# C.E.Q.A. PRELIMINARY HYDROLOGY AND HYDRAULICS STUDY

**Tentative Map 5156**
**ER99-18-001**
**County of San Diego**

**June 5, 2001**
**Rev. August 13, 2002**
**Rev. January 22, 2003**
**Rev. April 9, 2003**
**Rev. July 10, 2003**
**Rev. Feb. 10, 2004**

*Prepared For:*
Legacy Builders
1987 Friendship Drive
Suite A
El Cajon, CA 92020
(619) 596-6424

*Prepared By:*
Masson and Associates
200 E. Washington Avenue
Suite 200
Escondido, CA 92025
(760) 741-3570

Dennis R. Furman R.C.E. 32391

# TABLE OF CONTENTS

# PROJECT DESCRIPTION

## 1.0 Project Description

1.2 The project proposes to build 13 single family detached homes on 13.0 acres of land that has high topographic relief. Because of this relief, although the site is zoned for half-acre lots, many of the lots will be graded only enough to provide the building pad and necessary yard area. The development is an in-fill project in that there is pre-existing residential development on all sides. The infrastructure necessary to support the development is available and close.

## 2.0 Existing Condition ~~Pre-Development~~

2.2 The existing site condition is a steep ~~sloping~~, south facing hillside with flat areas left by a previous grading operation. A contributory offsite watershed to the north of the site drains southward through the site towards Acacia Avenue. ~~and continues to Long Canyon Creek just south of Acacia Avenue~~. Historically this surface flow coming down from the hillside and migrating through the existing residential lots along the north side of Acacia Avenue has been a problem. Once in the street, it flows west toward two existing drop inlets at the intersection of Acacia Avenue and Fallbrook Court.

2.3 The total estimated quantity of storm water reaching the existing drop inlets at Fallbrook Court from the existing 26.01 acre watershed is 38.9 cfs for the 100-year storm.

## 3.0 Developed ~~Post~~ Condition

3.1 The proposed project, 13 half acre lot residential development, will convey the site runoff plus contributory offsite drainage from the north in the onsite street to a point just east of Lot ~~2~~ 5. Curb inlets at this point will intercept and convey the flow in an underground storm drain ~~southerly~~ to the southeasterly ~~line~~ corner of the project ~~where it will collect~~ collecting additional onsite storm water from the east and west via ~~brow ditches~~ slope terrace drains. The underground storm drain will extended ~~to the west along the south boundary line of the project site, then southerly through Lot 24 of Map 2139 to Acacia Avenue where it will connect to the existing storm drain system that extends southerly in Fallbrook Court to Long Canyon Creek~~ across the county of San Diego boundary into the City of Chula Vista, then south along this boundary to outlet into Long Canyon Creek.

3.2.1 The total quantity of storm water to be conveyed by the proposed project storm drain easterly to ~~the existing drop inlets at the intersection of Fallbrook Court and Acacia Avenue is 29.8 cfs~~ Long Canyon Creek is estimated to be 24.6 cfs from

15.32 acres. Effects to the channel low flow condition by the addition of the project flows are calculated in section 9.3, and 9.4.

~~3.2.2~~ Street flow from existing residential development along Acacia Avenue flowing westerly to the existing drop inlets at Fallbrook Court will be lowered due to the interception of the 15.32 acre of runoff by the project storm drain~~. reduction of drainage area conveyed to the drop inlets.~~

~~II. Effect Due to Project~~

3.3 The proposed project will ~~increase~~ decrease the estimated 100-year peak flow to the existing storm drain in Fallbrook Court from 38.9 cfs from 26.01 pre-development acres to ~~46.9~~ 16.1cfs from 10.49 post-development acres, ~~an~~ a ~~increase~~ decrease of ~~8.0~~ 21.6cfs. ~~The increase is due to the increase in impervious surfaces normally associated with development and the reduced flow time resulting from improved drainage paths like gutters and pipes.~~

3.4 The project will eliminate runoff flows that in the pre-development condition migrated through the residential lots on the north side of Acacia Avenue to eventually end up in Long Canyon Creek. ~~The residents have reported this as a problem in the past.~~

3.5 The interception capacity of the existing storm drain system in Fallbrook Court, ~~where the proposed project storm drain will connect~~, has been estimated to be 31 cfs. This is based on the available head water buildup in the existing drop inlets of 3.5 feet and is the limit to the entrance capacity. The pipe capacity is estimated to be 44 cfs if the additional water could get into the system. The 31 cfs ~~is 66 percent of the estimated 100 year flow of 46.9 cfs; therefore, the system inlet~~ capacity is approximately a ~~10~~ 25 year storm when compared to the existing pre-development 100 year storm flow of 38.9 cfs. ~~In an extraordinary event like a 50 or 100 year storm, Fallbrook Court, with a street grade of 6% has enough gutter flow capacity to carry the 15.9 cfs overflow to Long Canyon Creek~~. The elimination of 15.3 acres of the project drainage area that previously drain to this existing system will reduce the potential for flooding at the intersection.

## 4.0 Storm Water Management

4.1 The use of a vegetative swale or Bio-Swale at the outlet of the proposed storm drain to the east provides an effective storm water treatment that has a low maintenance requirement. The Bio-Swale is designed to accommodate the 85$^{th}$ percentile flow of 4.7 cfs. Flows that exceed this amount will be directed by the by-pass box into a high flow by-pass pipe that outlets into Long Canyon Creek The by-pass is necessary to prevent the higher storm flows from damaging the vegetative cover in the swale.

## 5.0 Summary

5.1 The existing condition runoff is intercepted by Acacia Avenue and conveyed westerly to an existing substandard drainage system at the intersection with Fallbrook Court. This system outlets into Long Canyon Creek at the Fallbrook court creek crossing. The developed project will convey ~~a portion of~~ the project run off in a storm drain, easterly in to the City of Chula Vista, and discharge it into Long Canyon Creek approximately 2200 feet upstream from Fallbrook Court. Upstream from the Fallbrook Court creek crossing the creek is not natural, it is a rock lined trapezoidal channel with an estimated capacity of 343.7 cfs., at a depth of 48" (4 feet). The discharge of the project site runoff of 25.6 cfs into the channel at the upstream discharge point will increase the channels theoretical, calculated 100 year water surface by 2 inches. The channel along this 2200-foot reach is in a canyon 15 to 20 feet below any adjacent development and therefore will have no effect on the adjacent property owners. Also, due to the 15 to 20 foot depression of the canyon, the creek capacity greatly exceeds the current estimated peak flows.

