HYDROLOGY STUDY
for
1404 WINTER HAVEN ROAD

City of Fallbrook, California

Prepared for:
G & F Properties, LLC
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July 24, 2012

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CHAPTER 1 - EXECUTIVE SUMMARY

1.1 - Introduction

The site is located within a 12.3 acre parcel within the City of Fallbrook, CA. It is bound by Winter Haven Road on the south, a natural drainage channel on the north, and private parcels on both the east and west sides. The site is directly east of the Winter Haven Road – Brooke Road intersection. See Vicinity Map below. The site is mostly vacant and hilly except for a driveway, a house, and shed. It contains a concrete lined sediment basin at the southwest corner and a pond at the northwest corner of the site. The proposed grading will flatten the site to be used as growing pads for flower crops.

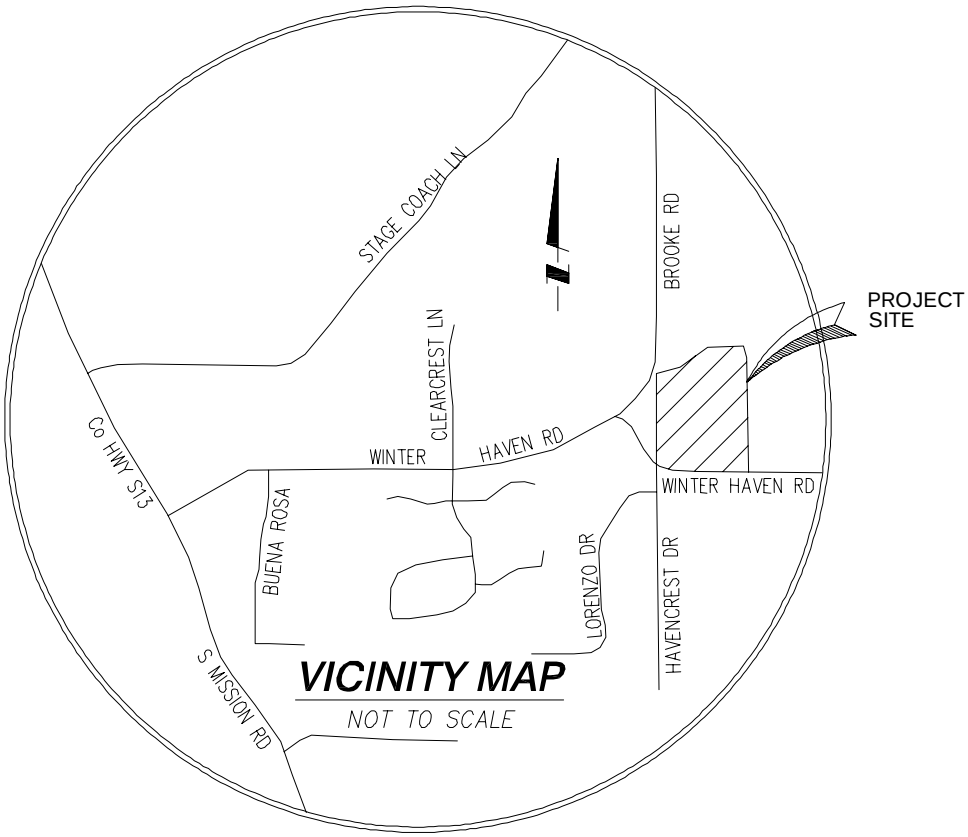
A hill bisects the pre-project site in an east-west direction. In existing condition, the site slopes towards the southwest and northwest corners of the site. The proposed condition of the site will be graded with the hill cut and the majority of the site sloped towards the north. A small area on the southwest corner of the site will continue to drain towards the southwest as will the existing residence and driveway. All runoff will be directed towards its pre-graded location via either storm drain or above ground ditches or swales.

This report has been prepared to analyze the existing and proposed peak runoff rates generated by the 100-year storm event. A separate hydrologic analysis was also prepared to determine peak flows along the bottom valley area located on the north side of the site. Onsite runoff will empty into this natural drainage channel. Calculations will determine the 100-year water surface elevations within this valley drainageway and delineate it on the 'Upstream Watershed' exhibit located in Chapter 6.

The project site is located at N 33.35^0 latitude and W117.23^0 longitude. It is within the Bonsall Canyon Hydrologic Sub-Area within the San Luis Rey Watershed. The Beneficial Uses of this hydrologic area per Table 2-2 (Beneficial Uses of Inland Surface Waters) of the San Diego RWQCB Basin Plan include Agricultural Supply, Industrial Service Supply, Hydropower Generation, Contact Water Recreation, Warm Freshwater Habitat, and Wildlife Habitat. It has been excepted from Municipal and Domestic Supply use.

Per County of San Diego drainage criteria, the Modified Rational Method should be used to determine peak design flowrates when the contributing drainage area is less than 1.0 square mile. Since the total watershed area discharging from the site is less than 1.0 square mile, the AES-2003 computer software was used to model the runoff response per the Modified Rational Method. Methodology used for the computation of design rainfall events, runoff coefficients, and rainfall intensity values are consistent with criteria set forth in the "County of San Diego 2003 Hydrology Manual." A more detailed explanation of methodology used for this analysis is listed in Chapter 2 of this report.

Vicinity Map



1.2 – Summary of Existing Conditions

The existing '1404 Winter Haven' site currently contains a home, driveway, and shed. There is one pond located at the northwest corner of the site and one concrete-line lined retention basin at the southwest corner adjacent to Winter Haven Road. The remaining site area is vacant land which was previously used for agriculture. A hill with an upstream elevation of about 655 feet bisects the parcel from east to west. The downstream elevation at the northwest corner of the site is approximately 575 feet. The site is mainly composed of highly pervious areas which help to retain much of the rainfall from the low intensity runoff events. Runoff from the higher intensity events are collected at the existing pond facility. When the pond reaches capacity, runoff exits the facility via storm drain and outlets into its natural drainage course downstream of the site.

The site currently receives run on from the property located along the eastern project boundary. Run on from approximately 5.5 acres crosses the project boundary. This offsite area is currently undeveloped native land with no impervious areas.

The following table summarizes the existing condition runoff information from the site including the offsite area east of the project boundary. Please refer to Hydrology Map 1 of 2 in Chapter 6 for existing drainage patterns and areas. A separate hydrologic analysis was also prepared for the upstream watershed tributary to the natural drainage channel located along the northern portion of the site. The exhibit for this analysis is also included in Chapter 6.

TABLE 1 – Summary of Existing Conditions Peak Flows

Discharge Location	Drainage Area (Ac)	100-Year Peak Flow (cfs)
Northwest Corner	12.5	13.81
Southwest Corner	4.1	6.22
Total (Combined Areas)	16.6	20.03

1.3 – Summary of Developed Conditions

The graded site as shown on the Proposed Hydrology Map in Chapter 6 will essentially cut into the existing hill and flattened the site. The graded site will be used for flower crop pads and will not introduce any new impervious areas such as concrete, roofs, or driveways. Drainage patterns are reflected on the Hydrology Map and will increase the acreage draining to the northwest corner and decrease acreage towards the southwest corner. A basin will be constructed along the northern boundary of the site. The basin will act in two capacities. It will attenuate flows by retaining the entire runoff volume from the 100-year storm. See Chapter 4 for basin calculations. Secondly, the basin will provide secondary water quality treatment of the site. Refer to the *Master Stormwater Management Plan for 1404 Winter Haven Road* (7-24-2012) for further stormwater treatment discussion.

Run on from the adjacent property on the east side will be intercepted along the eastern boundary and directed north via a swale and brow ditch. This runoff will then be directed west towards the proposed basin. Runoff which reaches the southwest corner of the site will be reduced compared to pre-developed amounts as shown on the table below.

The table below summarizes the expected cumulative 100-year peak flow rates from both the southern and northern hydrologic subareas. Per the San Diego County rainfall isopluvial maps, the design 100-year rainfall depth for the site area is 3.6 inches. See Chapter 3 for hydrologic calculations and Chapter 6 for Hydrology Maps. Chapter 4 contains brow ditch, inlet, and basin calculations. Hydraulic and rip rap calculations are included in Chapter 5.

TABLE 2 – Summary of Developed Conditions Peak Flows

Discharge Location	Drainage Area (Ac)	100-Year Peak Flow (cfs)
Northwest Corner	15.2	16.02
Southwest Corner	1.4	3.68
Total (Combined Areas)	16.6	19.70

1.4 - Summary of Results

Table 3 summarizes pre and post developed condition drainage areas and resultant 100-year peak flow rates at the storm drain discharge location.

TABLE 3 - Summary Pre Vs Post Developed Peak Flows

	Drainage Area (acres)	**100-Year Peak Flow (cfs)**
Pre-Developed Condition	16.2	20.03
Post-Developed Conditions	16.2	19.70
DIFFERENCE	**0**	**-0.33**

As illustrated in the table above, the cumulative pre-graded and post-graded runoff amounts are essentially equal for the same drainage area. This can be attributed to similar pre and post runoff coefficients and not introducing any additional impervious areas. Also, flattening the site allowed for an increased time of concentration resulting in a lower runoff amount. The proposed basin along the northern project boundary will further attenuate flows well below existing amounts. The basin will retain the 100-year runoff volume which will be recycled and used for irrigating of the proposed flower crops.

1.5 - Summary of Upstream Watershed Runoff

A hydrologic analysis was prepared to evaluate the expected peak flows and water surface elevations for the natural drainage channel located immediately north of the site. The upstream watershed map located in Chapter 6 delineates the upstream watershed and the corresponding 100-year water surface contour. As shown on the exhibit, the project's outlets and brow ditches will not encroach within this 100-year contour. Development of the site will not have an effect on increasing the 100-year WSEL contour relative to the site in its existing condition. The increase in acreage runoff towards the northwest corner of the site will be attenuated via the proposed basin which was sized to collect the entire volume from the 100-year storm.

1.6 - References

County of San Diego Design Hydrology Manual, June 2003

"Major Stormwater Management Plan for 1404 Winter Haven Road", prepared by Raymond Escobar, July 2012.

"Stormwater Pollution Prevention Plan- 1404 Winter Haven", Prepared by Raymond Escobar, December 2010.

"Plans for the Improvement of Storm Drain Plan & Profile", City of Encinitas Drawing No. 7457-IR, Pasco Engineering, October 2002.

"*City of San Diego Standard Drawings*", filed December 31, 2006.

CHAPTER 2

METHODOLOGY

CHAPTER 2 METHODOLOGY

Modified Rational Method Hydrologic Analysis

Computer Software Package – AES-2003

Design Storm - 100-year return interval

Land Use – Agricultural

Soil Type – Hydrologic soil group D was assumed for all areas. Group D soils have very slow infiltration rates when thoroughly wetted. Consisting chiefly of clay soils with a high swelling potential, soils with a high permanent water table, soils with clay pan or clay layer at or near the surface, and shallow soils over nearly impervious materials, Group D soils have a very slow rate of water transmission.

Runoff Coefficient - In accordance with the County of San Diego standards, runoff coefficients were based on land use and slope.

Rainfall Intensity - Initial time of concentration values were determined using the County of San Diego's overland flow nomograph for natural areas.

