VISTA VALLEY COUNTRY CLUB
VISTA CA 92084

HYDROLOGY AND HYDRAULIC STUDY

PERMIT NUMBER: PDS2014-MUP-14-021
PDS2014-VAC-14-002
PDS2014-ER-14-08-008

FOR

VISTA VALLEY
POOL CENTER PROJECT
VISTA VALLEY DRIVE
VISTA, CA 92084

SAN DIEGO COUNTY, CALIFORNIA

PREPARED
May 15, 2014
REVISION(S):
1. July 28, 2014
2. September 15, 2014

PREPARED BY:

EXCEL ENGINEERING

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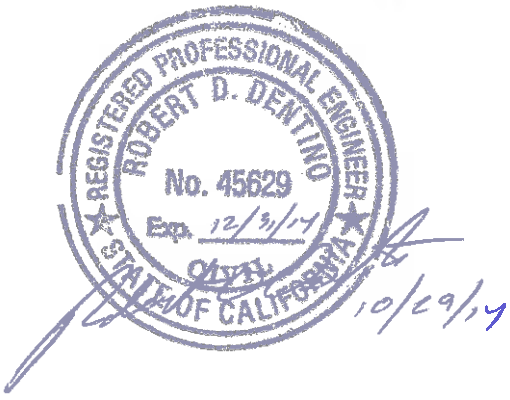

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HYDROLOGY / HYDRAULICS STUDY

1.0 Objective

The objective of this study is to establish pre-developed and post developed drainage flows and characteristics as a result of the proposed pool center. Data collected by this study was used to analyze impacts the proposed project may have on existing drainage facilities and watercourses. The study further calculates sizes for proposed private drainage structures including catch basins and drainage pipes.

2.0 Project Description

The Vista Valley Pool Center project site is located in north San Diego County just south of Gopher Canyon Road *(Please see vicinity map in appendix A)*. The site is particularly situated at the intersection of Vista Valley Drive and Hoxie Ranch Road, which is currently an unused portion of a private road easement. The site is further identified as APN 170-271-24, a Portion of APN 170-271-23 and a Portion of APN 170-191-07.

The site improvements consist of removing existing buildings and asphalt along an existing cut pad in the site slope to accommodate the proposed pool center. There will be a driveway leading up to the parking lot from Vista Valley Drive. Buildings for the pool center and the pool will sit at the top of a raised pad. The pad is sited where the existing buildings are now.

From a field investigation and the use of a property profile map using the County's Land Use & Environment Group program (LUEG) no environmentally sensitive areas have been identified within 100 feet of the proposed Pool Center. A Biology report has been submitted which discusses the environmental impacts associated with this project. Also, the project site is not inside any flood zone according to the FEMA flood map for this area.

The overall project is 9.88 acres. The Pool Center property is a mostly rectangular 9.55 acres and ranges from about 730 feet Mean Sea Level (MSL), at the east side of the project, to about 430 feet (MSL) at the west side of the project. In addition to the Pool site there is a proposed Open Space Vacation area of 0.33 acres. Topographically, the site drains from the east to west at about a 50 percent grade above the existing buildings. Below the existing buildings, the site slope lessens and drains at about a 20 percent grade. Because the project site is out of any flood boundary and is positioned relatively high on the drainage basin, flooding is not anticipated.

Aside from the buildings which will be removed for the Pool Center, there is an existing residence that is located in the northwesterly portion of the property. This residence is proposed to remain in place as a caretaker/staff residence. It is physically separated from the portion of the property with the proposed pool center by an existing drainage course which drains westerly towards an unimproved portion of the Hoxie Ranch Road easement and the existing brow ditches just offsite to the west.

Currently runoff is captured by a system of brow ditches located at the south and west side of the property. The site is located on a hillside, where the storm water runoff flows overland from the hilltop on the east to the existing brow ditches on the west and south. To the east and above the existing buildings and road, the landscaping is undisturbed and consists of the natural vegetation. West and downhill, the grade is not as steep and the landscaping is maintained. Trees and grass

line the Vista Valley Drive and the private road easement. The existing brow ditches eventually join near the intersection of Hoxie Ranch Road and Vista Valley Drive near the south west corner of the site. The runoff then continues to flow down an existing brow ditch which parallels Vista Valley Drive for about 280 feet and enters an existing storm drain system inlet.

The proposed Pool Center, will create a disturbed area of approximately 2.0 acres. The Center proposes a raised platform containing the pool deck and support buildings. The platform will be sited along the existing cut pad where the structures will be removed. A parking lot containing 37 parking spaces will be constructed adjacent to and slightly below grade from the pool deck. The pool deck will be accessed via a stairway. An elevator will provide ADA access. The Pool Center grading is designed to follow the contour of the existing underlying land form. The parking lot will access from Vista Valley Drive. All runoff from the pool deck and parking lot will be directed to water quality, bio-retention ponds which will function as the primary treatment control BMP and hydromodification control facilities. A separate report will be submitted for the discussion of water quality and hydromodification.

Once completed the Pool Center will treat and release all runoff into the same tributary basins that were shown in the pre development conditions scenario. The treated and attenuated flows will be directed to the same facilities as in the pre developed scenario. Since the drainage flows will be lessened from the pre development condition, there is no need to upsize the existing offsite facilities (brow ditches).

3.0 Methodology

Peak runoff was calculated in accordance with the San Diego County Hydrology Manual, 2003. Because the area of study is less than one square mile (+/- 10 acres), the rational method was used. Peak run off for the 100-year event was calculated at node 4 for the pre development condition, which is the same location as node 8 in the post development scenario. Appendix B contains tables, figures and graphs from the Hydrology Manual used for reference in this study.

C values for pre and post conditions were calculated based percentage of impervious area for each sub-basin. A summary table for the calculation of “C” can be found in Appendix H.

4.0 Hydrology Software

The “Rational Hydrology Method, San Diego County (2003 Manual)” module of the CIVILCADD/CIVIL DESIGN engineering software version 7.4 is used in this study. Because the program limits how C values are entered, soil types and land uses were manipulated to yield the proper value.

Output data for the pre and post developed studies can be found in Appendix C & D respectively.

5.0 Conclusion / Summary

A comparison of 100- year peak flows for pre-developed and post developed conditions was made. The proposed project does not substantially alter the existing drainage patterns on or downstream of the site. This is largely due to existing brow ditches just offsite and almost adjacent to the southerly and westerly boundaries, which serve to collect and convey all runoff generated from the project.

The common point of comparisons are at node 4 and node 9(pre development) or node 24 (post-development. The Post developed peak runoff was reduced by use of a private drainage system and several water quality/hydromodification ponds situated around the parking lot. These ponds effectively increased time of concentration in the post development scenario thereby attenuating flows. All of the connections to the offsite drainage facilities have been designed as "hard" connections to lessen the possibility of erosion. For outlets where a hard connection could not be designed, a rip rap pad was placed to dissipate energy and lessen erosion potential.

The proposed project will not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage system since there is no peak discharge increase. The peak flow increase was mitigated through detention and longer runoff travel path.

For a direct comparison of Pre Development vs Post Development flows, the most appropriate place is the existing brow ditch near the Southwest corner of the site. As shown on the Pre development Basin Map and the Post Development Basin Map, all basins confluence at Node #4, where an existing brow ditch collects runoff and directs it down the side of Vista Valley Drive. About 280 ft further down Vista Valley Drive, the brow ditch is directed into the back of an existing curb inlet and from there runoff is piped to an outlet near the existing channel which traverses the Vista Valley Golf Course and on to the San Luis Rey River.

There are also Pre and Post Development flows for drainage directly on the surface of Vista Valley Drive. However, these basins do not change significantly from the Pre Development to the Post Development Scenarios.

A direct comparison of the runoff parameters at these points is as follows:

	Node 4							Node 9/24						
	H	L	C	Tc	I	A	Q	H	L	C	Tc	I	A	Q
Pre-Dev	320	N/A	0.38	6.80	7.49	8.35	23.1	66	N/A	0.56	5.5	8.2	0.547	2.53
Post-Dev	320	N/A	0.48	6.08	7.11	8.39	22.45*	39	N/A	0.63	6.9	7.1	0.505	2.37

There are 3.65 cfs total reduction of the system with detention calculation (please see Appendix D for result of bioretention pond inflow hydrograph and outflow hydrograph). Therefore, the Q at node 4 is 26.1 – 3.65 cfs =22.45 cfs.

The on-site drainage patterns and conveyance facilities have been designed to avoid existing natural drainage features. All runoff from impacted areas is collected and redirected into previously existing, well designed, hard bottom drainage facilities (i.e. the previously discussed brow ditches along southerly and westerly boundaries). This project will not alter the existing drainage pattern of the site or surrounding area. In the site area there is no alteration of a course of a stream or river in a manner that would result in substantial erosion or siltation on or offsite. This is due to avoiding natural drainage features and providing well protected conveyance devices and energy dissipaters at all outlets to non-hardened areas.

of a stream or river in a manner that would result in substantial erosion or siltation on or offsite. This is due to avoiding natural drainage features and providing well protected conveyance devices and energy dissipaters at all outlets to non-hardened areas.

All drainage facilities that convey runoff, both existing and proposed, have been confirmed to be of a size and character to adequately convey the Q(100). In addition to adequately designed and constructed facilities both on-site and downstream, this report has shown that the proposed development will be releasing less runoff than in the pre-development condition, thereby lessening impacts on downstream facilities and reducing the opportunity for flooding on-site or downstream. Therefore, the proposed project will not alter the existing drainage pattern of the site or surrounding area, including through the alteration of the course of a stream or a river or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on or off site.

This project will not create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems. As stated, the proposed project has lessened the anticipated runoff to less than in the pre-development condition. All on-site facilities conveying the runoff have been verified as being of the size and character required. In addition, all downstream facilities have been verified to adequately convey anticipated runoff flows.

This project will not place housing in a 100 year flood hazard area as mapped on a federal flood hazard boundary or flood insurance rate map or other flood hazard delineation map, including County floodplain maps. At this time there is no known floodplain or area that can impact the project since it is located on a hillside, high above any local watercourse. Also, since the project is designed to reduce the runoff conveyance offsite, there will be no additional impacts to flood boundaries caused by this project.

This project will not affect housing or existing 100 year floodplains as mapped on a Federal Hazard Boundary or Flood Insurance Rate map, including County Floodplain Maps (source: FIRM San Diego County Map number 06073C0489 F Panel 489 and Panel 0777). See appendix J for 100 year flood map (in red color).

Data contained in CivilD out put files, Appendix C, D was used to establish pipe sizes and sub-basin peak flows. The Appendix contains a summary of the catch basin sizes along with sample calculations and a summary of storm pipe data, including pipe size, normal depths and velocities. Existing offsite facilities were also analyzed and found to be able to handle peak flows. The Appendix contains pre-developed and post developed basin maps with the runoff calculations. Basin maps show sub-basins, points of concentration and size and type of existing and proposed drainage facilities. Drainage facilities described by this report will be incorporated into construction documents.

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 codes, and that the design is consistent with current design.

I understand that the check of the project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

ENGINEER OF WORK
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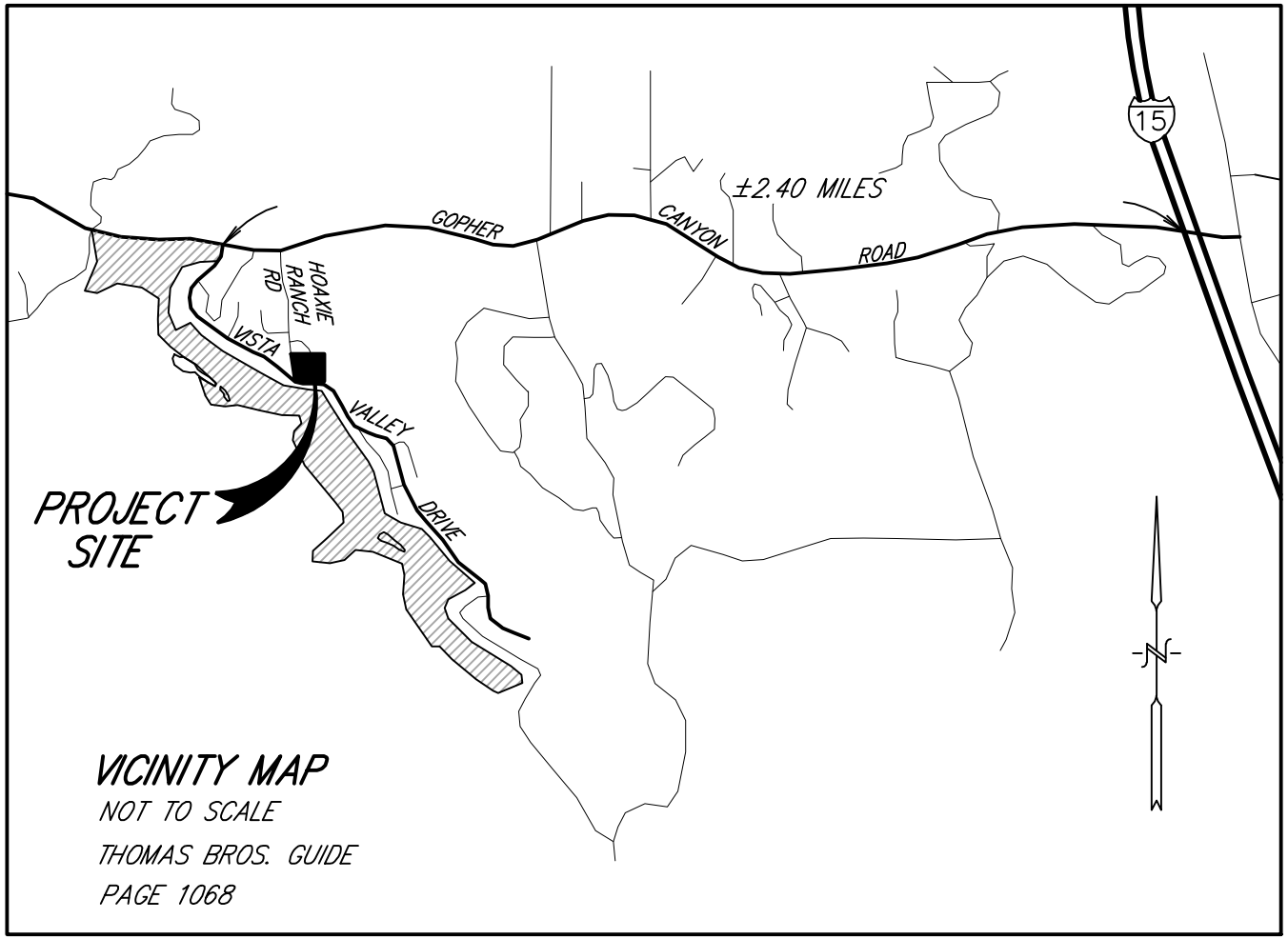
Registration Expire: December 31, 2012

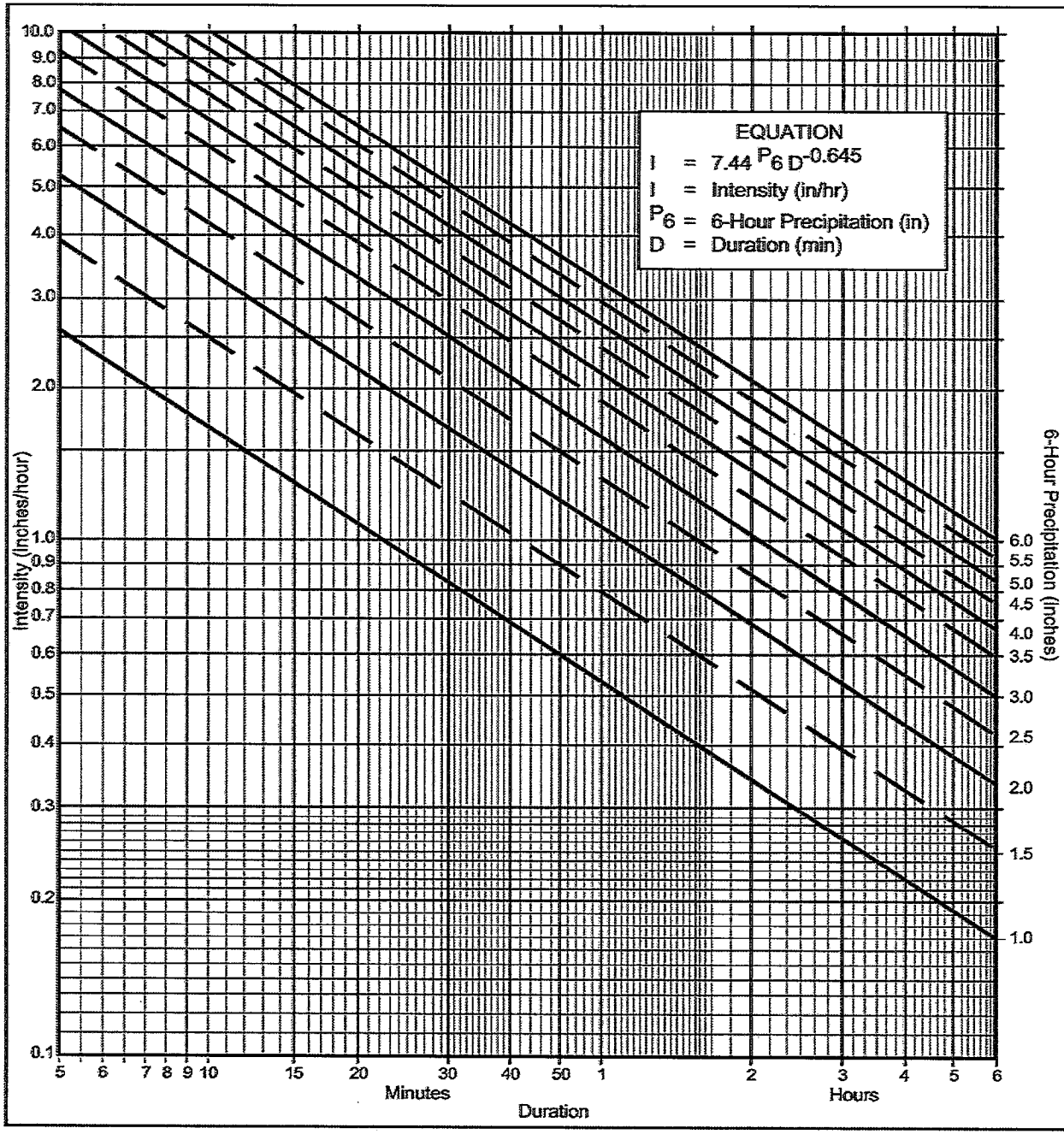
10/29/14
Date

APPENDIX A

Vicinity Map


15
±2.40 MILES
GOPHER
CANYON
ROAD
HOAXIE RANCH RD
VISTA
VALLEY
DRIVE
PROJECT SITE
VICINITY MAP
NOT TO SCALE
THOMAS BROS. GUIDE
PAGE 1068

APPENDIX B
CHARTS & FIGURES FROM THE SAN DIEGO HYDROLOGY MANUAL DATED 2003



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.3 in., P_{24} = 5.9, $\frac{P_6}{P_{24}}$ = 56 %(2)

(c) Adjusted P_6(2) = 3.3 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

SEE APPENDIX C AND D FOR INTENSITY CALCULATION

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

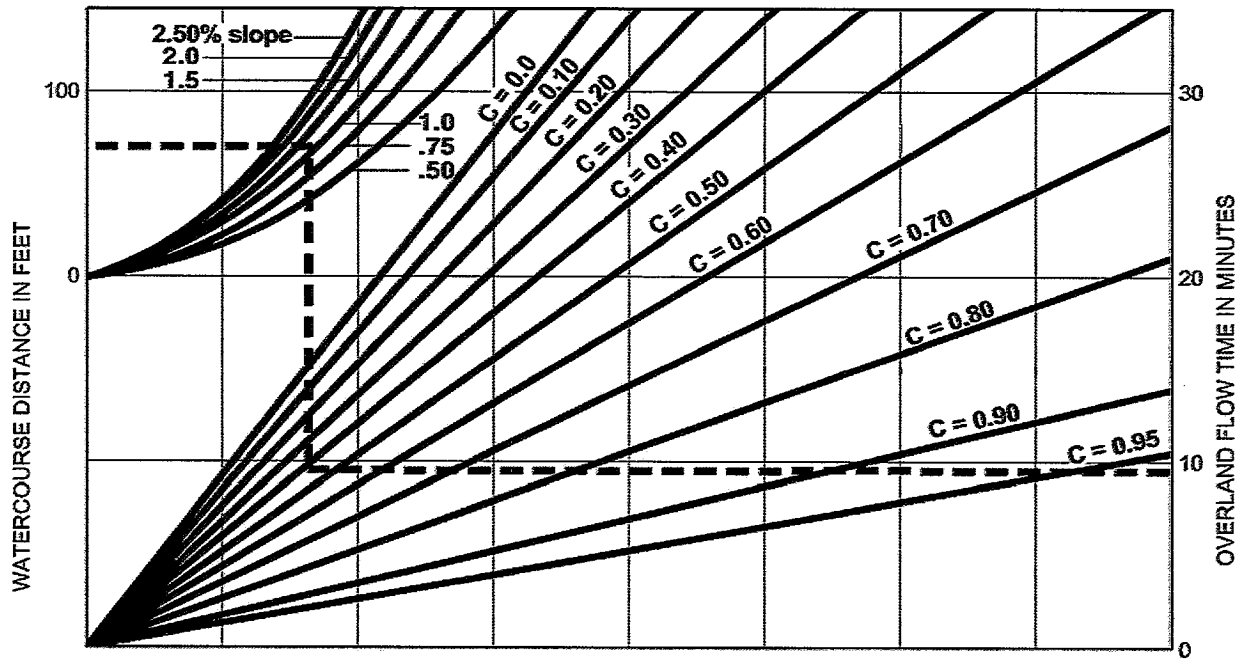
FIGURE 3-1

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

PLEASE NOTE THAT THE C VALUE HIGHLIGHTED IN THIS TABLE IS C AVERAGE. THE ACTUAL C THAT REFLECTS THE AMOUNT OF IMPERVIOUS IN EACH BASIN WAS USED IN THE CALCULATION.