# 6. EXISTING CONDITION HYDROLOGY

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2001 Version 6.2

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 01/24/03

---

TM 5156
100 YEAR EXISTING RUNOFF
FILE: 8059TME

---

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

---

Masson & Associates, Inc., Escondido, California - S/N 889

---

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.000
Adjusted 6 hour precipitation (inches) = 3.000
P6/P24 = 50.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.011 to Point/Station 1.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****

---

User specified 'C' value of 0.100 given for subarea
Rainfall intensity (I) = 5.055(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 10.00 min. Rain intensity = 5.05(In/Hr)
Total area = 0.003(Ac.) Total runoff = 0.010(CFS)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.011 to Point/Station 1.012
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

---

Estimated mean flow rate at midpoint of channel = 4.543(CFS)
Depth of flow = 0.506(Ft.), Average velocity = 3.553(Ft/s)
******* Irregular Channel Data ***********

---

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|---|---|---|
| 1 | 0.00 | 2.00 |
| 2 | 10.00 | 0.00 |
| 3 | 20.00 | 2.00 |

Manning's 'N' friction factor = 0.080

---

Sub-Channel flow = 4.543(CFS)
' ' flow top width = 5.057(Ft.)
' ' velocity= 3.553(Ft/s)
' ' area = 1.279(Sq.Ft)
' ' Froude number = 1.245

Upstream point elevation = 429.000(Ft.)
Downstream point elevation = 257.000(Ft.)
Flow length = 732.000(Ft.)
Travel time = 3.43 min.

```
Time of concentration =   13.43 min.
Depth of flow =   0.506(Ft.)
Average velocity =   3.553(Ft/s)
Total irregular channel flow =     4.543(CFS)
Irregular channel normal depth above invert elev. =   0.506(Ft.)
Average velocity of channel(s) =   3.553(Ft/s)

Sub-Channel No. 1 Critical depth =      0.551(Ft.)
  '     '       '     Critical flow top width =      5.508(Ft.)
  '     '       '     Critical flow velocity=    2.995(Ft/s)
  '     '       '     Critical flow area =      1.517(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.500 given for subarea
Rainfall intensity =      4.178(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.500
Subarea runoff =      5.683(CFS) for    2.720(Ac.)
Total runoff =      5.693(CFS)      Total area =        2.72(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.012 to Point/Station        1.022
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =     13.146(CFS)
Depth of flow =   0.630(Ft.), Average velocity =   3.314(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              4.00              2.00
Manning's 'N' friction factor =   0.045
------------------------------------------------------------------------
Sub-Channel flow  =     13.146(CFS)
  '     '    flow top width =     12.597(Ft.)
  '     '    velocity=    3.314(Ft/s)
  '     '    area =      3.967(Sq.Ft)
  '     '    Froude number =     1.041

Upstream point elevation =   257.000(Ft.)
Downstream point elevation =   203.000(Ft.)
Flow length =  1075.000(Ft.)
Travel time  =    5.41 min.
Time of concentration =   18.84 min.
Depth of flow =   0.630(Ft.)
Average velocity =   3.314(Ft/s)
Total irregular channel flow =    13.146(CFS)
Irregular channel normal depth above invert elev. =   0.630(Ft.)
Average velocity of channel(s) =   3.314(Ft/s)

Sub-Channel No. 1 Critical depth =      0.641(Ft.)
  '     '       '     Critical flow top width =     12.813(Ft.)
  '     '       '     Critical flow velocity=    3.203(Ft/s)
  '     '       '     Critical flow area =      4.104(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      3.359(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     10.779(CFS) for    7.130(Ac.)
Total runoff =     16.471(CFS)      Total area =        9.85(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.022 to Point/Station        1.022
**** CONFLUENCE OF MINOR STREAMS ****
```

```
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      9.853(Ac.)
Runoff from this stream =     16.471(CFS)
Time of concentration =   18.84 min.
Rainfall intensity =     3.359(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.011 to Point/Station        2.011
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
User specified 'C' value of 0.700 given for subarea
Rainfall intensity (I) =      5.055(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.00 min.  Rain intensity =       5.05(In/Hr)
Total area =        0.003(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.011 to Point/Station        2.012
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   260.000(Ft.)
End of street segment elevation =   203.000(Ft.)
Length of street segment  =  1813.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  36.000(Ft.)
Distance from crown to crossfall grade break  =  34.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.560(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 =  0.0170
Estimated mean flow rate at midpoint of street =      0.091(CFS)
Depth of flow =   0.087(Ft.), Average velocity =   2.058(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   1.500(Ft.)
Flow velocity =   2.06(Ft/s)
Travel time =   14.68 min.     TC =   24.68  min.
 Adding area flow to street
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      2.822(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =     25.069(CFS) for   16.151(Ac.)
Total runoff =     25.079(CFS)      Total area =       16.15(Ac.)
Street flow at end of street =     25.079(CFS)
Half street flow at end of street =     25.079(CFS)
Depth of flow =   0.526(Ft.), Average velocity =   5.424(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    1.04(Ft.)
Flow width (from curb towards crown)=  21.297(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.012 to Point/Station        2.012
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =     16.154(Ac.)
Runoff from this stream =     25.079(CFS)
Time of concentration =   24.68 min.
Rainfall intensity =     2.822(In/Hr)
```

Summary of stream data:

| Stream No. | Flow rate (CFS) | TC (min) | Rainfall Intensity (In/Hr) |
|---|---|---|---|
| 1 | 16.471 | 18.84 | 3.359 |
| 2 | 25.079 | 24.68 | 2.822 |

```
Qmax(1) =
          1.000 *    1.000 *    16.471) +
          1.000 *    0.763 *    25.079) + =      35.613
Qmax(2) =
          0.840 *    1.000 *    16.471) +
          1.000 *    1.000 *    25.079) + =      38.916

Total of 2 streams to confluence:
Flow rates before confluence point:
      16.471      25.079
Maximum flow rates at confluence using above data:
       35.613       38.916
Area of streams before confluence:
        9.853       16.154
Results of confluence:
Total flow rate =     38.916(CFS)
Time of concentration =    24.685 min.
Effective stream area after confluence =     26.007(Ac.)
End of computations, total study area =          26.007 (Ac.)
```

# 7. DEVELOPED CONDITION HYDROLOGY

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2001 Version 6.2

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 04/09/03

---

TM 5156
100 YEAR DEVELOPED RUNOFF
FILE: 8059TMD

---

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

---

Masson & Associates, Inc., Escondido, California - S/N 889

---

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

Map data precipitation entered:
6 hour, precipitation(inches) = 3.000
24 hour precipitation(inches) = 6.000
Adjusted 6 hour precipitation (inches) = 3.000
P6/P24 = 50.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.010 to Point/Station 1.010
**** USER DEFINED FLOW INFORMATION AT A POINT ****

---

User specified 'C' value of 0.600 given for subarea
Rainfall intensity (I) = 5.055(In/Hr) for a 100.0 year storm
User specified values are as follows:
TC = 10.00 min. Rain intensity = 5.05(In/Hr)
Total area = 0.003(Ac.) Total runoff = 0.010(CFS)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.010 to Point/Station 1.020
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