Method of Analysis – The Rational Method is the most widely used hydrologic model for estimating peak runoff rates. Applied to small urban and semi-urban areas with drainage areas less than 1 square mile, the Rational Method relates storm rainfall intensity, a runoff coefficient, and drainage area to peak runoff rate. This relationship is expressed by the equation:

Q = CIA, where:

- Q = The peak runoff rate in cubic feet per second at the point of analysis.
- C = A runoff coefficient representing the area - averaged ratio of runoff to rainfall intensity.
- I = The time-averaged rainfall intensity in inches per hour corresponding to the time of concentration.
- A = The drainage basin area in acres.

To perform a node-link study, the total watershed area is divided into subareas which discharge at designated nodes.

The procedure for the subarea summation model is as follows:

(1) Subdivide the watershed into subareas with the initial subarea being less than 10 acres in size (generally 1 lot will do), and subsequent subareas gradually increasing in size. Assign upstream and downstream nodal numbers to each subarea to correlate calculations to the watershed map.

(2) Estimate an initial T_c by using the appropriate nomograph or overland flow velocity estimation.

(3) Using the initial T_c, determine the corresponding values of I. Then Q = CIA.

(4) Using Q, estimate the travel time between this node and the next by Manning's equation as applied to the particular channel or conduit linking the two nodes. Then, repeat the calculation for Q based on the revised intensity (which is a function of the revised time of concentration)

The nodes are joined together by links, which may be street gutter flows, drainage swales, drainage ditches, pipe flow, or various channel flows. The AES-2003 computer subarea menu is as follows:

SUBAREA HYDROLOGIC PROCESS

1. Confluence analysis at node.
2. Initial subarea analysis (including time of concentration calculation).
3. Pipeflow travel time (computer estimated).
4. Pipeflow travel time (user specified).
5. Trapezoidal channel, Valley, or Mountainous travel time.
6. Street flow analysis through subarea.
7. User - specified information at node.
8. Addition of subarea runoff to main line.
9. V-gutter flow through area.
10. Copy main stream data to memory bank
11. Confluence main stream data with a memory bank
12. Clear a memory bank

At the confluence point of two or more basins, the following procedure is used to combine peak flow rates to account for differences in the basin's times of concentration. This adjustment is based on the assumption that each basin's hydrographs are triangular in shape.

(1). If the collection streams have the same times of concentration, then the Q values are directly summed,

$$Q_p = Q_a + Q_b;\ T_p = T_a = T_b$$

(2). If the collection streams have different times of concentration, the smaller of the tributary Q values may be adjusted as follows:

(i). The most frequent case is where the collection stream with the longer time of concentration has the larger Q. The smaller Q value is adjusted by the ratio of rainfall intensities.

$Q_p = Q_a + Q_b\ (I_a/I_b);\ T_p = T_a$

(ii). In some cases, the collection stream with the shorter time of concentration has the larger Q. Then the smaller Q is adjusted by a ratio of the T values.

$Q_p = Q_b + Q_a\ (T_b/T_a);\ T_p = T_b$

Underground storm drains are analyzed in a similar way. Flow data obtained from the surface model for inlets and collection points are input into the nodes representing those structures. Design grades and lengths are used to compute the capacity of the storm drains and to model the downstream travel times.

Brow Ditch Design

Design Storm – 100-year return interval

Minimum Freeboard – 6 inches

Mannings Coefficient – 0.015

Storm Drain System Design (Storm)

Design Storm – 100-year return interval

Roughness Coefficient – Mannings “n” value of 0.01 (PVC pipe)

Minimum Pipe Diameter – 4 inches (PVC)

Minimum Grade of Storm Drains – 0.5%

Given the discharge and the physical characteristics of a proposed storm drain system, the “Storm” computer program, from Los Angeles Public Works, generates hydraulic grade line elevations at junctions and inlet locations.

Hydraulic grade line elevations are calculated by evaluating friction and minor losses throughout the system. To determine the hydraulic characteristics at a junction, the pressure plus momentum equation is applied at end points of the junction to determine the control point and to compute the conjugate depth at the opposite end of the junction.

When flow changes from partial flow to full flow or from full flow to partial flow, the program determines the location in the line where the change occurs. The program also determines the precise locations of hydraulic jumps (where flow changes from supercritical to subcritical flow) along with the pressure plus momentum at the jump and flow depth before and after the jump.

A typical storm drain analysis procedure is as follows:

1.) Establish the main line of the entire storm drain system. Generally, lines carrying the majority of the flow will constitute the main line.

2.) Establish the main line of any lateral system by proceeding upstream from the main line junction to the highest upstream inlet.

3.) Number the main line segments consecutively in the upstream direction to the most upstream inlet. Then, number each lateral system in the same manner (with values greater than that of the main line).

    Note: The storm program is number sensitive. Therefore, a chronological number system must be established.

4.) For each line, tabulate pertinent data such as the maximum design flow, conduit size and length, flow line elevations, minor loss coefficients for manholes, bends, etc., entrance loss coefficients for the inlets, and confluence angles at all junctions.

Junction loss coefficients, K_j, range from 0 to 1.0 depending on the efficiency of the junction design. Junction losses are calculated by multiplying K_j times the velocity head in the outlet conduit. If the value of K_j is left blank or the pipe flow condition is partially full, the pressure plus momentum equation is used to determine the junction losses.

Entrance loss coefficients, K_e, range from 0.04 (bell-mounted entrance) to 0.5 (flush headwall entrance). The entrance loss is computed by multiplying K_e times the velocity head in the outlet conduit.

Minor loss coefficients, K_m, are the summation of losses from bends, manholes, etc. The total minor loss, computed as K_m times the velocity head in the conduit, is added to friction losses in the hydraulic analysis for full flow only.

100-Year, 6-Hour Rainfall Isopluvial Map
100-Year, 24-Hour Rainfall Isopluvial Map

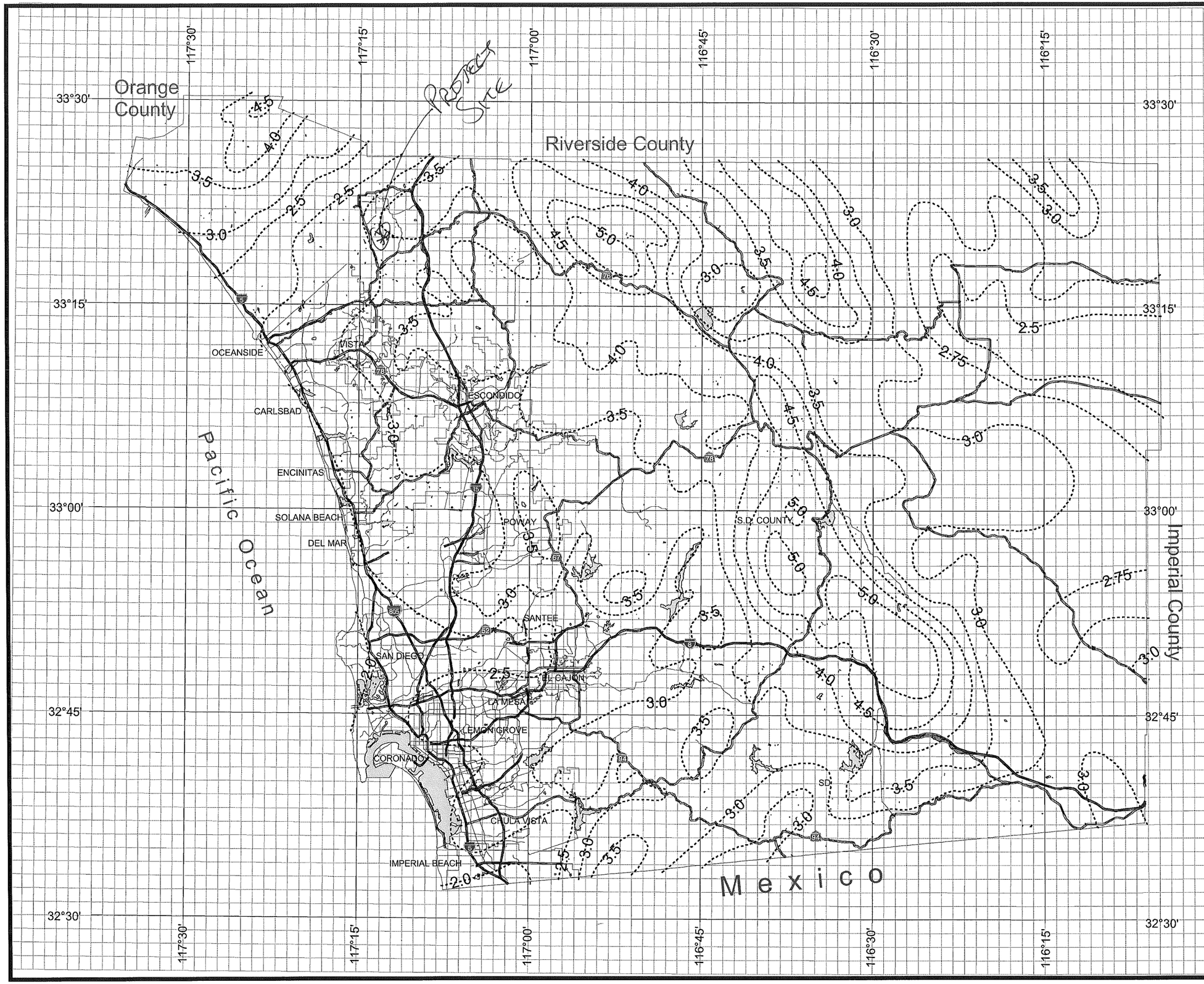
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