EXAMPLE:
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE

Rational Formula - Overland Time of Flow Nomograph

3-3

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

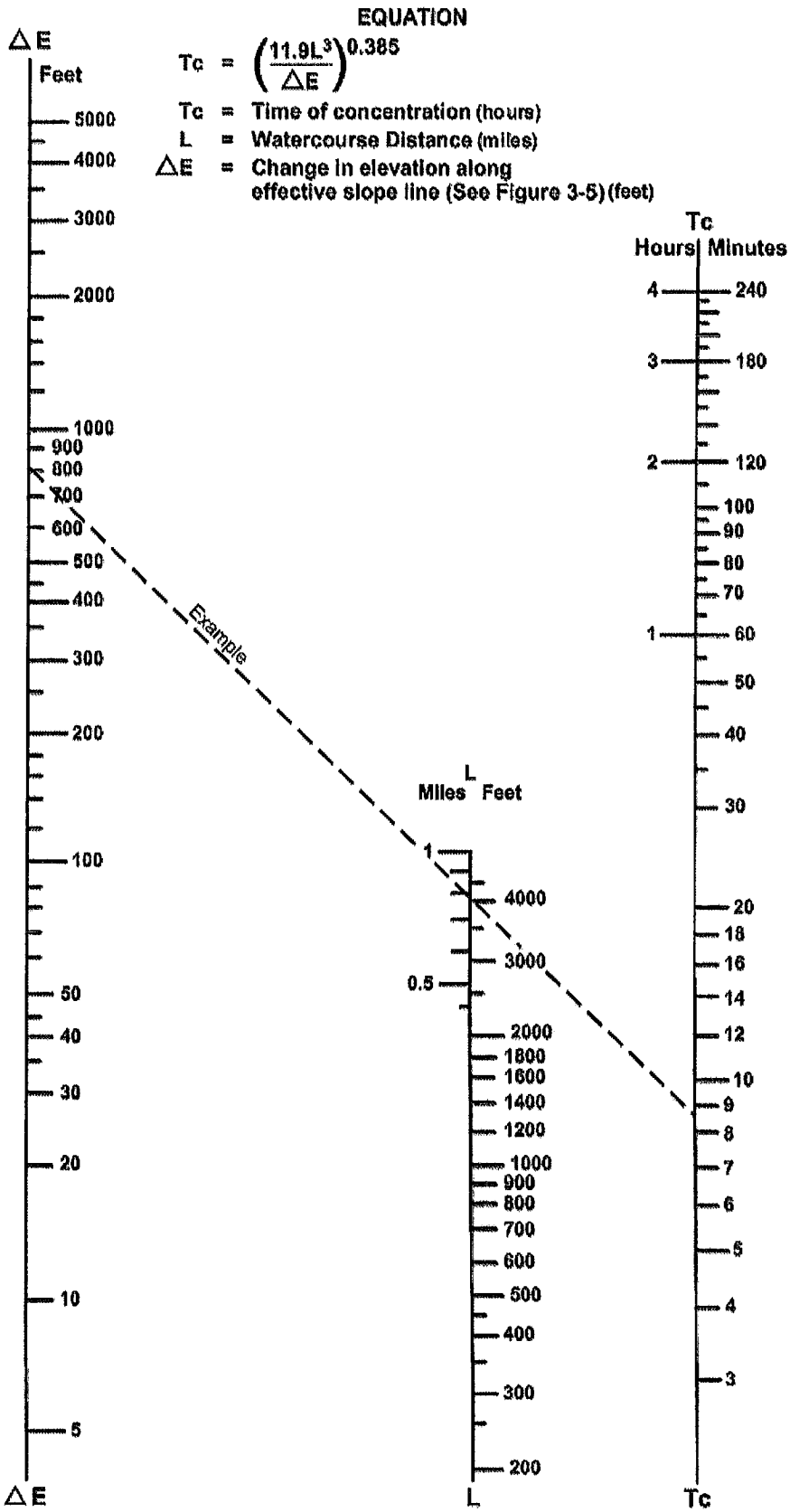
SEE APPENDIX C AND D FOR FLOW LENGHT

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

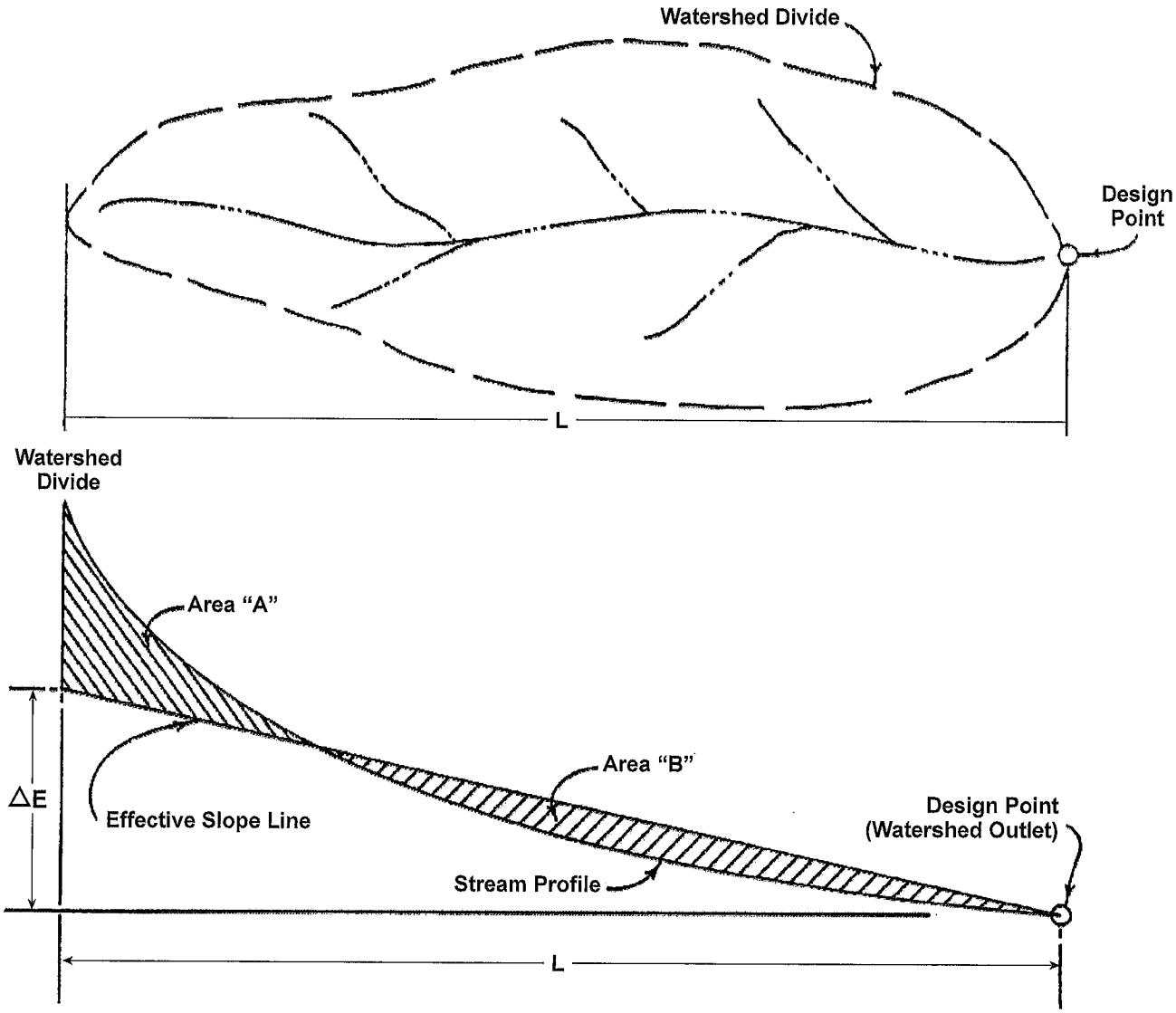
*See Table 3-1 for more detailed description



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

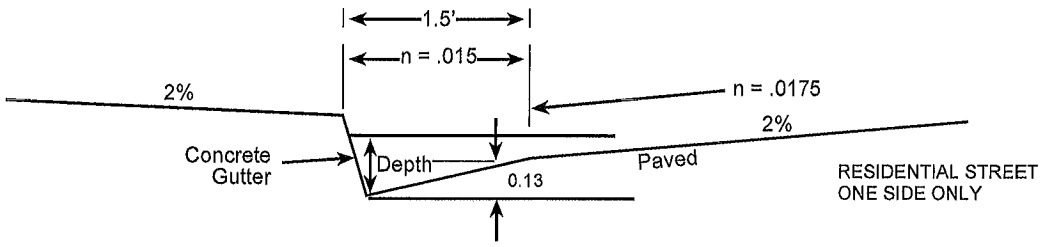


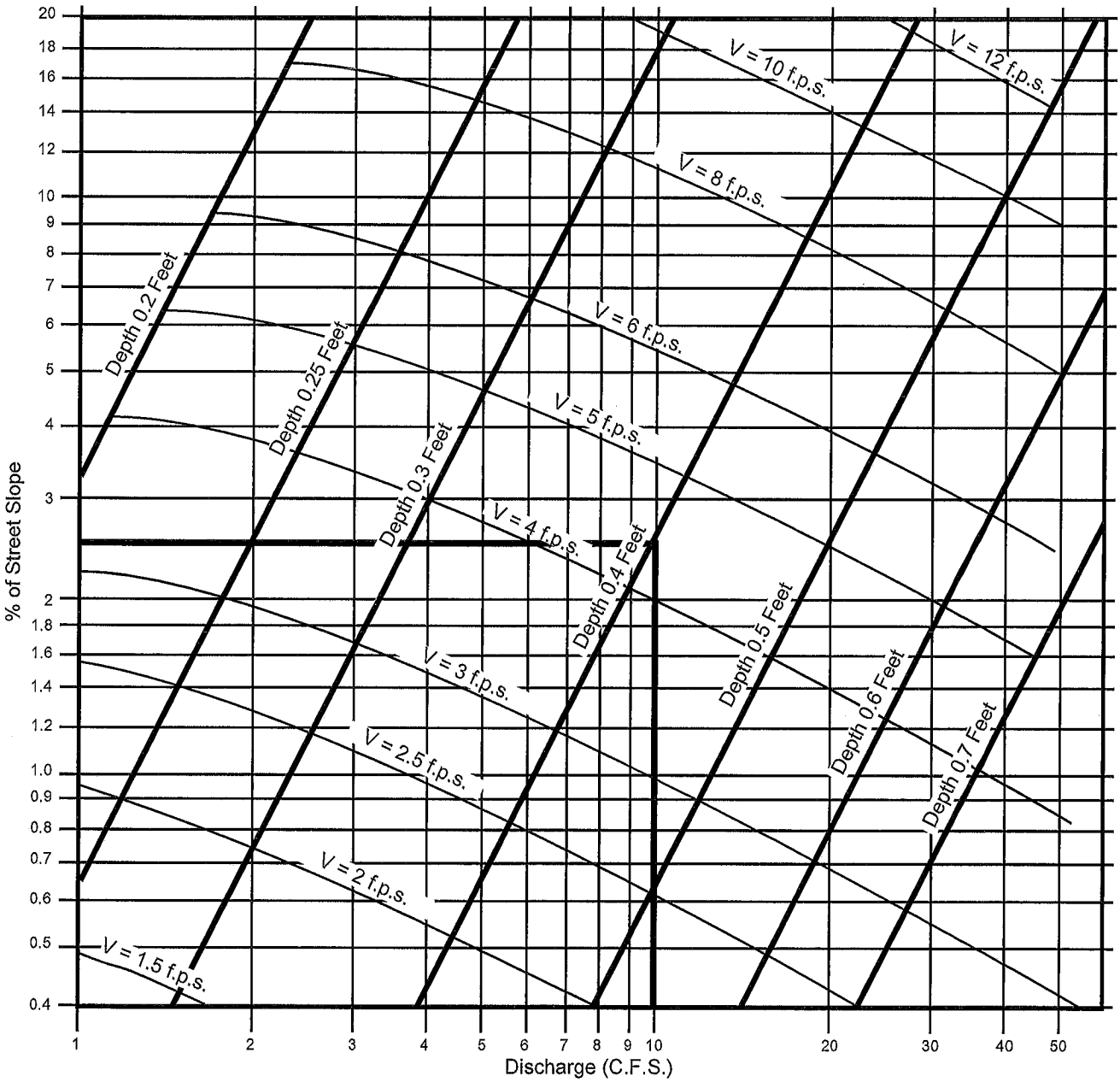
Area "A" = Area "B"

SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-5

Computation of Effective Slope for Natural Watersheds





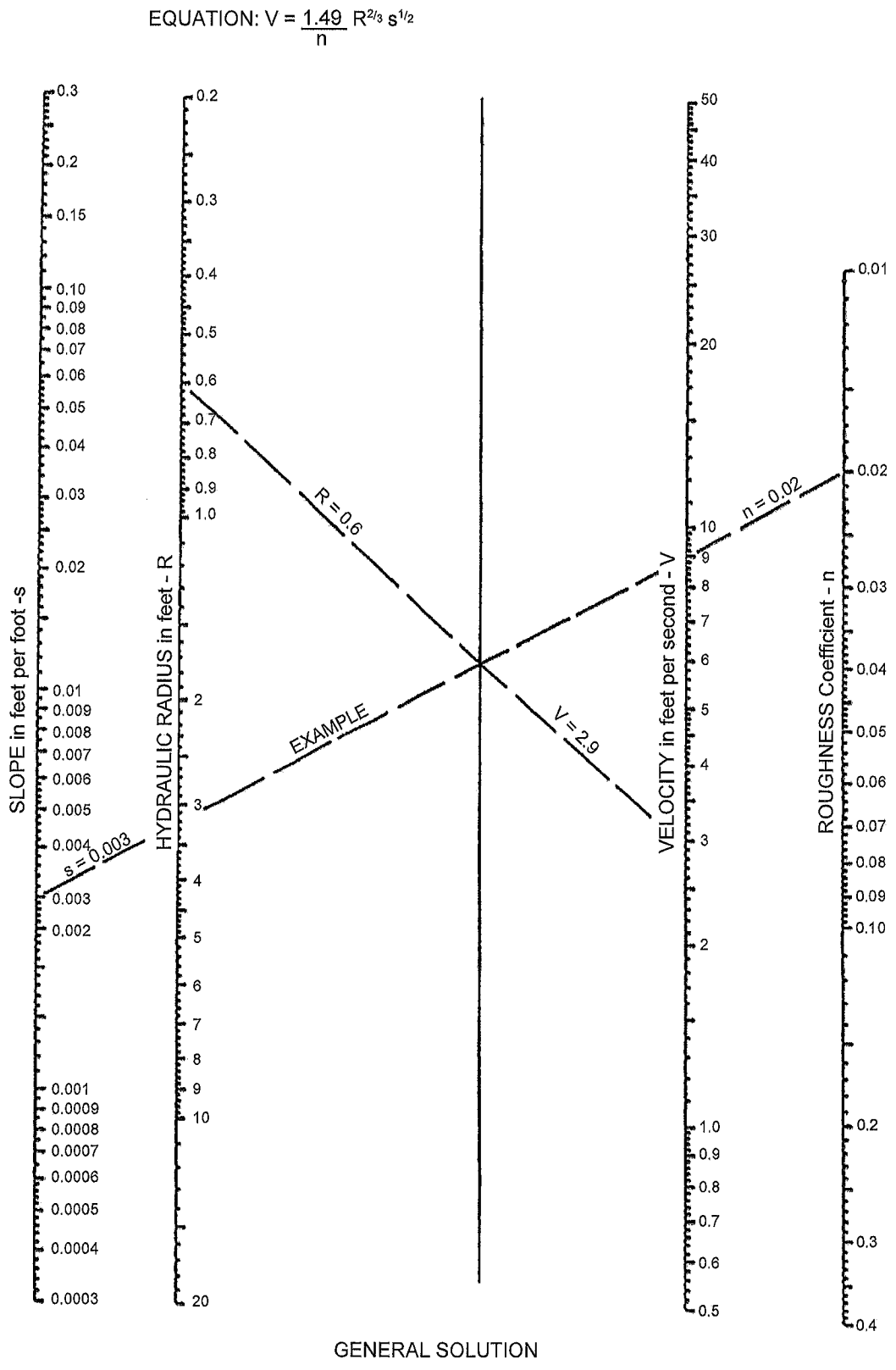
EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6



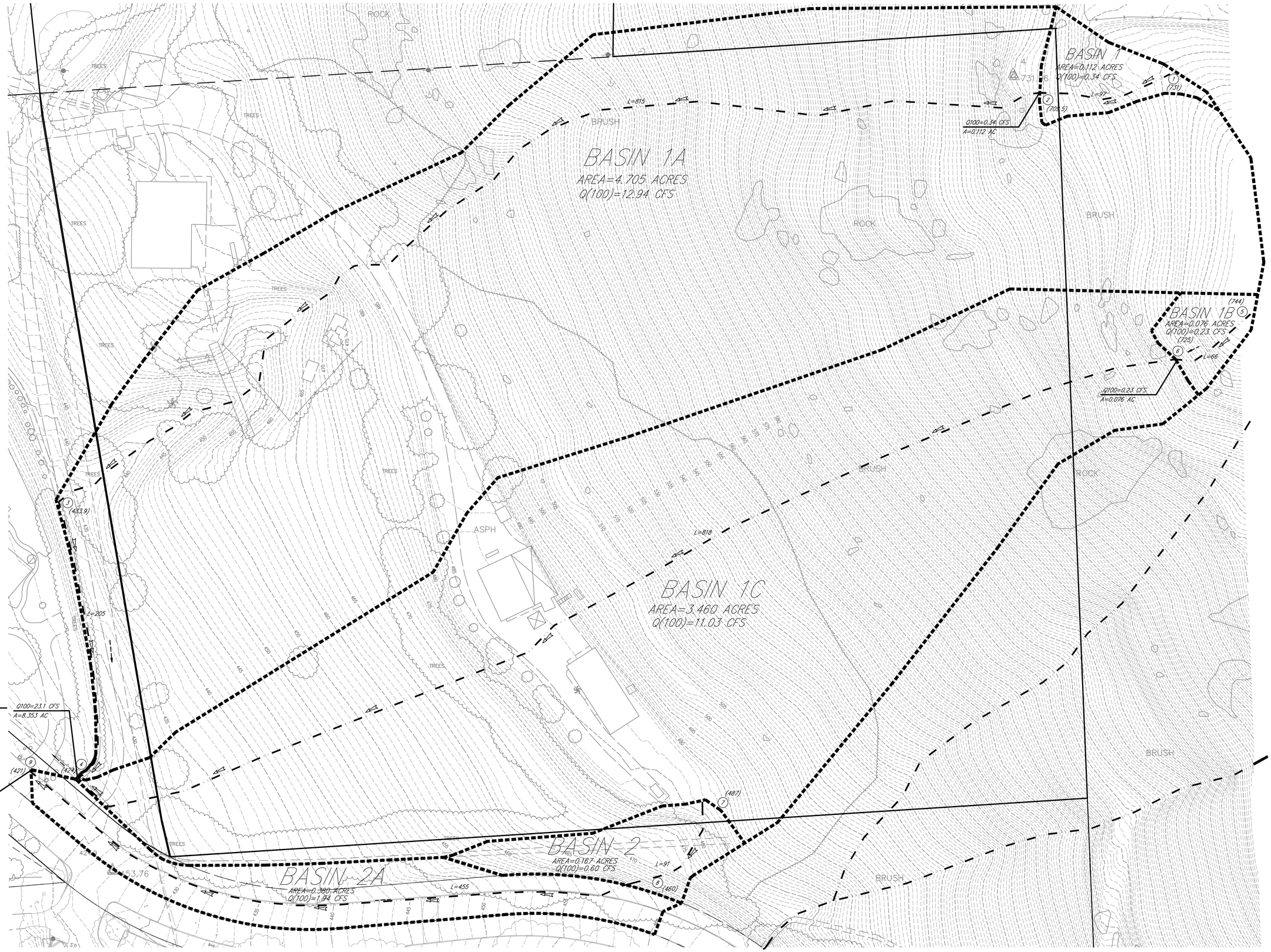
SOURCE: USDOT, FHWA, HDS-3 (1961)

FIGURE 3-7

Manning's Equation Nomograph

APPENDIX C
PRE-DEVELOPMENT RUNOFF BASIN EXHIBIT AND CALCULATIONS (100 YR)

VISTA VALLEY POOL
PRE DEVELOPMENT
DRAINAGE EXHIBIT



LEGEND

WATERCOURSE	
WATERSHED BOUNDARY	
NODE NUMBER	(X)
ELEVATION	(XXX)
AREA (ACRES)	XXX
WATERCOURSE LENGTH	L=XXX
FLOW PATH DIRECTION	

SCALE 1" = 30'

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 09/13/14

PRE-DEVELOPMENT CALCULATION
BASIN 1, 1A, 1B, AND 1C
DOWNSTREAM NODE 4
FILE:13008PreDev.rd3

********* Hydrology Study Control Information **********

Program License Serial Number 6312

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.300
24 hour precipitation(inches) = 5.900
P6/P24 = 55.9%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance = 97.000(Ft.)
Highest elevation = 731.000(Ft.)
Lowest elevation = 709.500(Ft.)
Elevation difference = 21.500(Ft.) Slope = 22.165 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 22.16 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.81 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*(100.000^.5)/(22.165^(1/3)]= 4.81
Calculated TC of 4.806 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 8.695(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff = 0.341(CFS)
Total initial stream area = 0.112(Ac.)

++
Process from Point/Station 2.000 to Point/Station 3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 6.578(CFS)
Depth of flow = 0.300(Ft.), Average velocity = 8.104(Ft/s)
******* Irregular Channel Data **********

```
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              5.00
       2             45.00              0.00
       3             90.00              5.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      6.578(CFS)
  '     '       flow top width =      5.406(Ft.)
  '     '    velocity=    8.104(Ft/s)
  '     '       area =      0.812(Sq.Ft)
  '     '       Froude number =     3.686

Upstream point elevation =   709.500(Ft.)
Downstream point elevation =   433.900(Ft.)
Flow length =   815.000(Ft.)
Travel time  =    1.68 min.
Time of concentration =    6.48 min.
Depth of flow =   0.300(Ft.)
Average velocity =   8.104(Ft/s)
Total irregular channel flow =     6.578(CFS)
Irregular channel normal depth above invert elev. =   0.300(Ft.)
Average velocity of channel(s) =   8.104(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.354(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity =      7.354(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360  CA =      1.733
Subarea runoff =     12.404(CFS) for      4.705(Ac.)
Total runoff =     12.745(CFS)        Total area =       4.817(Ac.)
Depth of flow =   0.385(Ft.), Average velocity =   9.561(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.829(Ft.), Average velocity =  12.356(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              1.00
       2              1.50              0.00
       3              3.00              1.00
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =     12.745(CFS)
  '     '       flow top width =      2.488(Ft.)
  '     '    velocity=   12.356(Ft/s)
  '     '       area =      1.031(Sq.Ft)
  '     '       Froude number =     3.382

Upstream point elevation =   433.900(Ft.)
Downstream point elevation =   424.000(Ft.)
Flow length =   205.000(Ft.)
Travel time  =    0.28 min.
Time of concentration =    6.76 min.
Depth of flow =   0.829(Ft.)
Average velocity =  12.356(Ft/s)
Total irregular channel flow =    12.745(CFS)
Irregular channel normal depth above invert elev. =   0.829(Ft.)
```

```
Average velocity of channel(s) =  12.356(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.817(Ac.)
Runoff from this stream =     12.745(CFS)
Time of concentration =    6.76 min.
Rainfall intensity =     7.159(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  =   66.000(Ft.)
Highest elevation =  744.000(Ft.)
Lowest elevation =  725.000(Ft.)
Elevation difference =   19.000(Ft.) Slope = 28.788 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  28.79 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  28.788^(1/3)]=   4.40
Calculated TC of    4.405 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =      0.231(CFS)
Total initial stream area =        0.076(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      5.496(CFS)
Depth of flow =   0.234(Ft.), Average velocity =   7.174(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.50
       2             35.00              0.00
       3             70.00              2.50
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      5.496(CFS)
  '     '       flow top width =      6.550(Ft.)
  '     '    velocity=    7.174(Ft/s)
  '     '       area =      0.766(Sq.Ft)
  '     '       Froude number =     3.697

Upstream point elevation =   725.000(Ft.)
Downstream point elevation =   424.000(Ft.)
Flow length =   818.000(Ft.)
Travel time  =    1.90 min.
```

```
Time of concentration =    6.31 min.
Depth of flow =   0.234(Ft.)
Average velocity =   7.174(Ft/s)
Total irregular channel flow =     5.496(CFS)
Irregular channel normal depth above invert elev. =   0.234(Ft.)
Average velocity of channel(s) =   7.174(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.487(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      7.487(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.409  CA =      1.445
Subarea runoff =     10.588(CFS) for      3.460(Ac.)
Total runoff =     10.820(CFS)       Total area =       3.536(Ac.)
Depth of flow =   0.302(Ft.), Average velocity =   8.498(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.536(Ac.)
Runoff from this stream =     10.820(CFS)
Time of concentration =    6.31 min.
Rainfall intensity =     7.487(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       12.745      6.76               7.159
2       10.820      6.31               7.487
Qmax(1) =
          1.000 *    1.000 *    12.745) +
          0.956 *    1.000 *    10.820) + =      23.090
Qmax(2) =
          1.000 *    0.933 *    12.745) +
          1.000 *    1.000 *    10.820) + =      22.709

Total of 2 streams to confluence:
Flow rates before confluence point:
      12.745      10.820
Maximum flow rates at confluence using above data:
       23.090       22.709
Area of streams before confluence:
        4.817        3.536
Results of confluence:
Total flow rate =     23.090(CFS)
Time of concentration =     6.759 min.
Effective stream area after confluence =      8.353(Ac.)
End of computations, total study area =           8.353 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
       Rational Hydrology Study   Date: 09/13/14

PRE-DEVELOPMENT CALCULATION
BASIN 2 AND 2A
DOWNSTREAM NODE 9
FILE: 13008PreDevBas2

 *********   Hydrology Study Control Information **********

Program License Serial Number 6312

Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.300
24 hour precipitation(inches) = 5.900
P6/P24 =   55.9%
San Diego hydrology manual 'C' values used

++
Process from Point/Station   7.000 to Point/Station   8.000
**** INITIAL AREA EVALUATION ****
_____
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL   ]
(1.0 DU/A or Less   )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Initial subarea total flow distance =   91.000(Ft.)
Highest elevation = 487.000(Ft.)
Lowest elevation = 460.000(Ft.)
Elevation difference =   27.000(Ft.) Slope = 29.670 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 29.67 %, in a development type of
 1.0 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.01 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4100)*(100.000^.5)/(29.670^(1/3)]=   4.01
Calculated TC of   4.012 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =   8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.410
Subarea runoff =   0.595(CFS)
Total initial stream area =   0.167(Ac.)

++
Process from Point/Station   8.000 to Point/Station   9.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____
Estimated mean flow rate at midpoint of channel =   1.524(CFS)
Depth of flow =   0.127(Ft.), Average velocity =   5.276(Ft/s)
       ******* Irregular Channel Data **********

```
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2             17.50              0.00
       3             18.00              0.50
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------
Sub-Channel flow  =      1.524(CFS)
  '     '       flow top width =      4.561(Ft.)
  '     '    velocity=    5.276(Ft/s)
  '     '       area =      0.289(Sq.Ft)
  '     '       Froude number =     3.694