---

Estimated mean flow rate at midpoint of channel = 1.153(CFS)
Depth of flow = 0.181(Ft.), Average velocity = 1.767(Ft/s)
******* Irregular Channel Data **********

---

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|---|---|---|
| 1 | 0.00 | 0.50 |
| 2 | 10.00 | 0.00 |
| 3 | 20.00 | 0.50 |

Manning's 'N' friction factor = 0.100

---

Sub-Channel flow = 1.153(CFS)
' ' flow top width = 7.227(Ft.)
' ' velocity= 1.767(Ft/s)

```
  '     '    area =      0.653(Sq.Ft)
  '     '    Froude number =     1.036

Upstream point elevation =   429.000(Ft.)
Downstream point elevation =   305.000(Ft.)
Flow length =   355.000(Ft.)
Travel time  =    3.35 min.
Time of concentration =   13.35 min.
Depth of flow =   0.181(Ft.)
Average velocity =   1.767(Ft/s)
Total irregular channel flow =     1.153(CFS)
Irregular channel normal depth above invert elev. =   0.181(Ft.)
Average velocity of channel(s) =   1.767(Ft/s)

Sub-Channel No. 1 Critical depth =      0.184(Ft.)
  '     '       '     Critical flow top width =      7.344(Ft.)
  '     '       '     Critical flow velocity=    1.711(Ft/s)
  '     '       '     Critical flow area =      0.674(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      4.195(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      1.295(CFS) for    0.686(Ac.)
Total runoff =      1.305(CFS)      Total area =        0.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.020 to Point/Station        1.030
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      2.407(CFS)
Depth of flow =   0.377(Ft.), Average velocity =   0.847(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              0.50
      2             10.00              0.00
      3             20.00              0.50
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =      2.407(CFS)
  '     '    flow top width =     15.081(Ft.)
  '     '    velocity=    0.847(Ft/s)
  '     '    area =      2.843(Sq.Ft)
  '     '    Froude number =     0.344

Upstream point elevation =   305.000(Ft.)
Downstream point elevation =   303.000(Ft.)
Flow length =   266.000(Ft.)
Travel time  =    5.24 min.
Time of concentration =   18.59 min.
Depth of flow =   0.377(Ft.)
Average velocity =   0.847(Ft/s)
Total irregular channel flow =     2.407(CFS)
Irregular channel normal depth above invert elev. =   0.377(Ft.)
Average velocity of channel(s) =   0.847(Ft/s)

Sub-Channel No. 1 Critical depth =      0.246(Ft.)
  '     '       '     Critical flow top width =      9.844(Ft.)
```

```
  '     '       '     Critical flow velocity=    1.987(Ft/s)
  '     '       '     Critical flow area =      1.211(Sq.Ft)

 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[SINGLE FAMILY area type                    ]
Rainfall intensity =      3.389(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      2.168(CFS) for    1.163(Ac.)
Total runoff =      3.473(CFS)      Total area =        1.85(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.030 to Point/Station        1.040
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   302.000(Ft.)
End of street segment elevation =   276.000(Ft.)
Length of street segment  =   327.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   2.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.560(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0170
 Manning's N from grade break to crown =  0.0170
Estimated mean flow rate at midpoint of street =      9.417(CFS)
Depth of flow =   0.340(Ft.), Average velocity =   6.196(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  12.021(Ft.)
Flow velocity =   6.20(Ft/s)
Travel time =    0.88 min.     TC =   19.47  min.
 Adding area flow to street
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      3.289(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =     11.470(CFS) for    6.340(Ac.)
Total runoff =     14.943(CFS)      Total area =        8.19(Ac.)
Street flow at end of street =     14.943(CFS)
Half street flow at end of street =     14.943(CFS)
Depth of flow =   0.389(Ft.), Average velocity =   6.919(Ft/s)
Flow width (from curb towards crown)=  14.438(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.040 to Point/Station        2.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   271.000(Ft.)
Downstream point/station elevation =   269.500(Ft.)
Pipe length  =    24.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.943(CFS)
```

```
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =    14.943(CFS)
Normal flow depth in pipe =   11.39(In.)
Flow top width inside pipe =   12.82(In.)
Critical depth could not be calculated.
Pipe flow velocity =     14.94(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    19.49 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.020 to Point/Station        2.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.550 given for subarea
Time of concentration =    19.49 min.
Rainfall intensity =      3.286(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      6.990(CFS) for    3.867(Ac.)
Total runoff =     21.933(CFS)      Total area =       12.06(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.020 to Point/Station        3.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   269.500(Ft.)
Downstream point/station elevation =   252.500(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    21.933(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =    21.933(CFS)
Normal flow depth in pipe =    9.28(In.)
Flow top width inside pipe =   10.05(In.)
Critical depth could not be calculated.
Pipe flow velocity =     33.64(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =    19.51 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.020 to Point/Station        3.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    19.51 min.
Rainfall intensity =      3.284(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.928(CFS) for    0.807(Ac.)
Total runoff =     22.860(CFS)      Total area =       12.87(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.020 to Point/Station        4.020
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   252.500(Ft.)
Downstream point/station elevation =   251.500(Ft.)
Pipe length  =    95.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    22.860(CFS)
Given pipe size =     24.00(In.)
```

```
Calculated individual pipe flow  =    22.860(CFS)
Normal flow depth in pipe =   19.36(In.)
Flow top width inside pipe =   18.96(In.)
Critical Depth =   20.42(In.)
Pipe flow velocity =      8.42(Ft/s)
Travel time through pipe =    0.19 min.
Time of concentration (TC) =    19.70 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.020 to Point/Station        4.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    19.70 min.
Rainfall intensity =      3.264(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.329(CFS) for    0.288(Ac.)
Total runoff =     23.189(CFS)      Total area =       13.15(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.020 to Point/Station        5.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   251.500(Ft.)
Downstream point/station elevation =   248.900(Ft.)
Pipe length  =   343.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    23.189(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    23.189(CFS)
Normal flow depth in pipe =   19.31(In.)
Flow top width inside pipe =   24.37(In.)
Critical Depth =   20.23(In.)
Pipe flow velocity =      7.63(Ft/s)
Travel time through pipe =    0.75 min.
Time of concentration (TC) =    20.45 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.020 to Point/Station        5.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    20.45 min.
Rainfall intensity =      3.186(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      2.418(CFS) for    2.168(Ac.)
Total runoff =     25.607(CFS)      Total area =       15.32(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.020 to Point/Station        5.030
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   248.900(Ft.)
Downstream point/station elevation =   247.930(Ft.)
Pipe length  =   224.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    25.607(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    25.607(CFS)
```

```
Normal flow depth in pipe =   23.30(In.)
Flow top width inside pipe =   24.99(In.)
Critical Depth =   20.70(In.)
Pipe flow velocity =      6.26(Ft/s)
Travel time through pipe =    0.60 min.
Time of concentration (TC) =    21.05 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.010 to Point/Station        6.010
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Rainfall intensity (I) =      5.055(In/Hr) for a   100.0 year storm
User specified values are as follows:
TC =  10.00 min.  Rain intensity =       5.05(In/Hr)
Total area =        0.006(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.010 to Point/Station        6.020
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =   248.000(Ft.)
Downstream point elevation =   203.000(Ft.)
Channel length thru subarea  =  1813.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      8.750(CFS)
Manning's 'N'    = 0.025
Maximum depth of channel  =    0.100(Ft.)
Flow(q) thru subarea =      8.750(CFS)
Depth of flow =   0.403(Ft.), Average velocity =   4.671(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =    5.300(Ft.)
Flow Velocity =    4.67(Ft/s)
Travel time  =    6.47 min.
Time of concentration =   16.47 min.
Critical depth =      0.488(Ft.)
ERROR - Channel depth exceeds maximum allowable depth
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      3.664(In/Hr) for a   100.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =     17.292(CFS) for   10.488(Ac.)
Total runoff =     17.302(CFS)      Total area =       10.49(Ac.)
End of computations, total study area =          25.816 (Ac.)
```

