Preliminary

HYDROLOGY STUDY

8575 Ilex St.

APN 0229-202-14-0-000
8575 Ilex St.
Fontana, CA 92335

Prepared for:

County of San Bernardino
BUILDING AND SAFETY
PRELIMINARY
APPROVAL
THE APPROVAL OF THIS REPORT SHALL NOT BE CONSTRUED TO BE A PERMIT FOR ANY DEVELOPMENT OR SITE IMPROVEMENT.
By
Date 06/08/2020
This report has Preliminary Approval. Prior to Final Approval the report, all outstanding comments/ requirements shall be met.

Prepared by:

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Date: June 7, 2019

Prepared under the supervision of:

_____
Kevin J. Richer
RCE 43714, Exp. 3/31/21

Stamp and signature required

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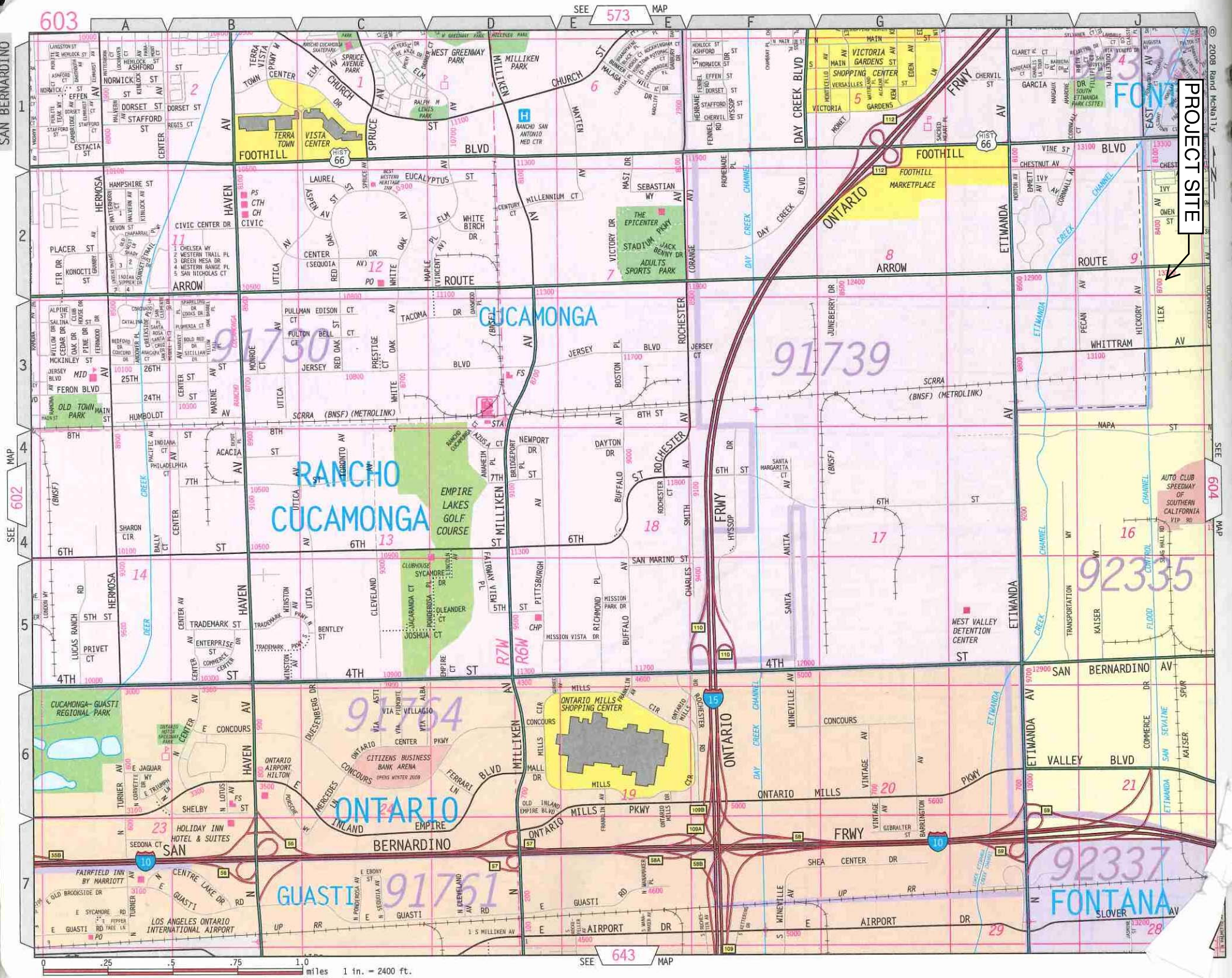
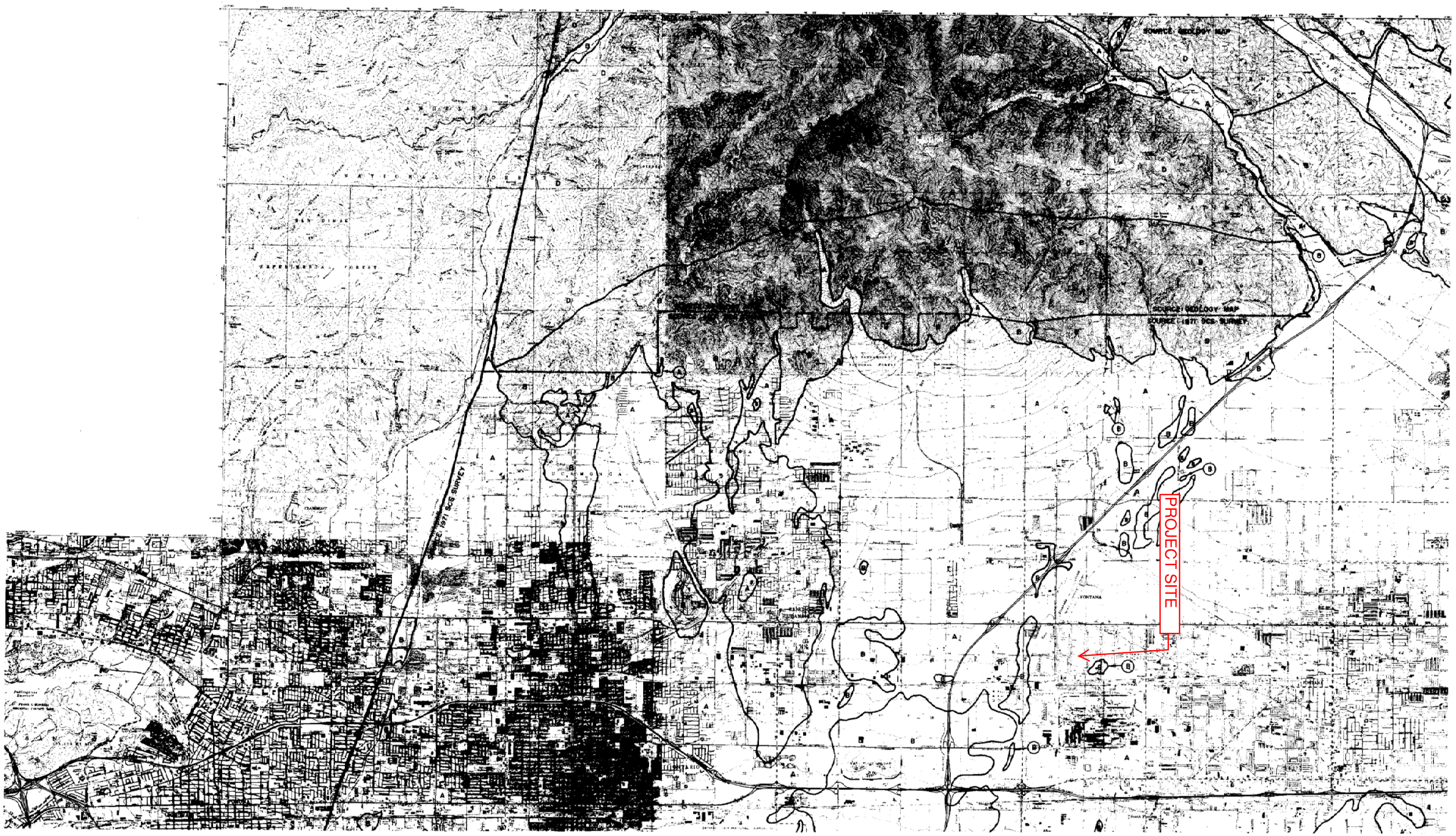
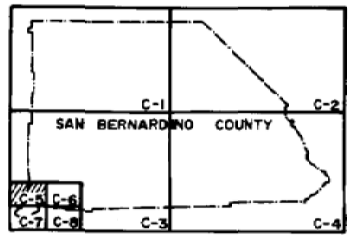
Appendix A