Upstream point elevation =   460.000(Ft.)
Downstream point elevation =   421.000(Ft.)
Flow length =   455.000(Ft.)
Travel time  =    1.44 min.
Time of concentration =    5.45 min.
Depth of flow =   0.127(Ft.)
Average velocity =   5.276(Ft/s)
Total irregular channel flow =     1.524(CFS)
Irregular channel normal depth above invert elev. =   0.127(Ft.)
Average velocity of channel(s) =   5.276(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      8.225(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.630 given for subarea
Rainfall intensity =      8.225(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.563  CA =      0.308
Subarea runoff =      1.937(CFS) for      0.380(Ac.)
Total runoff =      2.532(CFS)       Total area =       0.547(Ac.)
Depth of flow =   0.153(Ft.), Average velocity =   5.990(Ft/s)
End of computations, total study area =           0.547 (Ac.)
```

APPENDIX D
POST-DEVELOPMENT RUNOFF BASIN EXHIBIT AND CALCULATIONS (100 YR)

EXCEL ENGINEERING
LAND PLANNING • ENGINEERING • GIS • SURVEYING
440 STATE PLACE, ESCONDIDO, CA 92029
PH (760)745-8118 FX (760)745-1890

POST-DEVELOPMENT HYDROLOGY TRIBUTARY MAP
VISTA VALLEY COUNTRY CLUB

THE 100-YEAR FLOOD PLAIN IS APPROXIMATELY 2000 FT NORTH OF THE PROJECT SITE. PLEASE SEE APPENDIX J THE 200 FT SCALED TOPO MAP.

SCALE 1"=30'
0 30 60 90 120

LEGEND

WATERCOURSE	— · —
WATERSHED BOUNDARY	■■■■
NODE NUMBER	(X)
ELEVATION	(XXX)
AREA (ACRES)	[XXX]
WATERCOURSE LENGTH	L=XXX
FLOW PATH DIRECTION	⇒ ⇒ ⇒ ⇒
IMP SC-##	BIORETENTION SC-##

BASIN 1
0.112
Q100=0.341 CFS
A=0.112 AC
L=97
L=677
BASIN 1A
3.627
Q100=9.74 CFS
BASIN 1B
0.076
L=66
Q100=0.231 CFS
A=0.076 AC
BASIN 1C
2.093
L=663 FT
BASIN 1D
0.251
Q100=12.95 CFS
A=4.243 AC
Q100=2.99 CFS
A=0.420 AC
Q100=3.33 CFS
A=0.504 AC
BLDG A
BASIN 1E
0.420
Q100=2.417 CFS
A=0.366 AC
Q100=1.768 CFS
A=0.248 AC
BASIN 1G
0.390
L=205
BASIN 1H
0.471
Q100=3.56 CFS
A=0.499 AC
IMP SC-41
BASIN 1J
BLDG B
0.248
BASIN 1K
BASIN 1Q
0.113
Q100=4.08 CFS
A=0.669 AC
BASIN 2C
EXISTING BROWDITCH
Q100=26.1 CFS (WITHOUT DETENTION)
Q100=22.45 CFS (WITH DETENTION)
A=8.394 AC
Q100=2.37 CFS
A=0.505 AC
BASIN 1P
0.170
BASIN 1O
0.055
BASIN 1N
0.049
BASIN 2B
0.051
Q100=6.576 CFS
A=2.17 AC
Q100=12.56 CFS
A=3.342 AC
Q100=9.18 CFS
A=2.673 AC
Q100=2.417 CFS
A=0.366 AC
BASIN 2
0.140
BASIN 2A
0.214
L=225 FT
L=110 FT
EXISTING BROWDITCH
PROPOSED CULVERT

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology program based on
San Diego County Flood Control Division 2003 hydrology manual
Rational Hydrology Study Date: 08/01/14

POST-DEVELOPMENT CALCULATION
BASIN 1,1A THROUGH 1Q
100 YEAR STORM EVENT
DOWNSTREAM NODE 4

********* Hydrology Study Control Information **********

Program License Serial Number 6312

Rational hydrology study storm event year is 100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour, precipitation(inches) = 3.300
24 hour precipitation(inches) = 5.900
P6/P24 = 55.9%
San Diego hydrology manual 'C' values used

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN]
(Permanent Open Space)
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance = 97.000(Ft.)
Highest elevation = 731.000(Ft.)
Lowest elevation = 709.500(Ft.)
Elevation difference = 21.500(Ft.) Slope = 22.165 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of 22.16 %, in a development type of
Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration = 4.81 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*(100.000^.5)/(22.165^(1/3)]= 4.81
Calculated TC of 4.806 minutes is less than 5 minutes,
resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) = 8.695(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff = 0.341(CFS)
Total initial stream area = 0.112(Ac.)

++
Process from Point/Station 2.000 to Point/Station 3.100
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 5.254(CFS)
Depth of flow = 0.278(Ft.), Average velocity = 7.567(Ft/s)
******* Irregular Channel Data ***********

```
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              5.00
       2             45.00              0.00
       3             90.00              5.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      5.254(CFS)
  '     '       flow top width =      5.000(Ft.)
  '     '    velocity=    7.567(Ft/s)
  '     '       area =      0.694(Sq.Ft)
  '     '       Froude number =     3.578

Upstream point elevation =   709.500(Ft.)
Downstream point elevation =   488.000(Ft.)
Flow length =   677.000(Ft.)
Travel time  =    1.49 min.
Time of concentration =    6.30 min.
Depth of flow =   0.278(Ft.)
Average velocity =   7.567(Ft/s)
Total irregular channel flow =     5.254(CFS)
Irregular channel normal depth above invert elev. =   0.278(Ft.)
Average velocity of channel(s) =   7.567(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.493(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.360
Rainfall intensity =      7.493(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.360  CA =      1.345
Subarea runoff =      9.736(CFS) for      3.627(Ac.)
Total runoff =     10.077(CFS)        Total area =       3.739(Ac.)
Depth of flow =   0.355(Ft.), Average velocity =   8.905(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.100 to Point/Station        3.100
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.739(Ac.)
Runoff from this stream =     10.077(CFS)
Time of concentration =    6.30 min.
Rainfall intensity =     7.493(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                       ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  181.000(Ft.)
Highest elevation =  476.000(Ft.)
Lowest elevation =  472.000(Ft.)
Elevation difference =    4.000(Ft.) Slope =  2.210 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
```

```
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   2.21 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.35 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   2.210^(1/3)]=   3.35
Calculated TC of    3.351 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      2.994(CFS)
Total initial stream area =        0.420(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   472.000(Ft.)
Downstream point/station elevation =   462.000(Ft.)
Pipe length  =    32.00(Ft.) Slope =   0.3125  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.994(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     2.994(CFS)
Normal flow depth in pipe =    4.69(In.)
Flow top width inside pipe =    4.96(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.18(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     3.38 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        7.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
Calculated TC of    3.380 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.460 given for subarea
Time of concentration =     3.38 min.
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.760  CA =      0.383
Subarea runoff =      0.336(CFS) for      0.084(Ac.)
Total runoff =      3.330(CFS)        Total area =       0.504(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        3.100
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   459.000(Ft.)
Downstream point/station elevation =   448.000(Ft.)
Pipe length  =    50.00(Ft.) Slope =   0.2200  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.330(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     3.330(CFS)
Normal flow depth in pipe =    4.12(In.)
Flow top width inside pipe =    8.97(In.)
Critical depth could not be calculated.
Pipe flow velocity =     16.89(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     3.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.100 to Point/Station        3.100
**** CONFLUENCE OF MINOR STREAMS ****
```

```
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.504(Ac.)
Runoff from this stream =      3.330(CFS)
Time of concentration =    3.43 min.
Rainfall intensity =     8.695(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1       10.077      6.30               7.493
2        3.330      3.43               8.695
Qmax(1) =
          1.000 *    1.000 *    10.077) +
          0.862 *    1.000 *     3.330) + =      12.947
Qmax(2) =
          1.000 *    0.545 *    10.077) +
          1.000 *    1.000 *     3.330) + =       8.819

Total of 2 streams to confluence:
Flow rates before confluence point:
      10.077       3.330
Maximum flow rates at confluence using above data:
       12.947        8.819
Area of streams before confluence:
        3.739        0.504
Results of confluence:
Total flow rate =     12.947(CFS)
Time of concentration =     6.297 min.
Effective stream area after confluence =      4.243(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.100 to Point/Station        3.200
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
------------------------------------------------------------------------
Estimated mean flow rate at midpoint of channel =     13.118(CFS)
Depth of flow =   0.800(Ft.), Average velocity =   8.157(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00             17.00
       2             40.00              0.00
       3             72.00             12.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =     13.118(CFS)
  '     '       flow top width =      4.018(Ft.)
  '     '    velocity=    8.157(Ft/s)
  '     '       area =      1.608(Sq.Ft)
  '     '       Froude number =     2.272

Upstream point elevation =   448.000(Ft.)
Downstream point elevation =   434.000(Ft.)
Flow length =   138.000(Ft.)
Travel time  =    0.28 min.
Time of concentration =    6.58 min.
Depth of flow =   0.800(Ft.)
Average velocity =   8.157(Ft/s)
Total irregular channel flow =    13.118(CFS)
Irregular channel normal depth above invert elev. =   0.800(Ft.)
Average velocity of channel(s) =   8.157(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.284(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      7.284(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.404  CA =      1.816
Subarea runoff =      0.279(CFS) for      0.251(Ac.)
Total runoff =     13.226(CFS)        Total area =       4.494(Ac.)
Depth of flow =   0.803(Ft.), Average velocity =   8.173(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.200 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =     13.519(CFS)
Depth of flow =   1.404(Ft.), Average velocity =   6.858(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.00
       2              2.00              0.00
       3              4.00              2.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =     13.519(CFS)
  '     '       flow top width =      2.808(Ft.)
  '     '    velocity=    6.858(Ft/s)
  '     '       area =      1.971(Sq.Ft)
  '     '       Froude number =     1.443

Upstream point elevation =   434.000(Ft.)
Downstream point elevation =   424.000(Ft.)
Flow length =   205.000(Ft.)
Travel time  =    0.50 min.
Time of concentration =    7.08 min.
Depth of flow =   1.404(Ft.)
Average velocity =   6.858(Ft/s)
Total irregular channel flow =    13.519(CFS)
Irregular channel normal depth above invert elev. =   1.404(Ft.)
Average velocity of channel(s) =   6.858(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      6.949(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      6.949(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.405  CA =      1.976
Subarea runoff =      0.503(CFS) for      0.390(Ac.)
Total runoff =     13.729(CFS)        Total area =       4.884(Ac.)
Depth of flow =   1.412(Ft.), Average velocity =   6.885(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      4.884(Ac.)
Runoff from this stream =     13.729(CFS)
```

```
Time of concentration =    7.08 min.
Rainfall intensity =     6.949(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station       10.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                         ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  108.000(Ft.)
Highest elevation =  476.000(Ft.)
Lowest elevation =  475.000(Ft.)
Elevation difference =    1.000(Ft.) Slope =  0.926 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 60.00 (Ft)
for the top area slope value of   0.93 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.01 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  60.000^.5)/(   0.926^(1/3)]=   4.01
Calculated TC of    4.005 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      1.768(CFS)
Total initial stream area =        0.248(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   472.500(Ft.)
Downstream point/station elevation =   460.000(Ft.)
Pipe length  =    28.00(Ft.) Slope =   0.4464  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.768(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     1.768(CFS)
Normal flow depth in pipe =    2.90(In.)
Flow top width inside pipe =    6.00(In.)
Critical depth could not be calculated.
Pipe flow velocity =     18.81(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     4.03 min.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Process from Point/Station       11.000 to Point/Station       11.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Calculated TC of    4.030 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                  ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
```

```
Time of concentration =     4.03 min.
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.745  CA =      0.220
Subarea runoff =      0.143(CFS) for      0.047(Ac.)
Total runoff =      1.911(CFS)        Total area =       0.295(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   460.000(Ft.)
Downstream point/station elevation =   456.000(Ft.)
Pipe length  =    62.00(Ft.) Slope =   0.0645  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.911(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.911(CFS)
Normal flow depth in pipe =    4.26(In.)
Flow top width inside pipe =    8.99(In.)
Critical Depth =    7.57(In.)
Pipe flow velocity =      9.29(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =     4.14 min.


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Process from Point/Station       12.000 to Point/Station       12.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Calculated TC of    4.141 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Time of concentration =     4.14 min.
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.760  CA =      0.278
Subarea runoff =      0.506(CFS) for      0.071(Ac.)
Total runoff =      2.417(CFS)        Total area =       0.366(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.542(CFS)
Depth of flow =   0.555(Ft.), Average velocity =   8.252(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              5.00
       2              5.00              0.00
       3             10.00              5.00
Manning's 'N' friction factor =   0.025
------------------------------------------------------------------
Sub-Channel flow  =      2.542(CFS)
  '     '       flow top width =      1.110(Ft.)
  '     '    velocity=    8.252(Ft/s)
  '     '       area =      0.308(Sq.Ft)
  '     '       Froude number =     2.760
```

```
Upstream point elevation =   456.000(Ft.)
Downstream point elevation =   444.000(Ft.)
Flow length =    71.000(Ft.)
Travel time  =    0.14 min.
Time of concentration =    4.28 min.
Depth of flow =   0.555(Ft.)
Average velocity =   8.252(Ft/s)
Total irregular channel flow =     2.542(CFS)
Irregular channel normal depth above invert elev. =   0.555(Ft.)
Average velocity of channel(s) =   8.252(Ft/s)
 Adding area flow to channel
Calculated TC of    4.285 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.718  CA =      0.298
Subarea runoff =      0.175(CFS) for      0.049(Ac.)
Total runoff =      2.592(CFS)        Total area =       0.415(Ac.)
Depth of flow =   0.559(Ft.), Average velocity =   8.292(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       13.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      0.415(Ac.)
Runoff from this stream =      2.592(CFS)
Time of concentration =    4.28 min.
Rainfall intensity =     8.695(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                       ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =  124.000(Ft.)
Highest elevation =  465.000(Ft.)
Lowest elevation =  463.000(Ft.)
Elevation difference =    2.000(Ft.) Slope =  1.613 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 75.00 (Ft)
for the top area slope value of   1.61 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   3.72 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  75.000^.5)/(   1.613^(1/3)]=   3.72
Calculated TC of    3.722 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.378(CFS)
```

```
Total initial stream area =        0.053(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.474(CFS)
Depth of flow =   0.233(Ft.), Average velocity =   4.987(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.00
       2              5.00              0.00
       3             10.00              5.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =      0.474(CFS)
  '     '       flow top width =      0.816(Ft.)
  '     '    velocity=    4.987(Ft/s)
  '     '       area =      0.095(Sq.Ft)
  '     '       Froude number =     2.575

Upstream point elevation =   463.000(Ft.)
Downstream point elevation =   454.000(Ft.)
Flow length =    30.000(Ft.)
Travel time  =    0.10 min.
Time of concentration =    3.82 min.
Depth of flow =   0.233(Ft.)
Average velocity =   4.987(Ft/s)
Total irregular channel flow =     0.474(CFS)
Irregular channel normal depth above invert elev. =   0.233(Ft.)
Average velocity of channel(s) =   4.987(Ft/s)
 Adding area flow to channel
Calculated TC of    3.822 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.654  CA =      0.058
Subarea runoff =      0.128(CFS) for      0.036(Ac.)
Total runoff =      0.506(CFS)        Total area =       0.089(Ac.)
Depth of flow =   0.239(Ft.), Average velocity =   5.070(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       13.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   452.000(Ft.)
Downstream point/station elevation =   444.000(Ft.)
Pipe length  =    68.00(Ft.) Slope =   0.1176  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.506(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.506(CFS)
Normal flow depth in pipe =    2.10(In.)
Flow top width inside pipe =    5.73(In.)
Critical Depth =    4.35(In.)
Pipe flow velocity =      8.27(Ft/s)
Travel time through pipe =    0.14 min.
Time of concentration (TC) =     3.96 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       13.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.089(Ac.)
Runoff from this stream =      0.506(CFS)
Time of concentration =    3.96 min.
Rainfall intensity =     8.695(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       19.000 to Point/Station       20.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Initial subarea total flow distance  =   66.000(Ft.)
Highest elevation =  744.000(Ft.)
Lowest elevation =  725.000(Ft.)
Elevation difference =   19.000(Ft.) Slope = 28.788 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  28.79 %, in a development type of
 Permanent Open Space
In Accordance With Figure 3-3
Initial Area Time of Concentration =   4.40 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.3500)*( 100.000^.5)/(  28.788^(1/3)]=   4.40
Calculated TC of    4.405 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.350
Subarea runoff =      0.231(CFS)
Total initial stream area =        0.076(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station       21.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      3.416(CFS)
Depth of flow =   0.156(Ft.), Average velocity =   5.607(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.00
       2             50.00              0.00
       3            100.00              2.00
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------------
Sub-Channel flow  =      3.416(CFS)
  '     '       flow top width =      7.805(Ft.)
  '     '    velocity=    5.607(Ft/s)
  '     '       area =      0.609(Sq.Ft)
  '     '       Froude number =     3.537

Upstream point elevation =   725.000(Ft.)
Downstream point elevation =   470.000(Ft.)
Flow length =   663.000(Ft.)
Travel time  =    1.97 min.
```

```
Time of concentration =    6.38 min.
Depth of flow =   0.156(Ft.)
Average velocity =   5.607(Ft/s)
Total irregular channel flow =     3.416(CFS)
Irregular channel normal depth above invert elev. =   0.156(Ft.)
Average velocity of channel(s) =   5.607(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.433(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      7.433(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.408  CA =      0.885
Subarea runoff =      6.345(CFS) for      2.093(Ac.)
Total runoff =      6.576(CFS)       Total area =       2.169(Ac.)
Depth of flow =   0.200(Ft.), Average velocity =   6.605(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.000 to Point/Station       13.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   470.000(Ft.)
Downstream point/station elevation =   444.000(Ft.)
Pipe length  =   187.00(Ft.) Slope =   0.1390  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.576(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     6.576(CFS)
Normal flow depth in pipe =    5.96(In.)
Flow top width inside pipe =   12.00(In.)
Critical depth could not be calculated.
Pipe flow velocity =     16.87(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =     6.56 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       13.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 3
Stream flow area =      2.169(Ac.)
Runoff from this stream =      6.576(CFS)
Time of concentration =    6.56 min.
Rainfall intensity =     7.298(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        2.592      4.28               8.695
2        0.506      3.96               8.695
3        6.576      6.56               7.298
Qmax(1) =
          1.000 *    1.000 *     2.592) +
          1.000 *    1.000 *     0.506) +
          1.000 *    0.653 *     6.576) + =       7.394
Qmax(2) =
          1.000 *    0.924 *     2.592) +
          1.000 *    1.000 *     0.506) +
          1.000 *    0.604 *     6.576) + =       6.870
Qmax(3) =
          0.839 *    1.000 *     2.592) +
```

```
          0.839 *    1.000 *     0.506) +
          1.000 *    1.000 *     6.576) + =       9.177

Total of 3 streams to confluence:
Flow rates before confluence point:
       2.592       0.506       6.576
Maximum flow rates at confluence using above data:
        7.394       6.870       9.177
Area of streams before confluence:
        0.415       0.089       2.169
Results of confluence:
Total flow rate =      9.177(CFS)
Time of concentration =     6.560 min.
Effective stream area after confluence =      2.673(Ac.)


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Process from Point/Station       13.000 to Point/Station       22.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      9.224(CFS)
Depth of flow =   0.886(Ft.), Average velocity =  15.671(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              2.00
       2              1.50              0.00
       3              3.00              2.00
Manning's 'N' friction factor =   0.013
------------------------------------------------------------------------
Sub-Channel flow  =      9.224(CFS)
  '     '       flow top width =      1.329(Ft.)
  '     '    velocity=   15.671(Ft/s)
  '     '       area =      0.589(Sq.Ft)
  '     '       Froude number =     4.150

Upstream point elevation =   444.000(Ft.)
Downstream point elevation =   433.000(Ft.)
Flow length =   100.000(Ft.)
Travel time  =    0.11 min.
Time of concentration =    6.67 min.
Depth of flow =   0.886(Ft.)
Average velocity =  15.671(Ft/s)
Total irregular channel flow =     9.224(CFS)
Irregular channel normal depth above invert elev. =   0.886(Ft.)
Average velocity of channel(s) =  15.671(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.222(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
The area added to the existing stream causes a
a lower flow rate of Q =      9.126(CFS)
therefore the upstream flow rate of Q =      9.177(CFS) is being used
Rainfall intensity =      7.222(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.463  CA =      1.264
Subarea runoff =      0.000(CFS) for      0.055(Ac.)
Total runoff =      9.177(CFS)       Total area =       2.728(Ac.)
Depth of flow =   0.884(Ft.), Average velocity =  15.651(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       22.000
```

```
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.728(Ac.)
Runoff from this stream =      9.177(CFS)
Time of concentration =    6.67 min.
Rainfall intensity =     7.222(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       26.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Initial subarea total flow distance  =   86.000(Ft.)
Highest elevation =  465.000(Ft.)
Lowest elevation =  461.000(Ft.)
Elevation difference =    4.000(Ft.) Slope =  4.651 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 90.00 (Ft)
for the top area slope value of   4.65 %, in a development type of
 General Commercial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   2.86 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8200)*(  90.000^.5)/(   4.651^(1/3)]=   2.86
Calculated TC of    2.864 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      0.200(CFS)
Total initial stream area =        0.028(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       26.000 to Point/Station       27.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      1.879(CFS)
Depth of flow =   0.110(Ft.), Average velocity =   2.571(Ft/s)
       ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00              0.50
       2             0.00              0.00
       3            60.00              0.50
Manning's 'N' friction factor =   0.015
----------------------------------------------------------------
Sub-Channel flow  =      1.879(CFS)
  '     '       flow top width =     13.244(Ft.)
  '     '    velocity=    2.571(Ft/s)
  '     '       area =      0.731(Sq.Ft)
  '     '       Froude number =     1.928

Upstream point elevation =   460.400(Ft.)
Downstream point elevation =   453.400(Ft.)
Flow length =   216.000(Ft.)
Travel time  =    1.40 min.
Time of concentration =    4.26 min.
Depth of flow =   0.110(Ft.)
Average velocity =   2.571(Ft/s)
Total irregular channel flow =     1.879(CFS)
```

```
Irregular channel normal depth above invert elev. =   0.110(Ft.)
Average velocity of channel(s) =   2.571(Ft/s)
 Adding area flow to channel
Calculated TC of    4.265 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type                        ]
(General Commercial    )
Impervious value, Ai = 0.850
Sub-Area C Value = 0.820
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.820  CA =      0.409
Subarea runoff =      3.358(CFS) for      0.471(Ac.)
Total runoff =      3.558(CFS)        Total area =       0.499(Ac.)
Depth of flow =   0.140(Ft.), Average velocity =   3.016(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       27.000 to Point/Station       28.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   448.000(Ft.)
Downstream point/station elevation =   435.000(Ft.)
Pipe length  =    40.00(Ft.) Slope =   0.3250  Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.558(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     3.558(CFS)
Normal flow depth in pipe =    3.83(In.)
Flow top width inside pipe =    8.90(In.)
Critical depth could not be calculated.
Pipe flow velocity =     19.85(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     4.30 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       28.000 to Point/Station       22.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      3.860(CFS)
Depth of flow =   0.331(Ft.), Average velocity =   7.058(Ft/s)
       ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              1.00
       2              5.00              0.00
       3             10.00              1.00
Manning's 'N' friction factor =   0.014
----------------------------------------------------------------
Sub-Channel flow  =      3.860(CFS)
  '     '       flow top width =      3.307(Ft.)
  '     '    velocity=    7.058(Ft/s)
  '     '       area =      0.547(Sq.Ft)
  '     '       Froude number =     3.059

Upstream point elevation =   435.000(Ft.)
Downstream point elevation =   433.000(Ft.)
Flow length =    40.000(Ft.)
Travel time  =    0.09 min.
Time of concentration =    4.39 min.
Depth of flow =   0.331(Ft.)
Average velocity =   7.058(Ft/s)
Total irregular channel flow =     3.860(CFS)
Irregular channel normal depth above invert elev. =   0.331(Ft.)
```

```
Average velocity of channel(s) =   7.058(Ft/s)
 Adding area flow to channel
Calculated TC of    4.393 minutes is less than 5 minutes,
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[UNDISTURBED NATURAL TERRAIN                ]
(Permanent Open Space   )
Impervious value, Ai = 0.000
Sub-Area C Value = 0.350
Rainfall intensity =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.701  CA =      0.469
Subarea runoff =      0.517(CFS) for      0.170(Ac.)
Total runoff =      4.075(CFS)        Total area =       0.669(Ac.)
Depth of flow =   0.338(Ft.), Average velocity =   7.154(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       22.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.669(Ac.)
Runoff from this stream =      4.075(CFS)
Time of concentration =    4.39 min.
Rainfall intensity =     8.695(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)


