 af
Outflow=0.13 cfs 0.094 af

Pond 5P: PR5 Peak Elev=10.03' Storage=2,672 cf Inflow=1.77 cfs 0.203 af
Outflow=0.22 cfs 0.201 af

Pond 6P: OUT Inflow=11.05 cfs 1.934 af
Primary=11.05 cfs 1.934 af

Pond 11P: PR1B Peak Elev=9.87' Storage=567 cf Inflow=0.65 cfs 0.072 af
Outflow=0.20 cfs 0.072 af

Pond 12P: PR1C Peak Elev=9.64' Storage=1,361 cf Inflow=1.19 cfs 0.141 af
Outflow=0.34 cfs 0.140 af

Total Runoff Area = 10.503 ac Runoff Volume = 1.942 af Average Runoff Depth = 2.22"

Summary for Subcatchment 1S: PR1A

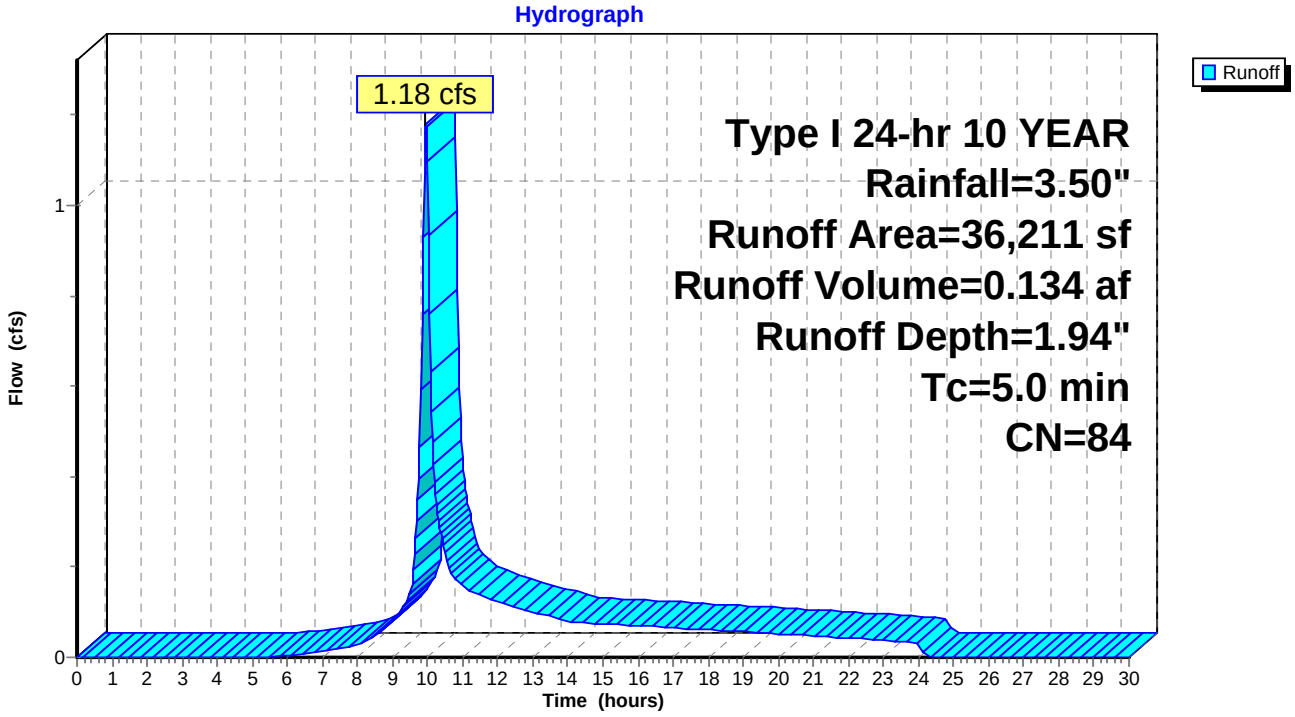
Runoff = 1.18 cfs @ 9.95 hrs, Volume= 0.134 af, Depth= 1.94"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	36,211	84	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1S: PR1A



Summary for Subcatchment 2S: PR2

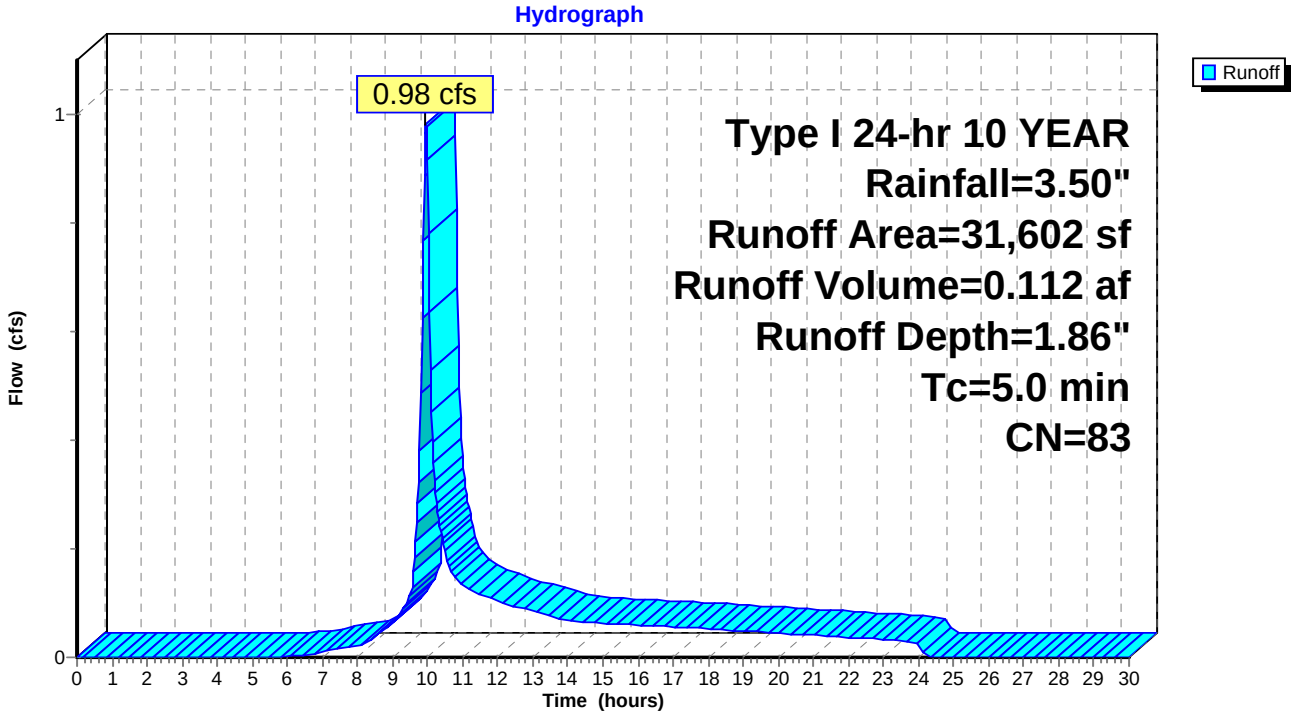
Runoff = 0.98 cfs @ 9.95 hrs, Volume= 0.112 af, Depth= 1.86"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	31,602	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2S: PR2



Summary for Subcatchment 3S: PR3

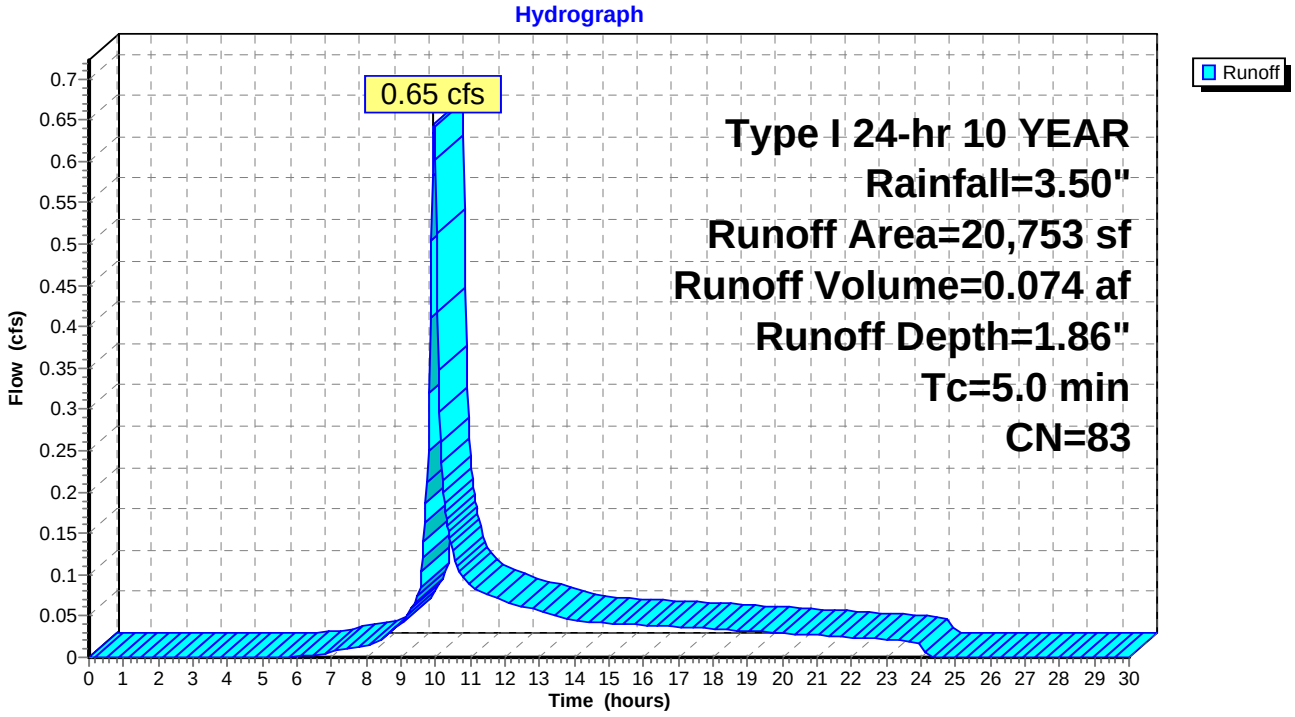
Runoff = 0.65 cfs @ 9.95 hrs, Volume= 0.074 af, Depth= 1.86"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	20,753	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3S: PR3



Summary for Subcatchment 4S: PR4

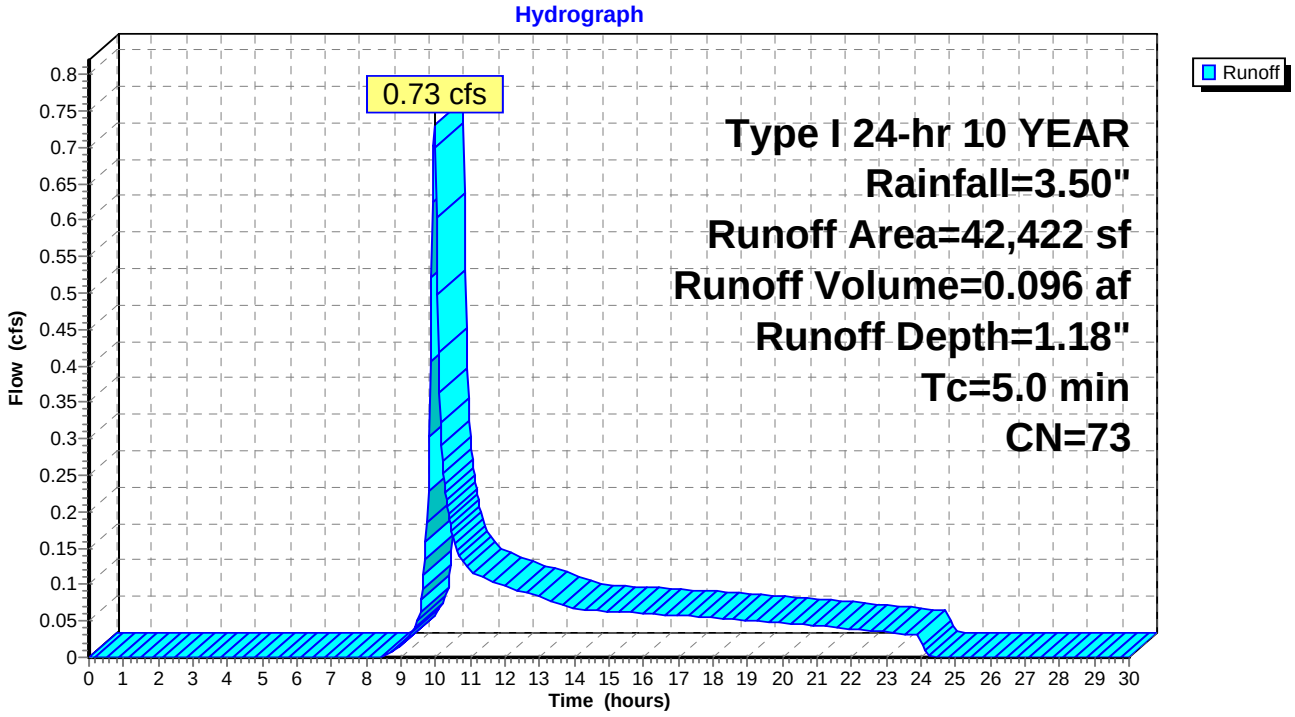
Runoff = 0.73 cfs @ 9.96 hrs, Volume= 0.096 af, Depth= 1.18"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	42,422	73	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: PR4



Summary for Subcatchment 5S: PR5

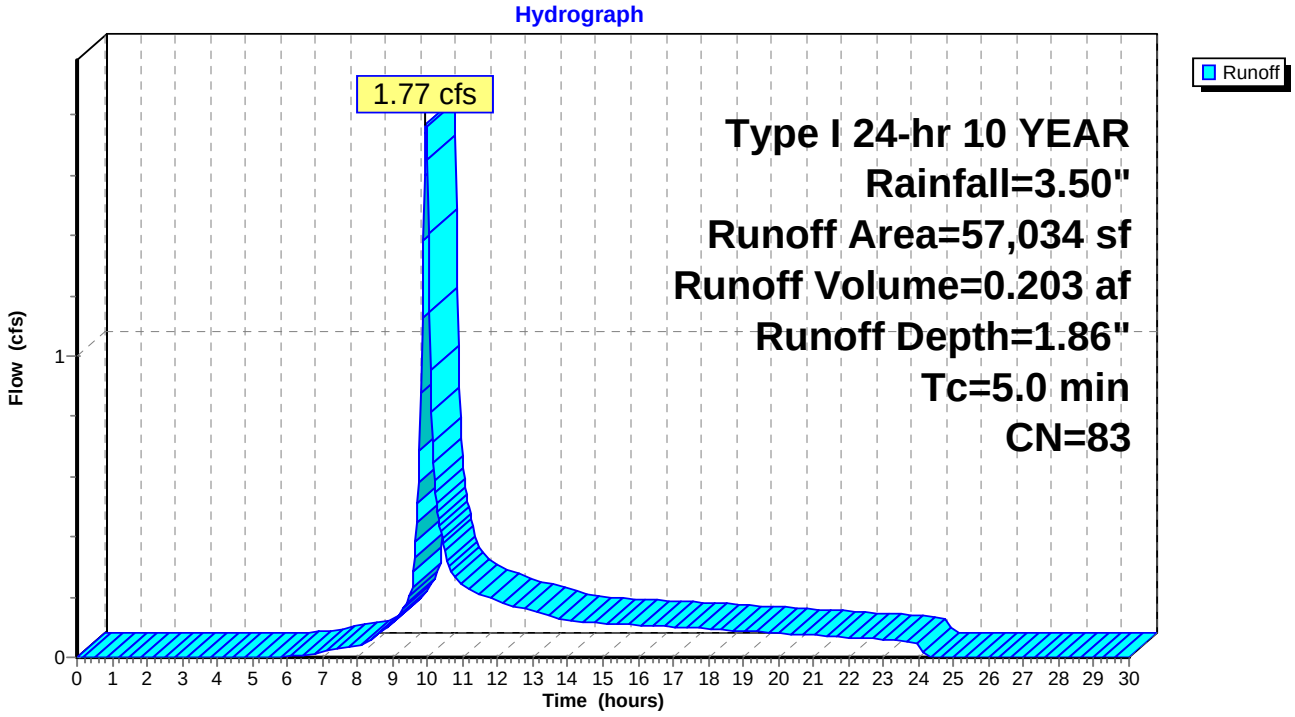
Runoff = 1.77 cfs @ 9.95 hrs, Volume= 0.203 af, Depth= 1.86"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	57,034	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 5S: PR5



