Appendix I Hydrology Reports

Hydrology and Hydraulics Study

HYDROLOGY AND HYDRAULICS STUDY
CITY OF SAN BERNARDINO
DRC/ERC CASE: REVIEW NO. 05-23
A.P.N. 266-041-62
COUNTY OF SAN BERNARDINO

Prepared for:

HURD/IDS Property
Investment Development Services, Inc.
515 South Figueroa Street, Suite 1600
Los Angeles, CA 90071
213-595-1871

Prepared by:

Stantec

Stantec Consulting, Inc.
22690 Cactus Avenue, Suite 300
Moreno Valley, CA 92553
951-697-8300

June 21, 2006
Revised November 2, 2007

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Prepared for:

HURD/IDS Property
Investment Development Services, Inc.
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Grant Becklund

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STUDY NARRATIVE

GENERAL

The project site is located in the City of San Bernardino, County of San Bernardino. It is situated west of Interstate Highway 215, south of Palm Avenue and north of Industrial Parkway. The proposed development is for a commercial development in approximately 45 acres of land. The site is undeveloped vacant land in the existing condition. It is surrounded by commercial developments.

PURPOSE

The purpose of this study is to provide hydrologic information for the development of the project site with regards to the sizing and location of a storm drain system to receive, convey and discharge all storm waters impacting the proposed Tract site. It will also investigate the treatment of storm water runoff.

HYDROLOGIC DESCRIPTION

Offsite flow enters the project site at the north-western side of the site through an existing culvert. This offsite flow will be conveyed through a storm drain pipe to discharge to the existing Industrial Parkway Street. One proposed commercial building encompassing an area of approximately 18 acres will be situated in the middle of the site. Trail parking and standard parking will be located surrounding the building. Half of the building will drain to the north side while the other half will drain to the south side. The flows generated from the northern side will be conveyed through a continuous vegetated swale and outlet through a storm drain pipe to Cable Creek channel; which will connect to Cajon Creek Wash through the Devil Creek Diversion; and ultimately discharge to Santa Ana River. The southern flows will be outlet to existing Industrial Parkway Street at several locations.

The city of San Bernardino Department of Public Works storm drain policy is that the 100-year storm flows will be contained the street right-of-way and 50-year flows will be contained between the curbs. The existing Industrial Parkway has more capacity than the 10 year, 50 year, and 100 year flows generated from the southerly area of the development. For this reason, the flows from the southerly development will be outlet to Industrial Parkway.

WATER QUALITY BMP

The proposed storm drain systems will include water quality BMP that will reduce pollutant discharge to the maximum extent practicable (MEP). The selected BMP type that will best fit the site constraints is a vegetated swale. This type of BMP is a flow based design type. Design guidelines are in accordance with the following document: "MODEL WATER QUALITY MANAGEMENT PLAN GUIDANCE" dated June 09, 2005 from San Bernardino Storm water program. The grassed swale BMP is sized to treat flows up to a design flow rate based upon runoff from BMP design rainfall intensity on the drainage tributary area and is dependent upon location, drainage tributary area and percentage of impervious area in the development.

The flows generated from the northern side will be treated through a continuous vegetated swale and outlet through a storm drain pipe to Cable Creek channel. The southern flows will be treated through vegetated swales along Industrial Parkway and outlet to existing Industrial Parkway Street at several locations.

Worksheets containing design flow calculation and the grassed swales design are included herein in the Appendix.

Periodic system maintenance will be necessary to clean the swales and mowing of the grass cover to maintain a height of 4 to 6 inches.

HYDROLOGY STUDIES SOFTWARE

Hydrology for this study is based upon "San Bernardino County Hydrology Manual", dated August 1986. Software designed by "CivilDESIGN" of San Bernardino was used to solve the drainage models of the site. The output is printed in the standard San Bernardino County format.

The Rational Method Hydrology is used for the onsite development and also provides preliminary pipeline sizing.

DESIGN ASSUMPTIONS FOR HYDROLOGY STUDIES

Soils Classification: Soil type was based on the Hydrologic Soils Group Map for South-West – B Area of San Bernardino County Manual Plate C-6. The predominant soil type in the project site is D, with a mix of type A.

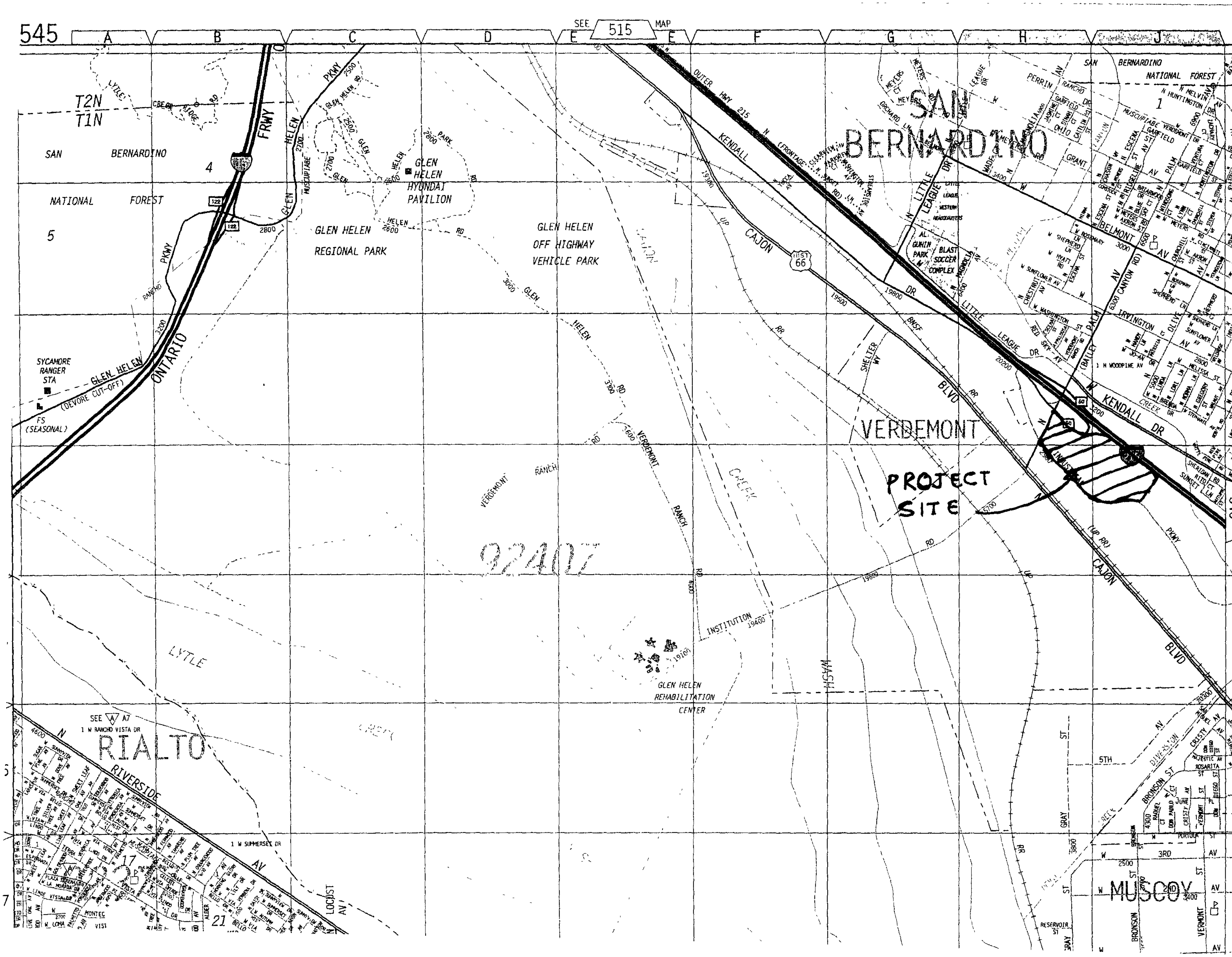
Antecedent Moisture Content (AMC) is assumed to be AMC-II for all 10-year and 50-year calculations. AMC-III is assumed for all 100-year calculations.

Rainfall:
Precipitation data was used from the precipitation isohyetals in San Bernardino County Flood Control District Hydrology Manual.

Slope of intensity duration curve:
Slope of intensity duration curve was assumed to be 0.6 since the project is located in valley watershed.

APPENDIX

Appendix I



545
SEE 515 MAP
SEE 546 MAP
© 2004 Thomas Bros. Maps ®
SAN BERNARDINO NATIONAL FOREST
T2N
T1N
ONTARIO FRWY
GLEN HELEN PKWY
GLEN HELEN REGIONAL PARK
GLEN HELEN HYUNDAI PAVILION
GLEN HELEN OFF HIGHWAY VEHICLE PARK
SYCAMORE RANGER STA
FS (SEASONAL)
GLEN HELEN (DEVORE CUT-OFF)
VERDEMONT RANCH RD
92407
GLEN HELEN REHABILITATION CENTER
INSTITUTION RD
LYTLE CREEK WASH
SAN BERNARDINO
OUTER HWY 215
KENDALL DR
CAJON BLVD
LITTLE LEAGUE DR
VERDEMONT
PROJECT SITE
RIALTO
RIVERSIDE AV
MUSCOY
SHELTER WY
PALM AV
BELMONT AV
LOCUST AV

Appendix II

100-YR FLOW FROM OFFSITE AND SOUTHERLY ONSITE (DEVELOPED)

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             San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
      Rational Hydrology Study        Date: 06/14/06
------------------------------------------------------------------------
JN 32037.00 - Developed Hydrology from Hurd Property
Developed Southerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 14, 2006
(P:\32037.00\Hyd\Trxx\Rat\SOUTH.OUT)
------------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.400 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


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Process from Point/Station      100.000 to Point/Station      105.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Initial subarea data:
Initial area flow distance =   450.000(Ft.)
Top (of initial area) elevation =  1695.000(Ft.)
Bottom (of initial area) elevation =  1692.000(Ft.)
Difference in elevation =     3.000(Ft.)
Slope =    0.00667  s(%)=       0.67
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.536 min.
Rainfall intensity =      4.221(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff =      9.046(CFS)
Total initial stream area =        2.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.033(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      110.000
```

already developed area

```
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1692.000(Ft.)
End of street segment elevation =  1676.000(Ft.)
Length of street segment  =   530.000(Ft.)
Height of curb above gutter flowline  =     8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     13.004(CFS)
Depth of flow =   0.417(Ft.), Average velocity =   4.729(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.665(Ft.)
Flow velocity =   4.73(Ft/s)
Travel time =    1.87 min.     TC =   11.40  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      3.791(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      6.176(CFS) for    2.100(Ac.)
Total runoff =     15.222(CFS)
Effective area this stream =        4.50(Ac.)
Total Study Area (Main Stream No. 1) =         4.50(Ac.)
Area averaged Fm value =    0.033(In/Hr)
Street flow at end of street =     15.222(CFS)
Half street flow at end of street =     15.222(CFS)
Depth of flow =   0.435(Ft.), Average velocity =   4.913(Ft/s)
Flow width (from curb towards crown)=  19.871(Ft.)


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Process from Point/Station      110.000 to Point/Station      115.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
________________________________________________________________________
Top of street segment elevation =  1676.000(Ft.)
End of street segment elevation =  1667.500(Ft.)
Length of street segment  =   336.000(Ft.)
Height of curb above gutter flowline  =     8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
```

add in portion to remain undevel.

edge of devel area

this has flow to street – what about BMP?

```
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     19.450(CFS)
Depth of flow =   0.477(Ft.), Average velocity =   4.878(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  22.658(Ft.)
Flow velocity =   4.88(Ft/s)
Travel time =    1.15 min.     TC =   12.55  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      3.579(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.892
Subarea runoff =      7.121(CFS) for    2.500(Ac.)
Total runoff =     22.342(CFS)
Effective area this stream =        7.00(Ac.)
Total Study Area (Main Stream No. 1) =         7.00(Ac.)
Area averaged Fm value =     0.033(In/Hr)
Street flow at end of street =     22.342(CFS)
Half street flow at end of street =     22.342(CFS)
Depth of flow =   0.495(Ft.), Average velocity =   5.047(Ft/s)
Flow width (from curb towards crown)=  23.918(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.000(Ac.)
Runoff from this stream =     22.342(CFS)
Time of concentration =   12.55 min.
Rainfall intensity =     3.579(In/Hr)
Area averaged loss rate (Fm) =    0.0329(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station       10.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
```

```
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.290(In/Hr)
Initial subarea data:
Initial area flow distance =   510.000(Ft.)
Top (of initial area) elevation =  1730.000(Ft.)
Bottom (of initial area) elevation =  1695.000(Ft.)
Difference in elevation =    35.000(Ft.)
Slope =    0.06863  s(%)=       6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.606 min.
Rainfall intensity =      3.268(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      7.773(CFS)
Total initial stream area =        2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.290(In/Hr)


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Process from Point/Station       15.000 to Point/Station       20.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1695.000(Ft.)
Downstream point/station elevation =  1693.000(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.773(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.773(CFS)
Normal flow depth in pipe =   10.70(In.)
Flow top width inside pipe =   17.68(In.)
Critical Depth =   12.95(In.)
Pipe flow velocity =      7.10(Ft/s)
Travel time through pipe =    0.38 min.
Time of concentration (TC) =    14.98 min.


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Process from Point/Station       20.000 to Point/Station       25.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     15.680(CFS)
Depth of flow =   0.561(Ft.), Average velocity =   2.494(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =     15.680(CFS)
```

```
  '     '     flow top width =      22.425(Ft.)
  '     '     velocity=    2.494(Ft/s)
  '     '     area =      6.286(Sq.Ft)
  '     '     Froude number =     0.830

Upstream point elevation =  1693.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Flow length =   650.000(Ft.)
Travel time  =    4.34 min.
Time of concentration =   19.32 min.
Depth of flow =   0.561(Ft.)
Average velocity =   2.494(Ft/s)
Total irregular channel flow =    15.680(CFS)
Irregular channel normal depth above invert elev. =   0.561(Ft.)
Average velocity of channel(s) =   2.494(Ft/s)

Sub-Channel No. 1 Critical depth =      0.520(Ft.)
  '     '       '     Critical flow top width =     20.781(Ft.)
  '     '       '     Critical flow velocity=    2.905(Ft/s)
  '     '       '     Critical flow area =     5.398(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.290(In/Hr)
Rainfall intensity =      2.763(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.806
Subarea runoff =     11.812(CFS) for    5.900(Ac.)
Total runoff =     19.585(CFS)
Effective area this stream =        8.80(Ac.)
Total Study Area (Main Stream No. 1) =       15.80(Ac.)
Area averaged Fm value =    0.290(In/Hr)


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Process from Point/Station       25.000 to Point/Station      115.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1667.500(Ft.)
Pipe length  =   865.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    19.585(CFS)
Nearest computed pipe diameter  =    21.00(In.)
Calculated individual pipe flow  =    19.585(CFS)
Normal flow depth in pipe =   15.49(In.)
Flow top width inside pipe =   18.47(In.)
Critical Depth =   19.05(In.)
Pipe flow velocity =     10.29(Ft/s)
Travel time through pipe =    1.40 min.
Time of concentration (TC) =    20.73 min.
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Process from Point/Station      25.000 to Point/Station      115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.800(Ac.)
Runoff from this stream =     19.585(CFS)
Time of concentration =   20.73 min.
Rainfall intensity =     2.649(In/Hr)
Area averaged loss rate (Fm) =    0.2900(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1        22.342     12.55                3.579
2        19.585     20.73                2.649
Qmax(1) =
          1.000 *    1.000 *    22.342) +
          1.394 *    0.606 *    19.585) + =      38.879
Qmax(2) =
          0.738 *    1.000 *    22.342) +
          1.000 *    1.000 *    19.585) + =      36.068

Total of 2 streams to confluence:
Flow rates before confluence point:
      22.342      19.585
Maximum flow rates at confluence using above data:
       38.879       36.068
Area of streams before confluence:
        7.000        8.800
Effective area values after confluence:
       12.329       15.800
Results of confluence:
Total flow rate =     38.879(CFS)
Time of concentration =    12.552 min.
Effective stream area after confluence =     12.329(Ac.)
Stream Area average Pervious fraction(Ap) =  0.601
Stream Area average soil loss rate(Fm) =    0.176(In/Hr)
Study area (this main stream) =      15.80(Ac.)


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Process from Point/Station     115.000 to Point/Station      120.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1667.500(Ft.)
End of street segment elevation =  1659.500(Ft.)
Length of street segment  =   575.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
```

```
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      49.443(CFS)
Depth of flow =   0.673(Ft.), Average velocity =   5.139(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.32(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   5.14(Ft/s)
Travel time =    1.86 min.     TC =   14.42  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      3.294(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.866
Subarea runoff =     15.380(CFS) for    6.700(Ac.)
Total runoff =     54.259(CFS)
Effective area this stream =        19.03(Ac.)
Total Study Area (Main Stream No. 1) =        22.50(Ac.)
Area averaged Fm value =    0.126(In/Hr)
Street flow at end of street =      54.259(CFS)
Half street flow at end of street =      54.259(CFS)
Depth of flow =   0.694(Ft.), Average velocity =   5.268(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    1.35(Ft.)
Flow width (from curb towards crown)=  32.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      125.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1659.500(Ft.)
End of street segment elevation =  1649.500(Ft.)
Length of street segment  =   431.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
```

```
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     64.524(CFS)
Depth of flow =   0.675(Ft.), Average velocity =   6.654(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.43(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   6.65(Ft/s)
Travel time =    1.08 min.     TC =   15.50  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      3.154(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.871
Subarea runoff =     17.834(CFS) for    7.200(Ac.)
Total runoff =     72.093(CFS)
Effective area this stream =       26.23(Ac.)
Total Study Area (Main Stream No. 1) =       29.70(Ac.)
Area averaged Fm value =    0.100(In/Hr)
Street flow at end of street =      72.093(CFS)
Half street flow at end of street =     72.093(CFS)
Depth of flow =   0.700(Ft.), Average velocity =   6.855(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    1.68(Ft.)
Flow width (from curb towards crown)=  32.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      125.000 to Point/Station     130.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1649.500(Ft.)
End of street segment elevation =  1630.000(Ft.)
Length of street segment  =   667.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
```

Gutter hike from flowline = 2.000(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150
Estimated mean flow rate at midpoint of street = 86.661(CFS)
Depth of flow = 0.716(Ft.), Average velocity = 7.836(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 2.47(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width = 32.000(Ft.)
Flow velocity = 7.84(Ft/s)
Travel time = 1.42 min. TC = 16.92 min.
Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.033(In/Hr)
Rainfall intensity = 2.993(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.876
Subarea runoff = 24.424(CFS) for 10.600(Ac.)
Total runoff = 96.517(CFS)
Effective area this stream = 36.83(Ac.)
Total Study Area (Main Stream No. 1) = 40.30(Ac.)
Area averaged Fm value = 0.081(In/Hr)
Street flow at end of street = 96.517(CFS)
Half street flow at end of street = 96.517(CFS)
Depth of flow = 0.742(Ft.), Average velocity = 8.063(Ft/s)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 3.77(Ft.)
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, Total Study Area = 40.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.297
Area averaged SCS curve number = 64.9

100-YR FLOWS FROM OFFSITE AND SOUTHERLY ONSITE
(UN-DEVELOPED)

```
          San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
     Rational Hydrology Study          Date: 06/22/06
------------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =   100.00    1 hour rainfall =     1.400 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


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Process from Point/Station      200.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.290(In/Hr)
Initial subarea data:
Initial area flow distance =   510.000(Ft.)
Top (of initial area) elevation =  1730.000(Ft.)
Bottom (of initial area) elevation =  1695.000(Ft.)
Difference in elevation =   35.000(Ft.)
Slope =     0.06863  s(%)=       6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.606 min.
Rainfall intensity =      3.268(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.820
Subarea runoff =      7.773(CFS)
Total initial stream area =       2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.290(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =  1695.000(Ft.)
Downstream point/station elevation =  1693.000(Ft.)
Pipe length  =    160.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =     7.773(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.773(CFS)
Normal flow depth in pipe =   10.70(In.)
Flow top width inside pipe =   17.68(In.)
Critical Depth =   12.95(In.)
Pipe flow velocity =       7.10(Ft/s)
Travel time through pipe =    0.38 min.
Time of concentration (TC) =    14.98 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     15.680(CFS)
Depth of flow =   0.561(Ft.), Average velocity =   2.494(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =     15.680(CFS)
  '     '    flow top width =     22.425(Ft.)
  '     '    velocity=    2.494(Ft/s)
  '     '    area =      6.286(Sq.Ft)
  '     '    Froude number =     0.830

Upstream point elevation =  1693.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Flow length =   650.000(Ft.)
Travel time  =   4.34 min.
Time of concentration =   19.32 min.
Depth of flow =   0.561(Ft.)
Average velocity =   2.494(Ft/s)
Total irregular channel flow =    15.680(CFS)
Irregular channel normal depth above invert elev. =   0.561(Ft.)
Average velocity of channel(s) =   2.494(Ft/s)

Sub-Channel No. 1 Critical depth =      0.520(Ft.)
  '     '       '     Critical flow top width =     20.781(Ft.)
  '     '       '     Critical flow velocity=    2.905(Ft/s)
  '     '       '     Critical flow area =      5.398(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Adjusted SCS curve number for AMC 3 = 84.60
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.290(In/Hr)
```

```
Rainfall intensity =      2.763(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.806
Subarea runoff =     11.812(CFS) for    5.900(Ac.)
Total runoff =     19.585(CFS)
Effective area this stream =        8.80(Ac.)
Total Study Area (Main Stream No. 1) =        8.80(Ac.)
Area averaged Fm value =    0.290(In/Hr)


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Process from Point/Station      230.000 to Point/Station      240.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1678.000(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    19.585(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    19.585(CFS)
Normal flow depth in pipe =   11.75(In.)
Flow top width inside pipe =   17.14(In.)
Critical depth could not be calculated.
Pipe flow velocity =     16.03(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    19.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      240.000 to Point/Station      250.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     32.938(CFS)
Depth of flow =   1.568(Ft.), Average velocity =   3.854(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
     1               0.00               1.00
     2               4.00               0.00
     3               8.00               1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     32.938(CFS)
  '     '    flow top width =      8.000(Ft.)
  '     '    velocity=    3.854(Ft/s)
  '     '    area =      8.546(Sq.Ft)
  '     '    Froude number =     0.657

Upstream point elevation =  1678.000(Ft.)
Downstream point elevation =  1671.000(Ft.)
Flow length =   682.000(Ft.)
Travel time  =    2.95 min.
Time of concentration =   22.38 min.
Depth of flow =   1.568(Ft.)
Average velocity =   3.854(Ft/s)
```