1        9.177      6.67               7.222
2        4.075      4.39               8.695
Qmax(1) =
          1.000 *    1.000 *     9.177) +
          0.831 *    1.000 *     4.075) + =      12.562
Qmax(2) =
          1.000 *    0.659 *     9.177) +
          1.000 *    1.000 *     4.075) + =      10.122

Total of 2 streams to confluence:
Flow rates before confluence point:
       9.177       4.075
Maximum flow rates at confluence using above data:
       12.562       10.122
Area of streams before confluence:
        2.728        0.669
Results of confluence:
Total flow rate =     12.562(CFS)
Time of concentration =     6.667 min.
Effective stream area after confluence =      3.397(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station        4.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =     12.649(CFS)
Depth of flow =   1.029(Ft.), Average velocity =  13.655(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1             0.00              2.00
       2             1.50              0.00
```

```
       3              3.00              1.50
       4              4.00              1.50
Manning's 'N' friction factor =   0.014
-----------------------------------------------------------------
Sub-Channel flow  =     12.649(CFS)
  '     '       flow top width =      1.801(Ft.)
  '     '    velocity=   13.655(Ft/s)
  '     '       area =      0.926(Sq.Ft)
  '     '       Froude number =     3.355

Upstream point elevation =   433.000(Ft.)
Downstream point elevation =   424.000(Ft.)
Flow length =   128.000(Ft.)
Travel time  =    0.16 min.
Time of concentration =    6.82 min.
Depth of flow =   1.029(Ft.)
Average velocity =  13.655(Ft/s)
Total irregular channel flow =    12.649(CFS)
Irregular channel normal depth above invert elev. =   1.029(Ft.)
Average velocity of channel(s) =  13.655(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.115(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(1.0 DU/A or Less       )
Impervious value, Ai = 0.100
Sub-Area C Value = 0.410
Rainfall intensity =      7.115(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.507  CA =      1.779
Subarea runoff =      0.093(CFS) for      0.113(Ac.)
Total runoff =     12.655(CFS)        Total area =       3.510(Ac.)
Depth of flow =   1.029(Ft.), Average velocity =  13.656(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.510(Ac.)
Runoff from this stream =     12.655(CFS)
Time of concentration =    6.82 min.
Rainfall intensity =     7.115(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1       13.729      7.08               6.949
2       12.655      6.82               7.115
Qmax(1) =
          1.000 *    1.000 *    13.729) +
          0.977 *    1.000 *    12.655) + =      26.089
Qmax(2) =
          1.000 *    0.964 *    13.729) +
          1.000 *    1.000 *    12.655) + =      25.891

Total of 2 main streams to confluence:
Flow rates before confluence point:
      13.729      12.655
Maximum flow rates at confluence using above data:
       26.089       25.891
Area of streams before confluence:
        4.884        3.510
```

```
Results of confluence:
Total flow rate =     26.089(CFS)
Time of concentration =     7.077 min.
Effective stream area after confluence  =      8.394(Ac.)
End of computations, total study area =          8.394 (Ac.)
```

```
               San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2012 Version 7.9

Rational method hydrology  program based on
San Diego County Flood Control Division 2003 hydrology manual
       Rational Hydrology Study        Date: 09/15/14
--------------------------------------------------------------------------
POST-DEVELOPMENT CALCULATION
BASIN 2, 2A, 2B AND 2C
100 YEAR STORM EVENT
DOWNSTREAM NODE 24
--------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

--------------------------------------------------------------------------


Program License Serial Number 6312

--------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
English (in-lb) input data Units used

Map data precipitation entered:
6 hour,  precipitation(inches) =  3.300
24 hour precipitation(inches) =  5.900
P6/P24 =    55.9%
San Diego hydrology manual 'C' values used


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.100 to Point/Station       23.000
**** INITIAL AREA EVALUATION ****
__________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[LOW DENSITY RESIDENTIAL                    ]
(2.9 DU/A or Less       )
Impervious value, Ai = 0.250
Sub-Area C Value = 0.490
Initial subarea total flow distance  =  110.000(Ft.)
Highest elevation =  460.000(Ft.)
Lowest elevation =  451.000(Ft.)
Elevation difference =    9.000(Ft.) Slope =  8.182 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of   8.18 %, in a development type of
 2.9 DU/A or Less
In Accordance With Figure 3-3
Initial Area Time of Concentration =   5.45 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.4900)*( 100.000^.5)/(   8.182^(1/3)]=   5.45
Rainfall intensity (I) =      8.226(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.490
Subarea runoff =      0.564(CFS)
Total initial stream area =        0.140(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       23.100
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
__________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.996(CFS)
Depth of flow =   0.108(Ft.), Average velocity =   4.256(Ft/s)
       ******* Irregular Channel Data ***********
--------------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2              0.00              0.00
       3             20.00              0.50
Manning's 'N' friction factor =   0.015
-----------------------------------------------------------------
Sub-Channel flow  =      0.996(CFS)
  '     '       flow top width =      4.326(Ft.)
  '     '    velocity=    4.256(Ft/s)
  '     '       area =      0.234(Sq.Ft)
  '     '       Froude number =     3.226

Upstream point elevation =   451.000(Ft.)
Downstream point elevation =   430.000(Ft.)
Flow length =   225.000(Ft.)
Travel time  =    0.88 min.
Time of concentration =    6.33 min.
Depth of flow =   0.108(Ft.)
Average velocity =   4.256(Ft/s)
Total irregular channel flow =     0.996(CFS)
Irregular channel normal depth above invert elev. =   0.108(Ft.)
Average velocity of channel(s) =   4.256(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.468(In/Hr) for a   100.0 year storm
User specified 'C' value of 0.630 given for subarea
Rainfall intensity =      7.468(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.575  CA =      0.203
Subarea runoff =      0.955(CFS) for      0.214(Ac.)
Total runoff =      1.519(CFS)        Total area =       0.354(Ac.)
Depth of flow =   0.127(Ft.), Average velocity =   4.730(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.100 to Point/Station       23.100
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.354(Ac.)
Runoff from this stream =      1.519(CFS)
Time of concentration =    6.33 min.
Rainfall intensity =     7.468(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.100 to Point/Station       21.200
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Initial subarea total flow distance  =   75.000(Ft.)
Highest elevation =  461.000(Ft.)
Lowest elevation =  453.000(Ft.)
Elevation difference =    8.000(Ft.) Slope = 10.667 %
INITIAL AREA TIME OF CONCENTRATION CALCULATIONS:
The maximum overland flow distance is 100.00 (Ft)
for the top area slope value of  10.67 %, in a development type of
 General Industrial
In Accordance With Figure 3-3
Initial Area Time of Concentration =   1.88 minutes
TC = [1.8*(1.1-C)*distance(Ft.)^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8700)*( 100.000^.5)/(  10.667^(1/3)]=   1.88
Calculated TC of    1.881 minutes is less than 5 minutes,
```

```
 resetting TC to 5.0 minutes for rainfall intensity calculations
Rainfall intensity (I) =      8.695(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.870
Subarea runoff =      0.386(CFS)
Total initial stream area =        0.051(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       21.200 to Point/Station       23.100
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   0.087(Ft.), Average velocity =   2.043(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2              0.00              0.00
       3             25.00              0.50
Manning's 'N' friction factor =   0.030
------------------------------------------------------------------
Sub-Channel flow  =      0.386(CFS)
  '     '       flow top width =      4.345(Ft.)
  '     '    velocity=    2.043(Ft/s)
  '     '       area =      0.189(Sq.Ft)
  '     '       Froude number =     1.728

Upstream point elevation =   453.000(Ft.)
Downstream point elevation =   430.000(Ft.)
Flow length =   201.000(Ft.)
Travel time  =    1.64 min.
Time of concentration =    3.52 min.
Depth of flow =   0.087(Ft.)
Average velocity =   2.043(Ft/s)
Total irregular channel flow =     0.386(CFS)
Irregular channel normal depth above invert elev. =   0.087(Ft.)
Average velocity of channel(s) =   2.043(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.100 to Point/Station       23.100
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.051(Ac.)
Runoff from this stream =      0.386(CFS)
Time of concentration =    3.52 min.
Rainfall intensity =     8.695(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                (In/Hr)


1        1.519      6.33               7.468
2        0.386      3.52               8.695
Qmax(1) =
          1.000 *    1.000 *     1.519) +
          0.859 *    1.000 *     0.386) + =       1.850
Qmax(2) =
          1.000 *    0.556 *     1.519) +
          1.000 *    1.000 *     0.386) + =       1.231

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.519       0.386
Maximum flow rates at confluence using above data:
        1.850        1.231
Area of streams before confluence:
        0.354        0.051
```

```
Results of confluence:
Total flow rate =      1.850(CFS)
Time of concentration =     6.330 min.
Effective stream area after confluence =      0.405(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.100 to Point/Station       24.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
____________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.079(CFS)
Depth of flow =   0.141(Ft.), Average velocity =   4.207(Ft/s)
       ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
       1              0.00              0.50
       2              0.00              0.00
       3             25.00              0.50
Manning's 'N' friction factor =   0.015
------------------------------------------------------------------
Sub-Channel flow  =      2.079(CFS)
  '     '       flow top width =      7.030(Ft.)
  '     '    velocity=    4.207(Ft/s)
  '     '       area =      0.494(Sq.Ft)
  '     '       Froude number =     2.796

