

Appendix E  
Drainage Study



## DRAINAGE STUDY

McDonalds and Starbucks

PROJECT ADDRESS:  
SWC Main Street & 7<sup>th</sup> Avenue  
Hesperia, California

Fountainhead Palace, LP  
1401 Quail Street, Suite 100  
Newport Beach, CA 92660



DATE: 12/10/2024

C3 CIVIL ENGINEERING, LLC  
10870 W FAIRVIEW AVE  
STE 102-1187  
BOISE, ID 83713  
208.918.0998



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## Section 1 – Project Description

### Existing Conditions:

The site is currently partially occupied by a used auto sales lot on the northern parcels. There is one building on the main auto sales area and an out building on the westernmost side of the northern half. The southern half of the project site is partially paved but otherwise unoccupied.

The site is bordered on the west by a commercial shopping center, medical offices across Main Street to the north, A gas station and sports bar to the east across Seventh Avenue, and an appliance store and open space to the south across Walnut Street.

### Proposed Conditions:

Proposed improvements begin with the demolition of current buildings and paving. The improvements on the project will include two drive-thru establishments, one coffee and one fast food. A drive aisle will traverse between Main Street and Walnut Street between the two drive-thru establishments and will provide adequate points of access for both. New paving and landscaping will accompany the project to fit zone requirements.

## Section 2 – Drainage Patterns

### Existing Drainage Patterns:

With an existing curb and building in the middle of the project site, it creates three separate drainage areas.

On the west side of the existing curb (DA-1), a gradual slope from south to north allows storm water to gather at the end of the drainage area and eventually discharge on to Main Street. By curb and gutter, the drainage from this area will travel east on Main Street into an existing catch basin that is connected to the storm drain main on Main Street.

On the north side of the existing curb and building (DA-2), the site gradually slopes from the southwest corner to the northeast corner of the drainage area. There is an existing grated catch basin southwest of the driveway entrance on Main Street, that was created as the low spot of the site to capture any runoff and pipe into an existing seepage pit.

On the south side of the existing curb and building (DA-3) is a vacant lot that gradually slopes from the southwest corner to the northeast corner of the drainage area. Stormwater will discharge into the adjacent property and eventually discharge onto 7<sup>th</sup> Avenue. By curb and gutter, storm water will travel north and collect at an existing catch basin on 7<sup>th</sup> Avenue that is connected to the storm drain main. Once the development has been completed, stormwater will no longer flow across the adjacent property.

### Proposed Drainage Patterns:

DA-1 includes the proposed McDonald's site. Runoff from the building will discharge at grade and sheet flow onto the parking lot and street paving. Curb and gutter will collect and convey runoff north to the nearest catch basin. There are three proposed catch basins throughout the drainage area. Storm water will be piped into the proposed StormTech Detention Chamber System for stormwater detention and attenuation. Due to poor soil infiltration characteristics in this area, dry wells will be used in addition to an ADS Stormtech system to help infiltrate into the ground within 48-hours of capture. The high flow will flow out of two of the three grated inlets and flow out of a parkway culvert or storm drainpipe to Main Street. The first grated inlet to discharge stormwater out into a storm drain out the back of the grated inlet and daylight into the back of an existing catch basin on Main Street. Once the elevation of the storm water on the site has surpassed a certain elevation, storm water will then discharge from the second grated inlet in the NEC of the property. Storm water will discharge onto the parkway culvert located at the north of the property. From this parkway culvert, storm water will travel east and then collected on the southwest corner of Main Street and 7<sup>th</sup> Avenue. This catch basin is connected by



pipe to the storm drain main on Main Street. Dimensions and design for the underground systems and drywell structure are provided in the Appendix.

DA-2 includes the proposed Starbucks site. Runoff from the building will discharge at grade and sheet flow onto the parking lot and street paving. Curb and gutter will collect and convey runoff north to the nearest catch basin. There are four proposed catch basins throughout the property. Storm water will then be piped into the proposed StormTech Detention Chamber System for stormwater detention and attenuation. Due to poor soil infiltration characteristics of the soil in this area, dry wells will be used in addition to an ADS Stormtech system to help infiltrate into the ground within 48-hours of capture. Once the elevation of the storm water on the site has surpassed a certain elevation in the underground system and drywell, storm water will bypass the diversion manhole and will be piped to the back of the existing catch basin on the NEC of Main Street and 7<sup>th</sup> Avenue. Dimensions and design for the underground systems and drywell structure are provided in the Appendix.

#### Run-On:

There are no areas of run-on this site.

#### Hydromodification:

This project is exempt from hydromodification.

## Section 3 – Methodology

The two primary methods used in the San Bernardino County area to determine design discharges are the Rational Method and the Unit Hydrograph method. The Rational method is generally intended for use on small watersheds of less than 640-acres while the Synthetic Unit Hydrograph method is intended for use on watersheds in excess of these limits. For the purposes of this report, we will be using the Rational Method for the 100-year storm event.

### RATIONAL METHOD

The Rational method is commonly used for determining peak discharge from relatively small drainage areas. The Rational method is based on the following equation:

$$Q = C I A$$

Where:

Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)

I = average rainfall intensity for a duration equal to the  $T_c$  for the area, in inches per hour (Note: If the computed  $T_c$  is less than 5 minutes, use 5 minutes for computing the peak discharge, Q). I is obtained from the Intensity-Duration Curves from the SB Manual.

$T_c$  = Time of Concentration (min.)

Soil Group B – see appendix for Soil Hydrologic Soil Groups Map

AMC III for 100-year storm calculations

A = drainage area contributing to the design location, in acres

Intensity-Duration Curve = 1.19" for 100-year storm @ 60-minutes

$F_M$  = 0.08 in/hr. (per Table C.2 from Hydrology Manual)

For this study, HydroCAD software was used to model the Rational Method using Intensity-Duration-Frequency (IDF) curves from the San Bernardino County Manual. The IDF curves were input based on the criteria below from Figure D-3 from the San Bernardino County Hydrology Manual.

A plot of the IDF curve is included in the Appendix.



The Tc values for each subarea were determined using nomographs from Figure D-1 from the San Bernardino County Hydrology Manual. These Tc values are directly input for each subarea in the HydroCAD model. A Tc of 5 minutes was used for initial subareas with calculated Tc values less than 5 minutes.

The runoff coefficient (C) for each surface cover is also directly input for each subarea. The runoff coefficient is calculated based on section D.5 of the San Bernardino Hydrology Manual. The following factor was used for calculation of the runoff coefficient:

$$F_p = \text{Loss rate for Soils Group B (in/hr) from San Bernardino Hydrology Manual (0.30 for soil group B)}$$

Each subarea is entered into the HydroCAD model as a Subcatchment and linked to a downstream node. A Subcatchment is defined in the HydroCAD manual as *“a relatively homogenous area of land that typically drains into a reach or pond.”* A Reach is defined as *“a uniform stream, channel, or pipe that conveys water from one point to another”*. A Pond is defined as *“a pond, swamp, dam, catch basin, manhole, drywell, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other outlet device(s).”* A Pond is also used to model the end point of the drainage study. A model of the drainage catchment area was created using Subcatchments, Reaches and Ponds. A diagram of the model is included in the Appendix for the existing and proposed conditions.

In the HydroCAD program, the rainfall duration and corresponding peak flow rate are calculated based on the Tc for each subarea using the Rational Method for the frequency storm specified. The program allows for the 2-, 5-, 10-, and 100-year storm frequencies. As noted above, the 100-year storm frequency will be calculated in this study.

#### Detention Modeling:

The San Bernardino County Hydrology Manual uses the Modified Puls method (also referred to as the Storage-Indication Method) for detention basin modeling. HydroCAD uses several methods for reach routing, including the Storage-Indication Method. For this project, we selected the Storage-Indication Method for analyzing detention basin routing. This method was used within the Rational Method model to evaluate time-discharge rates for the two underground storage chamber systems. Please see the calculations in the Appendix for details.



## Section 4 – Calculations

### Runoff Calculations

Using the San Bernardino County Hydrology Manual, the existing and proposed runoff for the project was calculated for the 100-Year Storm Event. The runoff calculations are shown below.

#### Existing Conditions:

##### DA-1

A = 0.166 acres

Impervious % = 72%

$F_m = 0.08$ "/hr

$T_c = 4.8$  min (see appendix for nomograph)

I = 7.0 in/hr (see appendix for Intensity-Duration)

$Q = 0.90 * (I - F_m) * A$

$Q_{EX\ DMA\ 1} = 0.90 * (I - F_m) * A = 0.90 * (7.0 - 0.08) * 0.166 = 1.03$  cfs

**$Q_{EX\ DMA\ 1} = 1.03$  cfs**

##### DA-2

A = 0.569 acres

Impervious % = 99%

$F_m = 0.08$ "/hr

$T_c = 5.1$  min (see appendix for nomograph)

I = 6.7 in/hr (see appendix for Intensity-Duration)

$Q = 0.90 * (I - F_m) * A$

$Q_{EX\ DMA\ A} = 0.90 * (I - F_m) * A = 0.90 * (6.7 - 0.08) * 0.569 = 3.39$  cfs

**$Q_{EX\ DMA\ A} = 3.39$  cfs**



### DA-3

A = 0.903 acres

Impervious % = 99%

$F_m = 0.08$ "/hr

$T_c = 5.1$  min (see appendix for nomograph)

I = 3.7 in/hr (see appendix for Intensity-Duration)

$Q = 0.90 * (I - F_m) * A$

$Q_{EX\ DMA\ A} = 0.90 * (I - F_m) * A = 0.90 * (3.7 - 0.08) * 0.903 = 2.94$  cfs

**$Q_{EX\ DMA\ A} = 2.94$  cfs**

### Proposed Conditions:

See Appendix to view HydroCAD Calculation for the proposed drainage area calculation.

## Section 5 – Summary

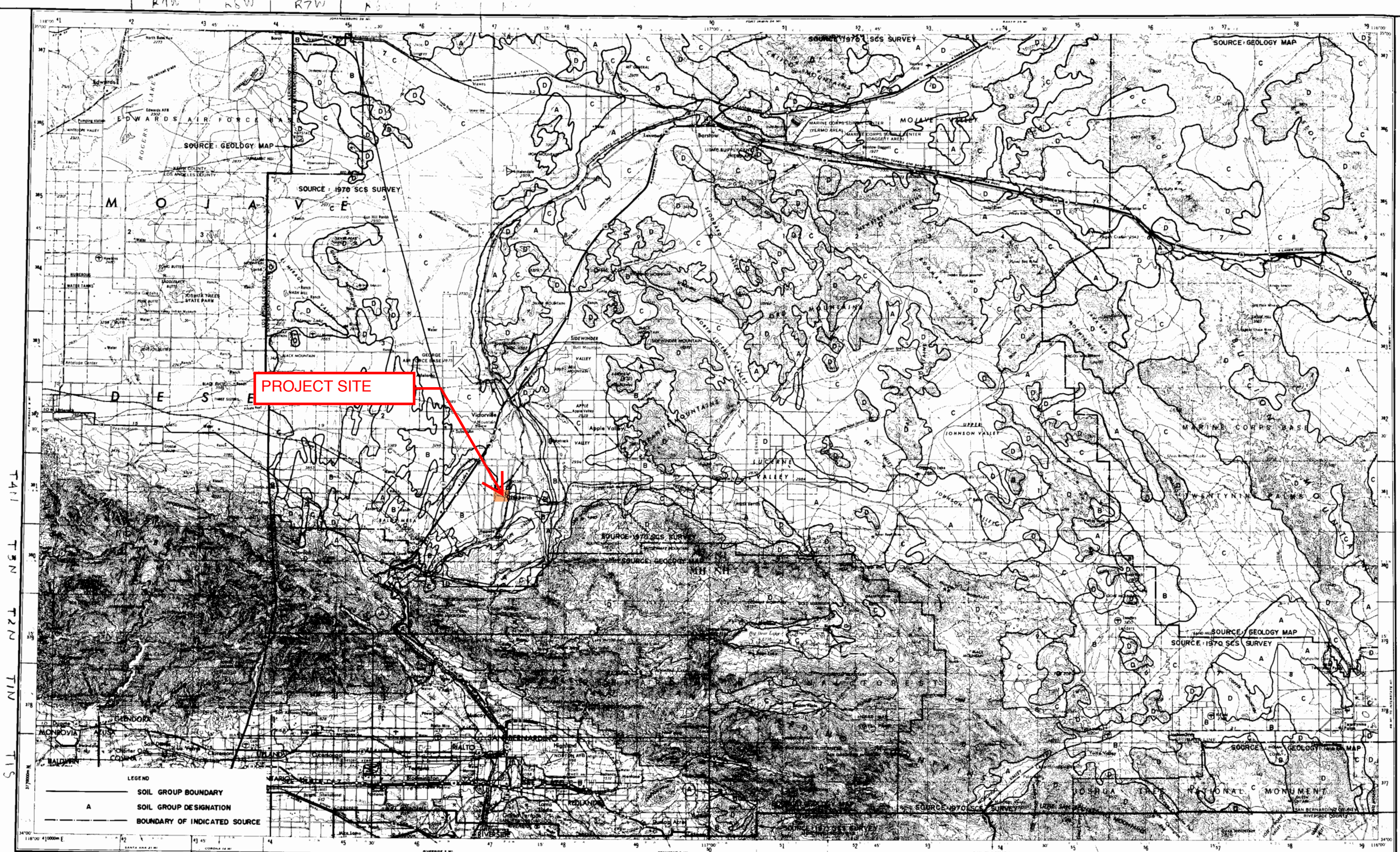
Based on the calculations provided in Section 4,

### 100-yr Storm Event

Subarea #	Existing $Q_{Peak}$ (cfs)	Proposed $Q_{Peak}$ (cfs)
Outlet #1	1.03	0.46
Outlet #2	3.39	2.06
Outlet #3	2.94	1.84
Total:	7.94	4.36

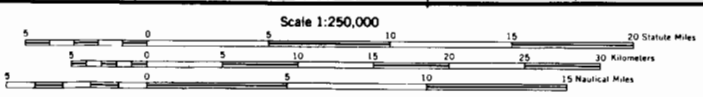
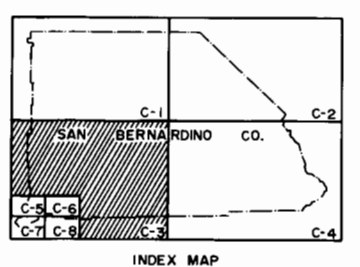


## Appendix



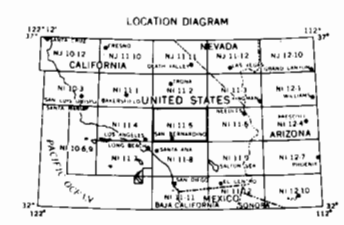
LEGEND  
 — SOIL GROUP BOUNDARY  
 A SOIL GROUP DESIGNATION  
 — BOUNDARY OF INDICATED SOURCE

**SAN BERNARDINO COUNTY**  
 HYDROLOGY MANUAL



Scale 1:250,000  
 CONTOUR INTERVAL 200 FEET  
 WITH SUPPLEMENTARY CONTOURS AT 100 FOOT INTERVALS  
 TRANSVERSE MERCATOR PROJECTION  
 BLACK NUMBERED LINES INDICATE THE 4300 METERS UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 11  
 1983 MAGNETIC DECLINATION FROM TRUE NORTH VARIES FROM 1.9M (200 MILES) EASTERLY FROM THE CENTER OF THE WEST EDGE TO 1.9° (210 MILES) EASTERLY FROM THE CENTER OF THE EAST EDGE