PROJECT SITE
SAN BERNARDINO
603
573
602
604
643
SEE MAP
© 2008 Rand McNally
RANCHO CUCAMONGA
CUCAMONGA
ONTARIO
GUASTI
FONTANA
91730
91739
91764
91761
92335
92337
FOOTHILL BLVD
ARROW ROUTE
SCRRA (BNSF) (METROLINK)
ONTARIO MILLS PKWY
SAN BERNARDINO AV
VALLEY BLVD
AIRPORT DR
EMPIRE LAKES GOLF COURSE
CUCAMONGA-GUASTI REGIONAL PARK
ONTARIO MILLS SHOPPING CENTER
CITIZENS BUSINESS BANK ARENA
ONTARIO AIRPORT HILTON
HOLIDAY INN HOTEL & SUITES
FAIRFIELD INN BY MARRIOTT
LOS ANGELES ONTARIO INTERNATIONAL AIRPORT
WEST VALLEY DETENTION CENTER
AUTO CLUB SPEEDWAY OF SOUTHERN CALIFORNIA
FOOTHILL MARKETPLACE
VICTORIA GARDENS SHOPPING CENTER
THE EPICENTER
STADIUM PKWY
JACK BENNY DR
ADULTS SPORTS PARK
OLD TOWN PARK
TERRA VISTA TOWN CENTER
SPRUCE AVENUE PARK
WEST GREENWAY PARK
MILLIKEN PARK
RALPH M LEWIS PARK
RANCHO SAN ANTONIO MED CTR
ONTARIO FRWY
15
10
110
112
66
0 .25 .5 .75 1.0 miles 1 in. = 2400 ft.