# 8. 85th PERCENTILE HYDROLOGY

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c)1991-2001 Version 6.2

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 04/10/03

---

TM 5156
85th PERCENTILE (FIRST fLUSH)
FILE: 8059SWMP

---

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

---

Masson & Associates, Inc., Escondido, California - S/N 889

---

Rational hydrology study storm event year is 85.0
English (in-lb) input data Units used
English (in) rainfall data used

Map data precipitation entered:
6 hour, precipitation(inches) = 0.600
24 hour precipitation(inches) = 1.200
Adjusted 6 hour precipitation (inches) = 0.600
P6/P24 = 50.0%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.010 to Point/Station 1.010
**** USER DEFINED FLOW INFORMATION AT A POINT ****

---

User specified 'C' value of 0.600 given for subarea
Rainfall intensity (I) = 1.011(In/Hr) for a 85.0 year storm
User specified values are as follows:
TC = 10.00 min. Rain intensity = 1.01(In/Hr)
Total area = 0.003(Ac.) Total runoff = 0.010(CFS)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

Process from Point/Station 1.010 to Point/Station 1.020
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

---

Estimated mean flow rate at midpoint of channel = 1.153(CFS)
Depth of flow = 0.181(Ft.), Average velocity = 1.767(Ft/s)
******* Irregular Channel Data **********

---

Information entered for subchannel number 1 :

| Point number | 'X' coordinate | 'Y' coordinate |
|---|---|---|
| 1 | 0.00 | 0.50 |
| 2 | 10.00 | 0.00 |
| 3 | 20.00 | 0.50 |