Summary for Subcatchment 6S: PR1C

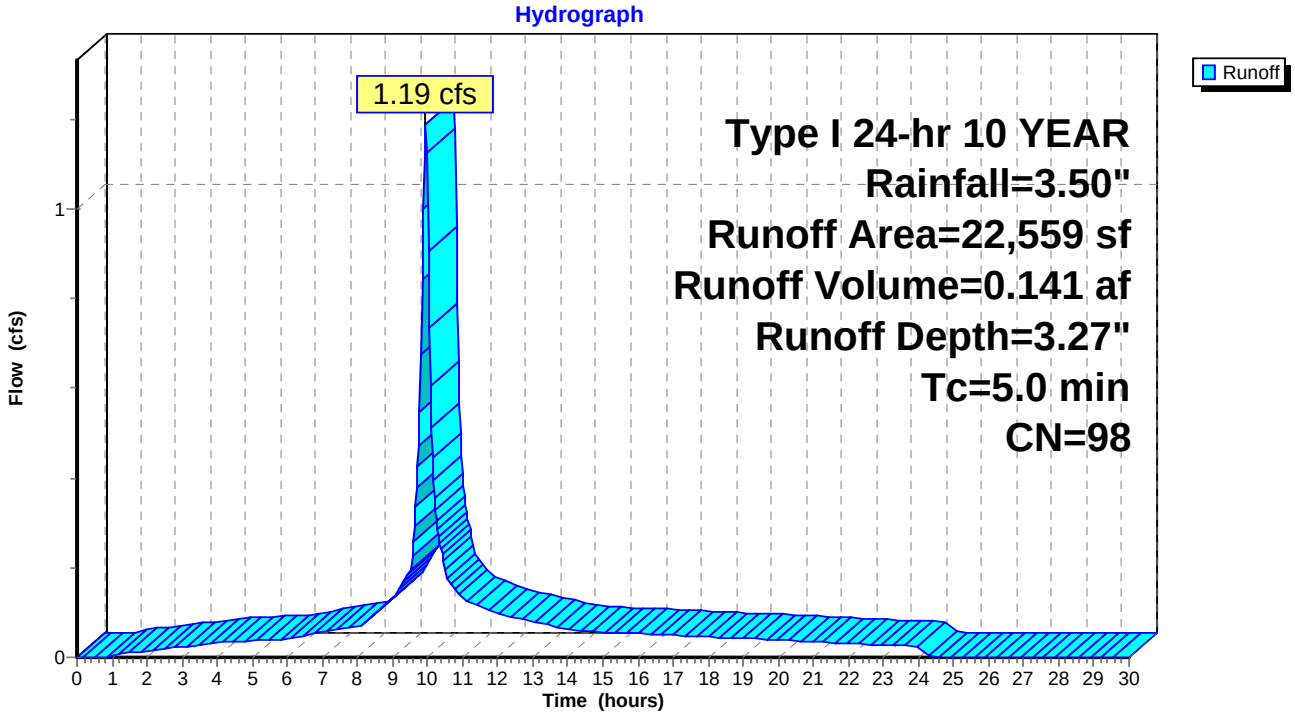
Runoff = 1.19 cfs @ 9.94 hrs, Volume= 0.141 af, Depth= 3.27"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	22,559	98	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 6S: PR1C



Summary for Subcatchment 7S: PR6

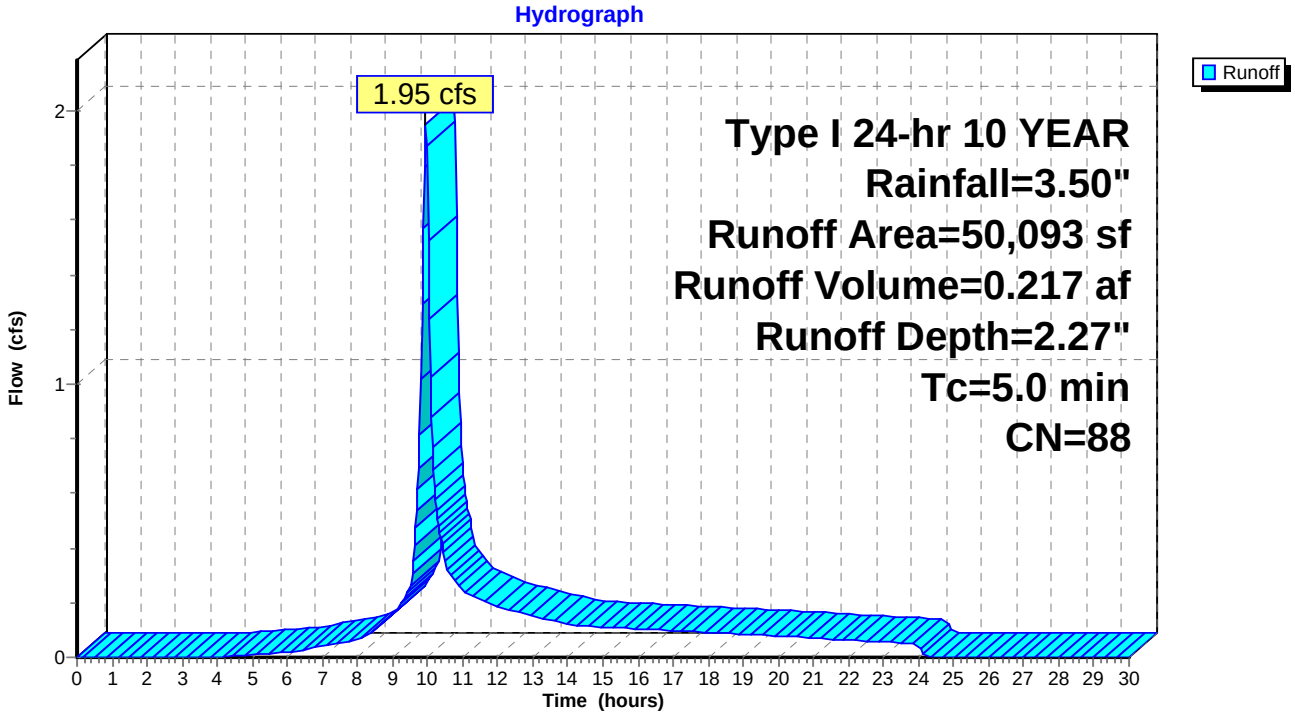
Runoff = 1.95 cfs @ 9.95 hrs, Volume= 0.217 af, Depth= 2.27"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	50,093	88	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: PR6



Summary for Subcatchment 8S: PR7

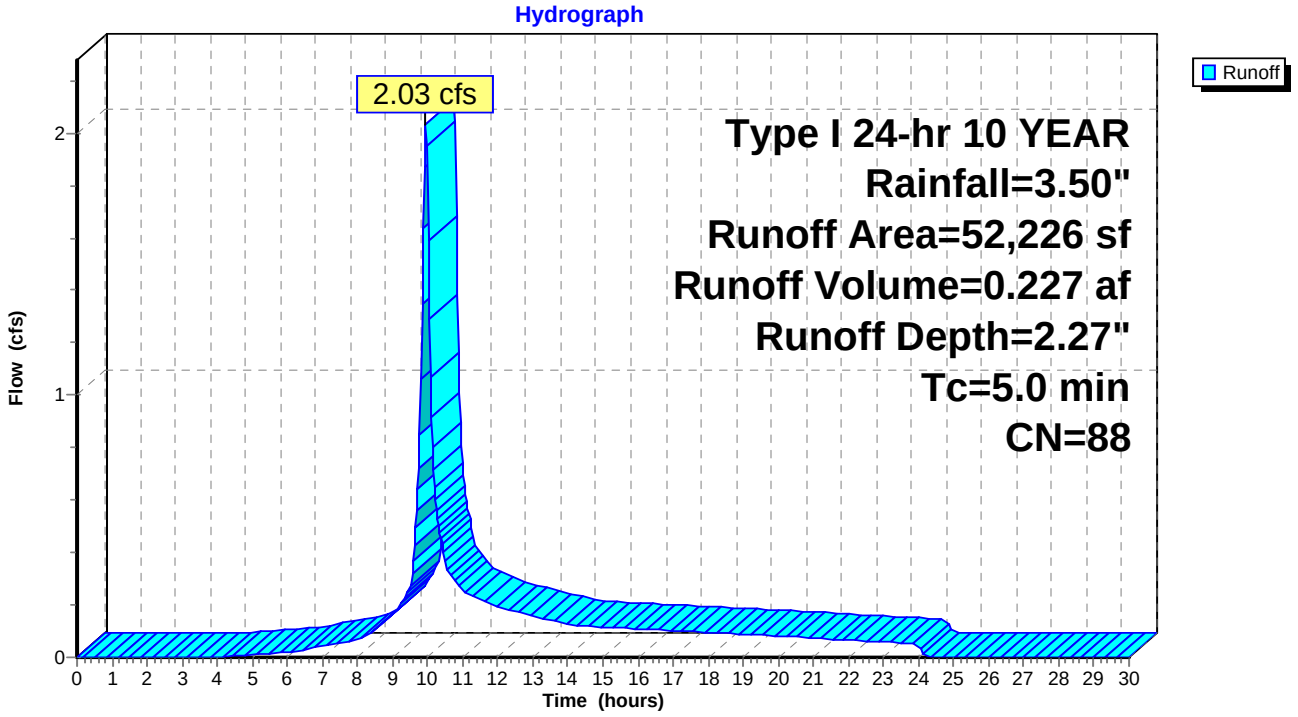
Runoff = 2.03 cfs @ 9.95 hrs, Volume= 0.227 af, Depth= 2.27"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	52,226	88	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 8S: PR7



Summary for Subcatchment 9S: PR8

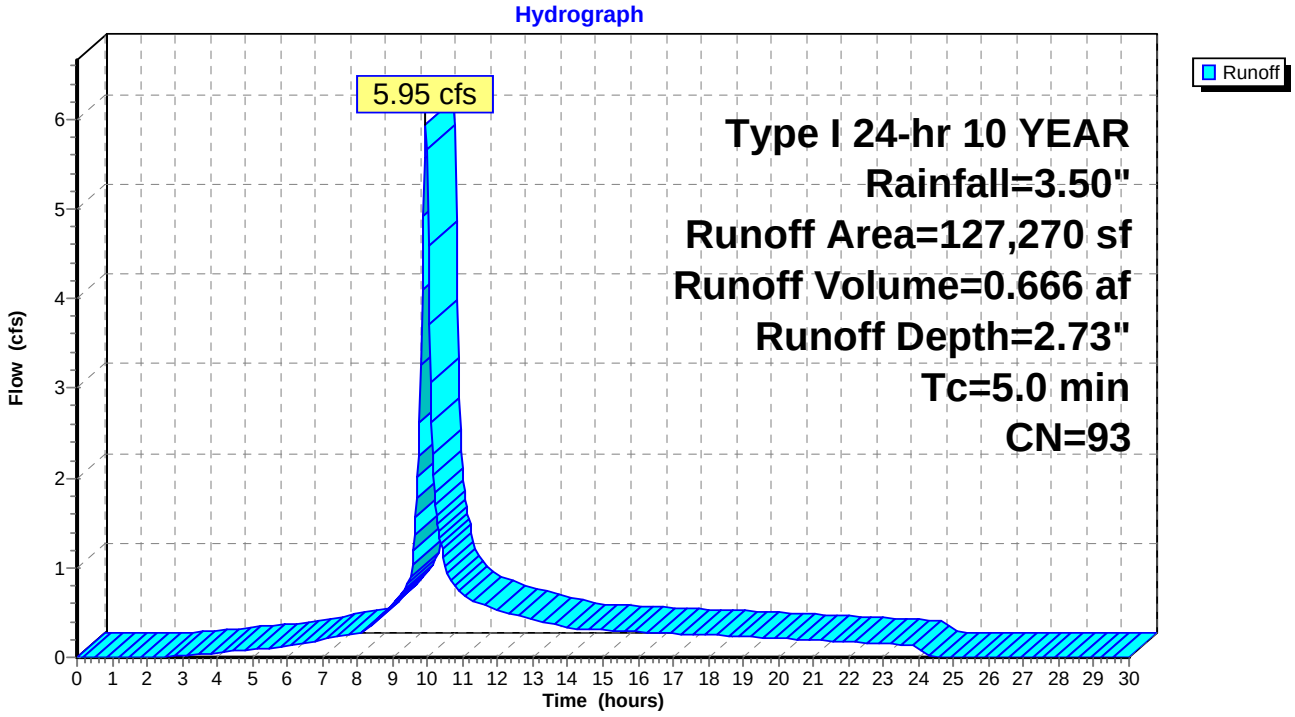
Runoff = 5.95 cfs @ 9.94 hrs, Volume= 0.666 af, Depth= 2.73"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	127,270	93	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0					**Direct Entry,**
4.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 9S: PR8



Summary for Subcatchment 10S: PR1B

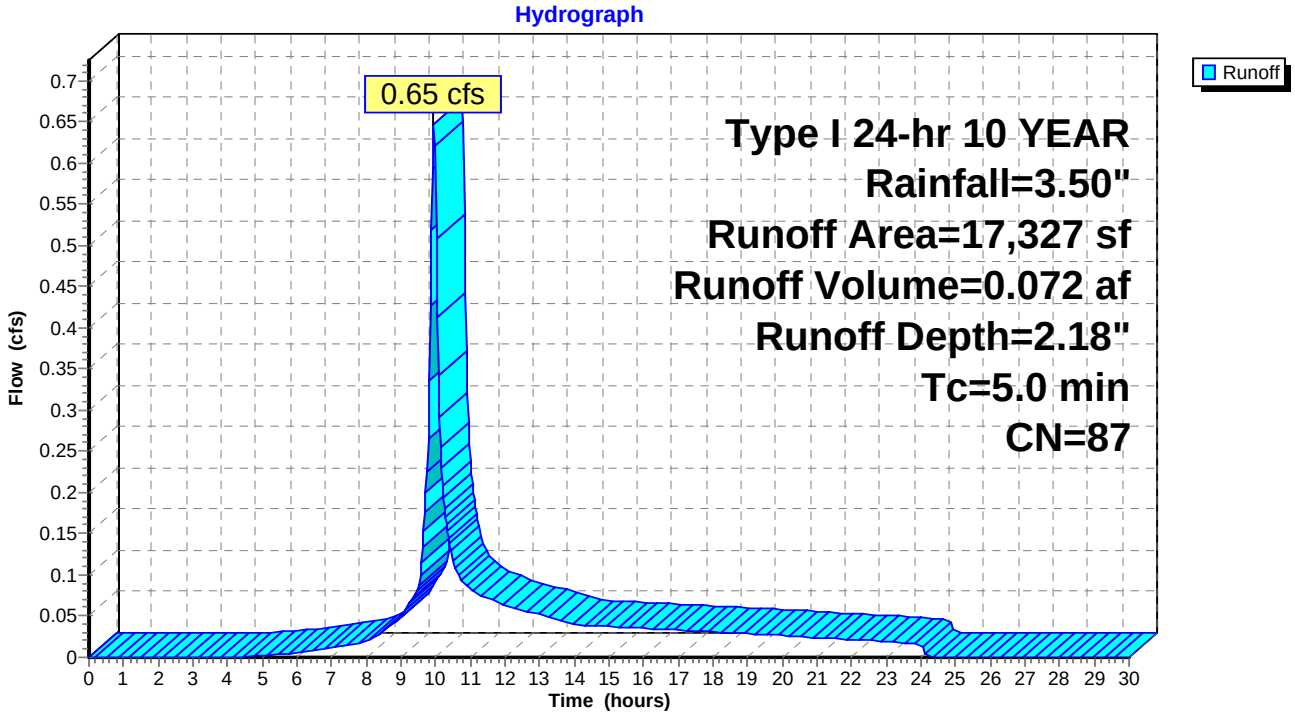
Runoff = 0.65 cfs @ 9.95 hrs, Volume= 0.072 af, Depth= 2.18"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 10 YEAR Rainfall=3.50"

	Area (sf)	CN	Description
*	17,327	87	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 10S: PR1B



Summary for Pond 1P: PR2

Inflow Area = 0.725 ac, Inflow Depth = 1.86" for 10 YEAR event
Inflow = 0.98 cfs @ 9.95 hrs, Volume= 0.112 af
Outflow = 0.20 cfs @ 10.48 hrs, Volume= 0.112 af, Atten= 80%, Lag= 31.6 min
Primary = 0.20 cfs @ 10.48 hrs, Volume= 0.112 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 11.33' @ 10.48 hrs Surf.Area= 0 sf Storage= 1,172 cf

Plug-Flow detention time= 78.6 min calculated for 0.112 af (99% of inflow)
Center-of-Mass det. time= 75.1 min (880.1 - 805.0)

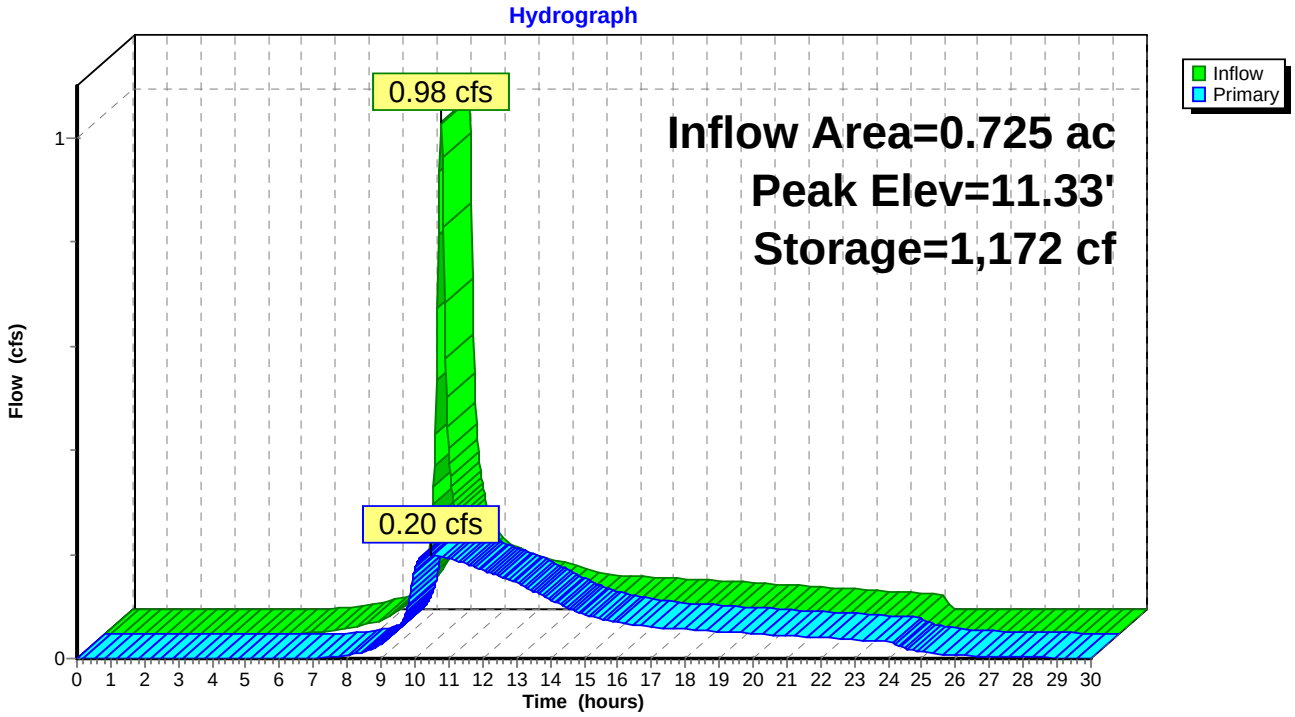
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	5,225 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	628
11.50	1,447
12.00	2,476
12.50	3,730
13.00	5,225