INDEX MAP

LEGEND

SOIL GROUP BOUNDARY

A SOIL GROUP DESIGNATION

BOUNDARY OF INDICATED SOURCE

SCALE 1:48,000

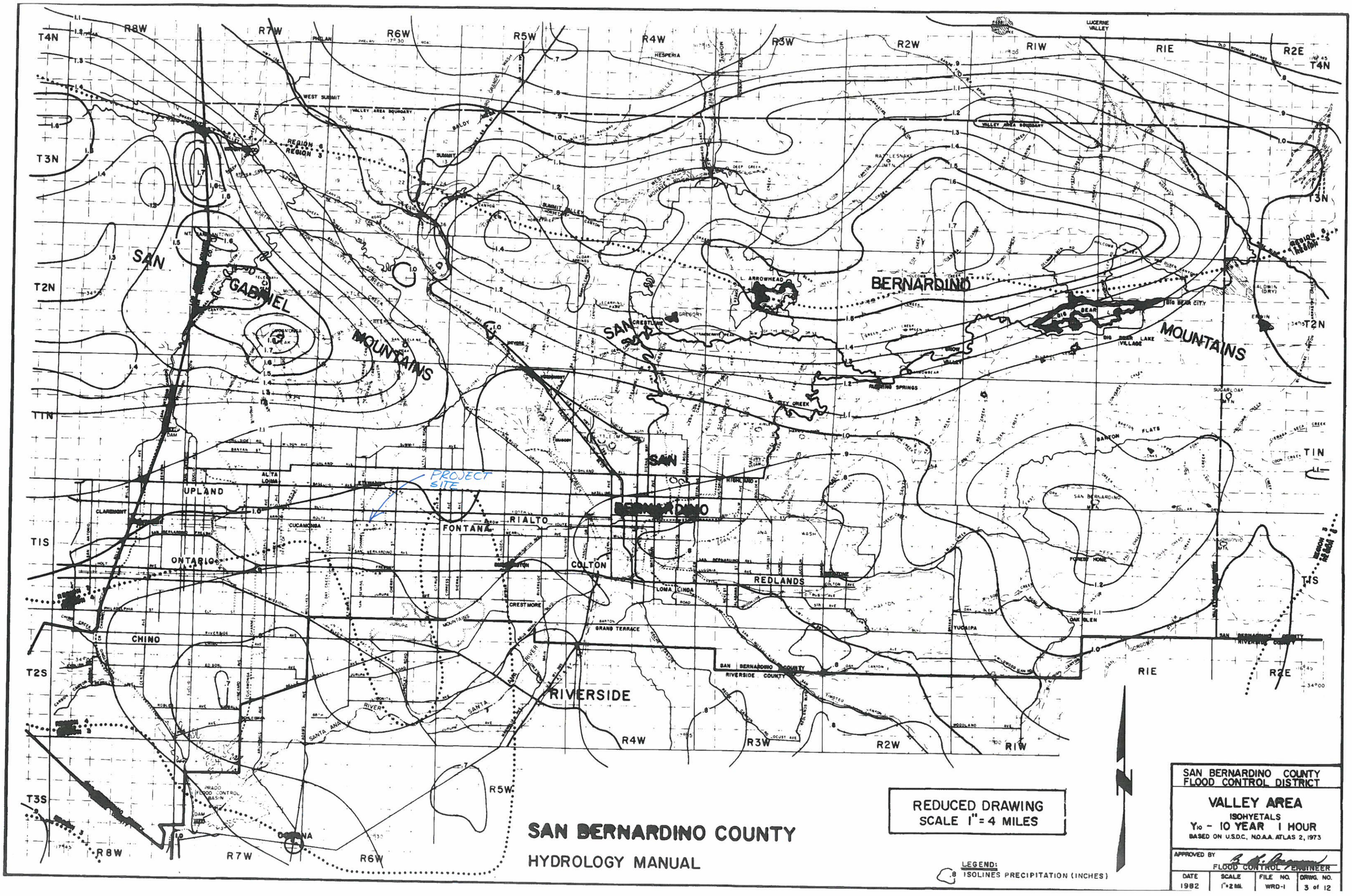
SCALE REDUCED BY 1/2

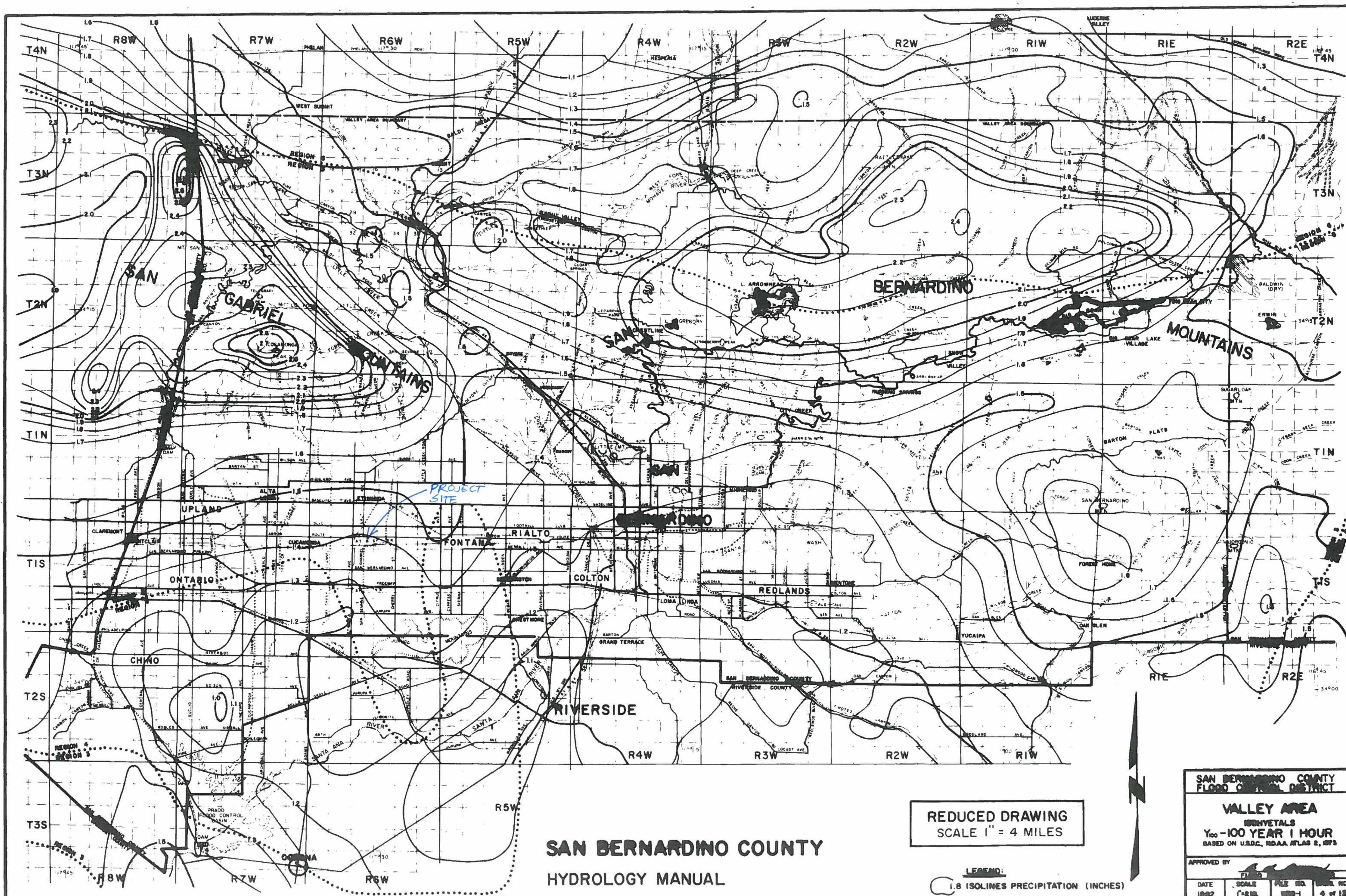
SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