```
Total irregular channel flow =    32.938(CFS)
Irregular channel normal depth above invert elev. =   1.568(Ft.)
Average velocity of channel(s) =   3.854(Ft/s)
!!Warning: Water is above left or right bank elevations

Sub-Channel No. 1 Critical depth =      1.313(Ft.)
  '     '       '     Critical flow top width =      8.000(Ft.)
  '     '       '     Critical flow velocity=    5.067(Ft/s)
  '     '       '     Critical flow area =      6.500(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      2.530(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.822
Subarea runoff =     23.665(CFS) for   12.000(Ac.)
Total runoff =    43.249(CFS)
Effective area this stream =       20.80(Ac.)
Total Study Area (Main Stream No. 1) =       20.80(Ac.)
Area averaged Fm value =    0.220(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      250.000 to Point/Station      260.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     49.903(CFS)
Depth of flow =   1.604(Ft.), Average velocity =   4.522(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     49.903(CFS)
  '     '    flow top width =      10.000(Ft.)
  '     '    velocity=    4.522(Ft/s)
  '     '    area =     11.036(Sq.Ft)
  '     '    Froude number =     0.759

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1663.000(Ft.)
Flow length =   600.000(Ft.)
Travel time  =    2.21 min.
Time of concentration =   24.59 min.
Depth of flow =   1.604(Ft.)
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Average velocity =   4.522(Ft/s)
Total irregular channel flow =    49.903(CFS)
Irregular channel normal depth above invert elev. =   1.604(Ft.)
Average velocity of channel(s) =   4.522(Ft/s)
!!Warning: Water is above left or right bank elevations

Sub-Channel No. 1 Critical depth =      1.422(Ft.)
  '     '       '     Critical flow top width =     10.000(Ft.)
  '     '       '     Critical flow velocity=    5.413(Ft/s)
  '     '       '     Critical flow area =      9.219(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      2.391(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.822
Subarea runoff =     10.199(CFS) for    6.400(Ac.)
Total runoff =     53.449(CFS)
Effective area this stream =       27.20(Ac.)
Total Study Area (Main Stream No. 1) =       27.20(Ac.)
Area averaged Fm value =    0.208(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      255.000 to Point/Station      260.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Time of concentration =    24.59 min.
Rainfall intensity =      2.391(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.824
Subarea runoff =     11.403(CFS) for    5.700(Ac.)
Total runoff =     64.851(CFS)
Effective area this stream =       32.90(Ac.)
Total Study Area (Main Stream No. 1) =       32.90(Ac.)
Area averaged Fm value =    0.201(In/Hr)


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Process from Point/Station      260.000 to Point/Station      270.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
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Top of street segment elevation =  1663.000(Ft.)
End of street segment elevation =  1636.000(Ft.)
Length of street segment  =   985.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     73.032(CFS)
Depth of flow =   0.684(Ft.), Average velocity =   7.312(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.88(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   7.31(Ft/s)
Travel time =    2.25 min.     TC =   26.83  min.
 Adding area flow to street
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      2.269(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.823
Subarea runoff =      12.076(CFS) for    8.300(Ac.)
Total runoff =     76.927(CFS)
Effective area this stream =       41.20(Ac.)
Total Study Area (Main Stream No. 1) =       41.20(Ac.)
Area averaged Fm value =    0.194(In/Hr)
Street flow at end of street =     76.927(CFS)
Half street flow at end of street =     76.927(CFS)
Depth of flow =   0.696(Ft.), Average velocity =   7.414(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    1.47(Ft.)
Flow width (from curb towards crown)=  32.000(Ft.)
End of computations, Total Study Area =          41.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  73.7
```

100 -YR FLOWS FROM NORTHERLY DEVELOPMENT (DEVELOPED)

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            San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
      Rational Hydrology Study        Date: 06/20/06
------------------------------------------------------------------------
JN 32037.00 - Developed Hydrology from Hurd Property
Developed Northerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 20, 2006
(P:\32037.00\Hyd\Trxx\Rat\NORTH.OUT)
------------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.400 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station     205.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Initial subarea data:
Initial area flow distance =   300.000(Ft.)
Top (of initial area) elevation =  1690.000(Ft.)
Bottom (of initial area) elevation =  1689.000(Ft.)
Difference in elevation =     1.000(Ft.)
Slope =    0.00333  s(%)=      0.33
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.314 min.
Rainfall intensity =      4.281(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.893
Subarea runoff =       5.352(CFS)
Total initial stream area =        1.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.033(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station     210.000
```

**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1689.000(Ft.)
Downstream point elevation = 1688.000(Ft.)
Channel length thru subarea = 300.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 20.000
Slope or 'Z' of right channel bank = 20.000
Estimated mean flow rate at midpoint of channel = 8.793(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 8.793(CFS)
Depth of flow = 0.455(Ft.), Average velocity = 2.128(Ft/s)
Channel flow top width = 18.181(Ft.)
Flow Velocity = 2.13(Ft/s)
Travel time = 2.35 min.
Time of concentration = 11.66 min.
Critical depth = 0.414(Ft.)
Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.033(In/Hr)
Rainfall intensity = 3.740(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.892
Subarea runoff = 5.325(CFS) for 1.800(Ac.)
Total runoff = 10.678(CFS)
Effective area this stream = 3.20(Ac.)
Total Study Area (Main Stream No. 1) = 3.20(Ac.)
Area averaged Fm value = 0.033(In/Hr)

++
Process from Point/Station 210.000 to Point/Station 215.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1688.000(Ft.)
Downstream point elevation = 1686.000(Ft.)
Channel length thru subarea = 437.000(Ft.)
Channel base width = 0.000(Ft.)
Slope or 'Z' of left channel bank = 20.000
Slope or 'Z' of right channel bank = 20.000
Estimated mean flow rate at midpoint of channel = 17.351(CFS)
Manning's 'N' = 0.015
Maximum depth of channel = 1.000(Ft.)
Flow(q) thru subarea = 17.351(CFS)
Depth of flow = 0.553(Ft.), Average velocity = 2.841(Ft/s)
Channel flow top width = 22.105(Ft.)
Flow Velocity = 2.84(Ft/s)
Travel time = 2.56 min.
Time of concentration = 14.23 min.
Critical depth = 0.543(Ft.)

Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.033(In/Hr)
Rainfall intensity = 3.320(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.891
Subarea runoff = 10.623(CFS) for 4.000(Ac.)
Total runoff = 21.301(CFS)
Effective area this stream = 7.20(Ac.)
Total Study Area (Main Stream No. 1) = 7.20(Ac.)
Area averaged Fm value = 0.033(In/Hr)

++
Process from Point/Station 211.000 to Point/Station 215.000
**** SUBAREA FLOW ADDITION ****

UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.168(In/Hr)
Time of concentration = 14.23 min.
Rainfall intensity = 3.320(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area,(total area with modified rational method)(Q=KCIA) is C = 0.886
Subarea runoff = 3.404(CFS) for 1.200(Ac.)
Total runoff = 24.705(CFS)
Effective area this stream = 8.40(Ac.)
Total Study Area (Main Stream No. 1) = 8.40(Ac.)
Area averaged Fm value = 0.052(In/Hr)

++
Process from Point/Station 215.000 to Point/Station 220.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1686.000(Ft.)
Downstream point elevation = 1684.000(Ft.)
Channel length thru subarea = 341.000(Ft.)
Channel base width = 7.000(Ft.)
Slope or 'Z' of left channel bank = 3.000
Slope or 'Z' of right channel bank = 3.000
Estimated mean flow rate at midpoint of channel = 29.999(CFS)
Manning's 'N' = 0.030
Maximum depth of channel = 2.000(Ft.)
Flow(q) thru subarea = 29.999(CFS)
Depth of flow = 0.977(Ft.), Average velocity = 3.093(Ft/s)

```
Channel flow top width =   12.861(Ft.)
Flow Velocity =    3.09(Ft/s)
Travel time  =    1.84 min.
Time of concentration =   16.07 min.
Critical depth =      0.742(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      3.087(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =      8.130(CFS) for    3.600(Ac.)
Total runoff =     32.835(CFS)
Effective area this stream =       12.00(Ac.)
Total Study Area (Main Stream No. 1) =       12.00(Ac.)
Area averaged Fm value =    0.046(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      225.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1684.000(Ft.)
Downstream point elevation =  1680.500(Ft.)
Channel length thru subarea  =   833.000(Ft.)
Channel base width       =    7.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     41.454(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     41.454(CFS)
Depth of flow =    1.269(Ft.), Average velocity =   3.022(Ft/s)
Channel flow top width =   14.616(Ft.)
Flow Velocity =    3.02(Ft/s)
Travel time  =    4.59 min.
Time of concentration =   20.66 min.
Critical depth =      0.898(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Adjusted SCS curve number for AMC 3 = 82.40
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.033(In/Hr)
Rainfall intensity =      2.654(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.886
Subarea runoff =     10.193(CFS) for    6.300(Ac.)
```

```
Total runoff =      43.028(CFS)
Effective area this stream =       18.30(Ac.)
Total Study Area (Main Stream No. 1) =       18.30(Ac.)
Area averaged Fm value =     0.042(In/Hr)
End of computations, Total Study Area =          18.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.159
Area averaged SCS curve number =  65.0
```

100-YR FLOWS FROM NORTHERLY DEVELOPMENT (UN-DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/22/06

The Keith Companies, Moreno Valley, CA - S/N 707

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

```
Rational hydrology study storm event year is   100.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.400 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      110.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Initial subarea data:
Initial area flow distance =   475.000(Ft.)
Top (of initial area) elevation =  1698.000(Ft.)
Bottom (of initial area) elevation =  1671.000(Ft.)
Difference in elevation =    27.000(Ft.)
Slope =    0.05684  s(%)=       5.68
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.742 min.
Rainfall intensity =       3.250(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.853
Subarea runoff =       5.825(CFS)
Total initial stream area =        2.100(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.168(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      120.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      10.817(CFS)
Depth of flow =   0.846(Ft.), Average velocity =   3.024(Ft/s)
      ******* Irregular Channel Data ***********
```

```
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              1.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     10.817(CFS)
  '     '    flow top width =      8.458(Ft.)
  '     '    velocity=    3.024(Ft/s)
  '     '    area =      3.577(Sq.Ft)
  '     '    Froude number =     0.820

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1665.000(Ft.)
Flow length =   280.000(Ft.)
Travel time  =    1.54 min.
Time of concentration =   16.28 min.
Depth of flow =   0.846(Ft.)
Average velocity =   3.024(Ft/s)
Total irregular channel flow =    10.817(CFS)
Irregular channel normal depth above invert elev. =   0.846(Ft.)
Average velocity of channel(s) =   3.024(Ft/s)

Sub-Channel No. 1 Critical depth =      0.781(Ft.)
  '     '       '     Critical flow top width =      7.813(Ft.)
  '     '       '     Critical flow velocity=    3.545(Ft/s)
  '     '       '     Critical flow area =      3.052(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      3.062(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.851
Subarea runoff =      9.018(CFS) for    3.600(Ac.)
Total runoff =     14.843(CFS)
Effective area this stream =       5.70(Ac.)
Total Study Area (Main Stream No. 1) =       5.70(Ac.)
Area averaged Fm value =    0.168(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      130.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     20.702(CFS)
Depth of flow =   0.807(Ft.), Average velocity =   3.181(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00               1.00
      2             10.00               0.00
      3             20.00               1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     20.702(CFS)
  '     '    flow top width =     16.133(Ft.)
  '     '    velocity=    3.182(Ft/s)
  '     '    area =      6.507(Sq.Ft)
  '     '    Froude number =     0.883

Upstream point elevation =  1665.000(Ft.)
Downstream point elevation =  1654.000(Ft.)
Flow length =   444.000(Ft.)
Travel time  =    2.33 min.
Time of concentration =   18.61 min.
Depth of flow =   0.807(Ft.)
Average velocity =   3.181(Ft/s)
Total irregular channel flow =    20.702(CFS)
Irregular channel normal depth above invert elev. =   0.807(Ft.)
Average velocity of channel(s) =   3.181(Ft/s)

Sub-Channel No. 1 Critical depth =      0.766(Ft.)
  '     '      '     Critical flow top width =     15.313(Ft.)
  '     '      '     Critical flow velocity=    3.532(Ft/s)
  '     '      '     Critical flow area =      5.862(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      2.826(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.846
Subarea runoff =       9.555(CFS) for    4.500(Ac.)
Total runoff =     24.398(CFS)
Effective area this stream =       10.20(Ac.)
Total Study Area (Main Stream No. 1) =       10.20(Ac.)
Area averaged Fm value =    0.168(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      130.000 to Point/Station     140.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     32.889(CFS)
Depth of flow =   0.992(Ft.), Average velocity =   3.339(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
```

```
Point number      'X' coordinate     'Y' coordinate
      1              0.00               1.00
      2             10.00               0.00
      3             20.00               1.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =     32.889(CFS)
  '     '    flow top width =     19.849(Ft.)
  '     '    velocity=    3.339(Ft/s)
  '     '    area =      9.850(Sq.Ft)
  '     '    Froude number =     0.835

Upstream point elevation =  1654.000(Ft.)
Downstream point elevation =  1641.000(Ft.)
Flow length =   628.000(Ft.)
Travel time  =    3.13 min.
Time of concentration =   21.75 min.
Depth of flow =   0.992(Ft.)
Average velocity =   3.339(Ft/s)
Total irregular channel flow =    32.889(CFS)
Irregular channel normal depth above invert elev. =   0.992(Ft.)
Average velocity of channel(s) =   3.339(Ft/s)

Sub-Channel No. 1 Critical depth =      0.922(Ft.)
  '     '        '     Critical flow top width =     18.438(Ft.)
  '     '        '     Critical flow velocity=    3.870(Ft/s)
  '     '        '     Critical flow area =     8.499(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Adjusted SCS curve number for AMC 3 = 91.30
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.168(In/Hr)
Rainfall intensity =      2.574(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.841
Subarea runoff =     13.060(CFS) for    7.100(Ac.)
Total runoff =    37.457(CFS)
Effective area this stream =       17.30(Ac.)
Total Study Area (Main Stream No. 1) =       17.30(Ac.)
Area averaged Fm value =    0.168(In/Hr)
End of computations, Total Study Area =          17.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  75.5
```

Appendix III

50-YR FLOW FROM OFFSITE AND SOUTHERLY ONSITE
(DEVELOPED)

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            San Bernardino County Rational Hydrology Program

                  (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
      Rational Hydrology Study        Date: 06/14/06
----------------------------------------------------------------------
JN 32037.00 - Developed Hydrology from Hurd Property
Developed Southerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 14, 2006
(P:\32037.00\Hyd\Trxx\Rat\SOUTH.OUT)
----------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
----------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

----------------------------------------------------------------------
Rational hydrology study storm event year is    50.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =    50.00    1 hour rainfall =     1.271 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      105.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Initial subarea data:
Initial area flow distance =   450.000(Ft.)
Top (of initial area) elevation =  1695.000(Ft.)
Bottom (of initial area) elevation =  1692.000(Ft.)
Difference in elevation =      3.000(Ft.)
Slope =    0.00667  s(%)=       0.67
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.536 min.
Rainfall intensity =       3.831(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.885
Subarea runoff =       8.140(CFS)
Total initial stream area =        2.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.062(In/Hr)


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Process from Point/Station      105.000 to Point/Station      110.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
```

```
Top of street segment elevation =  1692.000(Ft.)
End of street segment elevation =  1676.000(Ft.)
Length of street segment  =   530.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     11.702(CFS)
Depth of flow =   0.405(Ft.), Average velocity =   4.611(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  17.893(Ft.)
Flow velocity =   4.61(Ft/s)
Travel time =    1.92 min.     TC =   11.45  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      3.432(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =      5.509(CFS) for    2.100(Ac.)
Total runoff =     13.649(CFS)
Effective area this stream =        4.50(Ac.)
Total Study Area (Main Stream No. 1) =        4.50(Ac.)
Area averaged Fm value =    0.062(In/Hr)
Street flow at end of street =     13.649(CFS)
Half street flow at end of street =     13.649(CFS)
Depth of flow =   0.422(Ft.), Average velocity =   4.785(Ft/s)
Flow width (from curb towards crown)=  19.029(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      115.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation =  1676.000(Ft.)
End of street segment elevation =  1667.500(Ft.)
Length of street segment  =   336.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
```

```
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     17.440(CFS)
Depth of flow =   0.462(Ft.), Average velocity =   4.750(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  21.710(Ft.)
Flow velocity =   4.75(Ft/s)
Travel time =    1.18 min.     TC =   12.63  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      3.236(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.883
Subarea runoff =      6.348(CFS) for    2.500(Ac.)
Total runoff =     19.997(CFS)
Effective area this stream =        7.00(Ac.)
Total Study Area (Main Stream No. 1) =        7.00(Ac.)
Area averaged Fm value =    0.062(In/Hr)
Street flow at end of street =     19.997(CFS)
Half street flow at end of street =     19.997(CFS)
Depth of flow =   0.480(Ft.), Average velocity =   4.912(Ft/s)
Flow width (from curb towards crown)=  22.905(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.000(Ac.)
Runoff from this stream =     19.997(CFS)
Time of concentration =   12.63 min.
Rainfall intensity =     3.236(In/Hr)
Area averaged loss rate (Fm) =    0.0619(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Initial subarea data:
Initial area flow distance =   510.000(Ft.)
Top (of initial area) elevation =  1730.000(Ft.)
Bottom (of initial area) elevation =  1695.000(Ft.)
Difference in elevation =    35.000(Ft.)
Slope =    0.06863  s(%)=       6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.606 min.
Rainfall intensity =      2.966(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.725
Subarea runoff =      6.232(CFS)
Total initial stream area =       2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.578(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      15.000 to Point/Station      20.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1695.000(Ft.)
Downstream point/station elevation =  1693.000(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.232(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.232(CFS)
Normal flow depth in pipe =   10.75(In.)
Flow top width inside pipe =   13.52(In.)
Critical Depth =   12.09(In.)
Pipe flow velocity =      6.62(Ft/s)
Travel time through pipe =    0.40 min.
Time of concentration (TC) =    15.01 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      20.000 to Point/Station      25.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     12.571(CFS)
Depth of flow =   0.516(Ft.), Average velocity =   2.360(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =     12.571(CFS)
  '     '    flow top width =     20.642(Ft.)
  '     '    velocity=    2.360(Ft/s)
  '     '    area =      5.326(Sq.Ft)
  '     '    Froude number =     0.819
```

```
Upstream point elevation =  1693.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Flow length =   650.000(Ft.)
Travel time  =    4.59 min.
Time of concentration =   19.60 min.
Depth of flow =   0.516(Ft.)
Average velocity =   2.360(Ft/s)
Total irregular channel flow =    12.571(CFS)
Irregular channel normal depth above invert elev. =   0.516(Ft.)
Average velocity of channel(s) =   2.360(Ft/s)

Sub-Channel No. 1 Critical depth =      0.477(Ft.)
  '     '        '     Critical flow top width =     19.063(Ft.)
  '     '        '     Critical flow velocity=    2.768(Ft/s)
  '     '        '     Critical flow area =     4.542(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Rainfall intensity =      2.486(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.691
Subarea runoff =      8.879(CFS) for    5.900(Ac.)
Total runoff =     15.111(CFS)
Effective area this stream =        8.80(Ac.)
Total Study Area (Main Stream No. 1) =       15.80(Ac.)
Area averaged Fm value =    0.578(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station     115.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1667.500(Ft.)
Pipe length  =   865.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.111(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    15.111(CFS)
Normal flow depth in pipe =   12.83(In.)
Flow top width inside pipe =   20.48(In.)
Critical Depth =   17.28(In.)
Pipe flow velocity =       9.82(Ft/s)
Travel time through pipe =    1.47 min.
Time of concentration (TC) =    21.07 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station     115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
```

```
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.800(Ac.)
Runoff from this stream =      15.111(CFS)
Time of concentration =    21.07 min.
Rainfall intensity =     2.381(In/Hr)
Area averaged loss rate (Fm) =     0.5783(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1        19.997     12.63                 3.236
2        15.111     21.07                 2.381
Qmax(1) =
          1.000 *    1.000 *     19.997) +
          1.475 *    0.600 *     15.111) + =       33.356
Qmax(2) =
          0.731 *    1.000 *     19.997) +
          1.000 *    1.000 *     15.111) + =       29.720

Total of 2 streams to confluence:
Flow rates before confluence point:
      19.997      15.111
Maximum flow rates at confluence using above data:
       33.356       29.720
Area of streams before confluence:
        7.000        8.800
Effective area values after confluence:
       12.276       15.800
Results of confluence:
Total flow rate =     33.356(CFS)
Time of concentration =    12.631 min.
Effective stream area after confluence =     12.276(Ac.)
Stream Area average Pervious fraction(Ap) =  0.601
Stream Area average soil loss rate(Fm) =    0.350(In/Hr)
Study area (this main stream) =      15.80(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      120.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1667.500(Ft.)
End of street segment elevation =  1659.500(Ft.)
Length of street segment  =   575.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
```

```
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     42.459(CFS)
Depth of flow =   0.646(Ft.), Average velocity =   4.855(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   4.85(Ft/s)
Travel time =    1.97 min.     TC =   14.60  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.966(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.825
Subarea runoff =     13.065(CFS) for    6.700(Ac.)
Total runoff =     46.421(CFS)
Effective area this stream =       18.98(Ac.)
Total Study Area (Main Stream No. 1) =       22.50(Ac.)
Area averaged Fm value =    0.248(In/Hr)
Street flow at end of street =     46.421(CFS)
Half street flow at end of street =     46.421(CFS)
Depth of flow =   0.661(Ft.), Average velocity =   5.030(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  32.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station     125.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
____________________________________________________________________
Top of street segment elevation =  1659.500(Ft.)
End of street segment elevation =  1649.500(Ft.)
Length of street segment  =   431.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     55.228(CFS)
Depth of flow =   0.647(Ft.), Average velocity =   6.288(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
```

```
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   6.29(Ft/s)
Travel time =    1.14 min.      TC =   15.75  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.835(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.838
Subarea runoff =      15.732(CFS) for    7.200(Ac.)
Total runoff =     62.153(CFS)
Effective area this stream =        26.18(Ac.)
Total Study Area (Main Stream No. 1) =       29.70(Ac.)
Area averaged Fm value =    0.197(In/Hr)
Street flow at end of street =     62.153(CFS)
Half street flow at end of street =     62.153(CFS)
Depth of flow =   0.667(Ft.), Average velocity =   6.588(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.03(Ft.)
Flow width (from curb towards crown)=  32.000(Ft.)


