Appendix J

Hydrology Study

HYDROLOGY STUDY
FOR
The Exchange

Riverside, California

Prepared For:
AFG Development, LLC
1451 Research Park Drive, Suite 200
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Job No. 9179
August 30, 2018

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EXP. 6/30/20

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1. Purpose

The purpose of this study is to evaluate the impact of the project on the existing drainage pattern, to quantify any increase in peak runoff rates on the downstream facilities, and to develop the necessary mitigation necessary to offset such impacts.

2. Method of Analysis

The site hydrology was based upon Riverside County Flood Control and Water Conversation District Hydrology Manual, from which pertinent soil and rainfall information was obtained.

Storm flows were determined by the "RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM", Riverside County Flood Control & Water Conservation District 1978 Hydrology Manual, produced by Bondamin Engineering.

3. Project Description

The proposed mixed-use project consists of multi-family residential dwelling units, multi-tenant commercial buildings, a vehicle fueling station, a drive-thru restaurant, two hotels, a Recreational Vehicle (RV) overnight parking component, and on-site activities (e.g., farmers market, outdoor entertainment).

The residential portion of the project will be constructed on approximately 18.4 acres on the northern half of the project site and includes a total of 482 one-, two- and three- bedroom residential units in 21 three-story buildings. Project plans identify 479,773 square feet of residential space, resulting in a density of 26.2 dwelling units per acre. A total of 886 vehicle parking spaces are proposed for the residential use.

The commercial/retail, vehicle fueling station and drive-thru restaurant portion of the project would be located on approximately 7.6 acres on the southwest corner of the project site and includes a total of 49,500 square feet of multi-tenant lease space for restaurant and commercial retail tenants spread across 8 single-story buildings. The retail areas would generally operate 12 to 15 hours a day, with the exception of the proposed gas station, which would operate 24 hours a day. A total of 417 parking stalls are proposed for the commercial component of the project.

Two hotel buildings would be located on approximately 7.4 acres, near the southeast corner of the project site. The proposed RV Parking is located in the southeast corner of the project site, closest to the I-215/SR 60 interchange, adjacent to the proposed hotels. The RV Parking will contain 23 RV spaces and 23 vehicle stalls. The two, four-story hotels will total 130,000 square feet and contain 229 guest rooms. The hotels will operate independently of each other. The hotels and RV Parking would operate 24 hours a day. A total of 229 parking spaces are proposed for the two hotels.

The proposed development includes provisions for live entertainment and events and a farmers market to serve the proposed residences and surrounding community. The live entertainment would occur within the courtyard in the center of Buildings P1 through P4. The events would occur on occasion, on Fridays, Saturdays, or Sundays.

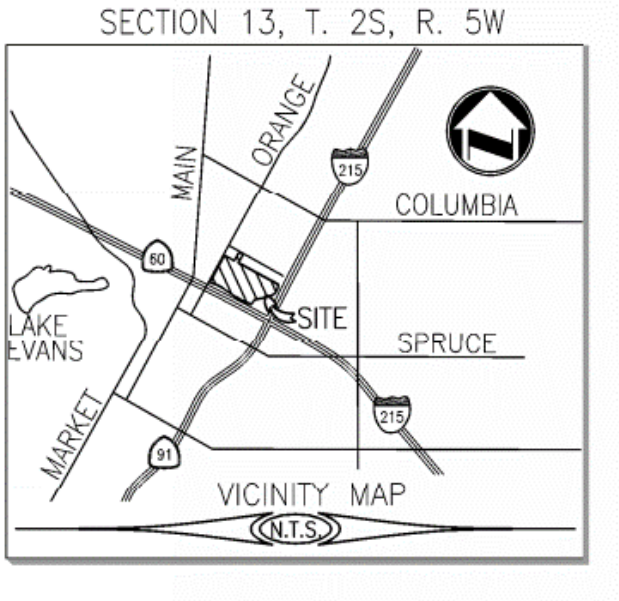
Events could include farmers market, outdoor entertainment, car shows (demonstration only) and similar type events.

Vehicular access to the project site would be provided by one driveway entrance located east of the site along La Cadena Drive, and two driveways located along the northwest boundary of the site on Orange Street. Residents would primarily access the site through the entrances located at La Cadena Drive and the northern-most driveway along Orange Street; retail customers and hotel visitors would primarily access the site through the driveways along Orange Street.

A Minor Conditional Use Permit has been submitted for freeway oriented signage up to 60 feet in height, as measured from the grade of the adjacent freeway.
As part of the proposed development the applicant has submitted a Parcel Map subdividing 8 parcels into 15 parcels.

A recreational vehicle (RV) parking lot with 27 spaces and 18 associated RV-car spaces would be placed in the southeast end of the project site, south of Hotel 2.

A. Vicinity Map



4. Pre-Development Hydrology

The site is currently vacant and has existing single family residential homes along the North and the Northeast of the site. West of the site is Fremont Elementary School. South and East of the site is Interstate 215 and Highway 60. The University Wash Channel runs through the center of the site and is a trapezoidal Channel with a 10' bottom with 1.5:1 side slopes that is 6.5' deep. Existing RCFC plans (DWG 1-0384) show the channel is designed to convey 1,900 cfs. The University Wash Channel is a RCFC master planned facility, no data is available to support this flow.

Offsite drainage flows from the north and the northeast corner drain into the Channel. Offsite flows located at the northeast corner of the site are from a double 4' x 3' RCB under La Cadena Drive. Existing Caltrans plans (Drainage System No. 35 Drainage Profiles D-79 Contract No. 08-334844 12-31-08) show the existing sizing of the RCB and catch basins with no cfs shown on the plans. Calculations were run for the existing double RCB resulting in 240 cfs. Offsite flows from Knoll Way and Strong Street flow towards the site by a 39" storm drain line (Knoll-Strong Strom Drain Line D-187). The storm drain plans showed no cfs on the plans. Calculations were run for the existing 39" RCP resulting in 46 cfs. Orange Street runoff sumps near Fremont Elementary School and drains into the channel. A map of the existing drainage area is located in Section 1.

5. Post-Development Hydrology

The majority of the onsite University Wash Channel will be replaced with a 96" R.C.P. All offsite runoff from the north and the northeast will connect directly to the proposed pipe. Proposed onsite runoff will also connect to the proposed pipe. All onsite runoff will be treated with proposed onsite BMP prior to draining into the proposed pipe. The onsite BMP will have the capacity to bypass the 100yr storm. Catch basins will be installed near Orange Street along the proposed pipe and will act as a bubbler to control the hydraulic grade line in the proposed pipe. A map of the proposed drainage area is located in Section 2.

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6. Conclusion

The hydrologic calculations provided herein substantiate the design of the proposed project and indicate the following:

- The proposed facilities demonstrate the ability to convey the 100 year storm events as required by the City of Riverside Conditions of Approval
- The post development impacts created by the additional impervious surface will be treated by the project Site Design and Structural BMP's and will have the capacity to bypass the 100yr storm. The on-site hydrodynamic separators were sized according to the Q100 flows determined by the analysis herein.

Therefore, it is our conclusion this project **does not** negatively impact the local community or watershed goals of the Santa Ana River.