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.20 cfs @ 10.48 hrs HW=11.33' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.05 fps)

Pond 1P: PR2


Hydrograph
0.98 cfs
0.20 cfs
Inflow Area=0.725 ac
Peak Elev=11.33'
Storage=1,172 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Summary for Pond 2P: PR1A

Inflow Area = 0.831 ac, Inflow Depth = 1.94" for 10 YEAR event
Inflow = 1.18 cfs @ 9.95 hrs, Volume= 0.134 af
Outflow = 0.18 cfs @ 10.79 hrs, Volume= 0.133 af, Atten= 85%, Lag= 50.1 min
Primary = 0.18 cfs @ 10.79 hrs, Volume= 0.133 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.68' @ 10.79 hrs Surf.Area= 0 sf Storage= 1,667 cf

Plug-Flow detention time= 123.8 min calculated for 0.132 af (99% of inflow)
Center-of-Mass det. time= 116.8 min (916.7 - 799.9)

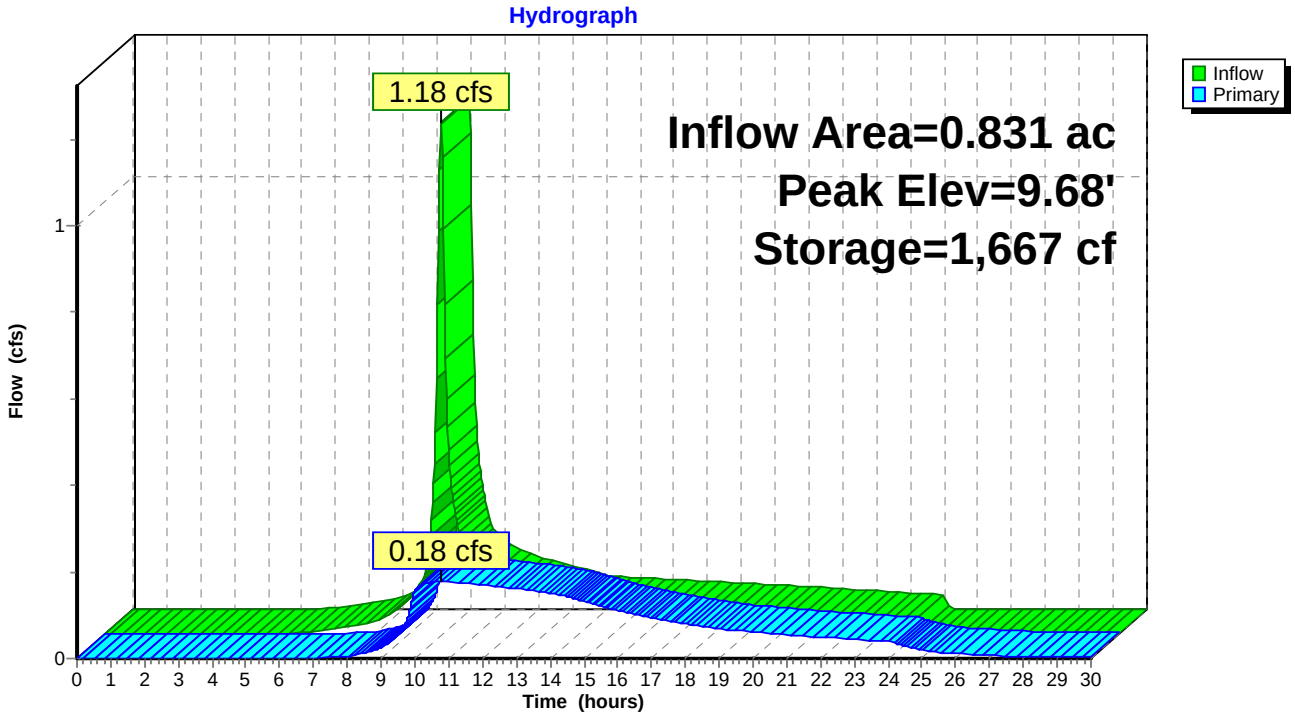
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	7,451 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	989
10.00	2,843
10.50	4,993
11.00	7,451

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.18 cfs @ 10.79 hrs HW=9.68' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.18 cfs @ 3.60 fps)

Pond 2P: PR1A


Hydrograph
1.18 cfs
0.18 cfs
Inflow Area=0.831 ac
Peak Elev=9.68'
Storage=1,667 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

Summary for Pond 3P: PR3

Inflow Area = 0.476 ac, Inflow Depth = 1.86" for 10 YEAR event
Inflow = 0.65 cfs @ 9.95 hrs, Volume= 0.074 af
Outflow = 0.15 cfs @ 10.38 hrs, Volume= 0.073 af, Atten= 77%, Lag= 25.9 min
Primary = 0.15 cfs @ 10.38 hrs, Volume= 0.073 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.53' @ 10.38 hrs Surf.Area= 0 sf Storage= 759 cf

Plug-Flow detention time= 83.8 min calculated for 0.073 af (99% of inflow)
Center-of-Mass det. time= 77.7 min (882.6 - 805.0)

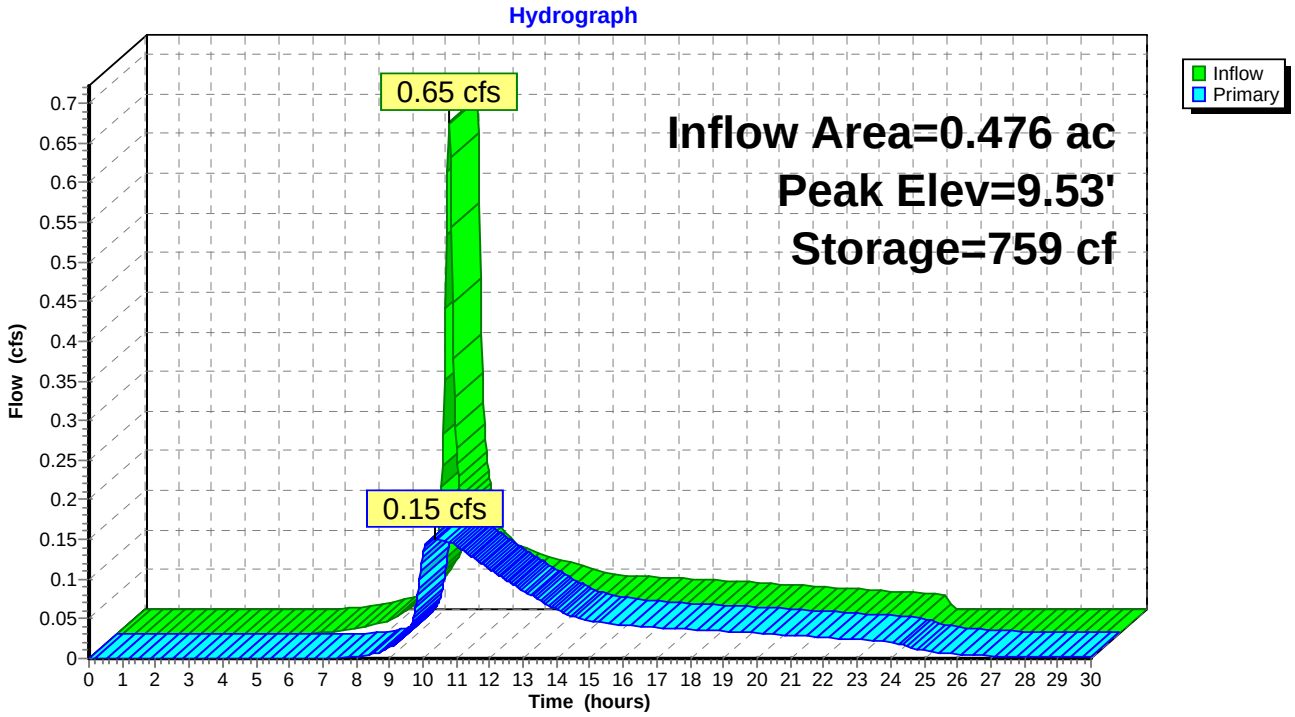
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,409 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	692
10.00	1,672
10.50	2,904
11.00	4,409

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.15 cfs @ 10.38 hrs HW=9.53' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.15 cfs @ 3.08 fps)

Pond 3P: PR3


Hydrograph
Inflow
Primary
0.65 cfs
0.15 cfs
Inflow Area=0.476 ac
Peak Elev=9.53'
Storage=759 cf
Flow (cfs)
Time (hours)

Summary for Pond 4P: PR4

Inflow Area = 0.974 ac, Inflow Depth = 1.18" for 10 YEAR event
Inflow = 0.73 cfs @ 9.96 hrs, Volume= 0.096 af
Outflow = 0.13 cfs @ 10.81 hrs, Volume= 0.094 af, Atten= 82%, Lag= 50.8 min
Primary = 0.13 cfs @ 10.81 hrs, Volume= 0.094 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 10.76' @ 10.81 hrs Surf.Area= 0 sf Storage= 895 cf

Plug-Flow detention time= 114.6 min calculated for 0.094 af (98% of inflow)
Center-of-Mass det. time= 103.6 min (958.3 - 854.6)

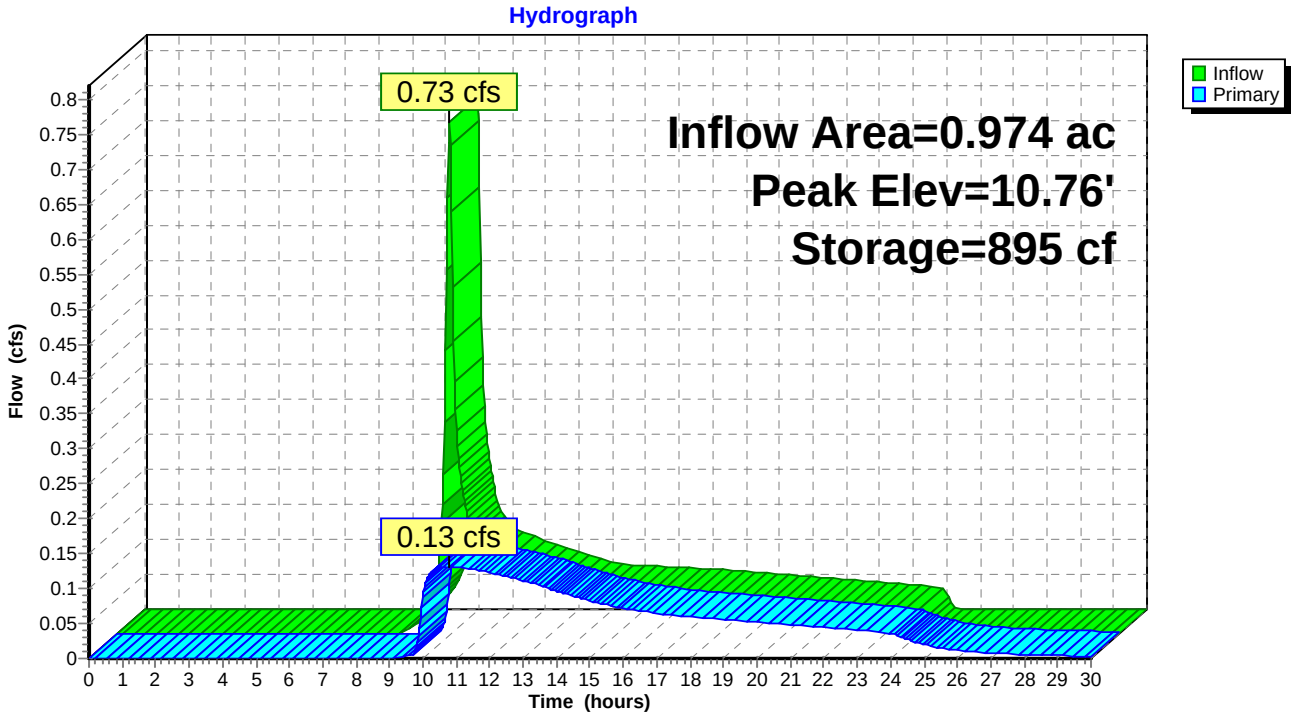
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	8,606 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	1,737
11.50	3,743
12.00	6,029
12.50	8,606

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**2.0" Vert. Orifice/Grate X 3.00** C= 0.600

Primary OutFlow Max=0.13 cfs @ 10.81 hrs HW=10.76' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.13 cfs @ 2.01 fps)

Pond 4P: PR4


Hydrograph
Inflow
Primary
0.73 cfs
0.13 cfs
Inflow Area=0.974 ac
Peak Elev=10.76'
Storage=895 cf
Flow (cfs)
Time (hours)

Summary for Pond 5P: PR5

Inflow Area = 1.309 ac, Inflow Depth = 1.86" for 10 YEAR event
Inflow = 1.77 cfs @ 9.95 hrs, Volume= 0.203 af
Outflow = 0.22 cfs @ 11.19 hrs, Volume= 0.201 af, Atten= 87%, Lag= 74.2 min
Primary = 0.22 cfs @ 11.19 hrs, Volume= 0.201 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 10.03' @ 11.19 hrs Surf.Area= 0 sf Storage= 2,672 cf

Plug-Flow detention time= 156.8 min calculated for 0.200 af (99% of inflow)
Center-of-Mass det. time= 150.1 min (955.1 - 805.0)

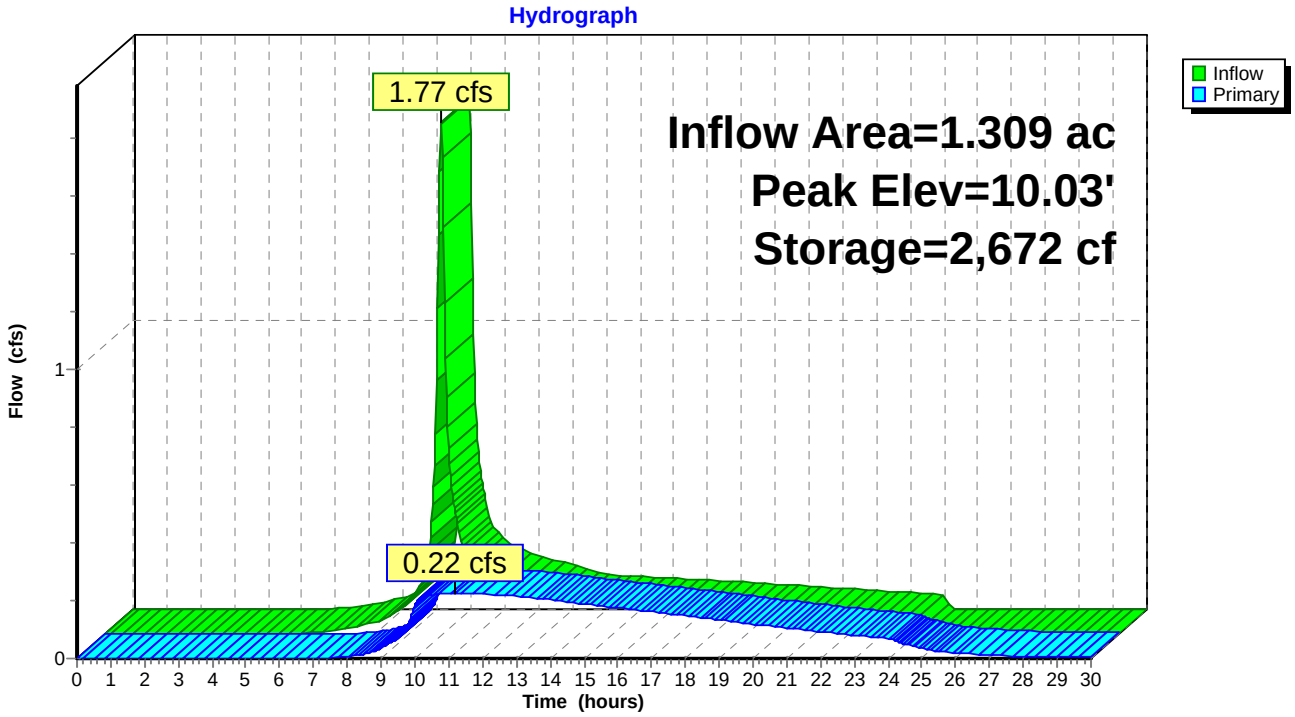
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	6,358 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,145
10.00	2,579
10.50	4,313
11.00	6,358

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.22 cfs @ 11.19 hrs HW=10.03' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.22 cfs @ 4.57 fps)

Pond 5P: PR5


Hydrograph
1.77 cfs
0.22 cfs
Inflow Area=1.309 ac
Peak Elev=10.03'
Storage=2,672 cf
Inflow
Primary
Flow (cfs)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Time (hours)

