Appendix F – Downtown Area Drainage Study for the City of La Quinta

La Quinta Village Build-out Plan EIR
City of La Quinta

DOWNTOWN AREA DRAINAGE STUDY

FOR

CITY OF LA QUINTA

COUNTY OF RIVERSIDE, CALIFORNIA

PREPARED BY:

PSOMAS

Date: 01/04/2008

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GENERAL DISCUSSION

a. INTRODUCTION

The downtown area of the City of La Quinta between Avenida Bermudas and Desert Club Drive and between Calle Tampico and Avenue 52 has generally been developed without requiring drainage detention on-site due to the commercial nature of the development and limited space. This study evaluates this situation to determine if this practice has resulted in adverse impacts in the area or downstream.

b. STUDY AREA LOCATION

The study area is approximately 25.6 acres and, as mentioned above, is bounded on the east by Desert Club Drive, on the west by Avenida Bermudas, on the north by Calle Tampico, and on the south by Avenue 52. See the Study Area Location Map below:

Study Area Location Map
N.T.S.

c. HYDROLOGIC METHODOLOGY

The Rational Method, as described in the Riverside County Hydrology Manual, was used to calculate the existing peak flows from a 10-year storm frequency. The hydrology calculations were conducted through the use of "CivilDesign" hydrology computer program by CivilDesign Corporation. The hydrology calculations are based on Soil Group A (Sandy Loam / Loamy Sand). The selection of the soil type is based on Percolation Testing Technical Memorandum from GeoPentech (September 22, 2004) included in the Master Drainage Plan as Appendix E. Also, in order to take into account the effect of existing dry wells and sand filters within the study area, an impervious percentage of 65% is used in the CivilDesign program.

The attached hydrology map depicts the accumulated runoff for the total drainage area flowing to the Calle Tampico drainage system.

HYDROLOGIC CONDITIONS

a. EXISTING CONDITIONS

The study area is approximately 25.6 acres with a 10-year frequency storm runoff of 41.5 cfs. An off-site drainage area of 48.5 acres, located westerly and basically upstream of the study area, is contributing to the drainage area with a 10-year frequency storm runoff of 70.9 cfs. The study area is mainly occupied by commercial buildings. Ground surface cover consists of existing asphalt concrete pavements and some landscaping. The delineation of the drainage areas is shown in Downtown Drainage Study Hydrology Map presented in this report.

b. EXISTING SITE DRAINAGE

This study analyzes these two major drainage areas that drain by sheet flow then street flow towards the north and east and discharge into Calle Tampico. The first area is the off-site area west of the downtown area. This area drains to Avenida Navarro and Avenida Bermudas towards the north and discharges into Calle Tampico. The off-site area consists of residential development, commercial areas and La Quinta Village Park. The drainage system does not include catch basins or pipes. Dry wells and local retention areas exist in the park. It is assumed that the runoff water drains to those dry wells then infiltrates into the soil.

The second major area is the downtown area that drains towards Desert Club Drive, then drains towards the north and discharges into Calle Tampico. The downtown area consists of commercial sites (retail) and some residential development. The drainage in this area is mostly sheet flow into local dry wells, sand filters and retention basins, then street flows towards Desert Club Drive. The street drainage system does not include catch basins in this area.
The runoff from the area west of downtown is intercepted by a 7-ft catch basin located along Calle Tampico, between Avenida Bermudas and Desert Club Drive. This catch basin conveys

the runoff to a 2'H x 6'W double reinforced concrete box that drains from west to east along Calle Tampico. However, the catch basin capacity collects only 26.5-cfs from the 71-cfs (10-yr storm flow) generated from the off-site area. The remaining flow ponds to a depth of 7-inches, then flows towards the east and joins the 41.5-cfs runoff from the subject site. The combined runoff flows east to another catch basin located along Calle Tampico east of Desert Club Drive. Hydrologic and hydraulic calculations for streets, catch basins and reinforced concrete boxes are presented in the Hydrologic and Hydraulic Calculations section of this report.

An existing Coachella Valley Water District (CVWD) 60" RCP storm drain flows north along Desert Club Drive. The 60" RCP conveys overflow runoff from the Crystal Canyon Detention Basins located south of the study area. The 60" RCP drains from south to north and discharges into the La Quinta Evacuation Channel. Also, a 66" RCP exists along Avenue 52 south of the study area. The 66" RCP drains from west to east and conveys a small portion of its flow into the 60" CVWD RCP in Desert Club Drive via an 18" lateral pipe connection.

c. HYDROLOGY SUMMARY TABLE

AREA	Acreage	Q10 (cfs)
A-1	3.6	7.23
A-2	3.8	6.87
A-3	3.8	6.36
A-4	3.8	6.06
A-5	2.5	3.76
A-6	1.8	2.45
A-7	2.2	4.03
A-8	2.2	2.65
A-9	3.6	6.78
A-10	5.4	8.76
A-11	6.7	6.85
A-12	2.2	3.15
A-13	2	2.66
A-14	1	1.99
A-15	0.8	1.23
A-16	2.1	2.64
A-17	1	1.18
TOTAL	**48.5**	**70.97**
B-1	4	8
B-2	5.1	9.1
B-3	3.1	5.2
B-4	5.4	8.22
B-5	4	5.67
B-6	4	5.29
TOTAL	**25.6**	**41.48**