$P_6 = 3.4$



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3 0 3 Miles

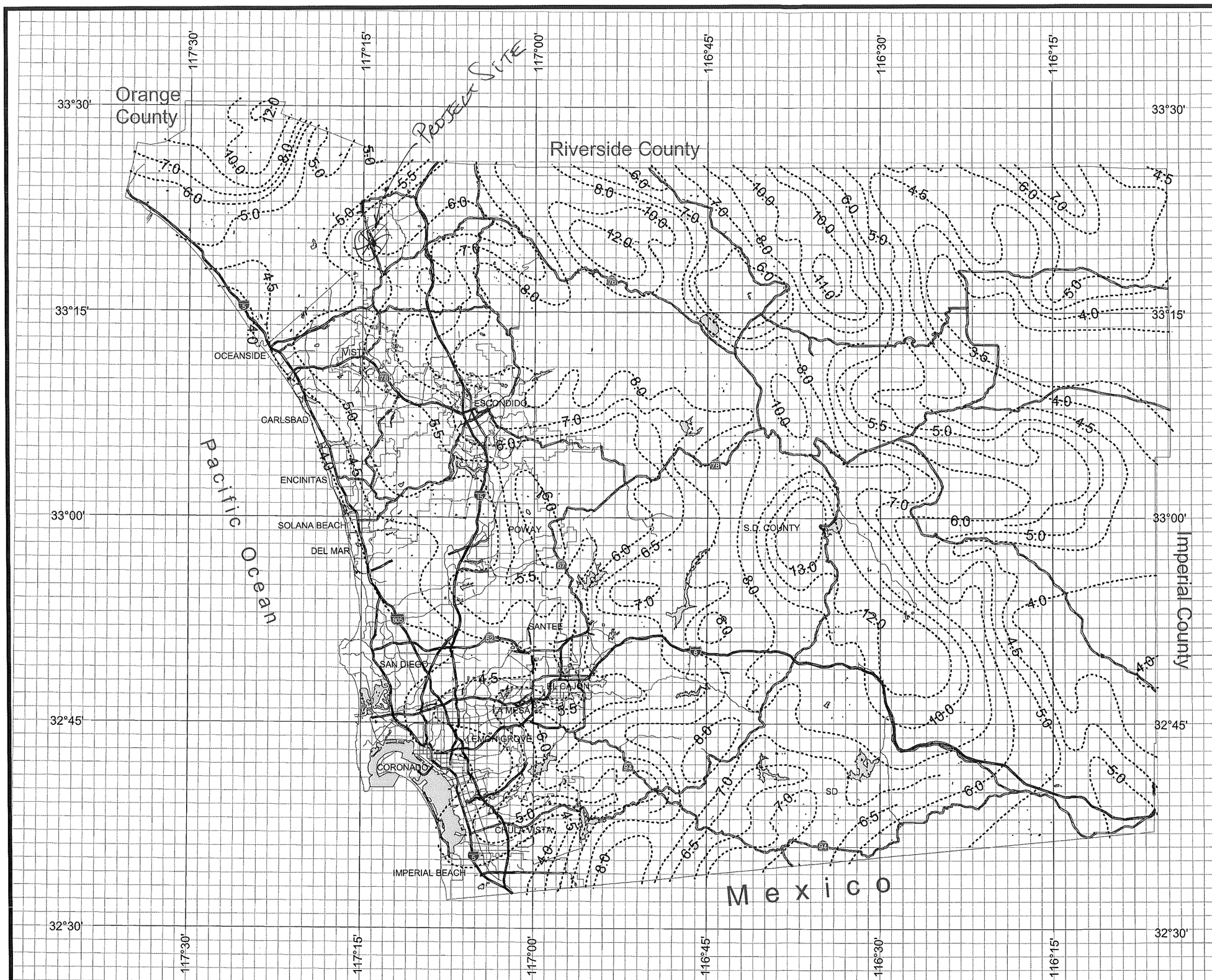
County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

$P_{24} = 6.0$



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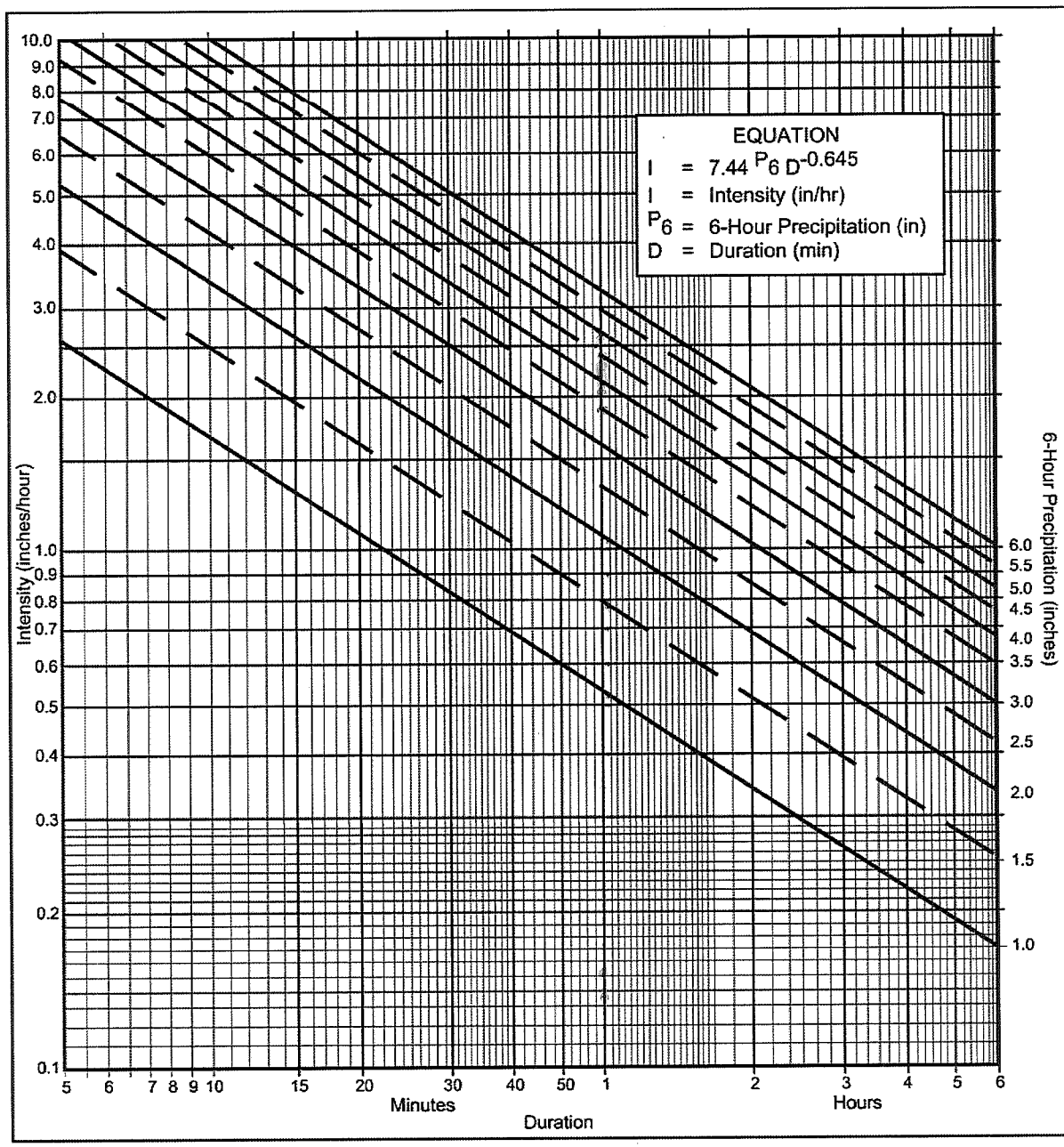
3 0 3 Miles

County of San Diego Design Criteria



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 = 3.4 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 56.6%(2)

(c) Adjusted $P_6^{(2)}$ = 3.4 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