BASE MAP REPRODUCED FROM U.S.G.S. "SAN BERNARDINO" TOPOGRAPHIC MAP  
**SCALE REDUCED BY 1/2**



**HYDROLOGIC SOILS GROUP MAP**  
 FOR  
 SOUTHCENTRAL AREA



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Tryppaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.04 (0.864-1.27)	1.45 (1.20-1.78)	2.02 (1.66-2.46)	2.47 (2.02-3.06)	3.12 (2.46-3.98)	3.62 (2.81-4.73)	4.15 (3.14-5.56)	4.72 (3.47-6.48)	5.48 (3.86-7.87)	6.11 (4.15-9.06)
10-min	0.744 (0.618-0.912)	1.04 (0.864-1.27)	1.44 (1.19-1.76)	1.77 (1.45-2.19)	2.23 (1.76-2.86)	2.60 (2.01-3.39)	2.98 (2.25-3.98)	3.38 (2.48-4.65)	3.94 (2.77-5.64)	4.37 (2.98-6.49)
15-min	0.600 (0.496-0.736)	0.840 (0.696-1.03)	1.16 (0.956-1.42)	1.43 (1.17-1.76)	1.80 (1.42-2.30)	2.10 (1.62-2.74)	2.40 (1.82-3.21)	2.72 (2.00-3.75)	3.17 (2.24-4.55)	3.53 (2.40-5.24)
30-min	0.440 (0.364-0.538)	0.616 (0.508-0.752)	0.850 (0.700-1.04)	1.05 (0.854-1.29)	1.32 (1.04-1.69)	1.53 (1.19-2.00)	1.76 (1.33-2.35)	1.99 (1.47-2.74)	2.32 (1.64-3.33)	2.58 (1.76-3.83)
60-min	0.299 (0.247-0.365)	0.417 (0.345-0.510)	0.576 (0.475-0.706)	0.709 (0.579-0.876)	0.894 (0.706-1.14)	1.04 (0.805-1.36)	1.19 (0.900-1.59)	1.35 (0.993-1.86)	1.57 (1.11-2.26)	1.75 (1.19-2.60)
2-hr	0.214 (0.177-0.261)	0.287 (0.237-0.350)	0.386 (0.318-0.473)	0.470 (0.384-0.580)	0.588 (0.464-0.751)	0.682 (0.528-0.890)	0.780 (0.589-1.04)	0.885 (0.650-1.22)	1.03 (0.726-1.48)	1.15 (0.781-1.70)
3-hr	0.177 (0.146-0.216)	0.234 (0.193-0.287)	0.313 (0.258-0.383)	0.379 (0.310-0.468)	0.473 (0.374-0.605)	0.549 (0.424-0.716)	0.628 (0.474-0.840)	0.712 (0.523-0.980)	0.831 (0.585-1.19)	0.926 (0.630-1.38)
6-hr	0.123 (0.102-0.151)	0.162 (0.134-0.198)	0.215 (0.177-0.264)	0.260 (0.213-0.322)	0.325 (0.257-0.415)	0.377 (0.291-0.492)	0.431 (0.326-0.577)	0.490 (0.360-0.674)	0.574 (0.404-0.823)	0.641 (0.436-0.952)
12-hr	0.079 (0.065-0.097)	0.106 (0.088-0.130)	0.144 (0.118-0.176)	0.175 (0.143-0.216)	0.220 (0.174-0.281)	0.256 (0.198-0.334)	0.294 (0.222-0.393)	0.334 (0.245-0.460)	0.391 (0.276-0.561)	0.438 (0.298-0.650)
24-hr	0.053 (0.047-0.061)	0.074 (0.065-0.085)	0.102 (0.090-0.118)	0.125 (0.110-0.146)	0.159 (0.134-0.191)	0.185 (0.154-0.228)	0.213 (0.173-0.269)	0.243 (0.192-0.315)	0.286 (0.216-0.386)	0.320 (0.234-0.447)
2-day	0.030 (0.027-0.035)	0.042 (0.037-0.049)	0.059 (0.052-0.068)	0.073 (0.064-0.085)	0.093 (0.079-0.112)	0.109 (0.090-0.134)	0.126 (0.102-0.159)	0.145 (0.114-0.188)	0.171 (0.129-0.231)	0.193 (0.141-0.269)
3-day	0.021 (0.019-0.025)	0.030 (0.027-0.035)	0.042 (0.037-0.049)	0.053 (0.046-0.061)	0.067 (0.057-0.081)	0.079 (0.066-0.098)	0.092 (0.074-0.116)	0.106 (0.083-0.137)	0.126 (0.095-0.170)	0.142 (0.104-0.198)
4-day	0.017 (0.015-0.020)	0.024 (0.021-0.028)	0.034 (0.030-0.039)	0.042 (0.037-0.049)	0.054 (0.046-0.066)	0.064 (0.053-0.079)	0.074 (0.060-0.094)	0.086 (0.067-0.111)	0.102 (0.077-0.138)	0.115 (0.084-0.161)
7-day	0.011 (0.009-0.012)	0.015 (0.013-0.018)	0.021 (0.019-0.025)	0.026 (0.023-0.031)	0.034 (0.029-0.041)	0.040 (0.033-0.049)	0.046 (0.037-0.059)	0.053 (0.042-0.069)	0.063 (0.048-0.086)	0.071 (0.052-0.100)
10-day	0.008 (0.007-0.009)	0.011 (0.010-0.013)	0.016 (0.014-0.018)	0.020 (0.017-0.023)	0.025 (0.021-0.030)	0.030 (0.024-0.036)	0.034 (0.028-0.043)	0.039 (0.031-0.051)	0.047 (0.035-0.063)	0.053 (0.038-0.074)
20-day	0.005 (0.004-0.005)	0.006 (0.006-0.008)	0.009 (0.008-0.011)	0.012 (0.010-0.013)	0.015 (0.012-0.018)	0.018 (0.014-0.022)	0.020 (0.016-0.026)	0.023 (0.018-0.031)	0.028 (0.021-0.038)	0.031 (0.023-0.044)
30-day	0.003 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.010-0.014)	0.013 (0.011-0.017)	0.016 (0.013-0.020)	0.018 (0.014-0.024)	0.022 (0.016-0.029)	0.024 (0.018-0.034)
45-day	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.007-0.011)	0.010 (0.009-0.013)	0.012 (0.010-0.015)	0.014 (0.011-0.018)	0.017 (0.013-0.023)	0.019 (0.014-0.027)
60-day	0.002 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.007)	0.007 (0.006-0.009)	0.009 (0.007-0.011)	0.010 (0.008-0.013)	0.012 (0.009-0.015)	0.014 (0.010-0.019)	0.016 (0.011-0.022)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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**PF graphical**

EXISTING CONDITION

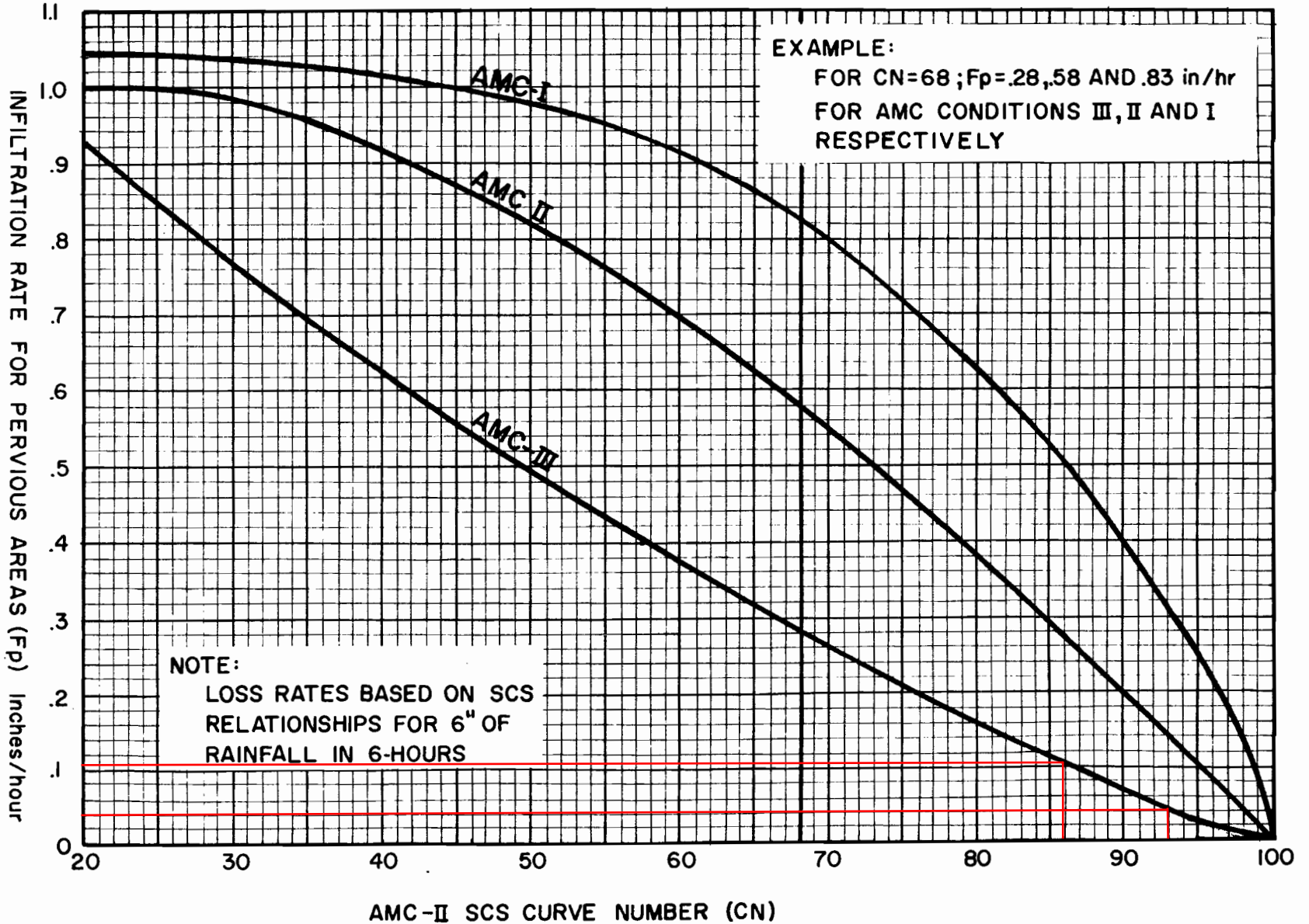
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AMC III for 100-year storm calculation  
Infiltration rate= 0.04 in/hr

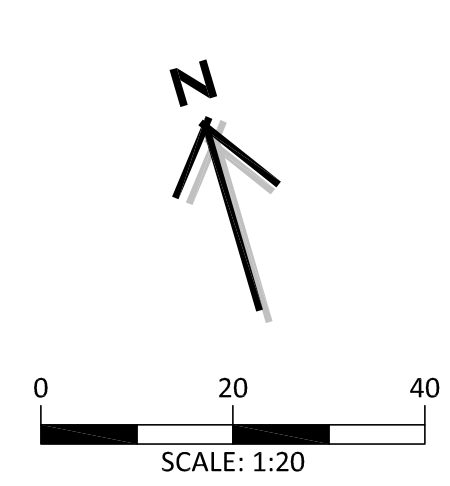
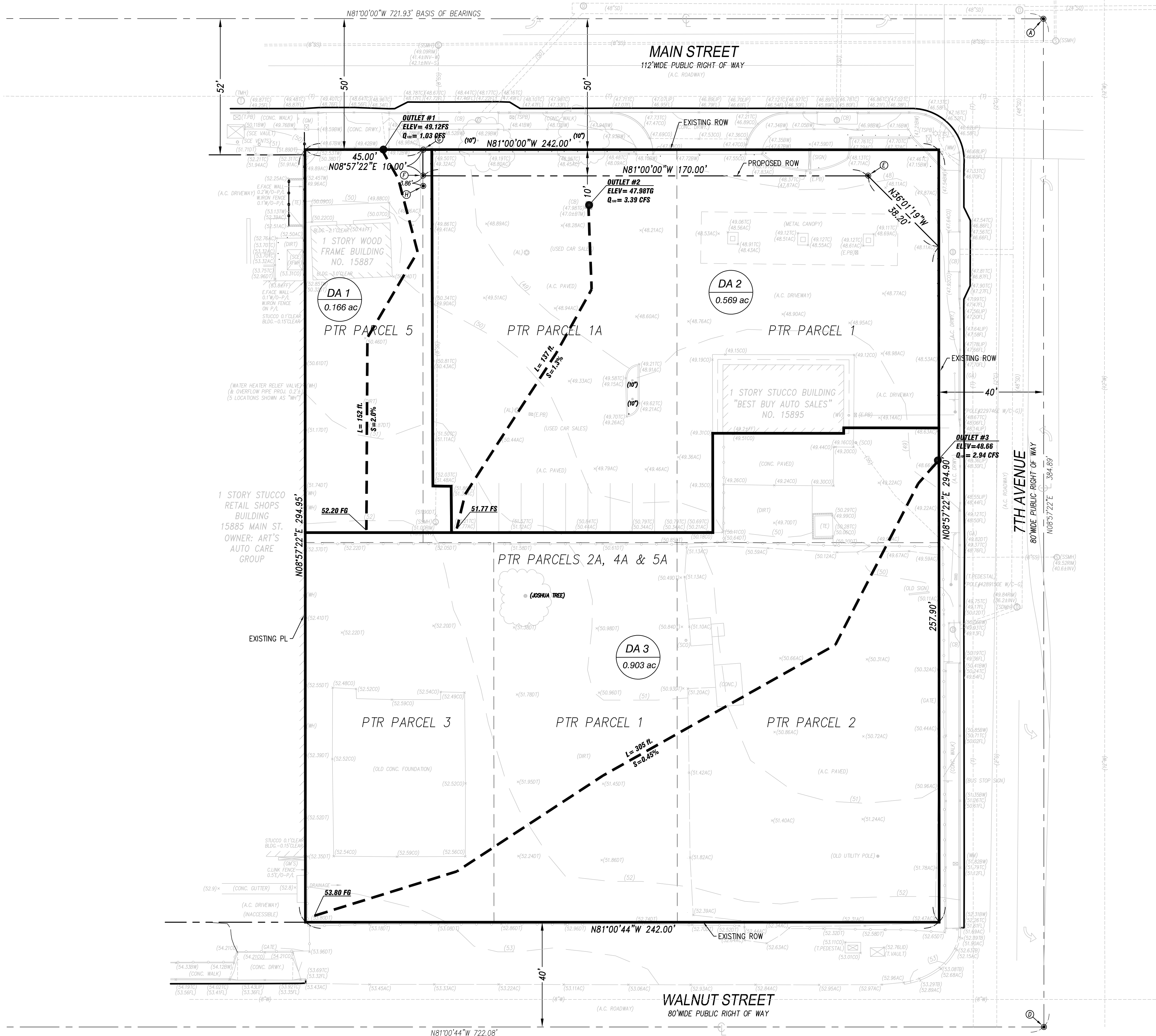
PROPOSED CONDITION

CN= 86 (HYDROCAD)  
AMC III for 100-year storm calculation  
Infiltration rate= 0.11 in/hr