Manning's 'N' friction factor = 0.100

---

Sub-Channel flow = 1.153(CFS)
' ' flow top width = 7.227(Ft.)
' ' velocity= 1.767(Ft/s)

```
  '     '    area =      0.653(Sq.Ft)
  '     '    Froude number =     1.036

Upstream point elevation =   429.000(Ft.)
Downstream point elevation =   305.000(Ft.)
Flow length =   355.000(Ft.)
Travel time  =    3.35 min.
Time of concentration =   13.35 min.
Depth of flow =   0.181(Ft.)
Average velocity =   1.767(Ft/s)
Total irregular channel flow =     1.153(CFS)
Irregular channel normal depth above invert elev. =   0.181(Ft.)
Average velocity of channel(s) =   1.767(Ft/s)

Sub-Channel No. 1 Critical depth =      0.184(Ft.)
  '     '       '     Critical flow top width =      7.344(Ft.)
  '     '       '     Critical flow velocity=    1.711(Ft/s)
  '     '       '     Critical flow area =      0.674(Sq.Ft)

 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      0.839(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      0.259(CFS) for    0.686(Ac.)
Total runoff =      0.269(CFS)      Total area =        0.69(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.020 to Point/Station        1.030
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.496(CFS)
Depth of flow =   0.209(Ft.), Average velocity =   0.570(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              0.50
      2             10.00              0.00
      3             20.00              0.50
Manning's 'N' friction factor =   0.050
------------------------------------------------------------------
Sub-Channel flow  =      0.496(CFS)
  '     '    flow top width =      8.341(Ft.)
  '     '    velocity=    0.570(Ft/s)
  '     '    area =      0.870(Sq.Ft)
  '     '    Froude number =     0.311

Upstream point elevation =   305.000(Ft.)
Downstream point elevation =   303.000(Ft.)
Flow length =   266.000(Ft.)
Travel time  =    7.77 min.
Time of concentration =   21.12 min.
Depth of flow =   0.209(Ft.)
Average velocity =   0.570(Ft/s)
Total irregular channel flow =     0.496(CFS)
Irregular channel normal depth above invert elev. =   0.209(Ft.)
Average velocity of channel(s) =   0.570(Ft/s)

Sub-Channel No. 1 Critical depth =      0.131(Ft.)
  '     '       '     Critical flow top width =      5.234(Ft.)
```

```
  '     '       '     Critical flow velocity=    1.448(Ft/s)
  '     '       '     Critical flow area =      0.342(Sq.Ft)

 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[SINGLE FAMILY area type                    ]
Rainfall intensity =      0.624(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      0.399(CFS) for    1.163(Ac.)
Total runoff =      0.668(CFS)      Total area =        1.85(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.030 to Point/Station        1.040
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =   302.000(Ft.)
End of street segment elevation =   276.000(Ft.)
Length of street segment  =   327.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  24.000(Ft.)
Distance from crown to crossfall grade break  =  22.500(Ft.)
Slope from gutter to grade break (v/hz) =   0.020
Slope from grade break to crown (v/hz)  =   0.020
Street flow is on [1] side(s) of the street
Distance from curb to property line  =   2.000(Ft.)
Slope from curb to property line (v/hz) =   0.025
Gutter width =   1.500(Ft.)
Gutter hike from flowline =  1.560(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0170
 Manning's N from grade break to crown =  0.0170
Estimated mean flow rate at midpoint of street =      1.812(CFS)
Depth of flow =   0.218(Ft.), Average velocity =   4.285(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   5.898(Ft.)
Flow velocity =   4.28(Ft/s)
Travel time =    1.27 min.     TC =   22.39  min.
 Adding area flow to street
User specified 'C' value of 0.550 given for subarea
Rainfall intensity =      0.601(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      2.096(CFS) for    6.340(Ac.)
Total runoff =      2.764(CFS)      Total area =        8.19(Ac.)
Street flow at end of street =      2.764(CFS)
Half street flow at end of street =      2.764(CFS)
Depth of flow =   0.244(Ft.), Average velocity =   4.680(Ft/s)
Flow width (from curb towards crown)=   7.181(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        1.040 to Point/Station        2.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   271.000(Ft.)
Downstream point/station elevation =   269.500(Ft.)
Pipe length  =    24.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.764(CFS)
```

```
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     2.764(CFS)
Normal flow depth in pipe =    5.38(In.)
Flow top width inside pipe =    8.83(In.)
Critical Depth =    8.51(In.)
Pipe flow velocity =     10.03(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    22.43 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.020 to Point/Station        2.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.550 given for subarea
Time of concentration =    22.43 min.
Rainfall intensity =      0.600(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.550
Subarea runoff =      1.277(CFS) for    3.867(Ac.)
Total runoff =      4.041(CFS)      Total area =       12.06(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        2.020 to Point/Station        3.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   269.500(Ft.)
Downstream point/station elevation =   252.500(Ft.)
Pipe length  =    40.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.041(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     4.041(CFS)
Normal flow depth in pipe =    3.82(In.)
Flow top width inside pipe =    8.90(In.)
Critical depth could not be calculated.
Pipe flow velocity =     22.66(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    22.46 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.020 to Point/Station        3.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    22.46 min.
Rainfall intensity =      0.600(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.169(CFS) for    0.807(Ac.)
Total runoff =      4.210(CFS)      Total area =       12.87(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.020 to Point/Station        4.020
**** PIPEFLOW TRAVEL TIME (User specified size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   252.500(Ft.)
Downstream point/station elevation =   251.500(Ft.)
Pipe length  =    95.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.210(CFS)
Given pipe size =     24.00(In.)
```

```
Calculated individual pipe flow  =     4.210(CFS)
Normal flow depth in pipe =    6.92(In.)
Flow top width inside pipe =   21.74(In.)
Critical Depth =    8.64(In.)
Pipe flow velocity =      5.61(Ft/s)
Travel time through pipe =    0.28 min.
Time of concentration (TC) =    22.74 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.020 to Point/Station        4.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    22.74 min.
Rainfall intensity =      0.595(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.060(CFS) for    0.288(Ac.)
Total runoff =      4.270(CFS)      Total area =       13.15(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.020 to Point/Station        5.020
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   251.500(Ft.)
Downstream point/station elevation =   248.900(Ft.)
Pipe length  =   343.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.270(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.270(CFS)
Normal flow depth in pipe =    9.77(In.)
Flow top width inside pipe =   14.29(In.)
Critical Depth =   10.04(In.)
Pipe flow velocity =      5.04(Ft/s)
Travel time through pipe =    1.13 min.
Time of concentration (TC) =    23.88 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.020 to Point/Station        5.020
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Time of concentration =    23.88 min.
Rainfall intensity =      0.577(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.350
Subarea runoff =      0.438(CFS) for    2.168(Ac.)
Total runoff =      4.708(CFS)      Total area =       15.32(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        5.020 to Point/Station        5.030
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   248.900(Ft.)
Downstream point/station elevation =   247.930(Ft.)
Pipe length  =   224.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.708(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     4.708(CFS)
```

```
Normal flow depth in pipe =   10.90(In.)
Flow top width inside pipe =   17.59(In.)
Critical Depth =   10.00(In.)
Pipe flow velocity =      4.21(Ft/s)
Travel time through pipe =    0.89 min.
Time of concentration (TC) =    24.77 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.010 to Point/Station        6.010
**** USER DEFINED FLOW INFORMATION AT A POINT ****
------------------------------------------------------------------------
User specified 'C' value of 0.350 given for subarea
Rainfall intensity (I) =      1.011(In/Hr) for a    85.0 year storm
User specified values are as follows:
TC =  10.00 min.  Rain intensity =       1.01(In/Hr)
Total area =        0.006(Ac.)  Total runoff =     0.010(CFS)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        6.010 to Point/Station        6.020
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =   248.000(Ft.)
Downstream point elevation =   203.000(Ft.)
Channel length thru subarea  =  1813.000(Ft.)
Channel base width      =    0.000(Ft.)
Slope or 'Z' of left channel bank =  50.000
Slope or 'Z' of right channel bank =   3.000
Estimated mean flow rate at midpoint of channel =      8.750(CFS)
Manning's 'N'    = 0.025
Maximum depth of channel  =    0.100(Ft.)
Flow(q) thru subarea =      8.750(CFS)
Depth of flow =   0.403(Ft.), Average velocity =   4.671(Ft/s)
!!Warning: Water is above left or right bank elevations
Channel flow top width =    5.300(Ft.)
Flow Velocity =    4.67(Ft/s)
Travel time  =    6.47 min.
Time of concentration =   16.47 min.
Critical depth =      0.488(Ft.)
ERROR - Channel depth exceeds maximum allowable depth
 Adding area flow to channel
User specified 'C' value of 0.450 given for subarea
Rainfall intensity =      0.733(In/Hr) for a    85.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.450
Subarea runoff =      3.458(CFS) for   10.488(Ac.)
Total runoff =      3.468(CFS)      Total area =       10.49(Ac.)
End of computations, total study area =          25.816 (Ac.)
```

# 9. HYDRAULICS

# 9.1

Orifice Calculator

**Entrance Capacity Of Existing 24" CMP**

Given Input Data:

| | |
|---|---|
| **Solving for** | **Flowrate** |
| Coefficient | 0.9800 |
| Diameter | 24.0000 in |
| Headwater | 3.4000 ft |
| Tailwater | 1.8000 ft |

Computed Results:

| | |
|---|---|
| **Flowrate** | **31.2395 cfs** |
| Velocity | 9.9438 fps |

# 9.2

Manning Pipe Calculator

**Capacity of Existing 24" CMP**

Given Input Data:

| | |
|---|---|
| Shape | Circular |
| **Solving for** | **Flowrate** |
| Diameter | 24.0000 in |
| Depth | 24.0000 in |
| Slope | 0.0500 ft/ft |
| Manning's n | 0.0150 |

Computed Results:

| | |
|---|---|
| **Flowrate** | **43.8405 cfs** |
| Area | 3.1416 ft2 |
| Wetted Area | 3.1416 ft2 |
| Wetted Perimeter | 75.3982 in |
| Perimeter | 75.3982 in |
| Velocity | 13.9549 fps |
| Hydraulic Radius | 6.0000 in |
| Percent Full | 100.0000 % |
| Full flow Flowrate | 43.8405 cfs |
| Full flow velocity | 13.9549 fps |

# 9.3

Channel Calculator

**CHANNEL CAPACITY**

Given Input Data:

| | |
|---|---|
| Shape | Trapezoidal |
| **Solving for** | **Flowrate** |
| Slope | 0.0183 ft/ft |
| Manning's n | 0.0450 |
| **Depth** | **48.0000 in** |
| Height | 60.0000 in |
| Bottom width | 96.0000 in |
| Left slope | 1.5000 ft/ft |
| Right slope | 1.5000 ft/ft |