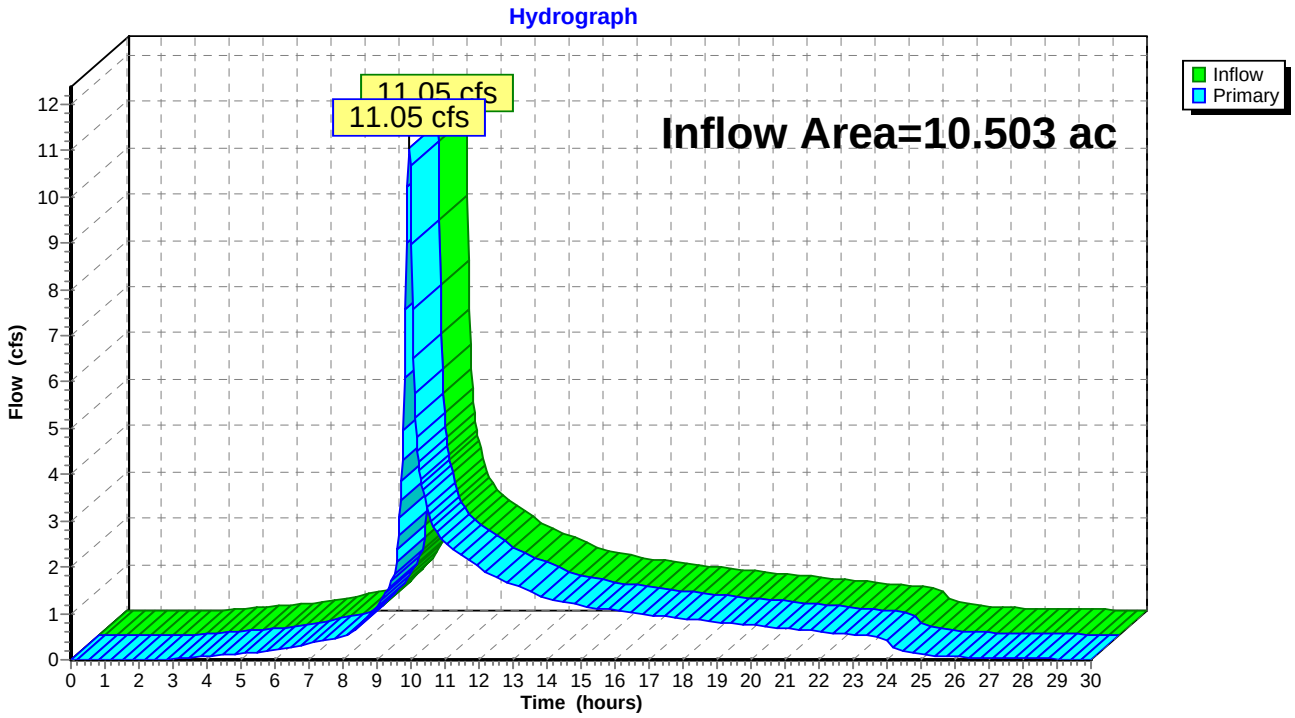
Summary for Pond 6P: OUT

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	10.503 ac,	Inflow Depth >	2.21"	for	10 YEAR event
Inflow =	11.05 cfs @	9.95 hrs,	Volume=	1.934 af	
Primary =	11.05 cfs @	9.95 hrs,	Volume=	1.934 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Pond 6P: OUT



Summary for Pond 11P: PR1B

Inflow Area = 0.398 ac, Inflow Depth = 2.18" for 10 YEAR event
Inflow = 0.65 cfs @ 9.95 hrs, Volume= 0.072 af
Outflow = 0.20 cfs @ 10.21 hrs, Volume= 0.072 af, Atten= 68%, Lag= 15.7 min
Primary = 0.20 cfs @ 10.21 hrs, Volume= 0.072 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.87' @ 10.21 hrs Surf.Area= 0 sf Storage= 567 cf

Plug-Flow detention time= 37.1 min calculated for 0.072 af (100% of inflow)
Center-of-Mass det. time= 36.6 min (820.6 - 784.0)

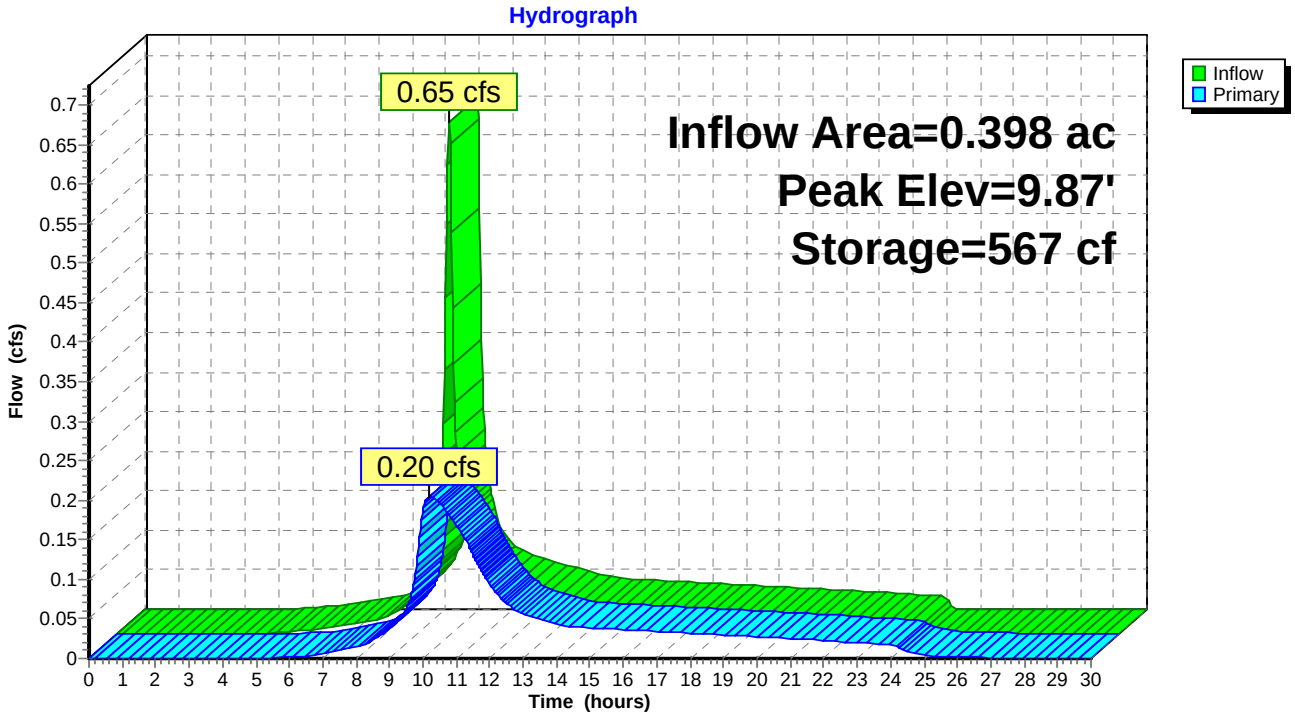
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	3,863 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	268
10.00	671
10.50	1,220
11.00	1,930
11.50	2,814
12.00	3,863

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.20 cfs @ 10.21 hrs HW=9.87' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.20 cfs @ 4.16 fps)

Pond 11P: PR1B



Summary for Pond 12P: PR1C

Inflow Area = 0.518 ac, Inflow Depth = 3.27" for 10 YEAR event
Inflow = 1.19 cfs @ 9.94 hrs, Volume= 0.141 af
Outflow = 0.34 cfs @ 10.22 hrs, Volume= 0.140 af, Atten= 72%, Lag= 16.8 min
Primary = 0.34 cfs @ 10.22 hrs, Volume= 0.140 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.64' @ 10.22 hrs Surf.Area= 0 sf Storage= 1,361 cf

Plug-Flow detention time= 68.6 min calculated for 0.140 af (99% of inflow)
Center-of-Mass det. time= 64.8 min (766.6 - 701.7)

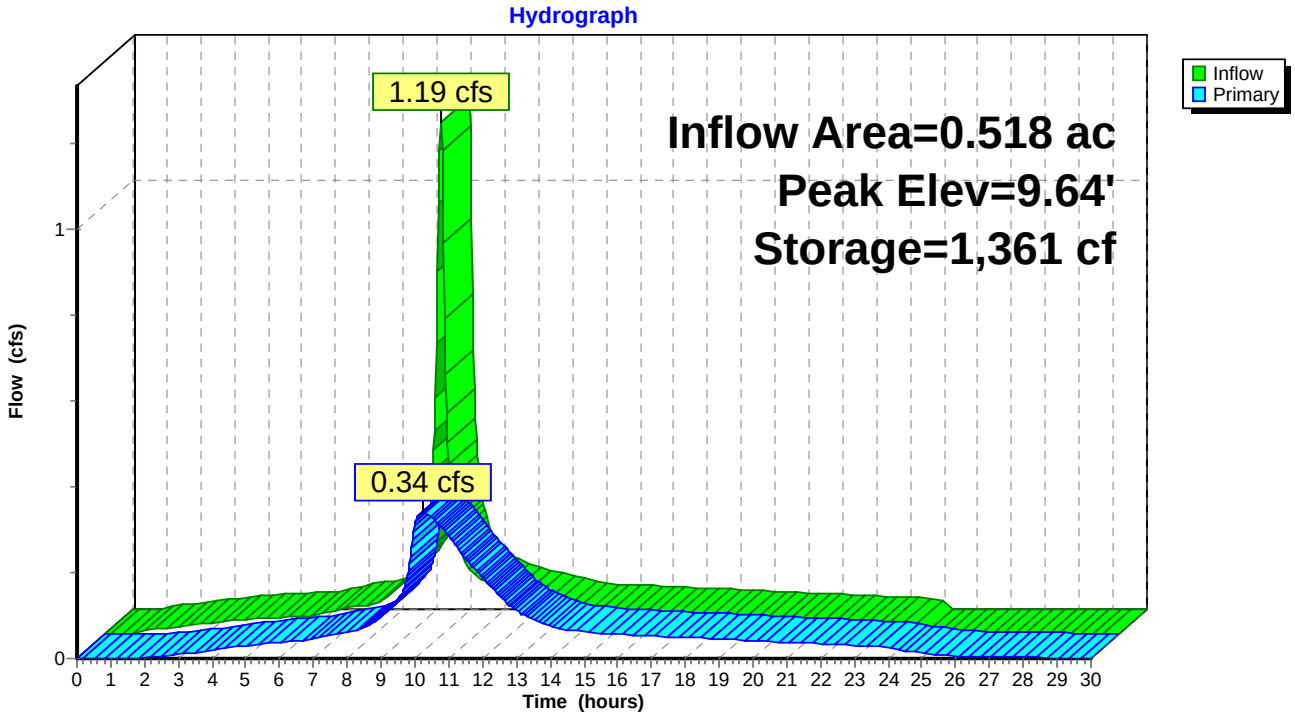
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	5,366 cf	**Custom Stage Data** Listed below

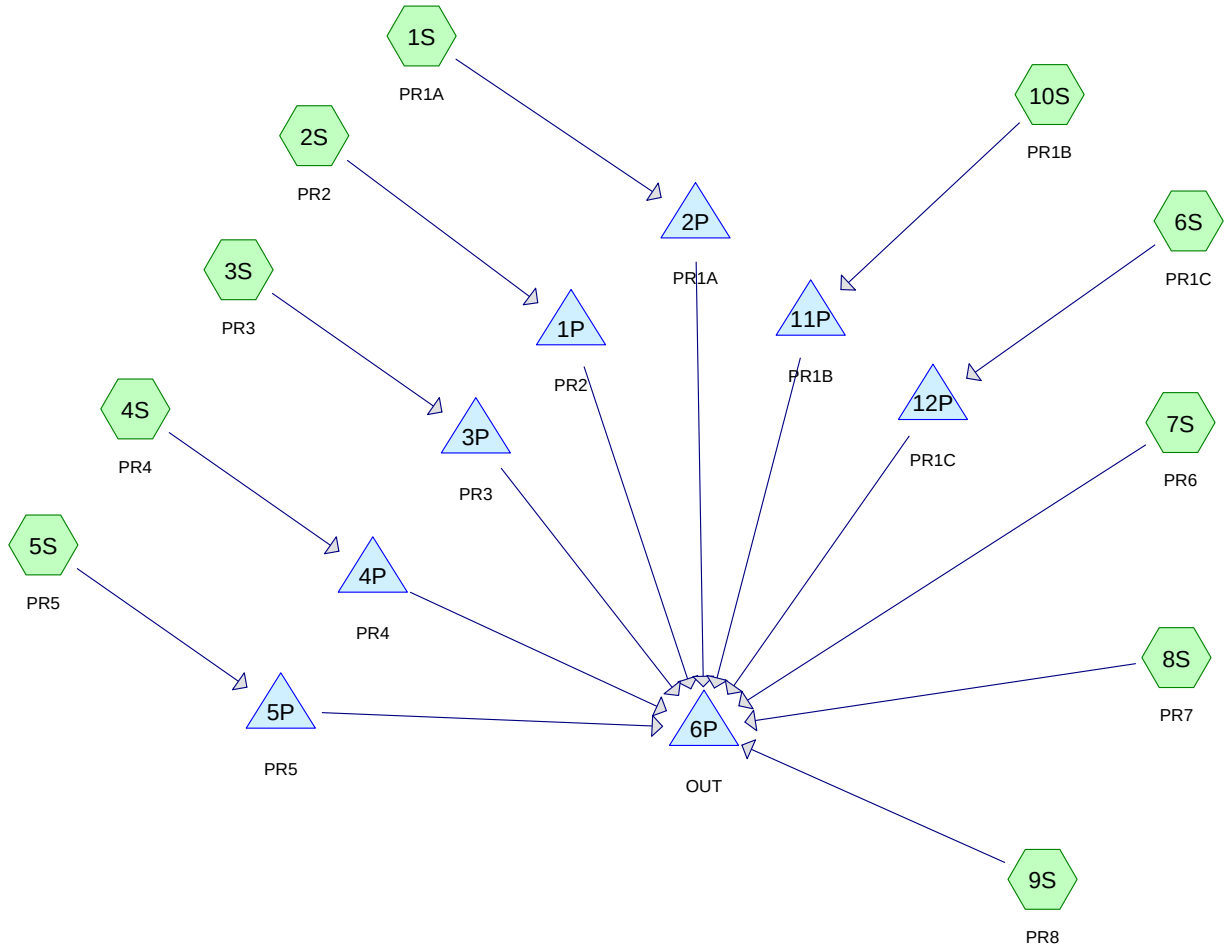
Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,023
10.00	2,248
10.50	3,690
11.00	5,366

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.34 cfs @ 10.22 hrs HW=9.64' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.45 fps)

Pond 12P: PR1C





Subcat Reach Pond Link

Drainage Diagram for Grover Proposed_2yr_det_1-19-12
Prepared by {enter your company name here}, Printed 1/20/2012
HydroCAD® 9.10 s/n 06659 © 2010 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.974	83	(4S)
2.511	90	(2S, 3S, 5S)
0.831	91	(1S)
0.398	93	(10S)
2.349	94	(7S, 8S)
2.922	97	(9S)
0.518	100	(6S)
10.503	93	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
10.503	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S
10.503		**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.03 hrs, 1001 points
Runoff by SBUH method
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: PR1A Runoff Area=36,211 sf Runoff Depth=1.16"
Tc=5.0 min CN=91 Runoff=0.72 cfs 0.081 af

Subcatchment 2S: PR2 Runoff Area=31,602 sf Runoff Depth=1.09"
Tc=5.0 min CN=90 Runoff=0.58 cfs 0.066 af

Subcatchment 3S: PR3 Runoff Area=20,753 sf Runoff Depth=1.09"
Tc=5.0 min CN=90 Runoff=0.38 cfs 0.043 af

Subcatchment 4S: PR4 Runoff Area=42,422 sf Runoff Depth=0.70"
Tc=5.0 min CN=83 Runoff=0.44 cfs 0.056 af

Subcatchment 5S: PR5 Runoff Area=57,034 sf Runoff Depth=1.09"
Tc=5.0 min CN=90 Runoff=1.05 cfs 0.119 af

Subcatchment 6S: PR1C Runoff Area=22,559 sf Runoff Depth=2.00"
Tc=5.0 min CN=100 Runoff=0.69 cfs 0.086 af

Subcatchment 7S: PR6 Runoff Area=50,093 sf Runoff Depth=1.40"
Tc=5.0 min CN=94 Runoff=1.20 cfs 0.134 af

Subcatchment 8S: PR7 Runoff Area=52,226 sf Runoff Depth=1.40"
Tc=5.0 min CN=94 Runoff=1.26 cfs 0.140 af

Subcatchment 9S: PR8 Runoff Area=127,270 sf Runoff Depth=1.67"
Tc=5.0 min CN=97 Runoff=3.59 cfs 0.407 af

Subcatchment 10S: PR1B Runoff Area=17,327 sf Runoff Depth=1.31"
Tc=5.0 min CN=93 Runoff=0.39 cfs 0.044 af

Pond 1P: PR2 Peak Elev=11.02' Storage=661 cf Inflow=0.58 cfs 0.066 af
Outflow=0.15 cfs 0.066 af

Pond 2P: PR1A Peak Elev=9.49' Storage=964 cf Inflow=0.72 cfs 0.081 af
Outflow=0.14 cfs 0.079 af

Pond 3P: PR3 Peak Elev=9.32' Storage=449 cf Inflow=0.38 cfs 0.043 af
Outflow=0.11 cfs 0.043 af

Pond 4P: PR4 Peak Elev=10.65' Storage=537 cf Inflow=0.44 cfs 0.056 af
Outflow=0.08 cfs 0.055 af

Pond 5P: PR5 Peak Elev=9.62' Storage=1,490 cf Inflow=1.05 cfs 0.119 af
Outflow=0.17 cfs 0.117 af

Pond 6P: OUT Inflow=6.84 cfs 1.169 af
Primary=6.84 cfs 1.169 af

Pond 11P: PR1B Peak Elev=9.56' Storage=319 cf Inflow=0.39 cfs 0.044 af
Outflow=0.16 cfs 0.044 af

Pond 12P: PR1C Peak Elev=9.39' Storage=791 cf Inflow=0.69 cfs 0.086 af
Outflow=0.24 cfs 0.086 af