SAN BERNARDINO COUNTY  
HYDROLOGY MANUAL

INFILTRATION RATE FOR  
PERVIOUS AREAS VERSUS  
SCS CURVE NUMBERS

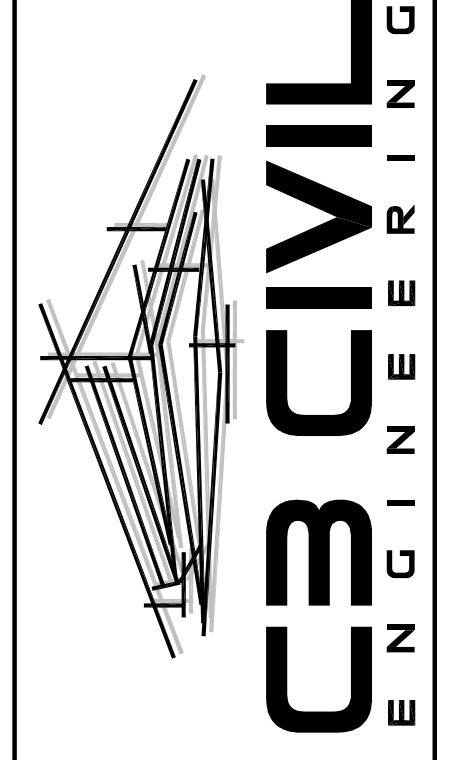




REVISION RECORD	
#	DESCRIPTION

**STARBUCKS AND MCDONALDS**  
SWC MAIN STREET & 7TH AVENUE  
HESPERIA, CA

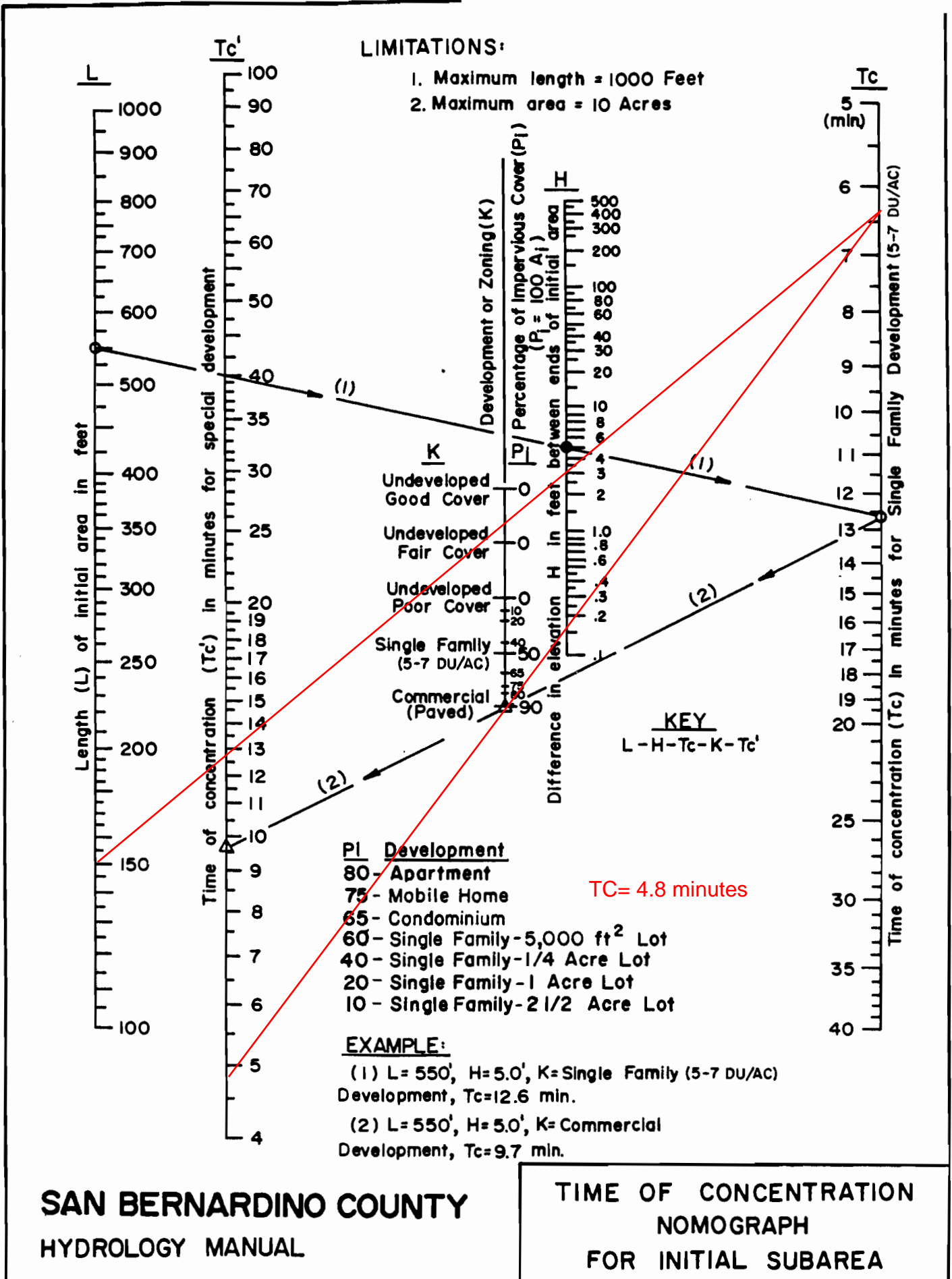
10870 W. FAIRVIEW DR  
STE 102-1187  
BOISE, ID 83713  
(208) 918-0928  
thomas@c3civileng.com  
www.c3civileng.com

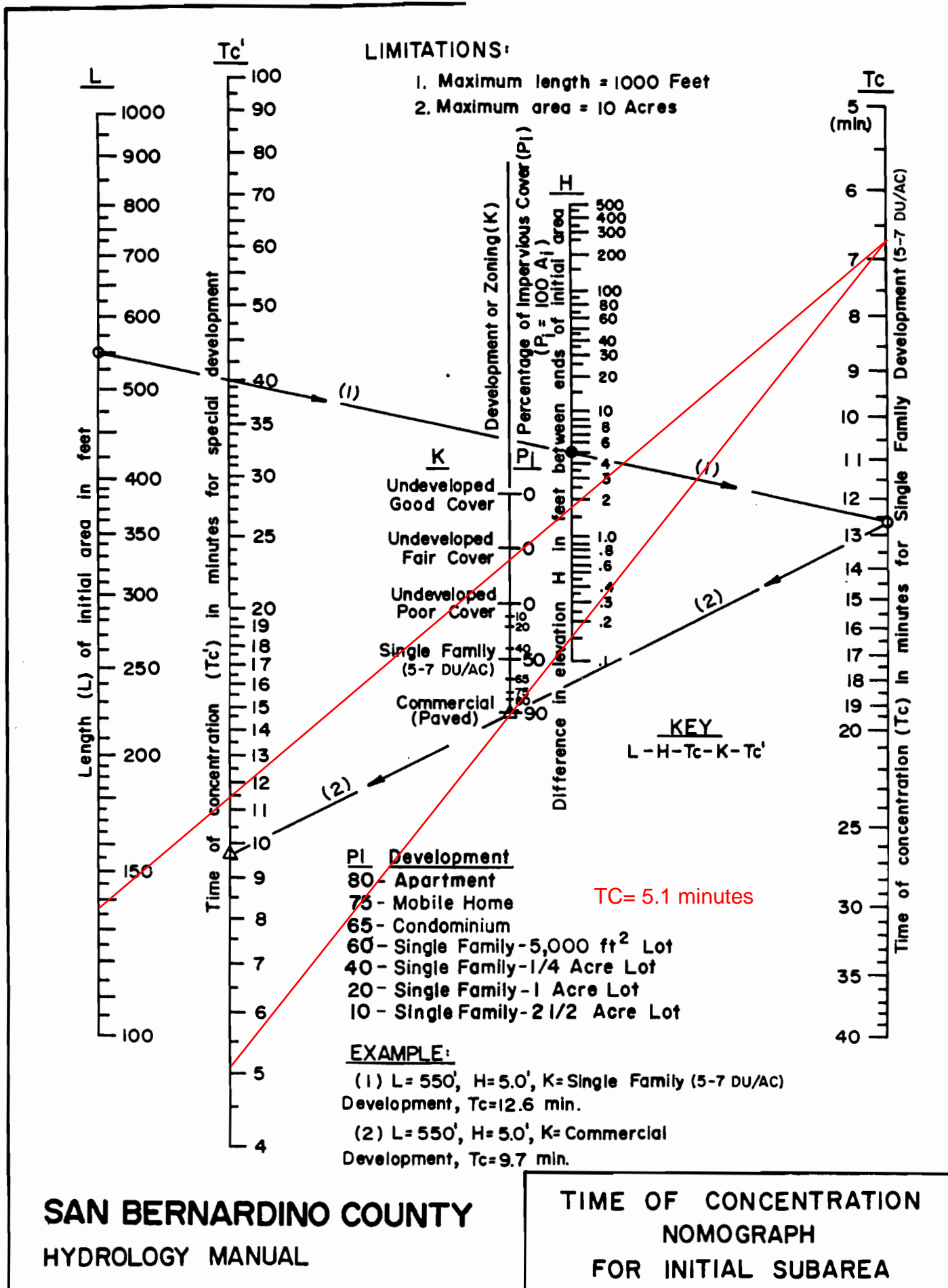


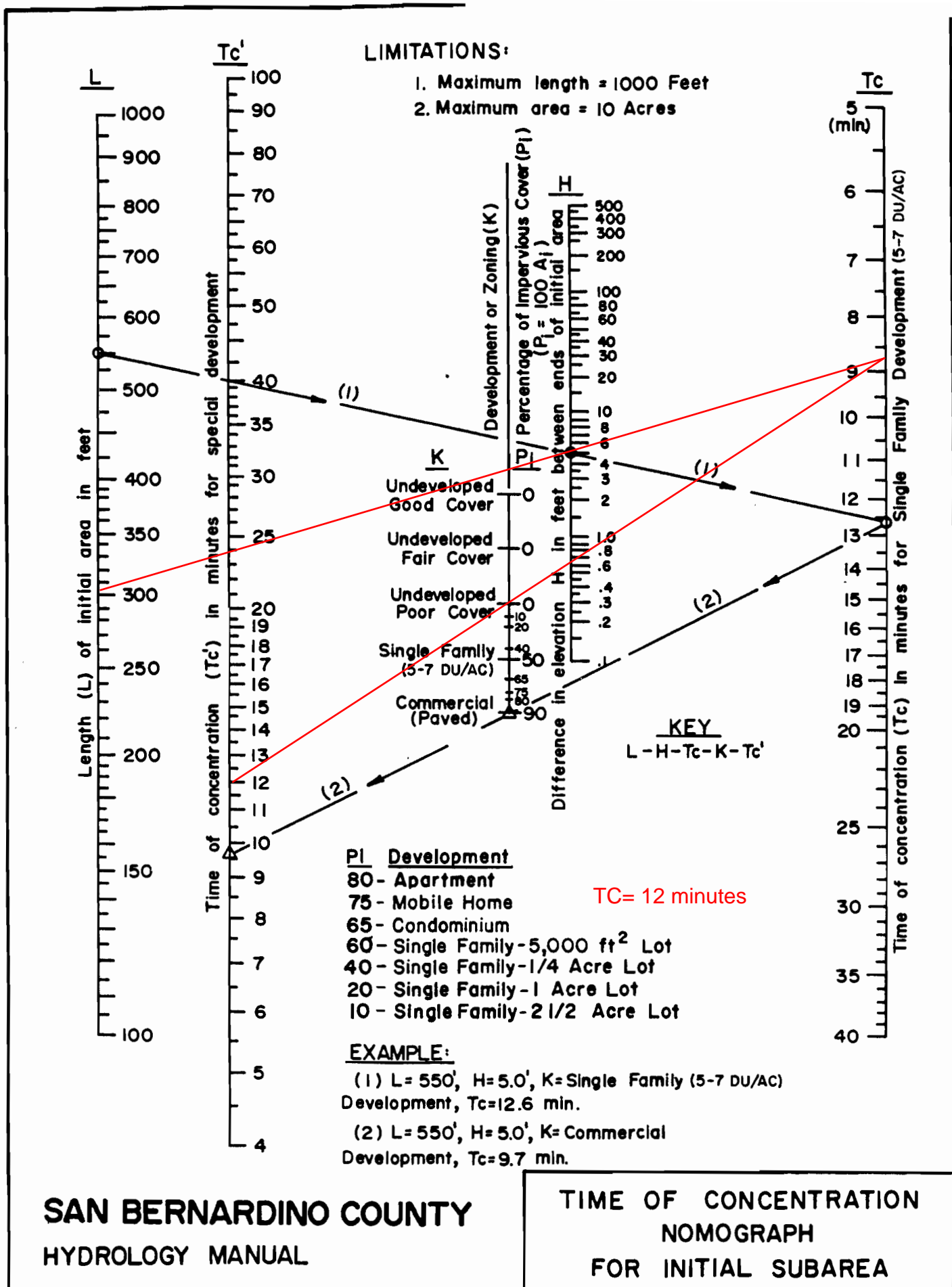
DATE: 12/06/2024  
CS JOB NO: 24-041  
DRAWN BY: NM  
CHECKED BY: TH

**EXISTING DRAINAGE MAP**



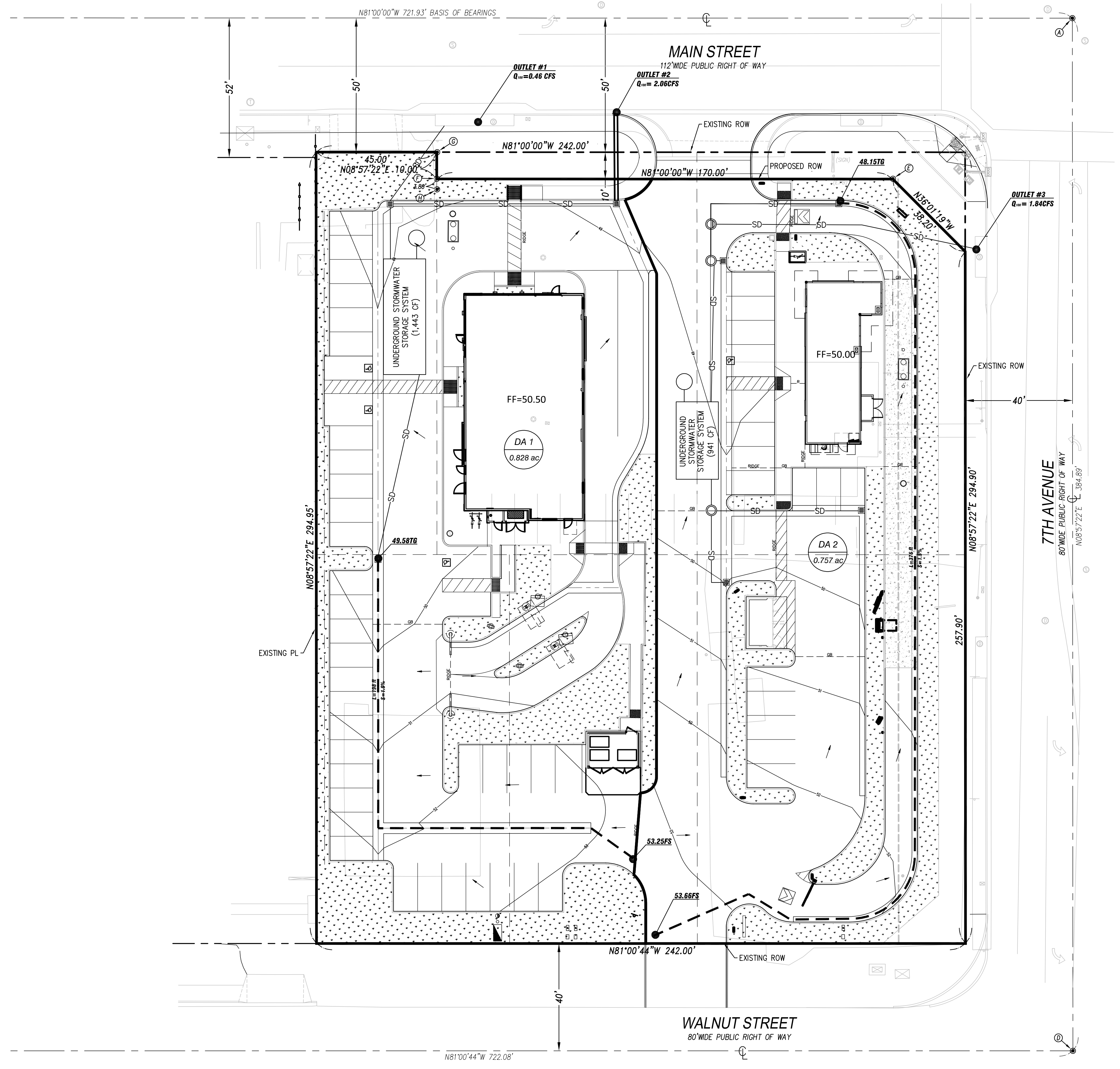




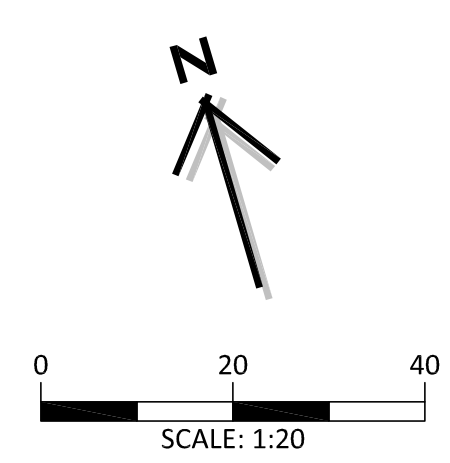


**SAN BERNARDINO COUNTY**  
HYDROLOGY MANUAL

**TIME OF CONCENTRATION**  
**NOMOGRAPH**  
**FOR INITIAL SUBAREA**



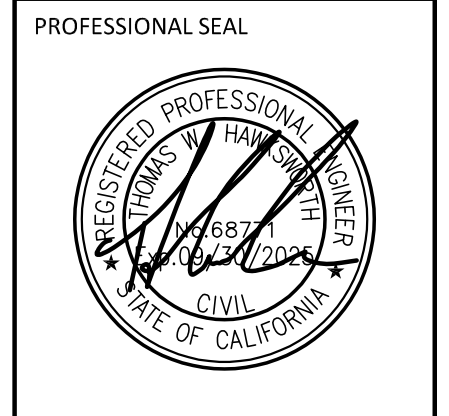
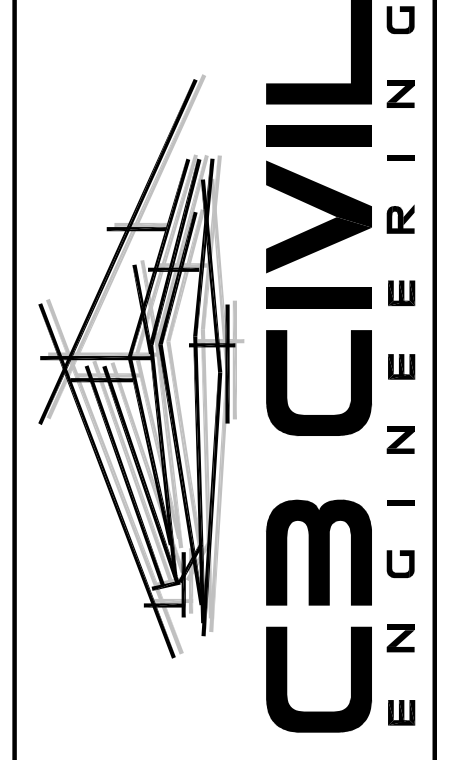
- LEGEND:**
- DRAINAGE AREA
  - FLOW LINE PATH
  - DRAINAGE CALLOUT
  - EXISTING CONTOUR