Computed Results:

| | |
|---|---|
| **Flowrate** | **343.7646 cfs** |
| Velocity | 8.0570 fps |
| Flow area | 42.6667 ft2 |
| Flow perimeter | 211.3776 in |
| Hydraulic radius | 29.0665 in |
| Top width | 160.0000 in |
| Area | 56.6667 ft2 |
| Perimeter | 240.2221 in |
| Percent full | 80.0000 % |

Critical Information

| | |
|---|---|
| Critical depth | 41.7887 in |
| Critical slope | 0.0294 ft/ft |
| Critical velocity | 9.5639 fps |
| Critical area | 35.9439 ft2 |
| Critical perimeter | 196.4476 in |
| Critical hydraulic radius | 26.3476 in |
| Critical top width | 151.7183 in |
| Specific energy | 5.0088 ft |
| Minimum energy | 5.2236 ft |
| Froude number | 0.7940 |
| Flow condition | Subcritical |

# 9.4

Channel Calculator

**CHANNEL INCREASE**

Given Input Data:

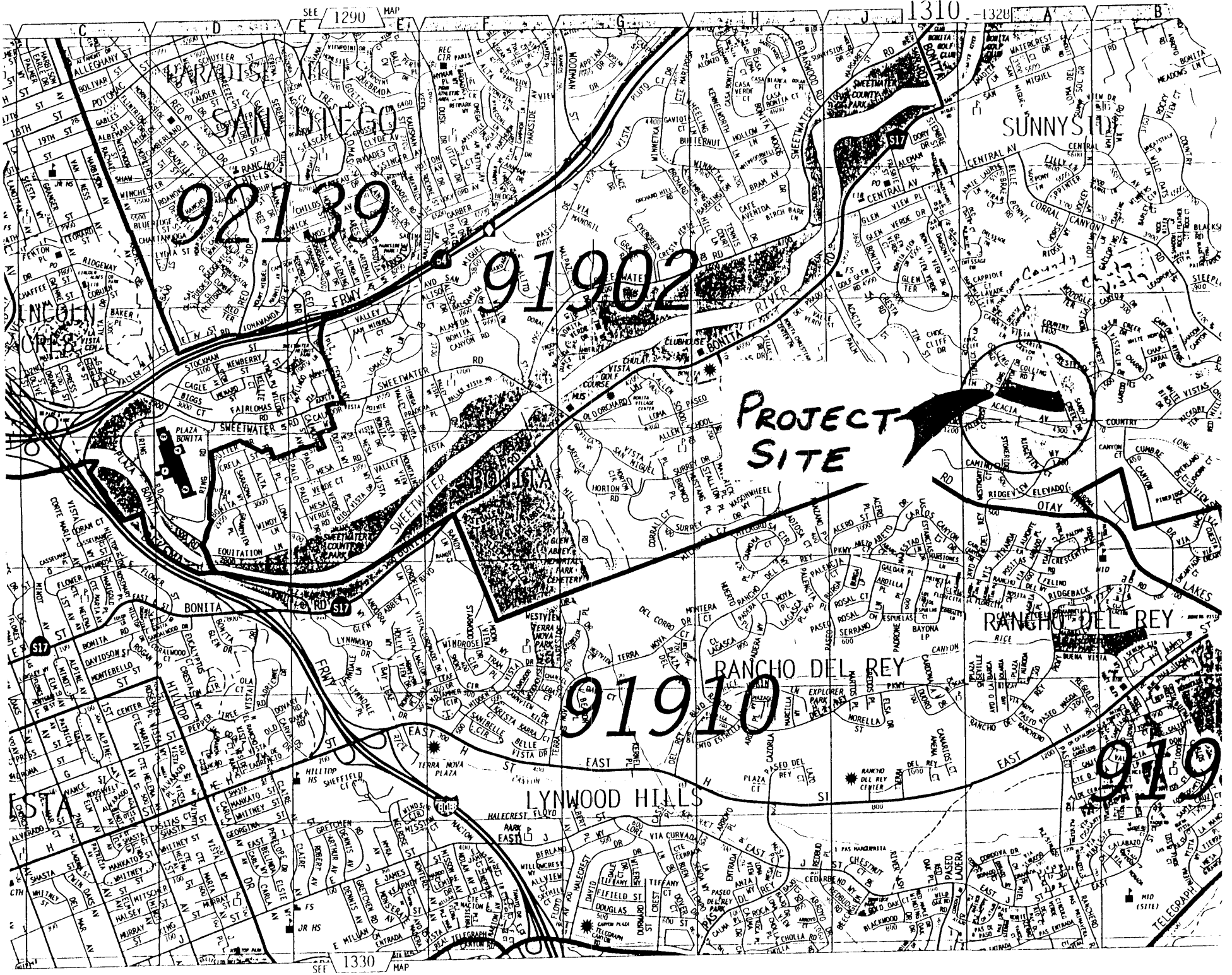
| | |
|---|---|
| Shape | Trapezoidal |
| **Solving for** | **Depth of Flow** |
| Flowrate | 369.3600 cfs |
| Slope | 0.0183 ft/ft |
| Manning's n | 0.0450 |
| Height | 60.0000 in |
| Bottom width | 96.0000 in |
| Left slope | 1.5000 ft/ft |
| Right slope | 1.5000 ft/ft |

Computed Results:

| | |
|---|---|
| **Depth** | **50.0434 in** |
| Velocity | 8.2159 fps |
| Flow area | 44.9565 ft2 |
| Flow perimeter | 216.2895 in |
| Hydraulic radius | 29.9309 in |
| Top width | 162.7246 in |
| Area | 56.6667 ft2 |
| Perimeter | 240.2221 in |
| Percent full | 83.4057 % |