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Process from Point/Station      125.000 to Point/Station      130.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1649.500(Ft.)
End of street segment elevation =  1630.000(Ft.)
Length of street segment  =   667.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     74.737(CFS)
Depth of flow =   0.682(Ft.), Average velocity =   7.533(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.78(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   7.53(Ft/s)
Travel time =    1.48 min.      TC =   17.22  min.
```

```
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=      0.062(In/Hr)
Rainfall intensity =      2.687(In/Hr) for a     50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.847
Subarea runoff =     21.545(CFS) for   10.600(Ac.)
Total runoff =     83.698(CFS)
Effective area this stream =       36.78(Ac.)
Total Study Area (Main Stream No. 1) =       40.30(Ac.)
Area averaged Fm value =    0.158(In/Hr)
Street flow at end of street =      83.698(CFS)
Half street flow at end of street =     83.698(CFS)
Depth of flow =   0.708(Ft.), Average velocity =   7.764(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.06(Ft.)
Flow width (from curb towards crown)=  32.000(Ft.)
End of computations, Total Study Area =          40.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.297
Area averaged SCS curve number =  64.9
```

50-YR FLOWS FROM OFFSITE AND SOUTHERLY ONSITE

(UN-DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/22/06

The Keith Companies, Moreno Valley, CA - S/N 707

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

Rational hydrology study storm event year is 50.0
10 Year storm 1 hour rainfall = 0.970(In.)
100 Year storm 1 hour rainfall = 1.400(In.)
Computed rainfall intensity:
Storm year = 50.00 1 hour rainfall = 1.271 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 200.000 to Point/Station 210.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Initial subarea data:
Initial area flow distance = 510.000(Ft.)
Top (of initial area) elevation = 1730.000(Ft.)
Bottom (of initial area) elevation = 1695.000(Ft.)
Difference in elevation = 35.000(Ft.)
Slope = 0.06863 s(%)= 6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 14.606 min.
Rainfall intensity = 2.966(In/Hr) for a 50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.725
Subarea runoff = 6.232(CFS)
Total initial stream area = 2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.578(In/Hr)

++
Process from Point/Station 210.000 to Point/Station 220.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation = 1695.000(Ft.)
Downstream point/station elevation = 1693.000(Ft.)
Pipe length = 160.00(Ft.) Manning's N = 0.013
No. of pipes = 1 Required pipe flow = 6.232(CFS)

```
Nearest computed pipe diameter   =      15.00(In.)
Calculated individual pipe flow   =      6.232(CFS)
Normal flow depth in pipe =    10.75(In.)
Flow top width inside pipe =    13.52(In.)
Critical Depth =    12.09(In.)
Pipe flow velocity =        6.62(Ft/s)
Travel time through pipe =     0.40 min.
Time of concentration (TC) =     15.01 min.


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Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      12.571(CFS)
Depth of flow =    0.516(Ft.), Average velocity =    2.360(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number       'X' coordinate      'Y' coordinate
      1               0.00               1.00
      2              20.00               0.00
      3              40.00               1.00
Manning's 'N' friction factor =    0.030
-----------------------------------------------------------------
Sub-Channel flow   =      12.571(CFS)
  '     '     flow top width =      20.642(Ft.)
  '     '     velocity=     2.360(Ft/s)
  '     '     area =       5.326(Sq.Ft)
  '     '     Froude number =      0.819

Upstream point elevation =   1693.000(Ft.)
Downstream point elevation =   1684.000(Ft.)
Flow length =    650.000(Ft.)
Travel time   =     4.59 min.
Time of concentration =    19.60 min.
Depth of flow =    0.516(Ft.)
Average velocity =    2.360(Ft/s)
Total irregular channel flow =     12.571(CFS)
Irregular channel normal depth above invert elev. =    0.516(Ft.)
Average velocity of channel(s) =    2.360(Ft/s)

Sub-Channel No. 1 Critical depth =       0.477(Ft.)
  '     '       '     Critical flow top width =      19.063(Ft.)
  '     '       '     Critical flow velocity=     2.768(Ft/s)
  '     '       '     Critical flow area =      4.542(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)   = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=      0.578(In/Hr)
Rainfall intensity =       2.486(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.691
Subarea runoff =      8.879(CFS) for    5.900(Ac.)
Total runoff =     15.111(CFS)
Effective area this stream =        8.80(Ac.)
Total Study Area (Main Stream No. 1) =        8.80(Ac.)
Area averaged Fm value =    0.578(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      230.000 to Point/Station      240.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1678.000(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    15.111(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    15.111(CFS)
Normal flow depth in pipe =   11.72(In.)
Flow top width inside pipe =   12.40(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.68(Ft/s)
Travel time through pipe =    0.11 min.
Time of concentration (TC) =    19.71 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      240.000 to Point/Station      250.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     25.414(CFS)
Depth of flow =   1.414(Ft.), Average velocity =   3.475(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              4.00              0.00
      3              8.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     25.414(CFS)
  '     '    flow top width =       8.000(Ft.)
  '     '    velocity=    3.475(Ft/s)
  '     '    area =      7.314(Sq.Ft)
  '     '    Froude number =     0.640

Upstream point elevation =  1678.000(Ft.)
Downstream point elevation =  1671.000(Ft.)
Flow length =   682.000(Ft.)
Travel time  =   3.27 min.
Time of concentration =   22.98 min.
Depth of flow =   1.414(Ft.)
Average velocity =   3.475(Ft/s)
Total irregular channel flow =    25.414(CFS)
Irregular channel normal depth above invert elev. =   1.414(Ft.)
```

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Average velocity of channel(s) =   3.475(Ft/s)
!!Warning: Water is above left or right bank elevations

Sub-Channel No. 1 Critical depth =      1.180(Ft.)
  '     '       '     Critical flow top width =      8.000(Ft.)
  '     '       '     Critical flow velocity=    4.674(Ft/s)
  '     '       '     Critical flow area =      5.438(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.260(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.700
Subarea runoff =     17.804(CFS) for   12.000(Ac.)
Total runoff =    32.915(CFS)
Effective area this stream =       20.80(Ac.)
Total Study Area (Main Stream No. 1) =       20.80(Ac.)
Area averaged Fm value =    0.501(In/Hr)


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Process from Point/Station      250.000 to Point/Station      260.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     37.979(CFS)
Depth of flow =   1.437(Ft.), Average velocity =   4.054(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1             0.00               1.00
      2             5.00               0.00
      3            10.00               1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     37.979(CFS)
  '     '    flow top width =     10.000(Ft.)
  '     '    velocity=    4.054(Ft/s)
  '     '    area =      9.369(Sq.Ft)
  '     '    Froude number =     0.738

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1663.000(Ft.)
Flow length =   600.000(Ft.)
Travel time  =    2.47 min.
Time of concentration =   25.45 min.
Depth of flow =   1.437(Ft.)
Average velocity =   4.054(Ft/s)
Total irregular channel flow =    37.979(CFS)
Irregular channel normal depth above invert elev. =   1.437(Ft.)
```

```
Average velocity of channel(s) =   4.054(Ft/s)
!!Warning: Water is above left or right bank elevations

Sub-Channel No. 1 Critical depth =      1.266(Ft.)
  '     '       '     Critical flow top width =     10.000(Ft.)
  '     '       '     Critical flow velocity=    4.961(Ft/s)
  '     '       '     Critical flow area =      7.656(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.126(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.693
Subarea runoff =      7.171(CFS) for    6.400(Ac.)
Total runoff =     40.086(CFS)
Effective area this stream =       27.20(Ac.)
Total Study Area (Main Stream No. 1) =       27.20(Ac.)
Area averaged Fm value =    0.488(In/Hr)


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Process from Point/Station      255.000 to Point/Station      260.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Time of concentration =    25.45 min.
Rainfall intensity =      2.126(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.697
Subarea runoff =      8.622(CFS) for    5.700(Ac.)
Total runoff =     48.708(CFS)
Effective area this stream =       32.90(Ac.)
Total Study Area (Main Stream No. 1) =       32.90(Ac.)
Area averaged Fm value =    0.481(In/Hr)


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Process from Point/Station      260.000 to Point/Station      270.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1663.000(Ft.)
End of street segment elevation =  1636.000(Ft.)
Length of street segment  =   985.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
```

```
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     54.852(CFS)
Depth of flow =   0.632(Ft.), Average velocity =   6.593(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   6.59(Ft/s)
Travel time =    2.49 min.     TC =   27.94  min.
 Adding area flow to street
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.010(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.688
Subarea runoff =      8.262(CFS) for    8.300(Ac.)
Total runoff =     56.970(CFS)
Effective area this stream =       41.20(Ac.)
Total Study Area (Main Stream No. 1) =       41.20(Ac.)
Area averaged Fm value =    0.473(In/Hr)
Street flow at end of street =     56.970(CFS)
Half street flow at end of street =     56.970(CFS)
Depth of flow =   0.638(Ft.), Average velocity =   6.693(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  32.000(Ft.)
End of computations, Total Study Area =          41.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  73.7
```

50-YR FLOWS FROM NORTHERLY DEVELOPMENT
(DEVELOPED)

```
           San Bernardino County Rational Hydrology Program

                (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
      Rational Hydrology Study        Date: 06/20/06
------------------------------------------------------------------------
JN 32037.00 - Developed Hydrology from Hurd Property
Developed Northerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 20, 2006
(P:\32037.00\Hyd\Trxx\Rat\NORTH.OUT)
------------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is    50.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =    50.00   1 hour rainfall =     1.271 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      205.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Initial subarea data:
Initial area flow distance =   300.000(Ft.)
Top (of initial area) elevation =  1690.000(Ft.)
Bottom (of initial area) elevation =  1689.000(Ft.)
Difference in elevation =     1.000(Ft.)
Slope =    0.00333  s(%)=       0.33
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.314 min.
Rainfall intensity =      3.885(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.886
Subarea runoff =       4.817(CFS)
Total initial stream area =        1.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.062(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      205.000 to Point/Station      210.000
**** IMPROVED CHANNEL TRAVEL TIME ****
```

```
Upstream point elevation =  1689.000(Ft.)
Downstream point elevation =  1688.000(Ft.)
Channel length thru subarea  =   300.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =      7.914(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      7.914(CFS)
Depth of flow =   0.437(Ft.), Average velocity =   2.073(Ft/s)
Channel flow top width =   17.476(Ft.)
Flow Velocity =    2.07(Ft/s)
Travel time  =    2.41 min.
Time of concentration =   11.73 min.
Critical depth =       0.395(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      3.384(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.884
Subarea runoff =       4.750(CFS) for    1.800(Ac.)
Total runoff =      9.567(CFS)
Effective area this stream =        3.20(Ac.)
Total Study Area (Main Stream No. 1) =        3.20(Ac.)
Area averaged Fm value =    0.062(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      215.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation =  1688.000(Ft.)
Downstream point elevation =  1686.000(Ft.)
Channel length thru subarea  =   437.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =     15.546(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     15.546(CFS)
Depth of flow =   0.530(Ft.), Average velocity =   2.764(Ft/s)
Channel flow top width =   21.213(Ft.)
Flow Velocity =    2.76(Ft/s)
Travel time  =    2.64 min.
Time of concentration =   14.36 min.
Critical depth =       0.520(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
```

```
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =       2.996(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.881
Subarea runoff =       9.447(CFS) for    4.000(Ac.)
Total runoff =     19.014(CFS)
Effective area this stream =        7.20(Ac.)
Total Study Area (Main Stream No. 1) =        7.20(Ac.)
Area averaged Fm value =    0.062(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      211.000 to Point/Station      215.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Time of concentration =    14.36 min.
Rainfall intensity =       2.996(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.865
Subarea runoff =       2.755(CFS) for    1.200(Ac.)
Total runoff =     21.769(CFS)
Effective area this stream =        8.40(Ac.)
Total Study Area (Main Stream No. 1) =        8.40(Ac.)
Area averaged Fm value =    0.117(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      215.000 to Point/Station      220.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1686.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Channel length thru subarea  =   341.000(Ft.)
Channel base width      =    7.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     26.434(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     26.434(CFS)
Depth of flow =   0.912(Ft.), Average velocity =   2.977(Ft/s)
Channel flow top width =   12.471(Ft.)
Flow Velocity =    2.98(Ft/s)
Travel time  =    1.91 min.
Time of concentration =   16.27 min.
```

```
Critical depth =      0.688(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.780(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.868
Subarea runoff =      7.173(CFS) for    3.600(Ac.)
Total runoff =     28.942(CFS)
Effective area this stream =       12.00(Ac.)
Total Study Area (Main Stream No. 1) =      12.00(Ac.)
Area averaged Fm value =    0.100(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     220.000 to Point/Station     225.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1684.000(Ft.)
Downstream point elevation =  1680.500(Ft.)
Channel length thru subarea  =   833.000(Ft.)
Channel base width       =    7.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     36.539(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     36.539(CFS)
Depth of flow =   1.187(Ft.), Average velocity =   2.913(Ft/s)
Channel flow top width =   14.124(Ft.)
Flow Velocity =    2.91(Ft/s)
Travel time  =   4.77 min.
Time of concentration =  21.04 min.
Critical depth =      0.836(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.383(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.867
Subarea runoff =      8.872(CFS) for    6.300(Ac.)
Total runoff =     37.814(CFS)
Effective area this stream =       18.30(Ac.)
Total Study Area (Main Stream No. 1) =      18.30(Ac.)
Area averaged Fm value =    0.087(In/Hr)
End of computations, Total Study Area =          18.30 (Ac.)
The following figures may
```

be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.159
Area averaged SCS curve number = 65.0

50-YR FLOWS FROM NORTHERLY DEVELOPMENT

(UN-DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/22/06

The Keith Companies, Moreno Valley, CA - S/N 707

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

```
Rational hydrology study storm event year is    50.0
   10 Year storm 1 hour rainfall  =      0.970(In.)
  100 Year storm 1 hour rainfall  =      1.400(In.)
Computed rainfall intensity:
Storm year =    50.00   1 hour rainfall =     1.271 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      110.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Initial subarea data:
Initial area flow distance =   475.000(Ft.)
Top (of initial area) elevation =  1698.000(Ft.)
Bottom (of initial area) elevation =  1671.000(Ft.)
Difference in elevation =    27.000(Ft.)
Slope =    0.05684  s(%)=       5.68
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.742 min.
Rainfall intensity =      2.950(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.764
Subarea runoff =      4.734(CFS)
Total initial stream area =       2.100(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.445(In/Hr)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      120.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      8.792(CFS)
Depth of flow =   0.783(Ft.), Average velocity =   2.871(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
```

```
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =       8.792(CFS)
  '     '    flow top width =      7.825(Ft.)
  '     '    velocity=    2.871(Ft/s)
  '     '    area =       3.062(Sq.Ft)
  '     '    Froude number =     0.809

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1665.000(Ft.)
Flow length =   280.000(Ft.)
Travel time  =    1.63 min.
Time of concentration =   16.37 min.
Depth of flow =   0.783(Ft.)
Average velocity =   2.871(Ft/s)
Total irregular channel flow =     8.792(CFS)
Irregular channel normal depth above invert elev. =   0.783(Ft.)
Average velocity of channel(s) =   2.871(Ft/s)

Sub-Channel No. 1 Critical depth =      0.719(Ft.)
  '     '       '     Critical flow top width =      7.188(Ft.)
  '     '       '     Critical flow velocity=    3.404(Ft/s)
  '     '       '     Critical flow area =      2.583(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.770(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.755
Subarea runoff =      7.195(CFS) for    3.600(Ac.)
Total runoff =     11.929(CFS)
Effective area this stream =        5.70(Ac.)
Total Study Area (Main Stream No. 1) =       5.70(Ac.)
Area averaged Fm value =    0.445(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      130.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     16.638(CFS)
Depth of flow =   0.743(Ft.), Average velocity =   3.012(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
```

```
      1             0.00               1.00
      2            10.00               0.00
      3            20.00               1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     16.638(CFS)
  '     '    flow top width =     14.864(Ft.)
  '     '    velocity=    3.012(Ft/s)
  '     '    area =     5.523(Sq.Ft)
  '     '    Froude number =     0.871

Upstream point elevation =  1665.000(Ft.)
Downstream point elevation =  1654.000(Ft.)
Flow length =   444.000(Ft.)
Travel time  =    2.46 min.
Time of concentration =   18.82 min.
Depth of flow =   0.743(Ft.)
Average velocity =   3.012(Ft/s)
Total irregular channel flow =    16.638(CFS)
Irregular channel normal depth above invert elev. =   0.743(Ft.)
Average velocity of channel(s) =   3.012(Ft/s)

Sub-Channel No. 1 Critical depth =      0.703(Ft.)
  '     '       '     Critical flow top width =     14.063(Ft.)
  '     '       '     Critical flow velocity=    3.365(Ft/s)
  '     '       '     Critical flow area =     4.944(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.547(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.743
Subarea runoff =      7.371(CFS) for    4.500(Ac.)
Total runoff =     19.300(CFS)
Effective area this stream =       10.20(Ac.)
Total Study Area (Main Stream No. 1) =       10.20(Ac.)
Area averaged Fm value =    0.445(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      130.000 to Point/Station     140.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     26.017(CFS)
Depth of flow =   0.909(Ft.), Average velocity =   3.149(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1             0.00               1.00
      2            10.00               0.00
```

```
      3              20.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     26.017(CFS)
  '     '    flow top width =     18.179(Ft.)
  '     '    velocity=    3.149(Ft/s)
  '     '    area =      8.262(Sq.Ft)
  '     '    Froude number =     0.823

Upstream point elevation =  1654.000(Ft.)
Downstream point elevation =  1641.000(Ft.)
Flow length =   628.000(Ft.)
Travel time  =    3.32 min.
Time of concentration =   22.15 min.
Depth of flow =   0.909(Ft.)
Average velocity =   3.149(Ft/s)
Total irregular channel flow =     26.017(CFS)
Irregular channel normal depth above invert elev. =   0.909(Ft.)
Average velocity of channel(s) =   3.149(Ft/s)

Sub-Channel No. 1 Critical depth =      0.844(Ft.)
  '     '       '     Critical flow top width =     16.875(Ft.)
  '     '       '     Critical flow velocity=    3.654(Ft/s)
  '     '       '     Critical flow area =      7.119(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.310(In/Hr) for a    50.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.727
Subarea runoff =      9.748(CFS) for    7.100(Ac.)
Total runoff =     29.047(CFS)
Effective area this stream =       17.30(Ac.)
Total Study Area (Main Stream No. 1) =       17.30(Ac.)
Area averaged Fm value =    0.445(In/Hr)
End of computations, Total Study Area =          17.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  75.5
```

Appendix IV

10-YR FLOWS FROM OFFSITE AND SOUTHERLY ONSITE (DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/14/06

JN 32037.00 - Developed Hydrology from Hurd Property
Developed Southerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 14, 2006
(P:\32037.00\Hyd\Trxx\Rat\SOUTH.OUT)

The Keith Companies, Moreno Valley, CA - S/N 707

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 100.000 to Point/Station 105.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 64.25
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.062(In/Hr)
Initial subarea data:
Initial area flow distance = 450.000(Ft.)
Top (of initial area) elevation = 1695.000(Ft.)
Bottom (of initial area) elevation = 1692.000(Ft.)
Difference in elevation = 3.000(Ft.)
Slope = 0.00667 s(%)= 0.67
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.536 min.
Rainfall intensity = 2.924(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff = 6.183(CFS)
Total initial stream area = 2.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.062(In/Hr)

++
Process from Point/Station 105.000 to Point/Station 110.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