Total Runoff Area = 10.503 ac Runoff Volume = 1.176 af Average Runoff Depth = 1.34"

Summary for Subcatchment 1S: PR1A

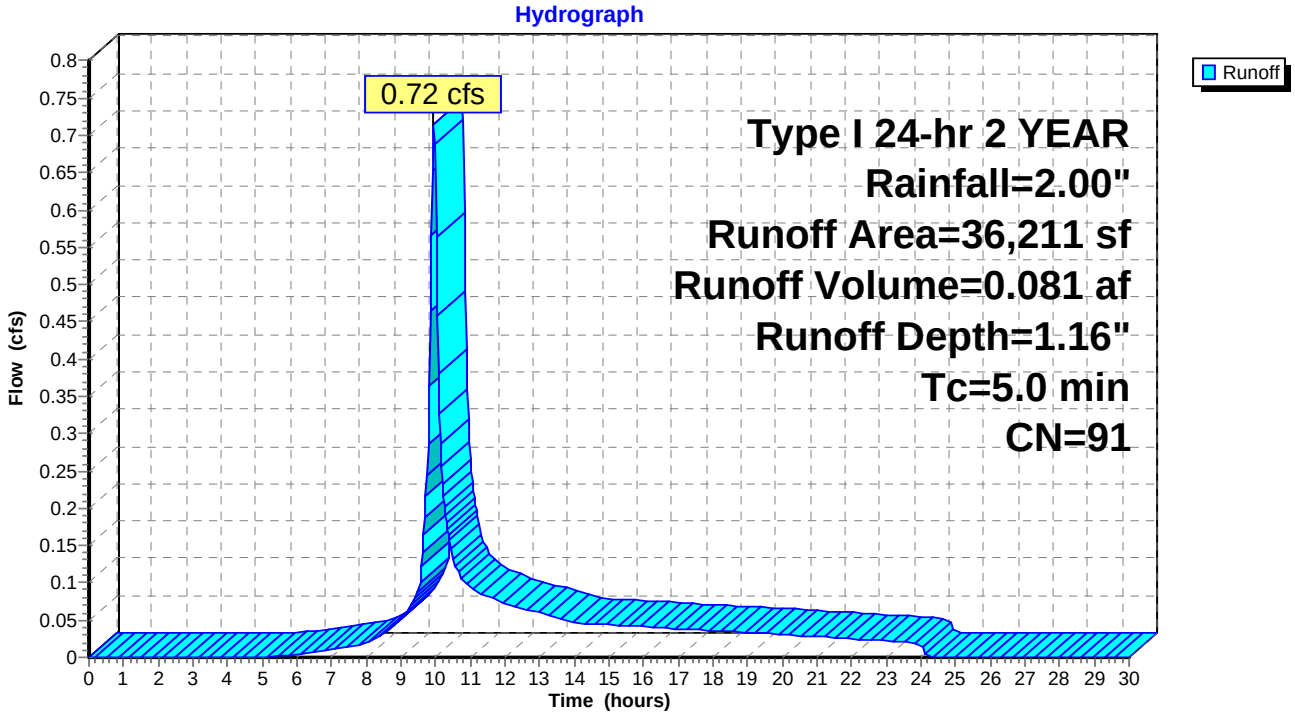
Runoff = 0.72 cfs @ 9.95 hrs, Volume= 0.081 af, Depth= 1.16"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	36,211	91	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 1S: PR1A



Summary for Subcatchment 2S: PR2

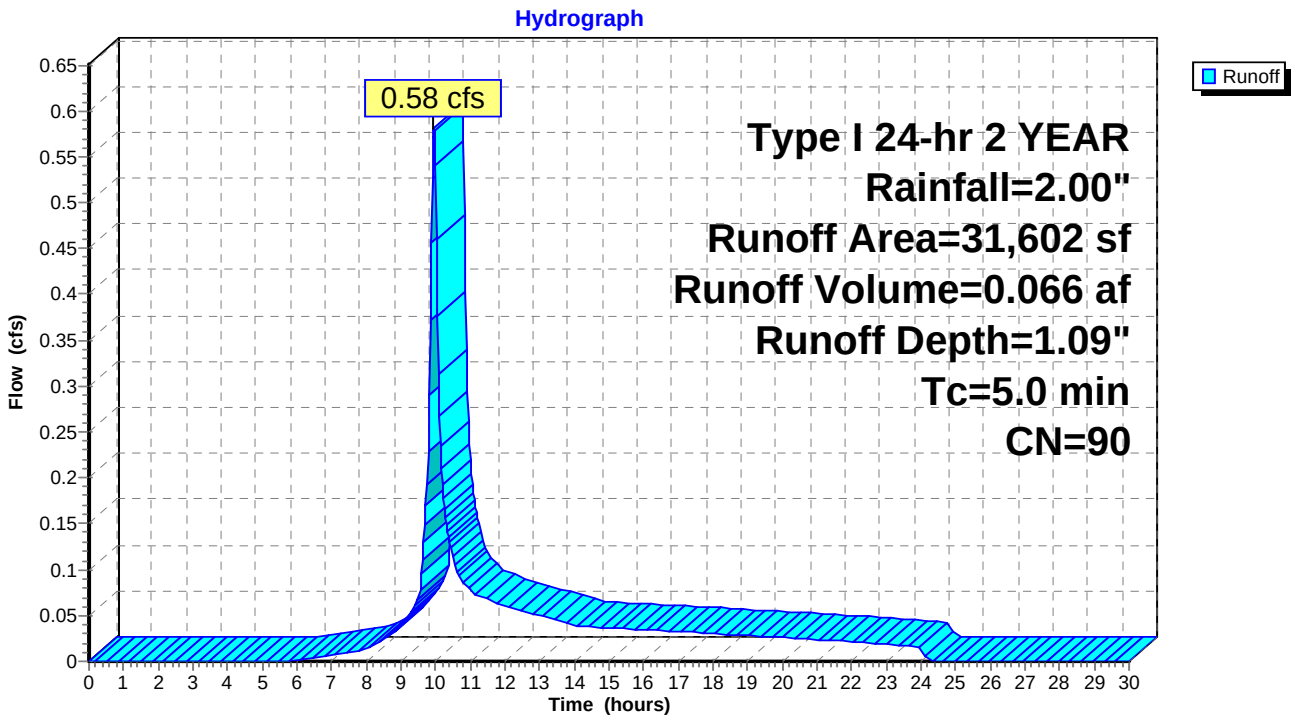
Runoff = 0.58 cfs @ 9.95 hrs, Volume= 0.066 af, Depth= 1.09"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	31,602	90	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 2S: PR2



Summary for Subcatchment 3S: PR3

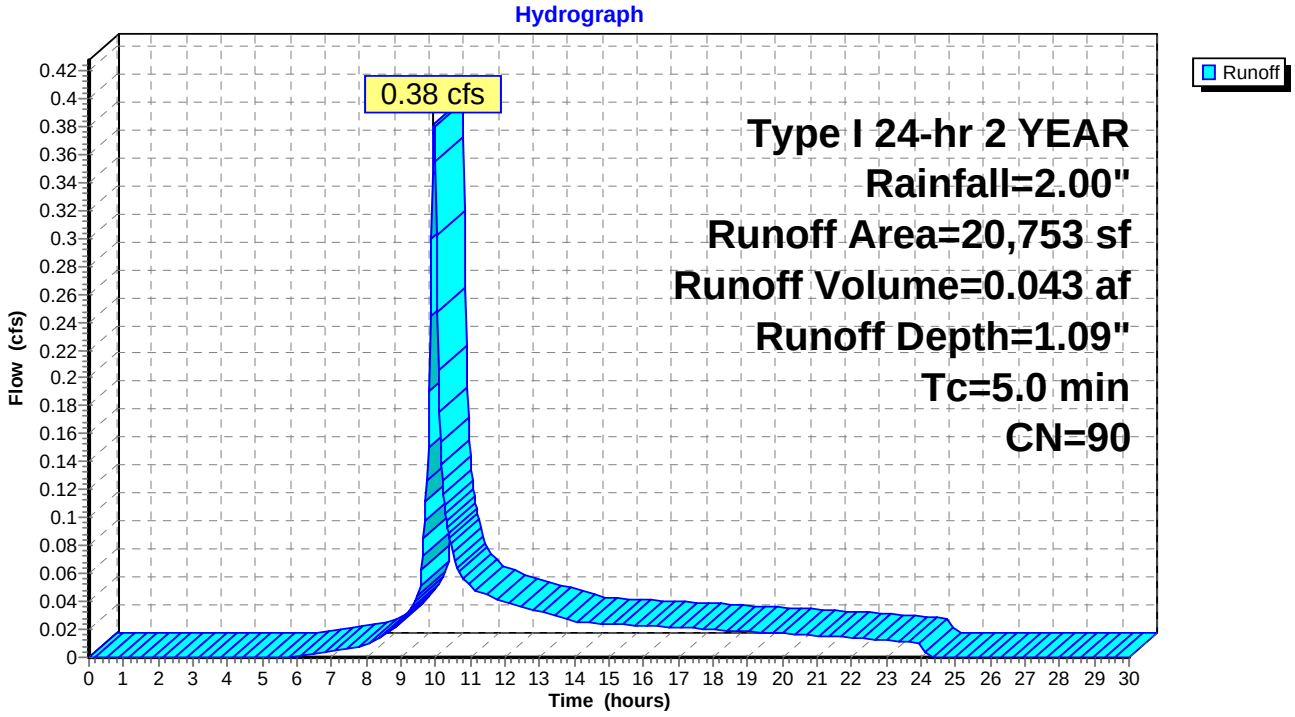
Runoff = 0.38 cfs @ 9.95 hrs, Volume= 0.043 af, Depth= 1.09"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	20,753	90	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 3S: PR3



Summary for Subcatchment 4S: PR4

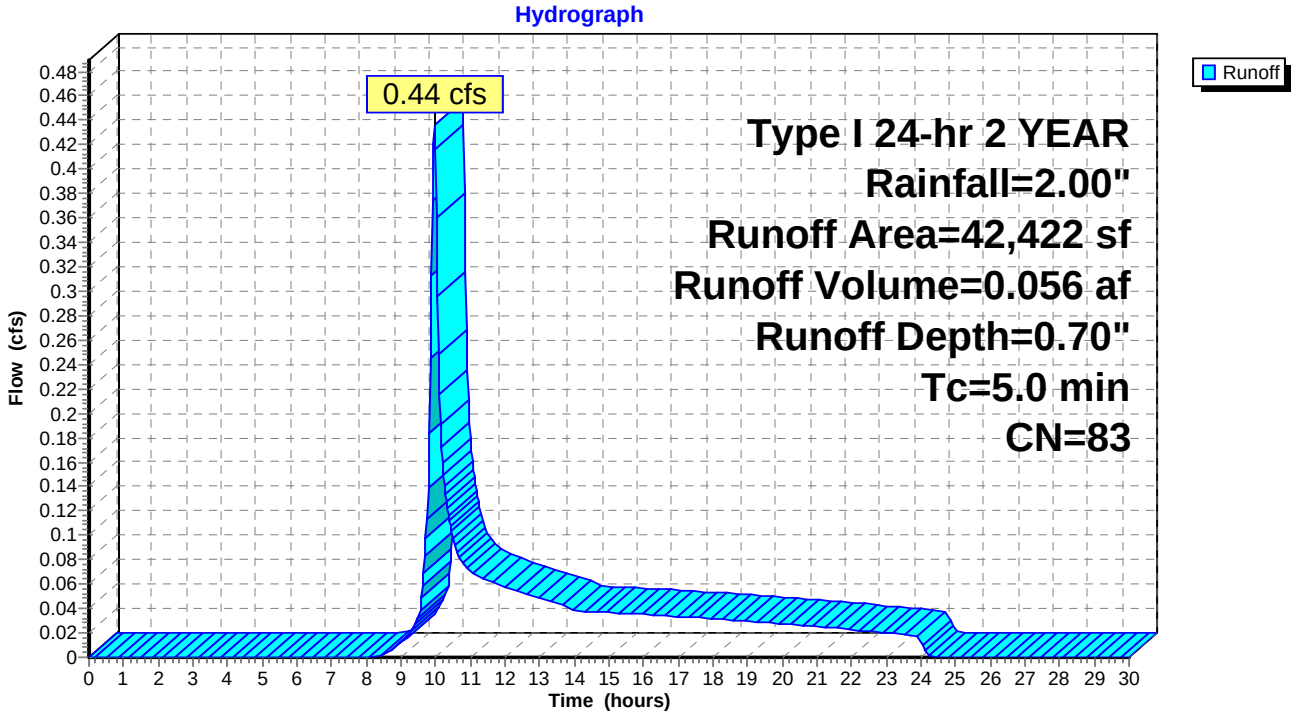
Runoff = 0.44 cfs @ 9.96 hrs, Volume= 0.056 af, Depth= 0.70"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	42,422	83	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 4S: PR4



Summary for Subcatchment 5S: PR5

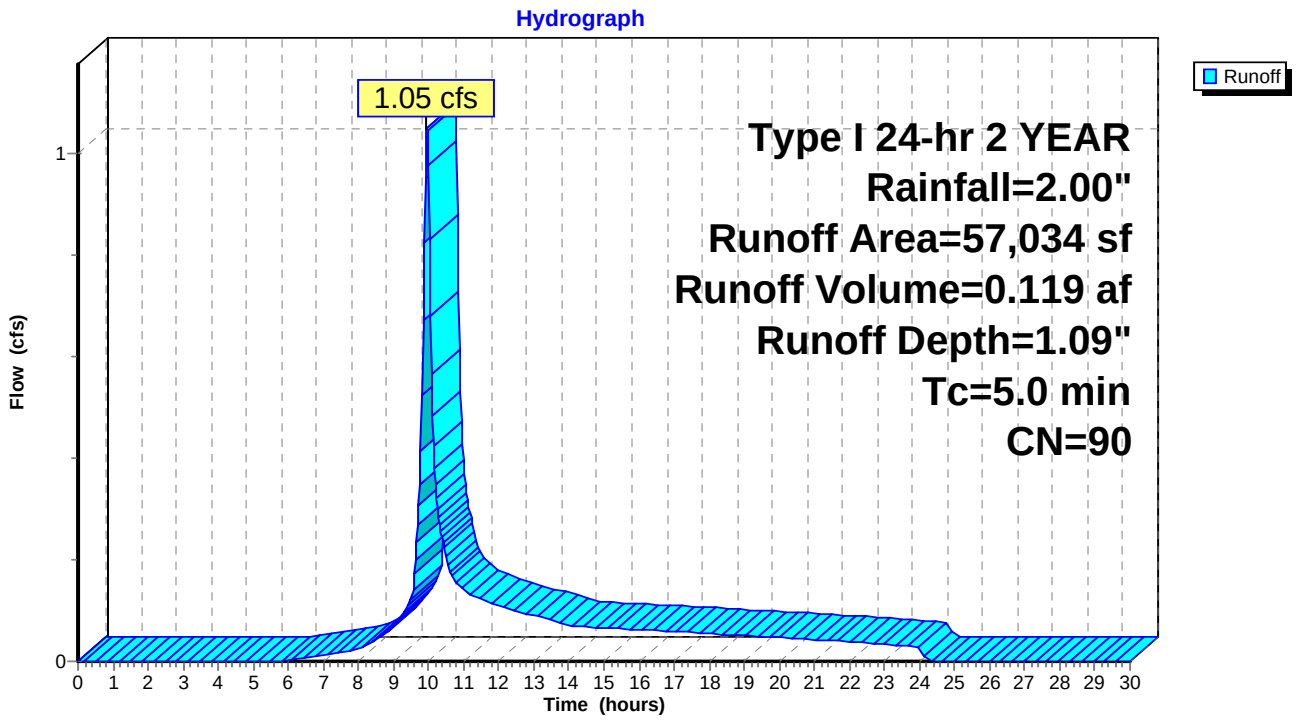
Runoff = 1.05 cfs @ 9.95 hrs, Volume= 0.119 af, Depth= 1.09"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	57,034	90	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 5S: PR5



Summary for Subcatchment 6S: PR1C

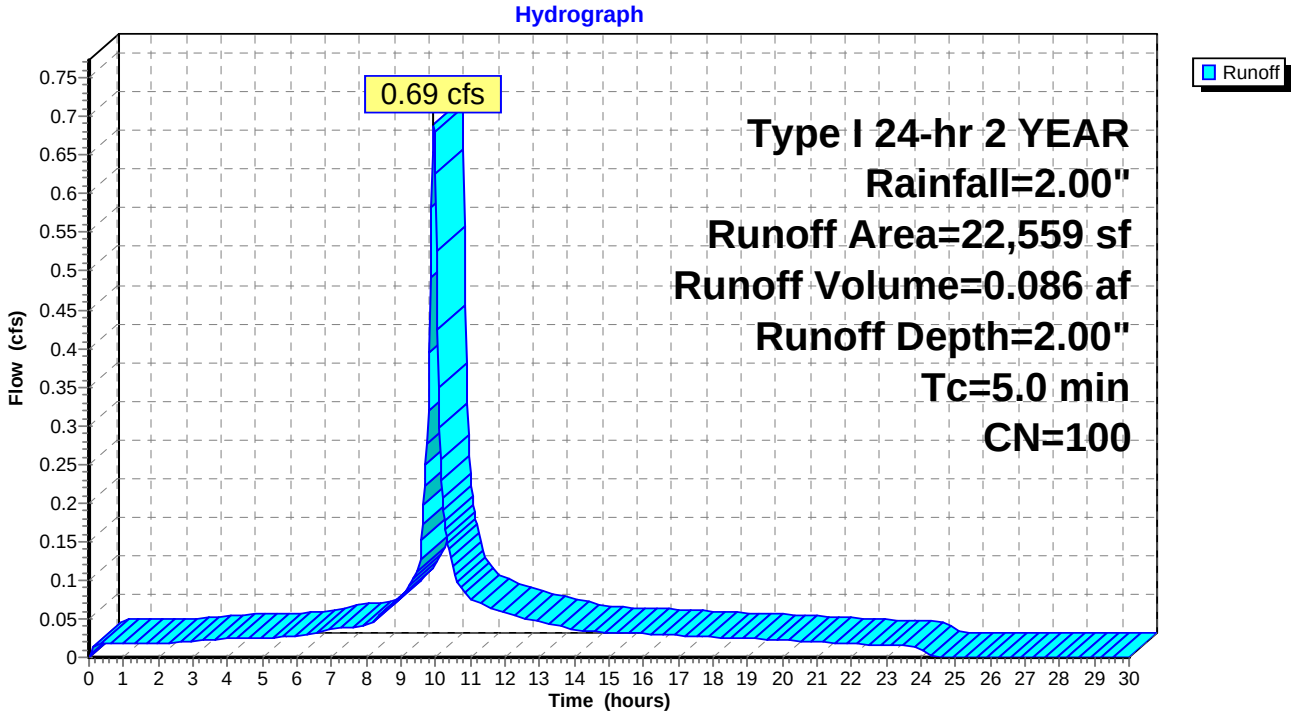
Runoff = 0.69 cfs @ 9.94 hrs, Volume= 0.086 af, Depth= 2.00"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	22,559	100	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 6S: PR1C