Upstream point elevation =   430.000(Ft.)
Downstream point elevation =   421.000(Ft.)
Flow length =   141.000(Ft.)
Travel time  =    0.56 min.
Time of concentration =    6.89 min.
Depth of flow =   0.141(Ft.)
Average velocity =   4.207(Ft/s)
Total irregular channel flow =     2.079(CFS)
Irregular channel normal depth above invert elev. =   0.141(Ft.)
Average velocity of channel(s) =   4.207(Ft/s)
 Adding area flow to channel
Rainfall intensity (I) =      7.071(In/Hr) for a   100.0 year storm
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
(General Industrial       )
Impervious value, Ai = 0.950
Sub-Area C Value = 0.870
Rainfall intensity =      7.071(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for total area
(Q=KCIA) is C = 0.663  CA =      0.335
Subarea runoff =      0.517(CFS) for      0.100(Ac.)
Total runoff =      2.367(CFS)       Total area =       0.505(Ac.)
Depth of flow =   0.148(Ft.), Average velocity =   4.346(Ft/s)
End of computations, total study area =           0.505 (Ac.)
```

Calculating Peak Flow Attenuation with Bioretention as a Detention System

1. Volume of each bioretention layer was calculated based on the available storage. Gravel layer was calculated as the bioretention area times the depth times 35% (void of gravel layer). Soil layer was calculated similar to gravel but with 40% of void (uncompacted soil). Surface storage was calculated as the ponding bioretention volume.
2. Stage/Storage/Discharge was calculated based on the orifices or weir discharges and tabularized.
3. A hydrograph was generated using Rick-Engineering Rational Hydrograph software.
4. The hydrograph result was exported to Hydrograph Hydraflow progam and routed the hydrograph to the bioretention storage.
5. Outflow hydrograph was created by the hydraflow program based on the provided discharge in the bioretention storage system.

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Manual	4.10	5	245	5,460	----	------	------	INFLOW SC-43
2	Reservoir	2.80	5	250	5,458	1	435.96	1,916	ROUTING SC-43
3	Manual	2.42	5	245	3,846	----	------	------	Inflow SC-42
4	Reservoir	1.67	5	250	3,845	3	456.90	1,108	ROUTING SC-42
5	Manual	0.51	5	245	333	----	------	------	Inflow SC-41
6	Reservoir	0.07	5	255	332	5	454.66	227	Routing SC-41
7	Manual	3.33	5	245	4,629	----	------	------	Inflow SC-40
8	Reservoir	2.17	5	250	4,627	7	462.96	1,624	Routing SC-40

Bioretention	Before detain (cfs)	After detain (cfs)	Reduction (cfs)
SC-40	4.10	2.80	1.30
SC-41	2.42	1.67	0.75
SC-42	0.51	0.07	0.44
SC-43	3.33	2.17	1.16
TOTAL REDUCTION			**3.65**

The total Q at node 4 before the peak flows attenuation included is 26.1 cfs, Therefore, the Q100 after detention calculation incorporated is 26.1 – 3.65 cfs = 22.45 cfs.

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Manual	4.10	5	245	5,460	----	------	------	INFLOW SC-43
2	Reservoir	2.80	5	250	5,458	1	435.96	1,916	ROUTING SC-43
3	Manual	2.42	5	245	3,846	----	------	------	Inflow SC-42
4	Reservoir	1.67	5	250	3,845	3	456.90	1,108	ROUTING SC-42
5	Manual	0.51	5	245	333	----	------	------	Inflow SC-41
6	Reservoir	0.07	5	255	332	5	454.66	227	Routing SC-41
7	Manual	3.33	5	245	4,629	----	------	------	Inflow SC-40
8	Reservoir	2.17	5	250	4,627	7	462.96	1,624	Routing SC-40

Hydrograph Plot

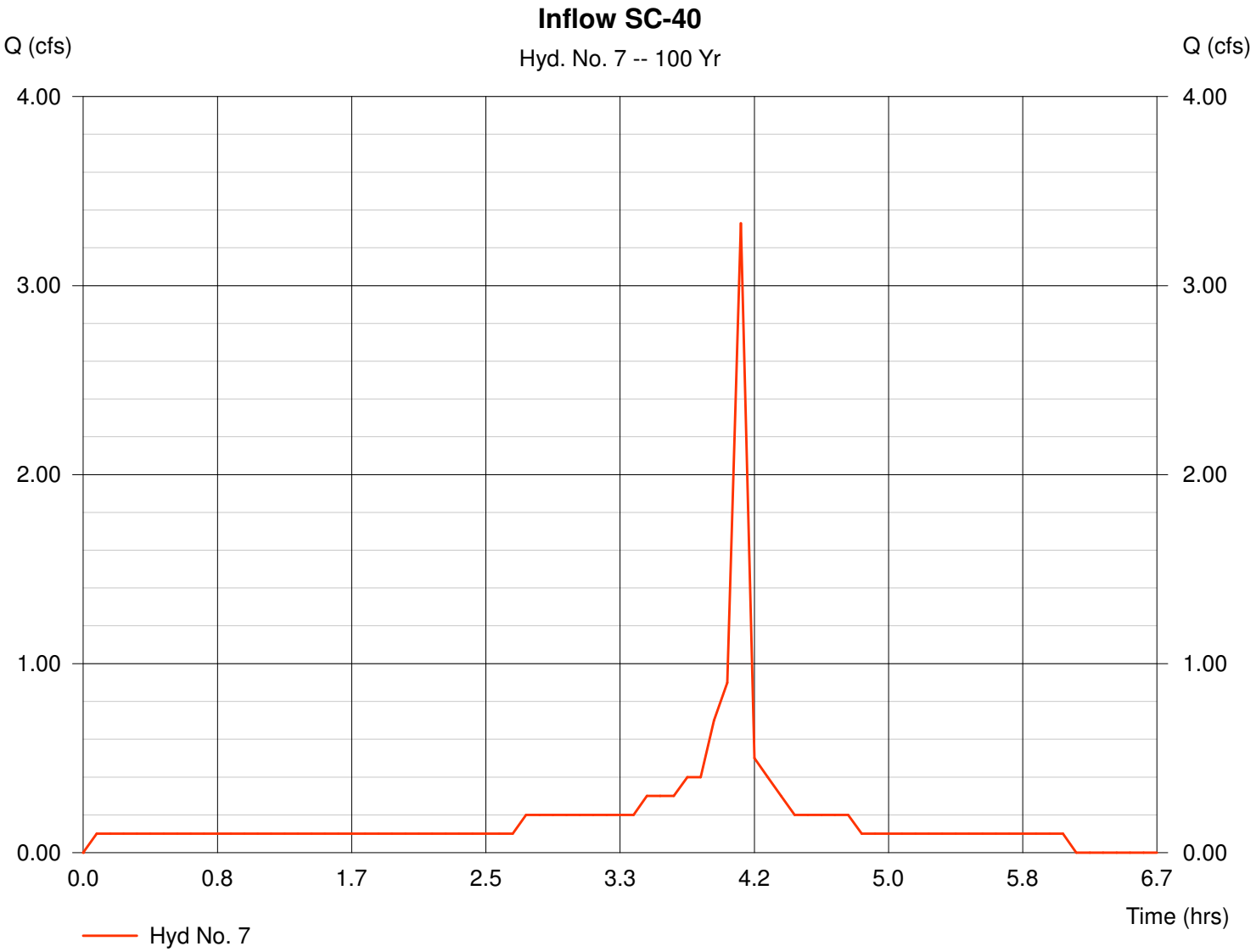
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:40 AM

Hyd. No. 7

Inflow SC-40

Hydrograph type	= Manual	Peak discharge	= 3.33 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 4,629 cuft



Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:42 AM

Hyd. No. 7

Inflow SC-40

Hydrograph type	= Manual	Peak discharge	= 3.33 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 4,629 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
0.08	0.10	2.92	0.20	5.75	0.10
0.17	0.10	3.00	0.20	5.83	0.10
0.25	0.10	3.08	0.20	5.92	0.10
0.33	0.10	3.17	0.20	6.00	0.10
0.42	0.10	3.25	0.20	6.08	0.10
0.50	0.10	3.33	0.20		
0.58	0.10	3.42	0.20		
0.67	0.10	3.50	0.30	*...End*	
0.75	0.10	3.58	0.30		
0.83	0.10	3.67	0.30		
0.92	0.10	3.75	0.40		
1.00	0.10	3.83	0.40		
1.08	0.10	3.92	0.70		
1.17	0.10	4.00	0.90		
1.25	0.10	4.08	3.33 <<		
1.33	0.10	4.17	0.50		
1.42	0.10	4.25	0.40		
1.50	0.10	4.33	0.30		
1.58	0.10	4.42	0.20		
1.67	0.10	4.50	0.20		
1.75	0.10	4.58	0.20		
1.83	0.10	4.67	0.20		
1.92	0.10	4.75	0.20		
2.00	0.10	4.83	0.10		
2.08	0.10	4.92	0.10		
2.17	0.10	5.00	0.10		
2.25	0.10	5.08	0.10		
2.33	0.10	5.17	0.10		
2.42	0.10	5.25	0.10		
2.50	0.10	5.33	0.10		
2.58	0.10	5.42	0.10		
2.67	0.10	5.50	0.10		
2.75	0.20	5.58	0.10		
2.83	0.20	5.67	0.10		

Hydrograph Plot

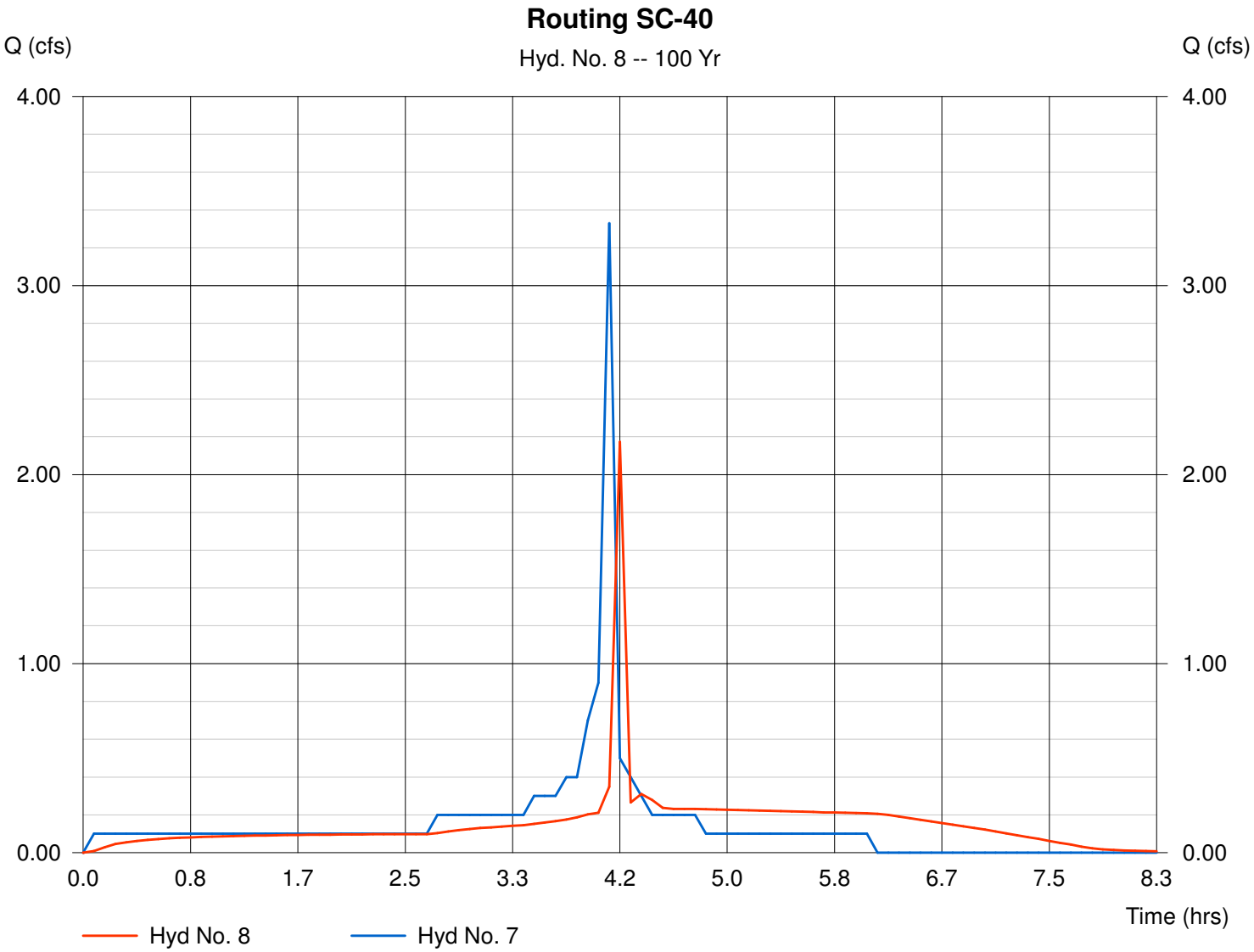
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:44 AM

Hyd. No. 8

Routing SC-40

Hydrograph type	=	Reservoir	Peak discharge	=	2.17 cfs
Storm frequency	=	100 yrs	Time interval	=	5 min
Inflow hyd. No.	=	7	Max. Elevation	=	462.96 ft
Reservoir name	=	Bioretention SC-40	Max. Storage	=	1,624 cuft

Storage Indication method used. | Hydrograph Volume = 4,627 cuft



Pond Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:44 AM

Pond No. 4 - Bioretention SC-40

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	459.50	00	0	0
1.00	460.50	00	264	264
2.50	462.00	00	452	716
3.50	463.00	00	948	1,664

Culvert / Orifice Structures

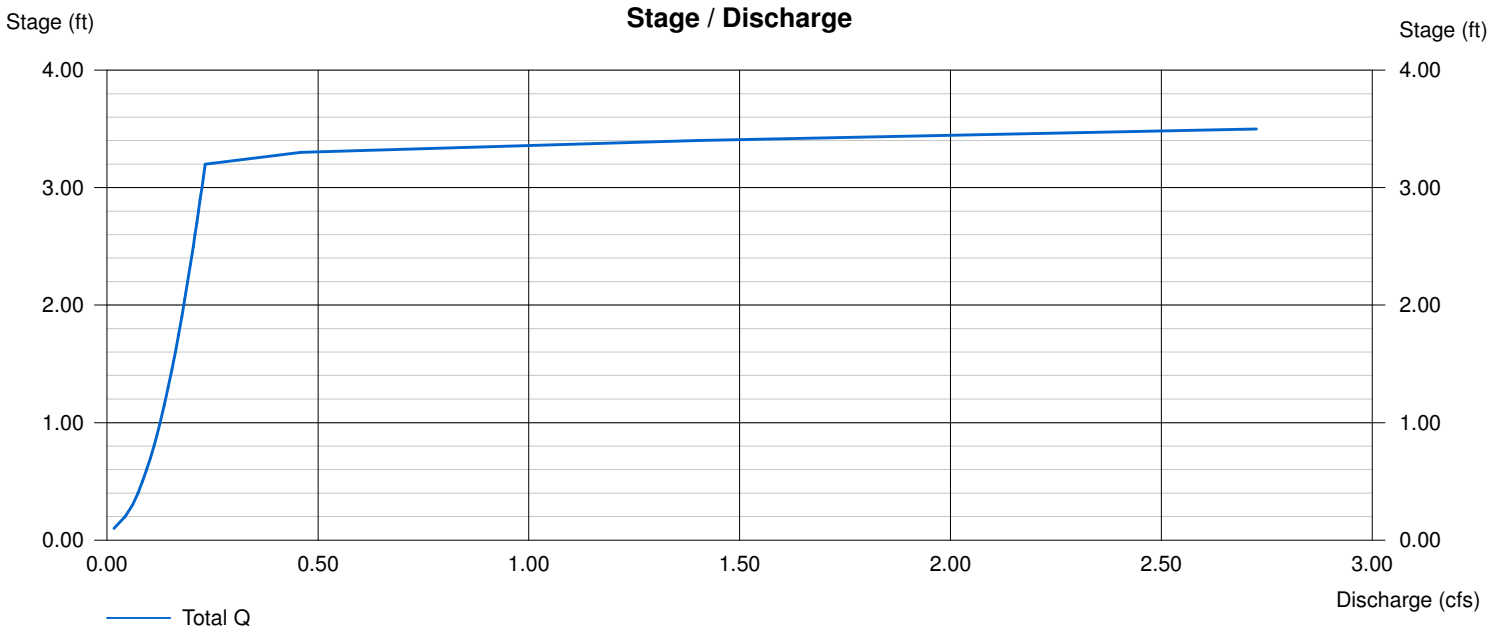
	[A]	[B]	[C]	[D]
Rise (in)	= 12.00	2.24	0.00	0.00
Span (in)	= 12.00	2.24	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 459.00	459.50	0.00	0.00
Length (ft)	= 43.00	0.00	0.00	0.00
Slope (%)	= 25.60	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	0.00	0.00	0.00
Crest El. (ft)	= 462.75	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:46 AM

Hyd. No. 8

Routing SC-40

Hydrograph type	= Reservoir	Peak discharge	= 2.17 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min
Inflow hyd. No.	= 7	Reservoir name	= Bioretention SC-4
Max. Elevation	= 462.96 ft	Max. Storage	= 1,624 cuft

Storage Indication method used. | Outflow hydrograph volume = 4,627 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.17	0.10	459.64	0.95	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
0.25	0.10	459.72	0.95	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
0.33	0.10	459.77	0.95	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.42	0.10	459.82	0.95	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.50	0.10	459.86	0.95	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.58	0.10	459.89	0.95	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.67	0.10	459.92	0.95	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.75	0.10	459.95	0.95	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.83	0.10	459.97	0.95	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.92	0.10	459.99	0.95	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.00	0.10	460.01	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.08	0.10	460.03	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.10	460.04	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.25	0.10	460.05	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.33	0.10	460.07	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.42	0.10	460.08	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.50	0.10	460.09	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.58	0.10	460.09	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.67	0.10	460.10	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.75	0.10	460.11	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.83	0.10	460.11	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.92	0.10	460.12	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.00	0.10	460.12	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.08	0.10	460.13	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.17	0.10	460.13	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.25	0.10	460.14	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.33	0.10	460.14	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.42	0.10	460.14	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.50	0.10	460.14	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.58	0.10	460.15	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.67	0.10	460.15	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.75	0.20	460.21	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.83	0.20	460.31	0.95	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
2.92	0.20	460.41	0.95	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
3.00	0.20	460.50	0.95	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
3.08	0.20	460.57	0.95	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
3.17	0.20	460.64	0.95	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
3.25	0.20	460.70	0.95	0.14	-----	-----	-----	-----	-----	-----	-----	0.14

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Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.33	0.20	460.76	0.95	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
3.42	0.20	460.81	0.95	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
3.50	0.30	460.92	0.95	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
3.58	0.30	461.06	0.95	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.67	0.30	461.20	0.95	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
3.75	0.40	461.37	0.95	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
3.83	0.40	461.59	0.95	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
3.92	0.70	461.95	0.95	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
4.00	0.90	462.17	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
4.08	3.33 <<	462.75	0.95	0.23	-----	-----	0.11	-----	-----	-----	-----	0.35
4.17	0.50	462.96	2.18	0.23	-----	-----	1.94	-----	-----	-----	-----	2.17 <<
4.25	0.40	462.71	0.95	0.23	-----	-----	0.03	-----	-----	-----	-----	0.27
4.33	0.30	462.73	0.95	0.23	-----	-----	0.08	-----	-----	-----	-----	0.31
4.42	0.20	462.72	0.95	0.23	-----	-----	0.05	-----	-----	-----	-----	0.28
4.50	0.20	462.70	0.95	0.23	-----	-----	0.00	-----	-----	-----	-----	0.24
4.58	0.20	462.69	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
4.67	0.20	462.68	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
4.75	0.20	462.67	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
4.83	0.10	462.65	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
4.92	0.10	462.60	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
5.00	0.10	462.56	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
5.08	0.10	462.52	0.95	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
5.17	0.10	462.48	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.25	0.10	462.45	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.33	0.10	462.41	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.42	0.10	462.37	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.50	0.10	462.33	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.58	0.10	462.29	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.67	0.10	462.26	0.95	0.22	-----	-----	-----	-----	-----	-----	-----	0.22
5.75	0.10	462.22	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
5.83	0.10	462.19	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
5.92	0.10	462.15	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.00	0.10	462.12	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.08	0.10	462.08	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.17	0.00	462.03	0.95	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.25	0.00	461.90	0.95	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
6.33	0.00	461.70	0.95	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
6.42	0.00	461.52	0.95	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
6.50	0.00	461.34	0.95	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
6.58	0.00	461.17	0.95	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
6.67	0.00	461.01	0.95	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.75	0.00	460.86	0.95	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
6.83	0.00	460.72	0.95	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
6.92	0.00	460.58	0.95	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
7.00	0.00	460.45	0.95	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
7.08	0.00	460.32	0.95	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
7.17	0.00	460.19	0.95	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
7.25	0.00	460.08	0.95	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
7.33	0.00	459.98	0.95	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
7.42	0.00	459.90	0.95	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
7.50	0.00	459.82	0.95	0.06	-----	-----	-----	-----	-----	-----	-----	0.06

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Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
7.58	0.00	459.75	0.95	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
7.67	0.00	459.70	0.95	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
7.75	0.00	459.66	0.95	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
7.83	0.00	459.63	0.95	0.02	-----	-----	-----	-----	-----	-----	-----	0.02

...End

Hydrograph Plot

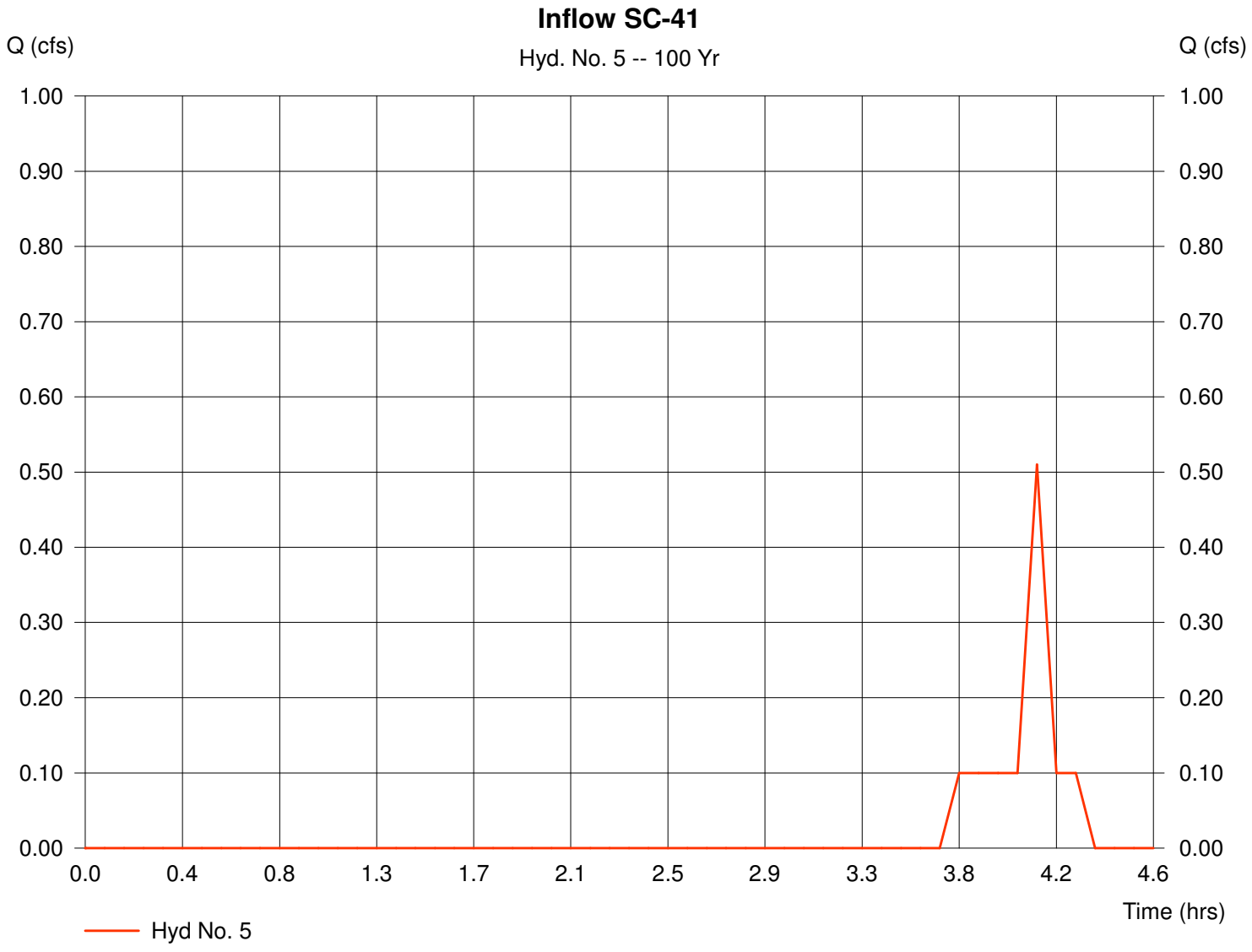
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:48 AM

Hyd. No. 5

Inflow SC-41

Hydrograph type	= Manual	Peak discharge	= 0.51 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 333 cuft



Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:49 AM

Hyd. No. 5

Inflow SC-41

Hydrograph type	= Manual	Peak discharge	= 0.51 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 333 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Outflow (cfs)
3.75	0.10
3.83	0.10
3.92	0.10
4.00	0.10
4.08	0.51 <<
4.17	0.10
4.25	0.10

...End

Hydrograph Plot

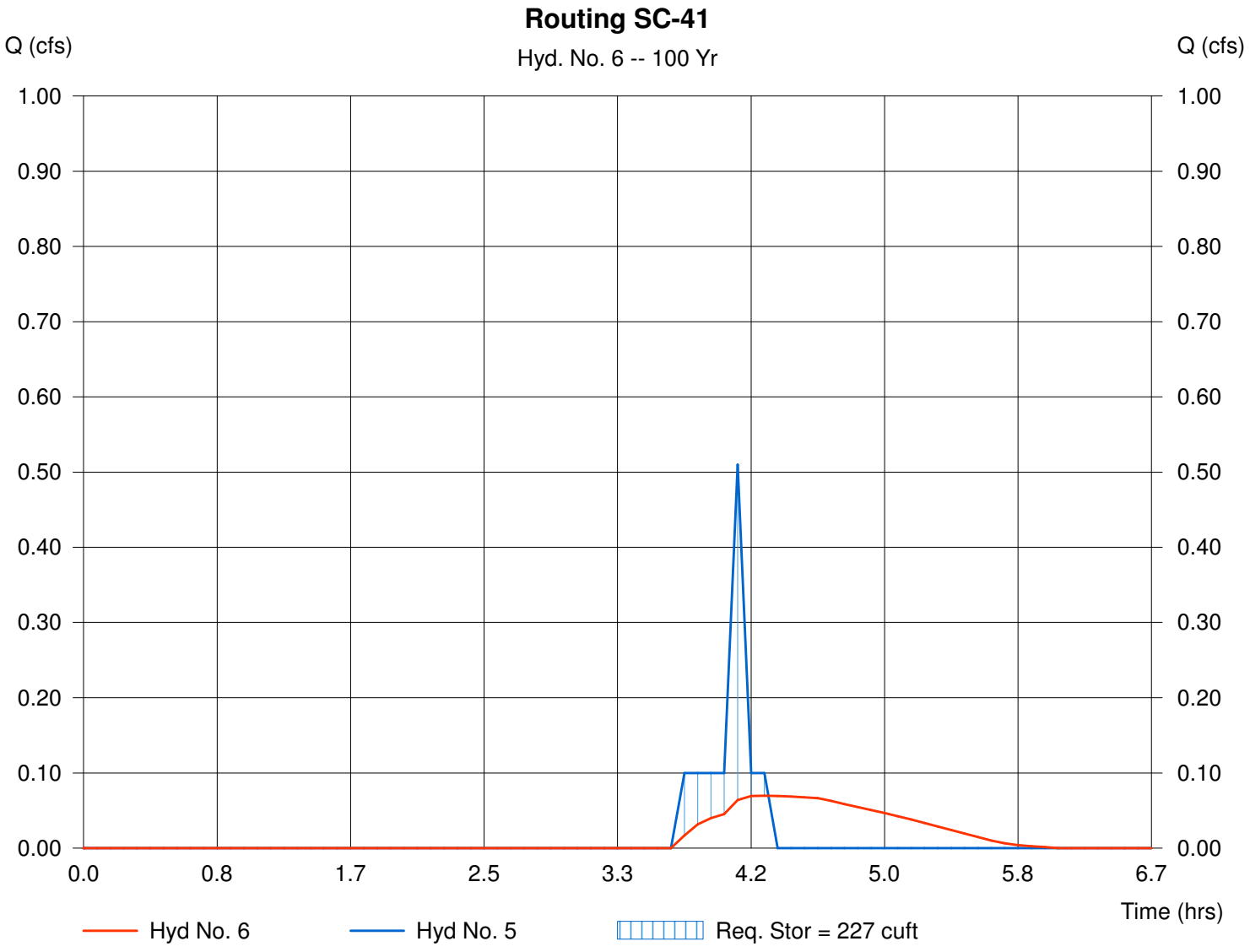
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:49 AM

Hyd. No. 6

Routing SC-41

Hydrograph type	=	Reservoir	Peak discharge	=	0.07 cfs
Storm frequency	=	100 yrs	Time interval	=	5 min
Inflow hyd. No.	=	5	Max. Elevation	=	454.66 ft
Reservoir name	=	Bioretention SC-41	Max. Storage	=	227 cuft

Storage Indication method used. | Hydrograph Volume = 332 cuft



Pond Report

Pond No. 3 - Bioretention SC-41

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	451.90	00	0	0
1.00	452.90	00	58	58
2.50	454.40	00	100	158
3.50	455.40	00	268	426