Critical Information

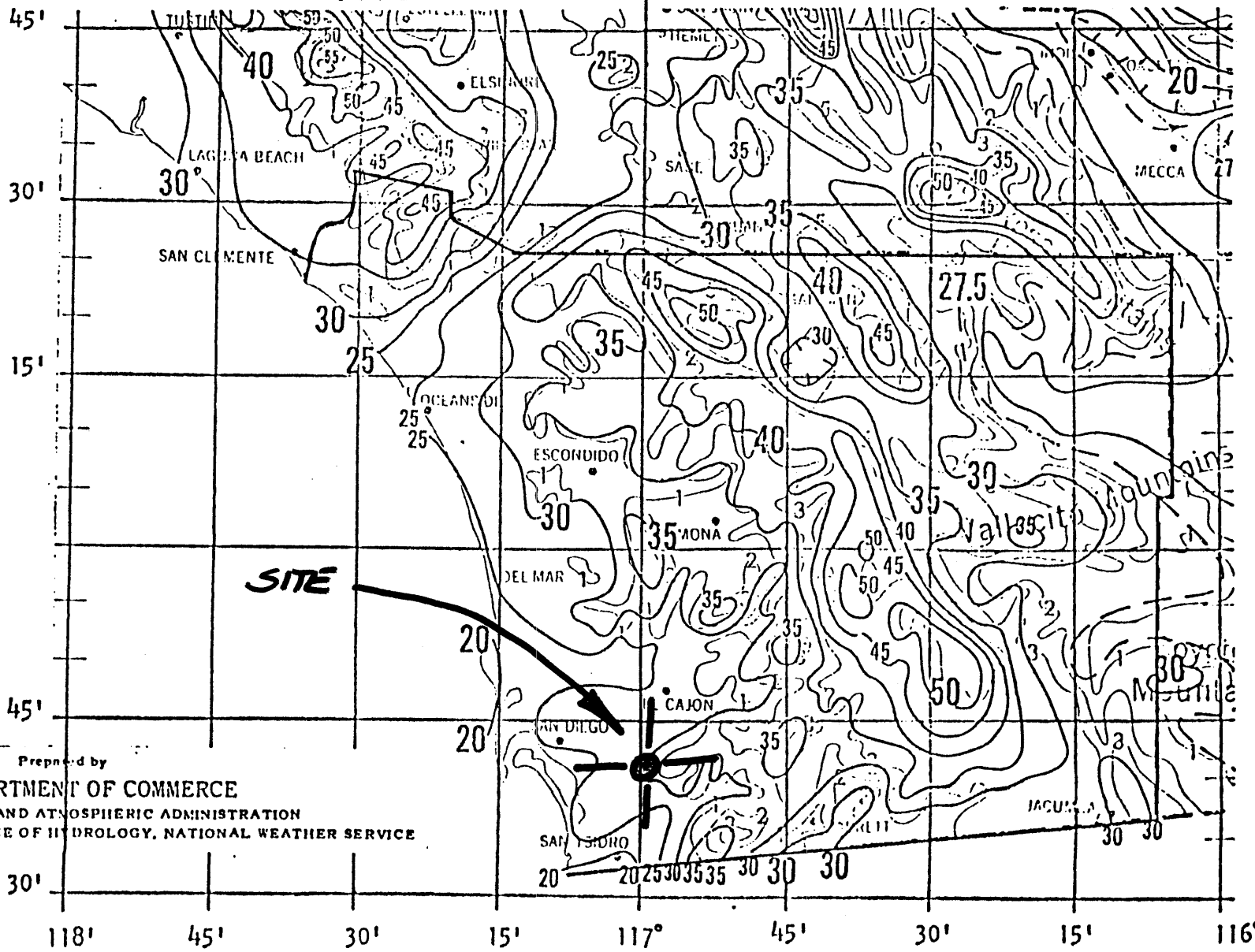
| | |
|---|---|
| Critical depth | 43.6397 in |
| Critical slope | 0.0293 ft/ft |
| Critical velocity | 9.7431 fps |
| Critical area | 37.9099 ft2 |
| Critical perimeter | 200.8968 in |
| Critical hydraulic radius | 27.1733 in |
| Critical top width | 154.1863 in |
| Specific energy | 5.2193 ft |
| Minimum energy | 5.4550 ft |
| Froude number | 0.7955 |
| Flow condition | Subcritical |



COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

# 100-YEAR 6-HOUR PRECIPITATION

(20) ISOPLUVIALS OF 100-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH

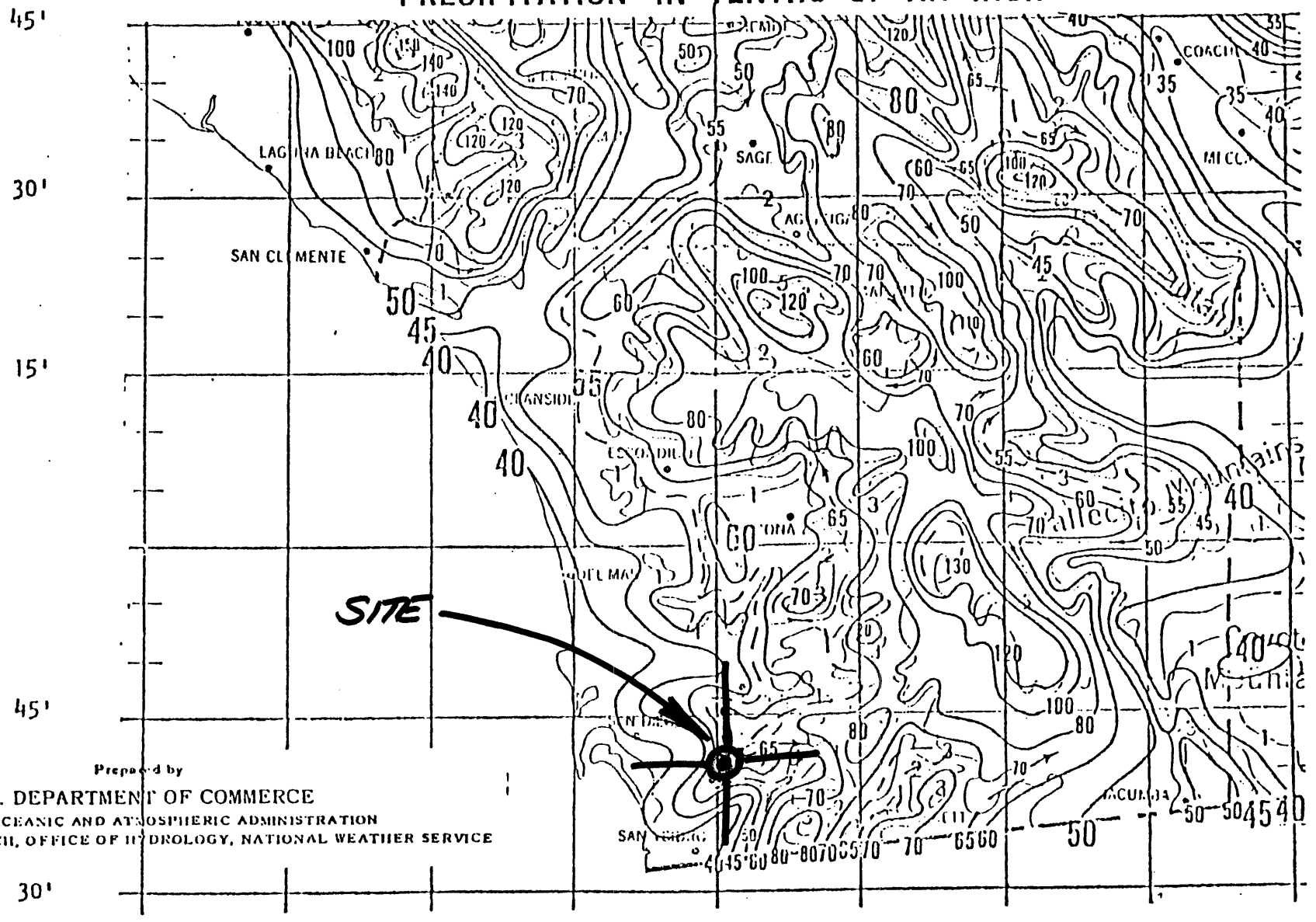



Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

# 100-YEAR 24-HOUR PRECIPITATION

## (20) ISOPLUVIALS OF 100-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH




II-A-1

TABLE 2

RUNOFF COEFFICIENTS (RATIONAL METHOD)