Summary for Subcatchment 7S: PR6

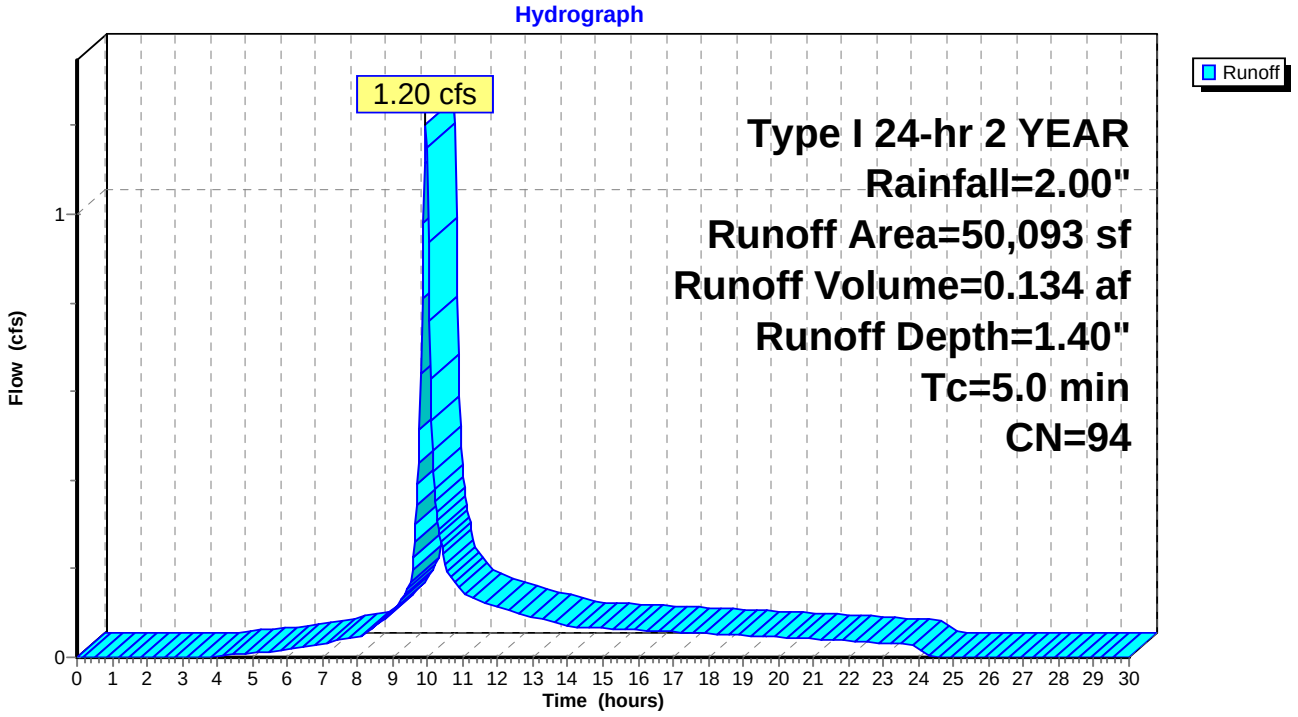
Runoff = 1.20 cfs @ 9.95 hrs, Volume= 0.134 af, Depth= 1.40"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	50,093	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 7S: PR6



Summary for Subcatchment 8S: PR7

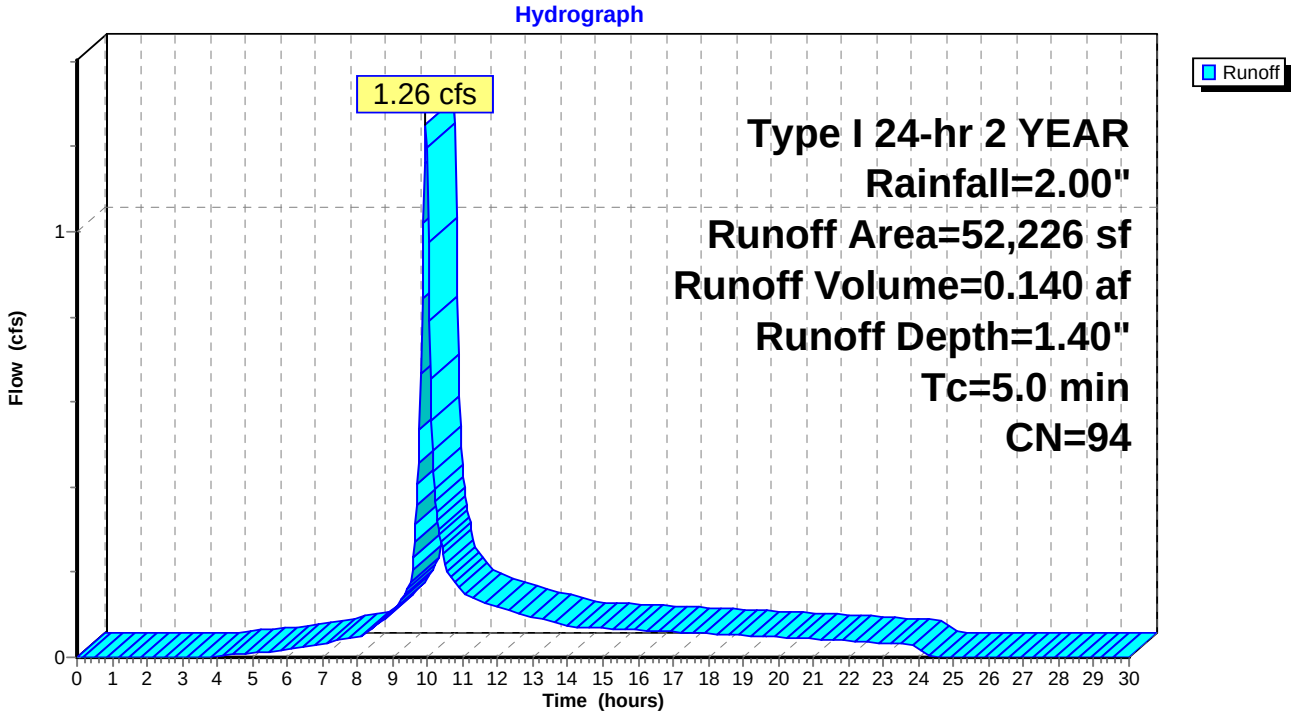
Runoff = 1.26 cfs @ 9.95 hrs, Volume= 0.140 af, Depth= 1.40"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	52,226	94	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.0					**Direct Entry,**
3.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 8S: PR7



Summary for Subcatchment 9S: PR8

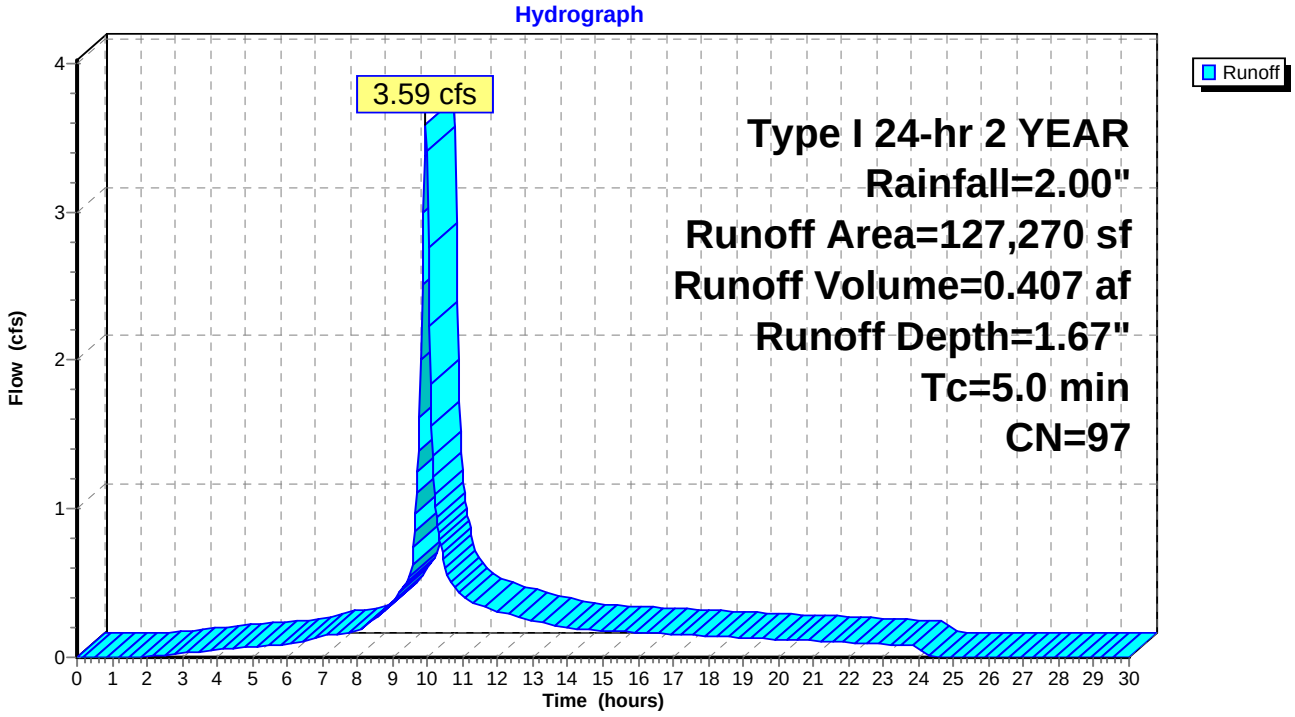
Runoff = 3.59 cfs @ 9.94 hrs, Volume= 0.407 af, Depth= 1.67"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	127,270	97	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0					**Direct Entry,**
4.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 9S: PR8



Summary for Subcatchment 10S: PR1B

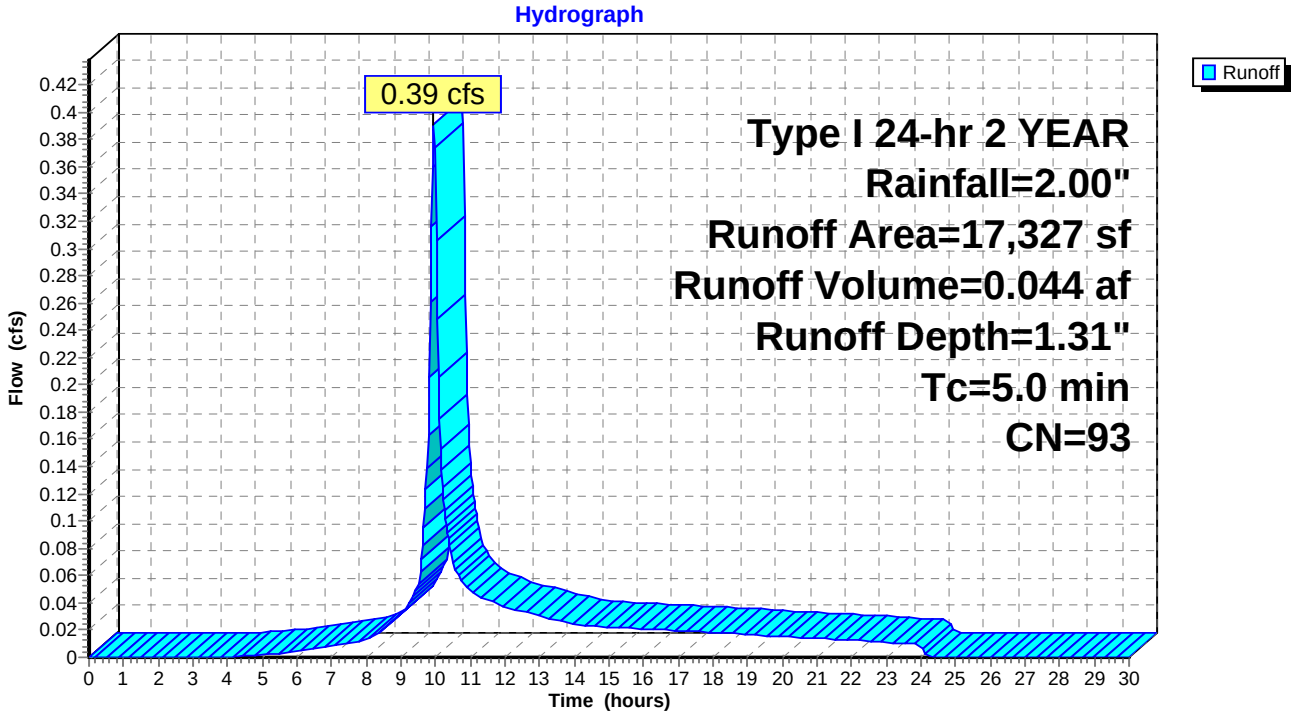
Runoff = 0.39 cfs @ 9.95 hrs, Volume= 0.044 af, Depth= 1.31"

Runoff by SBUH method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Type I 24-hr 2 YEAR Rainfall=2.00"

	Area (sf)	CN	Description
*	17,327	93	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0					**Direct Entry,**
2.0	0	Total, Increased to minimum Tc = 5.0 min			

Subcatchment 10S: PR1B



Summary for Pond 1P: PR2

Inflow Area = 0.725 ac, Inflow Depth = 1.09" for 2 YEAR event
Inflow = 0.58 cfs @ 9.95 hrs, Volume= 0.066 af
Outflow = 0.15 cfs @ 10.32 hrs, Volume= 0.066 af, Atten= 74%, Lag= 22.4 min
Primary = 0.15 cfs @ 10.32 hrs, Volume= 0.066 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 11.02' @ 10.32 hrs Surf.Area= 0 sf Storage= 661 cf

Plug-Flow detention time= 77.7 min calculated for 0.065 af (99% of inflow)
Center-of-Mass det. time= 72.4 min (873.7 - 801.3)

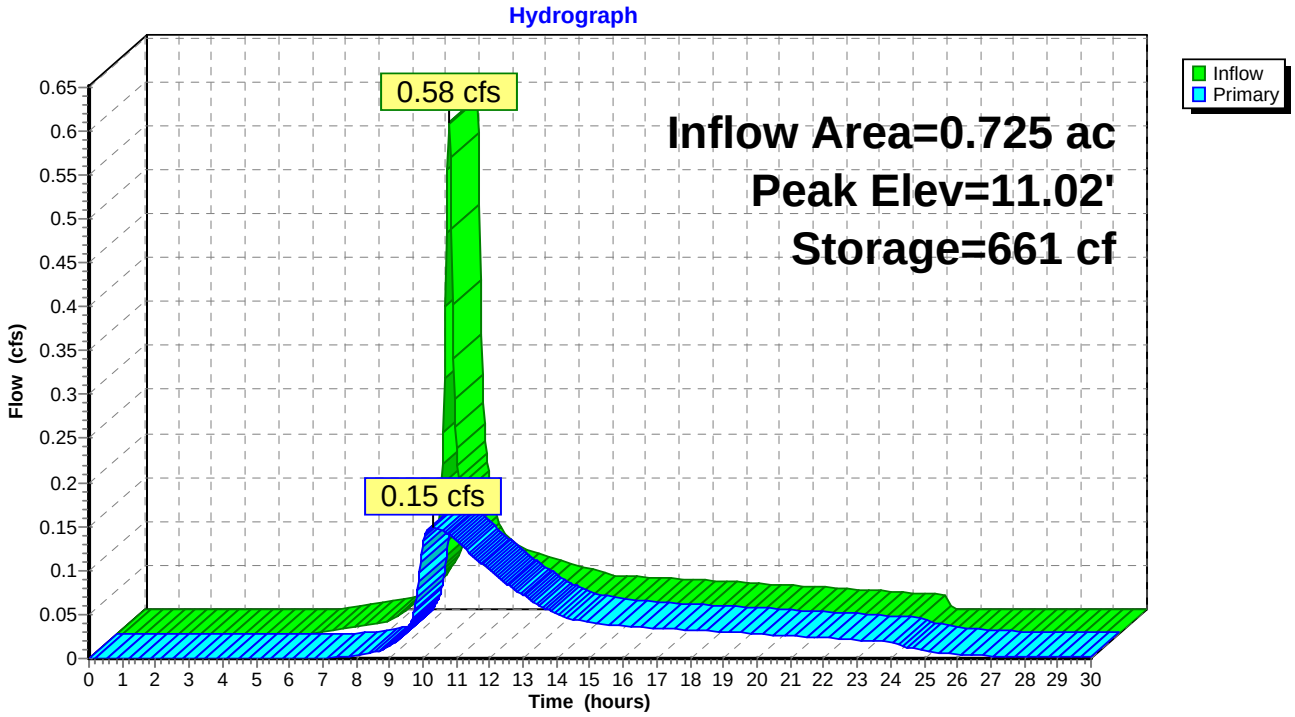
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	5,225 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	628
11.50	1,447
12.00	2,476
12.50	3,730
13.00	5,225