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 12.00	1.27	0.00	0.00
Span (in)	= 12.00	1.27	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 451.00	451.90	0.00	0.00
Length (ft)	= 57.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	0.00	0.00	0.00
Crest El. (ft)	= 454.90	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	451.90	0.00	0.00	---	---	0.00	---	---	---	---	0.00
1.00	58	452.90	2.41	0.04	---	---	0.00	---	---	---	---	0.04
2.50	158	454.40	2.41	0.07	---	---	0.00	---	---	---	---	0.07
3.50	426	455.40	6.63	0.03	---	---	6.61	---	---	---	---	6.63

Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:51 AM

Hyd. No. 6

Routing SC-41

Hydrograph type	= Reservoir	Peak discharge	= 0.07 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min
Inflow hyd. No.	= 5	Reservoir name	= Bioretention SC-4
Max. Elevation	= 454.66 ft	Max. Storage	= 227 cuft

Storage Indication method used. | Outflow hydrograph volume = 332 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.75	0.10	452.11	2.41	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
3.83	0.10	452.51	2.41	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
3.92	0.10	452.84	2.41	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
4.00	0.10	453.11	2.41	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
4.08	0.51 <<	454.23	2.41	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
4.17	0.10	454.63	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
4.25	0.10	454.66 <<	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07 <<
4.33	0.00	454.64	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
4.42	0.00	454.56	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
4.50	0.00	454.48	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
4.58	0.00	454.41	2.41	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
4.67	0.00	454.15	2.41	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
4.75	0.00	453.87	2.41	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
4.83	0.00	453.62	2.41	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
4.92	0.00	453.38	2.41	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
5.00	0.00	453.16	2.41	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
5.08	0.00	452.96	2.41	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
5.17	0.00	452.76	2.41	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
5.25	0.00	452.58	2.41	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
5.33	0.00	452.42	2.41	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
5.42	0.00	452.28	2.41	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
5.50	0.00	452.17	2.41	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
5.58	0.00	452.08	2.41	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
5.67	0.00	452.01	2.41	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
5.75	0.00	451.97	1.70	0.01	-----	-----	-----	-----	-----	-----	-----	0.01
5.83	0.00	451.94	1.05	0.00	-----	-----	-----	-----	-----	-----	-----	0.00
5.92	0.00	451.93	0.64	0.00	-----	-----	-----	-----	-----	-----	-----	0.00
6.00	0.00	451.92	0.39	0.00	-----	-----	-----	-----	-----	-----	-----	0.00

...End

Hydrograph Plot

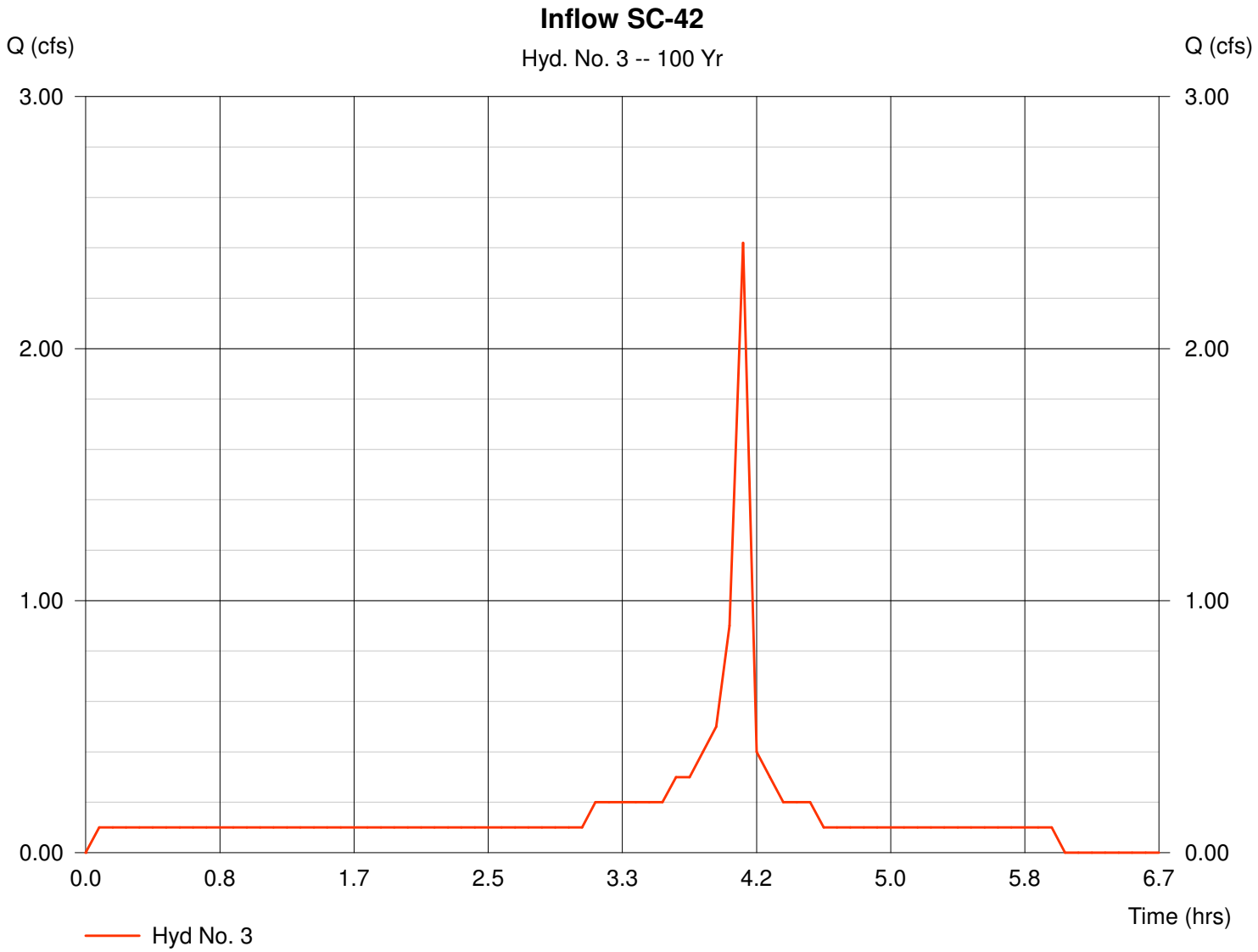
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:56 AM

Hyd. No. 3

Inflow SC-42

Hydrograph type	= Manual	Peak discharge	= 2.42 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 3,846 cuft



Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:57 AM

Hyd. No. 3

Inflow SC-42

Hydrograph type	= Manual	Peak discharge	= 2.42 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 3,846 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
0.08	0.10	2.92	0.10	5.75	0.10
0.17	0.10	3.00	0.10	5.83	0.10
0.25	0.10	3.08	0.10	5.92	0.10
0.33	0.10	3.17	0.20	6.00	0.10
0.42	0.10	3.25	0.20		
0.50	0.10	3.33	0.20		
0.58	0.10	3.42	0.20	*...End*	
0.67	0.10	3.50	0.20		
0.75	0.10	3.58	0.20		
0.83	0.10	3.67	0.30		
0.92	0.10	3.75	0.30		
1.00	0.10	3.83	0.40		
1.08	0.10	3.92	0.50		
1.17	0.10	4.00	0.90		
1.25	0.10	4.08	2.42 <<		
1.33	0.10	4.17	0.40		
1.42	0.10	4.25	0.30		
1.50	0.10	4.33	0.20		
1.58	0.10	4.42	0.20		
1.67	0.10	4.50	0.20		
1.75	0.10	4.58	0.10		
1.83	0.10	4.67	0.10		
1.92	0.10	4.75	0.10		
2.00	0.10	4.83	0.10		
2.08	0.10	4.92	0.10		
2.17	0.10	5.00	0.10		
2.25	0.10	5.08	0.10		
2.33	0.10	5.17	0.10		
2.42	0.10	5.25	0.10		
2.50	0.10	5.33	0.10		
2.58	0.10	5.42	0.10		
2.67	0.10	5.50	0.10		
2.75	0.10	5.58	0.10		
2.83	0.10	5.67	0.10		

Hydrograph Plot

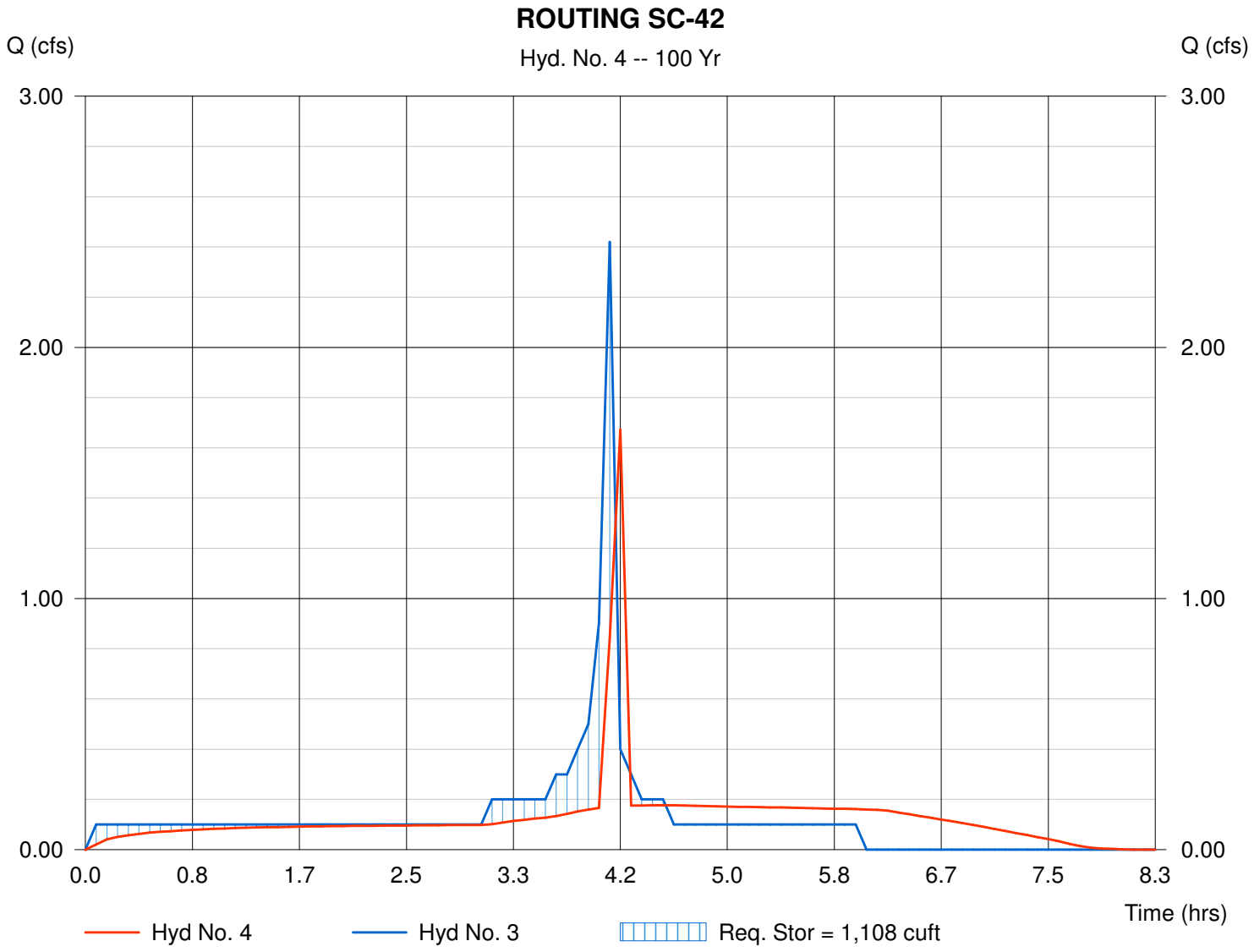
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:57 AM

Hyd. No. 4

ROUTING SC-42

Hydrograph type	=	Reservoir	Peak discharge	=	1.67 cfs
Storm frequency	=	100 yrs	Time interval	=	5 min
Inflow hyd. No.	=	3	Max. Elevation	=	456.90 ft
Reservoir name	=	Bioretention SC-42	Max. Storage	=	1,108 cuft

Storage Indication method used. | Hydrograph Volume = 3,845 cuft



Pond Report

Pond No. 2 - Bioretention SC-42

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	453.50	00	0	0
1.00	454.50	00	182	182
2.50	456.00	00	311	493
3.50	457.00	00	686	1,179

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 12.00	1.94	0.00	0.00
Span (in)	= 12.00	1.94	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 453.00	432.50	0.00	0.00
Length (ft)	= 16.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 456.75	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	453.50	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	18	453.60	0.89	0.03	---	---	0.00	---	---	---	---	0.03
0.20	36	453.70	0.89	0.04	---	---	0.00	---	---	---	---	0.04
0.30	55	453.80	0.89	0.05	---	---	0.00	---	---	---	---	0.05
0.40	73	453.90	0.89	0.06	---	---	0.00	---	---	---	---	0.06
0.50	91	454.00	0.89	0.07	---	---	0.00	---	---	---	---	0.07
0.60	109	454.10	0.89	0.08	---	---	0.00	---	---	---	---	0.08
0.70	127	454.20	0.89	0.08	---	---	0.00	---	---	---	---	0.08
0.80	146	454.30	0.89	0.09	---	---	0.00	---	---	---	---	0.09
0.90	164	454.40	0.89	0.09	---	---	0.00	---	---	---	---	0.09
1.00	182	454.50	0.89	0.10	---	---	0.00	---	---	---	---	0.10
1.15	213	454.65	0.89	0.11	---	---	0.00	---	---	---	---	0.11
1.30	244	454.80	0.89	0.11	---	---	0.00	---	---	---	---	0.11
1.45	275	454.95	0.89	0.12	---	---	0.00	---	---	---	---	0.12
1.60	306	455.10	0.89	0.13	---	---	0.00	---	---	---	---	0.13
1.75	338	455.25	0.89	0.13	---	---	0.00	---	---	---	---	0.13
1.90	369	455.40	0.89	0.14	---	---	0.00	---	---	---	---	0.14
2.05	400	455.55	0.89	0.14	---	---	0.00	---	---	---	---	0.14
2.20	431	455.70	0.89	0.15	---	---	0.00	---	---	---	---	0.15
2.35	462	455.85	0.89	0.15	---	---	0.00	---	---	---	---	0.15
2.50	493	456.00	0.89	0.16	---	---	0.00	---	---	---	---	0.16
2.60	562	456.10	0.89	0.16	---	---	0.00	---	---	---	---	0.16
2.70	630	456.20	0.89	0.16	---	---	0.00	---	---	---	---	0.16
2.80	699	456.30	0.89	0.17	---	---	0.00	---	---	---	---	0.17
2.90	767	456.40	0.89	0.17	---	---	0.00	---	---	---	---	0.17
3.00	836	456.50	0.89	0.17	---	---	0.00	---	---	---	---	0.17
3.10	905	456.60	0.89	0.17	---	---	0.00	---	---	---	---	0.17
3.20	973	456.70	0.89	0.18	---	---	0.00	---	---	---	---	0.18
3.30	1,042	456.80	0.89	0.18	---	---	0.30	---	---	---	---	0.48
3.40	1,110	456.90	1.72	0.17	---	---	1.55	---	---	---	---	1.72
3.50	1,179	457.00	3.49	0.16	---	---	3.33	---	---	---	---	3.49

Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:57 AM

Hyd. No. 4

ROUTING SC-42

Hydrograph type	= Reservoir	Peak discharge	= 1.67 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min
Inflow hyd. No.	= 3	Reservoir name	= Bioretention SC-4
Max. Elevation	= 456.90 ft	Max. Storage	= 1,108 cuft

Storage Indication method used. | Outflow hydrograph volume = 3,845 cuft

Hydrograph Discharge Table

(Printed values >= 1% of Qp.)

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.08	0.10	453.57	0.58	0.02	-----	-----	-----	-----	-----	-----	-----	0.02
0.17	0.10	453.68	0.89	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
0.25	0.10	453.77	0.89	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
0.33	0.10	453.84	0.89	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.42	0.10	453.91	0.89	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.50	0.10	453.97	0.89	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.58	0.10	454.02	0.89	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.67	0.10	454.06	0.89	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.75	0.10	454.10	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.83	0.10	454.14	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.92	0.10	454.17	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.00	0.10	454.20	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.08	0.10	454.23	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
1.17	0.10	454.25	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.25	0.10	454.28	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.33	0.10	454.30	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.42	0.10	454.32	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.50	0.10	454.33	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.58	0.10	454.35	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.67	0.10	454.36	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.75	0.10	454.38	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.83	0.10	454.39	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.92	0.10	454.40	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
2.00	0.10	454.41	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
2.08	0.10	454.42	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
2.17	0.10	454.43	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.25	0.10	454.43	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.33	0.10	454.44	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.42	0.10	454.45	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.50	0.10	454.45	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.58	0.10	454.46	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.67	0.10	454.46	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.75	0.10	454.47	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.83	0.10	454.47	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.92	0.10	454.48	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
3.00	0.10	454.48	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
3.08	0.10	454.48	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
3.17	0.20	454.56	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10

Continues on next page...

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.25	0.20	454.70	0.89	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
3.33	0.20	454.83	0.89	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
3.42	0.20	454.95	0.89	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
3.50	0.20	455.06	0.89	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
3.58	0.20	455.17	0.89	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
3.67	0.30	455.34	0.89	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
3.75	0.30	455.58	0.89	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
3.83	0.40	455.87	0.89	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
3.92	0.50	456.09	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
4.00	0.90	456.32	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
4.08	2.42 <<	456.83	1.14	0.18	-----	-----	0.67	-----	-----	-----	-----	0.84
4.17	0.40	456.90 <<	1.69	0.17	-----	-----	1.50	-----	-----	-----	-----	1.67 <<
4.25	0.30	456.65	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.33	0.20	456.68	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.42	0.20	456.69	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.50	0.20	456.70	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.58	0.10	456.69	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.67	0.10	456.65	0.89	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
4.75	0.10	456.62	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
4.83	0.10	456.59	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
4.92	0.10	456.56	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.00	0.10	456.52	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.08	0.10	456.49	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.17	0.10	456.46	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.25	0.10	456.43	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.33	0.10	456.40	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.42	0.10	456.37	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.50	0.10	456.34	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.58	0.10	456.31	0.89	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
5.67	0.10	456.29	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
5.75	0.10	456.26	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
5.83	0.10	456.23	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
5.92	0.10	456.20	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.00	0.10	456.17	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.08	0.00	456.13	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.17	0.00	456.06	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.25	0.00	455.96	0.89	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
6.33	0.00	455.74	0.89	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
6.42	0.00	455.53	0.89	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
6.50	0.00	455.33	0.89	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
6.58	0.00	455.15	0.89	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
6.67	0.00	454.97	0.89	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
6.75	0.00	454.80	0.89	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
6.83	0.00	454.64	0.89	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
6.92	0.00	454.49	0.89	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
7.00	0.00	454.34	0.89	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
7.08	0.00	454.19	0.89	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
7.17	0.00	454.07	0.89	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
7.25	0.00	453.95	0.89	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
7.33	0.00	453.85	0.89	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
7.42	0.00	453.76	0.89	0.05	-----	-----	-----	-----	-----	-----	-----	0.05

Continues on next page...

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