REVISION RECORD		
#	DATE	DESCRIPTION

**STARBUCKS AND MCDONALDS**  
 SWC MAIN STREET & 7TH AVENUE  
 HESPERIA, CA

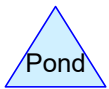
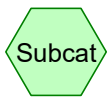
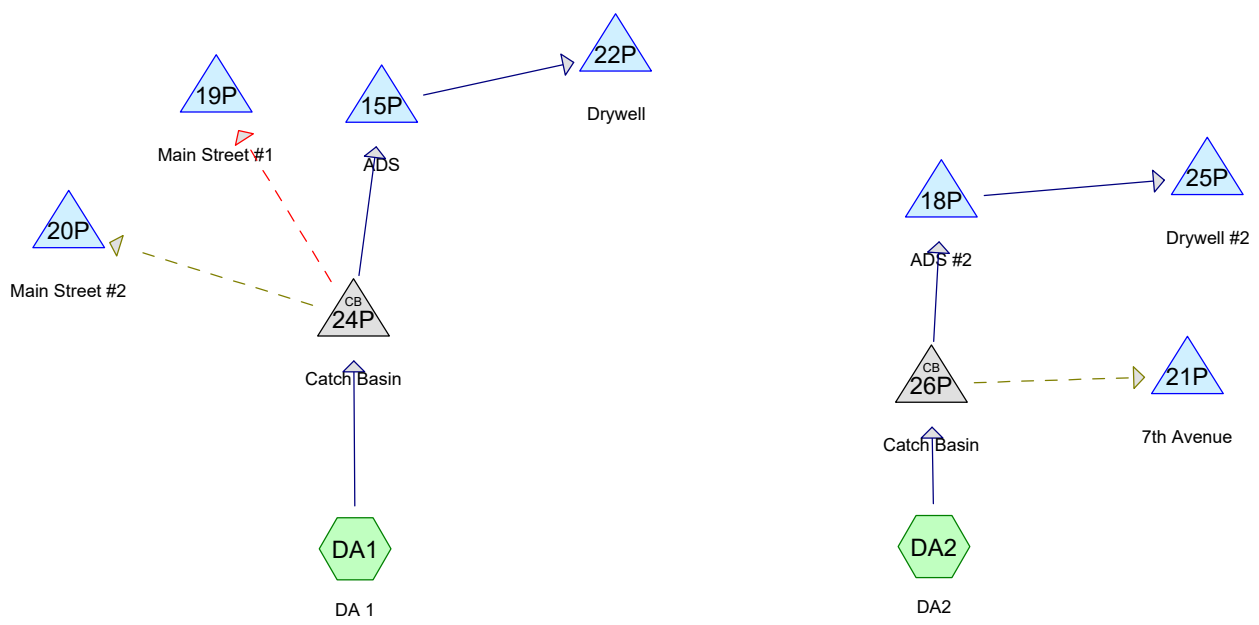
10870 W. FAIRVIEW DR  
 STE 102-1187  
 BOISE, ID 83713  
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 thomas@c3civileng.com  
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DATE: 12/10/2024  
 CS JOB NO: 24-041  
 DRAWN BY: NMY  
 CHECKED BY: TH

SHEET TITLE  
**PROPOSE DRAINAGE MAP**

SHEET NUMBER  
**2 of 2**



**Routing Diagram for 24041- HydroCAD Calculations**  
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**24041- HydroCAD Calculations**

Prepared by C3 Civil Engineering

Printed 12/10/2024

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Page 2

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	15P	39.59	39.50	5.0	0.0180	0.009	0.0	4.0	0.0
2	18P	41.70	41.68	4.5	0.0044	0.010	0.0	12.0	0.0
3	24P	47.50	44.40	34.5	0.0899	0.010	0.0	4.0	0.0
4	24P	47.61	47.22	32.3	0.0121	0.012	24.0	3.0	0.0
5	24P	45.60	45.50	19.3	0.0052	0.012	0.0	4.0	0.0
6	26P	45.50	44.29	120.6	0.0100	0.010	0.0	4.0	0.0
7	26P	44.91	42.96	97.4	0.0200	0.120	0.0	12.0	0.0

Time span=0.00-12.00 hrs, dt=0.01 hrs, 1201 points  
 Runoff by Rational method, Rise/Fall=1.0/1.0 xTc  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**SubcatchmentDA1: DA 1** Runoff Area=36,055 sf 79.00% Impervious Runoff Depth=0.32"  
 Tc=5.0 min C=0.93 Runoff=3.11 cfs 0.022 af

**SubcatchmentDA2: DA2** Runoff Area=33,068 sf 74.55% Impervious Runoff Depth=0.32"  
 Tc=5.0 min C=0.92 Runoff=2.82 cfs 0.020 af

**Pond 15P: ADS** Peak Elev=40.30' Storage=0.004 af Inflow=0.59 cfs 0.007 af  
 4.0" Round Culvert n=0.009 L=5.0' S=0.0180 '/ Outflow=0.31 cfs 0.007 af

**Pond 18P: ADS #2** Peak Elev=42.24' Storage=0.001 af Inflow=0.98 cfs 0.007 af  
 12.0" Round Culvert n=0.010 L=4.5' S=0.0044 '/ Outflow=0.91 cfs 0.007 af

**Pond 19P: Main Street #1** Inflow=0.46 cfs 0.003 af  
 Primary=0.46 cfs 0.003 af

**Pond 20P: Main Street #2** Inflow=2.06 cfs 0.013 af  
 Primary=2.06 cfs 0.013 af

**Pond 21P: 7th Avenue** Inflow=1.84 cfs 0.013 af  
 Primary=1.84 cfs 0.013 af

**Pond 22P: Drywell** Peak Elev=38.97' Storage=0.006 af Inflow=0.31 cfs 0.007 af  
 Outflow=0.02 cfs 0.007 af

**Pond 24P: Catch Basin** Peak Elev=48.44' Inflow=3.11 cfs 0.022 af  
 Primary=0.59 cfs 0.007 af Secondary=0.46 cfs 0.003 af Tertiary=2.06 cfs 0.013 af Outflow=3.11 cfs 0.022 af

**Pond 25P: Drywell #2** Peak Elev=50.50' Storage=0.007 af Inflow=0.91 cfs 0.007 af  
 Outflow=0.00 cfs 0.001 af

**Pond 26P: Catch Basin** Peak Elev=66.36' Inflow=2.82 cfs 0.020 af  
 Primary=0.98 cfs 0.007 af Tertiary=1.84 cfs 0.013 af Outflow=2.82 cfs 0.020 af

**Total Runoff Area = 1.587 ac Runoff Volume = 0.042 af Average Runoff Depth = 0.32"**  
**23.13% Pervious = 0.367 ac 76.87% Impervious = 1.220 ac**

**Summary for Subcatchment DA1: DA 1**

Runoff = 3.11 cfs @ 0.08 hrs, Volume= 0.022 af, Depth= 0.32"

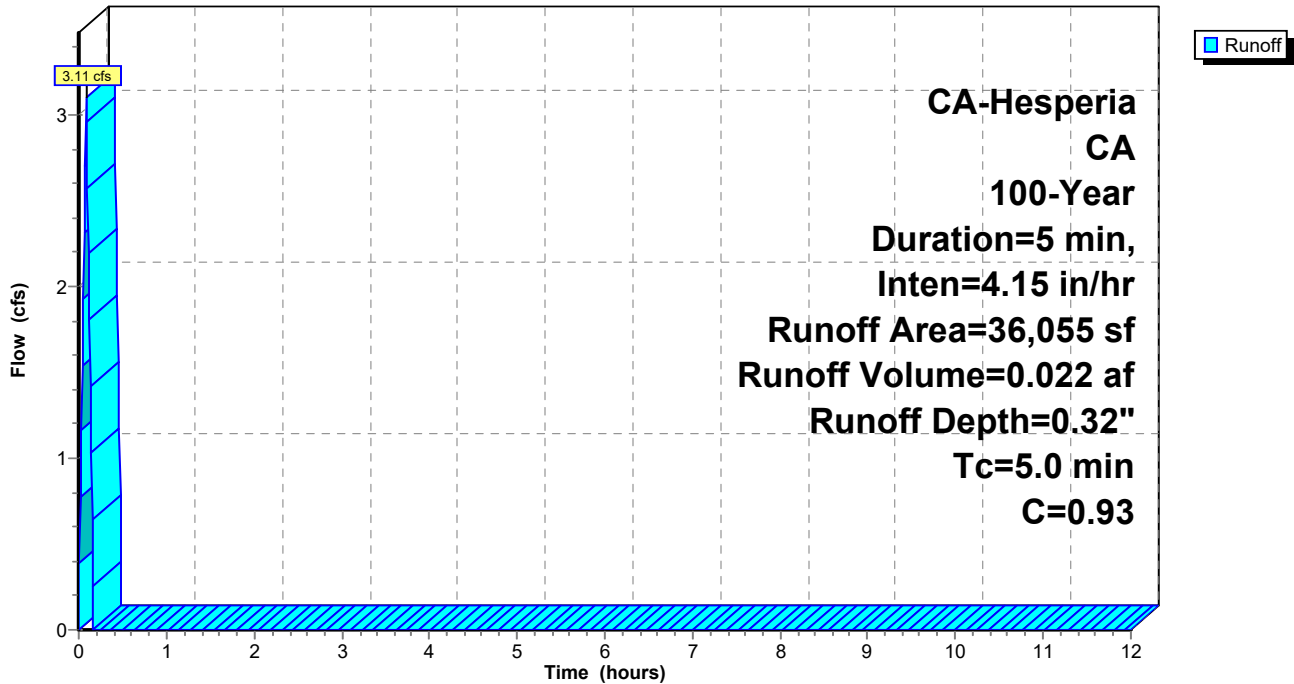
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 CA-Hesperia, CA 100-Year Duration=5 min, Inten=4.15 in/hr

Area (sf)	C	Description
21,883	0.98	Ashphalt
3,525	0.98	McDonalds Building
3,075	0.98	Concrete
7,572	0.75	50-75% Grass cover, Fair, HSG B
36,055	0.93	Weighted Average
7,572		21.00% Pervious Area
28,483		79.00% Impervious Area

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

**Subcatchment DA1: DA 1**

Hydrograph





**Hydrograph for Subcatchment DA1: DA 1**

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	<b>0.00</b>	5.10	0.00	10.20	0.00
0.10	<b>2.58</b>	5.20	0.00	10.30	0.00
0.20	0.00	5.30	0.00	10.40	0.00
0.30	0.00	5.40	0.00	10.50	0.00
0.40	0.00	5.50	0.00	10.60	0.00
0.50	0.00	5.60	0.00	10.70	0.00
0.60	0.00	5.70	0.00	10.80	0.00
0.70	0.00	5.80	0.00	10.90	0.00
0.80	0.00	5.90	0.00	11.00	0.00
0.90	0.00	6.00	0.00	11.10	0.00
1.00	0.00	6.10	0.00	11.20	0.00
1.10	0.00	6.20	0.00	11.30	0.00
1.20	0.00	6.30	0.00	11.40	0.00
1.30	0.00	6.40	0.00	11.50	0.00
1.40	0.00	6.50	0.00	11.60	0.00
1.50	0.00	6.60	0.00	11.70	0.00
1.60	0.00	6.70	0.00	11.80	0.00
1.70	0.00	6.80	0.00	11.90	0.00
1.80	0.00	6.90	0.00	12.00	0.00
1.90	0.00	7.00	0.00		
2.00	0.00	7.10	0.00		
2.10	0.00	7.20	0.00		
2.20	0.00	7.30	0.00		
2.30	0.00	7.40	0.00		
2.40	0.00	7.50	0.00		
2.50	0.00	7.60	0.00		
2.60	0.00	7.70	0.00		
2.70	0.00	7.80	0.00		
2.80	0.00	7.90	0.00		
2.90	0.00	8.00	0.00		
3.00	0.00	8.10	0.00		
3.10	0.00	8.20	0.00		
3.20	0.00	8.30	0.00		
3.30	0.00	8.40	0.00		
3.40	0.00	8.50	0.00		
3.50	0.00	8.60	0.00		
3.60	0.00	8.70	0.00		
3.70	0.00	8.80	0.00		
3.80	0.00	8.90	0.00		
3.90	0.00	9.00	0.00		
4.00	0.00	9.10	0.00		
4.10	0.00	9.20	0.00		
4.20	0.00	9.30	0.00		
4.30	0.00	9.40	0.00		
4.40	0.00	9.50	0.00		
4.50	0.00	9.60	0.00		
4.60	0.00	9.70	0.00		
4.70	0.00	9.80	0.00		
4.80	0.00	9.90	0.00		
4.90	0.00	10.00	0.00		
5.00	0.00	10.10	0.00		

**Summary for Subcatchment DA2: DA2**

Runoff = 2.82 cfs @ 0.08 hrs, Volume= 0.020 af, Depth= 0.32"

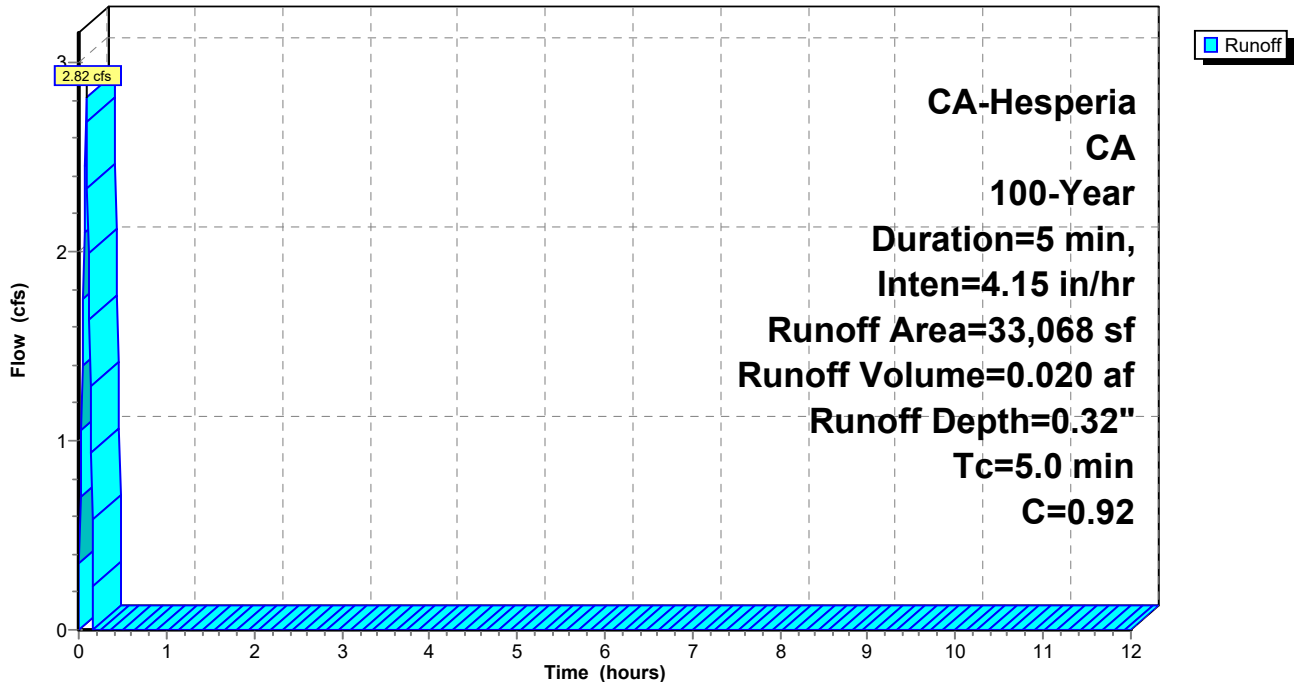
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 CA-Hesperia, CA 100-Year Duration=5 min, Inten=4.15 in/hr

Area (sf)	C	Description
19,990	0.98	Ashphalt
3,322	0.98	Concrete
1,339	0.98	Roof
8,417	0.75	>75% Grass cover, Good, HSG B
33,068	0.92	Weighted Average
8,417		25.45% Pervious Area
24,651		74.55% Impervious Area