DEVELOPED AREAS (URBAN)

| Land Use | Coefficient, C Soil Group (1) A | B | C | D |
|---|---|---|---|---|
| Residential: | | | | |
| Single Family | .40 | .45 | .50 | .55 |
| Multi-Units | .45 | .50 | .60 | .70 |
| Mobile homes | .45 | .50 | .55 | .65 |
| Rural (lots greater than 1/2 acre) | .30 | .35 | .40 | .45 |
| Commercial(2) 80% Impervious | .70 | .75 | .80 | .85 |
| Industrial(2) 90% Impervious | .80 | .85 | .90 | .95 |

NOTES:

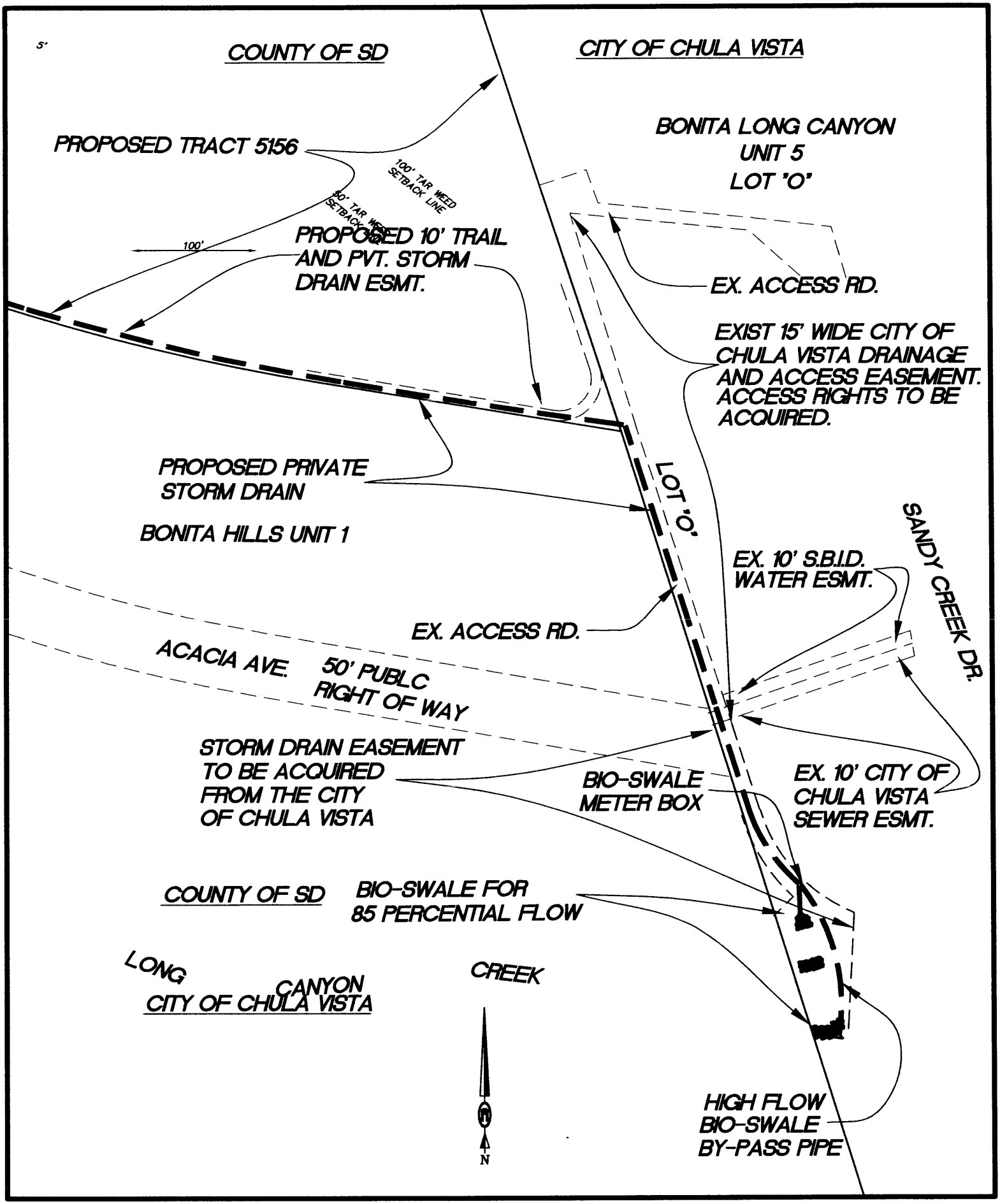
(1) Soil Group maps are available at the offices of the Department of Public Works.

(2) Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in no case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil group.

Actual imperviousness = 50%

Tabulated imperviousness = 80%

Revised $C = \frac{50}{80} \times 0.85 = 0.53$




# PRIVATE OFFSITE STORM DRAIN

## EXISTING AND PROPOSED EASEMENTS

SCALE: 1" = 100'

CITY OF
CHULA VISTA
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION

March 12, 2003
File No.0710-05-PA001

Masson & Associates
200 East Washington Ave.
Escondido, CA 92025

Attention: Dennis Furman

**SUBJECT: COUNTY OF SAN DIEGO TRACT 5156 DRAINAGE**

This is in response to your letter dated February 10, 2003 regarding the subject issue. The City has investigated the proposal to connect the County subdivision drainage system into the City's existing channel. At this time the proposal appears feasible if the following conditions are met:

- The storm drain outlet would probably require a drop structure to reduce velocity. Possibly a concrete energy dissipator such as a RSD D-41. We would need a hydraulic analysis to show Q's and velocity.

- The proposed storm drain system would be considered private since flows being picked up would be from private streets only. City would need to grant easements and have assurance of future permanent maintenance. The subdivision project engineer shall prepare all easement documents.

- The private easement would need to be purchased from the City at fair market value.

- Provide drainage calculations demonstrating that these flows naturally enter this same system downstream and that the additional flows from the new subdivision will not overburden the City's channel. Detention of onsite flows may be required.

- Comply with the City's Storm Water Manual for NPDES compliance. The storm runoff would need to be treated within the subdivision before entering our system.

- City would need to sign off on the grading /drainage plans.

If you have any questions regarding this letter, please contact me at 691-5115.

SILVESTER EVETOVICH
CIVIL ENGINEER

J:\Engineer\PERMITS\county_sub.LTR.doc

RECEIVED
MAR 13 2003