Section 1 – Pre-Development Hydrology (Rational Method)

```
                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:ex10.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.747(In/Hr)
Slope of intensity duration curve = 0.5000




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Process from Point/Station        1.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.660
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       0.91(In/Hr)
Total area =         0.00(Ac.)  Total runoff =     30.46(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.000(Ac.)
Runoff from this stream =     30.460(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     0.915(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.660
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       0.91(In/Hr)
Total area =         0.00(Ac.)  Total runoff =    158.94(CFS)
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Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.000(Ac.)
Runoff from this stream =    158.940(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     0.915(In/Hr)
Summary of stream data:

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


1       30.460     40.00                 0.915
2      158.940     40.00                 0.915
Largest stream flow has longer time of concentration
Qp =    158.940 + sum of
          Qb         Ia/Ib
          30.460 *    1.000 =     30.460
Qp =    189.400

Total of 2 streams to confluence:
Flow rates before confluence point:
      30.460     158.940
Area of streams before confluence:
        0.000        0.000
Results of confluence:
Total flow rate =    189.400(CFS)
Time of concentration =    40.000 min.
Effective stream area after confluence =      0.000(Ac.)


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Process from Point/Station        2.000 to Point/Station        4.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of natural channel elevation =    846.000(Ft.)
End of natural channel elevation =    839.000(Ft.)
Length of natural channel  =   872.000(Ft.)
Estimated mean flow rate at midpoint of channel =      1.#IO(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.#J(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0080
Corrected/adjusted channel slope =  0.0080
Travel time =    0.00 min.     TC =   40.00  min.


 Adding area flow to channel
USER INPUT of soil data for subarea
Runoff Coefficient = 0.615
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
Subarea runoff =      5.412(CFS) for      9.620(Ac.)
Total runoff =    194.812(CFS)       Total area =       9.620(Ac.)


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Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      9.620(Ac.)
Runoff from this stream =    194.812(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     0.915(In/Hr)


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Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Initial area flow distance =   236.000(Ft.)
Top (of initial area) elevation =   865.000(Ft.)
Bottom (of initial area) elevation =   854.000(Ft.)
Difference in elevation =    11.000(Ft.)
Slope =    0.04661  s(percent)=       4.66
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.405 min.
Rainfall intensity =      2.286(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.759
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      3.190(CFS)
Total initial stream area =        1.840(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        4.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of natural channel elevation =    854.000(Ft.)
End of natural channel elevation =    839.000(Ft.)
Length of natural channel  =   162.000(Ft.)
Estimated mean flow rate at midpoint of channel =      3.190(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   5.79(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0926
Corrected/adjusted channel slope =  0.0926
Travel time =    0.47 min.     TC =    6.87  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.769
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      2.207(In/Hr) for a    10.0 year storm
Subarea runoff =      0.000(CFS) for      0.000(Ac.)
Total runoff =      3.190(CFS)       Total area =       1.840(Ac.)


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Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.840(Ac.)
Runoff from this stream =      3.190(CFS)
Time of concentration =    6.87 min.
Rainfall intensity =     2.207(In/Hr)
Summary of stream data:

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


1      194.812     40.00                 0.915
2        3.190      6.87                 2.207
Largest stream flow has longer time of concentration
Qp =    194.812 + sum of
          Qb         Ia/Ib
           3.190 *    0.414 =      1.322
Qp =    196.135
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Total of 2 streams to confluence:
Flow rates before confluence point:
     194.812       3.190
Area of streams before confluence:
       9.620       1.840
Results of confluence:
Total flow rate =    196.135(CFS)
Time of concentration =    40.000 min.
Effective stream area after confluence =     11.460(Ac.)


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Process from Point/Station        4.000 to Point/Station        7.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of natural channel elevation =    839.000(Ft.)
End of natural channel elevation =    833.000(Ft.)
Length of natural channel  =   484.000(Ft.)
Estimated mean flow rate at midpoint of channel =    300.877(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   7.42(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0124
Corrected/adjusted channel slope =  0.0124
Travel time =    1.09 min.     TC =   41.09  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.635
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.903(In/Hr) for a    10.0 year storm
Subarea runoff =      7.018(CFS) for     12.240(Ac.)
Total runoff =    203.152(CFS)       Total area =      23.700(Ac.)


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Process from Point/Station        7.000 to Point/Station        8.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   833.000(Ft.)
Downstream point/station elevation =   828.000(Ft.)
Pipe length  =    64.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   203.152(CFS)
Nearest computed pipe diameter  =     39.00(In.)
Calculated individual pipe flow  =   203.152(CFS)
Normal flow depth in pipe =   28.41(In.)
Flow top width inside pipe =   34.69(In.)
Critical depth could not be calculated.
Pipe flow velocity =     31.39(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    41.12 min.


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Process from Point/Station        8.000 to Point/Station        8.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     23.700(Ac.)
Runoff from this stream =    203.152(CFS)
Time of concentration =   41.12 min.
Rainfall intensity =     0.902(In/Hr)


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Process from Point/Station        9.000 to Point/Station       10.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =  1000.000(Ft.)
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Top (of initial area) elevation =   866.000(Ft.)
Bottom (of initial area) elevation =   834.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.03200  s(percent)=       3.20
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   16.720 min.
Rainfall intensity =      1.415(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.711
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      5.714(CFS)
Total initial stream area =        5.680(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station       10.000 to Point/Station        8.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   834.000(Ft.)
Downstream point elevation =   828.000(Ft.)
Channel length thru subarea  =   479.000(Ft.)
Channel base width    =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =      6.071(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =      6.071(CFS)
Depth of flow =   0.160(Ft.), Average velocity =   3.696(Ft/s)
Channel flow top width =   10.481(Ft.)
Flow Velocity =    3.70(Ft/s)
Travel time  =    2.16 min.
Time of concentration =   18.88 min.

Sub-Channel No. 1 Critical depth =      0.223(Ft.)
  '     '       '     Critical flow top width =     10.668(Ft.)
  '     '       '     Critical flow velocity=    2.638(Ft/s)
  '     '       '     Critical flow area =      2.301(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.331(In/Hr) for a    10.0 year storm
Subarea runoff =      0.813(CFS) for      0.710(Ac.)
Total runoff =      6.527(CFS)       Total area =       6.390(Ac.)
Depth of flow =   0.168(Ft.), Average velocity =   3.801(Ft/s)

Sub-Channel No. 1 Critical depth =      0.234(Ft.)
  '     '       '     Critical flow top width =     10.703(Ft.)
  '     '       '     Critical flow velocity=    2.690(Ft/s)
  '     '       '     Critical flow area =      2.426(Sq.Ft)



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Process from Point/Station        8.000 to Point/Station        8.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      6.390(Ac.)
Runoff from this stream =      6.527(CFS)
Time of concentration =   18.88 min.
Rainfall intensity =     1.331(In/Hr)
Summary of stream data:

Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)
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```
1      203.152     41.12                  0.902
2        6.527     18.88                  1.331
Largest stream flow has longer time of concentration
Qp =    203.152 + sum of
          Qb         Ia/Ib
           6.527 *    0.678 =      4.423
Qp =    207.575

Total of 2 streams to confluence:
Flow rates before confluence point:
     203.152       6.527
Area of streams before confluence:
       23.700        6.390
Results of confluence:
Total flow rate =    207.575(CFS)
Time of concentration =    41.121 min.
Effective stream area after confluence =     30.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station       11.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   828.000(Ft.)
Downstream point elevation =   825.200(Ft.)
Channel length thru subarea  =   239.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    207.733(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =    207.733(CFS)
Depth of flow =   1.331(Ft.), Average velocity =  13.014(Ft/s)
Channel flow top width =   13.992(Ft.)
Flow Velocity =   13.01(Ft/s)
Travel time  =    0.31 min.
Time of concentration =   41.43 min.

Sub-Channel No. 1 Critical depth =      2.125(Ft.)
  '     '       '     Critical flow top width =     16.375(Ft.)
  '     '       '     Critical flow velocity=    7.413(Ft/s)
  '     '       '     Critical flow area =     28.023(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.852
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      0.899(In/Hr) for a    10.0 year storm
Subarea runoff =      0.253(CFS) for      0.330(Ac.)
Total runoff =    207.828(CFS)       Total area =      30.420(Ac.)
Depth of flow =   1.331(Ft.), Average velocity =  13.015(Ft/s)

Sub-Channel No. 1 Critical depth =      2.125(Ft.)
  '     '       '     Critical flow top width =     16.375(Ft.)
  '     '       '     Critical flow velocity=    7.416(Ft/s)
  '     '       '     Critical flow area =     28.023(Sq.Ft)



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Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.420(Ac.)
Runoff from this stream =    207.828(CFS)
Time of concentration =   41.43 min.
Rainfall intensity =     0.899(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =  1000.000(Ft.)
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Top (of initial area) elevation =   851.000(Ft.)
Bottom (of initial area) elevation =   831.000(Ft.)
Difference in elevation =    20.000(Ft.)
Slope =    0.02000  s(percent)=       2.00
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   18.368 min.
Rainfall intensity =      1.350(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.704
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      5.007(CFS)
Total initial stream area =        5.270(Ac.)
Pervious area fraction = 1.000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   831.000(Ft.)
Downstream point/station elevation =   825.200(Ft.)
Pipe length  =    44.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.007(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     5.007(CFS)
Normal flow depth in pipe =    6.28(In.)
Flow top width inside pipe =    8.26(In.)
Critical depth could not be calculated.
Pipe flow velocity =     15.21(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =    18.42 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      5.270(Ac.)
Runoff from this stream =      5.007(CFS)
Time of concentration =   18.42 min.
Rainfall intensity =     1.348(In/Hr)
Summary of stream data:
Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                 (In/Hr)
1      207.828     41.43                  0.899
2        5.007     18.42                  1.348
Largest stream flow has longer time of concentration
Qp =    207.828 + sum of
          Qb         Ia/Ib
           5.007 *    0.667 =      3.338
Qp =    211.166
Total of 2 streams to confluence:
Flow rates before confluence point:
     207.828       5.007
Area of streams before confluence:
       30.420        5.270
Results of confluence:
Total flow rate =    211.166(CFS)
Time of concentration =    41.427 min.
Effective stream area after confluence =     35.690(Ac.)


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Process from Point/Station       11.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   825.200(Ft.)
Downstream point elevation =   824.500(Ft.)
Channel length thru subarea  =    51.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    211.217(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
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Flow(q) thru subarea =    211.217(CFS)
Depth of flow =   1.283(Ft.), Average velocity =  13.802(Ft/s)
Channel flow top width =   13.850(Ft.)
Flow Velocity =   13.80(Ft/s)
Travel time  =    0.06 min.
Time of concentration =   41.49 min.
Sub-Channel No. 1 Critical depth =      2.156(Ft.)
  '     '       '     Critical flow top width =     16.469(Ft.)
  '     '       '     Critical flow velocity=    7.402(Ft/s)
  '     '       '     Critical flow area =     28.537(Sq.Ft)
 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.852
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      0.898(In/Hr) for a    10.0 year storm
Subarea runoff =      0.038(CFS) for      0.050(Ac.)
Total runoff =    211.204(CFS)       Total area =      35.740(Ac.)
Depth of flow =   1.283(Ft.), Average velocity =  13.801(Ft/s)
Sub-Channel No. 1 Critical depth =      2.156(Ft.)
  '     '       '     Critical flow top width =     16.469(Ft.)
  '     '       '     Critical flow velocity=    7.401(Ft/s)
  '     '       '     Critical flow area =     28.537(Sq.Ft)


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Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     35.740(Ac.)
Runoff from this stream =    211.204(CFS)
Time of concentration =   41.49 min.
Rainfall intensity =     0.898(In/Hr)


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Process from Point/Station       15.000 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   745.000(Ft.)
Top (of initial area) elevation =   861.000(Ft.)
Bottom (of initial area) elevation =   829.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.04295  s(percent)=       4.30
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.013 min.
Rainfall intensity =      1.545(In/Hr) for a    10.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.724
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      4.788(CFS)
Total initial stream area =        4.280(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station       16.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   829.000(Ft.)
Downstream point/station elevation =   824.500(Ft.)
Pipe length  =    37.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.788(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     4.788(CFS)
Normal flow depth in pipe =    6.26(In.)
Flow top width inside pipe =    8.28(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.60(Ft/s)
Travel time through pipe =    0.04 min.
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Time of concentration (TC) =    14.06 min.


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Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.280(Ac.)
Runoff from this stream =      4.788(CFS)
Time of concentration =   14.06 min.
Rainfall intensity =     1.543(In/Hr)
Summary of stream data:
Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)               (In/Hr)
1      211.204     41.49                 0.898
2        4.788     14.06                 1.543
Largest stream flow has longer time of concentration
Qp =    211.204 + sum of
          Qb         Ia/Ib
           4.788 *    0.582 =      2.787
Qp =    213.991
Total of 2 streams to confluence:
Flow rates before confluence point:
     211.204       4.788
Area of streams before confluence:
      35.740       4.280
Results of confluence:
Total flow rate =    213.991(CFS)
Time of concentration =    41.489 min.
Effective stream area after confluence =     40.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       17.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Covered channel
Upstream point elevation =   824.500(Ft.)
Downstream point elevation =   816.000(Ft.)
Channel length thru subarea  =    51.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    215.014(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =    215.014(CFS)
Depth of flow =   0.623(Ft.), Average velocity =  31.564(Ft/s)
Channel flow top width =   11.869(Ft.)
Flow Velocity =   31.56(Ft/s)
Travel time  =    0.03 min.
Time of concentration =   41.52 min.
Sub-Channel No. 1 Critical depth =      2.156(Ft.)
  '     '       '     Critical flow top width =     16.469(Ft.)
  '     '       '     Critical flow velocity=    7.535(Ft/s)
  '     '       '     Critical flow area =     28.537(Sq.Ft)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.634
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      0.898(In/Hr) for a    10.0 year storm
Subarea runoff =      1.982(CFS) for      3.480(Ac.)
Total runoff =    215.973(CFS)       Total area =      43.500(Ac.)
Depth of flow =   0.625(Ft.), Average velocity =  31.614(Ft/s)
Sub-Channel No. 1 Critical depth =      2.172(Ft.)
  '     '       '     Critical flow top width =     16.516(Ft.)
  '     '       '     Critical flow velocity=    7.501(Ft/s)
  '     '       '     Critical flow area =     28.794(Sq.Ft)
End of computations, total study area =           43.50 (Ac.)
The following figures maybe used for a unit hydrograph study of the same area.
Area averaged pervious area fraction(Ap) = 0.912
Area averaged RI index number =  74.5
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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:EXST10.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.747(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       19.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   958.000(Ft.)
Top (of initial area) elevation =   864.000(Ft.)
Bottom (of initial area) elevation =   832.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.03340  s(percent)=       3.34
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.224 min.
Rainfall intensity =      1.905(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.068(CFS)
Total initial stream area =        2.460(Ac.)
Pervious area fraction = 0.100
End of computations, total study area =            2.46 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:ex100.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.100(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.703
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       1.35(In/Hr)
Total area =         0.00(Ac.)  Total runoff =     46.00(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.000(Ac.)
Runoff from this stream =     46.000(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     1.347(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.703
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       1.35(In/Hr)
Total area =         0.00(Ac.)  Total runoff =    240.00(CFS)
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Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.000(Ac.)
Runoff from this stream =    240.000(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     1.347(In/Hr)
Summary of stream data:

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


1       46.000     40.00                 1.347
2      240.000     40.00                 1.347
Largest stream flow has longer time of concentration
Qp =    240.000 + sum of
          Qb         Ia/Ib
          46.000 *    1.000 =     46.000
Qp =    286.000

Total of 2 streams to confluence:
Flow rates before confluence point:
      46.000     240.000
Area of streams before confluence:
        0.000        0.000
Results of confluence:
Total flow rate =    286.000(CFS)
Time of concentration =    40.000 min.
Effective stream area after confluence =      0.000(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of natural channel elevation =    846.000(Ft.)
End of natural channel elevation =    839.000(Ft.)
Length of natural channel  =   872.000(Ft.)
Estimated mean flow rate at midpoint of channel =      1.#IO(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.#J(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0080
Corrected/adjusted channel slope =  0.0080
Travel time =    0.00 min.     TC =   40.00  min.


 Adding area flow to channel
USER INPUT of soil data for subarea
Runoff Coefficient = 0.678
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  69.00
Pervious area fraction =  0.800; Impervious fraction =  0.200
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
Subarea runoff =      8.792(CFS) for      9.620(Ac.)
Total runoff =    294.792(CFS)       Total area =       9.620(Ac.)


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Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      9.620(Ac.)
Runoff from this stream =    294.792(CFS)
Time of concentration =   40.00 min.
Rainfall intensity =     1.347(In/Hr)


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Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
----------------------------------------------------------------------------
Initial area flow distance =   236.000(Ft.)
Top (of initial area) elevation =   865.000(Ft.)
Bottom (of initial area) elevation =   854.000(Ft.)
Difference in elevation =    11.000(Ft.)
Slope =    0.04661  s(percent)=       4.66
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.405 min.
Rainfall intensity =      3.367(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.793
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      4.914(CFS)
Total initial stream area =        1.840(Ac.)
Pervious area fraction = 0.500


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Process from Point/Station        6.000 to Point/Station        4.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of natural channel elevation =    854.000(Ft.)
End of natural channel elevation =    839.000(Ft.)
Length of natural channel  =   162.000(Ft.)
Estimated mean flow rate at midpoint of channel =      4.914(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   6.39(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0926
Corrected/adjusted channel slope =  0.0926
Travel time =    0.42 min.     TC =    6.83  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.807
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      3.261(In/Hr) for a   100.0 year storm
Subarea runoff =      0.000(CFS) for      0.000(Ac.)
Total runoff =      4.914(CFS)       Total area =       1.840(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MINOR STREAMS ****
----------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.840(Ac.)
Runoff from this stream =      4.914(CFS)
Time of concentration =    6.83 min.
Rainfall intensity =     3.261(In/Hr)
Summary of stream data:

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


1      294.792     40.00                 1.347
2        4.914      6.83                 3.261
Largest stream flow has longer time of concentration
Qp =    294.792 + sum of
          Qb         Ia/Ib
           4.914 *    0.413 =      2.030
Qp =    296.822
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```
Total of 2 streams to confluence:
Flow rates before confluence point:
     294.792       4.914
Area of streams before confluence:
       9.620       1.840
Results of confluence:
Total flow rate =    296.822(CFS)
Time of concentration =    40.000 min.
Effective stream area after confluence =     11.460(Ac.)


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Process from Point/Station        4.000 to Point/Station        7.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of natural channel elevation =    839.000(Ft.)
End of natural channel elevation =    833.000(Ft.)
Length of natural channel  =   484.000(Ft.)
Estimated mean flow rate at midpoint of channel =    455.335(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   8.46(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
       Normal channel slope =  0.0124
Corrected/adjusted channel slope =  0.0124
Travel time =    0.95 min.     TC =   40.95  min.


 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.702
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      1.331(In/Hr) for a   100.0 year storm
Subarea runoff =     11.437(CFS) for     12.240(Ac.)
Total runoff =    308.259(CFS)       Total area =      23.700(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        8.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
________________________________________________________________________
Upstream point/station elevation =   833.000(Ft.)
Downstream point/station elevation =   828.000(Ft.)
Pipe length  =    64.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   308.259(CFS)
Nearest computed pipe diameter  =     45.00(In.)
Calculated individual pipe flow  =   308.259(CFS)
Normal flow depth in pipe =   33.75(In.)
Flow top width inside pipe =   38.97(In.)
Critical depth could not be calculated.
Pipe flow velocity =     34.69(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    40.98 min.


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Process from Point/Station        8.000 to Point/Station        8.000
**** CONFLUENCE OF MINOR STREAMS ****
________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     23.700(Ac.)
Runoff from this stream =    308.259(CFS)
Time of concentration =   40.98 min.
Rainfall intensity =     1.331(In/Hr)


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Process from Point/Station        9.000 to Point/Station       10.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =  1000.000(Ft.)
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Top (of initial area) elevation =   866.000(Ft.)
Bottom (of initial area) elevation =   834.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.03200  s(percent)=       3.20
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   16.720 min.
Rainfall intensity =      2.084(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.762
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      9.024(CFS)
Total initial stream area =        5.680(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station       10.000 to Point/Station        8.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   834.000(Ft.)
Downstream point elevation =   828.000(Ft.)
Channel length thru subarea  =   479.000(Ft.)
Channel base width    =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =      9.588(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =      9.588(CFS)
Depth of flow =   0.211(Ft.), Average velocity =   4.407(Ft/s)
Channel flow top width =   10.633(Ft.)
Flow Velocity =    4.41(Ft/s)
Travel time  =    1.81 min.
Time of concentration =   18.53 min.

Sub-Channel No. 1 Critical depth =      0.301(Ft.)
  '     '       '     Critical flow top width =     10.902(Ft.)
  '     '       '     Critical flow velocity=    3.050(Ft/s)
  '     '       '     Critical flow area =      3.144(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.869
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.979(In/Hr) for a   100.0 year storm
Subarea runoff =      1.221(CFS) for      0.710(Ac.)
Total runoff =     10.245(CFS)       Total area =       6.390(Ac.)
Depth of flow =   0.219(Ft.), Average velocity =   4.520(Ft/s)

Sub-Channel No. 1 Critical depth =      0.313(Ft.)
  '     '       '     Critical flow top width =     10.938(Ft.)
  '     '       '     Critical flow velocity=    3.132(Ft/s)
  '     '       '     Critical flow area =      3.271(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        8.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      6.390(Ac.)
Runoff from this stream =     10.245(CFS)
Time of concentration =   18.53 min.
Rainfall intensity =     1.979(In/Hr)
Summary of stream data:

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

```
1      308.259     40.98                 1.331
2       10.245     18.53                 1.979
Largest stream flow has longer time of concentration
Qp =    308.259 + sum of
          Qb         Ia/Ib
          10.245 *    0.672 =      6.889
Qp =    315.148

Total of 2 streams to confluence:
Flow rates before confluence point:
     308.259      10.245
Area of streams before confluence:
       23.700        6.390
Results of confluence:
Total flow rate =    315.148(CFS)
Time of concentration =    40.984 min.
Effective stream area after confluence =     30.090(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station       11.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Upstream point elevation =   828.000(Ft.)
Downstream point elevation =   825.200(Ft.)
Channel length thru subarea  =   239.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    315.384(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =    315.384(CFS)
Depth of flow =   1.692(Ft.), Average velocity =  14.869(Ft/s)
Channel flow top width =   15.075(Ft.)
Flow Velocity =   14.87(Ft/s)
Travel time  =    0.27 min.
Time of concentration =   41.25 min.