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

**Subcatchment DA2: DA2**

Hydrograph



**Hydrograph for Subcatchment DA2: DA2**

Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)	Time (hours)	Runoff (cfs)
0.00	<b>0.00</b>	5.10	0.00	10.20	0.00
0.10	<b>2.34</b>	5.20	0.00	10.30	0.00
0.20	0.00	5.30	0.00	10.40	0.00
0.30	0.00	5.40	0.00	10.50	0.00
0.40	0.00	5.50	0.00	10.60	0.00
0.50	0.00	5.60	0.00	10.70	0.00
0.60	0.00	5.70	0.00	10.80	0.00
0.70	0.00	5.80	0.00	10.90	0.00
0.80	0.00	5.90	0.00	11.00	0.00
0.90	0.00	6.00	0.00	11.10	0.00
1.00	0.00	6.10	0.00	11.20	0.00
1.10	0.00	6.20	0.00	11.30	0.00
1.20	0.00	6.30	0.00	11.40	0.00
1.30	0.00	6.40	0.00	11.50	0.00
1.40	0.00	6.50	0.00	11.60	0.00
1.50	0.00	6.60	0.00	11.70	0.00
1.60	0.00	6.70	0.00	11.80	0.00
1.70	0.00	6.80	0.00	11.90	0.00
1.80	0.00	6.90	0.00	12.00	0.00
1.90	0.00	7.00	0.00		
2.00	0.00	7.10	0.00		
2.10	0.00	7.20	0.00		
2.20	0.00	7.30	0.00		
2.30	0.00	7.40	0.00		
2.40	0.00	7.50	0.00		
2.50	0.00	7.60	0.00		
2.60	0.00	7.70	0.00		
2.70	0.00	7.80	0.00		
2.80	0.00	7.90	0.00		
2.90	0.00	8.00	0.00		
3.00	0.00	8.10	0.00		
3.10	0.00	8.20	0.00		
3.20	0.00	8.30	0.00		
3.30	0.00	8.40	0.00		
3.40	0.00	8.50	0.00		
3.50	0.00	8.60	0.00		
3.60	0.00	8.70	0.00		
3.70	0.00	8.80	0.00		
3.80	0.00	8.90	0.00		
3.90	0.00	9.00	0.00		
4.00	0.00	9.10	0.00		
4.10	0.00	9.20	0.00		
4.20	0.00	9.30	0.00		
4.30	0.00	9.40	0.00		
4.40	0.00	9.50	0.00		
4.50	0.00	9.60	0.00		
4.60	0.00	9.70	0.00		
4.70	0.00	9.80	0.00		
4.80	0.00	9.90	0.00		
4.90	0.00	10.00	0.00		
5.00	0.00	10.10	0.00		

**Summary for Pond 15P: ADS**

Inflow Area = 0.828 ac, 79.00% Impervious, Inflow Depth = 0.10" for 100-Year event  
 Inflow = 0.59 cfs @ 0.08 hrs, Volume= 0.007 af  
 Outflow = 0.31 cfs @ 0.16 hrs, Volume= 0.007 af, Atten= 47%, Lag= 4.5 min  
 Primary = 0.31 cfs @ 0.16 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 40.30' @ 0.16 hrs Storage= 0.004 af

Plug-Flow detention time= 11.3 min calculated for 0.007 af (100% of inflow)  
 Center-of-Mass det. time= 11.1 min ( 16.1 - 5.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	39.59'	0.015 af	<b>15.75"W x 39.22'L x 3.75'H Field A</b> Impervious 0.053 af Overall - 0.016 af Embedded = 0.037 af x 40.0% Voids
#2A	40.34'	0.016 af	<b>ADS_StormTech DC-780 +Cap</b> x 15 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56"L with 0.44' Overlap 15 Chambers in 3 Rows
		0.031 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	39.59'	<b>4.0" Round Culvert</b> L= 5.0' Ke= 0.500 Inlet / Outlet Invert= 39.59' / 39.50' S= 0.0180 '/ Cc= 0.900 n= 0.009, Flow Area= 0.09 sf

**Primary OutFlow** Max=0.31 cfs @ 0.16 hrs HW=40.30' (Free Discharge)  
 ↑**1=Culvert** (Inlet Controls 0.31 cfs @ 3.55 fps)

### Pond 15P: ADS - Chamber Wizard Field A

**Chamber Model = ADS\_StormTechDC-780 +Cap (ADS StormTech®DC-780 with cap length)**

Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

5 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 37.22' Row Length +12.0" End Stone x 2 = 39.22' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

9.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.75' Field Height

15 Chambers x 46.2 cf = 693.6 cf Chamber Storage

2,316.2 cf Field - 693.6 cf Chambers = 1,622.6 cf Stone x 40.0% Voids = 649.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,342.6 cf = 0.031 af

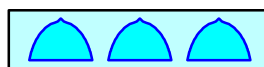
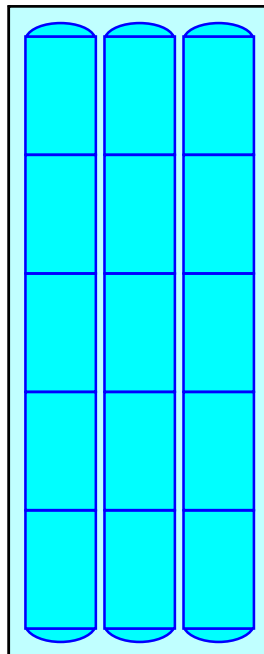
Overall Storage Efficiency = 58.0%

Overall System Size = 39.22' x 15.75' x 3.75'

15 Chambers

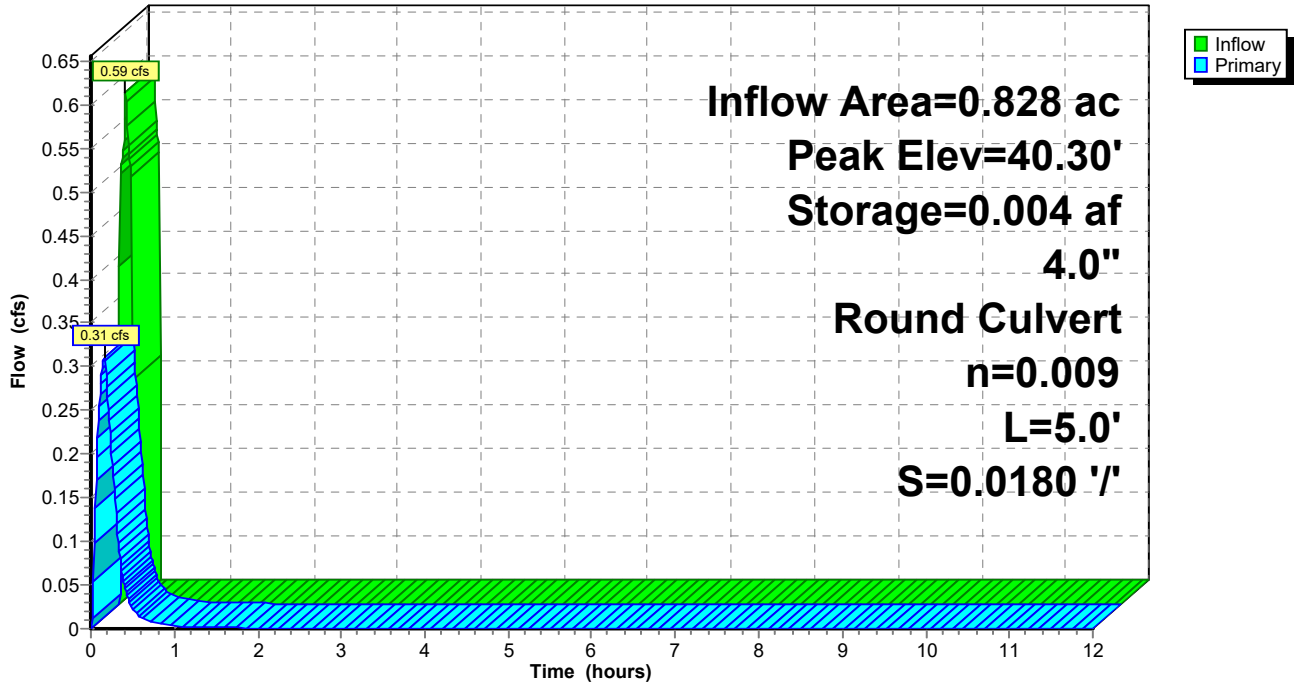
85.8 cy Field

60.1 cy Stone



### Pond 15P: ADS

Hydrograph



**Hydrograph for Pond 15P: ADS**

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	<b>0.00</b>	<b>0.000</b>	<b>39.59</b>	<b>0.00</b>
0.50	<b>0.00</b>	<b>0.001</b>	<b>39.69</b>	<b>0.02</b>
1.00	0.00	0.000	39.62	0.00
1.50	0.00	0.000	39.61	0.00
2.00	0.00	0.000	39.60	0.00
2.50	0.00	0.000	39.59	0.00
3.00	0.00	0.000	39.59	0.00
3.50	0.00	0.000	39.59	0.00
4.00	0.00	0.000	39.59	0.00
4.50	0.00	0.000	39.59	0.00
5.00	0.00	0.000	39.59	0.00
5.50	0.00	0.000	39.59	0.00
6.00	0.00	0.000	39.59	0.00
6.50	0.00	0.000	39.59	0.00
7.00	0.00	0.000	39.59	0.00
7.50	0.00	0.000	39.59	0.00
8.00	0.00	0.000	39.59	0.00
8.50	0.00	0.000	39.59	0.00
9.00	0.00	0.000	39.59	0.00
9.50	0.00	0.000	39.59	0.00
10.00	0.00	0.000	39.59	0.00
10.50	0.00	0.000	39.59	0.00
11.00	0.00	0.000	39.59	0.00
11.50	0.00	0.000	39.59	0.00
12.00	0.00	0.000	39.59	0.00

### Summary for Pond 18P: ADS #2

Inflow Area = 0.759 ac, 74.55% Impervious, Inflow Depth = 0.10" for 100-Year event  
 Inflow = 0.98 cfs @ 0.08 hrs, Volume= 0.007 af  
 Outflow = 0.91 cfs @ 0.09 hrs, Volume= 0.007 af, Atten= 7%, Lag= 0.6 min  
 Primary = 0.91 cfs @ 0.09 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 42.24' @ 0.09 hrs Surf.Area= 0.006 ac Storage= 0.001 af

Plug-Flow detention time= 1.8 min calculated for 0.007 af (100% of inflow)  
 Center-of-Mass det. time= 1.9 min ( 6.9 - 5.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	41.70'	0.007 af	<b>15.75'W x 17.86'L x 3.75'H Field A</b> 0.024 af Overall - 0.006 af Embedded = 0.018 af x 40.0% Voids
#2A	42.45'	0.006 af	<b>ADS_StormTech DC-780 +Cap</b> x 6 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56"L with 0.44' Overlap 6 Chambers in 3 Rows
		0.014 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	41.70'	<b>12.0" Round Culvert</b> L= 4.5' Ke= 0.015 Inlet / Outlet Invert= 41.70' / 41.68' S= 0.0044 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf

**Primary OutFlow** Max=0.89 cfs @ 0.09 hrs HW=42.24' (Free Discharge)  
 ↑**1=Culvert** (Barrel Controls 0.89 cfs @ 2.99 fps)



### Pond 18P: ADS #2 - Chamber Wizard Field A

**Chamber Model = ADS\_StormTechDC-780 +Cap (ADS StormTech®DC-780 with cap length)**

Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf

Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

2 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 15.86' Row Length +12.0" End Stone x 2 = 17.86' Base Length

3 Rows x 51.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 15.75' Base Width

9.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.75' Field Height

6 Chambers x 46.2 cf = 277.4 cf Chamber Storage

1,054.7 cf Field - 277.4 cf Chambers = 777.2 cf Stone x 40.0% Voids = 310.9 cf Stone Storage

Chamber Storage + Stone Storage = 588.3 cf = 0.014 af

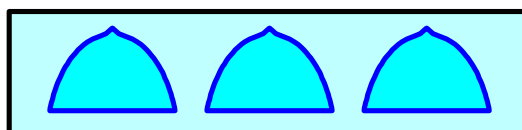
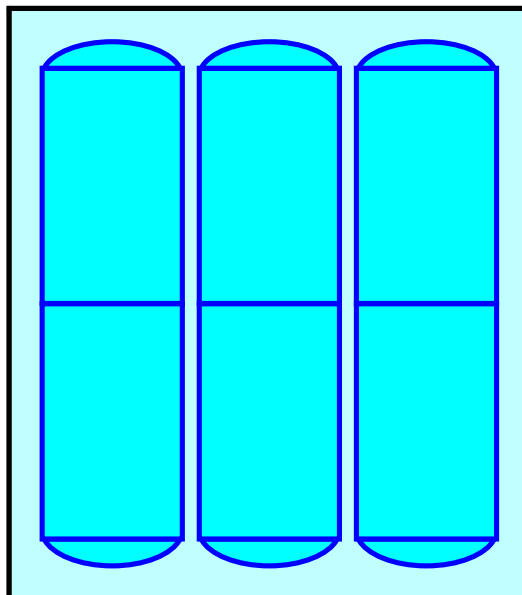
Overall Storage Efficiency = 55.8%

Overall System Size = 17.86' x 15.75' x 3.75'

6 Chambers

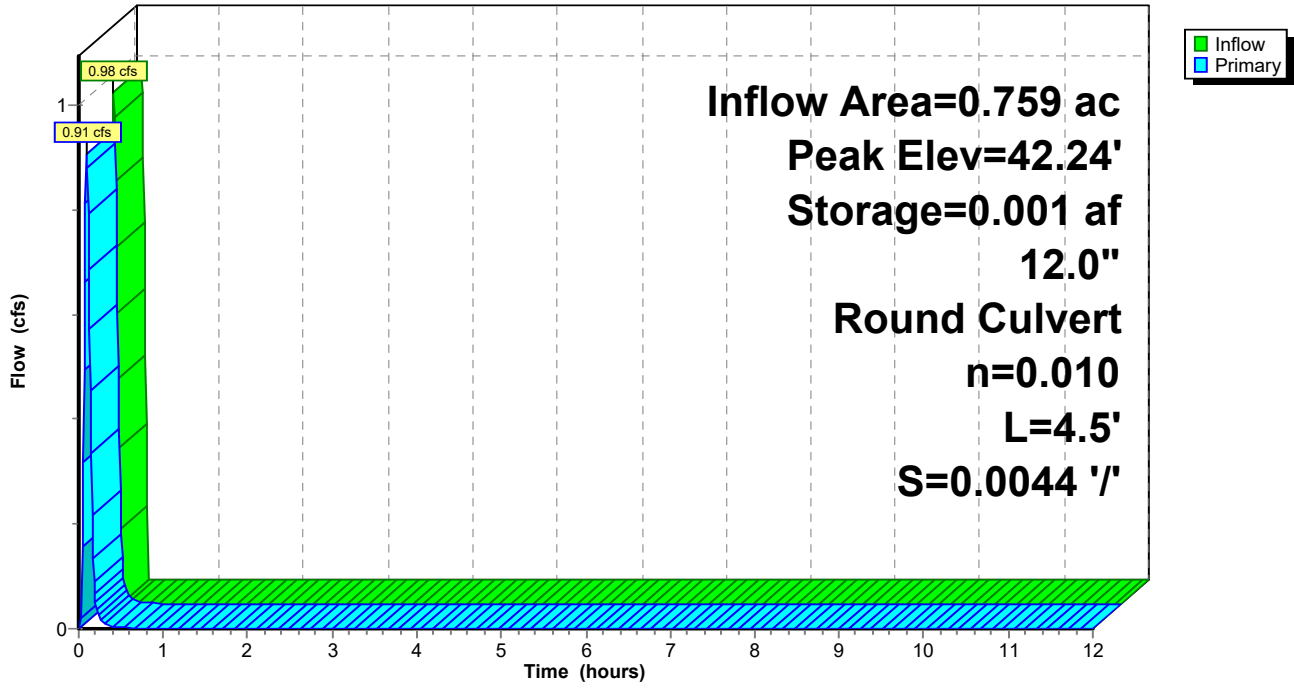
39.1 cy Field

28.8 cy Stone



### Pond 18P: ADS #2

Hydrograph



**Hydrograph for Pond 18P: ADS #2**

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	<b>0.00</b>	<b>0.000</b>	<b>41.70</b>	<b>0.00</b>
0.50	<b>0.00</b>	<b>0.000</b>	<b>41.72</b>	<b>0.00</b>
1.00	0.00	0.000	41.70	0.00
1.50	0.00	0.000	41.70	0.00
2.00	0.00	0.000	41.70	0.00
2.50	0.00	0.000	41.70	0.00
3.00	0.00	0.000	41.70	0.00
3.50	0.00	0.000	41.70	0.00
4.00	0.00	0.000	41.70	0.00
4.50	0.00	0.000	41.70	0.00
5.00	0.00	0.000	41.70	0.00
5.50	0.00	0.000	41.70	0.00
6.00	0.00	0.000	41.70	0.00
6.50	0.00	0.000	41.70	0.00
7.00	0.00	0.000	41.70	0.00
7.50	0.00	0.000	41.70	0.00
8.00	0.00	0.000	41.70	0.00
8.50	0.00	0.000	41.70	0.00
9.00	0.00	0.000	41.70	0.00
9.50	0.00	0.000	41.70	0.00
10.00	0.00	0.000	41.70	0.00
10.50	0.00	0.000	41.70	0.00
11.00	0.00	0.000	41.70	0.00
11.50	0.00	0.000	41.70	0.00
12.00	0.00	0.000	41.70	0.00