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

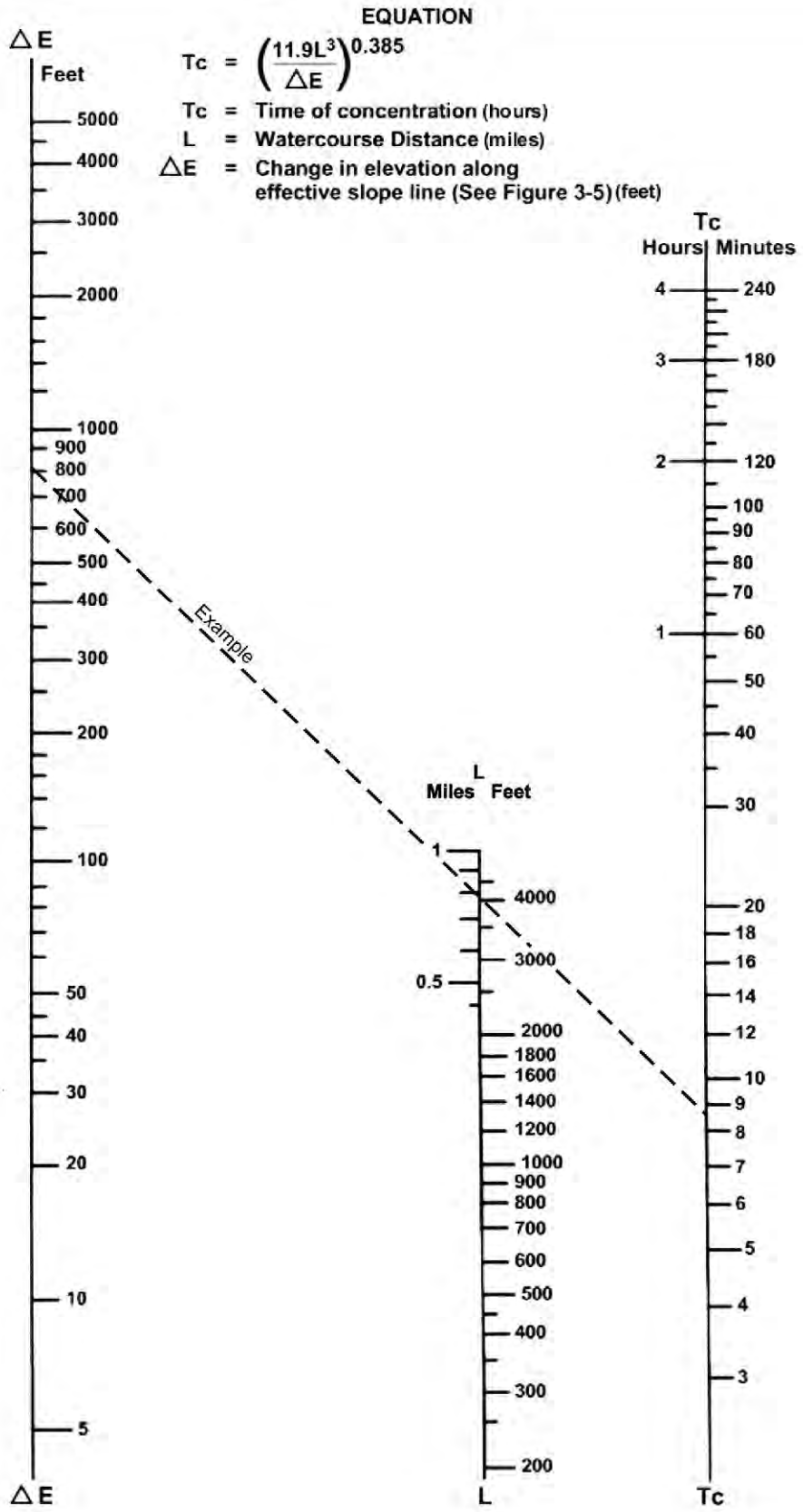
FIGURE

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

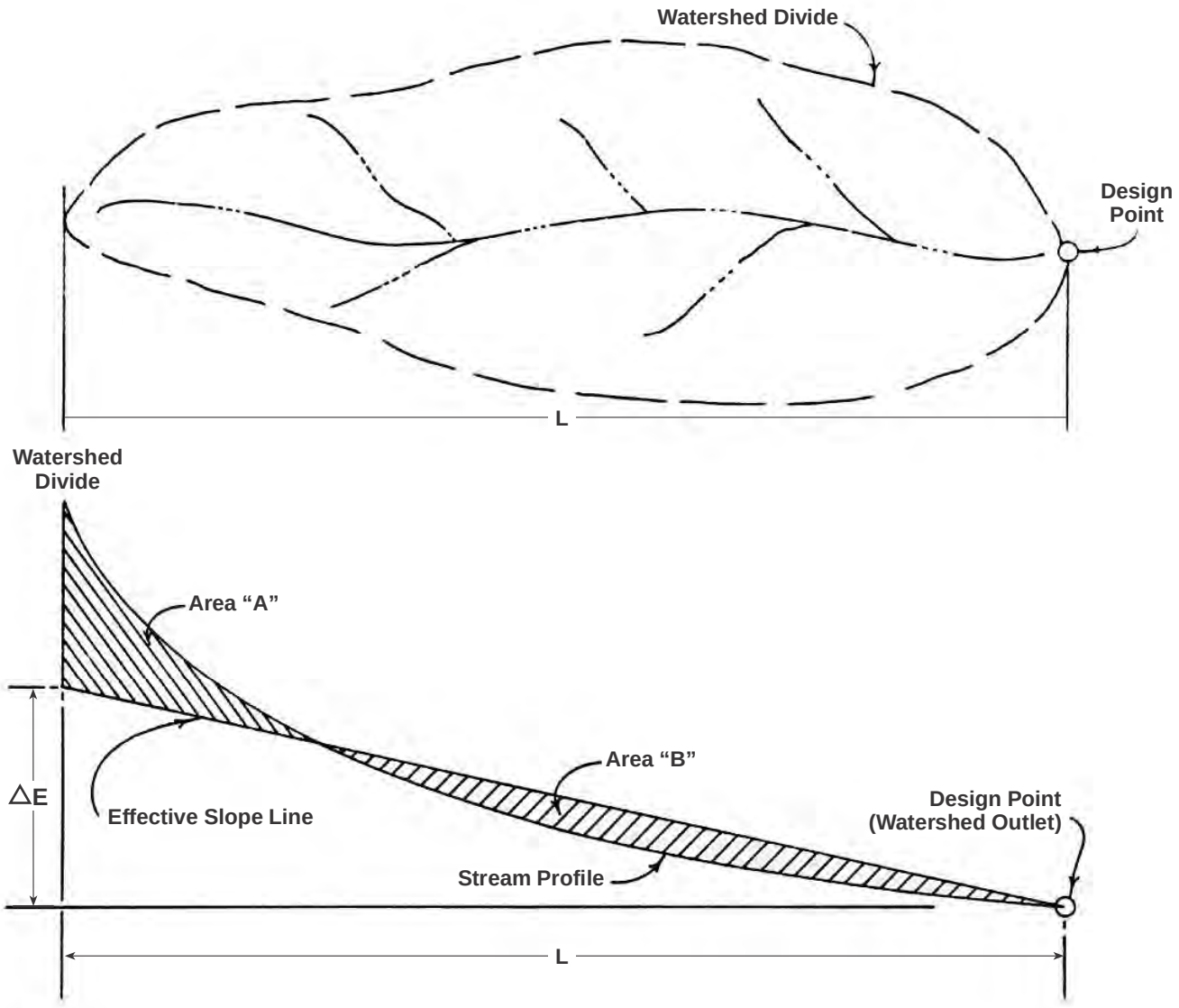


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-4

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



Area "A" = Area "B"

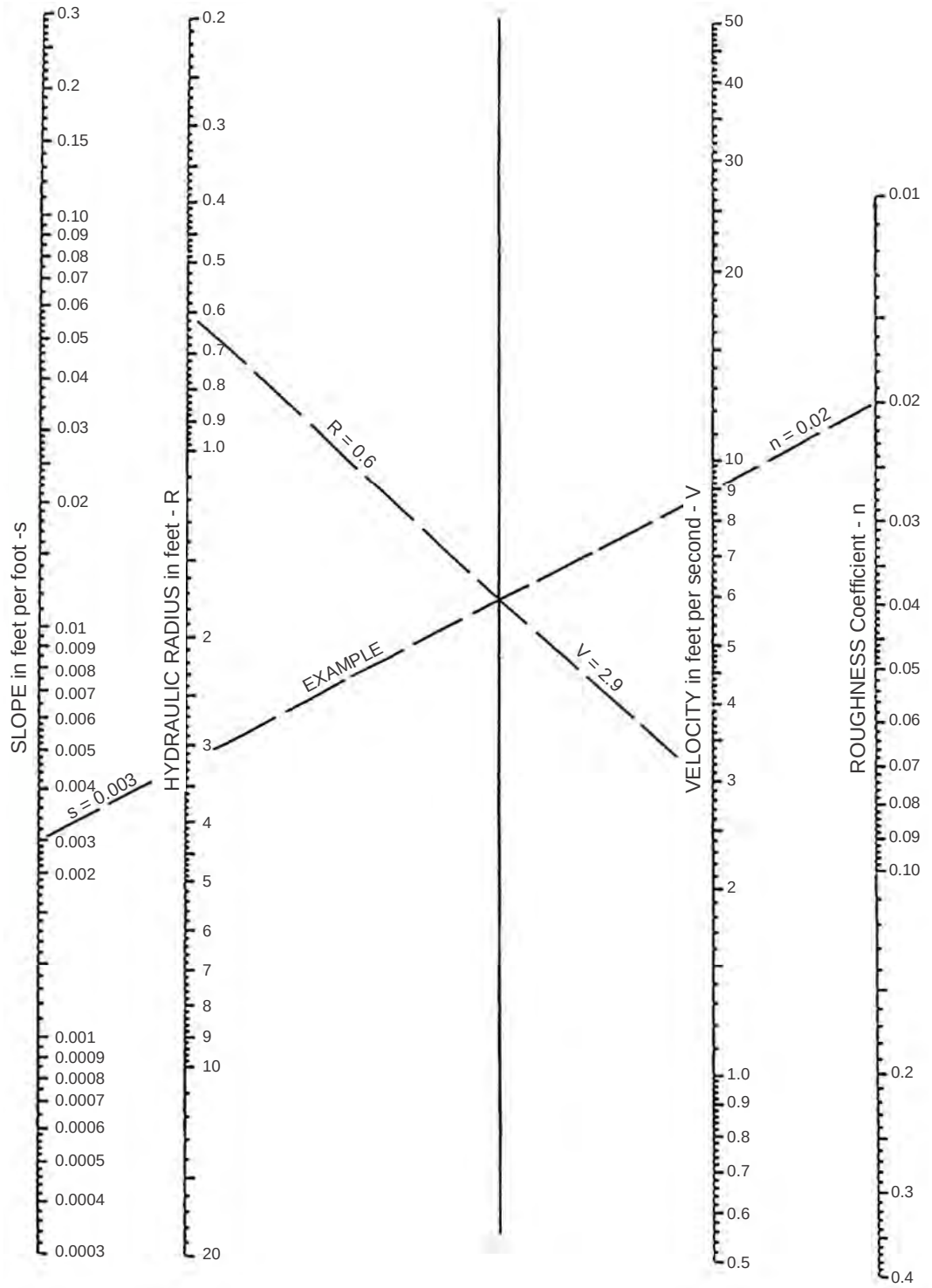
SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

Computation of Effective Slope for Natural Watersheds

3-5

EQUATION: $V = \frac{1.49}{n} R^{2/3} s^{1/2}$



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

FIGURE

Manning's Equation Nomograph

3-7

CHAPTER 3

100-Year Hydrologic Model

Existing Condition Model
See Chapter 6 for Hydrology Map

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____________________________________________________________________________
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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1239

                           Analysis prepared by:

                    Hunsaker & Associates San Diego, Inc.
                              9707 Waples Street
                           San Diego,  CA  92121


 ************************** DESCRIPTION OF STUDY **************************
* 1404 Winter Haven Road                                                  *
* 100-year storm event hydrology model                                    *
* Pre-Developed Scenario                                                  *
 ***************************************************************************

  FILE NAME: R:\9999\FBROOK\Q100E.DAT
  TIME/DATE OF STUDY: 16:54 06/26/2011
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.400
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  4.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  UPSTREAM ELEVATION(FEET) =    685.00
  DOWNSTREAM ELEVATION(FEET) =    680.00
  ELEVATION DIFFERENCE(FEET) =      5.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.738
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.759
  SUBAREA RUNOFF(CFS) =      0.29
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.29

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    680.00  DOWNSTREAM(FEET) =    595.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   814.00   CHANNEL SLOPE =  0.1044
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.29
  FLOW VELOCITY(FEET/SEC) =   1.81 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   7.50   Tc(MIN.) =   15.23
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     898.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.366
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3459
  SUBAREA AREA(ACRES) =    3.95   SUBAREA RUNOFF(CFS) =    6.04
  TOTAL AREA(ACRES) =        4.1   TOTAL RUNOFF(CFS) =       6.22
  TC(MIN.) =   15.23

+----------------------------------------------------------------------------+
| End hydrology model for 'Existing' runoff to southeast corner.             |
|                                                                            |
| Begin hydrology calcs for 'Existing' flows to northwest corner.            |
+----------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =    687.00
  DOWNSTREAM ELEVATION(FEET) =    685.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.606
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.515
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    685.00  DOWNSTREAM(FEET) =    623.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   455.00   CHANNEL SLOPE =  0.1363
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.60   Tc(MIN.) =   12.20
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.038
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
```

```
  SUBAREA AREA(ACRES) =    2.59   SUBAREA RUNOFF(CFS) =    3.26
  TOTAL AREA(ACRES) =        2.8   TOTAL RUNOFF(CFS) =       3.49
  TC(MIN.) =   12.20

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    623.00  DOWNSTREAM(FEET) =    587.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   710.00   CHANNEL SLOPE =  0.0507
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.49
  FLOW VELOCITY(FEET/SEC) =   4.37 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.71   Tc(MIN.) =   14.91
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    203.00 =    1250.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.427
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
  SUBAREA AREA(ACRES) =    9.71   SUBAREA RUNOFF(CFS) =   10.75
  TOTAL AREA(ACRES) =       12.5   TOTAL RUNOFF(CFS) =      13.81
  TC(MIN.) =   14.91
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       12.5  TC(MIN.) =     14.91
  PEAK FLOW RATE(CFS)   =      13.81
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Proposed Condition Model
See Chapter 6 for Hydrology Map

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1239

                           Analysis prepared by:

                    Hunsaker & Associates San Diego, Inc.
                              9707 Waples Street
                           San Diego,  CA  92121


 ************************** DESCRIPTION OF STUDY **************************
* 1404 Winter Haven Road                                                  *
* 100-year storm event hydrology model                                    *
* Post-Developed Scenario                                                 *
 ***************************************************************************

  FILE NAME: R:\9999\FBROOK\Q100P.DAT
  TIME/DATE OF STUDY: 10:34 12/17/2011
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.400
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  4.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+---------------------------------------------------------------------------+
| Begin hydrology model for 'Proposed' flows to northwest corner.           |
|                                                                           |
|                                                                           |
+---------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    84.00
  UPSTREAM ELEVATION(FEET) =    685.00
  DOWNSTREAM ELEVATION(FEET) =    680.00
  ELEVATION DIFFERENCE(FEET) =      5.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    7.738
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.759
  SUBAREA RUNOFF(CFS) =      0.29
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.29
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    680.00  DOWNSTREAM(FEET) =    655.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   232.00   CHANNEL SLOPE =  0.1078
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.29
  FLOW VELOCITY(FEET/SEC) =   1.84 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.10   Tc(MIN.) =    9.84
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     316.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.788
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
  SUBAREA AREA(ACRES) =    0.85   SUBAREA RUNOFF(CFS) =    1.23
  TOTAL AREA(ACRES) =        1.0   TOTAL RUNOFF(CFS) =       1.48
  TC(MIN.) =    9.84