RECOMMENDATIONS

Based on existing studies and the hydrologic studies presented in the Hydrologic Calculations section of this report, the downtown study area is subject to flooding in the northern reaches of Avenida Bermudas, Desert Club Drive and all along Calle Tampico. The capacity of the existing catch basins and 2'H x 6'W DBL. RCB are not enough to convey the 10-year peak storm runoff from the downtown area and adjacent neighborhood. Therefore, at a minimum, bio-retention, dry wells, sand filters and retention basins are recommended for the proposed and future development within the downtown area to reduce the runoff generated-similar to the existing facilities in the developed sites in the downtown area. Also, it is recommended that some catch basins be constructed upstream (south) of the following intersections, with connections to either dry wells or the RCB storm drain: The roundabout at Avenida Navarro and Avenida Montezuma, Avenida Navarro and Calle Tampico, and Avenida Bermudas and Calle Tampico. The locations of the recommended catch basins and dry wells/sand filters are shown on the Downtown Drainage Study Hydrology Map.

As an alternative to completely eliminate this localized flooding potential, a Preliminary Design Report could be prepared to determine if a storm drain connection could be made from just upstream of the existing 2'H x 6'W DBL. RCB in Calle Tampico across Calle Tampico connecting to the existing storm drain running north adjacent to Avenida Bermudas that drains into an existing retention basin. It may be that there are existing utility conflicts that prohibit this connection but this should be investigated to determine if a connection can be made, hydraulically, which could divert some of the flow to the retention basin.

HYDROLOGIC AND HYDRAULIC CALCULATIONS

a. OFF-SITE RUNOFF HYDROLOGIC CALCULATIONS

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 12/13/07 File:LAQ10YR.out

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

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

Offsite Area, 10-yr Storm

Program License Serial Number 6124

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

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

2 year, 1 hour precipitation = 0.700(In.)
100 year, 1 hour precipitation = 1.600(In.)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 1.070(In/Hr)
Slope of intensity duration curve = 0.5900

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Process from Point/Station 2.000 to Point/Station 4.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 630.000(Ft.)
Top (of initial area) elevation = 61.000(Ft.)
Bottom (of initial area) elevation = 55.000(Ft.)
Difference in elevation = 6.000(Ft.)
Slope = 0.00952 s(percent)= 0.95
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.364 min.
Rainfall intensity = 2.718(In/Hr) for a 10.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.739
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
RI index for soil(AMC 2) = 32.00
Pervious area fraction = 0.350; Impervious fraction = 0.650
Initial subarea runoff = 7.233(CFS)
Total initial stream area = 3.600(Ac.)
Pervious area fraction = 0.350

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Process from Point/Station        4.000 to Point/Station        6.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of street segment elevation =    55.000(Ft.)
End of street segment elevation =    54.000(Ft.)
Length of street segment  =   250.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     10.765(CFS)
Depth of flow =   0.447(Ft.), Average velocity =   1.923(Ft/s)
Note:  depth of flow exceeds top of street crown.
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   1.92(Ft/s)
Travel time =    2.17 min.     TC =   14.53  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.732
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.471(In/Hr) for a    10.0 year storm
Subarea runoff =      6.870(CFS) for      3.800(Ac.)
Total runoff =     14.103(CFS)      Total area =       7.400(Ac.)
Street flow at end of street =     14.103(CFS)
Half street flow at end of street =      7.052(CFS)
Depth of flow =   0.478(Ft.), Average velocity =   2.141(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station        6.000 to Point/Station        8.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------------
Top of street segment elevation =    54.000(Ft.)
End of street segment elevation =    53.000(Ft.)
Length of street segment  =   250.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
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Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     17.340(CFS)
Depth of flow =   0.508(Ft.), Average velocity =   2.303(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.38(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   2.30(Ft/s)
Travel time =    1.81 min.     TC =   16.34  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.726
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.306(In/Hr) for a    10.0 year storm
Subarea runoff =      6.363(CFS) for      3.800(Ac.)
Total runoff =     20.467(CFS)      Total area =      11.200(Ac.)
Street flow at end of street =     20.467(CFS)
Half street flow at end of street =     10.233(CFS)
Depth of flow =   0.539(Ft.), Average velocity =   2.374(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    1.97(Ft.)
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station        8.000 to Point/Station       10.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
---------------------------------------------------------------------------
Top of street segment elevation =    53.000(Ft.)
End of street segment elevation =    51.000(Ft.)
Length of street segment  =   250.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
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Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     23.550(CFS)
Depth of flow =   0.500(Ft.), Average velocity =   3.234(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    0.00(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   3.23(Ft/s)
Travel time =    1.29 min.     TC =   17.63  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.723
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.205(In/Hr) for a    10.0 year storm
Subarea runoff =      6.056(CFS) for      3.800(Ac.)
Total runoff =     26.522(CFS)      Total area =      15.000(Ac.)
Street flow at end of street =     26.522(CFS)
Half street flow at end of street =     13.261(CFS)
Depth of flow =   0.523(Ft.), Average velocity =   3.303(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    1.13(Ft.)
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station       10.000 to Point/Station       12.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
---------------------------------------------------------------------------
Top of street segment elevation =    51.000(Ft.)
End of street segment elevation =    50.000(Ft.)
Length of street segment  =   250.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     28.484(CFS)
Depth of flow =   0.606(Ft.), Average velocity =   2.536(Ft/s)
Warning: depth of flow exceeds top of curb
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Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    5.30(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  16.000(Ft.)
Flow velocity =   2.54(Ft/s)
Travel time =    1.64 min.     TC =   19.27  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.719
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.092(In/Hr) for a    10.0 year storm
Subarea runoff =      3.759(CFS) for      2.500(Ac.)
Total runoff =     30.281(CFS)      Total area =      17.500(Ac.)
Street flow at end of street =     30.281(CFS)
Half street flow at end of street =     15.140(CFS)
Depth of flow =   0.619(Ft.), Average velocity =   2.569(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    5.94(Ft.)
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station       12.000 to Point/Station       14.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    50.000(Ft.)
End of street segment elevation =    46.000(Ft.)
Length of street segment  =   575.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     31.588(CFS)
Depth of flow =   0.571(Ft.), Average velocity =   3.000(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.55(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   3.00(Ft/s)
Travel time =    3.19 min.     TC =   22.47  min.
 Adding area flow to street
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CONDOMINIUM subarea type
Runoff Coefficient = 0.712
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.911(In/Hr) for a    10.0 year storm
Subarea runoff =      2.448(CFS) for      1.800(Ac.)
Total runoff =     32.729(CFS)      Total area =      19.300(Ac.)
Street flow at end of street =     32.729(CFS)
Half street flow at end of street =     16.365(CFS)
Depth of flow =   0.577(Ft.), Average velocity =   3.029(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.84(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       12.000 to Point/Station       14.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     19.300(Ac.)
Runoff from this stream =     32.729(CFS)
Time of concentration =   22.47 min.
Rainfall intensity =     1.911(In/Hr)
Program is now starting with Main Stream No. 2