7.50	0.00	453.68	0.89	0.04	-----	-----	-----	-----	-----	-----	-----	0.04
7.58	0.00	453.62	0.89	0.03	-----	-----	-----	-----	-----	-----	-----	0.03
7.67	0.00	453.57	0.65	0.02	-----	-----	-----	-----	-----	-----	-----	0.02

...End

Hydrograph Plot

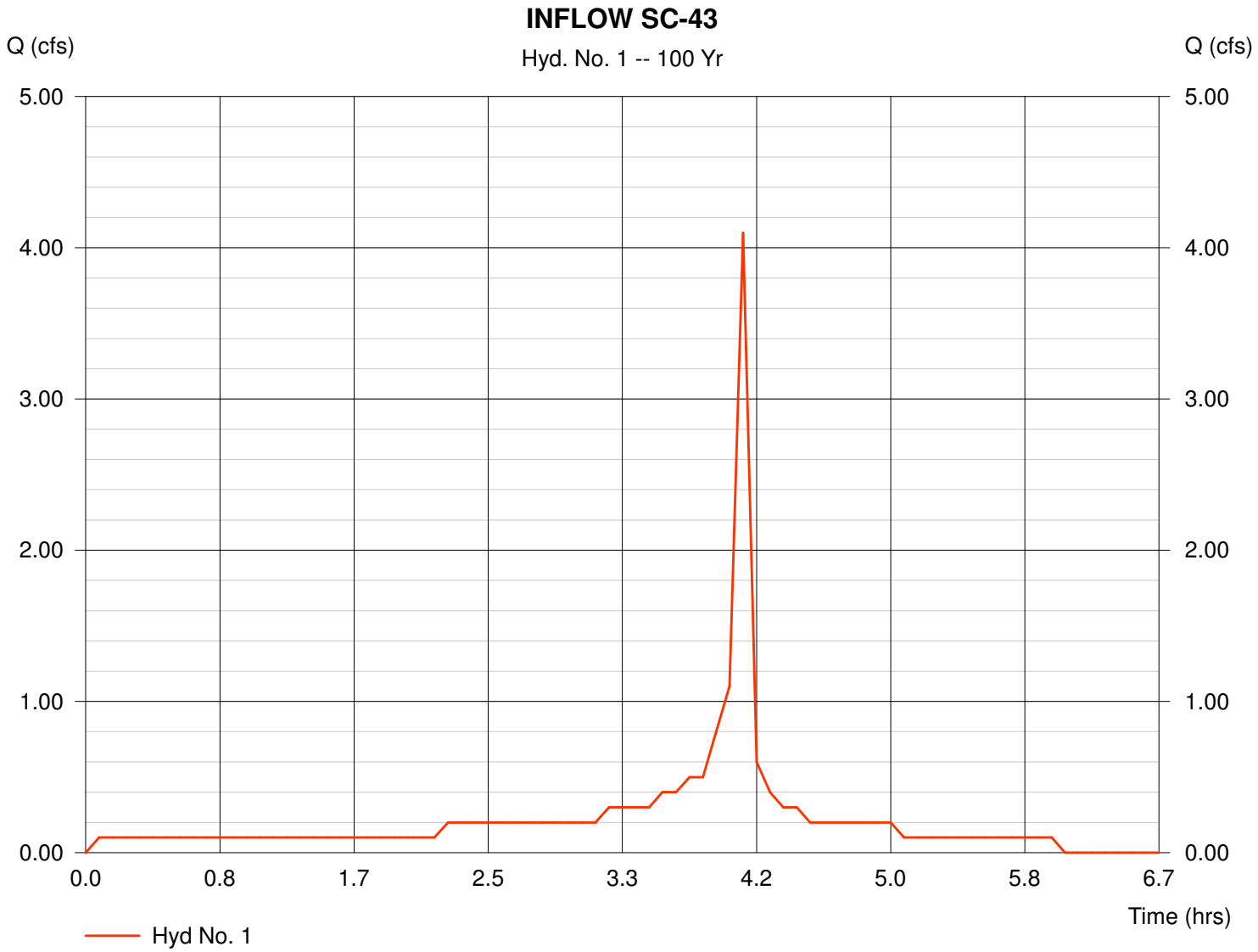
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 9:59 AM

Hyd. No. 1

INFLOW SC-43

Hydrograph type	= Manual	Peak discharge	= 4.10 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 5,460 cuft



Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 10:0 AM

Hyd. No. 1

INFLOW SC-43

Hydrograph type	= Manual	Peak discharge	= 4.10 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 5,460 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
0.08	0.10	2.92	0.20	5.75	0.10
0.17	0.10	3.00	0.20	5.83	0.10
0.25	0.10	3.08	0.20	5.92	0.10
0.33	0.10	3.17	0.20	6.00	0.10
0.42	0.10	3.25	0.30		
0.50	0.10	3.33	0.30		
0.58	0.10	3.42	0.30	*...End*	
0.67	0.10	3.50	0.30		
0.75	0.10	3.58	0.40		
0.83	0.10	3.67	0.40		
0.92	0.10	3.75	0.50		
1.00	0.10	3.83	0.50		
1.08	0.10	3.92	0.80		
1.17	0.10	4.00	1.10		
1.25	0.10	4.08	4.10 <<		
1.33	0.10	4.17	0.60		
1.42	0.10	4.25	0.40		
1.50	0.10	4.33	0.30		
1.58	0.10	4.42	0.30		
1.67	0.10	4.50	0.20		
1.75	0.10	4.58	0.20		
1.83	0.10	4.67	0.20		
1.92	0.10	4.75	0.20		
2.00	0.10	4.83	0.20		
2.08	0.10	4.92	0.20		
2.17	0.10	5.00	0.20		
2.25	0.20	5.08	0.10		
2.33	0.20	5.17	0.10		
2.42	0.20	5.25	0.10		
2.50	0.20	5.33	0.10		
2.58	0.20	5.42	0.10		
2.67	0.20	5.50	0.10		
2.75	0.20	5.58	0.10		
2.83	0.20	5.67	0.10		

Hydrograph Plot

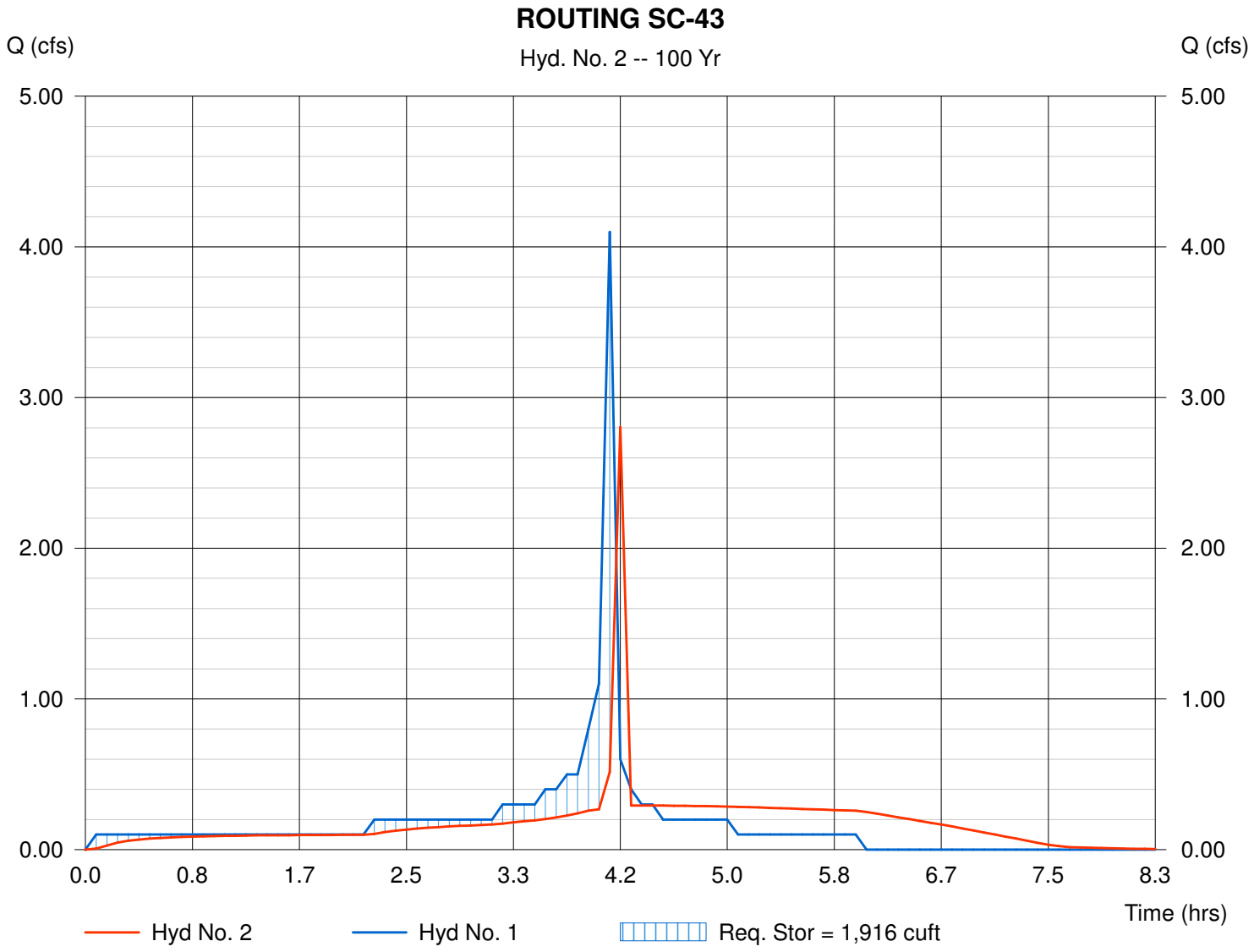
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 10:0 AM

Hyd. No. 2

ROUTING SC-43

Hydrograph type	=	Reservoir	Peak discharge	=	2.80 cfs
Storm frequency	=	100 yrs	Time interval	=	5 min
Inflow hyd. No.	=	1	Max. Elevation	=	435.96 ft
Reservoir name	=	Bioretention SC-43	Max. Storage	=	1,916 cuft

Storage Indication method used. | Hydrograph Volume = 5,458 cuft



Hydrograph Report

Hyd. No. 2

ROUTING SC-43

Hydrograph type	= Reservoir	Peak discharge	= 2.80 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min
Inflow hyd. No.	= 1	Reservoir name	= Bioretention SC-4
Max. Elevation	= 435.96 ft	Max. Storage	= 1,916 cuft

Storage Indication method used. Outflow hydrograph volume = 5,458 cuft

Hydrograph Discharge Table

(Printed values >= 1% of Qp.)

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.25	0.10	432.69	0.67	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
0.33	0.10	432.73	0.67	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.42	0.10	432.77	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.50	0.10	432.80	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.58	0.10	432.82	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.67	0.10	432.84	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.75	0.10	432.86	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.83	0.10	432.88	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
0.92	0.10	432.89	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.00	0.10	432.90	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.08	0.10	432.91	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.10	432.91	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.25	0.10	432.92	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.33	0.10	432.93	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.42	0.10	432.93	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.50	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.58	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.67	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.75	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.83	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.92	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.00	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.08	0.10	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.17	0.10	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.25	0.20	433.00	0.67	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
2.33	0.20	433.09	0.67	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
2.42	0.20	433.17	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
2.50	0.20	433.24	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
2.58	0.20	433.30	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
2.67	0.20	433.36	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
2.75	0.20	433.41	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
2.83	0.20	433.46	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
2.92	0.20	433.50	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.00	0.20	433.54	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.08	0.20	433.57	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.17	0.20	433.60	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
3.25	0.30	433.67	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
3.33	0.30	433.77	0.67	0.18	-----	-----	-----	-----	-----	-----	-----	0.18

Continues on next page...

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.42	0.30	433.87	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
3.50	0.30	433.97	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
3.58	0.40	434.10	0.67	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
3.67	0.40	434.26	0.67	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
3.75	0.50	434.46	0.67	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
3.83	0.50	434.69	0.67	0.24	-----	-----	-----	-----	-----	-----	-----	0.24
3.92	0.80	435.01	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
4.00	1.10	435.19	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
4.08	4.10 <<	435.77	0.67	0.30	-----	-----	0.22	-----	-----	-----	-----	0.52
4.17	0.60	435.96 <<	2.81	0.27	-----	-----	2.53	-----	-----	-----	-----	2.80 <<
4.25	0.40	435.68	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.33	0.30	435.69	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.42	0.30	435.70	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.50	0.20	435.68	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.58	0.20	435.66	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.67	0.20	435.64	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.75	0.20	435.61	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.83	0.20	435.59	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.92	0.20	435.57	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
5.00	0.20	435.54	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
5.08	0.10	435.51	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.17	0.10	435.46	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.25	0.10	435.41	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.33	0.10	435.36	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.42	0.10	435.32	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.50	0.10	435.27	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.58	0.10	435.23	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.67	0.10	435.18	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.75	0.10	435.14	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.83	0.10	435.10	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
5.92	0.10	435.05	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
6.00	0.10	435.01	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
6.08	0.00	434.86	0.67	0.25	-----	-----	-----	-----	-----	-----	-----	0.25
6.17	0.00	434.65	0.67	0.24	-----	-----	-----	-----	-----	-----	-----	0.24
6.25	0.00	434.45	0.67	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
6.33	0.00	434.26	0.67	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.42	0.00	434.08	0.67	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
6.50	0.00	433.91	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
6.58	0.00	433.75	0.67	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
6.67	0.00	433.61	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
6.75	0.00	433.46	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
6.83	0.00	433.32	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
6.92	0.00	433.19	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
7.00	0.00	433.07	0.67	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
7.08	0.00	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
7.17	0.00	432.87	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
7.25	0.00	432.80	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
7.33	0.00	432.73	0.67	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
7.42	0.00	432.68	0.67	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
7.50	0.00	432.64	0.67	0.03	-----	-----	-----	-----	-----	-----	-----	0.03

...End

Pond Report

Pond No. 1 - Bioretention SC-43

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	432.50	00	0	0
1.00	433.50	00	306	306
2.50	435.00	00	524	830
3.50	436.00	00	1,137	1,967

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 12.00	2.52	0.00	0.00
Span (in)	= 12.00	2.52	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 432.00	432.50	0.00	0.00
Length (ft)	= 8.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 435.75	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	432.50	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	31	432.60	0.67	0.02	---	---	0.00	---	---	---	---	0.02
0.20	61	432.70	0.67	0.05	---	---	0.00	---	---	---	---	0.05
0.30	92	432.80	0.67	0.07	---	---	0.00	---	---	---	---	0.07
0.40	122	432.90	0.67	0.09	---	---	0.00	---	---	---	---	0.09
0.50	153	433.00	0.67	0.10	---	---	0.00	---	---	---	---	0.10
0.60	184	433.10	0.67	0.12	---	---	0.00	---	---	---	---	0.12
0.70	214	433.20	0.67	0.13	---	---	0.00	---	---	---	---	0.13
0.80	245	433.30	0.67	0.14	---	---	0.00	---	---	---	---	0.14
0.90	275	433.40	0.67	0.15	---	---	0.00	---	---	---	---	0.15
1.00	306	433.50	0.67	0.16	---	---	0.00	---	---	---	---	0.16
1.15	358	433.65	0.67	0.17	---	---	0.00	---	---	---	---	0.17
1.30	411	433.80	0.67	0.18	---	---	0.00	---	---	---	---	0.18
1.45	463	433.95	0.67	0.19	---	---	0.00	---	---	---	---	0.19
1.60	516	434.10	0.67	0.20	---	---	0.00	---	---	---	---	0.20
1.75	568	434.25	0.67	0.21	---	---	0.00	---	---	---	---	0.21
1.90	620	434.40	0.67	0.22	---	---	0.00	---	---	---	---	0.22
2.05	673	434.55	0.67	0.23	---	---	0.00	---	---	---	---	0.23
2.20	725	434.70	0.67	0.24	---	---	0.00	---	---	---	---	0.24
2.35	778	434.85	0.67	0.25	---	---	0.00	---	---	---	---	0.25
2.50	830	435.00	0.67	0.26	---	---	0.00	---	---	---	---	0.26
2.60	944	435.10	0.67	0.26	---	---	0.00	---	---	---	---	0.26
2.70	1,057	435.20	0.67	0.27	---	---	0.00	---	---	---	---	0.27
2.80	1,171	435.30	0.67	0.27	---	---	0.00	---	---	---	---	0.27
2.90	1,285	435.40	0.67	0.28	---	---	0.00	---	---	---	---	0.28
3.00	1,399	435.50	0.67	0.28	---	---	0.00	---	---	---	---	0.28
3.10	1,512	435.60	0.67	0.29	---	---	0.00	---	---	---	---	0.29
3.20	1,626	435.70	0.67	0.29	---	---	0.00	---	---	---	---	0.29
3.30	1,740	435.80	0.67	0.30	---	---	0.30	---	---	---	---	0.60
3.40	1,853	435.90	1.83	0.28	---	---	1.55	---	---	---	---	1.83
3.50	1,967	436.00	3.59	0.26	---	---	3.33	---	---	---	---	3.59

Hydrograph Report

Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 10:0 AM

Hyd. No. 1

INFLOW SC-43

Hydrograph type	= Manual	Peak discharge	= 4.10 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min

Hydrograph Volume = 5,460 cuft

(Printed values >= 1% of Qp.)

Hydrograph Discharge Table

Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)	Time (hrs)	Outflow (cfs)
0.08	0.10	2.92	0.20	5.75	0.10
0.17	0.10	3.00	0.20	5.83	0.10
0.25	0.10	3.08	0.20	5.92	0.10
0.33	0.10	3.17	0.20	6.00	0.10
0.42	0.10	3.25	0.30		
0.50	0.10	3.33	0.30		
0.58	0.10	3.42	0.30	*...End*	
0.67	0.10	3.50	0.30		
0.75	0.10	3.58	0.40		
0.83	0.10	3.67	0.40		
0.92	0.10	3.75	0.50		
1.00	0.10	3.83	0.50		
1.08	0.10	3.92	0.80		
1.17	0.10	4.00	1.10		
1.25	0.10	4.08	4.10 <<		
1.33	0.10	4.17	0.60		
1.42	0.10	4.25	0.40		
1.50	0.10	4.33	0.30		
1.58	0.10	4.42	0.30		
1.67	0.10	4.50	0.20		
1.75	0.10	4.58	0.20		
1.83	0.10	4.67	0.20		
1.92	0.10	4.75	0.20		
2.00	0.10	4.83	0.20		
2.08	0.10	4.92	0.20		
2.17	0.10	5.00	0.20		
2.25	0.20	5.08	0.10		
2.33	0.20	5.17	0.10		
2.42	0.20	5.25	0.10		
2.50	0.20	5.33	0.10		
2.58	0.20	5.42	0.10		
2.67	0.20	5.50	0.10		
2.75	0.20	5.58	0.10		
2.83	0.20	5.67	0.10		

Hydrograph Plot

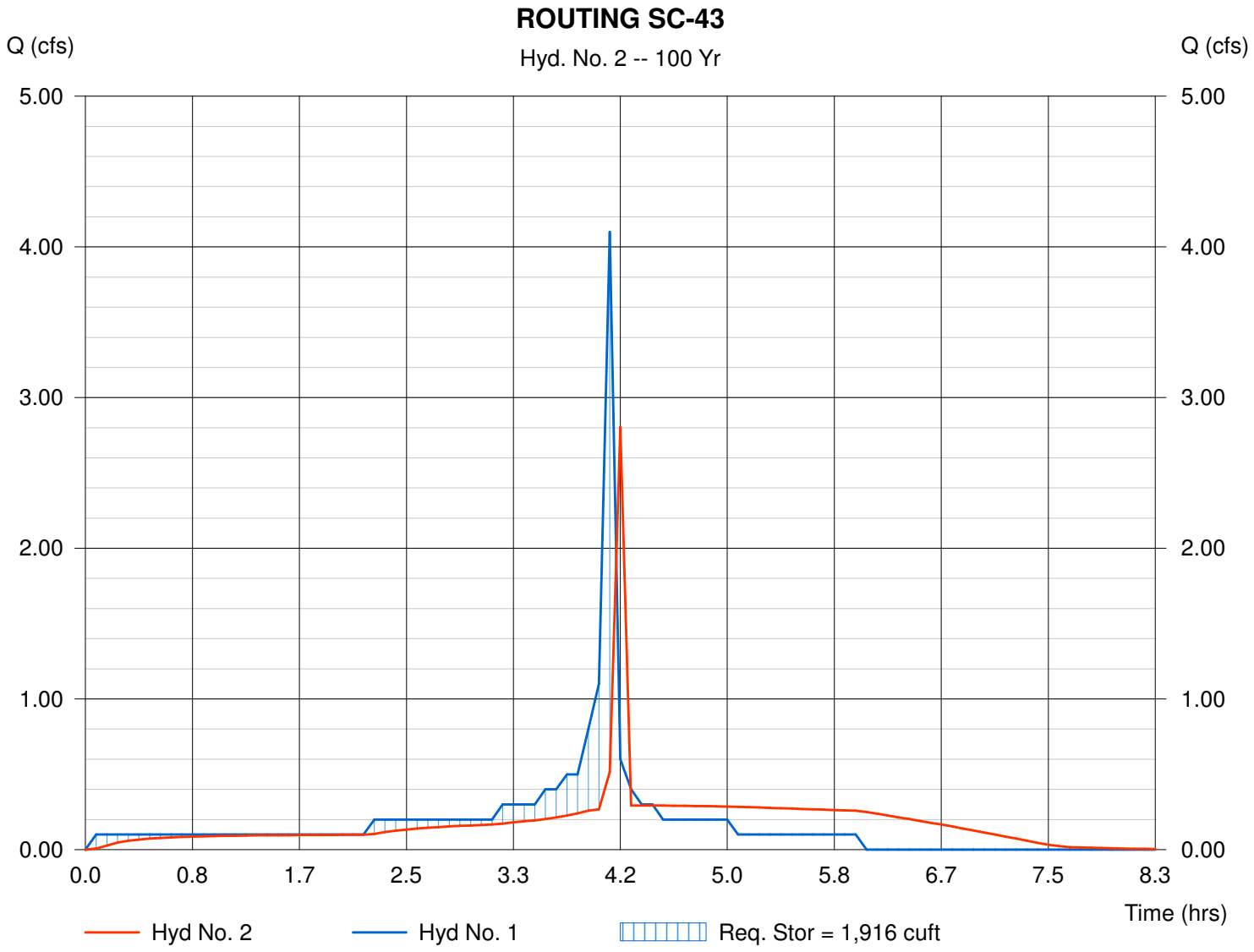
Hydraflow Hydrographs by Intelisolve | Monday, Sep 15 2014, 10:0 AM

Hyd. No. 2

ROUTING SC-43

Hydrograph type	=	Reservoir	Peak discharge	=	2.80 cfs
Storm frequency	=	100 yrs	Time interval	=	5 min
Inflow hyd. No.	=	1	Max. Elevation	=	435.96 ft
Reservoir name	=	Bioretention SC-43	Max. Storage	=	1,916 cuft

Storage Indication method used. | Hydrograph Volume = 5,458 cuft



Hydrograph Report

Hyd. No. 2

ROUTING SC-43

Hydrograph type	= Reservoir	Peak discharge	= 2.80 cfs
Storm frequency	= 100 yrs	Time interval	= 5 min
Inflow hyd. No.	= 1	Reservoir name	= Bioretention SC-4
Max. Elevation	= 435.96 ft	Max. Storage	= 1,916 cuft

Storage Indication method used. Outflow hydrograph volume = 5,458 cuft

Hydrograph Discharge Table

(Printed values >= 1% of Qp.)

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.25	0.10	432.69	0.67	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
0.33	0.10	432.73	0.67	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
0.42	0.10	432.77	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.50	0.10	432.80	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
0.58	0.10	432.82	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.67	0.10	432.84	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.75	0.10	432.86	0.67	0.08	-----	-----	-----	-----	-----	-----	-----	0.08
0.83	0.10	432.88	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
0.92	0.10	432.89	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.00	0.10	432.90	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.08	0.10	432.91	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.17	0.10	432.91	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.25	0.10	432.92	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.33	0.10	432.93	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