HYDROLOGIC SOILS GROUP MAP
FOR
SOUTHWEST-A AREA

FIGURE C-13


SAN BERNARDINO COUNTY
HYDROLOGY MANUAL
REDUCED DRAWING
SCALE 1" = 4 MILES
LEGEND:
ISOLINES PRECIPITATION (INCHES)
SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT
VALLEY AREA
ISOHYETALS
Y10 - 10 YEAR 1 HOUR
BASED ON U.S.D.C., N.O.A.A. ATLAS 2, 1973
APPROVED BY
FLOOD CONTROL ENGINEER
DATE 1982
SCALE 1"=2 MI.
FILE NO. WRD-1
DRWG. NO. 3 of 12
PROJECT SITE
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
UPLAND
ONTARIO
CHINO
FONTANA
RIALTO
COLTON
REDLANDS
RIVERSIDE
HIGHLAND
LOMA LINDA
GRAND TERRACE
CRESTMORE
YUCAIPA
OAK GLEN
BIG BEAR CITY
BIG BEAR LAKE VILLAGE
L. ARROWHEAD
L. GREGORY
CRESTLINE
HESPERIA
LUCERNE VALLEY
WEST SUMMIT
SUMMIT
SUMMIT VALLEY
VALLEY AREA BOUNDARY
REGION 6
REGION 3
REGION 5
REGION 1
REGION 2
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
T4N
T3N
T2N
T1N
T1S
T2S
T3S
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E


PROJECT SITE
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
T4N
T3N
T2N
T1N
T1S
T2S
T3S
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
UPLAND
CLAREMONT
ONTARIO
CHINO
FONTANA
RIALTO
COLTON
SAN BERNARDINO
REDLANDS
LOMA LINDA
GRAND TERRACE
RIVERSIDE
YUCAIPA
OAK GLEN
FOREST HOME
L. ARROWHEAD
CRESTLINE
VALLEY AREA BOUNDARY
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
PRADO FLOOD CONTROL BASIN
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
DATE
1982
SCALE
1"=2 MI.
4 of 12

Appendix B

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 06/05/19

JN6054 RATIONAL STUDY
PRE-DEVELOPED CONDITION
10YR STORM
DA 1

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.950 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

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

RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.8000 Max loss rate(Fm)= 0.782(In/Hr)
Initial subarea data:
Initial area flow distance = 302.000(Ft.)
Top (of initial area) elevation = 1159.000(Ft.)
Bottom (of initial area) elevation = 1154.900(Ft.)
Difference in elevation = 4.100(Ft.)
Slope = 0.01358 s(%)= 1.36
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.880 min.
Rainfall intensity = 2.646(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.634
Subarea runoff = 2.768(CFS)
Total initial stream area = 1.650(Ac.)
Pervious area fraction = 0.800
Initial area Fm value = 0.782(In/Hr)

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

Upstream point elevation = 1154.900(Ft.)
Downstream point elevation = 1150.100(Ft.)
Channel length thru subarea = 294.000(Ft.)
Channel base width = 40.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel = 3.561(CFS)
Manning's 'N' = 0.025

```
Maximum depth of channel  =    0.400(Ft.)
Flow(q) thru subarea =      3.561(CFS)
Depth of flow =   0.067(Ft.), Average velocity =   1.143(Ft/s)
Channel flow top width =   53.350(Ft.)
Flow Velocity =    1.14(Ft/s)
Travel time  =    4.29 min.
Time of concentration =   15.17 min.
Critical depth =      0.060(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Rainfall intensity =      2.168(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.616
Subarea runoff =      1.508(CFS) for    1.550(Ac.)
Total runoff =      4.276(CFS)
Effective area this stream =        3.20(Ac.)
Total Study Area (Main Stream No. 1) =        3.20(Ac.)
Area averaged Fm value =    0.683(In/Hr)
Depth of flow =   0.074(Ft.), Average velocity =   1.217(Ft/s)
Critical depth =      0.066(Ft.)
End of computations, Total Study Area =            3.20 (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) = 0.897
Area averaged SCS curve number =  49.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 06/05/19

RATIONAL STUDY
PRE-DEVELOPED CONDITION
10YR STORM
DA 2

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

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.950 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
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 = 203.000(Ft.)
Top (of initial area) elevation = 1152.100(Ft.)
Bottom (of initial area) elevation = 1149.600(Ft.)
Difference in elevation = 2.500(Ft.)
Slope = 0.01232 s(%)= 1.23
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.594 min.
Rainfall intensity = 2.689(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.706
Subarea runoff = 0.760(CFS)
Total initial stream area = 0.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.578(In/Hr)
End of computations, Total Study Area = 0.40 (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 = 67.0

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 06/05/19

JN6054 RATIONAL STUDY
PRE-DEVELOPED CONDITION
100YR STORM
DA 1

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

Rational hydrology study storm event year is 100.0
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 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.8000 Max loss rate(Fm)= 0.628(In/Hr)
Initial subarea data:
Initial area flow distance = 302.000(Ft.)
Top (of initial area) elevation = 1159.000(Ft.)
Bottom (of initial area) elevation = 1154.900(Ft.)
Difference in elevation = 4.100(Ft.)
Slope = 0.01358 s(%)= 1.36
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.880 min.
Rainfall intensity = 3.900(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.755
Subarea runoff = 4.859(CFS)
Total initial stream area = 1.650(Ac.)
Pervious area fraction = 0.800
Initial area Fm value = 0.628(In/Hr)

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

Upstream point elevation = 1154.900(Ft.)
Downstream point elevation = 1150.100(Ft.)
Channel length thru subarea = 294.000(Ft.)
Channel base width = 40.000(Ft.)
Slope or 'Z' of left channel bank = 100.000
Slope or 'Z' of right channel bank = 100.000
Estimated mean flow rate at midpoint of channel = 6.556(CFS)