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    202.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   655.00  DOWNSTREAM(FEET) =   630.00
  FLOW LENGTH(FEET) =   351.00   MANNING'S N =  0.030
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   6.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.68
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.48
  PIPE TRAVEL TIME(MIN.) =   1.25    Tc(MIN.) =   11.09
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    202.00 =     667.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.09
  RAINFALL INTENSITY(INCH/HR) =   5.36
  TOTAL STREAM AREA(ACRES) =     1.02
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.48

****************************************************************************
  FLOW PROCESS FROM NODE    600.00 TO NODE    601.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    96.00
  UPSTREAM ELEVATION(FEET) =    685.00
  DOWNSTREAM ELEVATION(FEET) =    680.00
  ELEVATION DIFFERENCE(FEET) =      5.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    8.649
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.291
  SUBAREA RUNOFF(CFS) =      0.27
```

```
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    202.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    680.00  DOWNSTREAM(FEET) =    625.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   419.00   CHANNEL SLOPE =  0.1313
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.27
  FLOW VELOCITY(FEET/SEC) =   2.03 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   3.44   Tc(MIN.) =   12.09
  LONGEST FLOWPATH FROM NODE    600.00 TO NODE    202.00 =     515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    601.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.068
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
  SUBAREA AREA(ACRES) =    0.88   SUBAREA RUNOFF(CFS) =    1.12
  TOTAL AREA(ACRES) =        1.0   TOTAL RUNOFF(CFS) =       1.33
  TC(MIN.) =   12.09

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.09
  RAINFALL INTENSITY(INCH/HR) =   5.07
  TOTAL STREAM AREA(ACRES) =     1.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.33

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =    687.00
  DOWNSTREAM ELEVATION(FEET) =    685.00
  ELEVATION DIFFERENCE(FEET) =      2.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =   10.606
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.515
  SUBAREA RUNOFF(CFS) =      0.25
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.25

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    685.00  DOWNSTREAM(FEET) =    623.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   466.00   CHANNEL SLOPE =  0.1330
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.25
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
```

```
  TRAVEL TIME(MIN.) =   1.64   Tc(MIN.) =   12.24
  LONGEST FLOWPATH FROM NODE    200.00 TO NODE    202.00 =     551.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    201.00 TO NODE    202.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.028
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
  SUBAREA AREA(ACRES) =    2.59   SUBAREA RUNOFF(CFS) =    3.26
  TOTAL AREA(ACRES) =        2.8   TOTAL RUNOFF(CFS) =       3.48
  TC(MIN.) =   12.24

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    202.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.24
  RAINFALL INTENSITY(INCH/HR) =   5.03
  TOTAL STREAM AREA(ACRES) =     2.77
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.48

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        1.48    11.09        5.359          1.02
      2        1.33    12.09        5.068          1.05
      3        3.48    12.24        5.028          2.77

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        5.85    11.09       5.359
      2        6.16    12.09       5.068
      3        6.19    12.24       5.028

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       6.19   Tc(MIN.) =   12.24
  TOTAL AREA(ACRES) =        4.8
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    202.00 =     667.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   623.00  DOWNSTREAM(FEET) =   592.00
  FLOW LENGTH(FEET) =   247.00   MANNING'S N =  0.030
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.35
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.19
  PIPE TRAVEL TIME(MIN.) =   0.49    Tc(MIN.) =   12.74
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    203.00 =     914.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    202.00 TO NODE    203.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.901
  CULTIVATED LAND WITH CONSERVATION TREATMENT RUNOFF COEFFICIENT = .2500
  SOIL CLASSIFICATION IS "B"
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2500
  SUBAREA AREA(ACRES) =    0.69   SUBAREA RUNOFF(CFS) =    0.85
  TOTAL AREA(ACRES) =        5.5   TOTAL RUNOFF(CFS) =       6.78
  TC(MIN.) =   12.74

******************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  52
------------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    592.00  DOWNSTREAM(FEET) =    567.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   420.00   CHANNEL SLOPE =  0.0595
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.78
  FLOW VELOCITY(FEET/SEC) =   5.54 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.26   Tc(MIN.) =   14.00
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    204.00 =    1334.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE    203.00 TO NODE    204.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.611
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .4000
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2760
  SUBAREA AREA(ACRES) =    1.16   SUBAREA RUNOFF(CFS) =    2.14
  TOTAL AREA(ACRES) =        6.7   TOTAL RUNOFF(CFS) =       8.51
  TC(MIN.) =   14.00

******************************************************************************
  FLOW PROCESS FROM NODE    205.00 TO NODE    204.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.611
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .4000
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.2857
  SUBAREA AREA(ACRES) =    0.57   SUBAREA RUNOFF(CFS) =    1.05
  TOTAL AREA(ACRES) =        7.3   TOTAL RUNOFF(CFS) =       9.57
  TC(MIN.) =   14.00

******************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  10
------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
==============================================================================

******************************************************************************
  FLOW PROCESS FROM NODE    210.00 TO NODE    211.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    617.00
  DOWNSTREAM ELEVATION(FEET) =    607.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.765
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
```

```
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.172
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.17   TOTAL RUNOFF(CFS) =      0.57

****************************************************************************
  FLOW PROCESS FROM NODE    211.00 TO NODE    304.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   587.00  DOWNSTREAM(FEET) =   585.00
  FLOW LENGTH(FEET) =   426.00   MANNING'S N =  0.030
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   1.35
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.57
  PIPE TRAVEL TIME(MIN.) =   5.25    Tc(MIN.) =   11.01
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    304.00 =     526.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    211.00 TO NODE    304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.383
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =    0.71   SUBAREA RUNOFF(CFS) =    1.57
  TOTAL AREA(ACRES) =        0.9   TOTAL RUNOFF(CFS) =       1.94
  TC(MIN.) =   11.01

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    300.00 TO NODE    301.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    657.00
  DOWNSTREAM ELEVATION(FEET) =    647.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.684
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.428
  SUBAREA RUNOFF(CFS) =      0.40
  TOTAL AREA(ACRES) =      0.18   TOTAL RUNOFF(CFS) =      0.40

****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.50  DOWNSTREAM(FEET) =    607.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   695.00   CHANNEL SLOPE =  0.0453
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.40
  FLOW VELOCITY(FEET/SEC) =   1.19 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   9.72   Tc(MIN.) =   16.40
  LONGEST FLOWPATH FROM NODE    300.00 TO NODE    302.00 =     795.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    301.00 TO NODE    302.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.164
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3000
  SUBAREA AREA(ACRES) =    2.39   SUBAREA RUNOFF(CFS) =    2.99
  TOTAL AREA(ACRES) =        2.6   TOTAL RUNOFF(CFS) =       3.21
  TC(MIN.) =   16.40

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    302.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   16.40
  RAINFALL INTENSITY(INCH/HR) =   4.16
  TOTAL STREAM AREA(ACRES) =     2.57
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      3.21

****************************************************************************
  FLOW PROCESS FROM NODE    400.00 TO NODE    401.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    657.00
  DOWNSTREAM ELEVATION(FEET) =    647.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.684
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.428
  SUBAREA RUNOFF(CFS) =      0.31
  TOTAL AREA(ACRES) =      0.14   TOTAL RUNOFF(CFS) =      0.31

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    302.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    638.50  DOWNSTREAM(FEET) =    608.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   905.00   CHANNEL SLOPE =  0.0337
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.31
  FLOW VELOCITY(FEET/SEC) =   1.03 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =  14.67   Tc(MIN.) =   21.36
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    302.00 =    1005.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    401.00 TO NODE    302.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.512
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .3000
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3000
  SUBAREA AREA(ACRES) =    4.05   SUBAREA RUNOFF(CFS) =    4.27
  TOTAL AREA(ACRES) =        4.2   TOTAL RUNOFF(CFS) =       4.41
  TC(MIN.) =   21.36
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    302.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   21.36
  RAINFALL INTENSITY(INCH/HR) =   3.51
  TOTAL STREAM AREA(ACRES) =     4.19
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.41

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        3.21    16.40        4.164          2.57
      2        4.41    21.36        3.512          4.19

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1        6.60    16.40       4.164
      2        7.12    21.36       3.512

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.12   Tc(MIN.) =   21.36
  TOTAL AREA(ACRES) =        6.8
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    302.00 =    1005.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   603.00  DOWNSTREAM(FEET) =   589.00
  FLOW LENGTH(FEET) =    42.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  23.22
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.12
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =   21.39
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    303.00 =    1047.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    302.00 TO NODE    303.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.508
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (7.3 DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3030
  SUBAREA AREA(ACRES) =    0.19   SUBAREA RUNOFF(CFS) =    0.27
  TOTAL AREA(ACRES) =        7.0   TOTAL RUNOFF(CFS) =       7.39
  TC(MIN.) =   21.39

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   589.00  DOWNSTREAM(FEET) =   584.00
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
```

```
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.22
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.39
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =   21.61
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    304.00 =    1187.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    303.00 TO NODE    304.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.484
  *USER SPECIFIED(SUBAREA):
  URBAN NEWLY GRADED AREAS RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3051
  SUBAREA AREA(ACRES) =    0.14   SUBAREA RUNOFF(CFS) =    0.20
  TOTAL AREA(ACRES) =        7.1   TOTAL RUNOFF(CFS) =       7.54
  TC(MIN.) =   21.61

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        7.54    21.61       3.484        7.09
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    304.00 =    1187.00 FEET.

  ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        1.94    11.01       5.383        0.88
  LONGEST FLOWPATH FROM NODE    210.00 TO NODE    304.00 =     526.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1       5.78      11.01        5.383
      2       8.80      21.61        3.484

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.80   Tc(MIN.) =   21.61
  TOTAL AREA(ACRES) =        8.0

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    304.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE    304.00 TO NODE    204.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   584.00  DOWNSTREAM(FEET) =   567.00
  FLOW LENGTH(FEET) =    52.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  23.77
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.80
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =   21.65
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    204.00 =    1239.00 FEET.