Top of street segment elevation = 1692.000(Ft.)

```
End of street segment elevation =  1676.000(Ft.)
Length of street segment  =   530.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      8.888(CFS)
Depth of flow =   0.377(Ft.), Average velocity =   4.317(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.010(Ft.)
Flow velocity =   4.32(Ft/s)
Travel time =    2.05 min.     TC =   11.58  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.602(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.879
Subarea runoff =      4.106(CFS) for    2.100(Ac.)
Total runoff =     10.289(CFS)
Effective area this stream =        4.50(Ac.)
Total Study Area (Main Stream No. 1) =        4.50(Ac.)
Area averaged Fm value =    0.062(In/Hr)
Street flow at end of street =     10.289(CFS)
Half street flow at end of street =     10.289(CFS)
Depth of flow =   0.392(Ft.), Average velocity =   4.470(Ft/s)
Flow width (from curb towards crown)=  16.990(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      115.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1676.000(Ft.)
End of street segment elevation =  1667.500(Ft.)
Length of street segment  =   336.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
```

```
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     13.147(CFS)
Depth of flow =   0.428(Ft.), Average velocity =   4.435(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  19.418(Ft.)
Flow velocity =   4.43(Ft/s)
Travel time =    1.26 min.     TC =   12.85  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.446(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.877
Subarea runoff =      4.729(CFS) for    2.500(Ac.)
Total runoff =     15.018(CFS)
Effective area this stream =        7.00(Ac.)
Total Study Area (Main Stream No. 1) =        7.00(Ac.)
Area averaged Fm value =    0.062(In/Hr)
Street flow at end of street =     15.018(CFS)
Half street flow at end of street =     15.018(CFS)
Depth of flow =   0.444(Ft.), Average velocity =   4.580(Ft/s)
Flow width (from curb towards crown)=  20.469(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      7.000(Ac.)
Runoff from this stream =     15.018(CFS)
Time of concentration =   12.85 min.
Rainfall intensity =     2.446(In/Hr)
Area averaged loss rate (Fm) =    0.0619(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       10.000 to Point/Station       15.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
```

```
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Initial subarea data:
Initial area flow distance =   510.000(Ft.)
Top (of initial area) elevation =  1730.000(Ft.)
Bottom (of initial area) elevation =  1695.000(Ft.)
Difference in elevation =    35.000(Ft.)
Slope =    0.06863  s(%)=       6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    14.606 min.
Rainfall intensity =      2.264(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.670
Subarea runoff =      4.401(CFS)
Total initial stream area =        2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.578(In/Hr)


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Process from Point/Station       15.000 to Point/Station      20.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1695.000(Ft.)
Downstream point/station elevation =  1693.000(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.401(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.401(CFS)
Normal flow depth in pipe =    8.46(In.)
Flow top width inside pipe =   14.88(In.)
Critical Depth =   10.21(In.)
Pipe flow velocity =      6.17(Ft/s)
Travel time through pipe =    0.43 min.
Time of concentration (TC) =    15.04 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       20.000 to Point/Station      25.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      8.877(CFS)
Depth of flow =   0.453(Ft.), Average velocity =   2.164(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =      8.877(CFS)
  '     '    flow top width =     18.117(Ft.)
  '     '    velocity=    2.164(Ft/s)
  '     '    area =      4.103(Sq.Ft)
  '     '    Froude number =     0.801

Upstream point elevation =  1693.000(Ft.)
```

```
Downstream point elevation =  1684.000(Ft.)
Flow length =   650.000(Ft.)
Travel time  =    5.01 min.
Time of concentration =   20.04 min.
Depth of flow =   0.453(Ft.)
Average velocity =   2.164(Ft/s)
Total irregular channel flow =     8.877(CFS)
Irregular channel normal depth above invert elev. =   0.453(Ft.)
Average velocity of channel(s) =   2.164(Ft/s)

Sub-Channel No. 1 Critical depth =      0.414(Ft.)
  '     '       '     Critical flow top width =     16.563(Ft.)
  '     '       '     Critical flow velocity=    2.589(Ft/s)
  '     '       '     Critical flow area =     3.429(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Rainfall intensity =      1.873(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.622
Subarea runoff =      5.851(CFS) for    5.900(Ac.)
Total runoff =     10.251(CFS)
Effective area this stream =        8.80(Ac.)
Total Study Area (Main Stream No. 1) =       15.80(Ac.)
Area averaged Fm value =    0.578(In/Hr)


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Process from Point/Station       25.000 to Point/Station      115.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1667.500(Ft.)
Pipe length  =   865.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.251(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    10.251(CFS)
Normal flow depth in pipe =   11.17(In.)
Flow top width inside pipe =   17.47(In.)
Critical Depth =   14.78(In.)
Pipe flow velocity =      8.90(Ft/s)
Travel time through pipe =    1.62 min.
Time of concentration (TC) =    21.66 min.


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Process from Point/Station       25.000 to Point/Station      115.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      8.800(Ac.)
```

```
Runoff from this stream =      10.251(CFS)
Time of concentration =   21.66 min.
Rainfall intensity =     1.787(In/Hr)
Area averaged loss rate (Fm) =    0.5783(In/Hr)
Area averaged Pervious ratio (Ap) = 1.0000
Summary of stream data:

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


1       15.018     12.85              2.446
2       10.251     21.66              1.787
Qmax(1) =
         1.000 *    1.000 *    15.018) +
         1.545 *    0.593 *    10.251) + =      24.406
Qmax(2) =
         0.724 *    1.000 *    15.018) +
         1.000 *    1.000 *    10.251) + =      21.121

Total of 2 streams to confluence:
Flow rates before confluence point:
      15.018      10.251
Maximum flow rates at confluence using above data:
       24.406       21.121
Area of streams before confluence:
        7.000        8.800
Effective area values after confluence:
       12.218       15.800
Results of confluence:
Total flow rate =     24.406(CFS)
Time of concentration =    12.845 min.
Effective stream area after confluence =     12.218(Ac.)
Stream Area average Pervious fraction(Ap) =  0.601
Stream Area average soil loss rate(Fm) =    0.350(In/Hr)
Study area (this main stream) =      15.80(Ac.)


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Process from Point/Station      115.000 to Point/Station      120.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1667.500(Ft.)
End of street segment elevation =  1659.500(Ft.)
Length of street segment  =   575.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
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 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     31.098(CFS)
Depth of flow =   0.594(Ft.), Average velocity =   4.370(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  30.505(Ft.)
Flow velocity =   4.37(Ft/s)
Travel time =    2.19 min.      TC =   15.04  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.225(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.800
Subarea runoff =      9.261(CFS) for    6.700(Ac.)
Total runoff =     33.667(CFS)
Effective area this stream =       18.92(Ac.)
Total Study Area (Main Stream No. 1) =       22.50(Ac.)
Area averaged Fm value =    0.248(In/Hr)
Street flow at end of street =      33.667(CFS)
Half street flow at end of street =      33.667(CFS)
Depth of flow =   0.608(Ft.), Average velocity =   4.457(Ft/s)
Flow width (from curb towards crown)=  31.447(Ft.)


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Process from Point/Station      120.000 to Point/Station      125.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1659.500(Ft.)
End of street segment elevation =  1649.500(Ft.)
Length of street segment  =   431.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     40.074(CFS)
Depth of flow =   0.594(Ft.), Average velocity =   5.641(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  30.480(Ft.)
Flow velocity =   5.64(Ft/s)
Travel time =    1.27 min.      TC =   16.31  min.
 Adding area flow to street
COMMERCIAL subarea type
```

```
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.119(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.817
Subarea runoff =     11.528(CFS) for    7.200(Ac.)
Total runoff =     45.195(CFS)
Effective area this stream =       26.12(Ac.)
Total Study Area (Main Stream No. 1) =       29.70(Ac.)
Area averaged Fm value =    0.196(In/Hr)
Street flow at end of street =     45.195(CFS)
Half street flow at end of street =     45.195(CFS)
Depth of flow =   0.615(Ft.), Average velocity =   5.811(Ft/s)
Flow width (from curb towards crown)=  31.918(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     125.000 to Point/Station     130.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1649.500(Ft.)
End of street segment elevation =  1630.000(Ft.)
Length of street segment  =   667.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     54.366(CFS)
Depth of flow =   0.626(Ft.), Average velocity =   6.698(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  32.000(Ft.)
Flow velocity =   6.70(Ft/s)
Travel time =    1.66 min.     TC =   17.97  min.
 Adding area flow to street
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      1.999(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

rational method)(Q=KCIA) is C = 0.829
Subarea runoff = 15.671(CFS) for 10.600(Ac.)
Total runoff = 60.866(CFS)
Effective area this stream = 36.72(Ac.)
Total Study Area (Main Stream No. 1) = 40.30(Ac.)
Area averaged Fm value = 0.158(In/Hr)
Street flow at end of street = 60.866(CFS)
Half street flow at end of street = 60.866(CFS)
Depth of flow = 0.644(Ft.), Average velocity = 7.007(Ft/s)
Note: depth of flow exceeds top of street crown.
Flow width (from curb towards crown)= 32.000(Ft.)
End of computations, Total Study Area = 40.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.297
Area averaged SCS curve number = 64.9

10-YR FLOWS FROM OFFSITE AND SOUTHERLY ONSITE

(UN-DEVELOPED)

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            San Bernardino County Rational Hydrology Program

                 (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2000 Version 6.3
      Rational Hydrology Study        Date: 06/22/06
-------------------------------------------------------------------------
The Keith Companies, Moreno Valley, CA - S/N   707
-------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

-------------------------------------------------------------------------
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =     10.00   1 hour rainfall =     0.970 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2


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Process from Point/Station      200.000 to Point/Station      210.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Initial subarea data:
Initial area flow distance =   510.000(Ft.)
Top (of initial area) elevation =  1730.000(Ft.)
Bottom (of initial area) elevation =  1695.000(Ft.)
Difference in elevation =    35.000(Ft.)
Slope =    0.06863   s(%)=       6.86
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.606 min.
Rainfall intensity =       2.264(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.670
Subarea runoff =      4.401(CFS)
Total initial stream area =        2.900(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.578(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      210.000 to Point/Station      220.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

Upstream point/station elevation =  1695.000(Ft.)
Downstream point/station elevation =  1693.000(Ft.)
Pipe length  =   160.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    4.401(CFS)
Nearest computed pipe diameter  =    15.00(In.)
Calculated individual pipe flow  =    4.401(CFS)
```

```
Normal flow depth in pipe =     8.46(In.)
Flow top width inside pipe =    14.88(In.)
Critical Depth =   10.21(In.)
Pipe flow velocity =      6.17(Ft/s)
Travel time through pipe =    0.43 min.
Time of concentration (TC) =    15.04 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      230.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =       8.877(CFS)
Depth of flow =   0.453(Ft.), Average velocity =   2.164(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number       'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             20.00              0.00
      3             40.00              1.00
Manning's 'N' friction factor =   0.030
-----------------------------------------------------------------
Sub-Channel flow  =      8.877(CFS)
  '     '    flow top width =     18.117(Ft.)
  '     '    velocity=    2.164(Ft/s)
  '     '    area =      4.103(Sq.Ft)
  '     '    Froude number =     0.801

Upstream point elevation =  1693.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Flow length =   650.000(Ft.)
Travel time  =    5.01 min.
Time of concentration =   20.04 min.
Depth of flow =   0.453(Ft.)
Average velocity =   2.164(Ft/s)
Total irregular channel flow =     8.877(CFS)
Irregular channel normal depth above invert elev. =   0.453(Ft.)
Average velocity of channel(s) =   2.164(Ft/s)

Sub-Channel No. 1 Critical depth =      0.414(Ft.)
  '     '       '     Critical flow top width =     16.563(Ft.)
  '     '       '     Critical flow velocity=    2.589(Ft/s)
  '     '       '     Critical flow area =      3.429(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.500
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Rainfall intensity =      1.873(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.622
Subarea runoff =      5.851(CFS) for    5.900(Ac.)
```

```
Total runoff =      10.251(CFS)
Effective area this stream =         8.80(Ac.)
Total Study Area (Main Stream No. 1) =        8.80(Ac.)
Area averaged Fm value =    0.578(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      230.000 to Point/Station      240.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1684.000(Ft.)
Downstream point/station elevation =  1678.000(Ft.)
Pipe length  =   100.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.251(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    10.251(CFS)
Normal flow depth in pipe =    8.79(In.)
Flow top width inside pipe =   14.78(In.)
Critical depth could not be calculated.
Pipe flow velocity =     13.72(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =    20.17 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      240.000 to Point/Station      250.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     17.241(CFS)
Depth of flow =   1.224(Ft.), Average velocity =   2.975(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1             0.00              1.00
      2             4.00              0.00
      3             8.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     17.241(CFS)
  '     '    flow top width =      8.000(Ft.)
  '     '    velocity=    2.975(Ft/s)
  '     '    area =      5.795(Sq.Ft)
  '     '    Froude number =     0.616

Upstream point elevation =  1678.000(Ft.)
Downstream point elevation =  1671.000(Ft.)
Flow length =   682.000(Ft.)
Travel time  =    3.82 min.
Time of concentration =   23.99 min.
Depth of flow =   1.224(Ft.)
Average velocity =   2.975(Ft/s)
Total irregular channel flow =    17.241(CFS)
Irregular channel normal depth above invert elev. =   1.224(Ft.)
Average velocity of channel(s) =   2.975(Ft/s)
!!Warning: Water is above left or right bank elevations
```

```
Sub-Channel No. 1 Critical depth =      1.023(Ft.)
  '     '       '     Critical flow top width =      8.000(Ft.)
  '     '       '     Critical flow velocity=    4.117(Ft/s)
  '     '       '     Critical flow area =      4.188(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      1.681(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.632
Subarea runoff =     11.840(CFS) for   12.000(Ac.)
Total runoff =     22.092(CFS)
Effective area this stream =       20.80(Ac.)
Total Study Area (Main Stream No. 1) =       20.80(Ac.)
Area averaged Fm value =    0.501(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      250.000 to Point/Station      260.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     25.490(CFS)
Depth of flow =   1.238(Ft.), Average velocity =   3.456(Ft/s)
!!Warning: Water is above left or right bank elevations
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     25.490(CFS)
  '     '    flow top width =     10.000(Ft.)
  '     '    velocity=    3.456(Ft/s)
  '     '    area =      7.375(Sq.Ft)
  '     '    Froude number =     0.709

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1663.000(Ft.)
Flow length =   600.000(Ft.)
Travel time  =    2.89 min.
Time of concentration =   26.88 min.
Depth of flow =   1.238(Ft.)
Average velocity =   3.456(Ft/s)
Total irregular channel flow =    25.490(CFS)
Irregular channel normal depth above invert elev. =   1.238(Ft.)
Average velocity of channel(s) =   3.456(Ft/s)
!!Warning: Water is above left or right bank elevations
```

```
Sub-Channel No. 1 Critical depth =      1.086(Ft.)
  '     '       '     Critical flow top width =     10.000(Ft.)
  '     '       '     Critical flow velocity=    4.350(Ft/s)
  '     '       '     Critical flow area =     5.859(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      1.570(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.620
Subarea runoff =      4.404(CFS) for    6.400(Ac.)
Total runoff =     26.496(CFS)
Effective area this stream =       27.20(Ac.)
Total Study Area (Main Stream No. 1) =       27.20(Ac.)
Area averaged Fm value =    0.488(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      255.000 to Point/Station      260.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Time of concentration =    26.88 min.
Rainfall intensity =      1.570(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.625
Subarea runoff =      5.774(CFS) for    5.700(Ac.)
Total runoff =     32.270(CFS)
Effective area this stream =       32.90(Ac.)
Total Study Area (Main Stream No. 1) =       32.90(Ac.)
Area averaged Fm value =    0.481(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      260.000 to Point/Station      270.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
______________________________________________________________________
Top of street segment elevation =  1663.000(Ft.)
End of street segment elevation =  1636.000(Ft.)
Length of street segment  =   985.000(Ft.)
Height of curb above gutter flowline  =    8.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  30.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.015
```

```
Slope from grade break to crown (v/hz)  =   0.015
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   8.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  2.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     36.340(CFS)
Depth of flow =   0.563(Ft.), Average velocity =   5.863(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  28.429(Ft.)
Flow velocity =   5.86(Ft/s)
Travel time =    2.80 min.     TC =   29.68  min.
 Adding area flow to street
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      1.480(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.612
Subarea runoff =      5.047(CFS) for    8.300(Ac.)
Total runoff =     37.316(CFS)
Effective area this stream =       41.20(Ac.)
Total Study Area (Main Stream No. 1) =       41.20(Ac.)
Area averaged Fm value =    0.473(In/Hr)
Street flow at end of street =      37.316(CFS)
Half street flow at end of street =      37.316(CFS)
Depth of flow =   0.567(Ft.), Average velocity =   5.901(Ft/s)
Flow width (from curb towards crown)=  28.721(Ft.)
End of computations, Total Study Area =          41.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  73.7
```

10-YR FLOWS FROM NORTHERLY DEVELOPMENT
(DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/20/06

JN 32037.00 - Developed Hydrology from Hurd Property
Developed Northerly Flows, including offsite flows
Modeled on January 09, 2006 by MSH, Modified on June 20, 2006
(P:\32037.00\Hyd\Trxx\Rat\NORTH.OUT)

The Keith Companies, Moreno Valley, CA - S/N 707

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 200.000 to Point/Station 205.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 64.25
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.062(In/Hr)
Initial subarea data:
Initial area flow distance = 300.000(Ft.)
Top (of initial area) elevation = 1690.000(Ft.)
Bottom (of initial area) elevation = 1689.000(Ft.)
Difference in elevation = 1.000(Ft.)
Slope = 0.00333 s(%)= 0.33
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 9.314 min.
Rainfall intensity = 2.966(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff = 3.659(CFS)
Total initial stream area = 1.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.062(In/Hr)

++
Process from Point/Station 205.000 to Point/Station 210.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 1689.000(Ft.)

```
Downstream point elevation =  1688.000(Ft.)
Channel length thru subarea  =   300.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =      6.012(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.012(CFS)
Depth of flow =   0.394(Ft.), Average velocity =   1.935(Ft/s)
Channel flow top width =   15.764(Ft.)
Flow Velocity =    1.94(Ft/s)
Travel time  =    2.58 min.
Time of concentration =   11.90 min.
Critical depth =      0.355(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.561(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.878
Subarea runoff =      3.538(CFS) for    1.800(Ac.)
Total runoff =      7.197(CFS)
Effective area this stream =        3.20(Ac.)
Total Study Area (Main Stream No. 1) =       3.20(Ac.)
Area averaged Fm value =    0.062(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station     210.000 to Point/Station     215.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1688.000(Ft.)
Downstream point elevation =  1686.000(Ft.)
Channel length thru subarea  =   437.000(Ft.)
Channel base width       =    0.000(Ft.)
Slope or 'Z' of left channel bank =  20.000
Slope or 'Z' of right channel bank =  20.000
Estimated mean flow rate at midpoint of channel =     11.695(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =     11.695(CFS)
Depth of flow =   0.477(Ft.), Average velocity =   2.574(Ft/s)
Channel flow top width =   19.065(Ft.)
Flow Velocity =    2.57(Ft/s)
Travel time  =    2.83 min.
Time of concentration =   14.73 min.
Critical depth =      0.463(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.253(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.875
Subarea runoff =      7.002(CFS) for    4.000(Ac.)
Total runoff =     14.199(CFS)
Effective area this stream =        7.20(Ac.)
Total Study Area (Main Stream No. 1) =        7.20(Ac.)
Area averaged Fm value =    0.062(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      211.000 to Point/Station      215.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Time of concentration =    14.73 min.
Rainfall intensity =      2.253(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.853
Subarea runoff =      1.953(CFS) for    1.200(Ac.)
Total runoff =     16.152(CFS)
Effective area this stream =        8.40(Ac.)
Total Study Area (Main Stream No. 1) =        8.40(Ac.)
Area averaged Fm value =    0.117(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      215.000 to Point/Station      220.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1686.000(Ft.)
Downstream point elevation =  1684.000(Ft.)
Channel length thru subarea  =   341.000(Ft.)
Channel base width      =    7.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     19.613(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =      19.613(CFS)
Depth of flow =   0.774(Ft.), Average velocity =   2.718(Ft/s)
Channel flow top width =   11.644(Ft.)
Flow Velocity =    2.72(Ft/s)
Travel time  =    2.09 min.
Time of concentration =  16.82 min.
Critical depth =      0.570(Ft.)
 Adding area flow to channel
```

```
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      2.081(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.857
Subarea runoff =      5.237(CFS) for    3.600(Ac.)
Total runoff =     21.388(CFS)
Effective area this stream =       12.00(Ac.)
Total Study Area (Main Stream No. 1) =       12.00(Ac.)
Area averaged Fm value =    0.100(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      220.000 to Point/Station      225.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1684.000(Ft.)
Downstream point elevation =  1680.500(Ft.)
Channel length thru subarea  =   833.000(Ft.)
Channel base width       =    7.000(Ft.)
Slope or 'Z' of left channel bank =   3.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =     27.003(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    2.000(Ft.)
Flow(q) thru subarea =     27.003(CFS)
Depth of flow =    1.010(Ft.), Average velocity =   2.666(Ft/s)
Channel flow top width =   13.059(Ft.)
Flow Velocity =    2.67(Ft/s)
Travel time  =    5.21 min.
Time of concentration =   22.03 min.
Critical depth =      0.695(Ft.)
 Adding area flow to channel
COMMERCIAL subarea type
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 64.25
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.062(In/Hr)
Rainfall intensity =      1.770(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.856
Subarea runoff =      6.325(CFS) for    6.300(Ac.)
Total runoff =     27.714(CFS)
Effective area this stream =       18.30(Ac.)
Total Study Area (Main Stream No. 1) =       18.30(Ac.)
Area averaged Fm value =    0.087(In/Hr)
End of computations, Total Study Area =          18.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
```

effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.159
Area averaged SCS curve number = 65.0

10-YR FLOWS FROM NORTHERLY DEVELOPMENT
(UN-DEVELOPED)

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2000 Version 6.3
Rational Hydrology Study Date: 06/22/06

The Keith Companies, Moreno Valley, CA - S/N 707

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.970 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 100.000 to Point/Station 110.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2) = 75.50
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.445(In/Hr)
Initial subarea data:
Initial area flow distance = 475.000(Ft.)
Top (of initial area) elevation = 1698.000(Ft.)
Bottom (of initial area) elevation = 1671.000(Ft.)
Difference in elevation = 27.000(Ft.)
Slope = 0.05684 s(%)= 5.68
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 14.742 min.
Rainfall intensity = 2.252(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.722
Subarea runoff = 3.415(CFS)
Total initial stream area = 2.100(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.445(In/Hr)

++
Process from Point/Station 110.000 to Point/Station 120.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Estimated mean flow rate at midpoint of channel = 6.343(CFS)
Depth of flow = 0.692(Ft.), Average velocity = 2.646(Ft/s)
******* Irregular Channel Data ***********

Information entered for subchannel number 1 :
Point number 'X' coordinate 'Y' coordinate

```
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =      6.343(CFS)
  '     '    flow top width =      6.924(Ft.)
  '     '    velocity=    2.646(Ft/s)
  '     '    area =      2.397(Sq.Ft)
  '     '    Froude number =     0.793

Upstream point elevation =  1671.000(Ft.)
Downstream point elevation =  1665.000(Ft.)
Flow length =   280.000(Ft.)
Travel time  =    1.76 min.
Time of concentration =   16.51 min.
Depth of flow =   0.692(Ft.)
Average velocity =   2.646(Ft/s)
Total irregular channel flow =      6.343(CFS)
Irregular channel normal depth above invert elev. =   0.692(Ft.)
Average velocity of channel(s) =   2.646(Ft/s)

Sub-Channel No. 1 Critical depth =      0.633(Ft.)
  '     '       '     Critical flow top width =      6.328(Ft.)
  '     '       '     Critical flow velocity=    3.168(Ft/s)
  '     '       '     Critical flow area =      2.002(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      2.104(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.710
Subarea runoff =      5.097(CFS) for    3.600(Ac.)
Total runoff =      8.513(CFS)
Effective area this stream =       5.70(Ac.)
Total Study Area (Main Stream No. 1) =       5.70(Ac.)
Area averaged Fm value =    0.445(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      130.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     11.873(CFS)
Depth of flow =   0.655(Ft.), Average velocity =   2.769(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             10.00              0.00
```

```
      3              20.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     11.873(CFS)
  '     '    flow top width =     13.097(Ft.)
  '     '    velocity=    2.769(Ft/s)
  '     '    area =     4.288(Sq.Ft)
  '     '    Froude number =     0.853

Upstream point elevation =  1665.000(Ft.)
Downstream point elevation =  1654.000(Ft.)
Flow length =   444.000(Ft.)
Travel time  =    2.67 min.
Time of concentration =   19.18 min.
Depth of flow =   0.655(Ft.)
Average velocity =   2.769(Ft/s)
Total irregular channel flow =     11.873(CFS)
Irregular channel normal depth above invert elev. =   0.655(Ft.)
Average velocity of channel(s) =   2.769(Ft/s)

Sub-Channel No. 1 Critical depth =      0.613(Ft.)
  '     '       '     Critical flow top width =     12.266(Ft.)
  '     '       '     Critical flow velocity=    3.157(Ft/s)
  '     '       '     Critical flow area =     3.761(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      1.923(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.692
Subarea runoff =      5.057(CFS) for    4.500(Ac.)
Total runoff =     13.570(CFS)
Effective area this stream =       10.20(Ac.)
Total Study Area (Main Stream No. 1) =       10.20(Ac.)
Area averaged Fm value =    0.445(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      130.000 to Point/Station      140.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =     18.292(CFS)
Depth of flow =   0.796(Ft.), Average velocity =   2.884(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             10.00              0.00
      3             20.00              1.00
Manning's 'N' friction factor =   0.040
```

```
-----------------------------------------------------------------
Sub-Channel flow  =      18.292(CFS)
  '     '    flow top width =      15.929(Ft.)
  '     '    velocity=     2.884(Ft/s)
  '     '    area =       6.344(Sq.Ft)
  '     '    Froude number =      0.805

Upstream point elevation =  1654.000(Ft.)
Downstream point elevation =  1641.000(Ft.)
Flow length =   628.000(Ft.)
Travel time  =    3.63 min.
Time of concentration =   22.81 min.
Depth of flow =   0.796(Ft.)
Average velocity =   2.884(Ft/s)
Total irregular channel flow =    18.292(CFS)
Irregular channel normal depth above invert elev. =   0.796(Ft.)
Average velocity of channel(s) =   2.884(Ft/s)

Sub-Channel No. 1 Critical depth =      0.730(Ft.)
  '     '       '     Critical flow top width =      14.609(Ft.)
  '     '       '     Critical flow velocity=    3.428(Ft/s)
  '     '       '     Critical flow area =      5.336(Sq.Ft)

 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 0.250
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.750
SCS curve number for soil(AMC 2)  = 75.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.445(In/Hr)
Rainfall intensity =      1.733(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.669
Subarea runoff =      6.488(CFS) for    7.100(Ac.)
Total runoff =     20.058(CFS)
Effective area this stream =       17.30(Ac.)
Total Study Area (Main Stream No. 1) =       17.30(Ac.)
Area averaged Fm value =    0.445(In/Hr)
End of computations, Total Study Area =          17.30 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  75.5
```