```
Manning's 'N'    = 0.025
Maximum depth of channel  =    0.400(Ft.)
Flow(q) thru subarea =      6.556(CFS)
Depth of flow =   0.095(Ft.), Average velocity =   1.402(Ft/s)
Channel flow top width =   58.904(Ft.)
Flow Velocity =    1.40(Ft/s)
Travel time  =    3.49 min.
Time of concentration =   14.37 min.
Critical depth =      0.087(Ft.)
 Adding area flow to channel
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
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 =      3.300(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.773
Subarea runoff =      3.307(CFS) for    1.550(Ac.)
Total runoff =      8.166(CFS)
Effective area this stream =        3.20(Ac.)
Total Study Area (Main Stream No. 1) =        3.20(Ac.)
Area averaged Fm value =    0.464(In/Hr)
Depth of flow =   0.107(Ft.), Average velocity =   1.506(Ft/s)
Critical depth =      0.100(Ft.)
End of computations, Total Study Area =            3.20 (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) = 0.897
Area averaged SCS curve number =  49.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 06/05/19

RATIONAL STUDY
PRE-DEVELOPED CONDITION
100YR STORM
DA 2

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

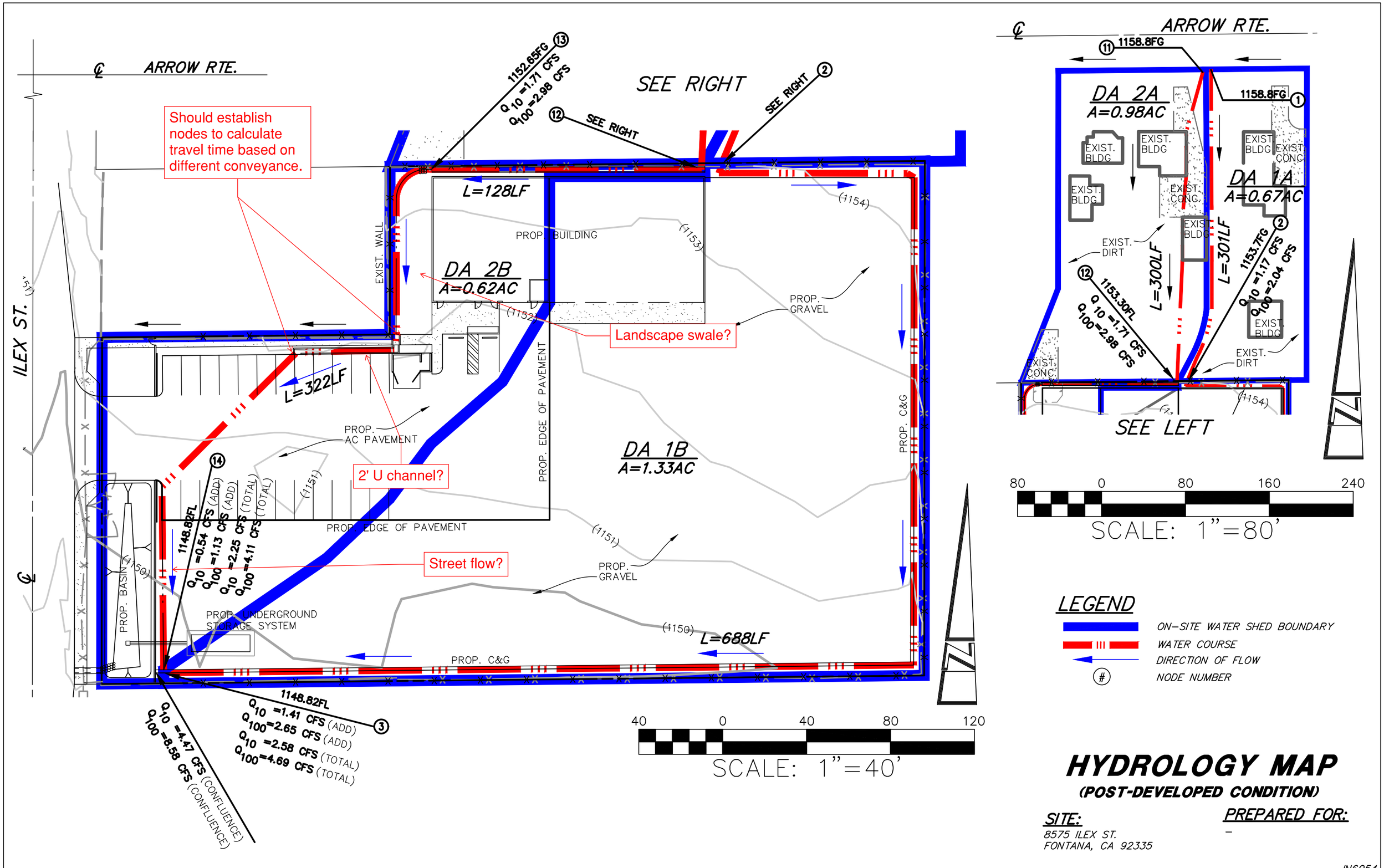
Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.400 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 3