1.42	0.10	432.93	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.50	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.58	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.67	0.10	432.94	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.75	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.83	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
1.92	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.00	0.10	432.95	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.08	0.10	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.17	0.10	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
2.25	0.20	433.00	0.67	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
2.33	0.20	433.09	0.67	0.12	-----	-----	-----	-----	-----	-----	-----	0.12
2.42	0.20	433.17	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
2.50	0.20	433.24	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
2.58	0.20	433.30	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
2.67	0.20	433.36	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
2.75	0.20	433.41	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
2.83	0.20	433.46	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
2.92	0.20	433.50	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.00	0.20	433.54	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.08	0.20	433.57	0.67	0.16	-----	-----	-----	-----	-----	-----	-----	0.16
3.17	0.20	433.60	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
3.25	0.30	433.67	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
3.33	0.30	433.77	0.67	0.18	-----	-----	-----	-----	-----	-----	-----	0.18

Continues on next page...

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
3.42	0.30	433.87	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
3.50	0.30	433.97	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
3.58	0.40	434.10	0.67	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
3.67	0.40	434.26	0.67	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
3.75	0.50	434.46	0.67	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
3.83	0.50	434.69	0.67	0.24	-----	-----	-----	-----	-----	-----	-----	0.24
3.92	0.80	435.01	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
4.00	1.10	435.19	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
4.08	4.10 <<	435.77	0.67	0.30	-----	-----	0.22	-----	-----	-----	-----	0.52
4.17	0.60	435.96 <<	2.81	0.27	-----	-----	2.53	-----	-----	-----	-----	2.80 <<
4.25	0.40	435.68	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.33	0.30	435.69	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.42	0.30	435.70	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.50	0.20	435.68	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.58	0.20	435.66	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.67	0.20	435.64	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.75	0.20	435.61	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.83	0.20	435.59	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
4.92	0.20	435.57	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
5.00	0.20	435.54	0.67	0.29	-----	-----	-----	-----	-----	-----	-----	0.29
5.08	0.10	435.51	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.17	0.10	435.46	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.25	0.10	435.41	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.33	0.10	435.36	0.67	0.28	-----	-----	-----	-----	-----	-----	-----	0.28
5.42	0.10	435.32	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.50	0.10	435.27	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.58	0.10	435.23	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.67	0.10	435.18	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.75	0.10	435.14	0.67	0.27	-----	-----	-----	-----	-----	-----	-----	0.27
5.83	0.10	435.10	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
5.92	0.10	435.05	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
6.00	0.10	435.01	0.67	0.26	-----	-----	-----	-----	-----	-----	-----	0.26
6.08	0.00	434.86	0.67	0.25	-----	-----	-----	-----	-----	-----	-----	0.25
6.17	0.00	434.65	0.67	0.24	-----	-----	-----	-----	-----	-----	-----	0.24
6.25	0.00	434.45	0.67	0.23	-----	-----	-----	-----	-----	-----	-----	0.23
6.33	0.00	434.26	0.67	0.21	-----	-----	-----	-----	-----	-----	-----	0.21
6.42	0.00	434.08	0.67	0.20	-----	-----	-----	-----	-----	-----	-----	0.20
6.50	0.00	433.91	0.67	0.19	-----	-----	-----	-----	-----	-----	-----	0.19
6.58	0.00	433.75	0.67	0.18	-----	-----	-----	-----	-----	-----	-----	0.18
6.67	0.00	433.61	0.67	0.17	-----	-----	-----	-----	-----	-----	-----	0.17
6.75	0.00	433.46	0.67	0.15	-----	-----	-----	-----	-----	-----	-----	0.15
6.83	0.00	433.32	0.67	0.14	-----	-----	-----	-----	-----	-----	-----	0.14
6.92	0.00	433.19	0.67	0.13	-----	-----	-----	-----	-----	-----	-----	0.13
7.00	0.00	433.07	0.67	0.11	-----	-----	-----	-----	-----	-----	-----	0.11
7.08	0.00	432.96	0.67	0.10	-----	-----	-----	-----	-----	-----	-----	0.10
7.17	0.00	432.87	0.67	0.09	-----	-----	-----	-----	-----	-----	-----	0.09
7.25	0.00	432.80	0.67	0.07	-----	-----	-----	-----	-----	-----	-----	0.07
7.33	0.00	432.73	0.67	0.06	-----	-----	-----	-----	-----	-----	-----	0.06
7.42	0.00	432.68	0.67	0.05	-----	-----	-----	-----	-----	-----	-----	0.05
7.50	0.00	432.64	0.67	0.03	-----	-----	-----	-----	-----	-----	-----	0.03

...End

Pond Report

Pond No. 1 - Bioretention SC-43

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	432.50	00	0	0
1.00	433.50	00	306	306
2.50	435.00	00	524	830
3.50	436.00	00	1,137	1,967

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise (in)	= 12.00	2.52	0.00	0.00
Span (in)	= 12.00	2.52	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 432.00	432.50	0.00	0.00
Length (ft)	= 8.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	0.00
N-Value	= .013	.013	.000	.000
Orif. Coeff.	= 0.60	0.60	0.00	0.00
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.00	0.00	0.00
Crest El. (ft)	= 435.75	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.00	0.00	0.00
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

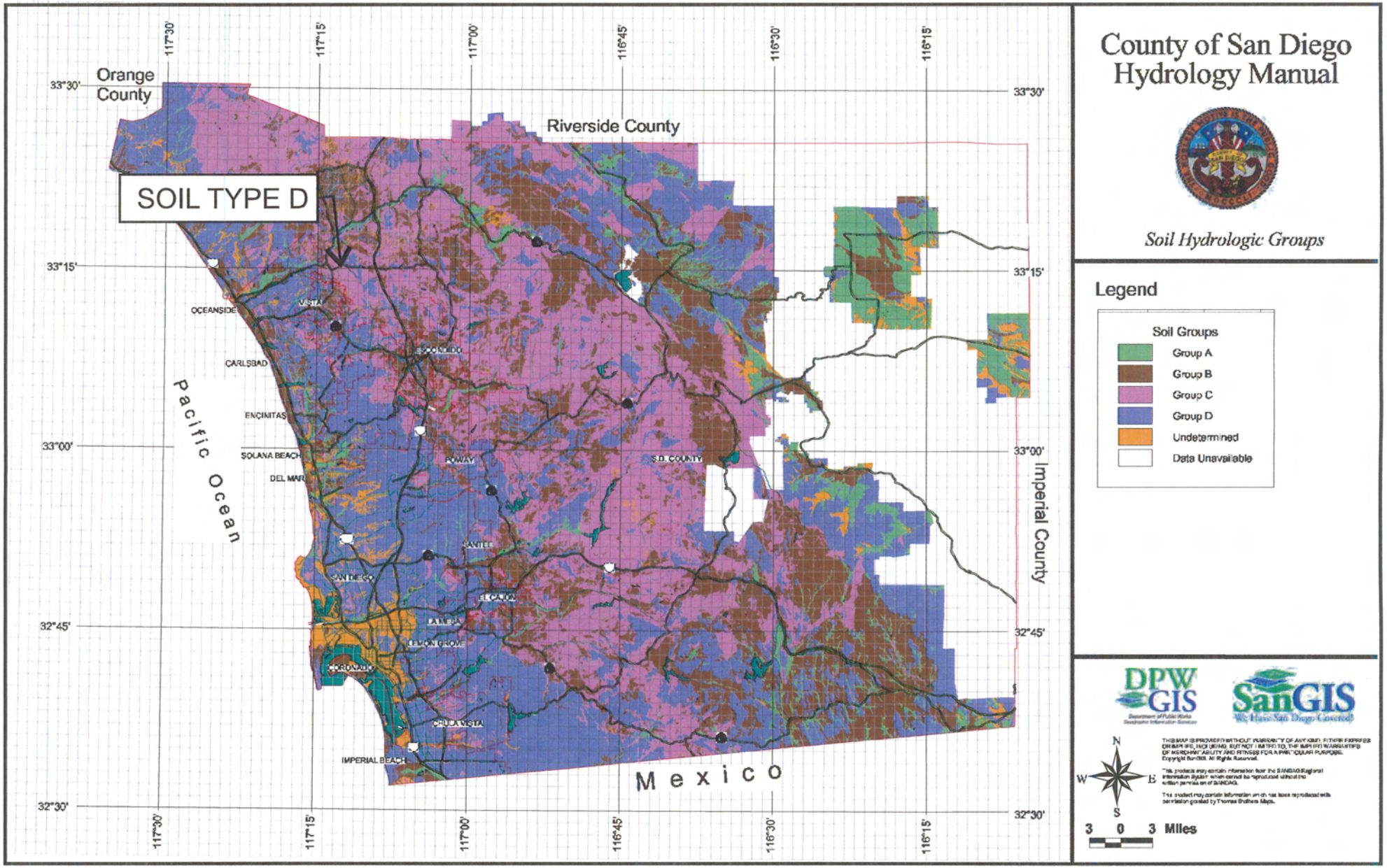
Exfiltration = 0.000 in/hr (Wet area) Tailwater Elev. = 0.00 ft

Note: Culvert/Orifice outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0	432.50	0.00	0.00	---	---	0.00	---	---	---	---	0.00
0.10	31	432.60	0.67	0.02	---	---	0.00	---	---	---	---	0.02
0.20	61	432.70	0.67	0.05	---	---	0.00	---	---	---	---	0.05
0.30	92	432.80	0.67	0.07	---	---	0.00	---	---	---	---	0.07
0.40	122	432.90	0.67	0.09	---	---	0.00	---	---	---	---	0.09
0.50	153	433.00	0.67	0.10	---	---	0.00	---	---	---	---	0.10
0.60	184	433.10	0.67	0.12	---	---	0.00	---	---	---	---	0.12
0.70	214	433.20	0.67	0.13	---	---	0.00	---	---	---	---	0.13
0.80	245	433.30	0.67	0.14	---	---	0.00	---	---	---	---	0.14
0.90	275	433.40	0.67	0.15	---	---	0.00	---	---	---	---	0.15
1.00	306	433.50	0.67	0.16	---	---	0.00	---	---	---	---	0.16
1.15	358	433.65	0.67	0.17	---	---	0.00	---	---	---	---	0.17
1.30	411	433.80	0.67	0.18	---	---	0.00	---	---	---	---	0.18
1.45	463	433.95	0.67	0.19	---	---	0.00	---	---	---	---	0.19
1.60	516	434.10	0.67	0.20	---	---	0.00	---	---	---	---	0.20
1.75	568	434.25	0.67	0.21	---	---	0.00	---	---	---	---	0.21
1.90	620	434.40	0.67	0.22	---	---	0.00	---	---	---	---	0.22
2.05	673	434.55	0.67	0.23	---	---	0.00	---	---	---	---	0.23
2.20	725	434.70	0.67	0.24	---	---	0.00	---	---	---	---	0.24
2.35	778	434.85	0.67	0.25	---	---	0.00	---	---	---	---	0.25
2.50	830	435.00	0.67	0.26	---	---	0.00	---	---	---	---	0.26
2.60	944	435.10	0.67	0.26	---	---	0.00	---	---	---	---	0.26
2.70	1,057	435.20	0.67	0.27	---	---	0.00	---	---	---	---	0.27
2.80	1,171	435.30	0.67	0.27	---	---	0.00	---	---	---	---	0.27
2.90	1,285	435.40	0.67	0.28	---	---	0.00	---	---	---	---	0.28
3.00	1,399	435.50	0.67	0.28	---	---	0.00	---	---	---	---	0.28
3.10	1,512	435.60	0.67	0.29	---	---	0.00	---	---	---	---	0.29
3.20	1,626	435.70	0.67	0.29	---	---	0.00	---	---	---	---	0.29
3.30	1,740	435.80	0.67	0.30	---	---	0.30	---	---	---	---	0.60
3.40	1,853	435.90	1.83	0.28	---	---	1.55	---	---	---	---	1.83
3.50	1,967	436.00	3.59	0.26	---	---	3.33	---	---	---	---	3.59

APPENDIX E
SOILS GROUP MAP



County of San Diego Hydrology Manual

Soil Hydrologic Groups

Legend

Soil Groups

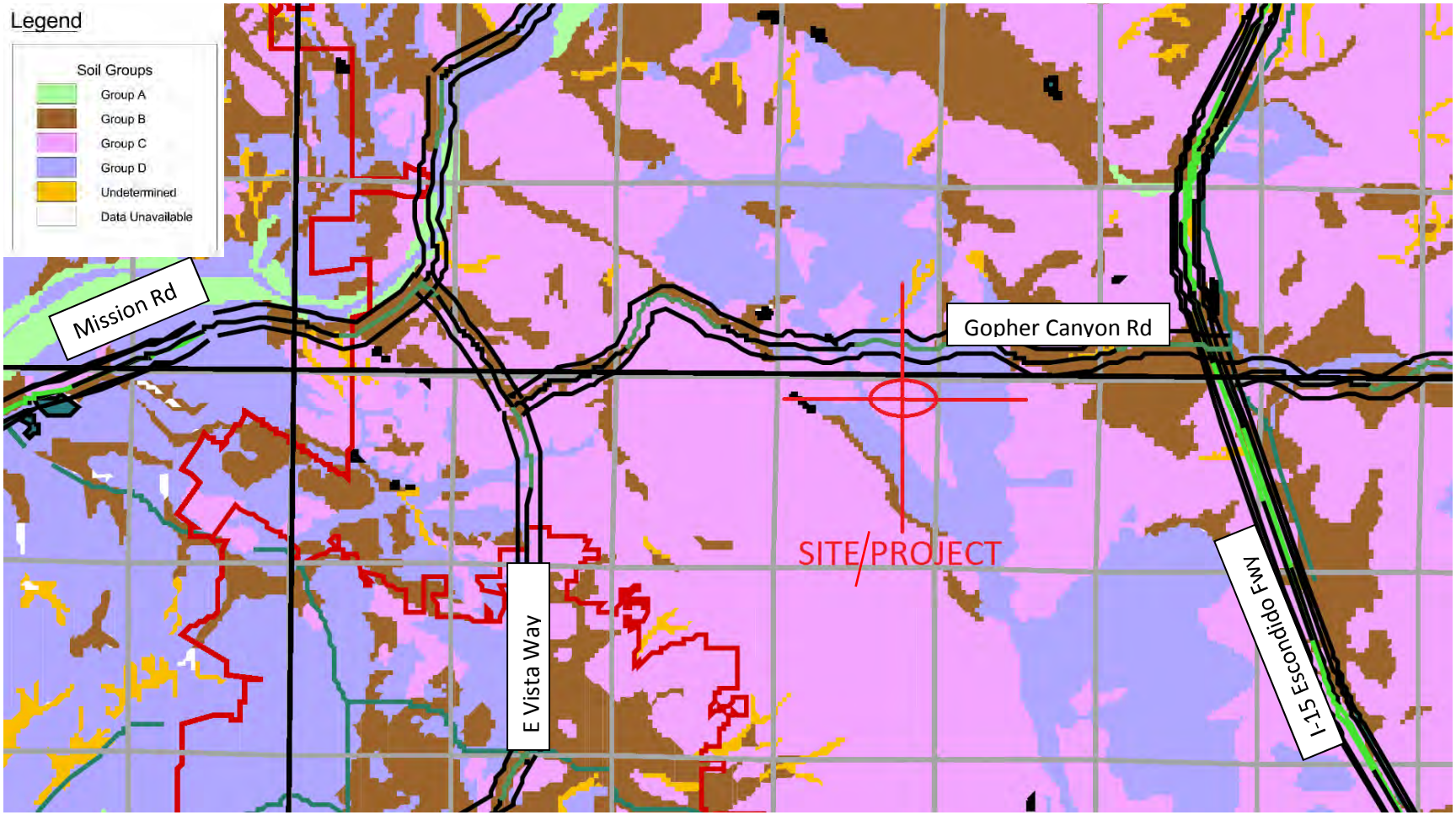
- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

DPW GIS

SanGIS

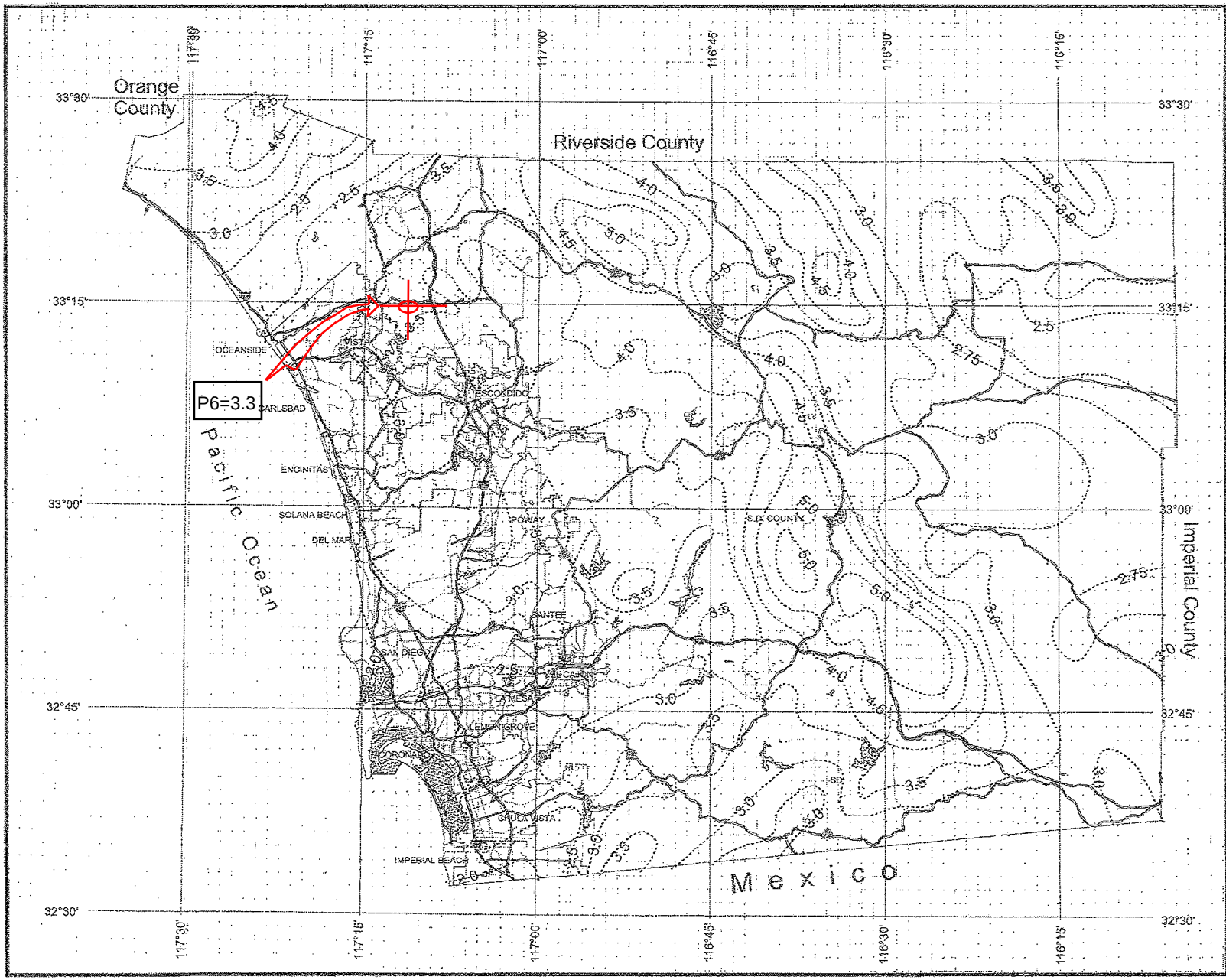
N W E S

3 0 3 Miles



The project site may contain soil group C and D however, all tributary area contributing in this project is assumed soil group D for a conservative approach and because the tributary area is less than 10 acres.

APPENDIX F
100-YR, 6-HOUR AND 24-HOUR ISOPLUVIALS



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

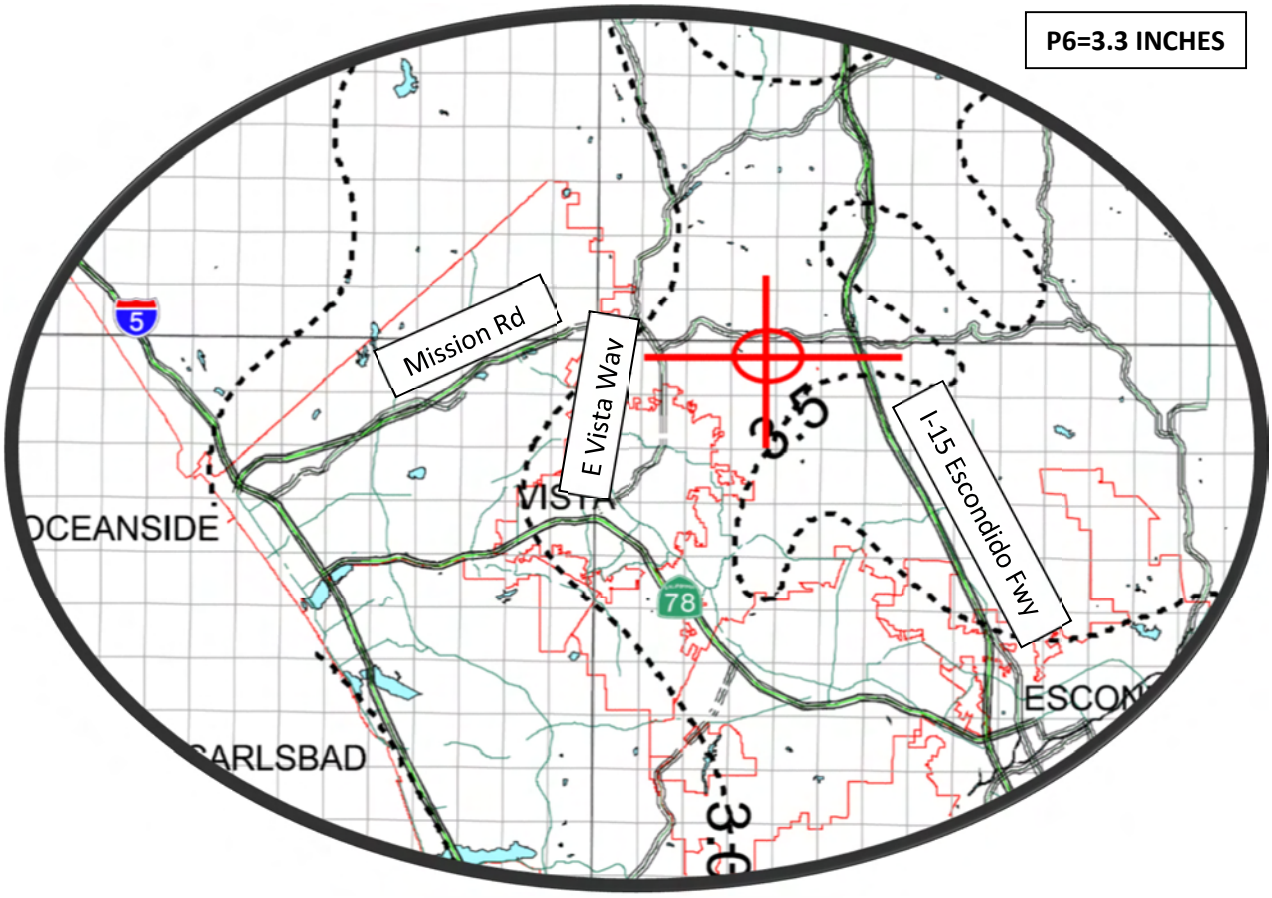
Isopluvial (inches)

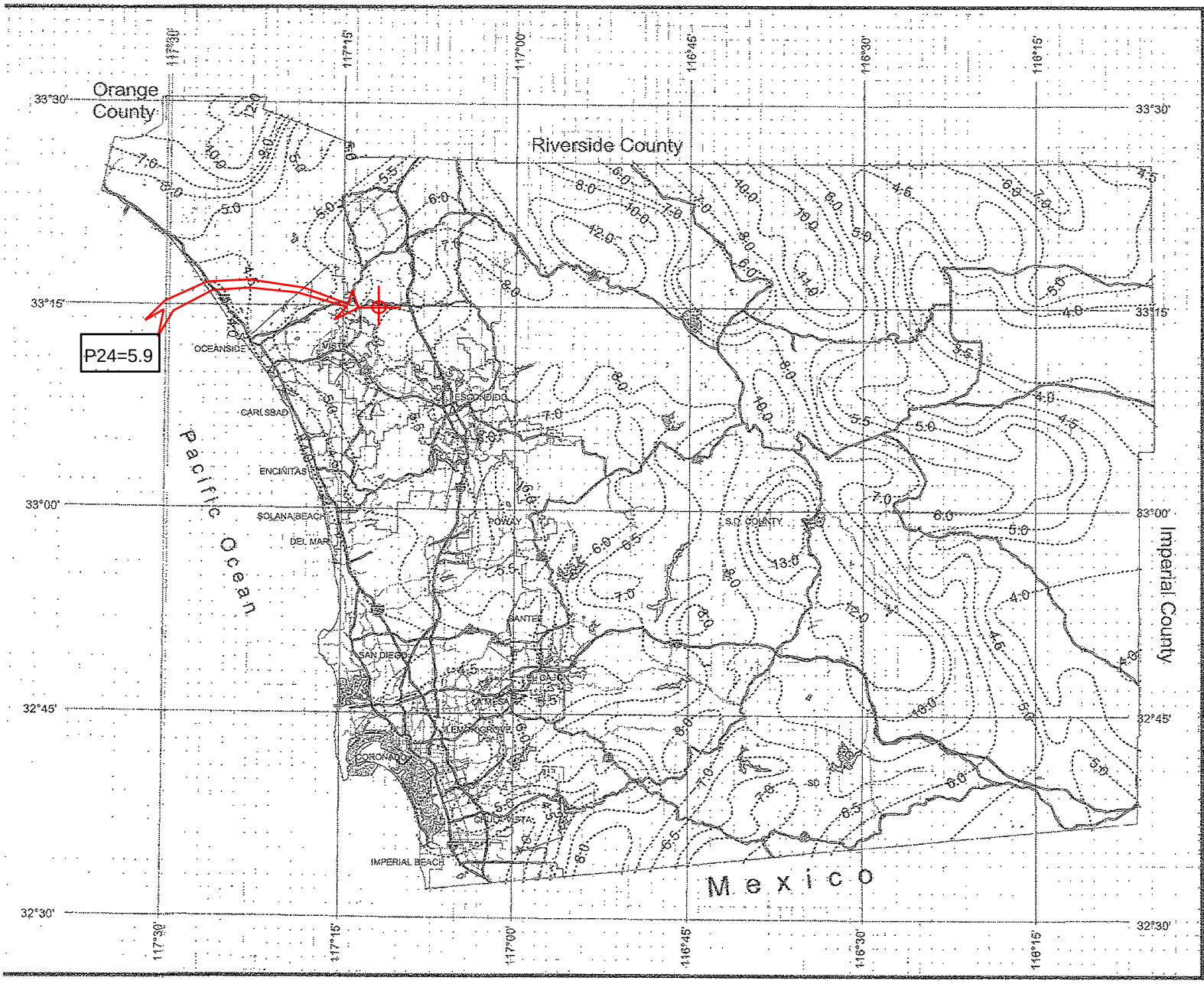
DPW GIS

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles


P6=3.3 INCHES
Mission Rd
E Vista Way
I-15 Escondido Fwy
5
78
3.5
3.3
OCEANSIDE
ARLSBAD



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

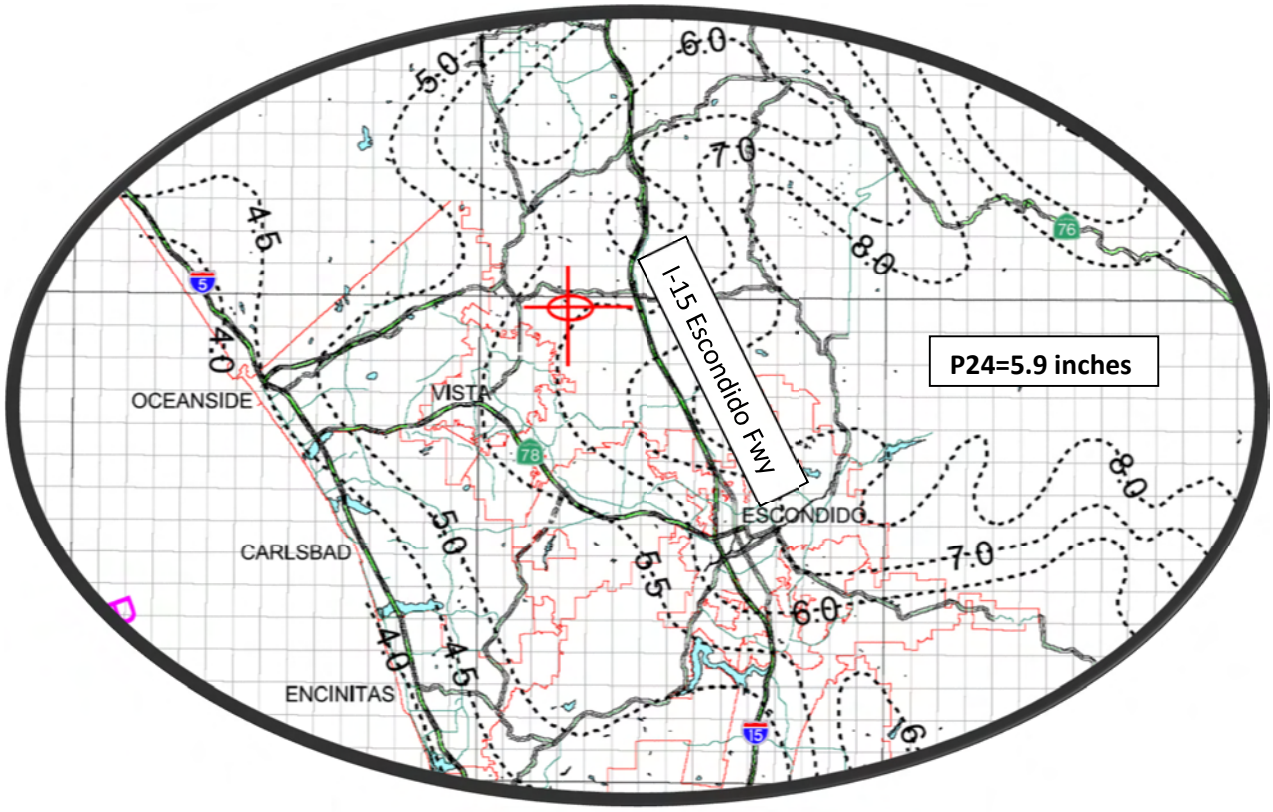
Isopluvial (inches)

DPW GIS

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles


4.5
5.0
6.0
7.0
8.0
4.0
5.0
5.5
6.0
7.0
8.0
4.0
4.5
5
76
78
15
OCEANSIDE
VISTA
CARLSBAD
ENCINITAS
ESCONDIDO
I-15 Escondido Fwy
P24=5.9 inches

APPENDIX G
SUMMARY TABLE FOR "C" CALCULATIONS

CALULATIONS FOR C
PRE-DEVELOPED CONDITION

Pre-Developed C

Basin No.	Area (AC)	Area Impervious (AC)	% Impervious	Soil Type	C*
1	0.112	0.000	0%	D	0.35
1A	4.705	0.107	2%	C	0.36
1B	0.076	0.000	0%	D	0.35
1C	3.46	0.205	6%	D	0.38
2	0.167	0.016	9%	D	0.40
2A	0.38	0.192	51%	D	0.63
Totals	**8.90**	**0.520**	6%		**0.38**

Post Developed C

Basin No.	Area (AC)	Area Impervious (AC)	% Impervious	Soil Type	C*
1	0.112	0.000	0%	D	0.35
1A	3.627	0.350	10%	C	0.36
1B	0.076	0.000	0%	D	0.35
1C	2.093	0.220	11%	D	0.41
1D	0.251	0.000	0%	D	0.35
1E	0.42	0.357	85%	D	0.82
1F	0.084	0.017	20%	D	0.46
1G	0.39	0.040	10%	D	0.41
1H	0.499	0.430	86%	D	0.82
1I	0.089	0.048	54%	D	0.65
1J	0.248	0.211	85%	D	0.82
1K	0.047	0.001	2%	D	0.36
1L	0.071	0.061	86%	D	0.82
1N	0.049	0.005	10%	D	0.41
1O	0.055	0.005	9%	D	0.40
1P	0.17	0.000	0%	D	0.35
1Q	0.113	0.012	11%	D	0.41
2	0.140	0.038	27%	D	0.50
2A	0.214	0.110	51%	D	0.63
2B	0.051	0.048	95%	D	0.87
2C	0.1	0.095	95%	D	0.87
Totals	**8.899**	**2.048**	23%		**0.48**

*C=0.90 x (% Impervious) + Cp x (1.0 - % Impervious)
Where Cp = 0.35 From San Diego Hydrology Manual, 2003, Table 3-1

APPENDIX H
CALCULATIONS FOR CATCH BASINS

3.1.2 Analyze the box capacity in a sump with Orifice formula:

The Grading Plan shows 2' x 2' Brooks Box type grate inlets in sumps through the parking lot and in the water quality ponds. In regards to the inlets, the worst case scenario occurs at the inlet in the lowest water quality pond. Here, the inlet is at an elevation of 435.0 with a top of weir at 436, allowing 1 foot of head. The 100 year flow to this point is 8.27 cfs (see Post Development Calculations for node 17).

Determine the flow capacity in cubic feet per second for a 24"X24" Brooks Box grated type inlet using the following orifice equation of grated inlets in a sump.

This equation is derived from the standard grated inlet formula from Seely's Data Book for Civil Engineers book page 18-27. c=0.6.

Given:	2'x2' box			We have:	
A =	4.000	sf		**Q(cap) = 9.64**	**cfs**
y =	1	ft			

When compared to the 100 yr flow of 8.27 cfs, the grate will have the capacity to drain the pond.

Where
A = Area of opening in square feet
y = Depth of flow at inlet or head of sump in feet
Therefore the proposed box is adequate to handle the Q100 runoff.

APPENDIX I
STORM PIPE SUMMARY

The VVCC Pool Center proposes the use of 24" PVC drainage pipes. The worst case scenario occurs at the lowest water quality pond with a Q(100)= 8.27 cfs (node 17-Post Development Scenario). For an approximate capacity check we will use Mannings Equation. For PVC, n=0.035.

For a 24" PVC pipe @ 2% slope the Capacity is:

Q=(1.49/n)(A)(R)-2/3(S)-1/2 S=0.02 (2%) A=3.14(r)-2 R=A/P = A/2(3.14)(r)
A=3.14 sf R=3.14/6.28=0.5

Q=9.39 cfs Capacity > Q(100) of 8.27 cfs so OK

For a 24" PVC pipe @ 1% slope the capacity is:

Q=(1.49/n)(A)(R)-2/3(S)-1/2 S=0.01 (1%) A=3.14(r)-2 R=A/P = A/2(3.14)(r)
A=0.785 sf R=0.25

Q=6.6 cfs The worst case scenario for the other 24" pipes is a Q of 4.14 cfs

Since 6.6 cfs Capacity > 4.14 cfs OK

APPENDIX J
COUNTY OF SAN DIEGO 1"=200' TOPO MAP

COUNTY OF SAN DIEGO — TOPOGRAPHIC SURVEY

-LEGEND-

Horizontal Control Monument, Third Order
Vertical Control Monument, Second Order or Better

Horizontal Control Monument, Second Order or Better
Vertical Control Monument, Third Order

Horizontal Control Monument, Second Order or Better
Horizontal Control Monument & Bench Mark, Second Order or Better
Horizontal Control Monument, Third Order
Horizontal Control Monument & Bench Mark, Third Order
Bench Mark, Second Order or Better
Vertical Control Monument, Third Order
Property Corner Found & Coordinated (California Coordinate System, Zone 6)

Found Section, Grant or Subdivision Corner

Photograph, Nadir Point
Geographic Tick

BOUNDARIES IN ORDER OF PRECEDENCE
(Land Lines Shown are Approximate)

National
County
City
Reservation
National, State or County Park
Land Grant
Township, Range or Section

PREPARED UNDER THE DIRECTION of DEPARTMENT OF PUBLIC WORKS County of San Diego

CONTROL DATA FURNISHED by SURVEY SECTION Department of Public Works

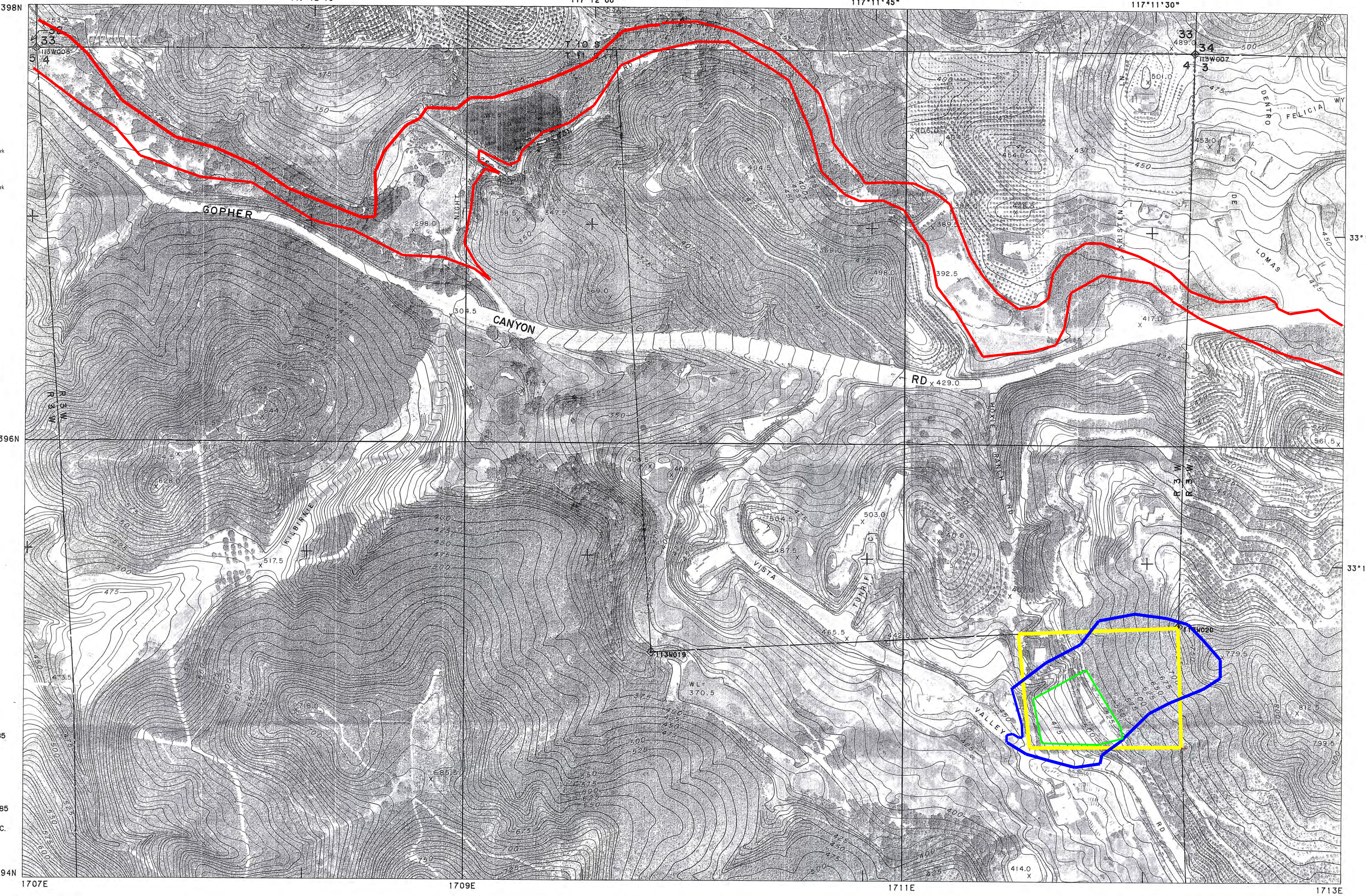
HORIZONTAL CONTROL BASED on NORTH AMERICAN 1927 DATUM

VERTICAL CONTROL BASED on U.S.C. & G.S. 1929 SEA LEVEL DATUM

ORTHOPHOTO IMAGE PREPARED from PHOTOGRAPHY DATED: APRIL 30,1985 by AMERICAN AERIAL SURVEYS, INC.

TOPOGRAPHY COMPILED by PHOTOGRAMMETRIC METHODS from PHOTOGRAPHY DATED: APRIL 30,1985 by BARTON WALTERS & ASSOCIATES,INC.

FINAL MAP PREPARED by MAPPING SECTION Department of Public Works



This Map Complies with NATIONAL MAP ACCURACY STANDARDS

SCALE 1: 2400 (1"= 200')
INDEX CONTOUR INTERVAL: 25 FEET
CONTOUR INTERVAL: 5 FEET

TWO THOUSAND FOOT CALIFORNIA RECTANGULAR GRID (ZONE VI)
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED
THE RECTANGULAR COORDINATE VALUES ARE SHOWN ON THE SOUTH AND WEST MARGINS
THE GEOGRAPHIC VALUES ARE SHOWN ON THE NORTH AND EAST MARGINS

INDEX TO ADJOINING SHEETS

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SAN DIEGO COUNTY
CALIFORNIA

SHEET NO. 394-1707