Appendix V

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel-Offsite
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

(PIPE TO CONVEY OFFSITE FLOW TO INDUSTRIAL PARKWAY)

Input Data		
Mannings Coeffic	0.013	
Channel Slope	.005000	ft/ft
Diameter	30.0	in

Results		
Depth	2.50	ft
Discharge	29.00	cfs
Flow Area	4.9	ft²
Wetted Perime	7.85	ft
Top Width	0.00	ft
Critical Depth	1.84	ft
Percent Full	100.0	%
Critical Slope	006318	ft/ft
Velocity	5.91	ft/s
Velocity Head	0.54	ft
Specific Energ	3.04	ft
Froude Numbe	0.00	
Maximum Disc	31.20	cfs
Discharge Full	29.00	cfs
Slope Full	005000	ft/ft
Flow Type	N/A	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	Circular Channel
Flow Element	Circular Channel
Method	Manning's Formu
Solve For	Full Flow Capacit

(PIPE TO CONVEY SOUTHERLY FLOWS TO CABLE CREEK)

Input Data		
Mannings Coeffic	0.013	
Channel Slope	.011000	ft/ft
Diameter	30.0	in

Results		
Depth	2.50	ft
Discharge	43.02	cfs
Flow Area	4.9	ft^2
Wetted Perime	7.85	ft
Top Width	0.00	ft
Critical Depth	2.19	ft
Percent Full	100.0	%
Critical Slope	009949	ft/ft
Velocity	8.76	ft/s
Velocity Head	1.19	ft
Specific Energ	3.69	ft
Froude Numbe	0.00	
Maximum Disc	46.27	cfs
Discharge Full	43.02	cfs
Slope Full	011000	ft/ft
Flow Type	N/A	

Appendix VI

Stantec

Designed by:

Checked by:

Street Slopes along Industrial Parkway:-

STA 0+00 TO 2+00 :- 1.6% (UPTO 80' U/S OF NODE 110)

STA 2+00 TO 4+00 :- 3.75%

STA. 4+00 TO 8+50 :- 2.00% (Use 2.0% for Node 115)

STA. 8+50 TO 15+00 :- 1.00% (Use 1.0% for Node 120)

STA. 15+00 TO 19+00 :- 4.44%

STA. 19+00 TO 22+31.59 :- 2.00%

STA. 22+31.59 TO 26+00 :- 3.46%

STA. 26+00 TO 31+00 :- 2.0%

Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	R/W @ 1.0%
Flow Element	Irregular Chann
Method	Manning's Forr
Solve For	Discharge

(FULL - STREET CAPACITY @ 1.0% SLOPE)

Input Data		
Channel Slope	.010000	ft/ft
Water Surface Elev	0.65	ft

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weightin;	Horton's Method

Results		
Mannings Coeffic	0.015	
Elevation Range	).00 to 0.81	
Discharge	105.29	cfs
Flow Area	22.0	ft²
Wetted Perimeter	65.19	ft
Top Width	64.17	ft
Actual Depth	0.65	ft
Critical Elevation	0.76	ft
Critical Slope	0.004560	ft/ft
Velocity	4.80	ft/s
Velocity Head	0.36	ft
Specific Energy	1.01	ft
Froude Number	1.45	
Flow Type	›upercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+08	0.025
0+08	0+72	0.015
0+72	0+80	0.025

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	0.81
0+08	0.65
0+08	0.00
0+10	0.10
0+40	0.55
0+70	0.10
0+72	0.00
0+72	0.65
0+80	0.81

Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	R/W @ 1.6%
Flow Element	Irregular Chanı
Method	Manning's Forr
Solve For	Discharge

(FULL STREET CAPACITY @ 1.6% SLOPE)

Input Data		
Channel Slope	.016000	ft/ft
Water Surface Elev	0.65	ft

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coeffic	0.015	
Elevation Range	).00 to 0.81	
Discharge	133.18	cfs
Flow Area	22.0	ft²
Wetted Perimetei	65.19	ft
Top Width	64.17	ft
Actual Depth	0.65	ft
Critical Elevation	0.83	ft
Critical Slope	0.004381	ft/ft
Velocity	6.07	ft/s
Velocity Head	0.57	ft
Specific Energy	1.22	ft
Froude Number	1.83	
Flow Type	;upercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+08	0.025
0+08	0+72	0.015
0+72	0+80	0.025

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	0.81
0+08	0.65
0+08	0.00
0+10	0.10
0+40	0.55
0+70	0.10
0+72	0.00
0+72	0.65
0+80	0.81

Worksheet
Worksheet for Irregular Channel

(FULL STREET CAPACITY @ 2.0% SLOPE)

Project Description	
Worksheet	R/W @ 2.0%
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Discharge

Input Data		
Channel Slope	.020000	ft/ft
Water Surface Elev	0.65	ft

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coeffic	0.015	
Elevation Range	).00 to 0.81	
Discharge	148.90	cfs
Flow Area	22.0	ft²
Wetted Perimete	65.19	ft
Top Width	64.17	ft
Actual Depth	0.65	ft
Critical Elevation	0.87	ft
Critical Slope	0.004280	ft/ft
Velocity	6.78	ft/s
Velocity Head	0.71	ft
Specific Energy	1.36	ft
Froude Number	2.04	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+08	0.025
0+08	0+72	0.015
0+72	0+80	0.025

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	0.81
0+08	0.65
0+08	0.00
0+10	0.10
0+40	0.55
0+70	0.10
0+72	0.00
0+72	0.65
0+80	0.81

Worksheet
Worksheet for Irregular Channel

(FULL STREET CAPACITY @ 3.75% SLOPE)

Project Description	
Worksheet	R/W @ 3.75%
Flow Element	Irregular Chan
Method	Manning's Forr
Solve For	Discharge

Input Data		
Channel Slope	.037500	ft/ft
Water Surface Elev	0.65	ft

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coeffic	0.015	
Elevation Range	).00 to 0.81	
Discharge	203.88	cfs
Flow Area	22.0	ft²
Wetted Perimete	65.19	ft
Top Width	64.17	ft
Actual Depth	0.65	ft
Critical Elevation	0.98	ft
Critical Slope	0.004005	ft/ft
Velocity	9.29	ft/s
Velocity Head	1.34	ft
Specific Energy	1.99	ft
Froude Number	2.80	
Flow Type	›upercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+08	0.025
0+08	0+72	0.015
0+72	0+80	0.025

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	0.81
0+08	0.65
0+08	0.00
0+10	0.10
0+40	0.55
0+70	0.10
0+72	0.00
0+72	0.65
0+80	0.81

Appendix VII

INSTRUCTIONS FOR ESTIMATING VOLUME- AND FLOW-BASED BMP DESIGN RUNOFF QUANTITIES[4]

1) Identify the "BMP Drainage Area" that drains to the proposed BMP element. This includes all areas that will drain to the proposed BMP element, including pervious areas, impervious areas, and off-site areas, whether or not they are directly or indirectly connected to the BMP element. Calculate the BMP Drainage Area (A) in acres.

2) Outline the Drainage Area on the NOAA Atlas 14 Precipitation Depths (2-year 1-hour Rainfall) map (Figure D-1).

3) Determine the area-averaged 2-year 1-hour rainfall value for the Drainage Area outlined above.

A. Flow-Based BMP Design

1) Calculate the composite runoff coefficient, C_{BMP}, as defined in part A.2, above.

2) Determine which Region the BMP Drainage Area is located in (Valley, Mountain or Desert).

3) Determine BMP design rainfall intensity, I_{BMP}, by multiplying the area-averaged 2-year 1-hour value from the NOAA Atlas 14 map by the appropriate regression coefficient from Table D-1 ("I"), and then multiplying by the safety factor specified in the criteria—usually a factor of 2.

---

[4] Rainfall analysis to develop regression coefficients in Table D-1 and modifications to the NOAA Atlas 14 map were conducted by:

Hromadka II, T.V., Professor Emeritus, Department of Mathematics, California State University, Fullerton, and Adjunct Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

Laton, W.R , Assistant Professor, Department of Geological Sciences, California State University, Fullerton

Picciuto J.A.., Assistant Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

With assistance from:

Rene Perez, M.S. Candidate, Department of Geological Sciences, California State University, Fullerton, and

Jim Friel, Ph.D. Professor Emeritus, Department of Mathematics, California State University, Fullerton

Reported as follows:

1. Hromadka II, T.V., Laton, W.R., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design. Final Report to the San Bernardino County Flood Control District.
2. Laton, W.R., Hromadka II, T.V., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design (submitted). Journal of the American Water Resources Association.

4) Calculate the target BMP flow rate, Q, by using the following formula (see Table D-2 below for limitations on the use of this formula):

$$Q = C_{BMP} \cdot I_{BMP} \cdot A$$

where: Q = flow in ft^3/s

I_{BMP} = BMP design rainfall intensity, in inches/hour

A = Drainage Area in acres

C_{BMP} = composite runoff coefficient

Table D-1: Regression Coefficients for Intensity (I) and 6-hour mean storm rainfall (P_6).

Quantity	Valley 85% upper confidence limit	Mountain 85% upper confidence limit	Desert 85% upper confidence limit
I	0.2787	0.3614	0.3250
P_6	1.4807	1.9090	1.2371

Table D-2: Use of the flow-based formula for BMP Design (CASQA 2003).

	Composite Runoff Coefficient, "C"			
BMP Drainage Area (Acres)	**0.00 to 0.25**	**0.26 to 0.50**	**0.51 to 0.75**	**0.76 to 1.00**
0 to 25	**Caution**	**Yes**	**Yes**	**Yes**
26 to 50	**High Caution**	**Caution**	**Yes**	**Yes**
51 to 75	**Not Recommended**	**High Caution**	**Caution**	**Yes**
76 to 100	**Not Recommended**	**High Caution**	**Caution**	**Yes**

If the flow-based BMP formula use case, as determined by Table D-2, shows "Caution," "High Caution," or "Not Recommended," considering the project's characteristics, then he project proponent must calculate the BMP design flow using the unit hydrograph method, as specified in the most current version of the San Bernardino County Hydrology Manual, using the design storm pattern with rainfall return frequency such that the peak one hour rainfall depth equals the 85th-percentile 1-hour rainfall multiplied by two.

Q_{BMP} Determination :- (Attachment D, S.B. County WQMP)

* Total Drainage Area = Project Area
  = Southern Area + Northern Area
  = 31.5 Ac + 18.4
  = 49.9 Ac

* 2-yr 1-hr Rainfall = 0.7 inches (from NOAA Atlas 14)

* Watershed Imperviousness Ratio = 0.9 (Commercial Area)

* C_{BMP} = 0.83 for 90% Imperviousness (Table B-2, Attachment B)

* Watershed Region = Valley

* I = 0.2787 for Valley (Table D-1)

* $I_{BMP} = 0.7 \times 0.2787 \times 2$
  $= 0.39$ in/hr

** Total Q_{BMP} from Site = $C_{BMP} * I_{BMP} * A$
  $= 0.83 \times 0.39 * 49.9$
  $= 16.2$ CFS

Designed by: MSH   Checked by:

Stantec

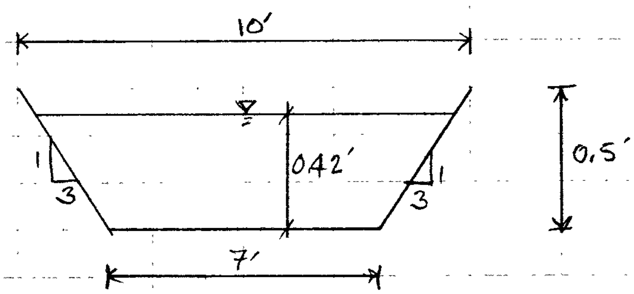
(1) Q_{BMP} at Node 110 :-

$Q_{BMP} = 0.83 \times 0.39 \times (2.4 + 2.1)$

$= 1.46$ CFS

ST. SLOPE = 1.6% for 0+00 to 2+00

ST. SLOPE = 3.75% for 2+00 to 4+00



Q = 1.65 CFS FOR 1.6% SLOPE

D = 0.42', V = 0.47 FPS

L = 7 m × 60 s × 0.47

= 197.4' ≃ 200'

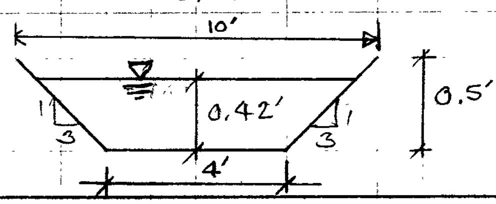
PROVIDE 200' LONG SWALE @ 1.6% SLOPE

(2) Q_{BMP} at Node 115 :-

$Q_{BMP} = 0.83 \times 0.39 \times 2.5$

$= 0.81$ CFS

ST. SLOPE = 3.75% FROM STA. 2+00 TO STA 4+00.



Q = 1.11 CFS FOR 2.0% SLOPE

D = 0.42', V = 0.50 FPS

L = 7 × 60 × 0.50 = 210'

PROVIDE 210' LONG SWALE @ 2%.

(3) Q_{BMP} at Node 120 :-

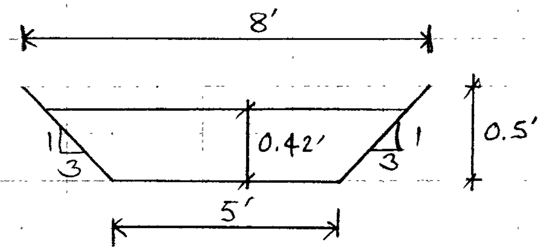
$Q_{BMP} = 0.83 \times 0.39 \times 6.7$

$= 2.17$ CFS

ST. SLOPE = 2.0% FROM STA. 4+00 TO STA. 8+50

ST. SLOPE = 1.0% FROM STA 8+50 TO STA. 15+00

Designed by: Checked by:



@ 2.0% SLOPE, $Q_{CAPACITY}$ = 1.35 CFS FOR 5" Depth
D = 0.42', V = 0.52 FPS

L = 7 × 60 × 0.52 = 218.4' ≃ 220'
PROVIDE SWALE @ 2% SLOPE FOR 220'.

@ 1.0% SLOPE, $Q_{CAPACITY}$ = 0.96 CFS FOR 5" Depth
D = 0.42', V = 0.36 CFS

L = 7 × 60 × 0.36 = 151.2' ≃ 155'

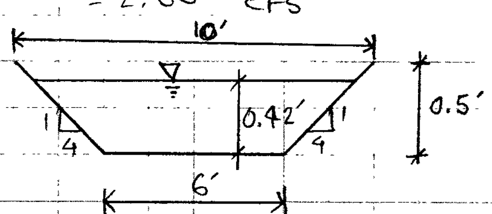
PROVIDE SWALE @ 1.0% SLOPE FOR 155'.

---

(4) Q_{BMP} at Node 125 :-

Q_{BMP} = 0.83 × 0.39 × 7.2
= 2.33 CFS

ST. SLOPE = 1.0% FROM
STA. 8+50 TO 15+00



Q_{BMP} capacity of swale
= 1.17 CFS @ 1.0% SLOPE
D = 0.42', V = 0.36 FPS
Length = 7 × 60 × 0.36 = 151.2'
≃ 155'

Provide 2 Swales, each 155' long @ 1.0% SLOPE
Bottom width = 6', Top width = 10', Side slope = 4:1

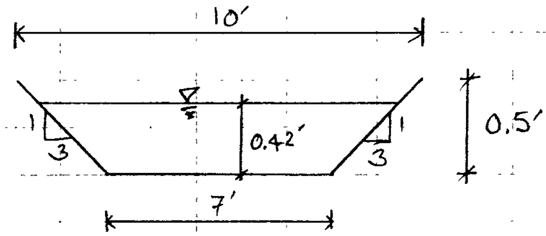
(5) Q_{BMP} at Node 130 :-

$Q_{BMP} = 0.83 \times 0.39 \times 10.6$

$= 3.43$ CFS

ST. SLOPE = 4.4% FROM STA. 15+00 TO 19+00

⇒ Use 2.0% FOR SWALE



Q_{BMP} capacity = 1.84 CFS for 5" depth

D = 0.42' ; V = 0.53 FPS

$L = 7 \times 60 \times 0.52$

$= 218.4'$

$\simeq 220'$

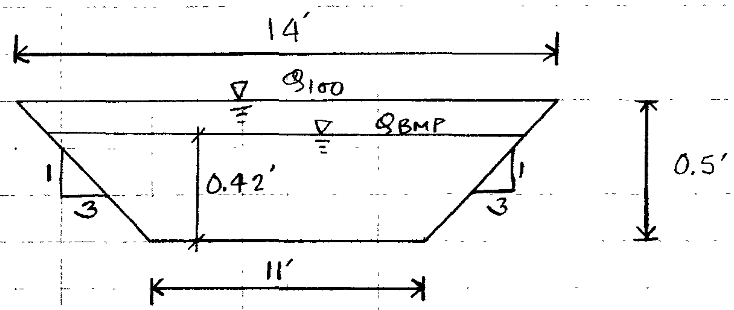
Provide 2 swales, each 220' long @ S = 2.0%

(6) Q_{BMP} at Node 215:-

Drainage Area = 1.4 + 1.8 + 4.0 + 1.2 = 8.4 AC

$Q_{BMP} = 0.83 \times 0.39 \times 8.4$
$= 2.72$ CFS

Q_{100} at Node 215 = 24.7 CFS



Q_{BMP} capacity = 2.82 CFS
D = 0.42′
V = 0.55 FPS

Length = $7 \times 60 \times 0.55$
= 231′

Provide 340′ Long Swale @ 2.0% Slope
Provide opening on Parking Areas @ 231′.
Q_{100} capacity = 25.4 CFS FOR 0.5′ Depth

No extra freeboard is required since swale is located at toe of slope from both sides

Designed by: Checked by:

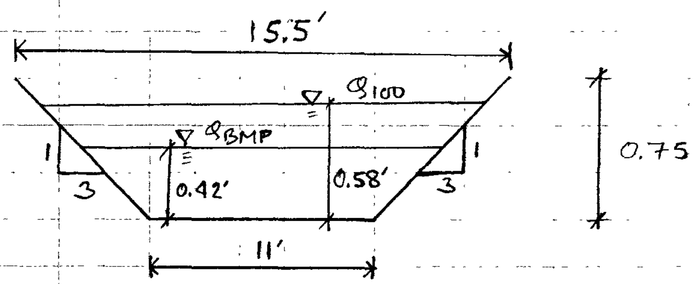
(7) Node 220 :-

Drainage Tributary Area = 3.6 Ac.

Q_{BMP} = 0.83 x 0.39 x 3.6

= 1.17 CFS

Q_{100} = 32.8 CFS



Q_{BMP} capacity = 2.82 CFS

D = 0.42'

V = 0.55 FPS

Length = 7 x 60 x 0.55

= 231'

Provide 231' long swale @ 2.0% slope

Then provide opening in Parking Area @ every 231'

Q_{100} capacity = 51.2 CFS

No extra freeboard is required since the swale is located at the toe of slope from both sides.

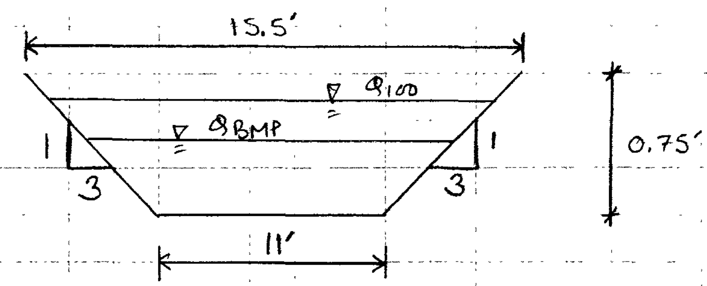
Designed by: Checked by:

⑧ Node 225 :-

Drainage Tributary Area = 6.3 Ac.

$Q_{BMP} = 0.83 \times 0.39 \times 6.3$
$= 2.04$ CFS

$Q_{100} = 43.0$ CFS



Q_{BMP} Capacity = 2.82 CFS
D = 0.42'
V = 0.55 FPS

Length = 7 X 60 X 0.55
= 231'

Continue the same swale section from Node 220 to the end of the site.

Provide opening in Parking Area & Landscaping @ every 231'

Q_{100} capacity = 51.2 CFS

No extra freeboard is required since the swale is located at toe of slope from both sides.