Sub-Channel No. 1 Critical depth =      2.719(Ft.)
  '     '       '     Critical flow top width =     18.156(Ft.)
  '     '       '     Critical flow velocity=    8.240(Ft/s)
  '     '       '     Critical flow area =     38.275(Sq.Ft)

 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.327(In/Hr) for a   100.0 year storm
Subarea runoff =      0.377(CFS) for      0.330(Ac.)
Total runoff =    315.524(CFS)       Total area =      30.420(Ac.)
Depth of flow =   1.692(Ft.), Average velocity =  14.871(Ft/s)

Sub-Channel No. 1 Critical depth =      2.719(Ft.)
  '     '       '     Critical flow top width =     18.156(Ft.)
  '     '       '     Critical flow velocity=    8.244(Ft/s)
  '     '       '     Critical flow area =     38.275(Sq.Ft)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     30.420(Ac.)
Runoff from this stream =    315.524(CFS)
Time of concentration =   41.25 min.
Rainfall intensity =     1.327(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =  1000.000(Ft.)
```

```
Top (of initial area) elevation =   851.000(Ft.)
Bottom (of initial area) elevation =   831.000(Ft.)
Difference in elevation =    20.000(Ft.)
Slope =    0.02000  s(percent)=       2.00
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   18.368 min.
Rainfall intensity =      1.988(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.757
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      7.929(CFS)
Total initial stream area =        5.270(Ac.)
Pervious area fraction = 1.000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       11.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   831.000(Ft.)
Downstream point/station elevation =   825.200(Ft.)
Pipe length  =    44.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.929(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     7.929(CFS)
Normal flow depth in pipe =    6.79(In.)
Flow top width inside pipe =   11.90(In.)
Critical depth could not be calculated.
Pipe flow velocity =     17.30(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    18.41 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       11.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      5.270(Ac.)
Runoff from this stream =      7.929(CFS)
Time of concentration =   18.41 min.
Rainfall intensity =     1.986(In/Hr)
Summary of stream data:
Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)                  (In/Hr)
1      315.524     41.25                1.327
2        7.929     18.41                1.986
Largest stream flow has longer time of concentration
Qp =    315.524 + sum of
          Qb         Ia/Ib
           7.929 *    0.668 =      5.297
Qp =    320.822
Total of 2 streams to confluence:
Flow rates before confluence point:
     315.524       7.929
Area of streams before confluence:
       30.420        5.270
Results of confluence:
Total flow rate =    320.822(CFS)
Time of concentration =    41.252 min.
Effective stream area after confluence =     35.690(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =   825.200(Ft.)
Downstream point elevation =   824.500(Ft.)
Channel length thru subarea  =    51.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    320.899(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
```

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Flow(q) thru subarea =    320.899(CFS)
Depth of flow =   1.633(Ft.), Average velocity =  15.784(Ft/s)
Channel flow top width =   14.899(Ft.)
Flow Velocity =   15.78(Ft/s)
Travel time  =    0.05 min.
Time of concentration =   41.31 min.
Sub-Channel No. 1 Critical depth =      2.750(Ft.)
  '     '       '     Critical flow top width =     18.250(Ft.)
  '     '       '     Critical flow velocity=    8.261(Ft/s)
  '     '       '     Critical flow area =     38.844(Sq.Ft)
 Adding area flow to channel
COMMERCIAL subarea type
Runoff Coefficient = 0.860
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.326(In/Hr) for a   100.0 year storm
Subarea runoff =      0.057(CFS) for      0.050(Ac.)
Total runoff =    320.879(CFS)       Total area =      35.740(Ac.)
Depth of flow =   1.633(Ft.), Average velocity =  15.784(Ft/s)
Sub-Channel No. 1 Critical depth =      2.750(Ft.)
  '     '       '     Critical flow top width =     18.250(Ft.)
  '     '       '     Critical flow velocity=    8.261(Ft/s)
  '     '       '     Critical flow area =     38.844(Sq.Ft)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     35.740(Ac.)
Runoff from this stream =    320.879(CFS)
Time of concentration =   41.31 min.
Rainfall intensity =     1.326(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   745.000(Ft.)
Top (of initial area) elevation =   861.000(Ft.)
Bottom (of initial area) elevation =   829.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.04295  s(percent)=       4.30
TC = k(0.530)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.013 min.
Rainfall intensity =      2.276(In/Hr) for a   100.0 year storm
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.772
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Initial subarea runoff =      7.524(CFS)
Total initial stream area =        4.280(Ac.)
Pervious area fraction = 1.000


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Process from Point/Station       16.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   829.000(Ft.)
Downstream point/station elevation =   824.500(Ft.)
Pipe length  =    37.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.524(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     7.524(CFS)
Normal flow depth in pipe =    6.74(In.)
Flow top width inside pipe =   11.91(In.)
Critical depth could not be calculated.
Pipe flow velocity =     16.57(Ft/s)
Travel time through pipe =    0.04 min.
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Time of concentration (TC) =    14.05 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      4.280(Ac.)
Runoff from this stream =      7.524(CFS)
Time of concentration =   14.05 min.
Rainfall intensity =     2.273(In/Hr)
Summary of stream data:
Stream   Flow rate      TC            Rainfall Intensity
 No.       (CFS)       (min)               (In/Hr)
1      320.879     41.31                1.326
2        7.524     14.05                2.273
Largest stream flow has longer time of concentration
Qp =    320.879 + sum of
          Qb         Ia/Ib
           7.524 *    0.583 =      4.388
Qp =    325.267
Total of 2 streams to confluence:
Flow rates before confluence point:
     320.879       7.524
Area of streams before confluence:
       35.740        4.280
Results of confluence:
Total flow rate =    325.267(CFS)
Time of concentration =    41.306 min.
Effective stream area after confluence =     40.020(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       17.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________________
Covered channel
Upstream point elevation =   824.500(Ft.)
Downstream point elevation =   816.000(Ft.)
Channel length thru subarea  =    51.000(Ft.)
Channel base width     =   10.000(Ft.)
Slope or 'Z' of left channel bank =   1.500
Slope or 'Z' of right channel bank =   1.500
Estimated mean flow rate at midpoint of channel =    326.933(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    6.500(Ft.)
Flow(q) thru subarea =    326.933(CFS)
Depth of flow =   0.798(Ft.), Average velocity =  36.580(Ft/s)
Channel flow top width =   12.395(Ft.)
Flow Velocity =   36.58(Ft/s)
Travel time  =    0.02 min.
Time of concentration =   41.33 min.
Sub-Channel No. 1 Critical depth =      2.781(Ft.)
  '     '       '     Critical flow top width =     18.344(Ft.)
  '     '       '     Critical flow velocity=    8.295(Ft/s)
  '     '       '     Critical flow area =     39.416(Sq.Ft)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Runoff Coefficient = 0.701
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  78.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Rainfall intensity =      1.325(In/Hr) for a   100.0 year storm
Subarea runoff =      3.234(CFS) for      3.480(Ac.)
Total runoff =    328.501(CFS)       Total area =      43.500(Ac.)
Depth of flow =   0.800(Ft.), Average velocity =  36.641(Ft/s)
Sub-Channel No. 1 Critical depth =      2.781(Ft.)
  '     '       '     Critical flow top width =     18.344(Ft.)
  '     '       '     Critical flow velocity=    8.334(Ft/s)
  '     '       '     Critical flow area =     39.416(Sq.Ft)

End of computations, total study area =           43.50 (Ac.)
The following figures maybe used for a unit hydrograph study of the same area.
Area averaged pervious area fraction(Ap) = 0.912
Area averaged RI index number =  74.5
```

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:EXST.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.100(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       18.000 to Point/Station       19.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =   958.000(Ft.)
Top (of initial area) elevation =   864.000(Ft.)
Bottom (of initial area) elevation =   832.000(Ft.)
Difference in elevation =    32.000(Ft.)
Slope =    0.03340  s(percent)=       3.34
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.224 min.
Rainfall intensity =      2.806(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      6.043(CFS)
Total initial stream area =        2.460(Ac.)
Pervious area fraction = 0.100
End of computations, total study area =            2.46 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```
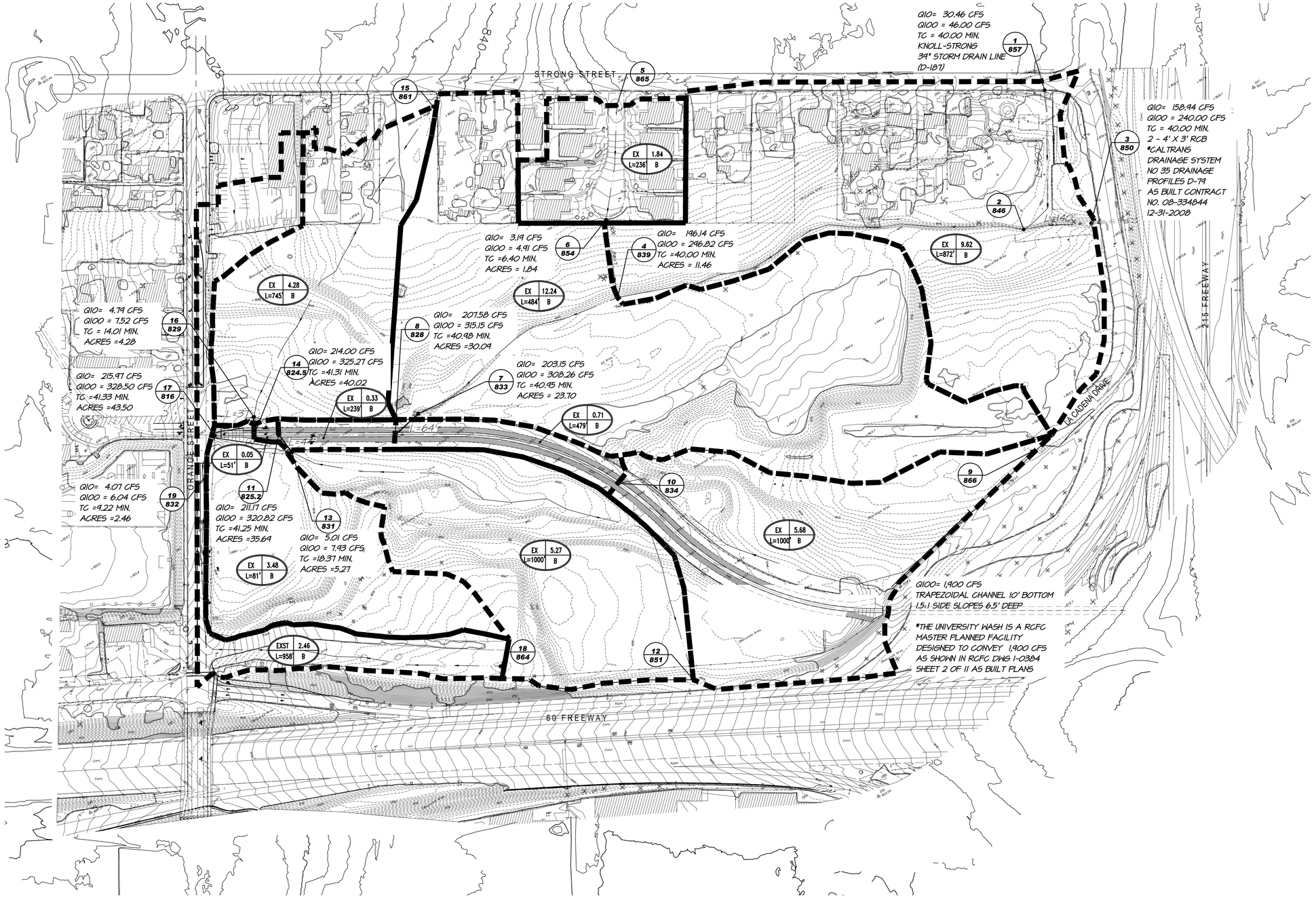
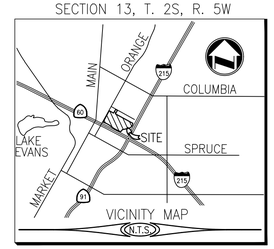

THE EXCHANGE: PRE-DEVELOPMENT RATIONAL HYDROLOGY MAP





0 100 300
50 200 400
SCALE: 1" = 100'

LEGEND

NODE ELEV

AREA | ACRES
LENGTH | SOIL

WATERSHED BOUNDARY

FLOW PATH

THE EXCHANGE
PRE-DEVELOPMENT HYDROLOGY MAP
PREPARATION DATE : FEBRUARY 2018
REVISION DATE : AUGUST 2018

PLAN PREPARED BY:
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Section 2 – Post-Development Hydrology (Rational Method)

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:off10.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.747(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   351.000(Ft.)
Top (of initial area) elevation =   852.000(Ft.)
Bottom (of initial area) elevation =   844.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02279  s(percent)=       2.28
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.663 min.
Rainfall intensity =      2.241(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      2.812(CFS)
Total initial stream area =        1.440(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.440(Ac.)
Runoff from this stream =      2.812(CFS)
Time of concentration =    6.66 min.
Rainfall intensity =     2.241(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.660
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
```

```
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       0.91(In/Hr)
Total area =         0.00(Ac.)  Total runoff =    158.94(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   846.000(Ft.)
Downstream point/station elevation =   844.000(Ft.)
Pipe length  =    72.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   158.940(CFS)
Nearest computed pipe diameter  =     42.00(In.)
Calculated individual pipe flow  =   158.940(CFS)
Normal flow depth in pipe =   32.63(In.)
Flow top width inside pipe =   34.98(In.)
Critical depth could not be calculated.
Pipe flow velocity =     19.83(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    40.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.000(Ac.)
Runoff from this stream =    158.940(CFS)
Time of concentration =   40.06 min.
Rainfall intensity =     0.914(In/Hr)
Summary of stream data:

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


1        2.812      6.66                 2.241
2      158.940     40.06                 0.914
Largest stream flow has longer time of concentration
Qp =    158.940 + sum of
          Qb         Ia/Ib
           2.812 *    0.408 =      1.147
Qp =    160.087

Total of 2 streams to confluence:
Flow rates before confluence point:
       2.812     158.940
Area of streams before confluence:
        1.440        0.000
Results of confluence:
Total flow rate =    160.087(CFS)
Time of concentration =    40.061 min.
Effective stream area after confluence =      1.440(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   844.000(Ft.)
Downstream point/station elevation =   833.000(Ft.)
Pipe length  =  1157.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   160.087(CFS)
Nearest computed pipe diameter  =     51.00(In.)
Calculated individual pipe flow  =   160.087(CFS)
Normal flow depth in pipe =   40.59(In.)
Flow top width inside pipe =   41.11(In.)
Critical Depth =   44.47(In.)
Pipe flow velocity =     13.22(Ft/s)
Travel time through pipe =    1.46 min.
Time of concentration (TC) =    41.52 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
```

```
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      1.440(Ac.)
Runoff from this stream =    160.087(CFS)
Time of concentration =   41.52 min.
Rainfall intensity =     0.898(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Initial area flow distance =   245.000(Ft.)
Top (of initial area) elevation =   865.000(Ft.)
Bottom (of initial area) elevation =   852.500(Ft.)
Difference in elevation =    12.500(Ft.)
Slope =    0.05102  s(percent)=       5.10
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.385 min.
Rainfall intensity =      2.289(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.759
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      5.037(CFS)
Total initial stream area =        2.900(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   852.500(Ft.)
Downstream point/station elevation =   835.600(Ft.)
Pipe length  =   210.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.037(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     5.037(CFS)
Normal flow depth in pipe =    5.99(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =   11.03(In.)
Pipe flow velocity =     12.86(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =     6.66 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        7.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.900(Ac.)
Runoff from this stream =      5.037(CFS)
Time of concentration =    6.66 min.
Rainfall intensity =     2.242(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        8.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------------
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.660
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       0.91(In/Hr)
Total area =         0.00(Ac.)  Total runoff =     30.46(CFS)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        9.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of natural channel elevation =    857.000(Ft.)
End of natural channel elevation =    841.500(Ft.)
Length of natural channel  =   505.000(Ft.)
Estimated mean flow rate at midpoint of channel =      1.#IO(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.#J(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0307
Corrected/adjusted channel slope =  0.0307
Travel time =    0.00 min.     TC =   40.00  min.