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.15 cfs @ 10.32 hrs HW=11.02' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.15 cfs @ 3.03 fps)

Pond 1P: PR2


Hydrograph
0.58 cfs
0.15 cfs
Inflow Area=0.725 ac
Peak Elev=11.02'
Storage=661 cf
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Pond 2P: PR1A

Inflow Area = 0.831 ac, Inflow Depth = 1.16" for 2 YEAR event
Inflow = 0.72 cfs @ 9.95 hrs, Volume= 0.081 af
Outflow = 0.14 cfs @ 10.47 hrs, Volume= 0.079 af, Atten= 80%, Lag= 31.3 min
Primary = 0.14 cfs @ 10.47 hrs, Volume= 0.079 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.49' @ 10.47 hrs Surf.Area= 0 sf Storage= 964 cf

Plug-Flow detention time= 115.1 min calculated for 0.079 af (98% of inflow)
Center-of-Mass det. time= 104.4 min (897.8 - 793.4)

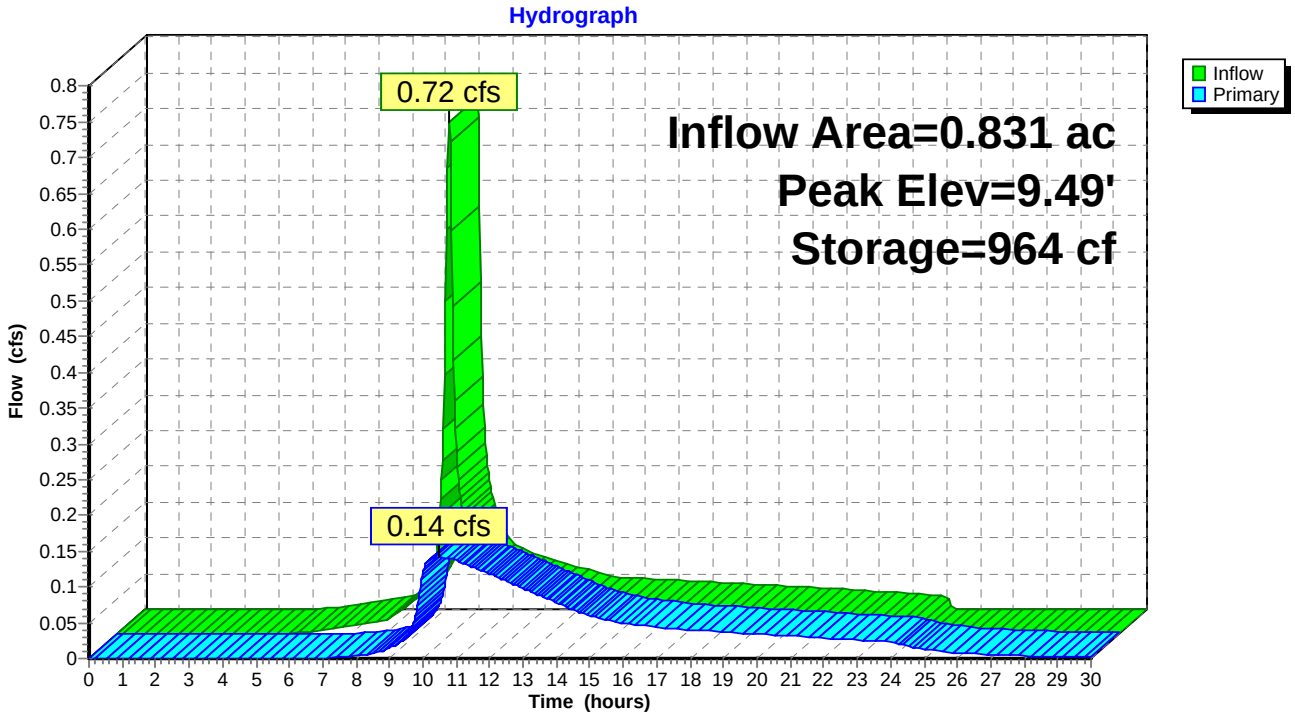
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	7,451 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	989
10.00	2,843
10.50	4,993
11.00	7,451

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.14 cfs @ 10.47 hrs HW=9.49' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.14 cfs @ 2.90 fps)

Pond 2P: PR1A


Hydrograph
Inflow
Primary
0.72 cfs
0.14 cfs
Inflow Area=0.831 ac
Peak Elev=9.49'
Storage=964 cf
Flow (cfs)
Time (hours)

Summary for Pond 3P: PR3

Inflow Area = 0.476 ac, Inflow Depth = 1.09" for 2 YEAR event
Inflow = 0.38 cfs @ 9.95 hrs, Volume= 0.043 af
Outflow = 0.11 cfs @ 10.28 hrs, Volume= 0.043 af, Atten= 72%, Lag= 19.7 min
Primary = 0.11 cfs @ 10.28 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.32' @ 10.28 hrs Surf.Area= 0 sf Storage= 449 cf

Plug-Flow detention time= 94.0 min calculated for 0.043 af (98% of inflow)
Center-of-Mass det. time= 84.7 min (886.0 - 801.3)

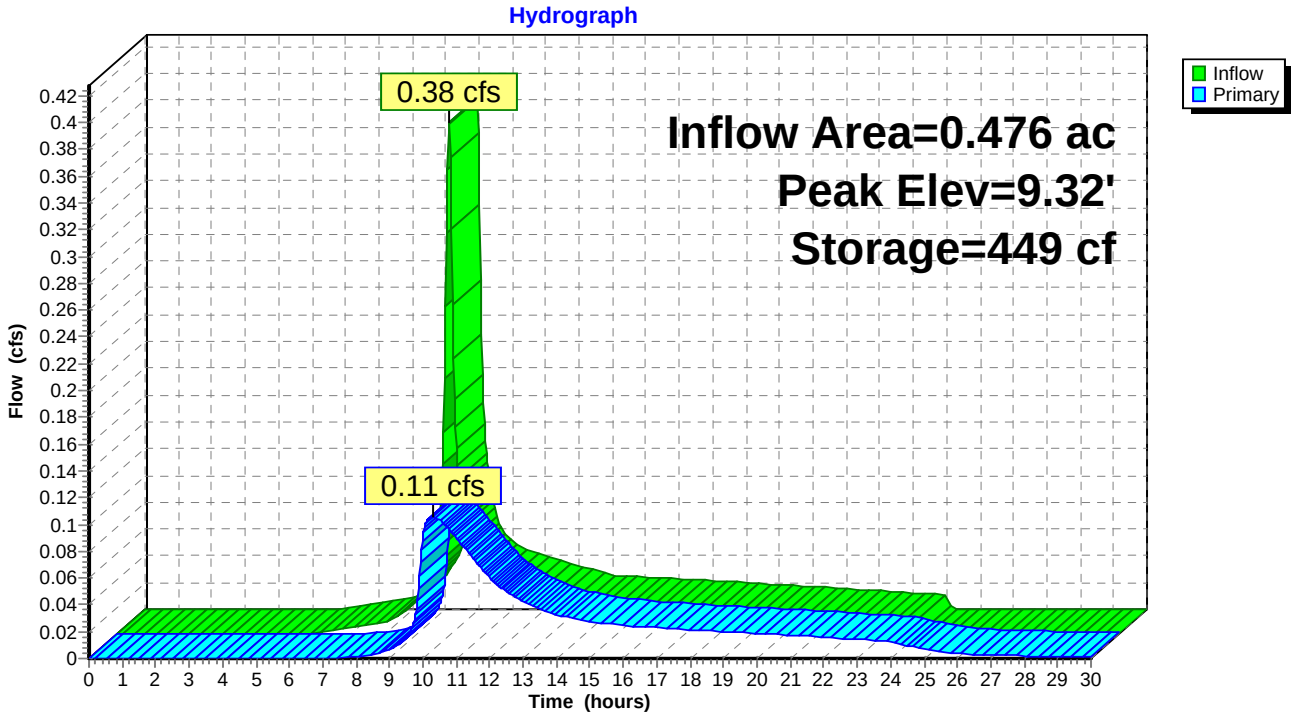
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,409 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	692
10.00	1,672
10.50	2,904
11.00	4,409

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.11 cfs @ 10.28 hrs HW=9.32' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.11 cfs @ 2.15 fps)

Pond 3P: PR3


Hydrograph
Inflow
Primary
0.38 cfs
0.11 cfs
Inflow Area=0.476 ac
Peak Elev=9.32'
Storage=449 cf
Flow (cfs)
Time (hours)

Summary for Pond 4P: PR4

Inflow Area = 0.974 ac, Inflow Depth = 0.70" for 2 YEAR event
Inflow = 0.44 cfs @ 9.96 hrs, Volume= 0.056 af
Outflow = 0.08 cfs @ 10.64 hrs, Volume= 0.055 af, Atten= 81%, Lag= 41.2 min
Primary = 0.08 cfs @ 10.64 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 10.65' @ 10.64 hrs Surf.Area= 0 sf Storage= 537 cf

Plug-Flow detention time= 129.8 min calculated for 0.055 af (97% of inflow)
Center-of-Mass det. time= 113.0 min (964.5 - 851.5)

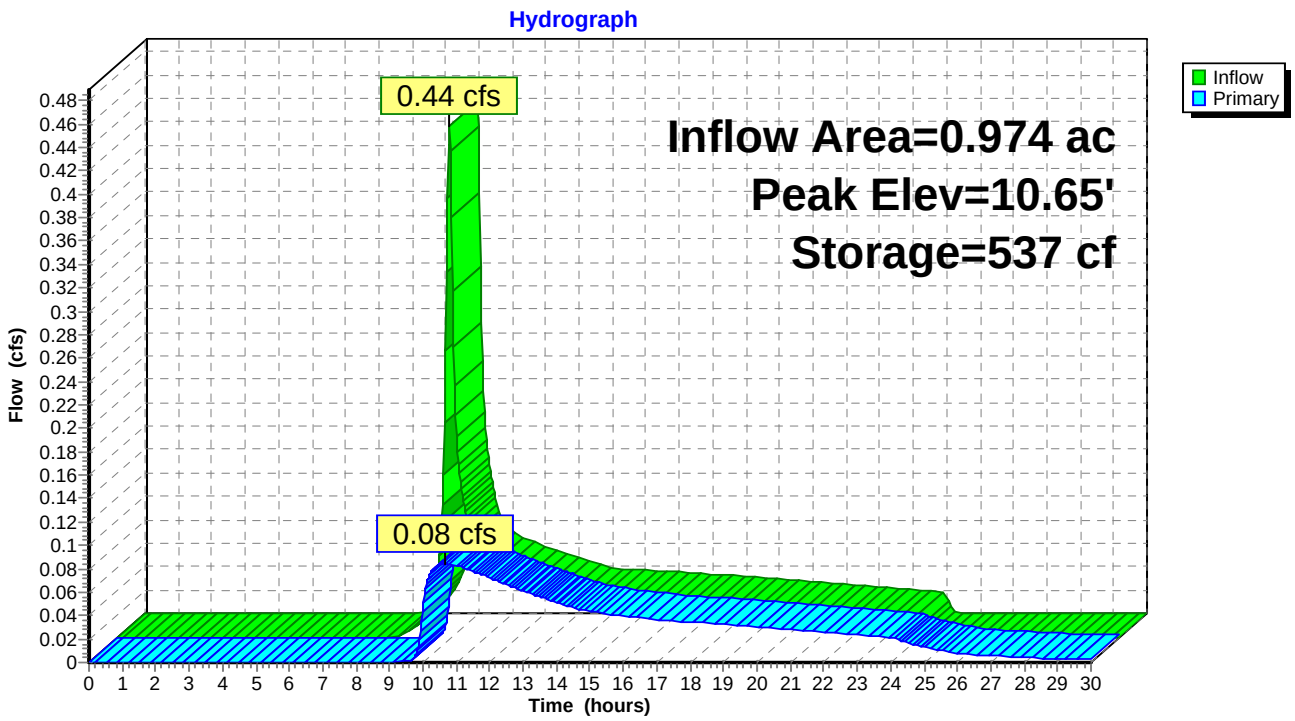
Volume	Invert	Avail.Storage	Storage Description
#1	10.50'	8,606 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
10.50	0
11.00	1,737
11.50	3,743
12.00	6,029
12.50	8,606

Device	Routing	Invert	Outlet Devices
#1	Primary	10.50'	**2.0" Vert. Orifice/Grate X 3.00** C= 0.600

Primary OutFlow Max=0.08 cfs @ 10.64 hrs HW=10.65' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.08 cfs @ 1.34 fps)

Pond 4P: PR4


Hydrograph
Inflow
Primary
0.44 cfs
0.08 cfs
Inflow Area=0.974 ac
Peak Elev=10.65'
Storage=537 cf
Flow (cfs)
Time (hours)

Summary for Pond 5P: PR5

Inflow Area = 1.309 ac, Inflow Depth = 1.09" for 2 YEAR event
Inflow = 1.05 cfs @ 9.95 hrs, Volume= 0.119 af
Outflow = 0.17 cfs @ 10.69 hrs, Volume= 0.117 af, Atten= 84%, Lag= 44.3 min
Primary = 0.17 cfs @ 10.69 hrs, Volume= 0.117 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.62' @ 10.69 hrs Surf.Area= 0 sf Storage= 1,490 cf

Plug-Flow detention time= 131.0 min calculated for 0.117 af (98% of inflow)
Center-of-Mass det. time= 120.7 min (922.0 - 801.3)

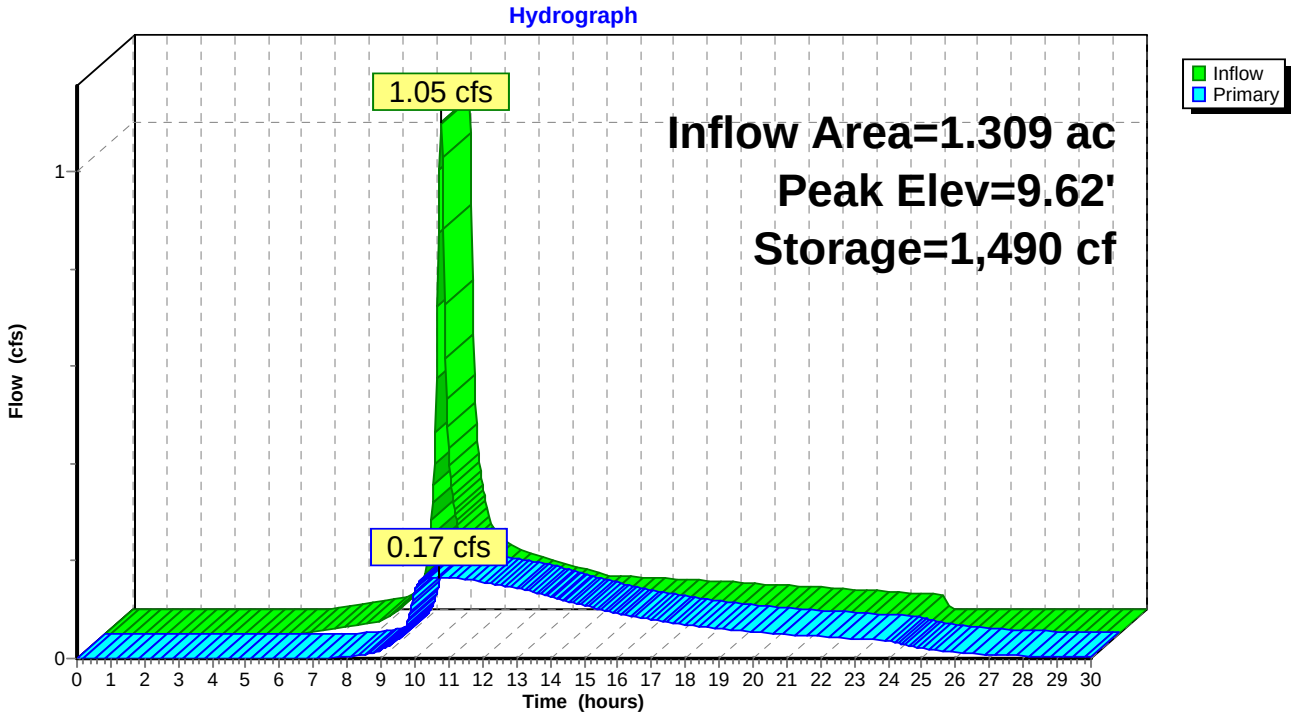
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	6,358 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,145
10.00	2,579
10.50	4,313
11.00	6,358

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.17 cfs @ 10.69 hrs HW=9.62' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.17 cfs @ 3.39 fps)

Pond 5P: PR5


Hydrograph
1.05 cfs
0.17 cfs
Inflow Area=1.309 ac
Peak Elev=9.62'
Storage=1,490 cf
Inflow
Primary
Flow (cfs)
Time (hours)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