### Summary for Pond 19P: Main Street #1

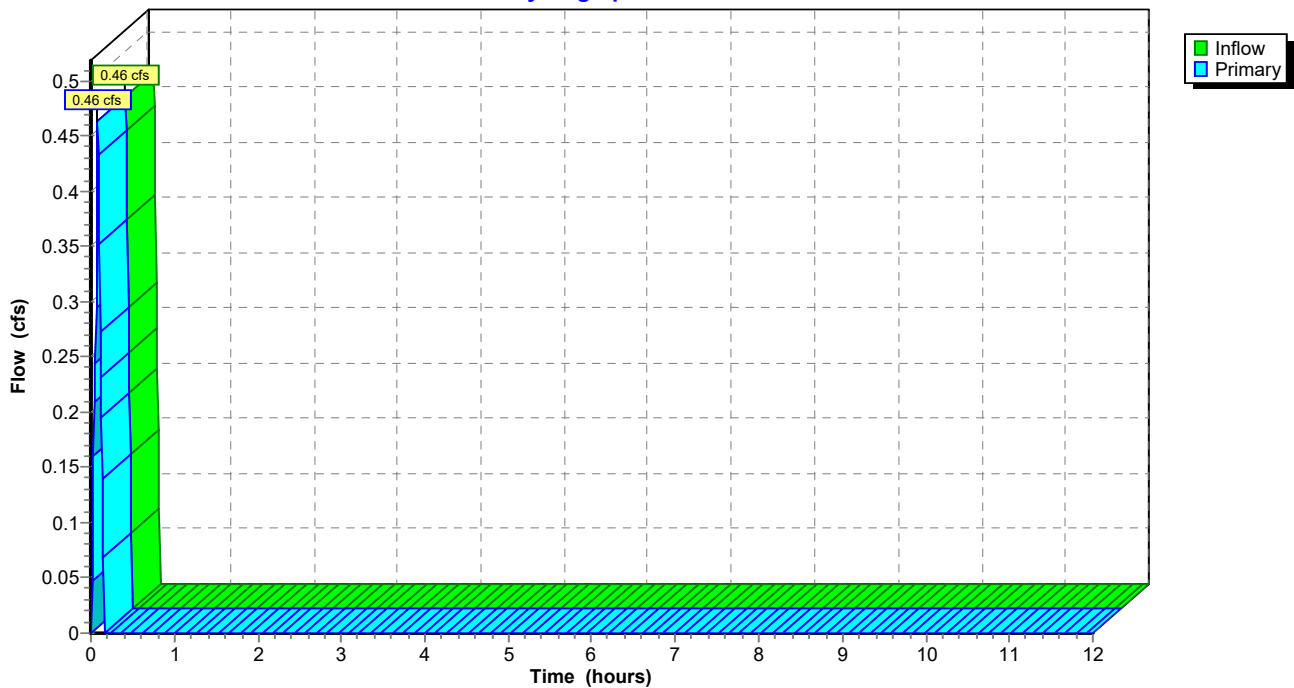
[40] Hint: Not Described (Outflow=Inflow)

Inflow = 0.46 cfs @ 0.08 hrs, Volume= 0.003 af  
Primary = 0.46 cfs @ 0.08 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs

### Pond 19P: Main Street #1

Hydrograph



**Hydrograph for Pond 19P: Main Street #1**

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00		0.00	10.20	0.00		0.00
0.20	0.00		0.00	10.40	0.00		0.00
0.40	0.00		0.00	10.60	0.00		0.00
0.60	0.00		0.00	10.80	0.00		0.00
0.80	0.00		0.00	11.00	0.00		0.00
1.00	0.00		0.00	11.20	0.00		0.00
1.20	0.00		0.00	11.40	0.00		0.00
1.40	0.00		0.00	11.60	0.00		0.00
1.60	0.00		0.00	11.80	0.00		0.00
1.80	0.00		0.00	12.00	0.00		0.00
2.00	0.00		0.00				
2.20	0.00		0.00				
2.40	0.00		0.00				
2.60	0.00		0.00				
2.80	0.00		0.00				
3.00	0.00		0.00				
3.20	0.00		0.00				
3.40	0.00		0.00				
3.60	0.00		0.00				
3.80	0.00		0.00				
4.00	0.00		0.00				
4.20	0.00		0.00				
4.40	0.00		0.00				
4.60	0.00		0.00				
4.80	0.00		0.00				
5.00	0.00		0.00				
5.20	0.00		0.00				
5.40	0.00		0.00				
5.60	0.00		0.00				
5.80	0.00		0.00				
6.00	0.00		0.00				
6.20	0.00		0.00				
6.40	0.00		0.00				
6.60	0.00		0.00				
6.80	0.00		0.00				
7.00	0.00		0.00				
7.20	0.00		0.00				
7.40	0.00		0.00				
7.60	0.00		0.00				
7.80	0.00		0.00				
8.00	0.00		0.00				
8.20	0.00		0.00				
8.40	0.00		0.00				
8.60	0.00		0.00				
8.80	0.00		0.00				
9.00	0.00		0.00				
9.20	0.00		0.00				
9.40	0.00		0.00				
9.60	0.00		0.00				
9.80	0.00		0.00				
10.00	0.00		0.00				

### Summary for Pond 20P: Main Street #2

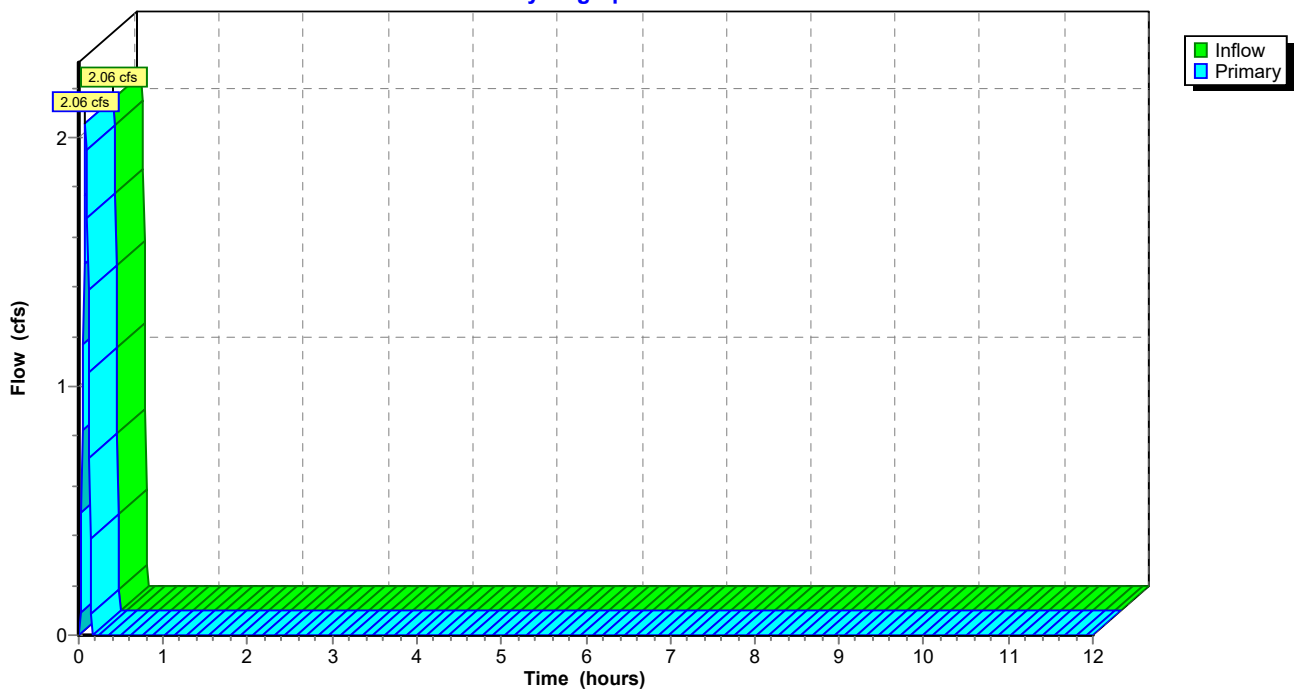
[40] Hint: Not Described (Outflow=Inflow)

Inflow = 2.06 cfs @ 0.08 hrs, Volume= 0.013 af  
Primary = 2.06 cfs @ 0.08 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs

### Pond 20P: Main Street #2

Hydrograph



**Hydrograph for Pond 20P: Main Street #2**

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00		0.00	10.20	0.00		0.00
0.20	0.00		0.00	10.40	0.00		0.00
0.40	0.00		0.00	10.60	0.00		0.00
0.60	0.00		0.00	10.80	0.00		0.00
0.80	0.00		0.00	11.00	0.00		0.00
1.00	0.00		0.00	11.20	0.00		0.00
1.20	0.00		0.00	11.40	0.00		0.00
1.40	0.00		0.00	11.60	0.00		0.00
1.60	0.00		0.00	11.80	0.00		0.00
1.80	0.00		0.00	12.00	0.00		0.00
2.00	0.00		0.00				
2.20	0.00		0.00				
2.40	0.00		0.00				
2.60	0.00		0.00				
2.80	0.00		0.00				
3.00	0.00		0.00				
3.20	0.00		0.00				
3.40	0.00		0.00				
3.60	0.00		0.00				
3.80	0.00		0.00				
4.00	0.00		0.00				
4.20	0.00		0.00				
4.40	0.00		0.00				
4.60	0.00		0.00				
4.80	0.00		0.00				
5.00	0.00		0.00				
5.20	0.00		0.00				
5.40	0.00		0.00				
5.60	0.00		0.00				
5.80	0.00		0.00				
6.00	0.00		0.00				
6.20	0.00		0.00				
6.40	0.00		0.00				
6.60	0.00		0.00				
6.80	0.00		0.00				
7.00	0.00		0.00				
7.20	0.00		0.00				
7.40	0.00		0.00				
7.60	0.00		0.00				
7.80	0.00		0.00				
8.00	0.00		0.00				
8.20	0.00		0.00				
8.40	0.00		0.00				
8.60	0.00		0.00				
8.80	0.00		0.00				
9.00	0.00		0.00				
9.20	0.00		0.00				
9.40	0.00		0.00				
9.60	0.00		0.00				
9.80	0.00		0.00				
10.00	0.00		0.00				

### Summary for Pond 21P: 7th Avenue

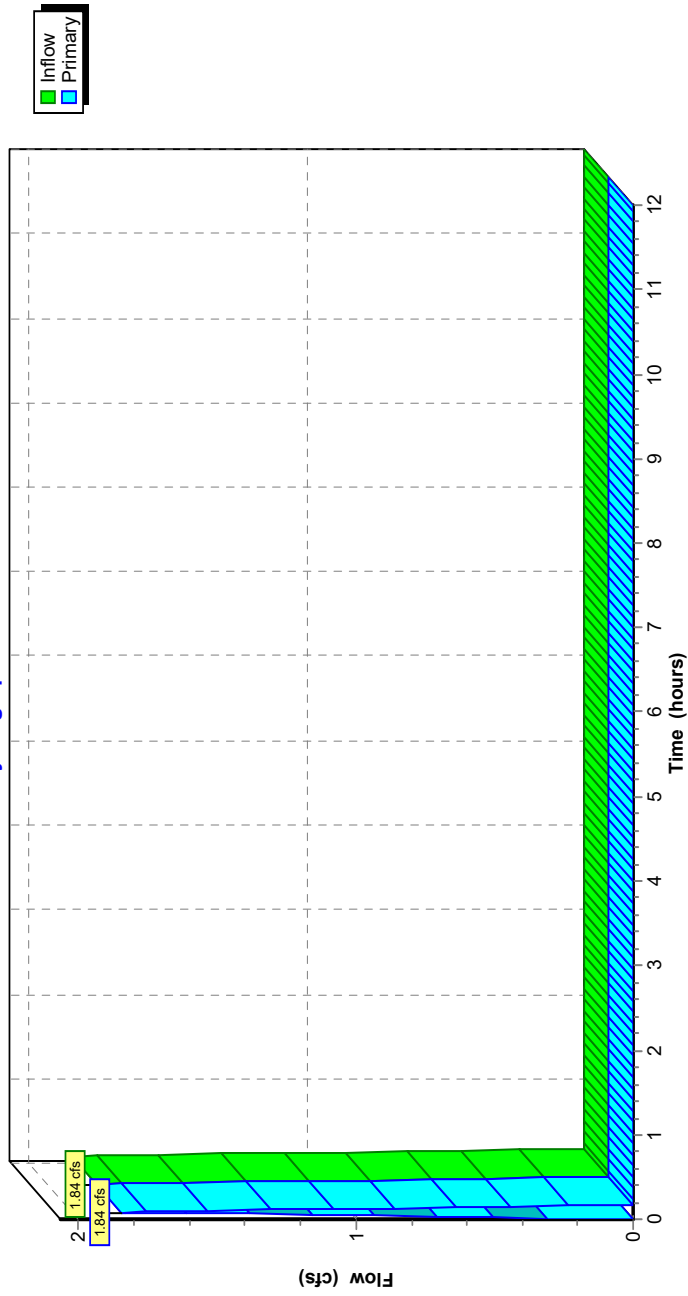
[40] Hint: Not Described (Outflow=Inflow)

Inflow = 1.84 cfs @ 0.08 hrs, Volume= 0.013 af  
Primary = 1.84 cfs @ 0.08 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs

### Pond 21P: 7th Avenue

Hydrograph





**Hydrograph for Pond 21P: 7th Avenue**

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00		0.00	10.20	0.00		0.00
0.20	0.00		0.00	10.40	0.00		0.00
0.40	0.00		0.00	10.60	0.00		0.00
0.60	0.00		0.00	10.80	0.00		0.00
0.80	0.00		0.00	11.00	0.00		0.00
1.00	0.00		0.00	11.20	0.00		0.00
1.20	0.00		0.00	11.40	0.00		0.00
1.40	0.00		0.00	11.60	0.00		0.00
1.60	0.00		0.00	11.80	0.00		0.00
1.80	0.00		0.00	12.00	0.00		0.00
2.00	0.00		0.00				
2.20	0.00		0.00				
2.40	0.00		0.00				
2.60	0.00		0.00				
2.80	0.00		0.00				
3.00	0.00		0.00				
3.20	0.00		0.00				
3.40	0.00		0.00				
3.60	0.00		0.00				
3.80	0.00		0.00				
4.00	0.00		0.00				
4.20	0.00		0.00				
4.40	0.00		0.00				
4.60	0.00		0.00				
4.80	0.00		0.00				
5.00	0.00		0.00				
5.20	0.00		0.00				
5.40	0.00		0.00				
5.60	0.00		0.00				
5.80	0.00		0.00				
6.00	0.00		0.00				
6.20	0.00		0.00				
6.40	0.00		0.00				
6.60	0.00		0.00				
6.80	0.00		0.00				
7.00	0.00		0.00				
7.20	0.00		0.00				
7.40	0.00		0.00				
7.60	0.00		0.00				
7.80	0.00		0.00				
8.00	0.00		0.00				
8.20	0.00		0.00				
8.40	0.00		0.00				
8.60	0.00		0.00				
8.80	0.00		0.00				
9.00	0.00		0.00				
9.20	0.00		0.00				
9.40	0.00		0.00				
9.60	0.00		0.00				
9.80	0.00		0.00				
10.00	0.00		0.00				

**Summary for Pond 22P: Drywell**

Inflow Area = 0.828 ac, 79.00% Impervious, Inflow Depth = 0.10" for 100-Year event  
 Inflow = 0.31 cfs @ 0.16 hrs, Volume= 0.007 af  
 Outflow = 0.02 cfs @ 0.54 hrs, Volume= 0.007 af, Atten= 94%, Lag= 22.8 min  
 Discarded = 0.02 cfs @ 0.54 hrs, Volume= 0.007 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 38.97' @ 0.54 hrs Surf.Area= 0.001 ac Storage= 0.006 af

Plug-Flow detention time= 160.8 min calculated for 0.007 af (100% of inflow)  
 Center-of-Mass det. time= 160.8 min ( 176.9 - 16.1 )