 Adding area flow to channel
SINGLE FAMILY (1/2 Acre Lot)
Runoff Coefficient = 0.612
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.600; Impervious fraction =  0.400
Rainfall intensity =      0.915(In/Hr) for a    10.0 year storm
Subarea runoff =      2.893(CFS) for      5.170(Ac.)
Total runoff =     33.353(CFS)       Total area =       5.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   841.500(Ft.)
Downstream point/station elevation =   835.600(Ft.)
Pipe length  =   214.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    33.353(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    33.353(CFS)
Normal flow depth in pipe =   17.60(In.)
Flow top width inside pipe =   21.22(In.)
Critical depth could not be calculated.
Pipe flow velocity =     13.51(Ft/s)
Travel time through pipe =    0.26 min.
Time of concentration (TC) =    40.26 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        7.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      5.170(Ac.)
Runoff from this stream =     33.353(CFS)
Time of concentration =   40.26 min.
Rainfall intensity =     0.912(In/Hr)
Summary of stream data:

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


1        5.037      6.66                  2.242
2       33.353     40.26                  0.912
Largest stream flow has longer time of concentration
Qp =     33.353 + sum of
          Qb          Ia/Ib
           5.037 *    0.407 =      2.048
Qp =     35.401

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.037      33.353
Area of streams before confluence:
        2.900        5.170
```

```
Results of confluence:
Total flow rate =     35.401(CFS)
Time of concentration =    40.264 min.
Effective stream area after confluence =      8.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   835.600(Ft.)
Downstream point/station elevation =   833.000(Ft.)
Pipe length  =   300.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    35.401(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    35.401(CFS)
Normal flow depth in pipe =   22.83(In.)
Flow top width inside pipe =   25.59(In.)
Critical Depth =   24.23(In.)
Pipe flow velocity =      8.83(Ft/s)
Travel time through pipe =    0.57 min.
Time of concentration (TC) =    40.83 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      8.070(Ac.)
Runoff from this stream =     35.401(CFS)
Time of concentration =   40.83 min.
Rainfall intensity =     0.905(In/Hr)
Summary of stream data:

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


1      160.087     41.52               0.898
2       35.401     40.83               0.905
Largest stream flow has longer time of concentration
Qp =    160.087 + sum of
          Qb         Ia/Ib
          35.401 *    0.992 =     35.106
Qp =    195.193

Total of 2 main streams to confluence:
Flow rates before confluence point:
     160.087      35.401
Area of streams before confluence:
        1.440        8.070


Results of confluence:
Total flow rate =    195.193(CFS)
Time of concentration =    41.519 min.
Effective stream area after confluence  =      9.510(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   833.000(Ft.)
Downstream point/station elevation =   832.000(Ft.)
Pipe length  =   301.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   195.193(CFS)
Nearest computed pipe diameter  =     66.00(In.)
Calculated individual pipe flow  =   195.193(CFS)
Normal flow depth in pipe =   54.56(In.)
Flow top width inside pipe =   49.96(In.)
Critical Depth =   46.92(In.)
Pipe flow velocity =      9.28(Ft/s)
Travel time through pipe =    0.54 min.
Time of concentration (TC) =    42.06 min.
End of computations, total study area =            9.51 (Ac.)
The following figures maybe used for a unit hydrograph study of the same area.
Area averaged pervious area fraction(Ap) = 0.494
Area averaged RI index number =  56.0
```

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:pro10.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 5006

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.747(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   585.000(Ft.)
Top (of initial area) elevation =   856.100(Ft.)
Bottom (of initial area) elevation =   851.300(Ft.)
Difference in elevation =     4.800(Ft.)
Slope =    0.00821  s(percent)=       0.82
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.027 min.
Rainfall intensity =      1.827(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.867
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      0.982(CFS)
Total initial stream area =        0.620(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Top of natural channel elevation =    851.300(Ft.)
End of natural channel elevation =    832.000(Ft.)
Length of natural channel  =  1312.000(Ft.)
Estimated mean flow rate at midpoint of channel =     18.441(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   3.56(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0147
Corrected/adjusted channel slope =  0.0147
Travel time =    6.15 min.     TC =   16.18  min.


 Adding area flow to channel
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```
COMMERCIAL subarea type
Runoff Coefficient = 0.862
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      1.438(In/Hr) for a    10.0 year storm
Subarea runoff =     27.329(CFS) for     22.040(Ac.)
Total runoff =     28.311(CFS)       Total area =      22.660(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   832.000(Ft.)
Downstream point/station elevation =   830.000(Ft.)
Pipe length  =   118.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    28.311(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    28.311(CFS)
Normal flow depth in pipe =   18.89(In.)
Flow top width inside pipe =   19.65(In.)
Critical Depth =   21.99(In.)
Pipe flow velocity =     10.68(Ft/s)
Travel time through pipe =    0.18 min.
Time of concentration (TC) =    16.36 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.660(Ac.)
Runoff from this stream =     28.311(CFS)
Time of concentration =   16.36 min.
Rainfall intensity =     1.430(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   551.000(Ft.)
Top (of initial area) elevation =   858.000(Ft.)
Bottom (of initial area) elevation =   830.000(Ft.)
Difference in elevation =    28.000(Ft.)
Slope =    0.05082  s(percent)=       5.08
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.798 min.
Rainfall intensity =      2.219(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      6.069(CFS)
Total initial stream area =        3.140(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.140(Ac.)
Runoff from this stream =      6.069(CFS)
Time of concentration =    6.80 min.
Rainfall intensity =     2.219(In/Hr)
Summary of stream data:

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

```
1       28.311     16.36                 1.430
2        6.069      6.80                 2.219
Largest stream flow has longer time of concentration
Qp =     28.311 + sum of
          Qb          Ia/Ib
           6.069 *    0.645 =      3.912
Qp =     32.223

Total of 2 streams to confluence:
Flow rates before confluence point:
      28.311       6.069
Area of streams before confluence:
       22.660        3.140
Results of confluence:
Total flow rate =     32.223(CFS)
Time of concentration =    16.361 min.
Effective stream area after confluence =     25.800(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   830.000(Ft.)
Downstream point/station elevation =   829.000(Ft.)
Pipe length  =   103.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    32.223(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    32.223(CFS)
Normal flow depth in pipe =   23.81(In.)
Flow top width inside pipe =   17.42(In.)
Critical Depth =   23.44(In.)
Pipe flow velocity =      8.68(Ft/s)
Travel time through pipe =    0.20 min.
Time of concentration (TC) =    16.56 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     25.800(Ac.)
Runoff from this stream =     32.223(CFS)
Time of concentration =   16.56 min.
Rainfall intensity =     1.422(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.500 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   903.000(Ft.)
Top (of initial area) elevation =   860.000(Ft.)
Bottom (of initial area) elevation =   829.000(Ft.)
Difference in elevation =    31.000(Ft.)
Slope =    0.03433  s(percent)=       3.43
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.959 min.
Rainfall intensity =      1.933(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =     13.427(CFS)
Total initial stream area =        8.000(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.000(Ac.)
Runoff from this stream =     13.427(CFS)
```

```
Time of concentration =    8.96 min.
Rainfall intensity =     1.933(In/Hr)
Summary of stream data:

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


1       32.223     16.56                 1.422
2       13.427      8.96                 1.933
Largest stream flow has longer time of concentration
Qp =     32.223 + sum of
          Qb         Ia/Ib
          13.427 *    0.736 =      9.876
Qp =     42.099

Total of 2 streams to confluence:
Flow rates before confluence point:
      32.223      13.427
Area of streams before confluence:
       25.800        8.000
Results of confluence:
Total flow rate =     42.099(CFS)
Time of concentration =    16.558 min.
Effective stream area after confluence =     33.800(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.750
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   829.000(Ft.)
Downstream point/station elevation =   826.000(Ft.)
Pipe length  =    28.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.099(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    42.099(CFS)
Normal flow depth in pipe =   14.37(In.)
Flow top width inside pipe =   19.52(In.)
Critical depth could not be calculated.
Pipe flow velocity =     24.02(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    16.58 min.
End of computations, total study area =           33.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/29/18  File:prost10.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =   10.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year =  10.0
Calculated rainfall intensity data:
1 hour intensity =  0.747(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =   972.000(Ft.)
Top (of initial area) elevation =   861.000(Ft.)
Bottom (of initial area) elevation =   832.000(Ft.)
Difference in elevation =    29.000(Ft.)
Slope =    0.02984  s(percent)=       2.98
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.489 min.
Rainfall intensity =      1.878(In/Hr) for a    10.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.868
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      5.459(CFS)
Total initial stream area =        3.350(Ac.)
Pervious area fraction = 0.100
End of computations, total study area =            3.35 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:off.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 5006

------------------------------------------------------------------------
Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.100(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   351.000(Ft.)
Top (of initial area) elevation =   852.000(Ft.)
Bottom (of initial area) elevation =   844.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02279  s(percent)=       2.28
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.663 min.
Rainfall intensity =      3.301(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      4.175(CFS)
Total initial stream area =        1.440(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
____________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.440(Ac.)
Runoff from this stream =      4.175(CFS)
Time of concentration =    6.66 min.
Rainfall intensity =     3.301(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
____________________________________________________________________________
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.703
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
```

```
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       1.35(In/Hr)
Total area =         0.00(Ac.)  Total runoff =    240.00(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        2.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   846.000(Ft.)
Downstream point/station elevation =   844.000(Ft.)
Pipe length  =    72.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   240.000(CFS)
Nearest computed pipe diameter  =     48.00(In.)
Calculated individual pipe flow  =   240.000(CFS)
Normal flow depth in pipe =   39.47(In.)
Flow top width inside pipe =   36.70(In.)
Critical depth could not be calculated.
Pipe flow velocity =     21.72(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =    40.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        2.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.000(Ac.)
Runoff from this stream =    240.000(CFS)
Time of concentration =   40.06 min.
Rainfall intensity =     1.346(In/Hr)
Summary of stream data:

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


1        4.175      6.66                 3.301
2      240.000     40.06                 1.346
Largest stream flow has longer time of concentration
Qp =    240.000 + sum of
          Qb         Ia/Ib
           4.175 *    0.408 =      1.703
Qp =    241.703

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.175     240.000
Area of streams before confluence:
        1.440        0.000
Results of confluence:
Total flow rate =    241.703(CFS)
Time of concentration =    40.055 min.
Effective stream area after confluence =      1.440(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   844.000(Ft.)
Downstream point/station elevation =   833.000(Ft.)
Pipe length  =  1157.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   241.703(CFS)
Nearest computed pipe diameter  =     60.00(In.)
Calculated individual pipe flow  =   241.703(CFS)
Normal flow depth in pipe =   46.78(In.)
Flow top width inside pipe =   49.73(In.)
Critical Depth =   52.45(In.)
Pipe flow velocity =     14.72(Ft/s)
Travel time through pipe =    1.31 min.
Time of concentration (TC) =    41.37 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
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The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      1.440(Ac.)
Runoff from this stream =    241.703(CFS)
Time of concentration =   41.37 min.
Rainfall intensity =     1.325(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.000 to Point/Station        6.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
Initial area flow distance =   245.000(Ft.)
Top (of initial area) elevation =   865.000(Ft.)
Bottom (of initial area) elevation =   852.500(Ft.)
Difference in elevation =    12.500(Ft.)
Slope =    0.05102  s(percent)=       5.10
TC = k(0.390)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.385 min.
Rainfall intensity =      3.372(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.793
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
Initial subarea runoff =      7.758(CFS)
Total initial stream area =        2.900(Ac.)
Pervious area fraction = 0.500


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   852.500(Ft.)
Downstream point/station elevation =   835.600(Ft.)
Pipe length  =   210.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.758(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     7.758(CFS)
Normal flow depth in pipe =    7.88(In.)
Flow top width inside pipe =   11.40(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.19(Ft/s)
Travel time through pipe =    0.25 min.
Time of concentration (TC) =     6.63 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        7.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.900(Ac.)
Runoff from this stream =      7.758(CFS)
Time of concentration =    6.63 min.
Rainfall intensity =     3.309(In/Hr)


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Process from Point/Station        8.000 to Point/Station        8.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------------
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
SINGLE FAMILY (1/4 Acre Lot)
Runoff Coefficient = 0.703
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.500; Impervious fraction =  0.500
User specified values are as follows:
TC =  40.00 min.  Rain intensity =       1.35(In/Hr)
Total area =         0.00(Ac.)  Total runoff =     46.00(CFS)
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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        8.000 to Point/Station        9.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________________
Top of natural channel elevation =    857.000(Ft.)
End of natural channel elevation =    841.500(Ft.)
Length of natural channel  =   505.000(Ft.)
Estimated mean flow rate at midpoint of channel =      1.#IO(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   1.#J(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0307
Corrected/adjusted channel slope =  0.0307
Travel time =    0.00 min.     TC =   40.00  min.