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
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 = 203.000(Ft.)
Top (of initial area) elevation = 1152.100(Ft.)
Bottom (of initial area) elevation = 1149.600(Ft.)
Difference in elevation = 2.500(Ft.)
Slope = 0.01232 s(%)= 1.23
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.594 min.
Rainfall intensity = 3.963(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.834
Subarea runoff = 1.322(CFS)
Total initial stream area = 0.400(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.290(In/Hr)
End of computations, Total Study Area = 0.40 (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 = 67.0

Appendix C



HYDROLOGY MAP

(POST-DEVELOPED CONDITION)

SITE:
8575 ILEX ST.
FONTANA, CA 92335

PREPARED FOR:
–

JN6054

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2005 Version 7.1
Rational Hydrology Study Date: 06/07/19

JN6054 RATIONAL STUDY
POST-DEVELOPED CONDITION
10YR STORM

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

```
Rational hydrology study storm event year is    10.0
Computed rainfall intensity:
Storm year =    10.00   1 hour rainfall =     0.950 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        2.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.8000     Max loss rate(Fm)=     0.782(In/Hr)
Initial subarea data:
Initial area flow distance =   301.000(Ft.)
Top (of initial area) elevation =  1158.800(Ft.)
Bottom (of initial area) elevation =  1153.700(Ft.)
Difference in elevation =     5.100(Ft.)
Slope =    0.01694  s(%)=       1.69
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.394 min.
Rainfall intensity =      2.720(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.641
Subarea runoff =      1.168(CFS)
Total initial stream area =        0.670(Ac.)
Pervious area fraction = 0.800
Initial area Fm value =    0.782(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.000 to Point/Station        3.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.240(Ft.), Average velocity =   1.728(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              0.50
      2              0.02              0.00
      3              1.50              0.11
```

```
      4             40.00              0.50
Manning's 'N' friction factor =   0.013
----------------------------------------------------------------
Sub-Channel flow  =      1.909(CFS)
  '     '    flow top width =     14.292(Ft.)
  '     '    velocity=    1.728(Ft/s)
  '     '    area =      1.105(Sq.Ft)
  '     '    Froude number =     1.095

Upstream point elevation =  1153.700(Ft.)
Downstream point elevation =  1148.820(Ft.)
Flow length =   688.000(Ft.)
Travel time  =    6.64 min.
Time of concentration =   17.03 min.
Depth of flow =   0.240(Ft.)
Average velocity =   1.728(Ft/s)
Total irregular channel flow =     1.909(CFS)
Irregular channel normal depth above invert elev. =   0.240(Ft.)
Average velocity of channel(s) =   1.728(Ft/s)
 Adding area flow to channel
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.489(In/Hr)
Rainfall intensity =      2.022(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.639
Subarea runoff =      1.415(CFS) for    1.330(Ac.)
Total runoff =      2.583(CFS)
Effective area this stream =        2.00(Ac.)
Total Study Area (Main Stream No. 1) =        2.00(Ac.)
Area averaged Fm value =    0.587(In/Hr)
Depth of flow =   0.258(Ft.), Average velocity =   1.858(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.000(Ac.)
Runoff from this stream =      2.583(CFS)
Time of concentration =   17.03 min.
Rainfall intensity =     2.022(In/Hr)
Area averaged loss rate (Fm) =    0.5872(In/Hr)
Area averaged Pervious ratio (Ap) = 0.6005
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
```

```
Pervious ratio(Ap) = 0.8000     Max loss rate(Fm)=     0.782(In/Hr)
Initial subarea data:
Initial area flow distance =   300.000(Ft.)
Top (of initial area) elevation =  1158.800(Ft.)
Bottom (of initial area) elevation =  1153.700(Ft.)
Difference in elevation =     5.100(Ft.)
Slope =    0.01700  s(%)=       1.70
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.374 min.
Rainfall intensity =      2.723(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.641
Subarea runoff =      1.712(CFS)
Total initial stream area =        0.980(Ac.)
Pervious area fraction = 0.800
Initial area Fm value =    0.782(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1153.300(Ft.)
Downstream point elevation =  1152.650(Ft.)
Channel length thru subarea  =   128.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Manning's 'N'    = 0.013
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      1.712(CFS)
Depth of flow =   0.286(Ft.), Average velocity =   2.991(Ft/s)
Channel flow top width =    2.000(Ft.)
Flow Velocity =    2.99(Ft/s)
Travel time  =    0.71 min.
Time of concentration =   11.09 min.
Critical depth =      0.285(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1152.650(Ft.)
Downstream point elevation =  1148.820(Ft.)
Channel length thru subarea  =   322.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  66.667
Slope or 'Z' of right channel bank =  66.667
Estimated mean flow rate at midpoint of channel =      2.020(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    0.150(Ft.)
Flow(q) thru subarea =      2.020(CFS)
Depth of flow =   0.053(Ft.), Average velocity =   1.608(Ft/s)
Channel flow top width =   27.109(Ft.)
Flow Velocity =    1.61(Ft/s)
Travel time  =    3.34 min.
Time of concentration =   14.42 min.
Critical depth =      0.063(Ft.)
 Adding area flow to channel
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