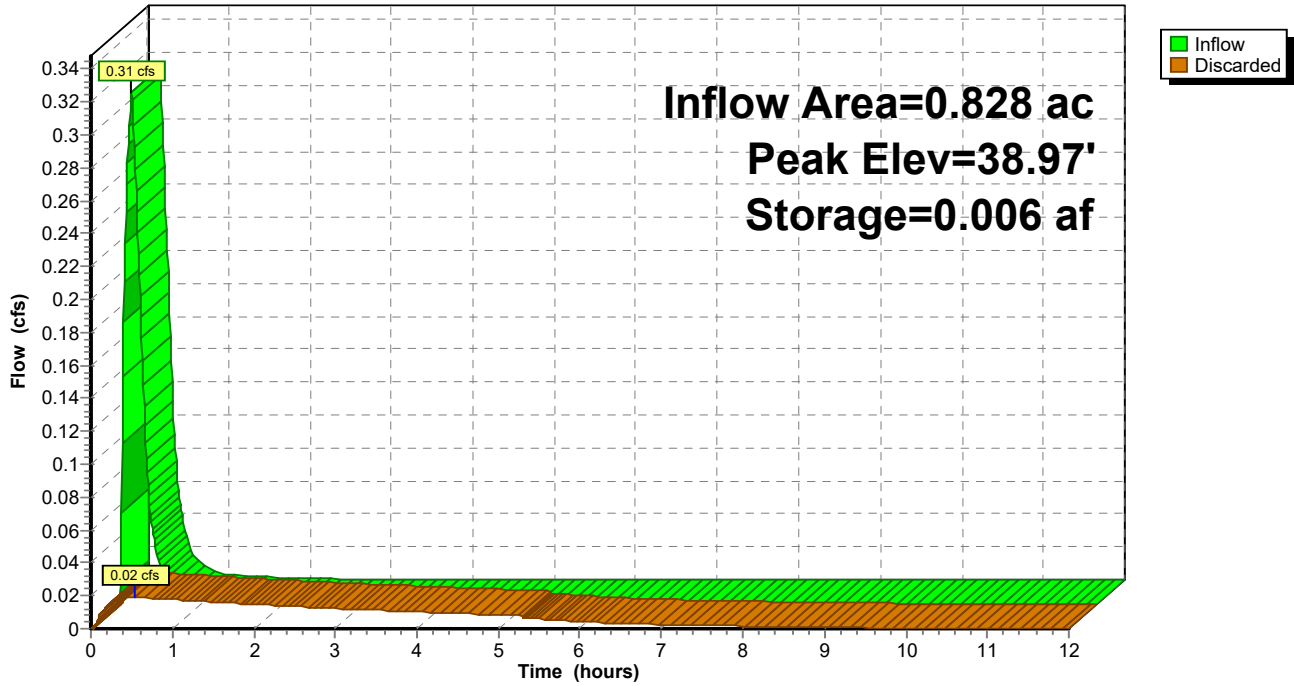
Volume	Invert	Avail.Storage	Storage Description
#1	23.27'	0.001 af	<b>4.00'D x 8.00'H Vertical Cone/Cylinder</b> 0.002 af Overall x 40.0% Voids
#2	31.27'	0.011 af	<b>6.00'D x 18.00'H Vertical Cone/Cylinder</b> 0.012 af Overall x 92.0% Voids
		0.012 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	23.27'	<b>2.150 in/hr Exfiltration over Wetted area from 23.00' - 41.27'</b> Conductivity to Groundwater Elevation = 5.00' Excluded Wetted area = 0.000 ac

**Discarded OutFlow** Max=0.02 cfs @ 0.54 hrs HW=38.97' (Free Discharge)  
 ↑1=Exfiltration ( Controls 0.02 cfs)

### Pond 22P: Drywell

Hydrograph



### Hydrograph for Pond 22P: Drywell

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
0.00	<b>0.00</b>	0.000	23.27	0.00
0.50	<b>0.02</b>	<b>0.006</b>	<b>38.96</b>	<b>0.02</b>
1.00	0.00	<b>0.005</b>	<b>38.30</b>	<b>0.02</b>
1.50	0.00	0.005	37.27	0.02
2.00	0.00	0.004	36.27	0.01
2.50	0.00	0.003	35.33	0.01
3.00	0.00	0.003	34.45	0.01
3.50	0.00	0.002	33.64	0.01
4.00	0.00	0.002	32.90	0.01
4.50	0.00	0.001	32.22	0.01
5.00	0.00	0.001	31.59	0.01
5.50	0.00	0.001	30.24	0.01
6.00	0.00	0.001	28.40	0.00
6.50	0.00	0.000	27.03	0.00
7.00	0.00	0.000	25.99	0.00
7.50	0.00	0.000	25.19	0.00
8.00	0.00	0.000	24.58	0.00
8.50	0.00	0.000	24.10	0.00
9.00	0.00	0.000	23.72	0.00
9.50	0.00	0.000	23.44	0.00
10.00	0.00	0.000	23.33	0.00
10.50	0.00	0.000	23.29	0.00
11.00	0.00	0.000	23.28	0.00
11.50	0.00	0.000	23.27	0.00
12.00	0.00	0.000	23.27	0.00

### Summary for Pond 24P: Catch Basin

[57] Hint: Peaked at 48.44' (Flood elevation advised)

Inflow Area = 0.828 ac, 79.00% Impervious, Inflow Depth = 0.32" for 100-Year event  
 Inflow = 3.11 cfs @ 0.08 hrs, Volume= 0.022 af  
 Outflow = 3.11 cfs @ 0.08 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min  
 Primary = 0.59 cfs @ 0.08 hrs, Volume= 0.007 af  
 Secondary = 0.46 cfs @ 0.08 hrs, Volume= 0.003 af  
 Tertiary = 2.06 cfs @ 0.08 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 48.44' @ 0.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Secondary	47.50'	<b>4.0" Round Culvert</b> L= 34.5' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 47.50' / 44.40' S= 0.0899 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf
#2	Tertiary	47.61'	<b>24.0" W x 3.0" H Box Culvert</b> L= 32.3' Ke= 0.150 Inlet / Outlet Invert= 47.61' / 47.22' S= 0.0121 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.50 sf
#3	Primary	45.60'	<b>4.0" Round Culvert</b> L= 19.3' Ke= 0.500 Inlet / Outlet Invert= 45.60' / 45.50' S= 0.0052 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf

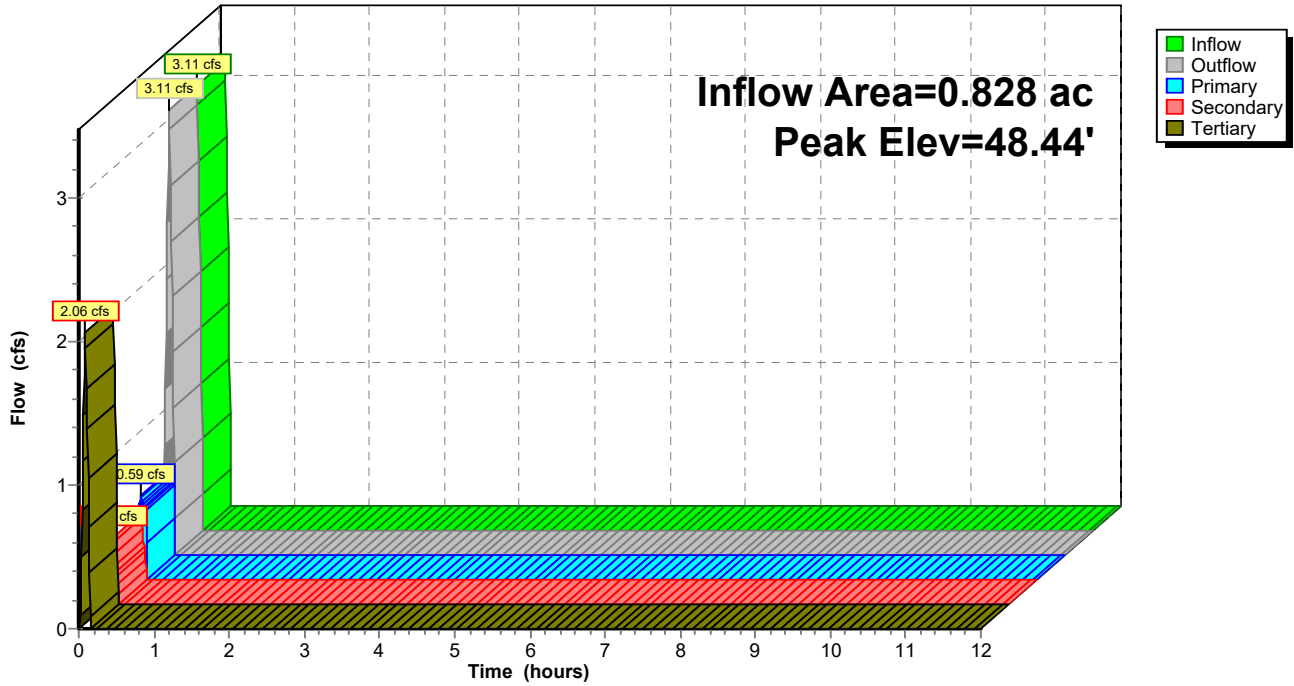
**Primary OutFlow** Max=0.58 cfs @ 0.08 hrs HW=48.41' (Free Discharge)  
 ↑**3=Culvert** (Barrel Controls 0.58 cfs @ 6.67 fps)

**Secondary OutFlow** Max=0.45 cfs @ 0.08 hrs HW=48.41' (Free Discharge)  
 ↑**1=Culvert** (Inlet Controls 0.45 cfs @ 5.19 fps)

**Tertiary OutFlow** Max=2.03 cfs @ 0.08 hrs HW=48.41' (Free Discharge)  
 ↑**2=Culvert** (Barrel Controls 2.03 cfs @ 4.05 fps)

### Pond 24P: Catch Basin

Hydrograph



### Hydrograph for Pond 24P: Catch Basin

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Tertiary (cfs)
0.00	<b>0.00</b>	<b>45.60</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
0.50	<b>0.00</b>	<b>45.60</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1.00	0.00	45.60	0.00	0.00	0.00	0.00
1.50	0.00	45.60	0.00	0.00	0.00	0.00
2.00	0.00	45.60	0.00	0.00	0.00	0.00
2.50	0.00	45.60	0.00	0.00	0.00	0.00
3.00	0.00	45.60	0.00	0.00	0.00	0.00
3.50	0.00	45.60	0.00	0.00	0.00	0.00
4.00	0.00	45.60	0.00	0.00	0.00	0.00
4.50	0.00	45.60	0.00	0.00	0.00	0.00
5.00	0.00	45.60	0.00	0.00	0.00	0.00
5.50	0.00	45.60	0.00	0.00	0.00	0.00
6.00	0.00	45.60	0.00	0.00	0.00	0.00
6.50	0.00	45.60	0.00	0.00	0.00	0.00
7.00	0.00	45.60	0.00	0.00	0.00	0.00
7.50	0.00	45.60	0.00	0.00	0.00	0.00
8.00	0.00	45.60	0.00	0.00	0.00	0.00
8.50	0.00	45.60	0.00	0.00	0.00	0.00
9.00	0.00	45.60	0.00	0.00	0.00	0.00
9.50	0.00	45.60	0.00	0.00	0.00	0.00
10.00	0.00	45.60	0.00	0.00	0.00	0.00
10.50	0.00	45.60	0.00	0.00	0.00	0.00
11.00	0.00	45.60	0.00	0.00	0.00	0.00
11.50	0.00	45.60	0.00	0.00	0.00	0.00
12.00	0.00	45.60	0.00	0.00	0.00	0.00

### Summary for Pond 25P: Drywell #2

[42] Hint: Gap in defined storage above volume #1 at 39.10'  
 [81] Warning: Exceeded Pond 18P by 8.79' @ 0.73 hrs

Inflow Area = 0.759 ac, 74.55% Impervious, Inflow Depth = 0.10" for 100-Year event  
 Inflow = 0.91 cfs @ 0.09 hrs, Volume= 0.007 af  
 Outflow = 0.00 cfs @ 0.68 hrs, Volume= 0.001 af, Atten= 100%, Lag= 35.0 min  
 Discarded = 0.00 cfs @ 0.68 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 50.50' @ 0.68 hrs Surf.Area= 0.001 ac Storage= 0.007 af

Plug-Flow detention time= 356.3 min calculated for 0.001 af (19% of inflow)  
 Center-of-Mass det. time= 352.9 min ( 359.8 - 6.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	31.10'	0.001 af	<b>4.00'D x 8.00'H Vertical Cone/Cylinder</b> 0.002 af Overall x 40.0% Voids
#2	41.10'	0.011 af	<b>6.00'D x 18.00'H Vertical Cone/Cylinder</b> 0.012 af Overall x 92.0% Voids
		0.012 af	Total Available Storage

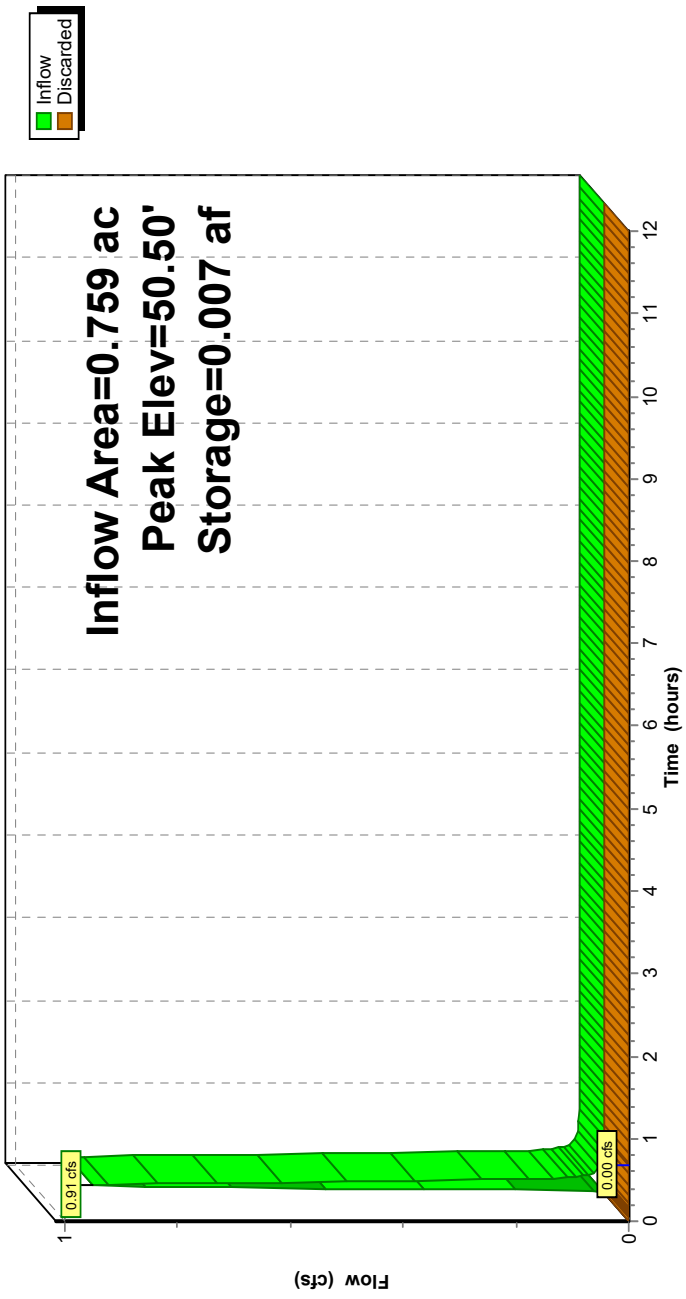
Device	Routing	Invert	Outlet Devices
#1	Discarded	31.10'	<b>1.650 in/hr Exfiltration over Surface area from 31.10' - 41.10'</b> Conductivity to Groundwater Elevation = 1.00' Excluded Surface area = 0.000 ac

**Discarded OutFlow** Max=0.00 cfs @ 0.68 hrs HW=50.50' (Free Discharge)  
 ↑1=Exfiltration ( Controls 0.00 cfs)



### Pond 25P: Drywell #2

Hydrograph



### Hydrograph for Pond 25P: Drywell #2

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Discarded (cfs)
0.00	<b>0.00</b>	0.000	31.10	0.00
0.50	<b>0.00</b>	<b>0.007</b>	<b>50.49</b>	<b>0.00</b>
1.00	0.00	<b>0.007</b>	<b>50.48</b>	<b>0.00</b>
1.50	0.00	0.006	50.40	0.00
2.00	0.00	0.006	50.31	0.00
2.50	0.00	0.006	50.22	0.00
3.00	0.00	0.006	50.12	0.00
3.50	0.00	0.006	50.03	0.00
4.00	0.00	0.006	49.94	0.00
4.50	0.00	0.006	49.85	0.00
5.00	0.00	0.006	49.76	0.00
5.50	0.00	0.006	49.67	0.00
6.00	0.00	0.006	49.58	0.00
6.50	0.00	0.006	49.49	0.00
7.00	0.00	0.006	49.40	0.00
7.50	0.00	0.006	49.31	0.00
8.00	0.00	0.006	49.22	0.00
8.50	0.00	0.006	49.13	0.00
9.00	0.00	0.006	49.04	0.00
9.50	0.00	0.006	48.95	0.00
10.00	0.00	0.006	48.86	0.00
10.50	0.00	0.006	48.77	0.00
11.00	0.00	0.005	48.68	0.00
11.50	0.00	0.005	48.59	0.00
12.00	0.00	0.005	48.50	0.00