 Adding area flow to channel
SINGLE FAMILY (1/2 Acre Lot)
Runoff Coefficient = 0.664
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.600; Impervious fraction =  0.400
Rainfall intensity =      1.347(In/Hr) for a   100.0 year storm
Subarea runoff =      4.623(CFS) for      5.170(Ac.)
Total runoff =     50.623(CFS)       Total area =       5.170(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        9.000 to Point/Station        7.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   841.500(Ft.)
Downstream point/station elevation =   835.600(Ft.)
Pipe length  =   214.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    50.623(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    50.623(CFS)
Normal flow depth in pipe =   21.75(In.)
Flow top width inside pipe =   21.37(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.74(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =    40.24 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        7.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      5.170(Ac.)
Runoff from this stream =     50.623(CFS)
Time of concentration =   40.24 min.
Rainfall intensity =     1.343(In/Hr)
Summary of stream data:

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


1        7.758      6.63                 3.309
2       50.623     40.24                 1.343
Largest stream flow has longer time of concentration
Qp =     50.623 + sum of
          Qb         Ia/Ib
           7.758 *    0.406 =      3.149
Qp =     53.773

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.758      50.623
Area of streams before confluence:
        2.900        5.170
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Results of confluence:
Total flow rate =     53.773(CFS)
Time of concentration =    40.242 min.
Effective stream area after confluence =      8.070(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        7.000 to Point/Station        4.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   835.600(Ft.)
Downstream point/station elevation =   833.000(Ft.)
Pipe length  =   300.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    53.773(CFS)
Nearest computed pipe diameter  =     36.00(In.)
Calculated individual pipe flow  =    53.773(CFS)
Normal flow depth in pipe =   25.88(In.)
Flow top width inside pipe =   32.37(In.)
Critical Depth =   28.57(In.)
Pipe flow velocity =      9.89(Ft/s)
Travel time through pipe =    0.51 min.
Time of concentration (TC) =    40.75 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        4.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      8.070(Ac.)
Runoff from this stream =     53.773(CFS)
Time of concentration =   40.75 min.
Rainfall intensity =     1.335(In/Hr)
Summary of stream data:

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


1      241.703     41.37               1.325
2       53.773     40.75               1.335
Largest stream flow has longer time of concentration
Qp =    241.703 + sum of
          Qb         Ia/Ib
          53.773 *    0.993 =     53.370
Qp =    295.072
Total of 2 main streams to confluence:
Flow rates before confluence point:
     241.703      53.773
Area of streams before confluence:
       1.440        8.070
Results of confluence:
Total flow rate =    295.072(CFS)
Time of concentration =    41.365 min.
Effective stream area after confluence  =      9.510(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station       10.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   833.000(Ft.)
Downstream point/station elevation =   832.000(Ft.)
Pipe length  =   301.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =   295.072(CFS)
Nearest computed pipe diameter  =     78.00(In.)
Calculated individual pipe flow  =   295.072(CFS)
Normal flow depth in pipe =   62.34(In.)
Flow top width inside pipe =   62.48(In.)
Critical Depth =   55.33(In.)
Pipe flow velocity =     10.38(Ft/s)
Travel time through pipe =    0.48 min.
Time of concentration (TC) =    41.85 min.
End of computations, total study area =           9.51 (Ac.)
The following figures maybe used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.494
Area averaged RI index number =  56.0
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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/30/18  File:pro.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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Program License Serial Number 5006

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.100(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
____________________________________________________________________________
Initial area flow distance =   585.000(Ft.)
Top (of initial area) elevation =   856.100(Ft.)
Bottom (of initial area) elevation =   851.300(Ft.)
Difference in elevation =     4.800(Ft.)
Slope =    0.00821  s(percent)=       0.82
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.027 min.
Rainfall intensity =      2.691(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      1.459(CFS)
Total initial stream area =        0.620(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** NATURAL CHANNEL TIME + SUBAREA FLOW ADDITION ****
____________________________________________________________________________
Top of natural channel elevation =    851.300(Ft.)
End of natural channel elevation =    832.000(Ft.)
Length of natural channel  =  1312.000(Ft.)
Estimated mean flow rate at midpoint of channel =     27.399(CFS)

Natural valley channel type used
L.A. County flood control district formula for channel velocity:
 Velocity(ft/s) = (7 + 8(q(English Units)^.352)(slope^0.5)
Velocity using mean channel flow =   3.96(Ft/s)

Correction to map slope used on extremely rugged channels with
drops and waterfalls (Plate D-6.2)
        Normal channel slope =  0.0147
Corrected/adjusted channel slope =  0.0147
Travel time =    5.52 min.     TC =   15.55  min.


 Adding area flow to channel
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COMMERCIAL subarea type
Runoff Coefficient = 0.871
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Rainfall intensity =      2.161(In/Hr) for a   100.0 year storm
Subarea runoff =     41.464(CFS) for     22.040(Ac.)
Total runoff =     42.923(CFS)       Total area =      22.660(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   832.000(Ft.)
Downstream point/station elevation =   830.000(Ft.)
Pipe length  =   118.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    42.923(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    42.923(CFS)
Normal flow depth in pipe =   20.37(In.)
Flow top width inside pipe =   28.01(In.)
Critical Depth =   26.27(In.)
Pipe flow velocity =     12.10(Ft/s)
Travel time through pipe =    0.16 min.
Time of concentration (TC) =    15.71 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     22.660(Ac.)
Runoff from this stream =     42.923(CFS)
Time of concentration =   15.71 min.
Rainfall intensity =     2.150(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       15.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   551.000(Ft.)
Top (of initial area) elevation =   858.000(Ft.)
Bottom (of initial area) elevation =   830.000(Ft.)
Difference in elevation =    28.000(Ft.)
Slope =    0.05082  s(percent)=       5.08
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.798 min.
Rainfall intensity =      3.268(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.878
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      9.011(CFS)
Total initial stream area =        3.140(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       14.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      3.140(Ac.)
Runoff from this stream =      9.011(CFS)
Time of concentration =    6.80 min.
Rainfall intensity =     3.268(In/Hr)
Summary of stream data:

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

```
1       42.923     15.71                 2.150
2        9.011      6.80                 3.268
Largest stream flow has longer time of concentration
Qp =     42.923 + sum of
          Qb          Ia/Ib
           9.011 *    0.658 =      5.928
Qp =     48.851

Total of 2 streams to confluence:
Flow rates before confluence point:
      42.923       9.011
Area of streams before confluence:
       22.660        3.140
Results of confluence:
Total flow rate =     48.851(CFS)
Time of concentration =    15.711 min.
Effective stream area after confluence =     25.800(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       16.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   830.000(Ft.)
Downstream point/station elevation =   829.000(Ft.)
Pipe length  =   103.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    48.851(CFS)
Nearest computed pipe diameter  =     33.00(In.)
Calculated individual pipe flow  =    48.851(CFS)
Normal flow depth in pipe =   25.36(In.)
Flow top width inside pipe =   27.84(In.)
Critical Depth =   27.66(In.)
Pipe flow velocity =      9.97(Ft/s)
Travel time through pipe =    0.17 min.
Time of concentration (TC) =    15.88 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =     25.800(Ac.)
Runoff from this stream =     48.851(CFS)
Time of concentration =   15.88 min.
Rainfall intensity =     2.138(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.500 to Point/Station       16.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________________
Initial area flow distance =   903.000(Ft.)
Top (of initial area) elevation =   860.000(Ft.)
Bottom (of initial area) elevation =   829.000(Ft.)
Difference in elevation =    31.000(Ft.)
Slope =    0.03433  s(percent)=       3.43
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.959 min.
Rainfall intensity =      2.847(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.876
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =     19.945(CFS)
Total initial stream area =        8.000(Ac.)
Pervious area fraction = 0.100


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.000(Ac.)
Runoff from this stream =     19.945(CFS)
```

```
Time of concentration =    8.96 min.
Rainfall intensity =     2.847(In/Hr)
Summary of stream data:

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


1       48.851     15.88                 2.138
2       19.945      8.96                 2.847
Largest stream flow has longer time of concentration
Qp =     48.851 + sum of
          Qb         Ia/Ib
          19.945 *    0.751 =     14.979
Qp =     63.830

Total of 2 streams to confluence:
Flow rates before confluence point:
      48.851      19.945
Area of streams before confluence:
       25.800        8.000
Results of confluence:
Total flow rate =     63.830(CFS)
Time of concentration =    15.883 min.
Effective stream area after confluence =     33.800(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       16.000 to Point/Station       16.750
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________________
Upstream point/station elevation =   829.000(Ft.)
Downstream point/station elevation =   826.000(Ft.)
Pipe length  =    28.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    63.830(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    63.830(CFS)
Normal flow depth in pipe =   17.18(In.)
Flow top width inside pipe =   21.65(In.)
Critical depth could not be calculated.
Pipe flow velocity =     26.51(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    15.90 min.
End of computations, total study area =           33.80 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```

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                Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2004 Version 7.0
        Rational Hydrology Study        Date: 08/29/18  File:PROST.out
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

 English (in-lb) Units used in input data file

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


Program License Serial Number 5006

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Rational Method Hydrology Program based on
Riverside County Flood Control & Water Conservation District
1978 hydrology manual

Storm event (year) =  100.00 Antecedent Moisture Condition = 2

2 year, 1 hour precipitation =  0.500(In.)
100 year, 1 hour precipitation =  1.100(In.)

Storm event year = 100.0
Calculated rainfall intensity data:
1 hour intensity =  1.100(In/Hr)
Slope of intensity duration curve = 0.5000




++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       17.000 to Point/Station       18.000
**** INITIAL AREA EVALUATION ****
________________________________________________________________________
Initial area flow distance =   972.000(Ft.)
Top (of initial area) elevation =   861.000(Ft.)
Bottom (of initial area) elevation =   832.000(Ft.)
Difference in elevation =    29.000(Ft.)
Slope =    0.02984  s(percent)=       2.98
TC = k(0.300)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.489 min.
Rainfall intensity =      2.766(In/Hr) for a   100.0 year storm
COMMERCIAL subarea type
Runoff Coefficient = 0.875
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  56.00
Pervious area fraction =  0.100; Impervious fraction =  0.900
Initial subarea runoff =      8.110(CFS)
Total initial stream area =        3.350(Ac.)
Pervious area fraction = 0.100
End of computations, total study area =            3.35 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged RI index number =  56.0
```
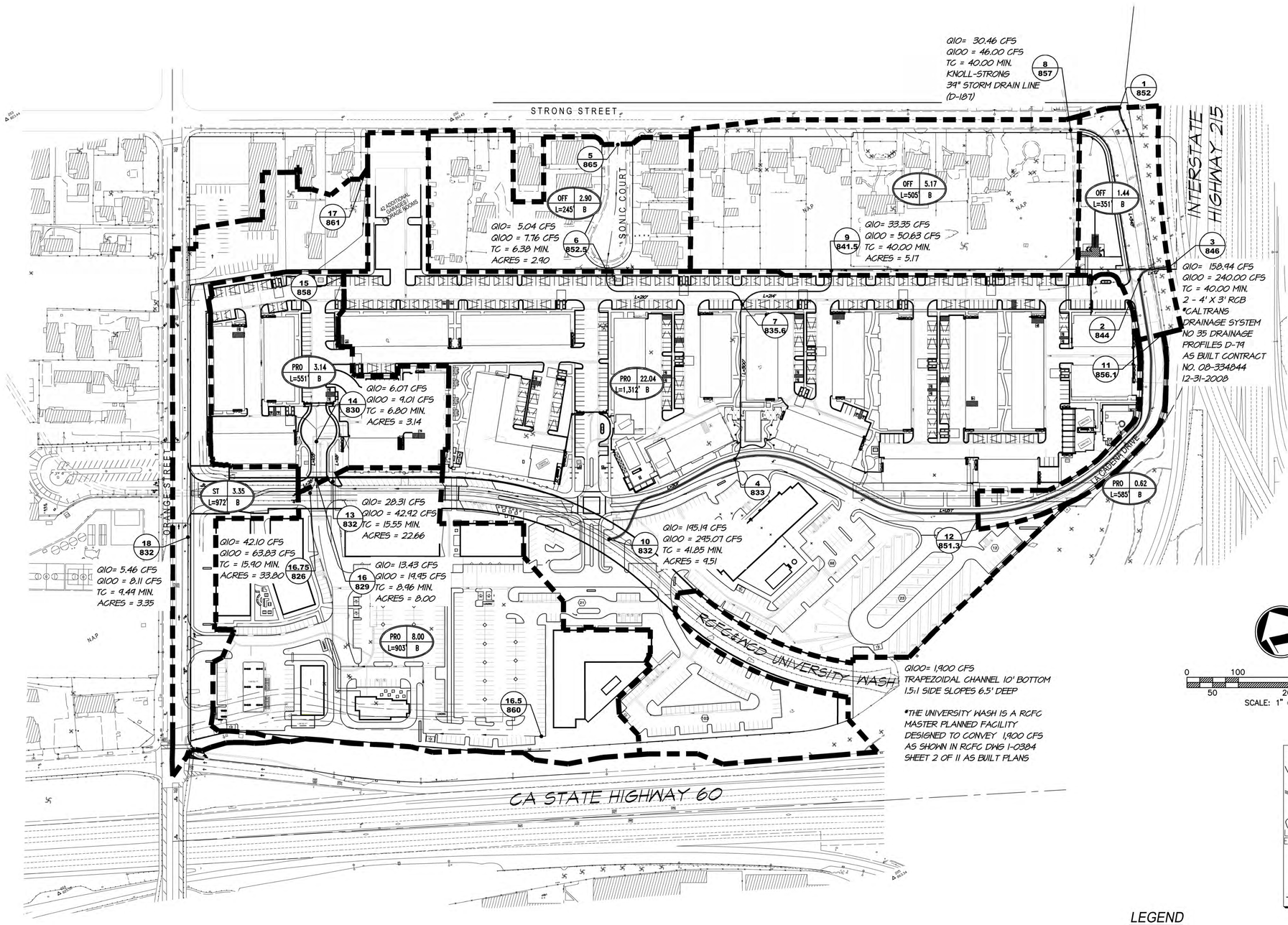
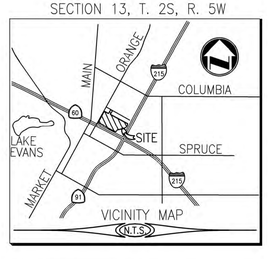

THE EXCHANGE: POST-DEVELOPMENT RATIONAL HYDROLOGY MAP





LEGEND

NODE ELEV

AREA ACRES LENGTH SOIL

WATERSHED BOUNDARY

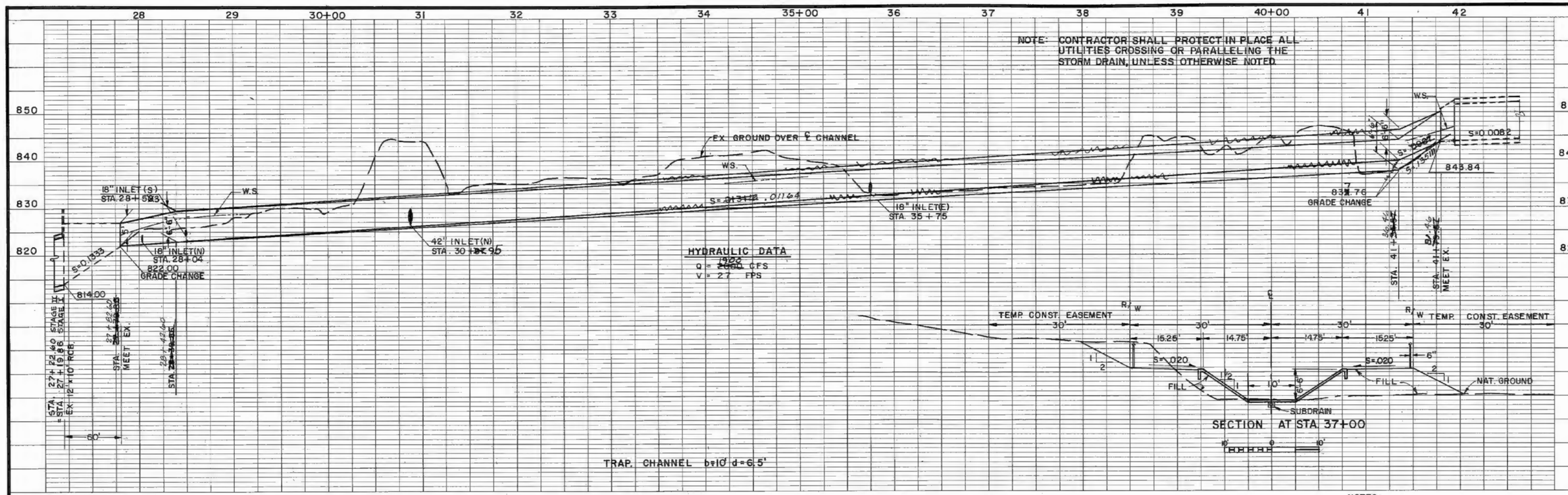
FLOW PATH

THE EXCHANGE:
POST-DEVELOPMENT HYDROLOGY MAP
PREPARATION DATE : August 18

PLAN PREPARED BY:
adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 · Fax:(951) 688-0599