```
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.489(In/Hr)
Rainfall intensity =      2.234(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.631
Subarea runoff =      0.543(CFS) for    0.620(Ac.)
Total runoff =      2.255(CFS)
Effective area this stream =        1.60(Ac.)
Total Study Area (Main Stream No. 2) =        3.60(Ac.)
Area averaged Fm value =    0.669(In/Hr)
Depth of flow =   0.057(Ft.), Average velocity =   1.669(Ft/s)
Critical depth =      0.067(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.600(Ac.)
Runoff from this stream =      2.255(CFS)
Time of concentration =   14.42 min.
Rainfall intensity =     2.234(In/Hr)
Area averaged loss rate (Fm) =    0.6686(In/Hr)
Area averaged Pervious ratio (Ap) = 0.6837
Summary of stream data:

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


1      2.58     2.000     17.03    0.587      2.022
2      2.25     1.600     14.42    0.669      2.234
Qmax(1) =
         1.000 *    1.000 *     2.583) +
         0.865 *    1.000 *     2.255) + =       4.533
Qmax(2) =
         1.148 *    0.847 *     2.583) +
         1.000 *    1.000 *     2.255) + =       4.766

Total of 2 main streams to confluence:
Flow rates before confluence point:
       3.583       3.255
Maximum flow rates at confluence using above data:
        4.533        4.766
Area of streams before confluence:
        2.000        1.600
Effective area values after confluence:
        3.600        3.294


Results of confluence:
Total flow rate =      4.766(CFS)
Time of concentration =    14.424 min.
Effective stream area after confluence  =      3.294(Ac.)
Study area average Pervious fraction(Ap) =  0.637
Study area average soil loss rate(Fm) =    0.623(In/Hr)
Study area total =       3.60(Ac.)
End of computations, Total Study Area =            3.60 (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) = 0.637
Area averaged SCS curve number = 32.0

```
      3              1.50              0.11
      4             40.00              0.50
Manning's 'N' friction factor =   0.013
----------------------------------------------------------------
Sub-Channel flow  =      3.412(CFS)
  '     '    flow top width =     18.032(Ft.)
  '     '    velocity=    1.987(Ft/s)
  '     '    area =      1.717(Sq.Ft)
  '     '    Froude number =     1.135

Upstream point elevation =  1153.700(Ft.)
Downstream point elevation =  1148.820(Ft.)
Flow length =   688.000(Ft.)
Travel time  =    5.77 min.
Time of concentration =   16.16 min.
Depth of flow =   0.278(Ft.)
Average velocity =   1.987(Ft/s)
Total irregular channel flow =     3.412(CFS)
Irregular channel normal depth above invert elev. =   0.278(Ft.)
Average velocity of channel(s) =   1.987(Ft/s)
 Adding area flow to channel
RESIDENTIAL(5 - 7 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Rainfall intensity =      3.075(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.762
Subarea runoff =      2.649(CFS) for    1.330(Ac.)
Total runoff =      4.687(CFS)
Effective area this stream =        2.00(Ac.)
Total Study Area (Main Stream No. 1) =        2.00(Ac.)
Area averaged Fm value =    0.471(In/Hr)
Depth of flow =   0.302(Ft.), Average velocity =   2.147(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.000 to Point/Station        3.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      2.000(Ac.)
Runoff from this stream =      4.687(CFS)
Time of concentration =   16.16 min.
Rainfall intensity =     3.075(In/Hr)
Area averaged loss rate (Fm) =    0.4715(In/Hr)
Area averaged Pervious ratio (Ap) = 0.6005
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       12.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(1 acre lot)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
```

This land designation is assuming that 50% of the area will be landscaped. Use appropriate land cover for proposed use.

Revise. Should be 2du/ac

```
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.8000     Max loss rate(Fm)=     0.628(In/Hr)
Initial subarea data:
Initial area flow distance =   300.000(Ft.)
Top (of initial area) elevation =  1158.800(Ft.)
Bottom (of initial area) elevation =  1153.700(Ft.)
Difference in elevation =     5.100(Ft.)
Slope =    0.01700  s(%)=       1.70
TC = k(0.469)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.374 min.
Rainfall intensity =      4.013(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.759
Subarea runoff =      2.985(CFS)
Total initial stream area =        0.980(Ac.)
Pervious area fraction = 0.800
Initial area Fm value =    0.628(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1153.300(Ft.)
Downstream point elevation =  1152.650(Ft.)
Channel length thru subarea  =   128.000(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   0.000
Slope or 'Z' of right channel bank =   0.000
Manning's 'N'    = 0.013
Maximum depth of channel  =    0.500(Ft.)
Flow(q) thru subarea =      2.985(CFS)
Depth of flow =   0.415(Ft.), Average velocity =   3.596(Ft/s)
Channel flow top width =    2.000(Ft.)
Flow Velocity =    3.60(Ft/s)
Travel time  =    0.59 min.
Time of concentration =   10.97 min.
Critical depth =      0.410(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1152.650(Ft.)
Downstream point elevation =  1148.820(Ft.)
Channel length thru subarea  =   322.000(Ft.)
Channel base width      =   20.000(Ft.)
Slope or 'Z' of left channel bank =  66.667
Slope or 'Z' of right channel bank =  66.667
Estimated mean flow rate at midpoint of channel =      3.574(CFS)
Manning's 'N'    = 0.013
Maximum depth of channel  =    0.150(Ft.)
Flow(q) thru subarea =      3.574(CFS)
Depth of flow =   0.074(Ft.), Average velocity =   1.945(Ft/s)
Channel flow top width =   29.836(Ft.)
Flow Velocity =    1.94(Ft/s)
Travel time  =    2.76 min.
Time of concentration =   13.73 min.
Critical depth =      0.090(Ft.)
 Adding area flow to channel
RESIDENTIAL(5 - 7 dwl/acre)
```

Conveyance through subarea varies. Revise calculations to better reflect site drainage.