### Summary for Pond 26P: Catch Basin

[57] Hint: Peaked at 66.36' (Flood elevation advised)

Inflow Area = 0.759 ac, 74.55% Impervious, Inflow Depth = 0.32" for 100-Year event  
 Inflow = 2.82 cfs @ 0.08 hrs, Volume= 0.020 af  
 Outflow = 2.82 cfs @ 0.08 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min  
 Primary = 0.98 cfs @ 0.08 hrs, Volume= 0.007 af  
 Tertiary = 1.84 cfs @ 0.08 hrs, Volume= 0.013 af

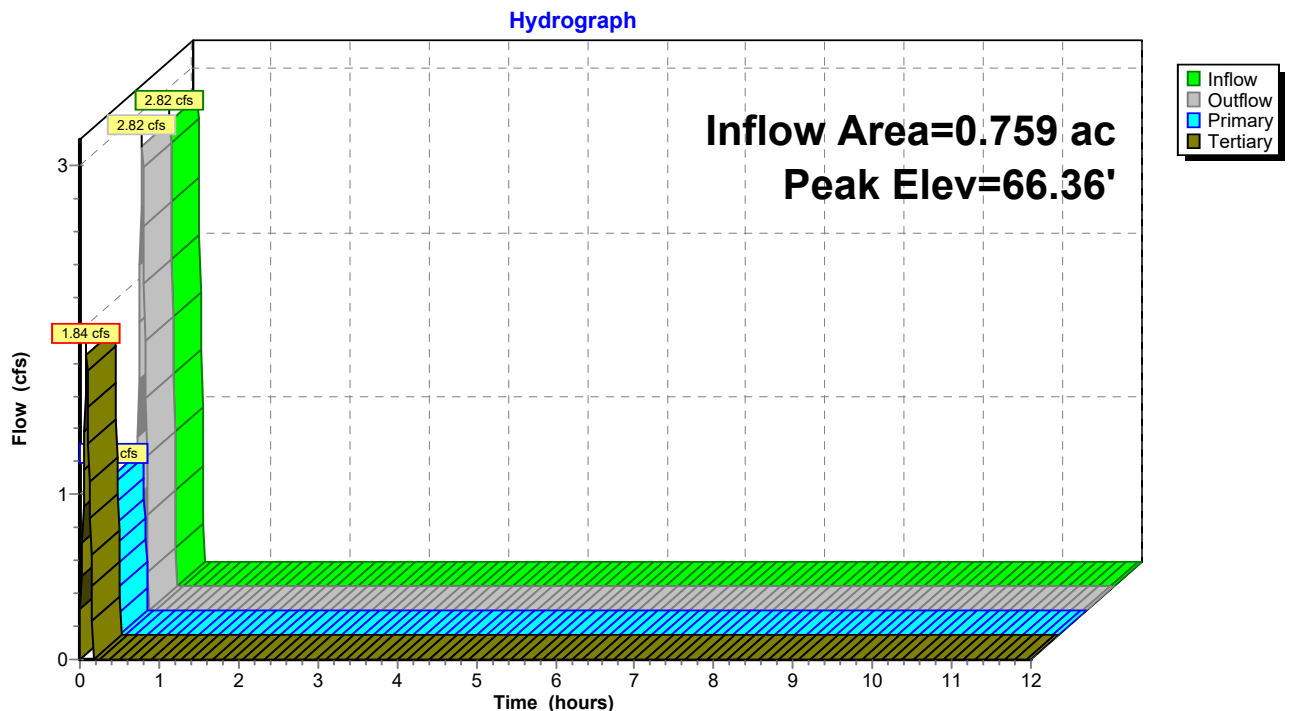
Routing by Stor-Ind method, Time Span= 0.00-12.00 hrs, dt= 0.01 hrs  
 Peak Elev= 66.36' @ 0.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	45.50'	<b>4.0" Round Culvert</b> L= 120.6' Ke= 0.500 Inlet / Outlet Invert= 45.50' / 44.29' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf
#2	Tertiary	44.91'	<b>12.0" Round Culvert</b> L= 97.4' Ke= 0.500 Inlet / Outlet Invert= 44.91' / 42.96' S= 0.0200 '/' Cc= 0.900 n= 0.120, Flow Area= 0.79 sf

**Primary OutFlow** Max=0.96 cfs @ 0.08 hrs HW=65.71' (Free Discharge)  
 ↳1=Culvert (Barrel Controls 0.96 cfs @ 11.02 fps)

**Tertiary OutFlow** Max=1.82 cfs @ 0.08 hrs HW=65.71' (Free Discharge)  
 ↳2=Culvert (Barrel Controls 1.82 cfs @ 2.31 fps)

### Pond 26P: Catch Basin



**Hydrograph for Pond 26P: Catch Basin**

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Primary (cfs)	Tertiary (cfs)
0.00	<b>0.00</b>	<b>44.91</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
0.50	<b>0.00</b>	<b>44.91</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
1.00	0.00	44.91	0.00	0.00	0.00
1.50	0.00	44.91	0.00	0.00	0.00
2.00	0.00	44.91	0.00	0.00	0.00
2.50	0.00	44.91	0.00	0.00	0.00
3.00	0.00	44.91	0.00	0.00	0.00
3.50	0.00	44.91	0.00	0.00	0.00
4.00	0.00	44.91	0.00	0.00	0.00
4.50	0.00	44.91	0.00	0.00	0.00
5.00	0.00	44.91	0.00	0.00	0.00
5.50	0.00	44.91	0.00	0.00	0.00
6.00	0.00	44.91	0.00	0.00	0.00
6.50	0.00	44.91	0.00	0.00	0.00
7.00	0.00	44.91	0.00	0.00	0.00
7.50	0.00	44.91	0.00	0.00	0.00
8.00	0.00	44.91	0.00	0.00	0.00
8.50	0.00	44.91	0.00	0.00	0.00
9.00	0.00	44.91	0.00	0.00	0.00
9.50	0.00	44.91	0.00	0.00	0.00
10.00	0.00	44.91	0.00	0.00	0.00
10.50	0.00	44.91	0.00	0.00	0.00
11.00	0.00	44.91	0.00	0.00	0.00
11.50	0.00	44.91	0.00	0.00	0.00
12.00	0.00	44.91	0.00	0.00	0.00

## User Inputs

<b>Chamber Model:</b>	DC-780
<b>Outlet Control Structure:</b>	No
<b>Project Name:</b>	Mcdonalds
<b>Engineer:</b>	Nadia Manzur n/a
<b>Project Location:</b>	California
<b>Measurement Type:</b>	Imperial
<b>Required Storage Volume:</b>	1413 cubic ft.
<b>Stone Porosity:</b>	40%
<b>Stone Foundation Depth:</b>	9 in.
<b>Stone Above Chambers:</b>	6 in.
<b>Design Constraint Dimensions:</b>	(20 ft. x 45 ft.)

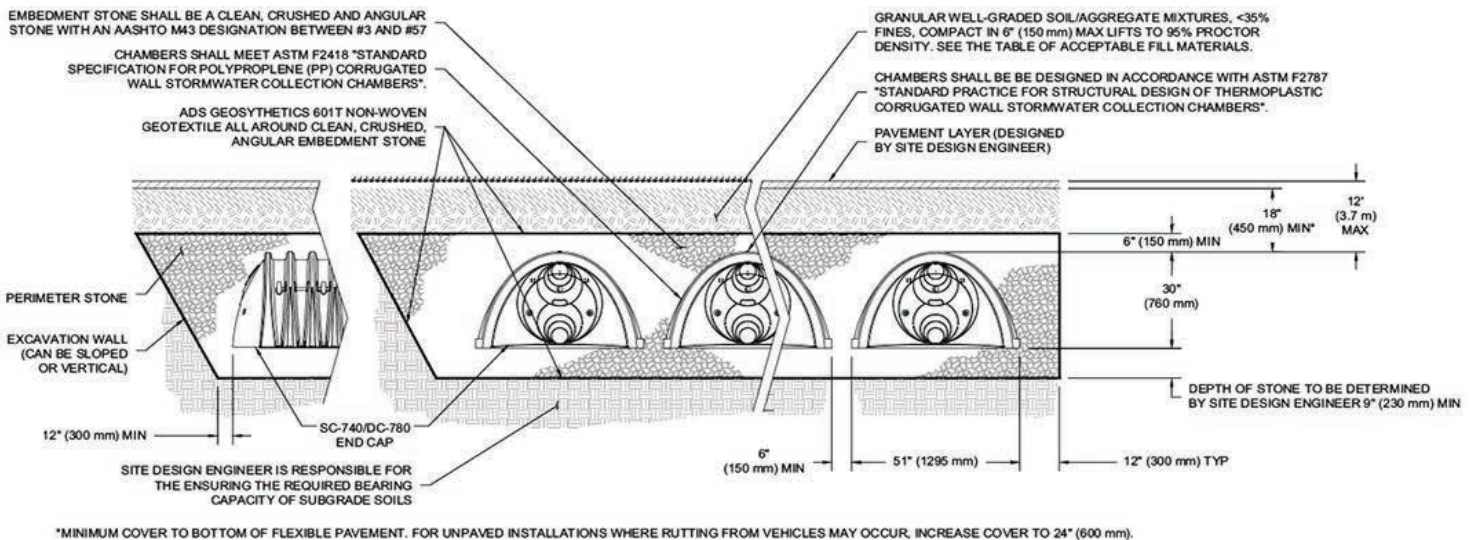
## Results

### System Volume and Bed Size

<b>Installed Storage Volume:</b>	1443.74 cubic ft.
<b>Storage Volume Per Chamber:</b>	46.20 cubic ft.
<b>Number Of Chambers Required:</b>	15
<b>Number Of End Caps Required:</b>	6
<b>Chamber Rows:</b>	3
<b>Maximum Length:</b>	43.11 ft.
<b>Maximum Width:</b>	15.75 ft.
<b>Approx. Bed Size Required:</b>	679.05 square ft.
<b>Average Cover Over Chambers:</b>	N/A .

### System Components

<b>Amount Of Stone Required:</b>	69 cubic yards
<b>Volume Of Excavation (Not Including Fill):</b>	95 cubic yards
<b>Total Non-woven Geotextile Required:</b>	240 square yards
<b>Woven Geotextile Required (excluding Isolator Row):</b>	21 square yards
<b>Woven Geotextile Required (Isolator Row):</b>	25 square yards
<b>Total Woven Geotextile Required:</b>	46 square yards
<b>Impervious Liner Required:</b>	0 square yards



## User Inputs

<b>Chamber Model:</b>	DC-780
<b>Outlet Control Structure:</b>	No
<b>Project Name:</b>	Starbucks
<b>Engineer:</b>	Nadia Manzur n/a
<b>Project Location:</b>	California
<b>Measurement Type:</b>	Imperial
<b>Required Storage Volume:</b>	915 cubic ft.
<b>Stone Porosity:</b>	40%
<b>Stone Foundation Depth:</b>	9 in.
<b>Stone Above Chambers:</b>	6 in.
<b>Design Constraint Dimensions:</b>	(20 ft. x 30 ft.)

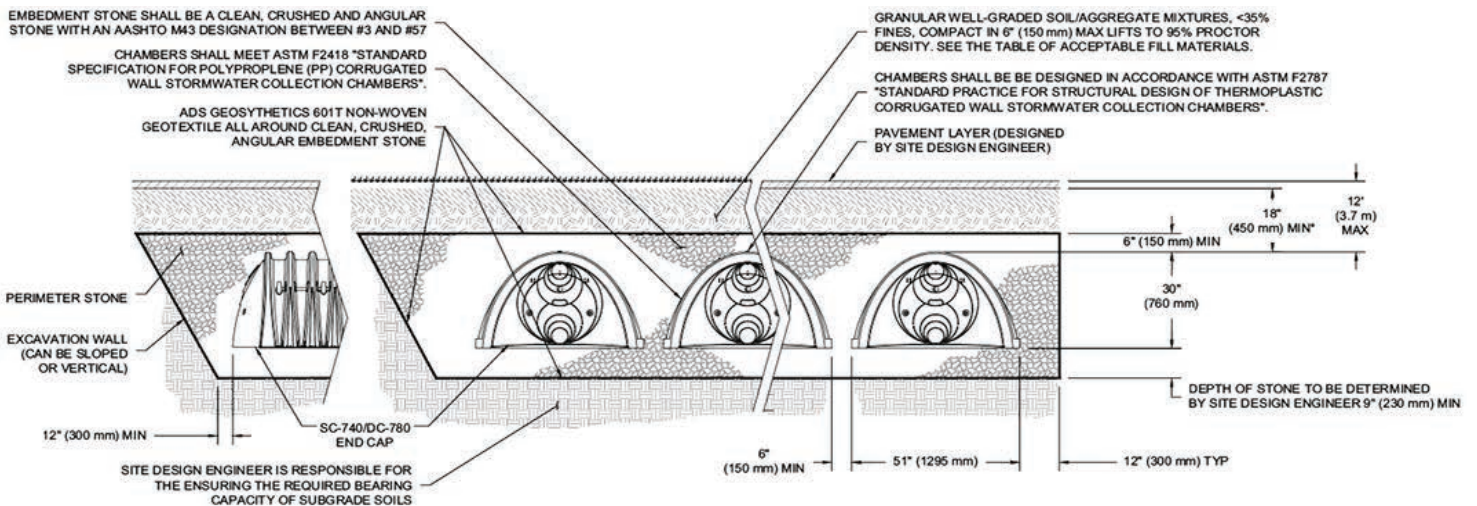
## Results

### System Volume and Bed Size

<b>Installed Storage Volume:</b>	941.16 cubic ft.
<b>Storage Volume Per Chamber:</b>	46.20 cubic ft.
<b>Number Of Chambers Required:</b>	9
<b>Number Of End Caps Required:</b>	6
<b>Chamber Rows:</b>	3
<b>Maximum Length:</b>	28.88 ft.
<b>Maximum Width:</b>	15.75 ft.
<b>Approx. Bed Size Required:</b>	454.88 square ft.
<b>Average Cover Over Chambers:</b>	N/A .

### System Components

<b>Amount Of Stone Required:</b>	48 cubic yards
<b>Volume Of Excavation (Not Including Fill):</b>	64 cubic yards
<b>Total Non-woven Geotextile Required:</b>	166 square yards
<b>Woven Geotextile Required (excluding Isolator Row):</b>	21 square yards
<b>Woven Geotextile Required (Isolator Row):</b>	16 square yards
<b>Total Woven Geotextile Required:</b>	37 square yards
<b>Impervious Liner Required:</b>	0 square yards



\*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

## Infiltration LID BMP – Dry wells

<sup>1</sup> $V_{ret} = (P_{design}/12 * SA_{inf} * T_{fill}) + (SA_{reservoir} * d_{resevoir} * n_{aggregate}) = X_1 + X_2$		
BMP Type	DMA A	DMA B
<sup>2</sup> Design capture Volume, DCV (ft <sup>3</sup> ) See Form 4.21 Item 7	1,788	1,239
<sup>3</sup> Infiltration Rate of underlying soils (in/hr)	4.3	3.3
<sup>4</sup> Infiltration Safety Factor See TGD section 5.4.2 and Appendix D	2	2
<sup>5</sup> Design percolation rate (in/hr) $P_{Design} = \text{Item 2} / \text{item 3}$	2.15	1.65
<sup>6</sup> $SA_{inf, res} =$ surface area (ft <sup>2</sup> ) for drywell	301.6	301.6
<sup>7</sup> Duration of storm when infiltration is occurring as basin is filling (hrs) ; $T_{fill}$ (default is 3 hours)	3	3
<sup>8</sup> Drawdown time for stored runoff (hrs); $T_{drawdown}$ (default is 48 hours)	48	48
<sup>9</sup> $X_1 =$ total infiltrating volume after 3 hrs (cf)	162.10	124.40
<sup>10</sup> Depth (ft) of Drywell	16	16
<sup>11</sup> Porosity of Aggregate, if none then 1.0	0.4	0.4
<sup>12</sup> $X_2 =$ Maximum volume of drywell (cf)	213	213
<sup>13</sup> Total Volume of Drywell, $V_{ret}$ (cf) = item 9 + item 12	375	337.4
<sup>14</sup> Minimum Retention Volume = Item 2 – item 9	1,626	1,114
<sup>15</sup> Additional storage volume required= Item 14- item 12	1,413	902
<sup>16</sup> Underground Retention Volume (ft <sup>3</sup> ), ADS Stormtech System	1,444	941
<sup>16</sup> Design Drawdown Time for stored runoff (hrs), $T_{design} = (\text{Item 14}) / (\text{Item 6} * (\text{Item 5})/12)$	30	27