Plot Date: 8/30/2018

REFERENCE INFORMATION

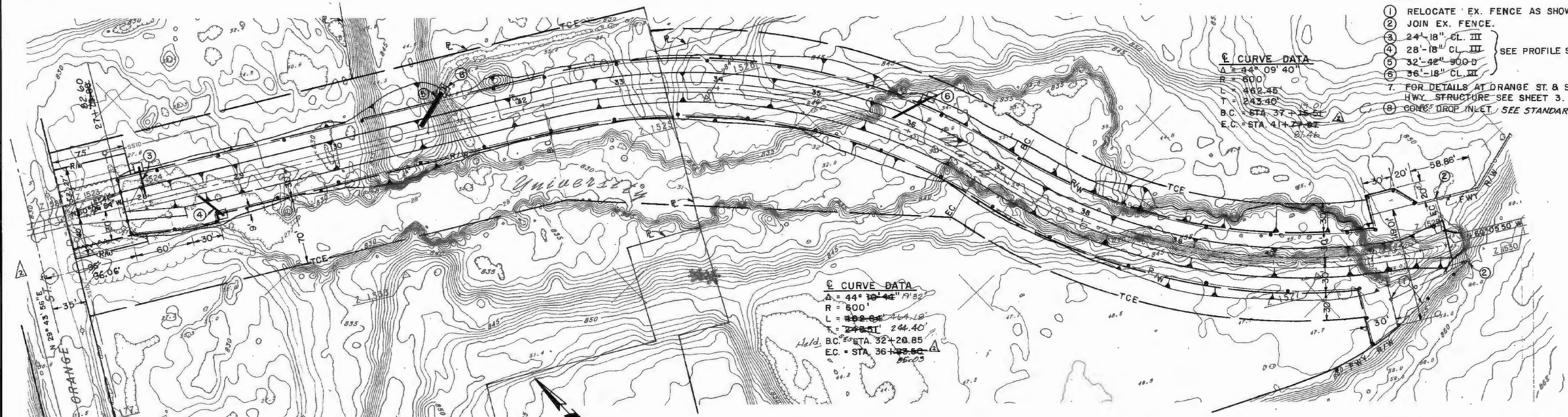


NOTES:

1. RELOCATE EX. FENCE AS SHOWN.
2. JOIN EX. FENCE.
3. 24'-18" CL. III
4. 28'-18" CL. III
5. 32'-42" 900 D
6. 36'-18" CL. III

SEE PROFILE SHEET 4

7. FOR DETAILS AT ORANGE ST. & STATE HWY. STRUCTURE SEE SHEET 3.
8. CONC. DROP INLET. SEE STANDARD & SHEET 4.



PLAN

1"=50'

BENCH MARK	REVISIONS			RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT	UNIVERSITY WASH CHANNEL STAGE II PLAN & PROFILE	PROJECT NO. 1-0-120
	Sta. Revisions			DESIGNED BY: JLH & PAU	APPROVED BY: Kenneth L. Edwards CHIEF ENGINEER R.E. NO. 12400	DRAWING NO. 1-384
SCALE:	Change R/W As Shown			DRAWN BY: SLM		
				DATE DRAWN: 3-79		SHEET NO. 2 OF 11
DATE:	C1 Note (8) Added data			CHECKED BY:	DATE: 7-18-80	
	REF.	DESCRIPTION	APPR. DATE		1970 STORM DRAIN BOND ISSUE PROJECT NO. 1	

AS BUILT

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215,60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	328R1	2838

REGISTERED CIVIL ENGINEER 3-20-06

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ALBERTO VERGEL DE DIOS — No. C58291 — Exp. 6-30-08 — CIVIL — STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov

Caltrans Metric

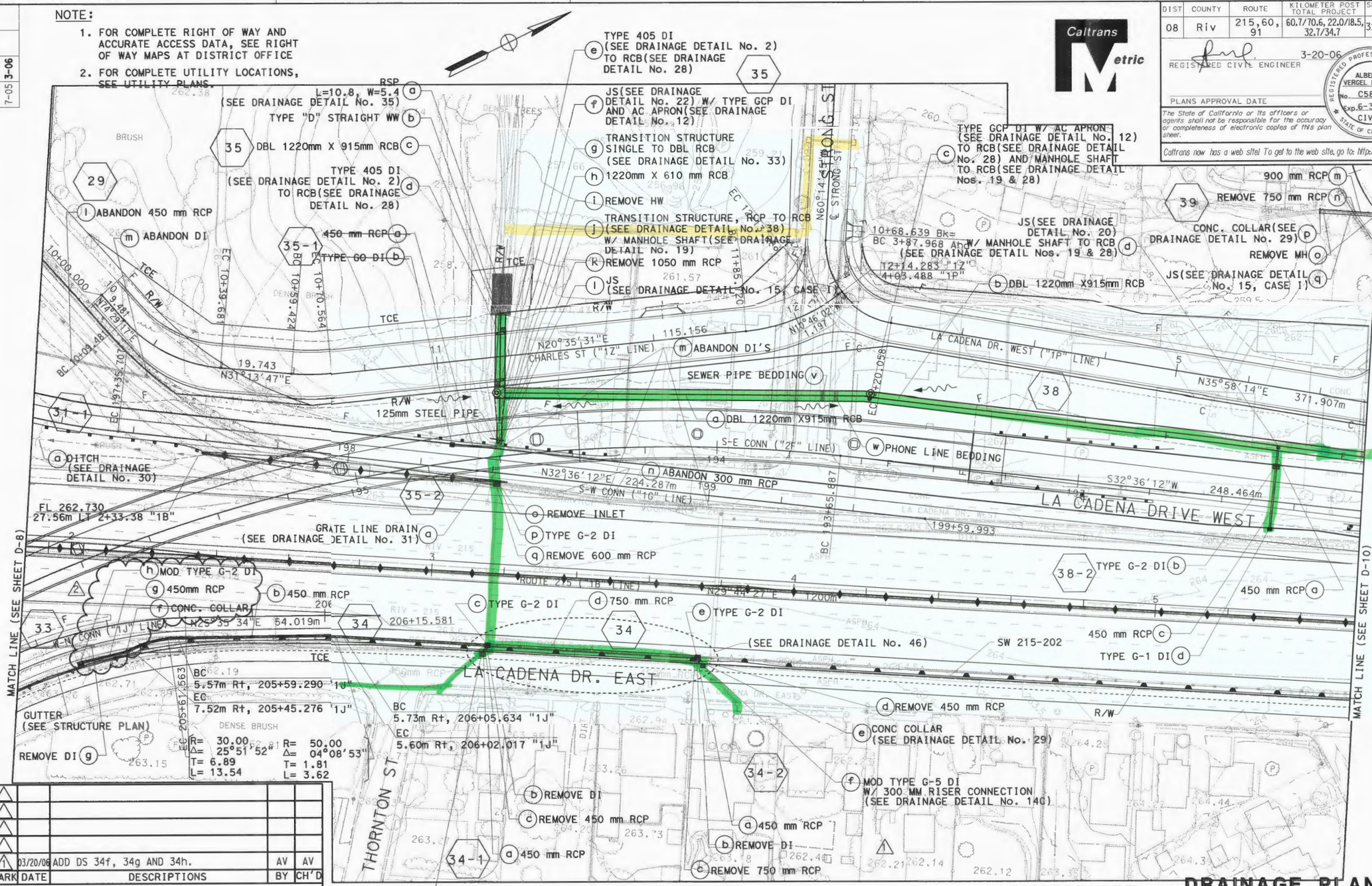
DATE	REVISED BY	DATE REVISED	CALCULATED/ DESIGNED BY	CHECKED BY
AV	AV	6-04	AV	AV
AV	AV	7-04	AV	3-06
AV	AV	9-04		
AV	AV	11-04		

PROJECT ENGINEER — ALBERTO VERGEL DE DIOS

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION — Caltrans PROJECT DEVELOPMENT

NOTE:

1. FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY MAPS AT DISTRICT OFFICE
2. FOR COMPLETE UTILITY LOCATIONS, SEE UTILITY PLANS.



MARK	DATE	DESCRIPTIONS	BY	CH'D
1	03/20/06	ADD DS 34f, 34g AND 34h.	AV	AV
		REVISIONS		

CONTRACT CHANGE ORDER NO. _____
SHEET ____ OF ____

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

AS BUILT
(NO CORRECTIONS ON THIS SHEET)
CONTRACT No. 08-334844
C.C.A. DATE 12-31-08
R.E. NAME Joe Lopez

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DRAINAGE PLAN

SCALE 1:500 D-9

DESIGN SEQUENCE 3

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => s123846
DGN FILE => 08-334844_0328r1.dgn

CU 08241 EA 334841

LAST REVISION 03-20-06
DATE PLOTTED => 05-AUG-2010
TIME PLOTTED => 09:09

NOTE:

1. FOR COMPLETE RIGHT OF WAY AND ACCURATE ACCESS DATA, SEE RIGHT OF WAY MAPS AT DISTRICT OFFICE
2. FOR COMPLETE UTILITY LOCATIONS, SEE UTILITY PLANS.

DATE	REVISED BY	DATE REVISED
	AV	10-04
	AV	9-04
	AV	7-04

CALCULATED/DESIGNED BY

CHECKED BY

PROJECT ENGINEER
ALBERTO VERGEL DE DIOS

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
08	Riv	215,60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	329	2838

REGISTERED CIVIL ENGINEER 11-29-04

ALBERTO VERGEL DE DIOS No. C58291 Exp.6-30-06 CIVIL STATE OF CALIFORNIA — REGISTERED PROFESSIONAL ENGINEER

PLANS APPROVAL DATE

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Caltrans now has a web site! To get to the web site, go to: http://www.dot.ca.gov

Caltrans Metric

ABANDON 450 mm CMP (a)
ABANDON CATCH BASIN (b)
ABANDON 450 mm CMP (c)
900 mm RCP (d)
REMOVE CATCH BASIN (e)
REMOVE JS (f)
REMOVE 900 mm RCP (g)
CONC COLLAR(SEE DRAINAGE DETAIL No. 29) (h)

EC 50.97 m Lt, 5+61.412 "1P"
(a) MH TYPE AX (SEE DRAINAGE DETAIL No. 17)
R= 38.41
Δ= 38°27'35"
T= 13.40
L= 25.78
BC 28.13 m Lt, 5+50.545 "1P"
(b) 900 mm RCP
(c) MH TYPE AX (SEE DRAINAGE DETAIL No. 17)
(e) TRANSITION STRUCTURE, DOUBLE TO SINGLE RCB (SEE DRAINAGE DETAIL No. 33)
900 mm RCP (d)
N60°14'08"W 6 KNOLL WAY
39
427
39-1
(SEE DRAINAGE DETAIL No. 2)
TYPE 405 DI (b)
450 mm RCP (a)
MH TYPE EZ (SEE (e) DRAINAGE DETAIL No. 18)
R/W
N35°58'14"E 371.907m
LA CADENA DRIVE WEST ("1P" LINE)
C/F
900 mm RCP (d)
S32°36'12"W 248.464m
S-E CONN ("2F" LINE)
39-2
191+17.423
450 mm RCP (a)
TYPE 407 DI (b)
(SEE DRAINAGE DETAIL No. 3)
JS(SEE DRAINAGE DETAIL No. 20) W/ MANHOLE SHAFT TO RCB (SEE DRAINAGE DETAIL Nos. 19 & 28) (h)
(a) 450mm RCP
(b) TYPE G-1 DI
38-1
450 mm RCP (f)
N29°44'27"E 1200m
ROUTE 215 ("1B" LINE)
(g) 1220mm X 915mm RCB
(f) JS(SEE DRAINAGE DETAIL No. 20) W/ TYPE GCP DI AND AC APRON(SEE DRAINAGE DETAIL No. 12) TO RCB(SEE DRAINAGE DETAIL No. 28)
TYPE G-1 DI TO RCB (SEE DRAINAGE DETAIL No. 28) (i)
37
MATCH LINE (SEE SHEET D-9)
R/W
LA CADENA DR EAST
TCE
TRANSITION STRUCTURE, RCP TO RCB (SEE DRAINAGE DETAIL No. 38) (j)
36
(b) 900 mm RCP TO BE JACKED
(f) ABANDON 600 mm RCP
(c) 900 mm RCP
(e) REMOVE DI
(d) MOD TYPE G5 DI (SEE DRAINAGE DETAIL No. 14A)
MARLBOROUGH AVE
BLENHEIM ST
CONC COLLAR(SEE DRAINAGE DETAIL No. 29) (m)
SW 215-202
MILTON ST

(f) TYPE G-2 DI
(j) REMOVE DI
(k) 900 mm RCP
(l) REMOVE 900 mm RCP
MH TYPE EZ(SEE (h) DRAINAGE DETAIL No. 18)
REMOVE 375 mm RCP (g)
EC 1.83 m Lt, 7+91.965 "1P"
BC 1.83 m Lt, 8+27.796 "1P"
R=617.82
Δ=03°18'47"
T=17.87
L=35.72
BC 7+91.965
EC 8+27.796
N60°14'45"W SPRING GARDEN ST
LA CADENA DR WEST
N34°39'27"E 86.280m
(d) CONC COLLAR(SEE DRAINAGE DETAIL No. 29)
(c) REMOVE 375 mm RCP
(b) REMOVE MH
(a) 375 mm RCP
39-3
R=6.86
Δ=59°54'02"
T=3.95
L=7.17
(i) TYPE 405 DI (SEE DRAINAGE DETAIL No. 2)
C BC 5.25 m Lt 8+92.158 "1P"
(k) 450 mm RCP
8+14.07
(j) CONC COLLAR(SEE DRAINAGE DETAIL No. 29)
EC 1.83 m Lt 8+86.223 "1P"
MODIFY DI (SEE (q) DRAINAGE DETAIL No. 13)
38
(SEE DRAINAGE DETAIL No. 47)
450 mm RCP (i)
9+09.427
40
MODIFY MH(SEE (a) DRAINAGE DETAIL No. 13)
(b) REMOVE 450 mm RCP
(a) MOD TYPE G5 DI (SEE DRAINAGE DETAIL No. 14)
(c) REMOVE DI
40-1

750 mm RCP (k)
REMOVE 750 mm RCP (l)
REMOVE DI (m)
TYPE G-2 DI (n)
750 mm RCP (o)
REMOVE 750 mm RCP (p)

AS BUILT
(NO CORRECTIONS ON THIS SHEET)
CONTRACT No. 08-334844
C.C.A. DATE 12-31-08
R.E. NAME Lopez

DRAINAGE PLAN

SCALE 1:500

D-10

3

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE WORK ONLY.