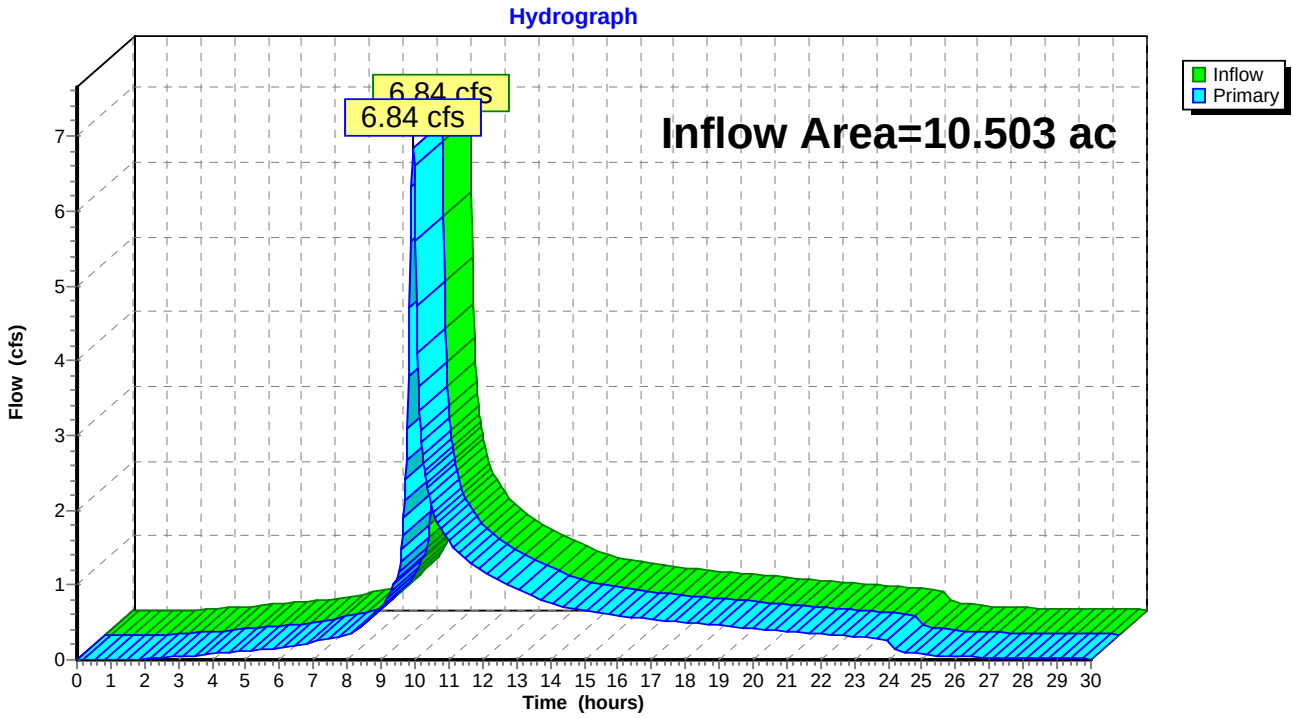
Summary for Pond 6P: OUT

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	10.503 ac,	Inflow Depth >	1.34"	for	2 YEAR event
Inflow =	6.84 cfs @	9.95 hrs,	Volume=	1.169 af	
Primary =	6.84 cfs @	9.95 hrs,	Volume=	1.169 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs

Pond 6P: OUT



Summary for Pond 11P: PR1B

Inflow Area = 0.398 ac, Inflow Depth = 1.31" for 2 YEAR event
Inflow = 0.39 cfs @ 9.95 hrs, Volume= 0.044 af
Outflow = 0.16 cfs @ 10.14 hrs, Volume= 0.044 af, Atten= 60%, Lag= 11.5 min
Primary = 0.16 cfs @ 10.14 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.56' @ 10.14 hrs Surf.Area= 0 sf Storage= 319 cf

Plug-Flow detention time= 39.5 min calculated for 0.044 af (100% of inflow)
Center-of-Mass det. time= 38.7 min (815.0 - 776.3)

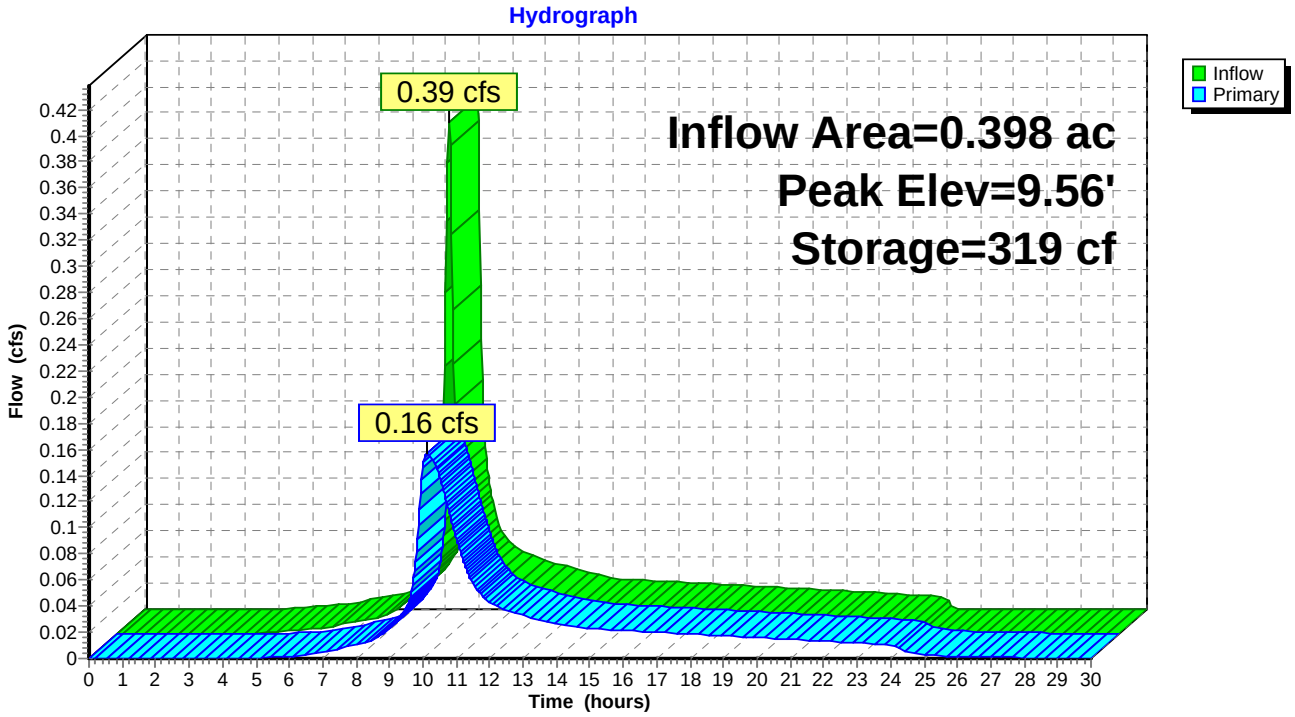
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	3,863 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	268
10.00	671
10.50	1,220
11.00	1,930
11.50	2,814
12.00	3,863

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.16 cfs @ 10.14 hrs HW=9.56' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.16 cfs @ 3.19 fps)

Pond 11P: PR1B



Summary for Pond 12P: PR1C

Inflow Area = 0.518 ac, Inflow Depth = 2.00" for 2 YEAR event
Inflow = 0.69 cfs @ 9.94 hrs, Volume= 0.086 af
Outflow = 0.24 cfs @ 10.16 hrs, Volume= 0.086 af, Atten= 65%, Lag= 13.0 min
Primary = 0.24 cfs @ 10.16 hrs, Volume= 0.086 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.03 hrs
Peak Elev= 9.39' @ 10.16 hrs Surf.Area= 0 sf Storage= 791 cf

Plug-Flow detention time= 79.9 min calculated for 0.086 af (99% of inflow)
Center-of-Mass det. time= 73.6 min (744.2 - 670.7)

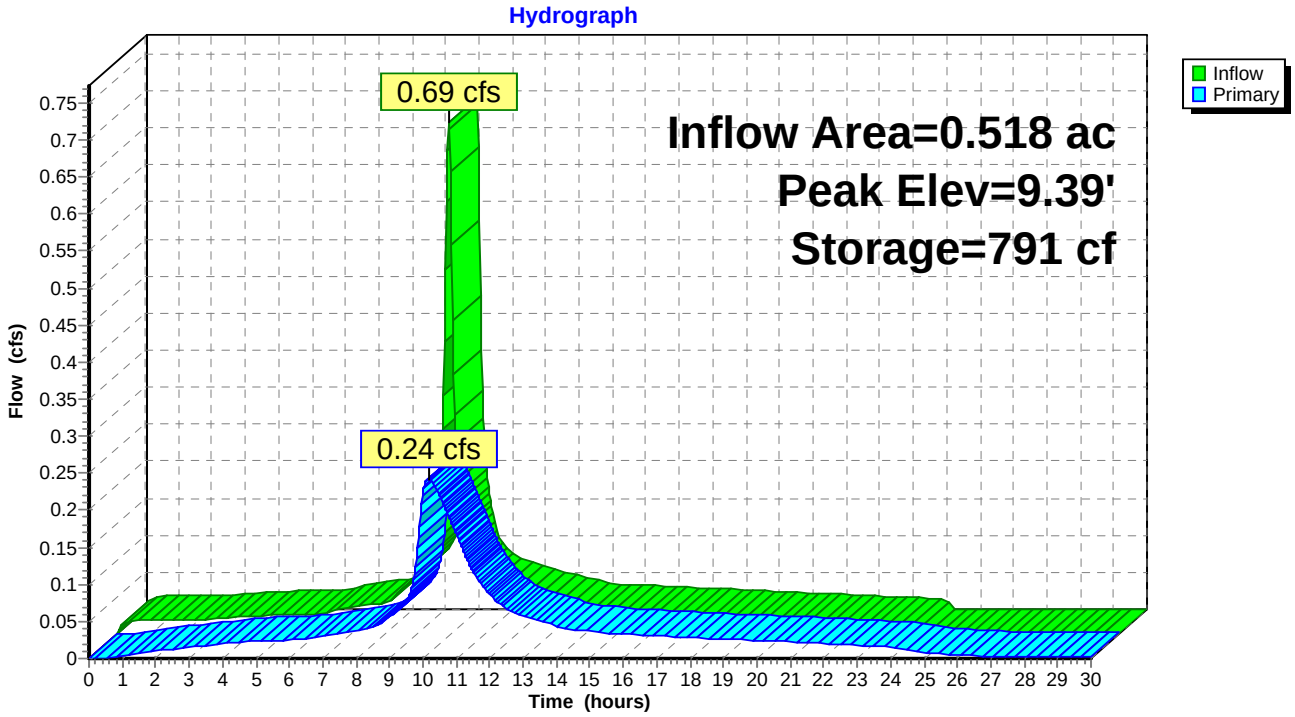
Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	5,366 cf	**Custom Stage Data** Listed below

Elevation (feet)	Cum.Store (cubic-feet)
9.00	0
9.50	1,023
10.00	2,248
10.50	3,690
11.00	5,366

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600

Primary OutFlow Max=0.24 cfs @ 10.16 hrs HW=9.39' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.24 cfs @ 2.46 fps)

Pond 12P: PR1C



ATTACHMENT 6

WATER QUALITY CALCULATIONS

ENGINEERING CALCULATIONS FOR BMP VOLUME BASED TREATMENT SIZING

Basin Number	Total Area Acres	Percent Impervious	C wqrt	V wqrt CF	BMP Proposed
PR-1A	0.831	49.56%	0.34	1,196	Bio-retention basin/detention basin
PR-1B	0.398	60.89%	0.42	707	Bio-retention basin/detention basin
PR-2	0.725	45.68%	0.31	970	Bio-retention basin/detention basin
PR-3	0.476	46.01%	0.31	641	Bio-retention basin/detention basin
PR-4	0.974	13.31%	0.13	546	Bio-retention basin/detention basin
PR-5	1.309	32.32%	0.24	1,330	Bio-retention basin, porous pavement
PR-6	1.150	57.03%	0.39	1,902	Bio-retention basin, porous pavement
PR-7	1.199	78.47%	0.58	2,981	Bio-retention basin, porous pavement
PR-8	2.922	85.86%	0.67	8,402	Bio-retention basin, porous pavement

Note: all basins are designed to the above volumes

Source: Urban Runoff Quality Management, WEF Manual of Practice No. 23
ASCE Manual and Report on Engineering Practice No. 87, ASCE 1998.

ATTACHMENT 7

HYDROLOGY MAP – EXISTING CONDITIONS

APPROXIMATE LOCATION OF 100 YEAR FLOOD LIMIT PER FEMA FLOOD MAP NO. 06079C1582F

LE SAGE DRIVE

STATE HWY 1

Q100 = 8.82 CFS

202 (12.50)

EX-2

3.336

L=400

100 YEAR FLOOD AT ELEV. OF 8 FEET. (FEMA ELEV. 10).

(12.50) 102

Q100 = 13.51 CFS

100 YEAR FLOOD AT ELEV. OF 8 FEET (FEMA ELEV. 10).

EX-1

7.073

L=785

(12.50) 201

101 (12.50)

GRAND AVENUE

DENSE TREE COVER

GRAPHIC SCALE

40 0 20 40 80 160

1 inch = 40 ft.

LEGEND

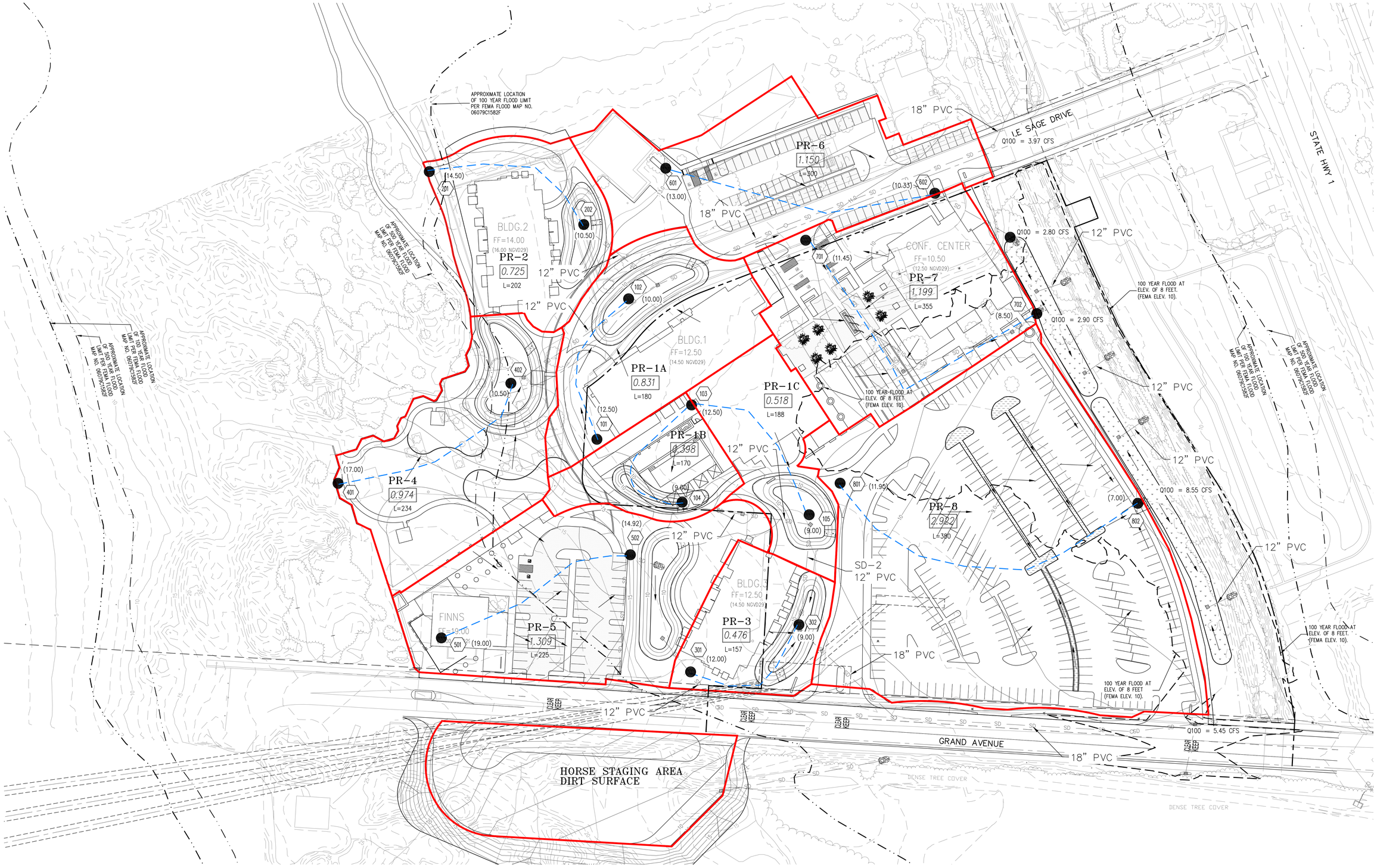
10	EXISTING CONTOUR (MAJOR)
	EXISTING CONTOUR (MINOR)
	HYDROLOGIC BASIN BOUNDARY
	HYDROLOGIC FLOW PATH
EX-1	BASIN NUMBER
0.63	AREA (ACRES)
101	NODE NUMBER
(12.00)	ELEVATION (FEET)

EXISTING HYDROLOGIC CONDITIONS

CONSTRUCTION TESTING & ENGINEERING, INC.
PLANNING - CIVIL ENGINEERING - LAND SURVEYING - GEOTECHNICAL
1441 MONTIEL ROAD, SUITE 115 ESCONDIDO CA. 92026, PH:(760) 746-4955

ATTACHMENT 8

HYDROLOGY MAP – PROPOSED CONDITIONS



GRAPHIC SCALE

40 0 20 40 80 160

1 inch = 40 ft.

LEGEND

10	EXISTING CONTOUR (MAJOR)
	EXISTING CONTOUR (MINOR)
	HYDROLOGIC BASIN BOUNDARY
	HYDROLOGIC FLOW PATH
PR-1	BASIN NUMBER
0.63	AREA (ACRES)
101	NODE NUMBER
(12.00)	ELEVATION (FEET)

PROPOSED HYDROLOGIC CONDITIONS

CONSTRUCTION TESTING & ENGINEERING, INC.
PLANNING - CIVIL ENGINEERING - LAND SURVEYING - GEOTECHNICAL
1441 MONTIEL ROAD, SUITE 115 ESCONDIDO CA. 92026, PH:(760) 746-4955