Designed by: Checked by:

Southern Channel on Industrial Parkway @ Node 110
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Southern Chann
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.016000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	7.00	ft

Should be 0.25

Results		
Discharge	1.65	cfs
Flow Area	3.5	ft²
Wetted Perim	9.66	ft
Top Width	9.52	ft
Critical Depth	0.12	ft
Critical Slope	1.215926	ft/ft
Velocity	0.47	ft/s
Velocity Head	0.00	ft
Specific Enerç	0.42	ft
Froude Numb	0.14	
Flow Type	Subcritical	

Southern Channel on Industrial Parkway @ Node 115
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Southern Chann
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.020000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	4.00	ft

Results		
Discharge	1.11	cfs
Flow Area	2.2	ft²
Wetted Perim	6.66	ft
Top Width	6.52	ft
Critical Depth	0.13	ft
Critical Slope	1.200286	ft/ft
Velocity	0.50	ft/s
Velocity Head	0.00	ft
Specific Enerç	0.42	ft
Froude Numb	0.15	
Flow Type	Subcritical	

Southern Channel on Industrial Parkway @ Node 120 for Slope 2.0%
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Southern Chann
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.020000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	5.00	ft

Results		
Discharge	1.35	cfs
Flow Area	2.6	ft²
Wetted Perim	7.66	ft
Top Width	7.52	ft
Critical Depth	0.13	ft
Critical Slope	1.195608	ft/ft
Velocity	0.52	ft/s
Velocity Head	0.00	ft
Specific Energ	0.42	ft
Froude Numb	0.15	
Flow Type	Subcritical	

Southern Channel on Industrial Parkway @ Node 120 for Slope 1.0%
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Copy of Southern Chai
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.010000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	5.00	ft

Results		
Discharge	0.96	cfs
Flow Area	2.6	ft²
Wetted Perim	7.66	ft
Top Width	7.52	ft
Critical Depth	0.10	ft
Critical Slope	1.277849	ft/ft
Velocity	0.36	ft/s
Velocity Head	0.00	ft
Specific Energ	0.42	ft
Froude Numb	0.11	
Flow Type	Subcritical	

Southern Channel on Industrial Parkway @ Node 125
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Southern Chann
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.010000	ft/ft
Depth	0.42	ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Bottom Width	6.00	ft

Results		
Discharge	1.17	cfs
Flow Area	3.2	ft^2
Wetted Perim	9.46	ft
Top Width	9.36	ft
Critical Depth	0.10	ft
Critical Slope	1.271672	ft/ft
Velocity	0.36	ft/s
Velocity Head	0.00	ft
Specific Energ	0.42	ft
Froude Numb	0.11	
Flow Type	Subcritical	

Southern Channel on Industrial Parkway @ Node 130
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Southern Chann
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.020000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	7.00	ft

Results		
Discharge	1.84	cfs
Flow Area	3.5	ft^2
Wetted Perim	9.66	ft
Top Width	9.52	ft
Critical Depth	0.13	ft
Critical Slope	1.183218	ft/ft
Velocity	0.53	ft/s
Velocity Head	0.00	ft
Specific Energ	0.42	ft
Froude Numb	0.16	
Flow Type	Subcritical	

Northern Channel from Node 215 to 225 for BMP flows
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Northern Channe
Flow Element	Trapezoidal Char
Method	Manning's Formu
Solve For	Discharge

Input Data		
Mannings Coeffic	0.200	
Channel Slope	.020000	ft/ft
Depth	0.42	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	11.00	ft

Results		
Discharge	2.82	cfs
Flow Area	5.1	ft²
Wetted Perim	13.66	ft
Top Width	13.52	ft
Critical Depth	0.13	ft
Critical Slope	1.178344	ft/ft
Velocity	0.55	ft/s
Velocity Head	0.00	ft
Specific Enerç	0.42	ft
Froude Numb	0.16	
Flow Type	Subcritical	

Northern Channel from Node 215 to 220 for Q100 flows
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Northern Channel-
Flow Element	Trapezoidal Chann
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coeffic	0.030	
Channel Slope	.020000	ft/ft
Depth	0.50	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	11.00	ft

Results		
Discharge	25.38	cfs
Flow Area	6.2	ft²
Wetted Perim	14.16	ft
Top Width	14.00	ft
Critical Depth	0.52	ft
Critical Slope	0.017209	ft/ft
Velocity	4.06	ft/s
Velocity Head	0.26	ft
Specific Energ	0.76	ft
Froude Numb	1.07	
Flow Type	Supercritical	

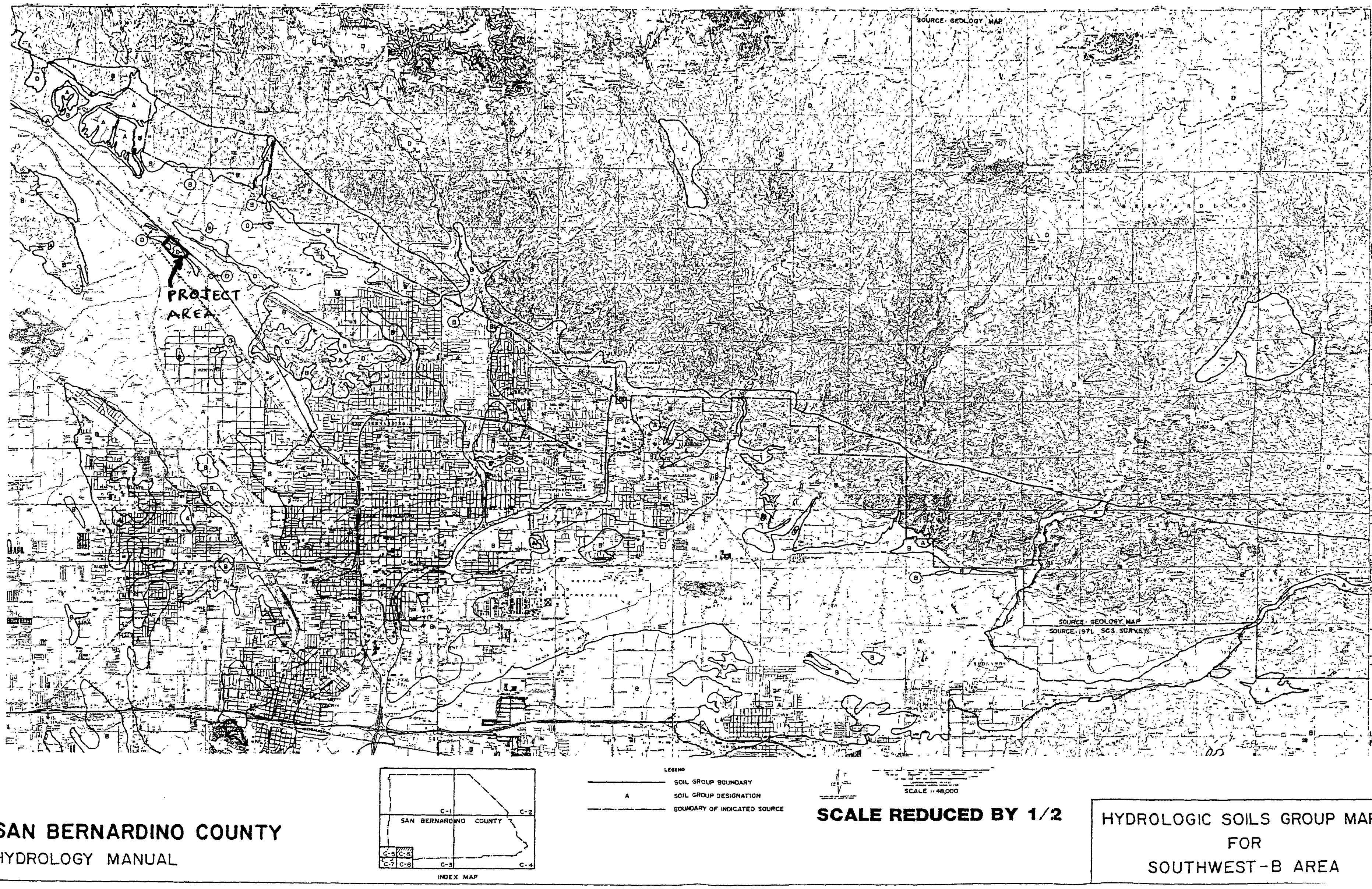
Northern Channel from Node 220 to 225 for Q100 flows
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Northern Channel-
Flow Element	Trapezoidal Chann
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coeffic	0.030	
Channel Slope	.020000	ft/ft
Depth	0.75	ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	11.00	ft

Results		
Discharge	51.22	cfs
Flow Area	9.9	ft^2
Wetted Perim	15.74	ft
Top Width	15.50	ft
Critical Depth	0.81	ft
Critical Slope	0.015203	ft/ft
Velocity	5.15	ft/s
Velocity Head	0.41	ft
Specific Energ	1.16	ft
Froude Numb	1.13	
Flow Type	Supercritical	

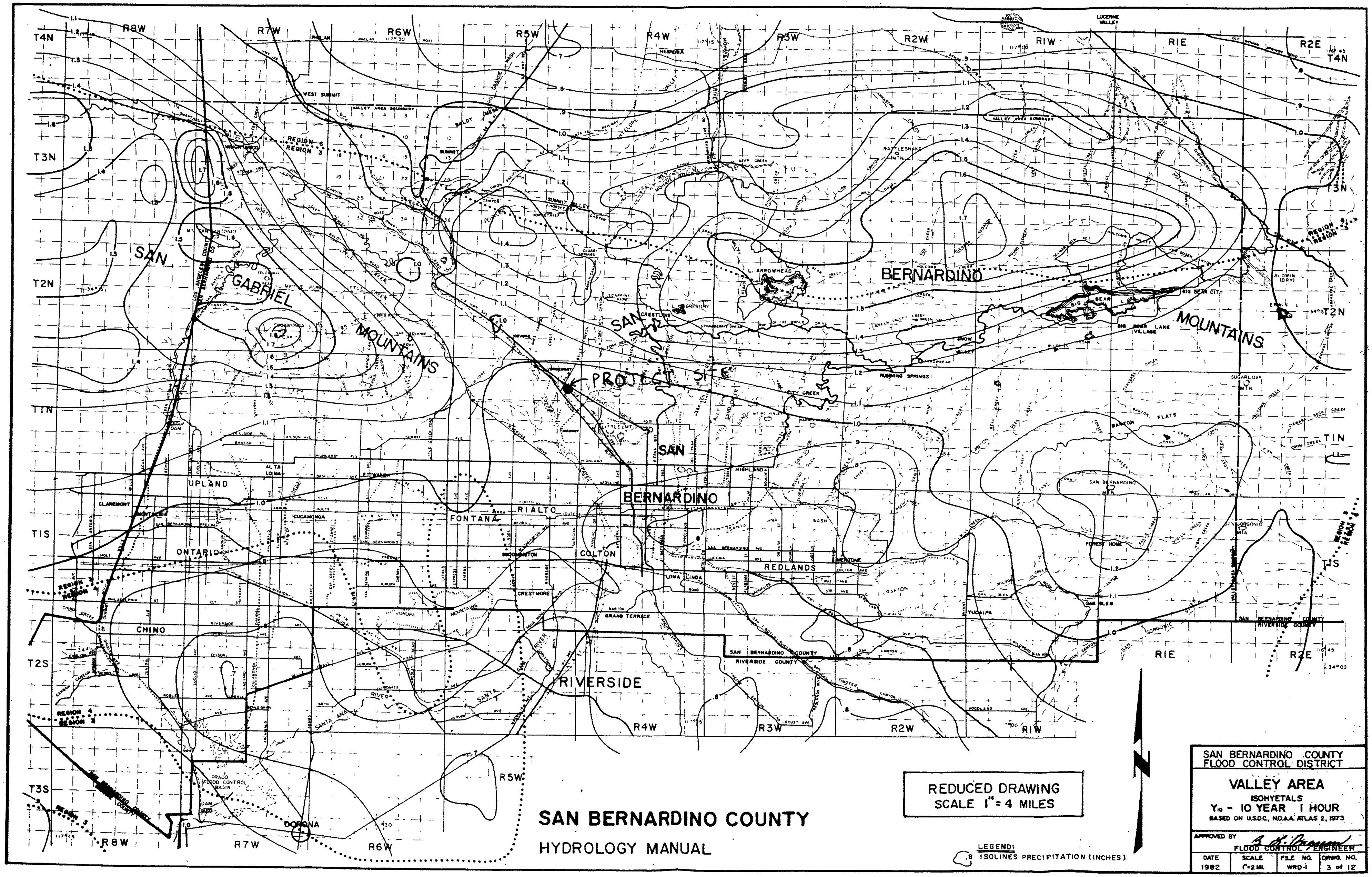
San Bernardino County Flood Control District Plates



SCALE REDUCED BY 1/2

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-B AREA


SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y10 - 10 YEAR 1 HOUR
BASED ON U.S.D.C., NOAA ATLAS 2, 1973
APPROVED BY
FLOOD CONTROL ENGINEER
DATE 1982
SCALE 1"=2 MI.
FILE NO. WRD-1
DRWG. NO. 3 of 12
REDUCED DRAWING
SCALE 1" = 4 MILES
SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
LEGEND:
.8 ISOLINES PRECIPITATION (INCHES)
PROJECT SITE
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
SAN BERNARDINO
UPLAND
ONTARIO
CHINO
FONTANA
RIALTO
COLTON
REDLANDS
LOMA LINDA
RIVERSIDE
CORONA
CLAREMONT
CUCAMONGA
ALTA LOMA
YUCAIPA
CRESTMORE
GRAND TERRACE
L. ARROWHEAD
BIG BEAR LAKE
RUNNING SPRINGS
FOREST HOME
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R8W
R7W
R6W
R5W
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R3W
R2W
R1W
R1E
R2E

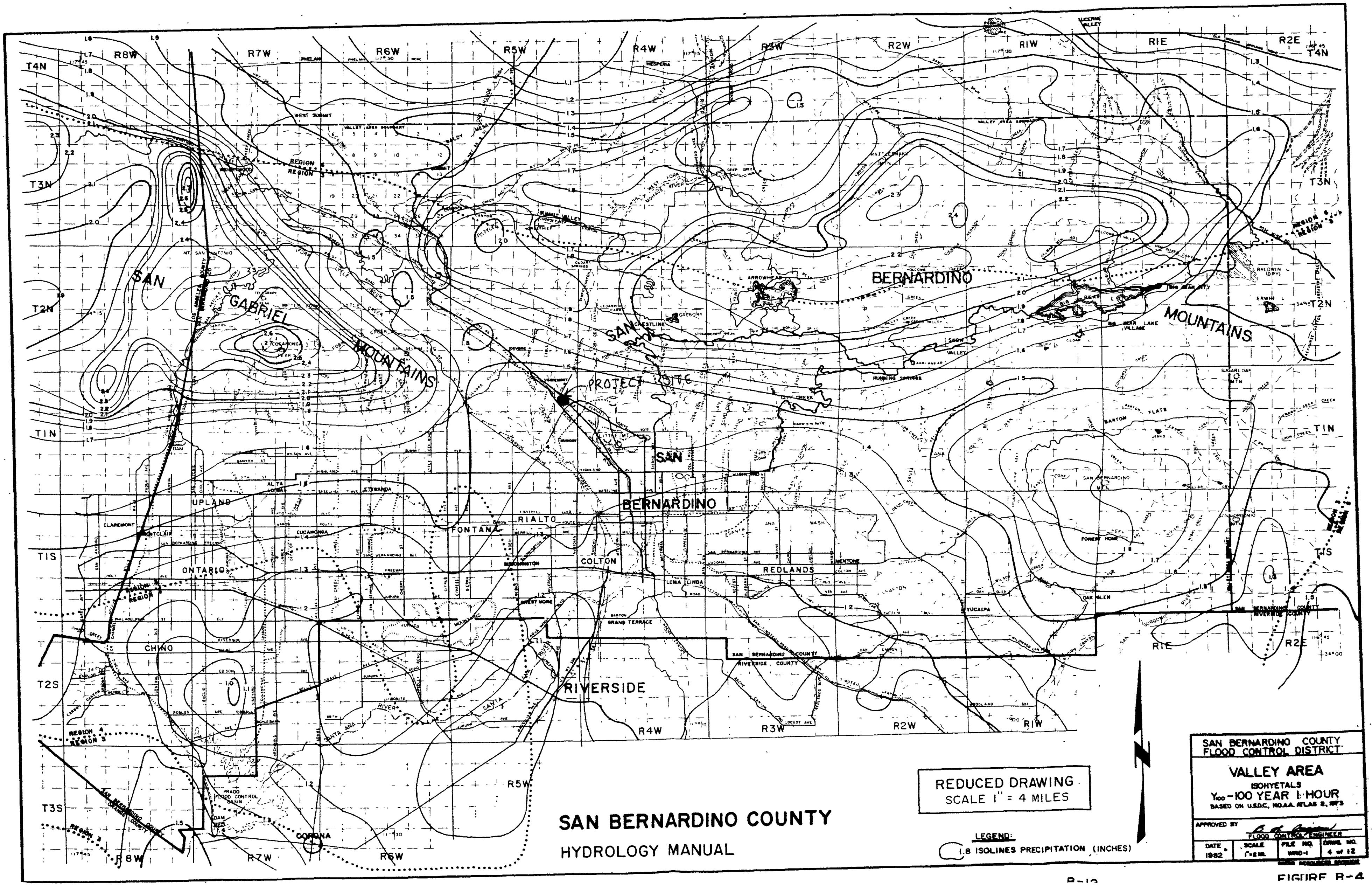
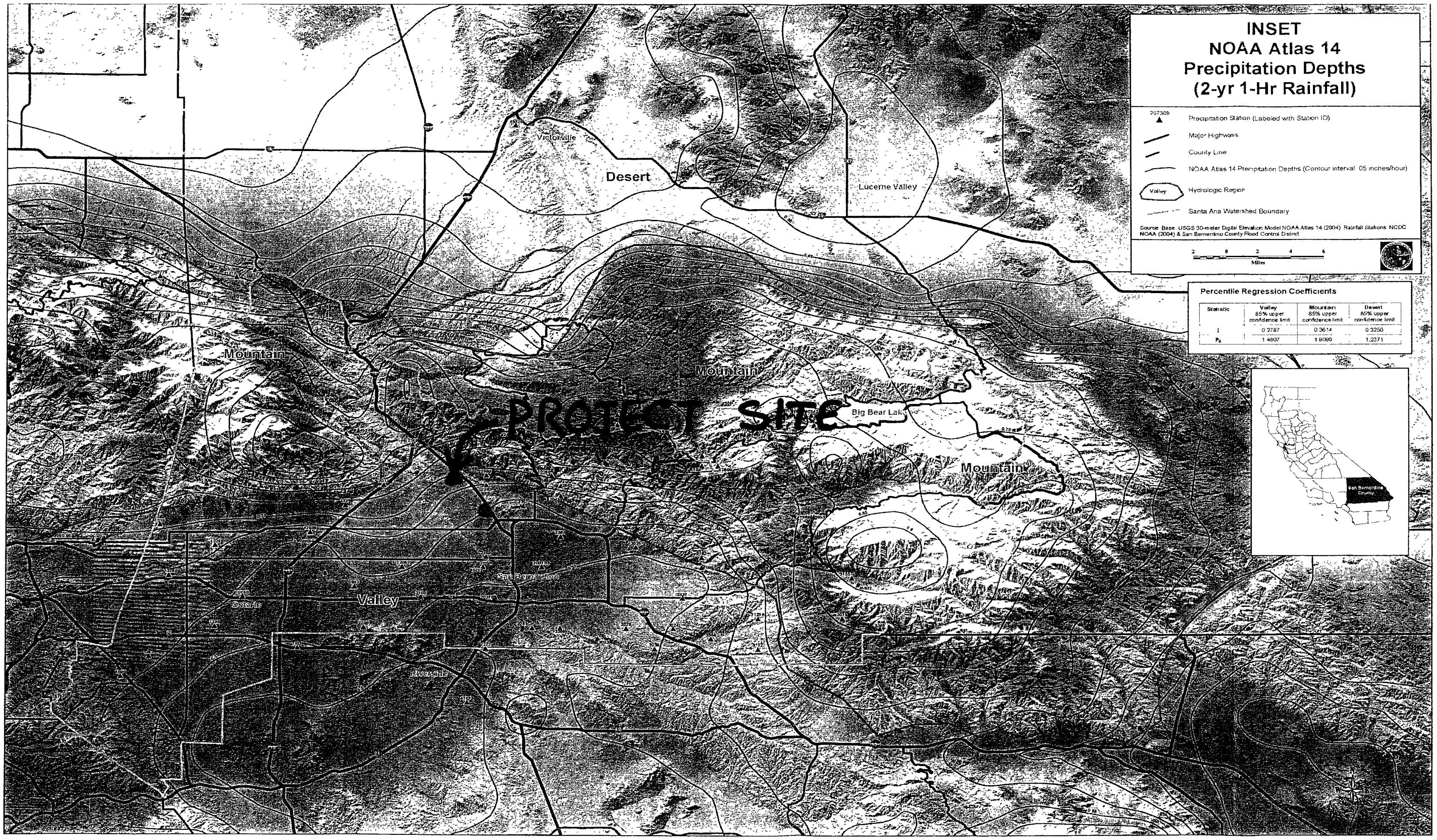

SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
REDUCED DRAWING
SCALE 1" = 4 MILES
LEGEND:
1.8 ISOLINES PRECIPITATION (INCHES)
SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y100-100 YEAR 1-HOUR
BASED ON U.S.D.C. NOAA ATLAS 2, 1973
APPROVED BY
FLOOD CONTROL ENGINEER
DATE 1982
SCALE 1"=2 MI.
FILE NO. WRD-1
DRWG. NO. 4 of 12
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
PROTECT SITE
SAN BERNARDINO
UPLAND
ONTARIO
FONTANA
RIALTO
COLTON
REDLANDS
LOMA LINDA
YUCAIPA
CHINO
RIVERSIDE
CORONA
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
T4N
T3N
T2N
T1N
T1S
T2S
T3S

FIGURE B-4

Figure D-1 NOAA Atlas 14 Inset Map



Percentile Regression Coefficients

Statistic	Valley 85% upper confidence limit	Mountain 85% upper confidence limit	Desert 85% upper confidence limit
I	0 2787	0 3614	0 3250
P_6	1 4807	1 9090	1.2371

Water Quality Management Plan

WATER QUALITY MANAGEMENT PLAN (WQMP)

For compliance with Santa Ana Regional Water Quality Control Board

Order Number R8-2002-0012 (NPDES Permit No. CAS618036)

for

HURD TRUST DISTRIBUTION CENTER

CITY OF SAN BERNARDINO DRC/ERC CASE:
PRE-APPLICATION REVIEW NO. 05-23
APN 266-041-62

Prepared for:
IDS Real Estate Group
515 South Figueroa Street, Suite 1600
Los Angeles, CA 90071
213-595-1871

WQMP Preparation Date
July 21, 2006
Revised: November 2, 2007

WATER QUALITY MANAGEMENT PLAN (WQMP)

PROJECT SITE INFORMATION

Name of Project: HURD Trust Distribution Center

Project Location: West of Interstate Highway 215, south of Palm Avenue, north of Industrial Parkway

Size of Significant Re-Development on an Already Developed Site (in feet^2): ____

Size of New Development (in feet^2): 1,748,767

Number of Home Subdivisions: 0

SIC Codes: 1542:General Contractors-Nonresidential Buildings, Other than Industrial Buildings and Warehouses

Erosive Site Conditions?: NO

Natural Slope More Than 25%?: NO

WATER QUALITY MANAGEMENT PLAN (WQMP)

Check the appropriate project category below:

Check below	**Project Categories**
	1. All significant re-development projects. Significant re-development is defined as the addition or creation of 5,000 or more square feet of impervious surface on an already developed site. This includes, but is not limited to, additional buildings and/or structures, extension of existing footprint of a building, construction of parking lots, etc. Where redevelopment results in an increase of less than fifty percent of the impervious surfaces of a previously existing development, and the existing development was not subject to SUSMPs, the design standards apply only to the addition, and not the entire development. When the redevelopment results in an increase of more than fifty percent of the impervious surfaces, then a WQMP is required for the entire development (new and existing).
	2. Home subdivisions of 10 units or more. This includes single family residences, multi-family residence, condominiums, apartments, etc.
X	3. Industrial/commercial developments of 100,000 square feet or more. Commercial developments include non-residential developments such as hospitals, educational institutions, recreational facilities, mini-malls, hotels, office buildings, warehouses, and light industrial facilities.
	4. Automotive repair shops (with SIC codes 5013, 5014, 5541, 7532- 7534, 7536-7539).
	5. Restaurants where the land area of development is 5,000 square feet or more.
	6. Hillside developments of 10,000 square feet or more which are located on areas with known erosive soil conditions or where the natural slope is twenty-five percent or more.
	7. Developments of 2,500 square feet of impervious surface or more adjacent to (within 200 feet) or discharging directly into environmentally sensitive areas such as areas designated in the Ocean Plan as areas of special biological significance or waterbodies listed on the CWA Section 303(d) list of impaired waters.
X	8. Parking lots of 5,000 square feet or more exposed to storm water. Parking lot is defined as land area or facility for the temporary storage of motor vehicles.
	The project does not fall into any of the categories described above. (If the project requires a precise plan of development [e.g. all commercial or industrial projects, residential projects of less than 10 dwelling units, and all other land development projects with potential for significant adverse water quality impacts] or subdivision of land, it is defined as a Non-Category Project.)