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => s123846
DGN FILE => 08-334844_0329.dgn

DESIGN SEQUENCE 3

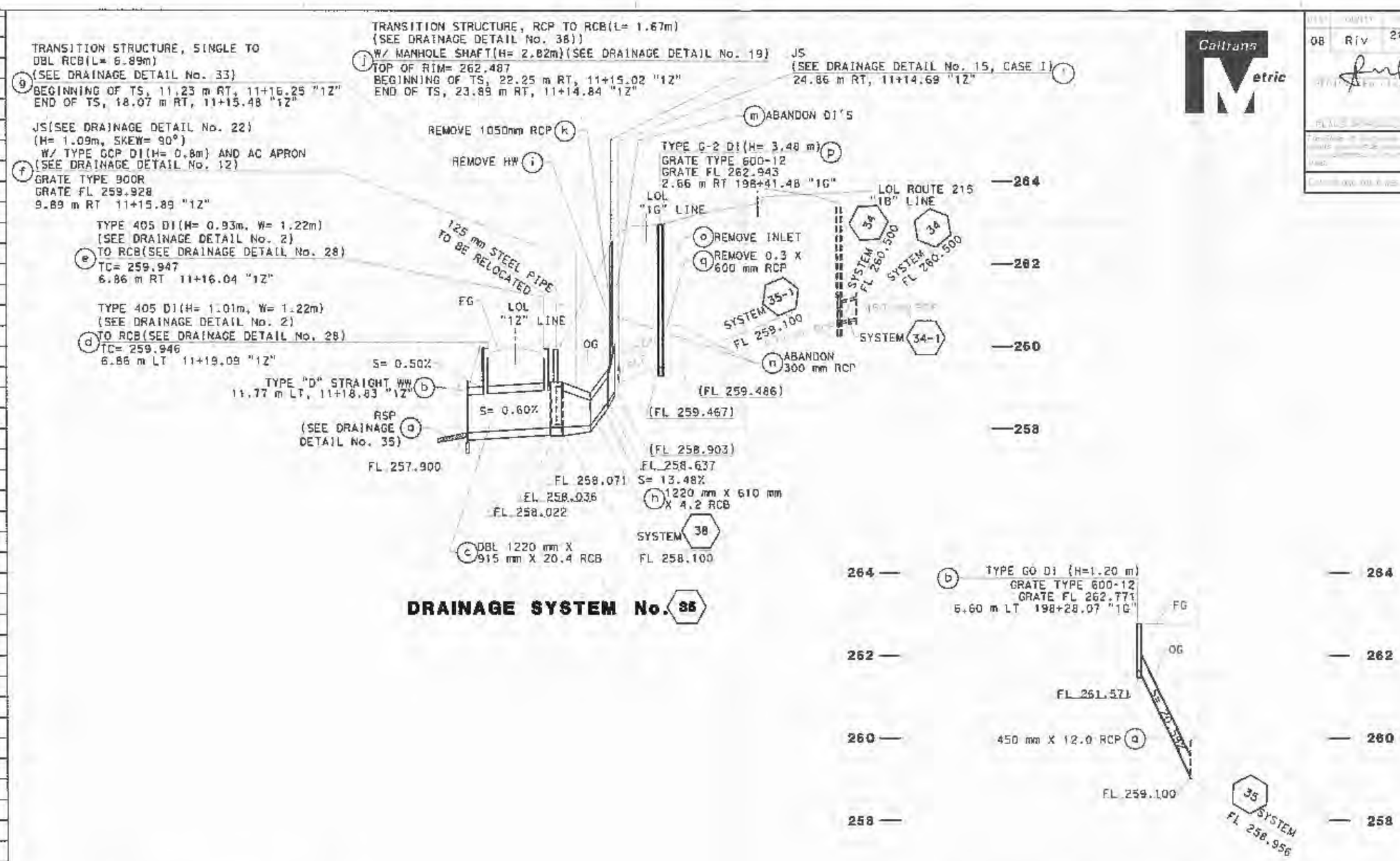
CU 08241 EA 334841

LAST REVISION 11-29-04
DATE PLOTTED => 05-AUG-2010
TIME PLOTTED => 09:10

DIST	COUNTY	ROUTE	POST MILE	SHEET	TOTAL SHEETS
08	Riv	215,60, 91	60.7/70.6, 22.0/18.5, 32.7/34.7	399	2838

11-29-04

ALBERTO VERGEL DE DIOS No. C58291 Exp. 6-30-06 CIVIL



DRAINAGE SYSTEM No. 35

DRAINAGE SYSTEM No. 35-1

NOTE:

1. EXISTING ELEVATIONS TO BE FIELD VERIFIED.
2. RCB IS PER CALTRANS STD PLAN Nos. D80 & D81
3. TYPE GCP, G-2 & GO DI's ARE PER CALTRANS STD PLAN Nos. D73, D74B & D75B
4. GRATE TYPE IS PER CALTRANS STD PLAN No. D77A & D77B
5. TYPE "D" STRAIGHT WINGWALL IS PER CALTRANS STD PLAN No. D85
6. EXCAVATION AND BACKFILL IS PER CALTRANS STD PLAN No. A62. SEE DRAINAGE DETAIL No. 42.

The drainage profiles shall be referenced to centerline or layout line stationing. The profiles shall be shown, as they would visually appear when looking in the direction of increasing stations.

AS BUILT (NO CORRECTIONS ON THIS SHEET) CONTRACT No. 08-334844 C.C.A. DATE 12-31-08 R.E. NAME Joe Lopez

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DRAINAGE PROFILES

SCALE 1:500 Horiz
1:50 Vert

D-79

DESIGN SEQUENCE 3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT

PROJECT ENGINEER ALBERTO VERGEL DE DIOS

CALCULATED/DESIGNED BY | CHECKED BY | DATE REVISED BY | DATE REVISED AV 6-04

Station | m³ Exc | Emb

Existing 4’ x 3’ RCB
Worksheet for Rectangular Channel

Project Description	
Worksheet	Existing 4'x3' RCB
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Discharge

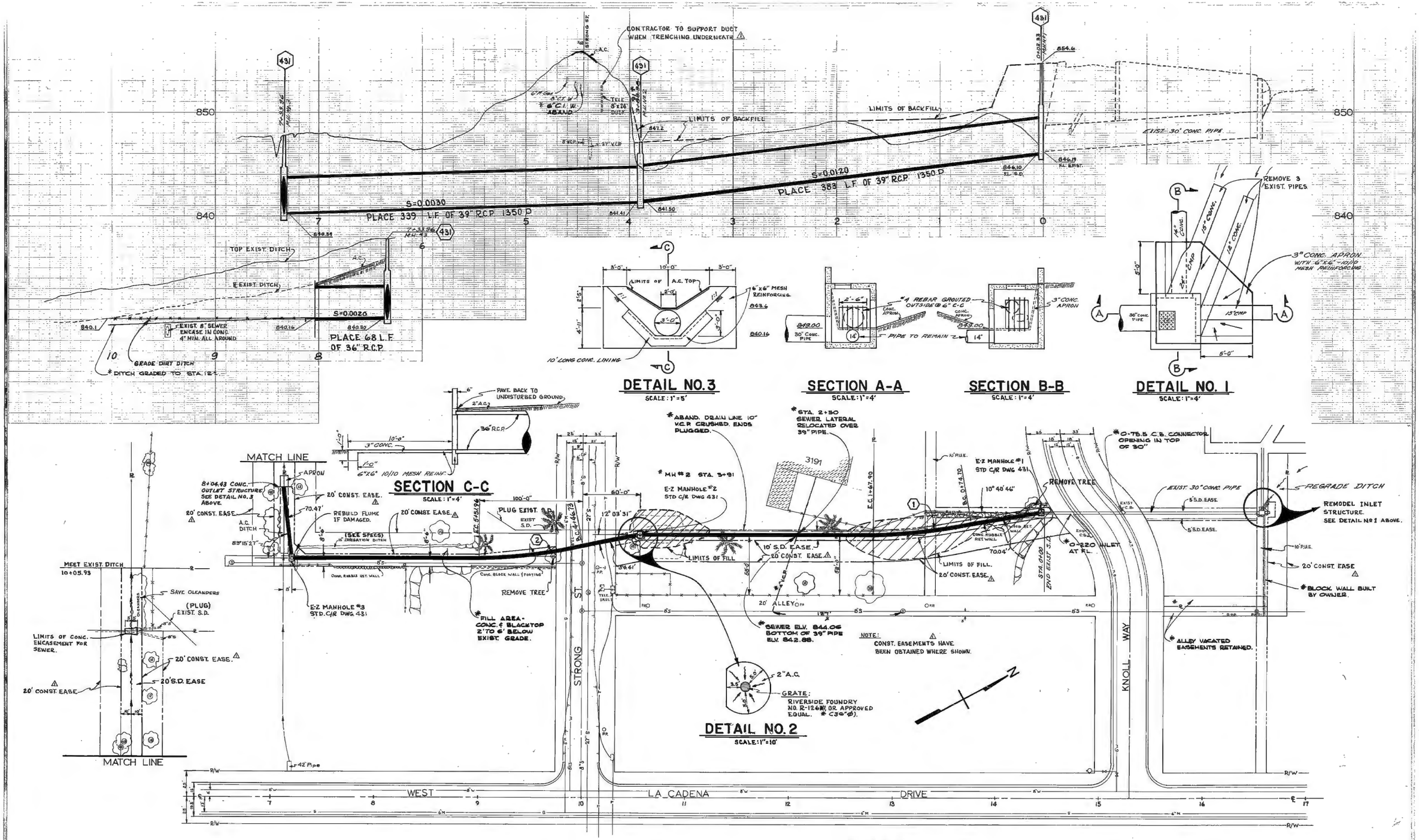
Input Data		
Mannings Coefficient	0.013	
Slope	0.006000	ft/ft
Depth	3.00	ft
Bottom Width	4.00	ft

Results		
Discharge	119.98	cfs
Flow Area	12.0	ft²
Wetted Perimeter	10.00	ft
Top Width	4.00	ft
Critical Depth	3.04	ft
Critical Slope	0.005825	ft/ft
Velocity	10.00	ft/s
Velocity Head	1.55	ft
Specific Energy	4.55	ft
Froude Number	1.02	
Flow Type	Supercritical	

*NOTE: Existing structure per Caltrans Drainage System No. 35 (Contract No. 08-334844) has Double 4’ X 3’ RCB.

119.98 cfs x 2=239.96. Assumed existing flows used for this structure will be 240 cfs

© Haestad Methods, Inc. 37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666



CONST. NOTES:

431 * CONST. M.H. PER C/R STD. DWG. NO. 431 - E-Z MANHOLE. MH. COVERS PER RIVERSIDE FOUNDRY NO. R-1261 (36"Ø).

* AS BUILT 6/15/70 KARL

CURVE DATA SEWER				
NO.	R	Δ	T	L
1	500'	10° 40' 46"	46.74'	93.20'
2	500'	12° 03' 31"	52.81	105.23'

-CAUTION-
PACIFIC TELEPHONE
CABLES UNDERGROUND
BEFORE EXCAVATING
CALL COLLECT:
7:30 A.M. to 5 P.M. — After Hours & Holidays
Orange County 714-533-0811 714-547-6606
Riverside County 714-684-0071 714-547-6606

MARK	REVISIONS	APPR.	DATE
1	CHANGED RIGHT OF ENTRY TO CONST. EASE. ADDED NOTE FOR CONTRACTOR AT TELEPHONE DUCT.		

DESIGNED BY RCW DRAWN BY R.K. CHECKED BY TCH

CITY OF RIVERSIDE, CALIFORNIA
DEPARTMENT OF PUBLIC WORKS

APPROVED BY	BY	DATE
PRINCIPAL ENGINEER		
PARK DEPARTM		
TRAFFIC DIVISION		
CHIEF P. W. ENGR.		

APPROVED BY
DIRECTOR OF PUBLIC WORKS
DATE

KNOLL-STRONG STORM DRAIN

BETWEEN KNOLL WAY AND 300'± SOUTH OF STRONG ST.

HORIZ. SCALE: 1" = 40' VERT. SCALE: 1" = 4'

PROJECT NO. 423

D-187

SHEET 1 OF 1

FILE NO.

Existing 39” RCP Strong Street
Worksheet for Circular Channel

Project Description	
Worksheet	Existing 39" RCP Strong Street
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.013	
Slope	0.003000	ft/ft
Depth	3.25	ft
Diameter	39	in

Results		
Discharge	45.22	cfs
Flow Area	8.3	ft²
Wetted Perimeter	10.21	ft
Top Width	7.6e-8	ft
Critical Depth	2.14	ft
Percent Full	100.0	%
Critical Slope	0.005027	ft/ft
Velocity	5.45	ft/s
Velocity Head	0.46	ft
Specific Energy	3.71	ft
Froude Number	9.2e-5	
Maximum Discharge	48.65	cfs
Discharge Full	45.22	cfs
Slope Full	0.003000	ft/ft
Flow Type	Subcritical	

NOTE: Existing 39” RCP Knoll-Strong Storm Drain Line (D-187). Pipe was run full per information provided in plan. 46 cfs will be used at discharge point for existing and proposed condition.