****************************************************************************
```

```
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        8.80    21.65       3.481        7.97
  LONGEST FLOWPATH FROM NODE    400.00 TO NODE    204.00 =    1239.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1        9.57    14.00       4.611        7.26
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    204.00 =    1334.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      15.25      14.00        4.611
      2      16.02      21.65        3.481

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      16.02   Tc(MIN.) =   21.65
  TOTAL AREA(ACRES) =       15.2

****************************************************************************
  FLOW PROCESS FROM NODE    204.00 TO NODE    204.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

+--------------------------------------------------------------------------+
| End hydrology model for 'Proposed' flows to northwest corner.            |
|                                                                          |
| Begin hydrology model for 'Proposed' flows to southwest corner.          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE    500.00 TO NODE    501.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    631.00
  DOWNSTREAM ELEVATION(FEET) =    625.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.835
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.322
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.20   TOTAL RUNOFF(CFS) =      0.60

****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   625.00  DOWNSTREAM(FEET) =   595.00
  FLOW LENGTH(FEET) =   370.00   MANNING'S N =  0.030
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   4.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.90
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.60
  PIPE TRAVEL TIME(MIN.) =   1.58    Tc(MIN.) =    8.42
  LONGEST FLOWPATH FROM NODE    500.00 TO NODE    502.00 =     470.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE    501.00 TO NODE    502.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.403
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =  81
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =    1.20   SUBAREA RUNOFF(CFS) =    3.15
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       3.68
  TC(MIN.) =    8.42