Section 1
Introduction and Project Description

1.1 Project Information

- IDS Real Estate Group
  515 South Figueroa Street, Suite 1600, Los Angeles, CA 90071
  213-595-1871

  West of Interstate Highway 215, south of Palm Avenue and north of Industrial Parkway, City of San Bernardino, CA

1.2 Permits

- List all tract or permit number(s), condition number(s), and any acquired waste discharge identification numbers (WDIDs) pertaining to project.

1.3 Project Description

The proposed project is a commercial distribution center located on 45 acres of land. The site will consist of a cross dock facility of approximately 1,748,767 square feet in the City of San Bernardino. The distribution center will include a concrete tilt-up building of 682,408 square feet and will contain four offices. Materials storage and delivery areas will be located within the building. Common areas will include trailer parking, loading docks, covered trash enclosures, and landscaped areas.

- There will be no formation of a Homeowners Association or property association for this project.

- Include location map and site plan identifying storm drain facilities and structures, structural BMPs, stormwater flow (drainage), and the receiving water. The location and site plan may be shown on the same map.

1.4 Site Description

- The proposed project site is undeveloped vacant land in its present state and is located in the Santa Ana Watershed.

- There have been no pre-existing water quality problems identified for this site.

Section 2
Pollutants of concern and hydrologic conditions of concern

2.1 Pollutants of Concern (NOT REQUIRED FOR NON-CATEGORY PROJECTS)

Use Table 2-1 in the WQMP Guidance to identify the potential pollutants expected to be generated by the development. List all expected pollutants of concern for the project site as directed below:

- The expected and potential pollutants for this site are shown below in the "Pollutant of Concern Summary Table".
- There are no additional pollutants of concern identified for the project site at this time.
- Identify pollutants of concern in the receiving waters as follows:
  1. Proximate receiving waters:
     Cable Creek Channel (Hydrologic Unit No. 801.72).

     Downstream receiving waters are:
     Devil Canyon Creek (Hydrologic Unit No. 801.57)
     Cajon Creek (Hydrologic Unit No. 801.52)
     Lytle Creek (Hydrologic Unit No. 801.41)
     Santa Ana River Reach 4 (Hydrologic Unit No. 801.27)
  2. Lytle Creek and Santa Ana River Reach 4 are identified on the most recent list of impaired water bodies, both of which are impaired by Bacteria/Pathogens.
  3. The pollutants of concern for this project are Bacteria/Pathogens.

Pollutant of Concern Summary Table

Pollutant Type	Expected	Potential	Listed for Receiving Water
Bacteria/Virus		X	Yes
Heavy Metals		X	No
Nutrients		X	No
Pesticides		X	No
Organic Compounds		X	No
Sediments		X	No
Trash & Debris	X		
Oxygen Demanding Substances		X	No
Oil & Grease	X		
Other—specify pollutant(s):			

2.2 HYDROLOGIC CONDITIONS OF CONCERN (NOT REQUIRED FOR NON-CATEGORY PROJECTS)

All Category projects must identify any hydrologic condition of concern (HCOC) that will be caused by the project, and implement Site Design, Source Control, and/or Treatment Control BMPs to address identified impacts. Project proponents must follow the procedure for identifying HCOCs specified in Section 2.3 of the Model WQMP. Use the following Table and instructions as a guide.

1. (from Section 2.3, Part 2): Determine if the project will create a Hydrologic Condition of Concern. Check "yes" or "no" as applicable and proceed to the appropriate section as outlined below.	**Yes**	**No**
A. All downstream conveyance channels, that will receive runoff from the project, are engineered, hardened (concrete, riprap or other), and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected. Engineered, hardened, and maintained channels include channel reaches that have been fully and properly approved (including CEQA review, and permitting by USACOE, RWQCB and California Dept. of Fish & Game) by June 1, 2004 for construction and hardening to achieve design capacity, whether construction of the channels is complete. Discharge from the project will be in full compliance with Agency requirements for connections and discharges to the MS4, including both quality and quantity requirements, and the project will be permitted by the Agency for the connection or discharge to the MS4.	X	
B. Project runoff rates, volumes, velocities, and flow duration for the post-development condition will not exceed those of the pre-development condition for 1-year, 2-year and 5-year frequency storm events. This condition will be substantiated with hydrologic modeling methods that are acceptable to the Agency, to the U.S. Army Corps of Engineers (USACOE), and to local watershed authorities. See method described below in Parts B1- B3.		X
C. Can the conditions in part A or B above be demonstrated for the project?	X	
▪ If the answer for A, B, and/or C above is yes, then the project does not create a HCOC—in this case go to Section 3 (page A-12). ▪ If the answer for C above is no, the go to section 2.3. Part 3, below.		

B1. To determine the projects' drainage characteristics, County of San Bernardino HCOC policy requires the project engineer to use the following guidelines:

a. The Design Storms to be considered include, as a minimum, the 5-year, 2 year, and 1-year return frequency storms, using the methods contained in the San Bernardino County Hydrology Manual (1986).

Project sites from 0-10 acres in size should use the Small Area Runoff Hydrograph method, found in Section J of the San Bernardino County Hydrology Manual (1986); sites greater than 10 acres should use the Unit Hydrograph Method, found in Section E of the San Bernardino County Hydrology Manual (1986). For each return frequency considered, and for both pre- and post-development conditions, determine the total runoff volume, the peak flow rate, and the time of duration, of runoff hydrograph flow rates that exceed the following flow rates: 90% of peak flow rate, 80% of peak flow rate, 70% of peak flow rate, 60% of peak flow rate, 50% of peak flow rate, 40% of peak flow rate, 30% of peak flow rate, 20% of peak flow rate, and 10% of peak flow rate (see Table B2-2, "Pre- and Post-development Hydrology Comparison Worksheet.")

b. Sediment supply is to be estimated for pre-and post-development conditions for the land altered by the subject project using Table 2-3, "Pre- and Post-development Hydrology Comparison Worksheet" or equivalent. The Universal Soil Loss Equation published by the USDA-Natural Resources Conservation Service may be considered as an estimate of changes in sediment yield due to development, if applicable. Flow velocities are to be estimated for the several return frequency design storms noted above, as a minimum, with flow velocities estimated for each percentage of the peak flow rate value listed above. Normal depth hydraulic estimates may be used unless significant backwater effects exist such that deposition of sediment is anticipated, in which case a standard backwater analysis is to be conducted.

c. Based upon the preceding task results, the project engineer shall evaluate the Project and its impact downstream and recommend other design storm return frequencies to be considered in order to satisfy the goals and intent of the HCOC document.

Table B2-2: Pre- and Post-development Hydrology Comparison Worksheet

Return Period	Total Volume		Peak Flow		Flow Time Duration			Sediment Transport	
	Pre	Post	Pre	Post	% of Peak	Pre	Post	Pre	Post
1-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				
2-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				
5-year					90				
					80				
					70				
					60				
					50				
					40				
					30				
					20				
					10				

2. (from Section 2.3, Part 3): The WQMP for projects that create a HCOC must include an evaluation of whether the project will adversely impact downstream erosion, sedimentation or stream habitat. The Agency may require that the evaluation be conducted by a registered civil engineer in the State of California, with experience in fluvial geomorphology. Perform the required evaluation as specified in A – F below. Check the boxes "yes" or "no" to verify a complete report and proceed to appropriate section based on results.

Does the evaluation include:	Yes	No
A. An evaluation of potential impacts to all downstream channel reaches.		
B. Consideration of the hydrology of the entire watershed. Review all applicable drainage area master plans to the extent available, to identify BMP requirements for new development that address cumulative inputs from development in the watershed.		
C. Consultation with all applicable agencies including the USACOE; local watershed authorities (e.g. San Timoteo Watershed Management Authority and SAWPA [Santa Ana Watershed Project Authority]); U.S. Geological Survey (USGS); California Dept. of Fish & Game (CDFG); and the San Bernardino County Flood Control District; to determine any areas of potential hydrologic impact.		
D. An evaluation of any available hydrologic modeling results. Modeling may have been performed by USGS, USACOE, local watershed authorities, the San Bernardino County Flood Control District, or other local jurisdiction.		
E. A field reconnaissance to evaluate any natural or partially natural downstream reaches, or other sensitive habitat. The field reconnaissance must evaluate representative downstream conditions, including undercutting erosion, slope/bank stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies), and the area's susceptibility to adverse impacts resulting from an altered flow regime or change in sediment supply and/or sediment transport .		
F. A report that summarizes the findings of evaluation components A through E above, and that considers the project's location, topography, soil and vegetation conditions, proportion of impervious surfaces, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project's watershed. The report must provide a determination of whether the project will adversely impact any downstream erosion, sedimentation or stream habitat, and identify any areas where adverse impacts are expected.		

- Is the report required by 2.3, Part 3.f complete? (Attach the report) If not, perform the required evaluation and add to the report.
- Does the report determine that the project will have an adverse downstream impact?
- If yes, then go to Section 2.3, Part 4, below.
- If no, then go to Section 3.

3. (from Section 2.3, Part 4): If the evaluation specified in (3) above, determines that adverse impacts to downstream erosion, sedimentation or stream habitat will occur, then the project proponent must perform the requirements specified in A, B, and C, below. Check the boxes "yes" or "no" to verify all requirements have been completed.	YES	NO
A. Conduct hydrologic modeling of the project and the potentially impacted areas, according to modeling standards recommended by the Agency or local watershed authority, for the 1-year, 2-year, and 5-year frequency storm events, at a minimum. Hydrologic modeling results must include determination of peak flow rate, flow velocity, runoff volume, time of concentration, and retention volume for the project area.		
B. Ensure that the project will be consistent with any approved master plans of drainage or analogous plans or programs.		
C. Implement Site Design BMPs as specified in Section 2.5.1, and recommend any additional BMPs that will be implemented to mitigate the adverse impacts identified in (3.F) above.		

- Are the requirements for Section 2.3 Part 4 adequate? (Attach report/results)
- Has the project proponent recommended BMPs to mitigate any impacts based on the modeling?
- If yes, then list/describe BMPs:
- If no, then explain how mitigation will be achieved:
- Will the BMPs be effective?
- Does the Agency have any additional requirements?
- Verify with Agency before submitting the project WQMP.

2.3 WATERSHED IMPACT OF PROJECT

The project proponent must include in the project WQMP:

- An evaluation of the pollutants of concern and/or hydrologic conditions of concern associated with the project, and a determination of whether the project will cause any significant impact(s) to any downstream receiving waters, alone or in conjunction with other projects in the watershed.
- A description of how any adverse impacts will effectively be mitigated through the incorporation and implementation of BMPs.

SECTION 3
BEST MANAGEMENT PRACTICE SELECTION PROCESS

3.1 SITE DESIGN BMPS

For listed Site Design BMPs, indicate in the following table whether it will be used (yes/no) and describe how used, or, if not used, provide justification/alternative. Provide detailed descriptions of planned Site Design BMPs, if applicable.

1. Minimize Stormwater Runoff, Minimize Project's Impervious Footprint, and Conserve Natural Areas		
Maximize the permeable area. This can be achieved in various ways, including but not limited to, increasing building density (number of stories above or below ground) and developing land use regulations seeking to limit impervious surfaces.		
Yes X	No	
Describe actions taken or justification/alternative: Landscape buffers will be used between Industrial Parkway and parking lots.		
Runoff from developed areas may be reduced by using alternative materials or surfaces with a lower Coefficient of Runoff, or "C-Factor".		
Yes	No X	
Describe actions taken or justification/alternative: Alternative materials cannot be used in heavy traffic areas.		
Conserve natural areas. This can be achieved by concentrating or clustering development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition.		
Yes	No X	
Describe actions taken or justification/alternative: There are no significant usable natural areas to conserve.		

Construct walkways, trails, patios, overflow parking lots, alleys, driveways, low-traffic streets, and other low-traffic areas with open-jointed paving materials or permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials.
Yes X | No
Describe actions taken or justification/alternative: Overflow parking lots on northeast corner will be built of unit pavers.

Construct streets, sidewalks, and parking lot aisles to the minimum widths necessary, provided that public safety and a pedestrian friendly environment are not compromised[1]. Incorporate landscaped buffer areas between sidewalks and streets.
Yes X | No
Describe actions taken or justification/alternative: Parking lot aisles are of minimum width. Landscaped areas are provided between parking lots and Industrial Parkway.

Reduce widths of street where off-street parking is available[2].
Yes | No X
Describe actions taken or justification/alternative: The project does not create any streets. Therefore, off-street parking will not be implemented for this project.

Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.
Yes X | No
Describe actions taken or justification/alternative: There are no existing native trees or shrubs to conserve. Landscape plans will incorporate native and drought tolerant plants, trees, and shrubs.

[1] Sidewalk widths must still comply with Americans with Disabilities Act regulations and other life safety requirements.

[2] However, street widths must still comply with life safety requirements for fire and emergency vehicle access.

Other comparable site design options that are equally effective.		
Describe actions taken _or justification/alternative:		
Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.		
Yes X	No	
Describe actions taken _or justification/alternative: No decorative concrete is being used in the landscape design.		
Use natural drainage systems.		
Yes	No X	
Describe actions taken or justification/alternative: There is no natural drainage system within the project site that could be utilized for storm flow conveyance		
Where soils conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration[3].		
Yes	No	
Describe actions taken or justification/alternative:		
Construct onsite ponding areas, rain gardens, or retention facilities to increase opportunities for infiltration, while being cognizant of the need to prevent the development of vector breeding areas.		
Yes	No	
Describe actions taken or justification/alternative:		

[3]However, projects must still comply with hillside grading ordinances that limit or restrict infiltration of runoff. Infiltration areas may be subject to regulation as Class V injection wells and may require a report to the USEPA. Consult the Agency for more information on use of this type of facility.

2. Minimize Directly Connected Impervious Areas

Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm drain.

Yes X	No	

Describe actions taken or justification/alternative:

Rooftops will discharge to landscaped areas through the parking lots, not to storm drain system.

Where landscaping is proposed, drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.

Yes X	No	

Describe actions taken or justification/alternative:

Landscaping around the perimeter of the site will receive discharge from the entire site.

Increase the use of vegetated drainage swales in lieu of underground piping or imperviously lined swales.

Yes X	No	

Describe actions taken or justification/alternative:

Vegetated swales are being proposed for treatment of this site.

Use one or more of the following:

Yes	**No**	**Design Feature**
	X	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings
	X	Urban curb/swale system; street slopes to curb; periodic swale inlets drain to vegetated swale/biofilter.
	X	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to municipal storm drain systems.
	X	Other comparable design concepts that are equally effective.

Describe actions taken or justification/alternative:

The development does not propose any streets. Vegetated swales are proposed along the perimeter of the site.

Use one or more of the following features for design of driveways and private residential parking areas:		
Yes	No	Design Feature
	X	▪ Design driveways with shared access, flared (single lane at street) or wheel strips (paving only under tires); or, drain into landscaping prior to discharging to the municipal storm drain system.
	X	▪ Uncovered temporary or guest parking on private residential lots may be paved with a permeable surface; or designed to drain into landscaping prior to discharging to the municipal storm drain system.
		▪ Other comparable design concepts that are equally effective.
Describe actions taken or justification/alternative: The proposed development is a commercial project and does not propose the use of the above design features.		

Use one or more of the following design concepts for the design of parking areas:		
Yes	**No**	Design Feature
X		Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.
X		Overflow parking (parking stalls provided in excess of the Agency's minimum parking requirements) may be constructed with permeable paving.
	X	Other comparable design concepts that are equally effective.
Describe actions taken or justification/alternative: The development has landscaping areas around the perimeter of the site. The overflow parking located on the east side will be constructed of permeable paving.		

3.2 SOURCE CONTROL BMPS

Complete the following selection table for Source Control BMPs, by checking boxes that are applicable. All listed BMPs shall be implemented for the project. Where a required Source Control BMP is not applicable to the project due to project characteristics, justification and/or alternative practices for preventing pollutants must be provided. In addition to completing the following tables, provide detailed descriptions on the implementation of planned Source Control BMPs.

Source Control BMP Selection Matrix*

Project Category	Source Control BMPs																								
	Education of Property Owners	*Activity Restrictions*	*Spill Contingency Plan*	*Employee Training/Education Program*	*Street Sweeping Private Street and Parking Lots*	*Common Areas Catch Basin Inspection*	*Landscape Planning (SD-10)*	*Hillside Landscaping*	*Roof Runoff Controls (SD-11)*	*Efficient Irrigation (SD-12)*	*Protect Slopes and Channels*	*Storm Drain Signage (SD-13)*	*Inlet Trash Racks*	*Energy Dissipaters*	*Trash Storage Areas (SD-32) and Litter Control*	*Fueling Areas (SD-30)*	*Air/Water Supply Area Drainage*	*Maintenance Bays and Docks (SD-31)*	*Vehicle Washing Areas (SD-33)*	*Outdoor Material Storage Areas (SD-34)*	*Outdoor Work Areas (SD-35)*	*Outdoor Processing Areas (SD-36)*	*Wash Water Controls for Food Preparation Areas*	*Pervious Pavement (SD-20)*	*Alternative Building Materials (SD-21)*
Significant Re-development																									
Home subdivisions of 10 or more units																									
Commercial/ Industrial Development >100,000 ft^2	X	X		X	X		X			X		X			X									X	
Automotive Repair Shop																									
Restaurants																									
Hillside Development >10,000 ft^2																									
Development of impervious surface >2,500 ft^2																									
Parking Lots >5,000 ft^2 of exposed storm water																									

* Provide justification of each Source Control BMP that will not be incorporated in the project WQMP, or explanation of proposed equally effective alternatives in the following table.

3.3 TREATMENT CONTROL BMPS (Not required for Non-Category projects)

- Complete the following Treatment Control BMPs Selection Matrix. For each pollutant of concern enter "yes" if identified in Section 2.1, above, or "no" if not identified for the project. Check the boxes of selected BMPs that will be implemented for the project to address each pollutant of concern from the project as listed above in section 2.1. Treatment Control BMPs must be selected and installed with respect to identified pollutant characteristics and concentrations that will be discharged from the site. For any identified pollutants of concern not listed in the Treatment Control BMP Selection Matrix, provide an explanation of how they will be addressed by Treatment Control BMPs. For identified pollutants of concern that are causing an impairment in receiving waters (as identified in Section 2.1, above), the project WQMP shall incorporate one or more Treatment Control BMPs of medium or high effectiveness in reducing those pollutants. It is the responsibility of the project proponent to demonstrate, and document in the project WQMP, that all pollutants of concern will be fully addressed. The Agency may require information beyond the minimum requirements of this WQMP to demonstrate that adequate pollutant treatment is being accomplished.

- In addition to completing the Selection Matrix, provide detailed descriptions on the location, implementation, installation, and long-term O&M of planned Treatment Control BMPs.

  - Flows generated from the northern side of the project site will be treated through a continuous vegetated swale and will outlet through a storm drain pipe to Cable Creek Channel. The southern project flows will be treated through vegetated swales along Industrial Parkway and will outlet to existing Industrial Parkway at several locations.

  - IDS Real Estate Group will provide ongoing funding and maintenance of the vegetated swales. The swales will be inspected for trash and debris on a weekly basis and will be trimmed to maintain a height of four to six inches as needed.

Treatment Control BMP Selection Matrix

Pollutant of Concern		Treatment Control BMP Categories							
		Biofilters	**Detention Basins(2)**	**Infiltration Basins(3)**	**Wet Ponds or Wetlands**	**Filtration**	**Water Quality Inlets**	**Hydrodynamic Separator Systems (4)**	**Manufactured/ Proprietary Devices**
Sediment/Turbidity		H/M	M	H/M	H/M	H/M	L	H/M (L for turbidity)	U
Yes/No?	No								
Nutrients		L	M	H/M	H/M	L/M	L	L	U
Yes/No?	No								
Organic Compounds		U	U	U	U	H/M	L	L	U
Yes/No?	No								
Trash & Debris		L	M	U	U	H/M	M	H/M	U
Yes/No?	No								
Oxygen Demanding Substances		L	M	H/M	H/M	H/M	L	L	U
Yes/No?	No								
Bacteria & Viruses		U	U	H/M	U	H/M	L	L	U
Yes/No?	Yes	X							
Oils & Grease		H/M	M	U	U	H/M	M	L/M	U
Yes/No?	No								
Pesticides (non-soil bound)		U	U	U	U	U	L	L	U
Yes/No?	No								
Metals		H/M	M	H	H	H	L	L	U
Yes/No?	No								

3.4 BMP DESIGN CRITERIA

- The following Treatment Control BMP(s) (Flow Based or Volume Based) will be implemented for this project (***check "Implemented" box, if used***):

Design Basis of Treatment Control BMPs

Implemented	Treatment Control BMP	Design Basis
	Vegetated Buffer Strips	Flow Based
X	Vegetated Swale	
	Multiple Systems	
	Manufactured/Proprietary	
	Bioretention	Volume Based
	Wet Pond	
	Constructed Wetland	
	Extended Detention Basin	
	Water Quality Inlet	
	Retention/Irrigation	
	Infiltration Basin	
	Infiltration Trench	
	Media Filter	
	Manufactured/Proprietary	

3.4.1 Flow Based Design Criteria

- Calculate the BMP design flow by using the method described in Attachment D, Section A. Show calculations in detail—attach a separate sheet of calculations.