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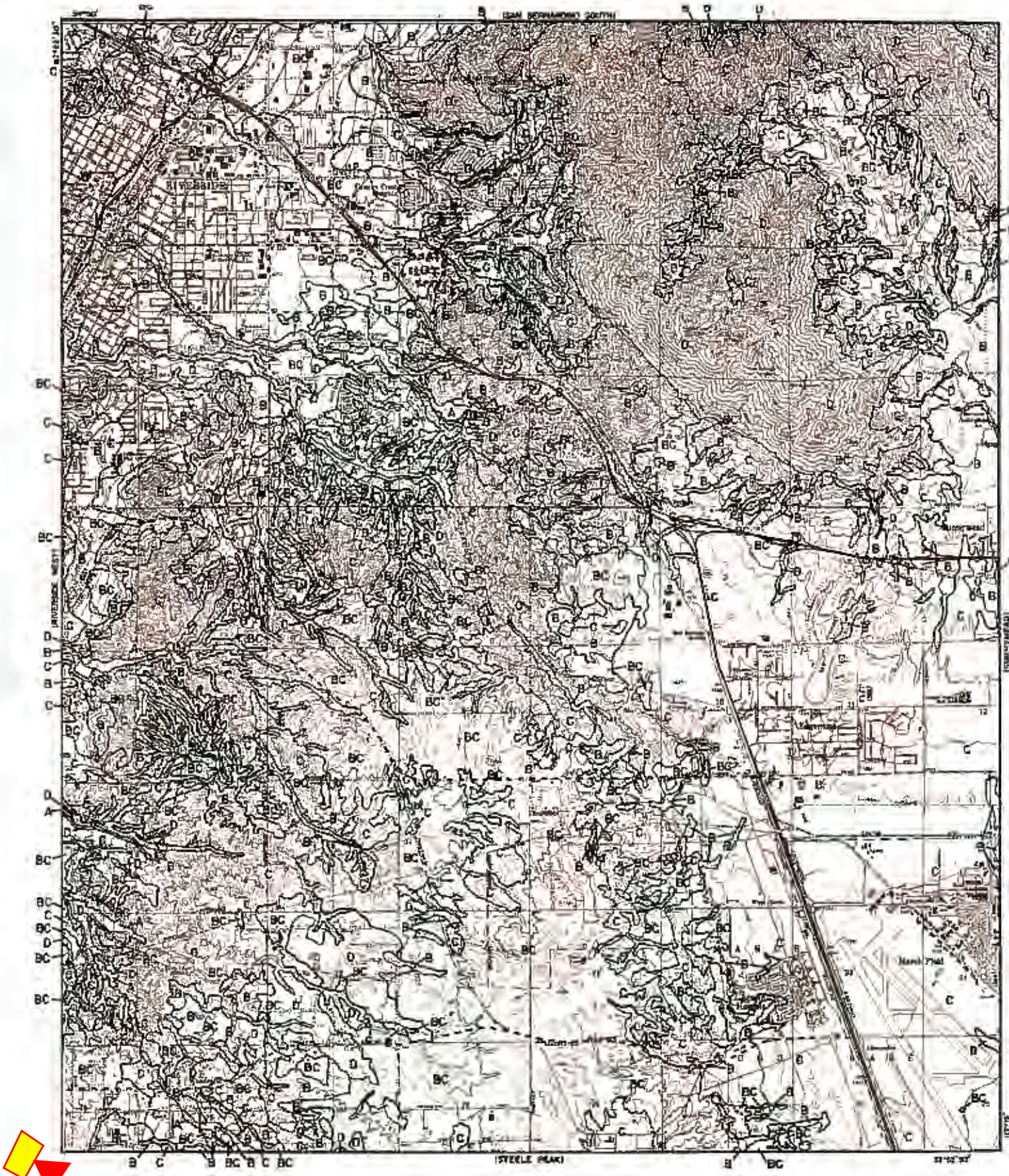
Section 3 – Riverside County Plates



SITE

LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC&WCD HYDROLOGY MANUAL

N

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR RIVERSIDE-EAST

PLATE C-1.16

RUNOFF INDEX NUMBERS OF HYDROLOGIC SOIL-COVER COMPLEXES FOR PERVIOUS AREAS-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparrel, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparrel, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	72	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	28	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		76	85	90	92

RCFC & WCD
HYDROLOGY MANUAL

RUNOFF INDEX NUMBERS FOR PERVIOUS AREA

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent(2)
Natural or Agriculture	0 - 10	0
Single Family Residential: (3)		
40,000 S. F. (1 Acre) Lots	10 - 25	20
20,000 S. F. (½ Acre) Lots	30 - 45	40
7,200 - 10,000 S. F. Lots	45 - 55	50
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 -100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

RCFC & WCD
HYDROLOGY MANUAL

IMPERVIOUS COVER FOR DEVELOPED AREAS

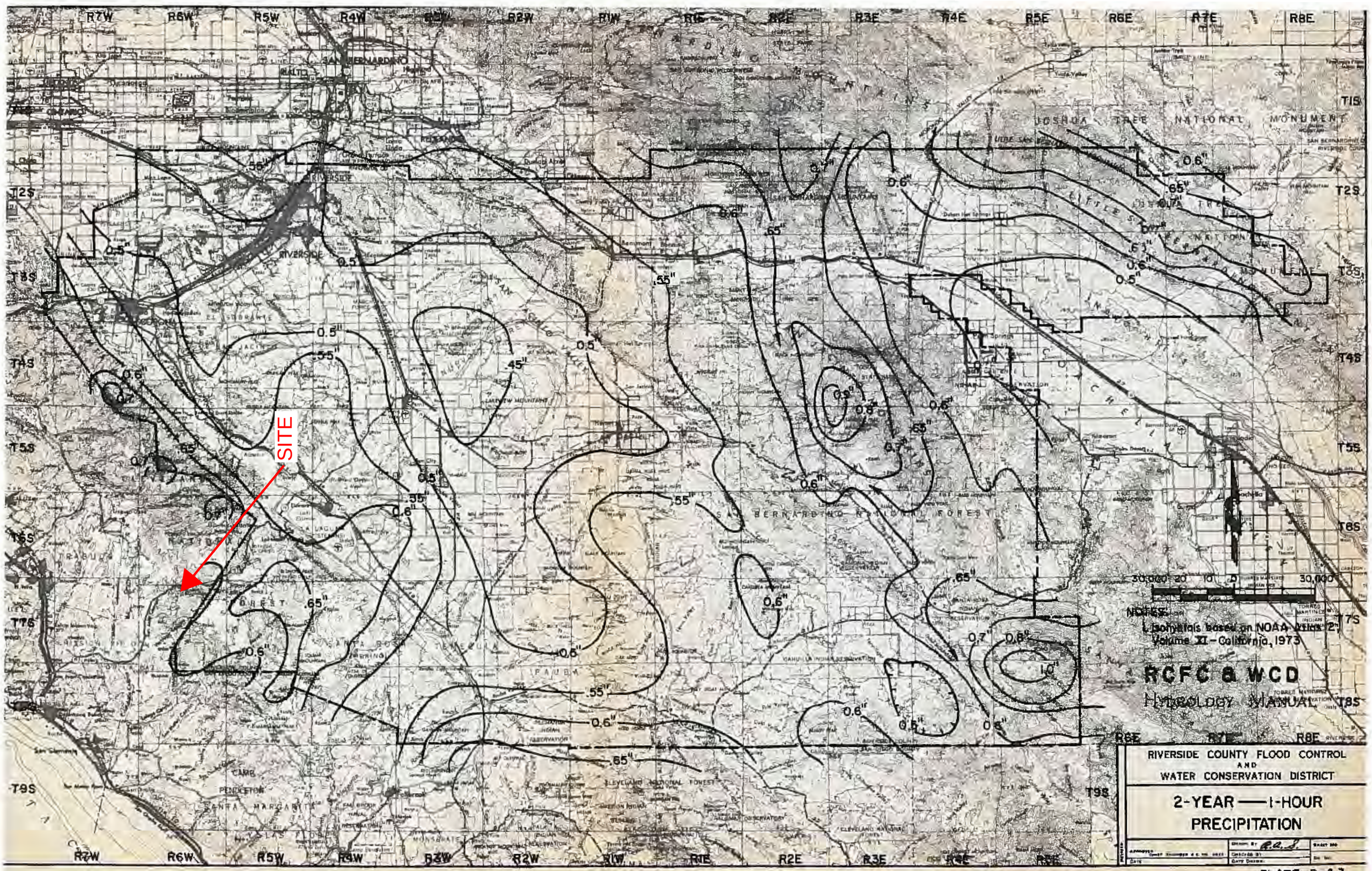

SITE
SAN BERNARDINO
RIVERSIDE
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
0.5"
0.55"
0.6"
0.65"
0.7"
0.8"
1.0"
30,000 20 10 0 30,000
NOTES:
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
RCFC & WCD
Hydrology MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
2-YEAR — 1-HOUR PRECIPITATION

PLATE D-4.3

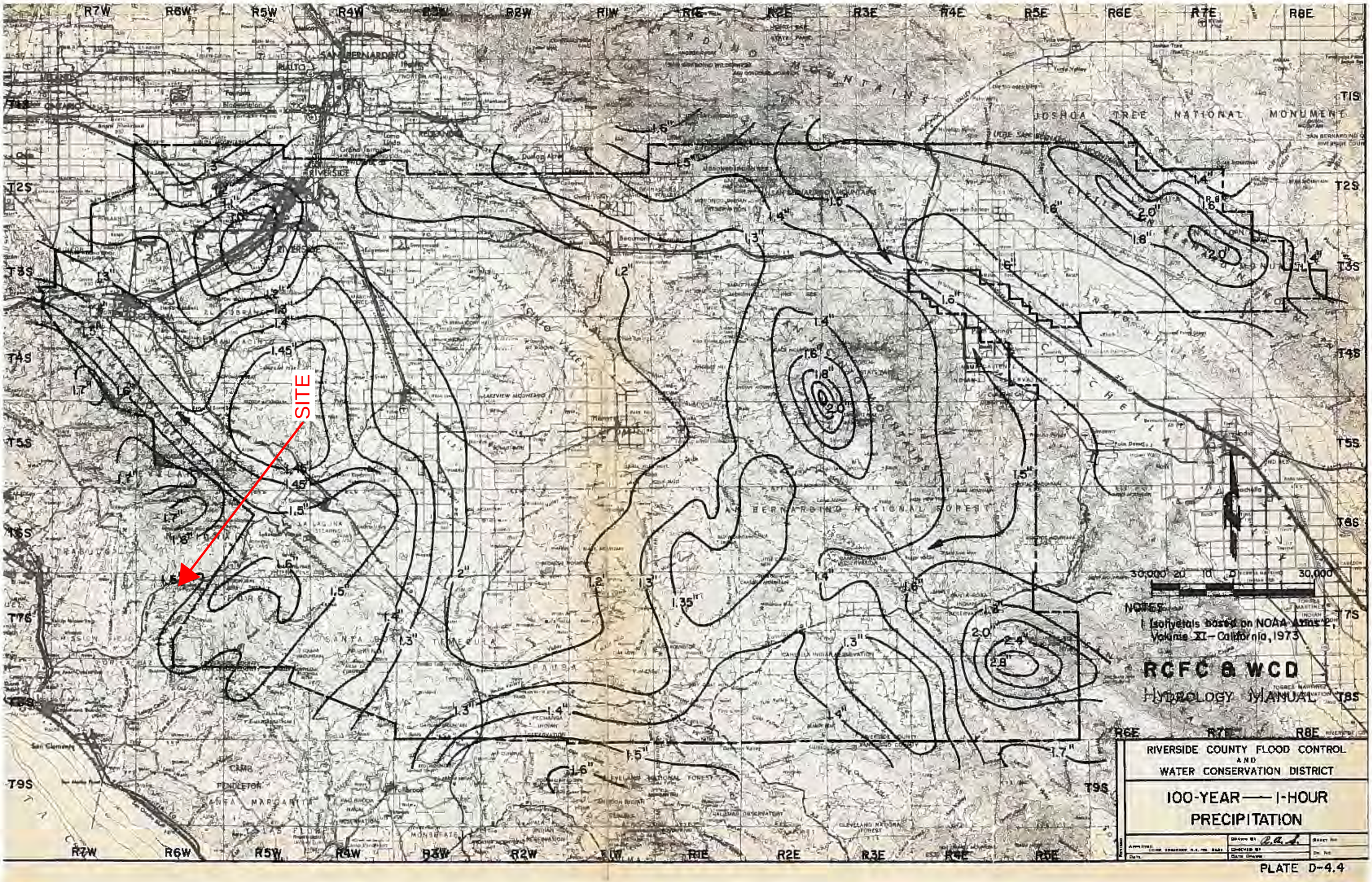
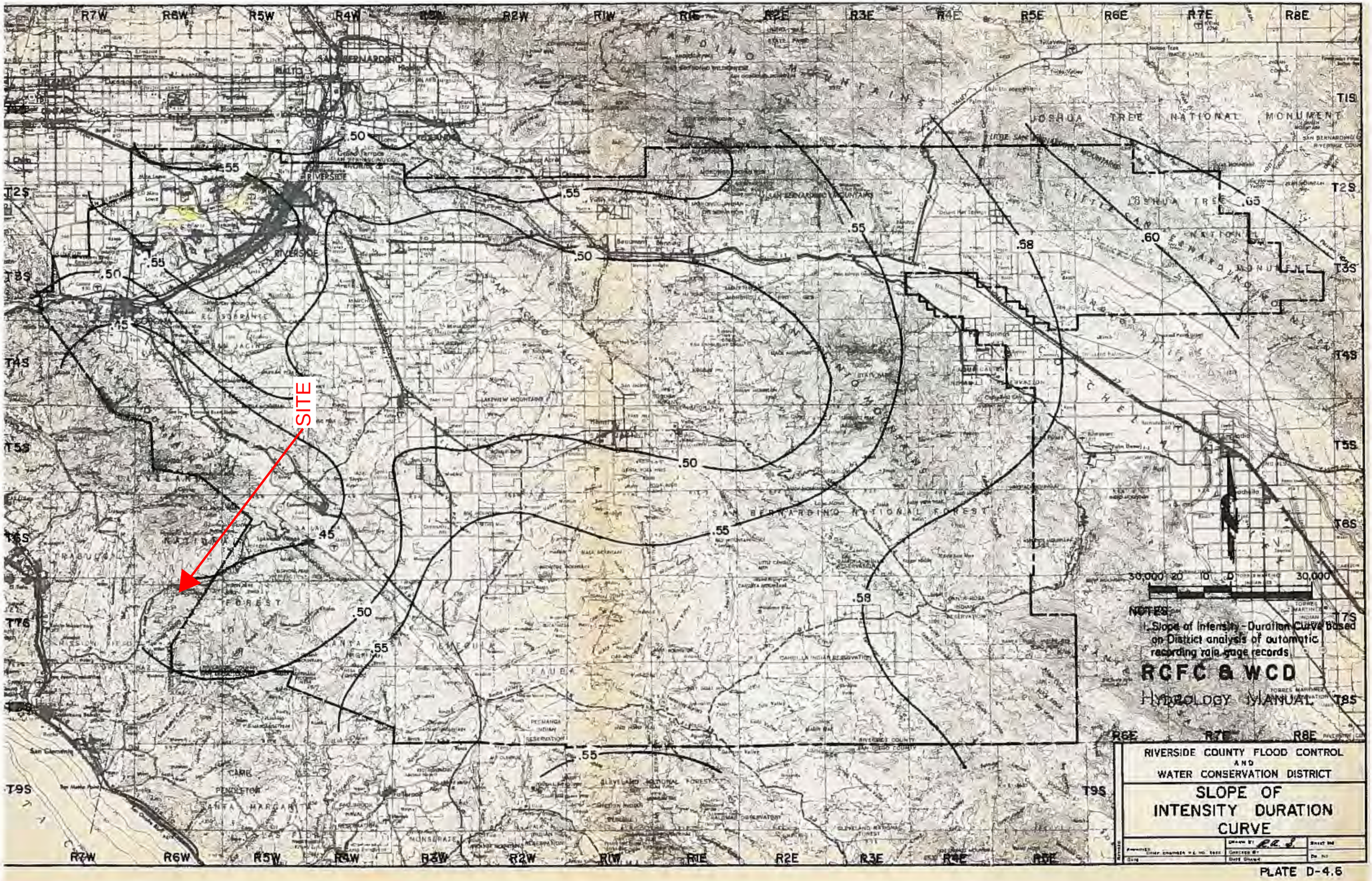

SITE
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO NATIONAL FOREST
RIVERSIDE
SAN BERNARDINO
RIALTO
NOTES
1. Isohyetals based on NOAA Atlas 2, Volume XI – California, 1973
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
100-YEAR — 1-HOUR PRECIPITATION
30,000 20 10 0 30,000

PLATE D-4.4


SITE
.50
.55
.45
.58
.60
.65
NOTES
1. Slope of Intensity - Duration Curve based on District analysis of automatic recording rain gauge records
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
SLOPE OF INTENSITY DURATION CURVE
PLATE D-4.6