+--------------------------------------------------------------------------+
| End Hydrology Model to southwest corner of site.                         |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.4  TC(MIN.) =      8.42
  PEAK FLOW RATE(CFS)   =       3.68
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Upstream Watershed Analysis
See Chapter 6 for Hydrology Map

```
****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                          2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1239

                           Analysis prepared by:

                    Hunsaker & Associates San Diego, Inc.
                              9707 Waples Street
                           San Diego,  CA  92121


 ************************** DESCRIPTION OF STUDY **************************
* 1404 Winter Haven Road                                                   *
* 100-year storm event hydrology model.                                    *
* Offsite developed condition scenario.                                    *
 ***************************************************************************

  FILE NAME: R:\9999\FBROOK\Q100WSHD.DAT
  TIME/DATE OF STUDY: 16:10 04/21/2012
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.400
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  4.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =    762.00
  DOWNSTREAM ELEVATION(FEET) =    752.00
  ELEVATION DIFFERENCE(FEET) =     10.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.765
  WARNING: THE MAXIMUM OVERLAND FLOW SLOPE, 10.%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.172
  SUBAREA RUNOFF(CFS) =      0.23
  TOTAL AREA(ACRES) =      0.07   TOTAL RUNOFF(CFS) =      0.23

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    751.00  DOWNSTREAM(FEET) =    682.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1215.00   CHANNEL SLOPE =  0.0568
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.23
  FLOW VELOCITY(FEET/SEC) =   3.57 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   5.66   Tc(MIN.) =   11.43
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1315.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.255
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =   23.49   SUBAREA RUNOFF(CFS) =   50.61
  TOTAL AREA(ACRES) =       23.6   TOTAL RUNOFF(CFS) =      50.77
  TC(MIN.) =   11.43

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  53
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL MOUNTAIN CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    682.00  DOWNSTREAM(FEET) =    610.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2188.00   CHANNEL SLOPE =  0.0329
  CHANNEL FLOW THRU SUBAREA(CFS) =      50.77
  FLOW VELOCITY(FEET/SEC) =   3.76 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   9.71   Tc(MIN.) =   21.14
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =    3503.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.535
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =   75.58   SUBAREA RUNOFF(CFS) =  109.54
  TOTAL AREA(ACRES) =       99.1   TOTAL RUNOFF(CFS) =     143.69
  TC(MIN.) =   21.14

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    610.00  DOWNSTREAM(FEET) =    589.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1235.00   CHANNEL SLOPE =  0.0170
  CHANNEL FLOW THRU SUBAREA(CFS) =     143.69
  FLOW VELOCITY(FEET/SEC) =   6.91 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.98   Tc(MIN.) =   24.12
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =    4738.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.247
  *USER SPECIFIED(SUBAREA):
```

```
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =   47.36   SUBAREA RUNOFF(CFS) =   63.04
  TOTAL AREA(ACRES) =      146.5   TOTAL RUNOFF(CFS) =     195.01
  TC(MIN.) =   24.12

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    589.00  DOWNSTREAM(FEET) =    575.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   638.00   CHANNEL SLOPE =  0.0219
  CHANNEL FLOW THRU SUBAREA(CFS) =     195.01
  FLOW VELOCITY(FEET/SEC) =   8.62 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.23   Tc(MIN.) =   25.35
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =    5376.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.144
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =   17.01   SUBAREA RUNOFF(CFS) =   21.93
  TOTAL AREA(ACRES) =      163.5   TOTAL RUNOFF(CFS) =     210.77
  TC(MIN.) =   25.35
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =      163.5  TC(MIN.) =     25.35
  PEAK FLOW RATE(CFS)   =     210.77
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

Upstream Watershed Analysis:
Calculations for 100-year WSEL within natural channel on north side of project.

See Hydrology Map in Chapter 6 for cross-section locations.

Cross Section 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.10	%
Discharge	210.77	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
2+32	581.00
2+10	577.00
1+99	575.00
0+50	575.00
0+16	578.00
0+04	579.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(2+32, 581.00)	(0+04, 579.00)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.02	ft
Elevation Range	575.00 to 581.00 ft	
Flow Area	160.84	ft^2
Wetted Perimeter	166.82	ft
Hydraulic Radius	0.96	ft
Top Width	166.68	ft
Normal Depth	1.02	ft

Cross Section 1

Results

Critical Depth		0.39	ft
Critical Slope		0.02457	ft/ft
Velocity		1.31	ft/s
Velocity Head		0.03	ft
Specific Energy		1.04	ft
Froude Number		0.24	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.02	ft
Critical Depth	0.39	ft
Channel Slope	0.10	%
Critical Slope	0.02457	ft/ft

Cross Section 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.40	%
Discharge	210.77	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
1+95	590.00
1+86	589.00
1+50	585.00
1+33	584.11
0+60	585.00
0+30	590.00
0+07	593.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(1+95, 590.00)	(0+07, 593.00)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.38	ft
Elevation Range	584.11 to 593.00 ft	
Flow Area	85.42	ft^2
Wetted Perimeter	96.95	ft
Hydraulic Radius	0.88	ft
Top Width	96.85	ft

Cross Section 2

Results

Normal Depth		1.38	ft
Critical Depth		1.00	ft
Critical Slope		0.02180	ft/ft
Velocity		2.47	ft/s
Velocity Head		0.09	ft
Specific Energy		1.47	ft
Froude Number		0.46	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.38	ft
Critical Depth	1.00	ft
Channel Slope	0.40	%
Critical Slope	0.02180	ft/ft

Cross Section 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.10	%
Discharge	210.77	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
2+07	590.00
1+58	587.00
1+27	585.00
1+14	584.81
0+86	585.00
0+48	590.00
0+17	595.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(2+07, 590.00)	(0+17, 595.00)	0.035

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.08	ft
Elevation Range	584.81 to 595.00 ft	
Flow Area	122.91	ft²
Wetted Perimeter	85.15	ft
Hydraulic Radius	1.44	ft
Top Width	84.97	ft

Cross Section 3

Results

Normal Depth		2.08	ft
Critical Depth		0.98	ft
Critical Slope		0.01984	ft/ft
Velocity		1.71	ft/s
Velocity Head		0.05	ft
Specific Energy		2.13	ft
Froude Number		0.25	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.08	ft
Critical Depth	0.98	ft
Channel Slope	0.10	%
Critical Slope	0.01984	ft/ft

CHAPTER 4

Brow Ditch, Basin, and Inlet Calculations

Worksheet for Brow Ditch 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	5.77	%
Diameter	2.00	ft
Discharge	7.54	ft^3/s

Results

Normal Depth	0.50	ft
Flow Area	0.62	ft^2
Wetted Perimeter	2.10	ft
Hydraulic Radius	0.29	ft
Top Width	1.74	ft
Critical Depth	0.98	ft
Percent Full	25.2	%
Critical Slope	0.00483	ft/ft
Velocity	12.16	ft/s
Velocity Head	2.30	ft
Specific Energy	2.80	ft
Froude Number	3.59	
Maximum Discharge	58.45	ft^3/s
Discharge Full	54.34	ft^3/s
Slope Full	0.00111	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	25.16	%
Downstream Velocity	Infinity	ft/s

Worksheet for Brow Ditch 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	1.00	%
Diameter	2.00	ft
Discharge	0.27	ft^3/s

Results

Normal Depth	0.15	ft
Flow Area	0.11	ft^2
Wetted Perimeter	1.12	ft