3.4.2 Volume-Based Design Criteria

- Calculate the required capture volume of the BMP using the method described in Attachment D, Section B. Show calculations in detail—attach a separate sheet of calculations.

Section 4
Operation and Maintenance

4.1 Operations and Maintenance

Operation and maintenance (O&M) requirements for all Source Control, Site Design, and Treatment Control BMPs shall be identified within the WQMP. The WQMP shall include the following:

4.1.1 O&M DESCRIPTION AND SCHEDULE:

IDS Real Estate Group will be responsible for the operation and maintenance of the vegetated swales on site. This will be provided by contracting a landscape maintenance company. They will monitor the site on a weekly basis and as needed and will remove wastes to an approved disposal site as buildup requires. A height of four to six inches will be maintained by trimming grass as needed. This maintenance process will begin prior to occupancy.

4.1.2 INSPECTION & MONITORING REQUIREMENTS:

- Water Quality Monitoring is not required.
- IDS Real Estate Group will require the Landscape Maintenance Company to report their activities regarding the vegetated swale maintenance on a quarterly basis to IDS. Maintenance records will be made available to the City's Inspector upon request and will kept for a period of five (5) years.

4.1.3 IDENTIFICATION OF RESPONSIBLE PARTIES FOR BMP O&M:

- The responsible party for the O&M of the vegetated swales will be:

IDS Real Estate Group
515 South Figueroa Street, Suite 1600
Los Angeles, CA 90071
Contact: Mr. Dan Sibson
213-595-1871

SECTION 5
FUNDING

5.1 Funding

- The party responsible for funding will be:

IDS Real Estate Group
515 South Figueroa Street, Suite 1600
Los Angeles, CA 90071
Contact: Mr. Dan Sibson
213-595-1871

SECTION 6
WQMP Certification

6.1 Certification

- The applicant is required to sign and certify that the WQMP is in conformance with Santa Ana Regional Water Quality Control Board Order Number R8-2002-0012 (NPDES Permit No. CAS618036).
- The applicant is required to sign and date the following statement 'word-for-word' certifying that the provisions of the WQMP have been accepted by the applicant and that the applicant will have the plan transferred to future successors (transferability statement). The certification must be signed by the property owner, unless a written designation by the owner allows a designee to sign on the owner's behalf.

"This Water Quality Management Plan has been prepared for Investment Development Services by Stantec-Inland Empire Division. It is intended to comply with the requirements of the City of San Bernardino for Tract/Parcel Map No. ______, Condition Number(s) ____________ requiring the preparation of a Water Quality Management Plan (WQMP). The undersigned is aware that Best Management Practices (BMPs) are enforceable pursuant to the City's Water Quality Ordinance No. 8.80. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Stormwater Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity. "

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

______________________________	______________________________
Applicant's Signature	Date
______________________________	______________________________
Applicant's Name	Applicant's Telephone Number

Attachment A-1

Maintenance Mechanisms

A-1.1 The Agency shall not accept stormwater structural BMPs as meeting the WQMP requirements standard, unless an O&M Plan is prepared (see WQMP Section 2.6) and a mechanism is in place that will ensure ongoing long-term maintenance of all structural and non-structural BMPs. This mechanism can be provided by the Agency or by the project proponent. As part of project review, if a project proponent is required to include interim or permanent structural and non-structural BMPs in project plans, and if the Agency does not provide a mechanism for BMP maintenance, the Agency shall require that the applicant provide verification of maintenance requirements through such means as may be appropriate, at the discretion of the Agency, including, but not limited to covenants, legal agreements, maintenance agreements, conditional use permits and/or funding arrangements (OC 2003)

A-1.2 Maintenance Mechanisms

1. **Public entity maintenance**: The Agency may approve a public or acceptable quasi-public entity (e.g., the County Flood Control District, or annex to an existing assessment district, an existing utility district, a state or federal resource agency, or a conservation conservancy) to assume responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual Agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the Permittees may seek protection from liability by appropriate releases and indemnities.

   The Agency shall have the authority to approve stormwater BMPs proposed for transfer to any other public entity within its jurisdiction before installation. The Permittee shall be involved in the negotiation of maintenance requirements with any other public entities accepting maintenance responsibilities within their respective jurisdictions; and in negotiations with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. The Agency must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

2. **Project proponent agreement to maintain stormwater BMPs:** The Agency may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the stormwater BMP as necessary into perpetuity. Security or a funding mechanism with a "no sunset" clause may be required.

3. **Assessment districts:** The Agency may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for stormwater BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions above.

4. **Lease provisions:** In those cases where the Agency holds title to the land in question, and the land is being leased to another party for private or public use, the Agency may assure stormwater BMP maintenance, repair and replacement through conditions in the lease.

5. **Conditional use permits:** For discretionary projects only, the Agency may assure maintenance of stormwater BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required.

6. **Alternative mechanisms:** The Agency may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

Attachment A-2

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement (adapted from documents from the Ventura County Stormwater Management Program)

Recorded at the request of:

City of ____

After recording, return to:

City of ____

City Clerk ____

Water Quality Management Plan and Stormwater BMP Transfer, Access and Maintenance Agreement

OWNER: ____

PROPERTY ADDRESS: __________________________________

____

APN: ____

THIS AGREEMENT is made and entered into in

________________________, California, this _______ day of

_________________ , by and between

____, herein after referred to as "Owner" and the CITY OF ______________________________, a municipal corporation, located in the County of San Bernardino, State of California hereinafter referred to as "CITY";

WHEREAS, the Owner owns real property ("Property") in the City of

_________________________, County of San Bernardino, State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B", each of which exhibits is attached hereto and incorporated herein by this reference;

WHEREAS, at the time of initial approval of development project known as

____ within the Property described herein, the City required the project to employ Best Management Practices, hereinafter referred to as "BMPs," to minimize pollutants in urban runoff;

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, on file with the City, hereinafter referred to as "WQMP", to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff;

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the City;

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement, therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement;

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner hereby provides the City of City's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by City's Director of Public Works no advance notice, for the purpose of inspection, sampling, testing of the Device, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 3 below. City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property.

2. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the City, the City is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full.

4. The City may require the owner to post security in form and for a time period satisfactory to the city to guarantee the performance of the obligations state herein. Should the Owner fail to perform the obligations under the Agreement, the City may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement. As an additional remedy, the Director may withdraw any previous stormwater-related approval with respect to the property on which BMPs have been installed and/or implemented until such time as Owner repays to City its reasonable costs incurred in accordance with paragraph 3 above.

5. This agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to pay all costs incurred by the City in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

7. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

8. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

9. Time is of the essence in the performance of this Agreement.

10. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

IF TO CITY: **IF TO OWNER:**

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

APPROVED AS TO FORM:

____
City Attorney

____
CITY OF

____
Name

____
Title

ATTEST:

____
City Clerk Date

OWNER:

____
Name

____
Title

OWNER:

____
Name

____
Title

NOTARIES ON FOLLOWING PAGE

EXHIBIT A
(Legal Description)

Pre-Application Review No. 05-23
Assessor's Parcel No. 266-041-62

EXHIBIT B
(Map/Ilustration)

Printed: 10:34 am 07/25/2006 File: P:\32037.00\GIS\Maps\VicMap-1.mxd | Cartographic Design By: Tracy Barger | Geographic Information Systems

Vicinity Map

Hurd Trust Distribution Center

Stantec 22690 Cactus Ave., Suite#300 Moreno Valley, CA 92553 Phone 951.697.8300 Fax 951.653.5308 www.stantec.com

Attachment B
Tables

Table B-1
303(d) List of Impaired Water Bodies

Waterbody	Pollutant					
	Bacteria Indicators/ Pathogens	Metals	Nutrients	Organic Enrichment	Sedimentation/Siltation	Suspended Solids
Big Bear Lake		X	X		X	
Canyon Lake (Railroad Canyon Reservoir)	X		X			
Chino Creek Reach 1	X		X			
Chino Creek Reach 2	X					
Cucamonga Creek, Valley Reach	X					
Grout Creek		X	X			
Knickerbocker Creek	X	X				
Lytle Creek	X					
Mill Creek (Prado Area)	X		X			X
Mill Creek Reach 1	X					
Mill Creek Reach 2	X					
Mountain Home Creek	X					
Mountain Home Creek, East Fork	X					
Prado Park Lake	X		X			
Rathbone (Rathbun Creek)			X		X	
Santa Ana River, Reach 3	X					
Santa Ana River, Reach 4	X					
Summit Creek			X			

NOTES:

1) Summary of the 2002 303(d) Listed Water Bodies and Associated Pollutants of Concern from RWQCB Region 8. Check for updated lists from the RWQCB.

2) Chlorides, pesticides, salinity, total dissolved solids (TDS), toxicity, and trash are listed impairments within the 303(d) table, however, they are not impairments in the above waterbodies.

Table B-2 ***C Values Based on Impervious/Pervious Area Ratios***		
% Impervious	**% Pervious**	**C**
0	100	0.15
5	95	0.19
10	90	0.23
15	85	0.26
20	80	0.30
25	75	0.34
30	70	0.38
35	65	0.41
40	60	0.45
45	55	0.49
50	50	0.53
55	45	0.56
60	40	0.60
65	35	0.64
70	30	0.68
75	25	0.71
80	20	0.75
85	15	0.79
90	10	0.83
95	5	0.86
100	0	0.90

NOTE:

Obtain individual runoff coefficient C-Factors from the local agency or from the local flood control district.

If C-Factors are not available locally, obtain factors from hydrology text books or estimate using this table.

Composite the individual C-Factors using area-weighted averages to calculate the Composite C Factor for the area draining to a treatment control BMP.

Do not use the C-Factors in this table for flood control design or related work.

Attachment C
Pollutants of Concern

Pollutants of Concern

- *Bacteria and Viruses* – Bacteria and Viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically cause by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses, can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

- *Metals* – The primary source of metal pollution in stormwater is typically commercially available metals and metal products. Metals of concern include cadmium, chromium, copper, lead, mercury, and zinc. Lead and chromium have been used as corrosion inhibitors in primer coatings and cooling tower systems. Metals are also raw material components in non-metal products such as fuels, adhesives, paints, and other coatings. At low concentrations naturally occurring in soil, metals may not be toxic. However, at higher concentrations, certain metals can be toxic to aquatic life. Humans can be impacted from contaminated groundwater resources, and bioaccumulation of metals in fish and shellfish. Environmental concerns, regarding the potential for release of metals to the environment, have already led to restricted metal usage in certain applications (OC 2003).

- *Nutrients* – Nutrients are inorganic substances, such as nitrogen and phosphorus. Excessive discharge of nutrients to water bodies and streams causes eutrophication, where aquatic plants and algae growth can lead to excessive decay of organic matter in the water body, loss of oxygen in the water, release of toxins in sediment, and the eventual death of aquatic organisms. Primary sources of nutrients in urban runoff are fertilizers and eroded soils.

- *Pesticides* -- Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Relatively low levels of the active component of pesticides can result in conditions of aquatic toxicity. Excessive or improper application of a pesticide may result in runoff containing toxic levels of its active ingredient (OC 2003).

- *Organic Compounds* – Organic compounds are carbon-based. Commercially available or naturally occurring organic compounds are found in pesticides, solvents, and hydrocarbons. Organic compounds can, at certain concentrations, indirectly or directly constitute a hazard to life or health. When rinsing off objects, toxic levels of solvents and cleaning compounds can be discharged to storm drains. Dirt, grease, and grime retained in the cleaning fluid or rinse water may also adsorb levels of organic compounds that are harmful or hazardous to aquatic life (OC 2003).

- *Sediments* – Sediments are solid materials that are eroded from the land surface. Sediments can increase turbidity, clog fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth.

- *Trash and Debris* – Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape. The presence of trash and debris may have a significant impact on the recreational value of a water body and aquatic habitat. Trash impacts water quality by increasing biochemical oxygen demand.

- *Oxygen-Demanding Substances* – This category includes biodegradable organic material as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions. A reduction of dissolved oxygen is detrimental to aquatic life and can generate hazardous compounds such as hydrogen sulfides.

- *Oil and Grease* – Oil and grease in water bodies decreases the aesthetic value of the water body, as well as the water quality. Primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular-weight fatty acids.

Attachment D
Flow- and Volume-Based BMP Design Calculations

"Hydrology Report and Calculations provided under separate cover"

INSTRUCTIONS FOR ESTIMATING VOLUME- AND FLOW-BASED BMP DESIGN RUNOFF QUANTITIES[4]

1) Identify the "BMP Drainage Area" that drains to the proposed BMP element. This includes all areas that will drain to the proposed BMP element, including pervious areas, impervious areas, and off-site areas, whether or not they are directly or indirectly connected to the BMP element. Calculate the BMP Drainage Area (A) in acres.

2) Outline the Drainage Area on the NOAA Atlas 14 Precipitation Depths (2-year 1-hour Rainfall) map (Figure D-1).

3) Determine the area-averaged 2-year 1-hour rainfall value for the Drainage Area outlined above.

A. Flow-Based BMP Design

1) Calculate the composite runoff coefficient, C_{BMP}, as defined in part A.2, above.

2) Determine which Region the BMP Drainage Area is located in (Valley, Mountain or Desert).

3) Determine BMP design rainfall intensity, I_{BMP}, by multiplying the area-averaged 2-year 1-hour value from the NOAA Atlas 14 map by the appropriate regression coefficient from Table D-1 ("I"), and then multiplying by the safety factor specified in the criteria—usually a factor of 2.

---

[4] Rainfall analysis to develop regression coefficients in Table D-1 and modifications to the NOAA Atlas 14 map were conducted by:

Hromadka II, T.V., Professor Emeritus, Department of Mathematics, California State University, Fullerton, and Adjunct Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

Laton, W.R , Assistant Professor, Department of Geological Sciences, California State University, Fullerton

Picciuto J.A.., Assistant Professor, Department of Mathematical Sciences, United States Military Academy, West Point, NY

With assistance from:

Rene Perez, M.S. Candidate, Department of Geological Sciences, California State University, Fullerton, and

Jim Friel, Ph.D. Professor Emeritus, Department of Mathematics, California State University, Fullerton

Reported as follows:

1. Hromadka II, T.V., Laton, W.R., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design. Final Report to the San Bernardino County Flood Control District.
2. Laton, W.R., Hromadka II, T.V., and Picciuto J.A., 2005. Estimating Runoff Quantities for Flow and Volume-based BMP Design (submitted). Journal of the American Water Resources Association.

4) Calculate the target BMP flow rate, Q, by using the following formula (see Table D-2 below for limitations on the use of this formula):

$$Q = C_{BMP} \cdot I_{BMP} \cdot A$$

where: Q = flow in ft^3/s

I_{BMP} = BMP design rainfall intensity, in inches/hour

A = Drainage Area in acres

C_{BMP} = composite runoff coefficient

Table D-1: Regression Coefficients for Intensity (I) and 6-hour mean storm rainfall (P_6).

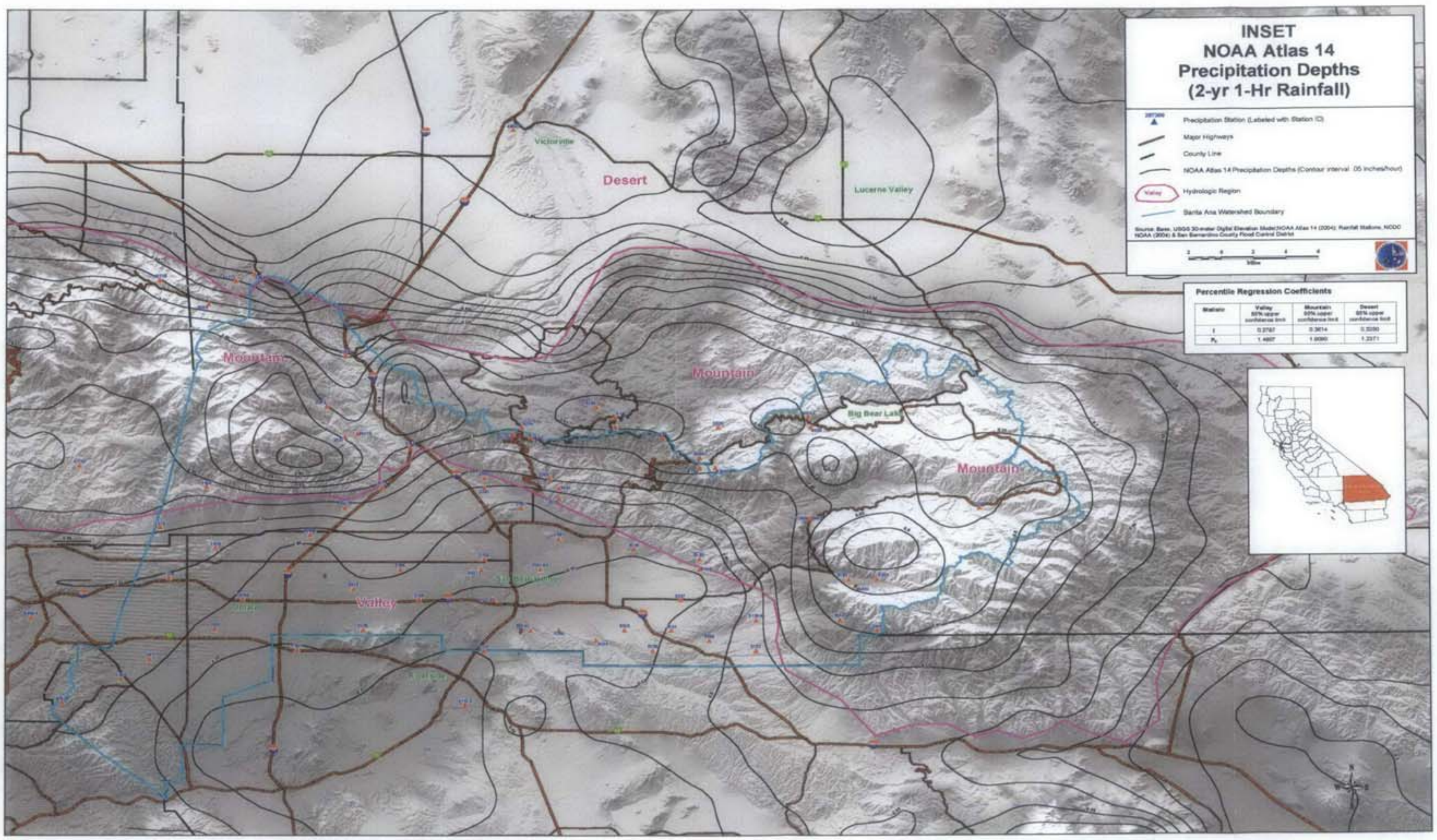
Quantity	**Valley** 85% upper confidence limit	**Mountain** 85% upper confidence limit	**Desert** 85% upper confidence limit
I	**0.2787**	**0.3614**	**0.3250**
P_6	**1.4807**	**1.9090**	**1.2371**

Table D-2: Use of the flow-based formula for BMP Design (CASQA 2003).

	Composite Runoff Coefficient, "C"			
BMP Drainage Area (Acres)	**0.00 to 0.25**	**0.26 to 0.50**	**0.51 to 0.75**	**0.76 to 1.00**
0 to 25	**Caution**	**Yes**	**Yes**	**Yes**
26 to 50	**High Caution**	**Caution**	**Yes**	**Yes**
51 to 75	**Not Recommended**	**High Caution**	**Caution**	**Yes**
76 to 100	**Not Recommended**	**High Caution**	**Caution**	**Yes**

If the flow-based BMP formula use case, as determined by Table D-2, shows "Caution," "High Caution," or "Not Recommended," considering the project's characteristics, then he project proponent must calculate the BMP design flow using the unit hydrograph method, as specified in the most current version of the San Bernardino County Hydrology Manual, using the design storm pattern with rainfall return frequency such that the peak one hour rainfall depth equals the 85th-percentile 1-hour rainfall multiplied by two.

Figure D-1: NOAA Atlas 14 Inset Map.



B. Volume-Based BMP Design

1) Calculate the "Watershed Imperviousness Ratio", i, which is equal to the percent of impervious area in the BMP Drainage Area divided by 100.

2) Calculate the composite runoff coefficient C_{BMP} for the Drainage Area above using the following equation:

$$C_{BMP} = 0.858i^3 - 0.78i^2 + 0.774i + 0.04$$

where: **C_{BMP}** = composite runoff coefficient; and,

i = watershed imperviousness ratio.

3) Determine which Region the Drainage Area is located in (Valley, Mountain or Desert).

4) Determine the area-averaged "6-hour Mean Storm Rainfall", P_6, for the Drainage Area. This is calculated by multiplying the area averaged 2-year 1-hour value by the appropriate regression coefficient from Table 1.

5) Determine the appropriate drawdown time. Use the regression constant a = 1.582 for 24 hours and a = 1.963 for 48 hours. *Note: Regression constants are provided for both 24 hour and 48 hour drawdown times; however, 48 hour drawdown times should be used in most areas of California. Drawdown times in excess of 48 hours should be used with caution as vector breeding can be a problem after water has stood in excess of 72 hours. (Use of the 24 hour drawdown time should be limited to drainage areas with coarse soils that readily settle and to watersheds where warming may be detrimental to downstream fisheries.)*

6) Calculate the "Maximized Detention Volume", P_0, using the following equation:

$$P_0 = a \cdot C_{BMP} \cdot P_6$$

where: **P_0** = Maximized Detention Volume, in inches

a = 1.582 for 24 hour and a = 1.963 for 48 hour drawdown,

C_{BMP} = composite runoff coefficient; and,

P_6 = 6-hour Mean Storm Rainfall, in inches

7) Calculate the "Target Capture Volume", V_0, using the following equation:

$$V_0 = (P_0 \cdot A) / 12$$

where:

V_0 = Target Capture Volume, in acre-feet

P_0 = Maximized Detention Volume, in inches; and,

A = BMP Drainage Area, in acres