Use appropriate land cover for proposed use.

```
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.5000     Max loss rate(Fm)=     0.393(In/Hr)
Rainfall intensity =      3.392(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.758
Subarea runoff =      1.126(CFS) for    0.620(Ac.)
Total runoff =      4.112(CFS)
Effective area this stream =        1.60(Ac.)
Total Study Area (Main Stream No. 2) =        3.60(Ac.)
Area averaged Fm value =    0.537(In/Hr)
Depth of flow =   0.080(Ft.), Average velocity =   2.035(Ft/s)
Critical depth =      0.098(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       11.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
______________________________________________________________________
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      1.600(Ac.)
Runoff from this stream =      4.112(CFS)
Time of concentration =   13.73 min.
Rainfall intensity =     3.392(In/Hr)
Area averaged loss rate (Fm) =    0.5368(In/Hr)
Area averaged Pervious ratio (Ap) = 0.6837
Summary of stream data:

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


1      4.69     2.000     16.16    0.471      3.075
2      4.11     1.600     13.73    0.537      3.392
Qmax(1) =
         1.000 *    1.000 *     4.687) +
         0.889 *    1.000 *     4.112) + =       8.342
Qmax(2) =
         1.122 *    0.849 *     4.687) +
         1.000 *    1.000 *     4.112) + =       8.576

Total of 2 main streams to confluence:
Flow rates before confluence point:
       5.687       5.112
Maximum flow rates at confluence using above data:
        8.342        8.576
Area of streams before confluence:
        2.000        1.600
Effective area values after confluence:
        3.600        3.298


Results of confluence:
Total flow rate =      8.576(CFS)
Time of concentration =    13.727 min.
Effective stream area after confluence  =      3.298(Ac.)
Study area average Pervious fraction(Ap) =  0.637
Study area average soil loss rate(Fm) =    0.501(In/Hr)
```

Study area total = 3.60(Ac.)
End of computations, Total Study Area = 3.60 (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) = 0.637
Area averaged SCS curve number = 32.0

Appendix D

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): 5,612 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*			
BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 BMP Type: Infiltration Basin	DA 1 BMP Type: Infiltration System	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*	7	7	
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2	2	
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	3.5	3.5	
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	14	14	
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	1.25	N/A	
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	621	600	
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	N/A	N/A	
10 Amended soil porosity	N/A	N/A	
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A	N/A	
12 Gravel porosity	N/A	N/A	
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	3	
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	1,320	525	
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	0	3,787	
16 Total Retention Volume from LID Infiltration BMPs (ft^3): 5,632 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: 100% *Retention% = Item 16 / Form 4.2-1 Item 7*			
18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.*			

UNDERGROUND STORAGE INFIL. SYSTEM

8'ϕ PERF. CMP ENCASED IN GRAVEL; SEE WQMP EXHIBIT

$V_{TRENCH} = (50\,LF)(12\,LF)(10\,LF) = 6{,}000\ CF$

$V_{PIPE} = \frac{\pi (8LF)^2}{4}(46LF) = 2{,}312\ CF$

$V_{GRAVEL} = (40\%)(6000 - 2312) = 1{,}475\ CF$

$V_{SYSTEM} = 2312 + 1475 = 3{,}787\ CF$

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			6054	

HYDRAULIC DESIGN

PARKWAY DRAIN

$Q_{100} = 8.58$ CFS

$b = 4$ CF $\quad n = 0.013$

OPEN CHANNEL FLOW: $d = 0.33$ LF $\quad S = 0.020 \quad A = 1.33$ LF $\quad P = 4.67$ LF

$$R = \frac{1.33}{4.67} = 0.28 \text{ LF}$$

$$Q = \frac{1.486}{0.013}(0.28^{2/3})(0.020^{1/2})(1.33) = 9.35 \text{ CFS} \checkmark$$

CLOSED CHANNEL FLOW: $d = 0.67$ LF $\quad S = \frac{0.33 + (20\%)(13)}{13} = 0.0456$

$A = 1.33$ LF $\quad P = 8.67$ LF

$$R = \frac{1.33}{8.67} = 0.15 \text{ LF}$$

$$Q = \frac{1.486}{0.013}(0.15^{2/3})(0.0456^{1/2})(1.33) = 9.34 \text{ CFS} \checkmark$$

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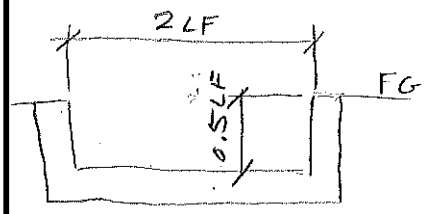
CONC. CHANNEL (12)

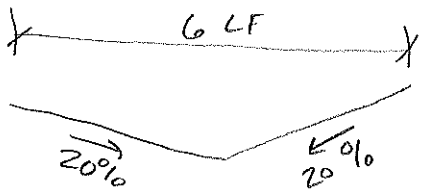


$Q_{100} = 2.98$ CFS $\quad n = 0.013 \quad S = 0.005$

$A = 1.0$ SF $\quad WP = 3.0$ LF $\quad R = 0.33$ LF

$$Q = \frac{1.486}{0.013}(0.33^{2/3})(0.005^{1/2})(1.0) = 3.89 \text{ CFS} \quad > Q_{100} \checkmark$$

LANDSCAPE SWALE (13)



$Q_{100} = 2.98$ CFS $\quad n = 0.025 \quad S = 0.010$

$A = 1.8$ SF $\quad WP = 5.10$ LF $\quad R = 0.25$ LF

$$Q = \frac{1.486}{0.025}(0.25^{2/3})(0.010^{1/2})(1.8) = 4.69 \text{ CFS} \quad > Q_{100} \checkmark$$

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			6054	