Hydraulic Radius	0.10	ft
Top Width	1.06	ft
Critical Depth	0.18	ft
Percent Full	7.7	%
Critical Slope	0.00539	ft/ft
Velocity	2.44	ft/s
Velocity Head	0.09	ft
Specific Energy	0.25	ft
Froude Number	1.33	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00000	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	7.67	%
Downstream Velocity	Infinity	ft/s

Worksheet for Brow Ditch 3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	13.15	%
Diameter	2.00	ft
Discharge	6.78	ft^3/s

Results

Normal Depth	0.39	ft
Flow Area	0.43	ft^2
Wetted Perimeter	1.83	ft
Hydraulic Radius	0.24	ft
Top Width	1.58	ft
Critical Depth	0.92	ft
Percent Full	19.4	%
Critical Slope	0.00473	ft/ft
Velocity	15.79	ft/s
Velocity Head	3.87	ft
Specific Energy	4.26	ft
Froude Number	5.34	
Maximum Discharge	88.24	ft^3/s
Discharge Full	82.03	ft^3/s
Slope Full	0.00090	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	19.44	%
Downstream Velocity	Infinity	ft/s

Worksheet for Brow Ditch 5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	1.00	%
Diameter	2.00	ft
Discharge	1.94	ft^3/s

Results

Normal Depth	0.40	ft
Flow Area	0.44	ft^2
Wetted Perimeter	1.84	ft
Hydraulic Radius	0.24	ft
Top Width	1.59	ft
Critical Depth	0.48	ft
Percent Full	19.8	%
Critical Slope	0.00449	ft/ft
Velocity	4.40	ft/s
Velocity Head	0.30	ft
Specific Energy	0.70	ft
Froude Number	1.48	
Maximum Discharge	24.33	ft^3/s
Discharge Full	22.62	ft^3/s
Slope Full	0.00007	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	19.80	%
Downstream Velocity	Infinity	ft/s

Worksheet for Swale 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	3.22	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	4.41	ft^3/s

Results

Normal Depth	0.62	ft
Flow Area	0.78	ft^2
Wetted Perimeter	2.79	ft
Hydraulic Radius	0.28	ft
Top Width	2.49	ft
Critical Depth	0.79	ft
Critical Slope	0.00923	ft/ft
Velocity	5.69	ft/s
Velocity Head	0.50	ft
Specific Energy	1.13	ft
Froude Number	1.80	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	0.79	ft
Channel Slope	3.22	%
Critical Slope	0.00923	ft/ft

Worksheet for Swale 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.020	
Channel Slope	1.00	%
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Discharge	3.21	ft^3/s

Results

Normal Depth	0.69	ft
Flow Area	0.95	ft^2
Wetted Perimeter	3.08	ft
Hydraulic Radius	0.31	ft
Top Width	2.75	ft
Critical Depth	0.69	ft
Critical Slope	0.00963	ft/ft
Velocity	3.39	ft/s
Velocity Head	0.18	ft
Specific Energy	0.87	ft
Froude Number	1.02	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.69	ft
Channel Slope	1.00	%
Critical Slope	0.00963	ft/ft

1404 Winter HavenRoad
Proposed Retention Basin Sizing

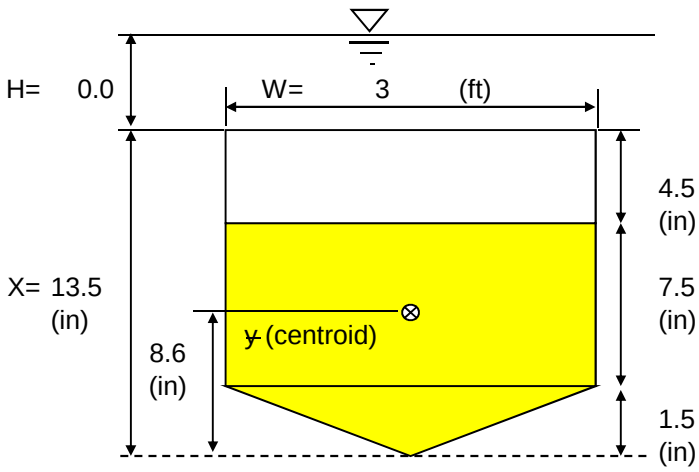
Vol = $C*P_6*A$
C – Runoff Coefficient
P6 – Precipitation (inches)
A – Area of watershed (acres)

Basin 1
C = 0.35
P_6 = 3.40 in.
A = 15.2 ac.
V = 18.09 ac-in = 65,659 ft^3
Basin Storage = 7' depth
Side-slopes= 2:1
Total Basin Depth = 6'
Basin Bottom Dimension = 70' x 113'
Storage Volume at 7' depth = 74,676 ft^3

1404 Winter Haven Development

MODIFIED CATCH BASIN TYPE "F"
MAXIMUM CAPACITY CALCULATION

Dimensions obtained from City of San Diego Standard Drawings (Drawing D-7):



W=	3.0	(ft)	Input width of opening
X=	13.5	(in)	Input depth from top of box to flowline
X-6"=	7.5	(in)	Height of rectangular opening
$\Sigma A\bar{y}$=	0.84	(ft^3)	Sum of each area times each centroid
ΣA=	2.06	(ft^2)	Sum of areas
$\bar{y}=\Sigma Ay/\Sigma A$=	0.41	(ft)	Height of effective centroid
h=	0.72	(ft)	Computed head to top of box ($X - \bar{y}$)
H=	0.00	(ft)	Additional ponding height allowable
H+h=	0.72	(ft)	Total height above centroid

$Q_{max} = 0.6A\sqrt{(2gh)}$

Qmax = 8.42 cfs per opening

*Assumes no clogging of opening

Both catch basins for this site have two openings.
Total flows at the catch basins are 7.1 cfs and 8.8 cfs
and have less than 8.42 cfs at each opening.

CHAPTER 5

Hydraulic Analysis
Rip Rap Sizing

SD LINE 'A'
(INTO BASIN)

LA COUNTY PUBLIC WORKS

STORM DRAIN ANALYSIS
(INPUT)

REPT: PC/RD4412.1
DATE: 12/17/11
PAGE 1

See 'Proposed Hydrology Map'
for storm drain location.

PROJECT: 1404 Winter Haven r:\9999\Fbrook\line a.dat
DESIGNER: RLE

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						568.50															
2	2	8.8	8.8	51.50	567.00	572.15	0.00	18.	0.	1	0.00	0.20	0.05	1	0	0	0	0.	0.	0.	3.00	0.013

PROJECT: 1404 Winter Haven r:\9999\Fbrook\line a.dat
DESIGNER: RLE

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 568.50																	
2	8.8	18	0	0.53	1.15	PART	0.00702	15.1	6.1	567.00	572.15	567.55	573.30	0.55	1.15	573.98	0.00	

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END

V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END

X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION

X(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER

X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE

F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP

D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)

D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)

SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART

HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP

HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE

HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

EOJ 12/17/2011 11:22

SD LINE 'B'

LA COUNTY PUBLIC WORKS

STORM DRAIN ANALYSIS
(INPUT)

REPT: PC/RD4412.1
DATE: 12/03/11
PAGE 1

See 'Proposed Hydrology Map' for storm drain location.

PROJECT: 1404 Winter Haven r:\9999\Fbrook\line b.dat
DESIGNER: RLE

CD	L2	MAX Q	ADJ Q	LENGTH	FL 1	FL 2	CTL/TW	D	W	S	KJ	KE	KM	LC	L1	L3	L4	A1	A3	A4	J	N
8	1						588.50															
2	2	7.1	7.1	39.00	588.00	602.50	0.00	18.	0.	1	0.00	0.20	0.05	1	0	0	0	0.	0.	0.	3.00	0.013

PROJECT: 1404 Winter Haven r:\9999\Fbrook\line b.dat
DESIGNER: RLE

LINE NO	Q (CFS)	D (IN)	W (IN)	DN (FT)	DC (FT)	FLOW TYPE	SF-FULL (FT/FT)	V 1 (FPS)	V 2 (FPS)	FL 1 (FT)	FL 2 (FT)	HG 1 CALC	HG 2 CALC	D 1 (FT)	D 2 (FT)	TW CALC	TW CK	REMARKS
1	HYDRAULIC GRADE LINE CONTROL = 588.50																	
2	7.1	18	0	0.34	1.03	PART	0.00457	13.8	5.5	588.00	602.50	588.50	603.53	0.50	1.03	604.09	0.00	

V 1, FL 1, D 1 AND HG 1 REFER TO DOWNSTREAM END

V 2, FL 2, D 2 AND HG 2 REFER TO UPSTREAM END

X - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HG INTERSECTS SOFFIT IN SEAL CONDITION

X(N) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE WATER SURFACE REACHES NORMAL DEPTH BY EITHER DRAWDOWN OR BACKWATER

X(J) - DISTANCE IN FEET FROM DOWNSTREAM END TO POINT WHERE HYDRAULIC JUMP OCCURS IN LINE

F(J) - THE COMPUTED FORCE AT THE HYDRAULIC JUMP

D(BJ) - DEPTH OF WATER BEFORE THE HYDRAULIC JUMP (UPSTREAM SIDE)

D(AJ) - DEPTH OF WATER AFTER THE HYDRAULIC JUMP (DOWNSTREAM SIDE)

SEAL INDICATES FLOW CHANGES FROM PART TO FULL OR FROM FULL TO PART

HYD JUMP INDICATES THAT FLOW CHANGES FROM SUPERCRITICAL TO SUBCRITICAL THROUGH A HYDRAULIC JUMP

HJ @ UJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE UPSTREAM END OF THE LINE

HJ @ DJT INDICATES THAT HYDRAULIC JUMP OCCURS AT THE JUNCTION AT THE DOWNSTREAM END OF THE LINE

EOJ 12/ 3/2011 13:28

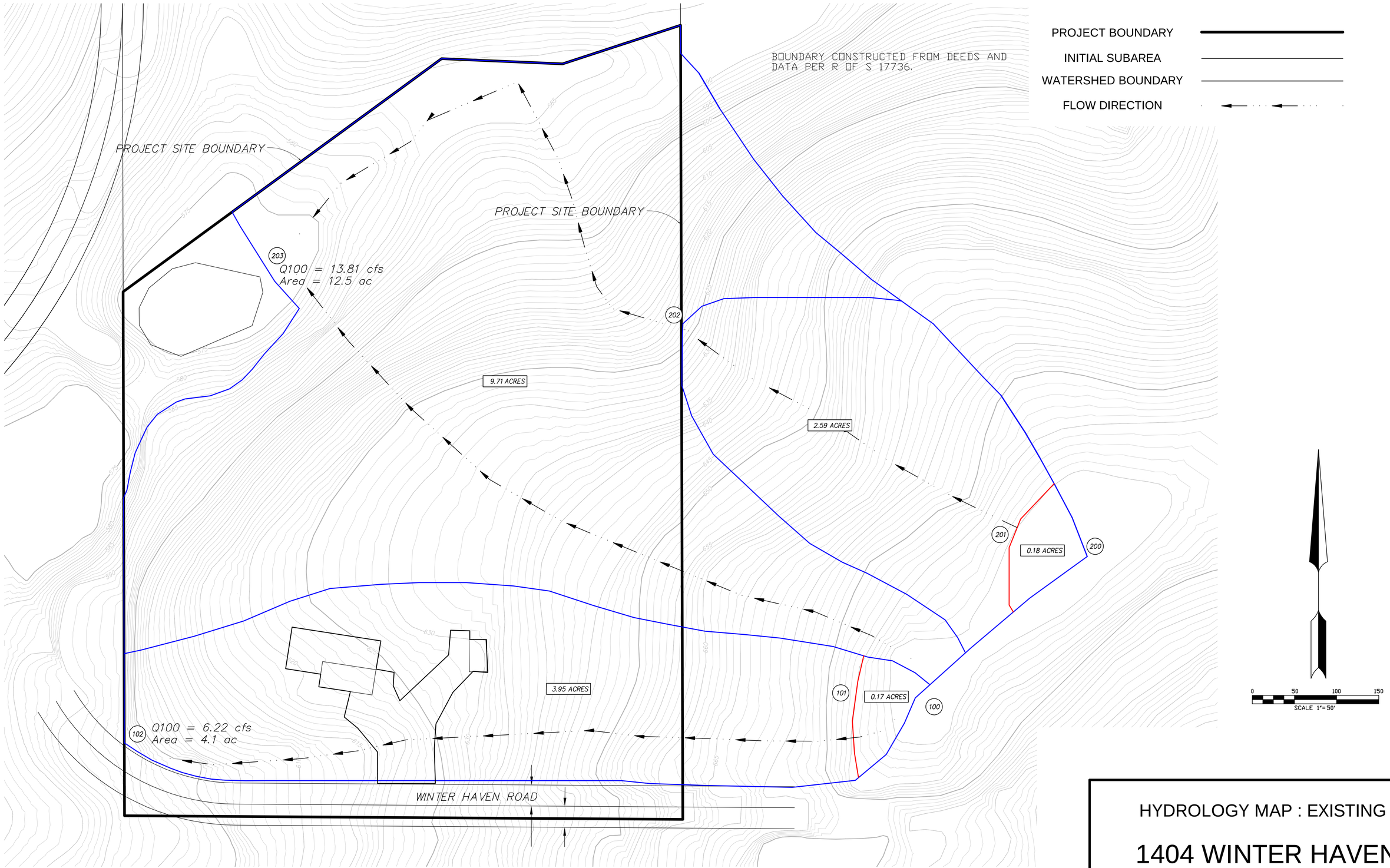
1404 Winter Haven
Rip Rap Design

Rip Rap Number	Location	Outlet Pipe Diameter (in)	Q (cfs)	Vel (ft/sec)	Width (ft)	Length (ft)	Rock Classification	Rip Rap Thickness (ft)
1	End of Brow Ditch #3	24	6.78	15.8	6	10	1/4-Ton	2.7
2	End of SD Line 'A' (into Basin)	18	8.80	15.1	4.5	10	1/4-Ton	2.7

R:\9999\Fbrook\HYD\riprap
W.O. #25-349
12/17/2011

CHAPTER 6

Hydrology Map

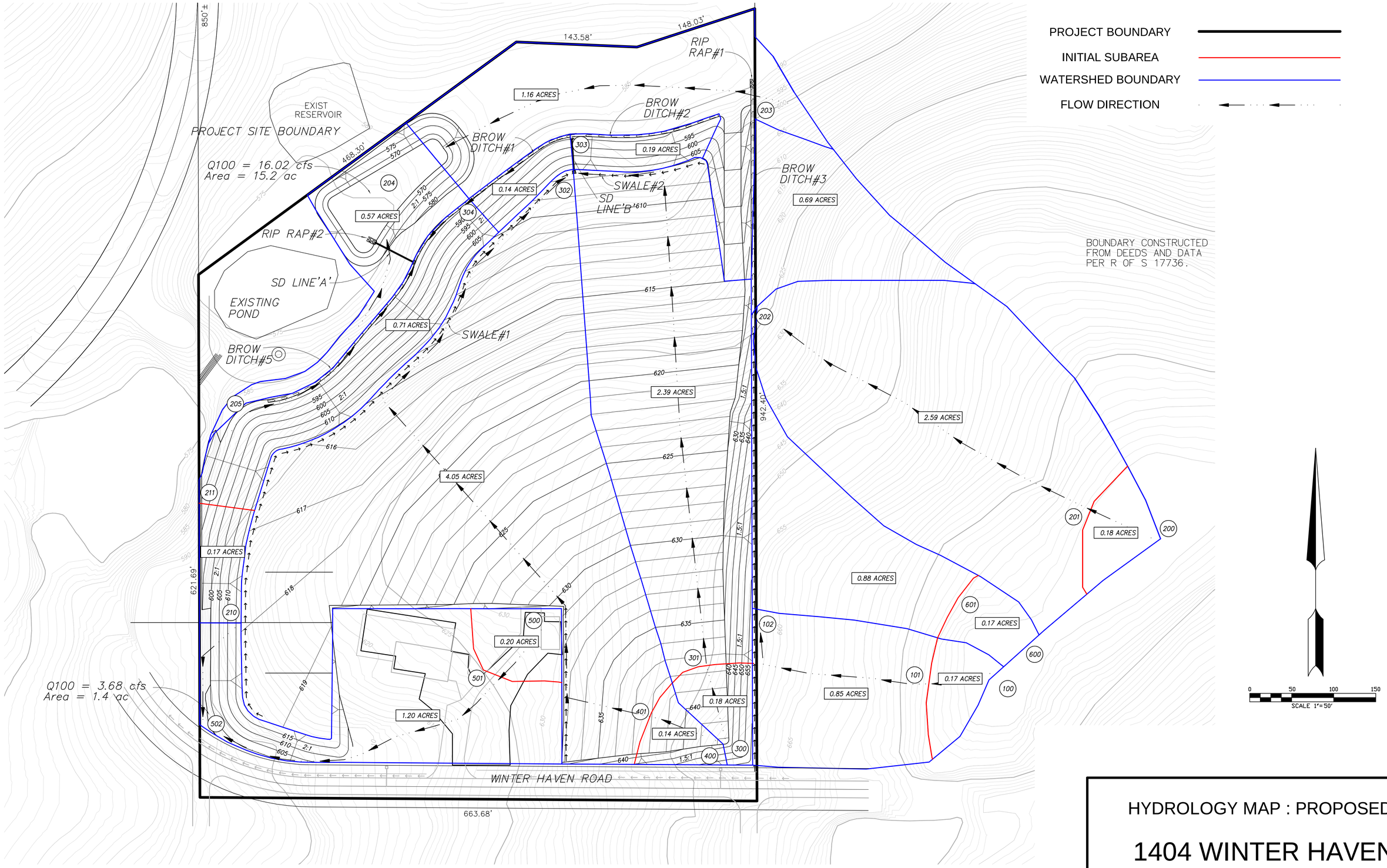


HYDROLOGY MAP : EXISTING

1404 WINTER HAVEN

CITY OF FALLBROOK, CALIFORNIA

R:\9999\Fbrook\HYD\1404 Winter Haven Existing Hydrology Map.dwg[]Dec-03-2011:13:05

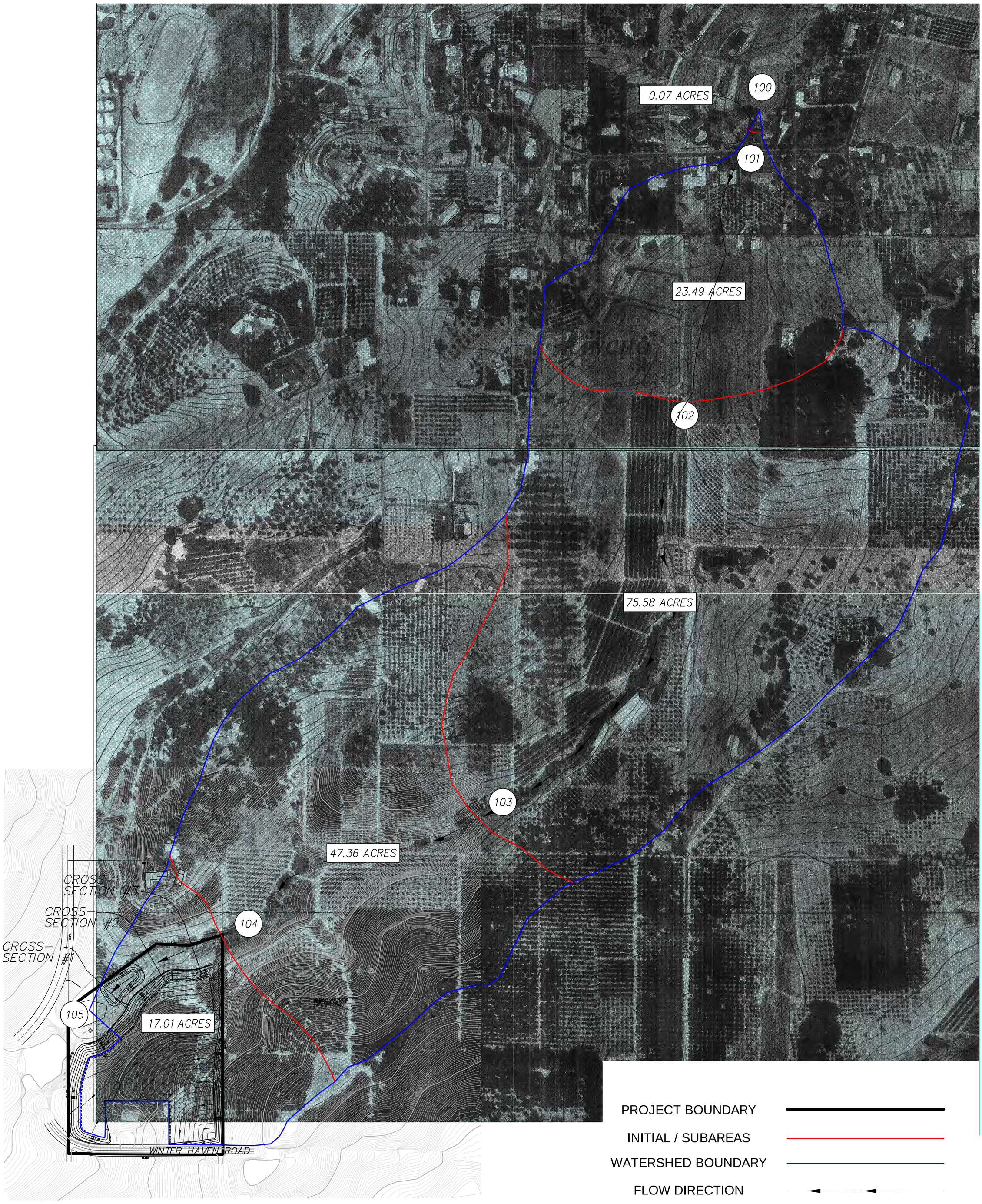


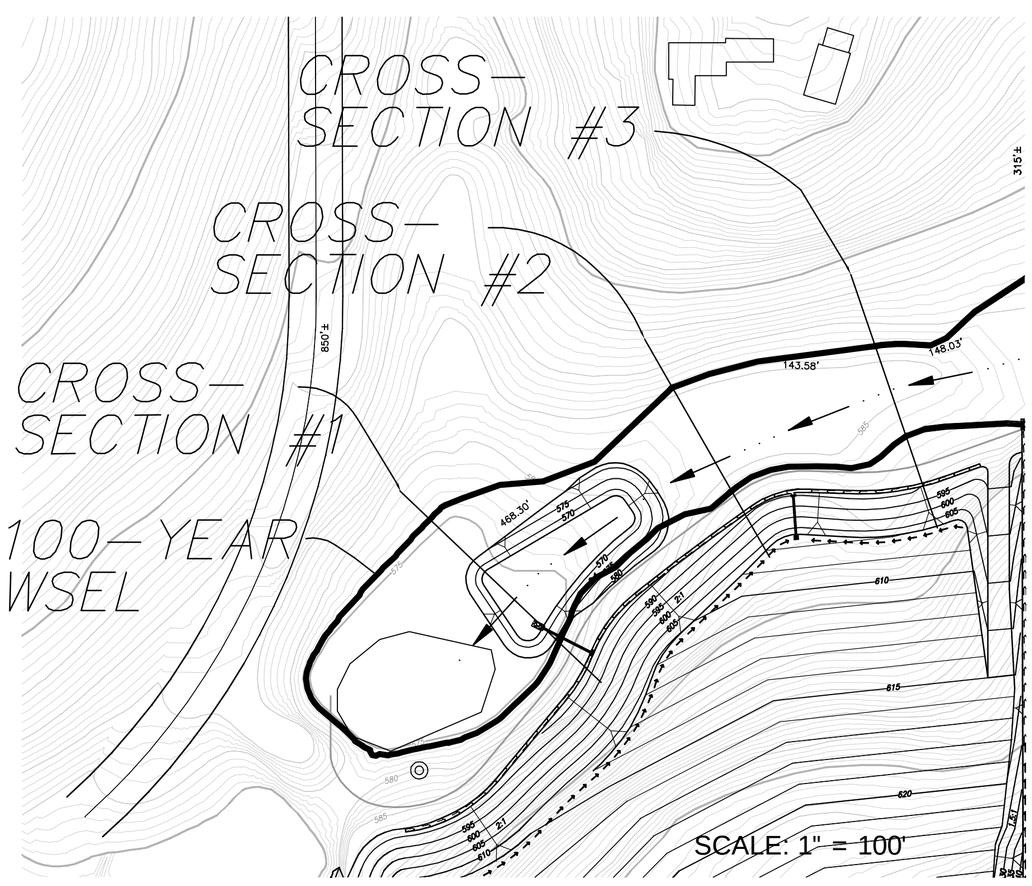
HYDROLOGY MAP : PROPOSED

1404 WINTER HAVEN

CITY OF FALLBROOK, CALIFORNIA

R:\9999\Fbrook\HYD\1404 Winter Haven Proposed Hydrology Map.dwg[]Jan-18-2012:09:41





SCALE: 1" = 200'

HYDROLOGY MAP
UPSTREAM WATERSHED

1404 WINTER HAVEN

CITY OF FALLBROOK, CALIFORNIA

R:\9999\Fbrook\HYD\1404 Winter Haven 200-scale Hydrology Map_recover_recover.dwg[]Jun-16-2012:13:57