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Process from Point/Station       13.000 to Point/Station       14.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Initial area flow distance =   800.000(Ft.)
Top (of initial area) elevation =    51.000(Ft.)
Bottom (of initial area) elevation =    45.000(Ft.)
Difference in elevation =     6.000(Ft.)
Slope =    0.00750  s(percent)=       0.75
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   14.270 min.
Rainfall intensity =      2.497(In/Hr) for a    10.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.733
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Initial subarea runoff =      4.025(CFS)
Total initial stream area =        2.200(Ac.)
Pervious area fraction = 0.350
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Process from Point/Station       13.000 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 =      2.200(Ac.)
Runoff from this stream =      4.025(CFS)
Time of concentration =   14.27 min.
Rainfall intensity =     2.497(In/Hr)
Summary of stream data:

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


1       32.729     22.47               1.911
2        4.025     14.27               2.497
Largest stream flow has longer time of concentration
Qp =     32.729 + sum of
        Qb         Ia/Ib
         4.025 *    0.765 =      3.080
Qp =     35.809

Total of 2 main streams to confluence:
Flow rates before confluence point:
      32.729       4.025
Area of streams before confluence:
       19.300        2.200


Results of confluence:
Total flow rate =     35.809(CFS)
Time of concentration =    22.466 min.
Effective stream area after confluence  =     21.500(Ac.)


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Process from Point/Station       14.000 to Point/Station       16.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    45.000(Ft.)
End of street segment elevation =    42.000(Ft.)
Length of street segment  =   725.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
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 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     37.195(CFS)
Depth of flow =   0.647(Ft.), Average velocity =   2.585(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    7.34(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   2.58(Ft/s)
Travel time =    4.67 min.     TC =   27.14  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.704
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.709(In/Hr) for a    10.0 year storm
Subarea runoff =      2.645(CFS) for      2.200(Ac.)
Total runoff =     38.454(CFS)      Total area =      23.700(Ac.)
Street flow at end of street =     38.454(CFS)
Half street flow at end of street =     19.227(CFS)
Depth of flow =   0.653(Ft.), Average velocity =   2.607(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    7.67(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       14.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =     23.700(Ac.)
Runoff from this stream =     38.454(CFS)
Time of concentration =   27.14 min.
Rainfall intensity =     1.709(In/Hr)
Program is now starting with Main Stream No. 2


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       32.000 to Point/Station       34.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Initial area flow distance =   650.000(Ft.)
Top (of initial area) elevation =    56.000(Ft.)
Bottom (of initial area) elevation =    50.000(Ft.)
Difference in elevation =     6.000(Ft.)
Slope =    0.00923  s(percent)=       0.92
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.599 min.
Rainfall intensity =      2.688(In/Hr) for a    10.0 year storm
CONDOMINIUM subarea type
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```
Runoff Coefficient = 0.738
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Initial subarea runoff =      1.985(CFS)
Total initial stream area =        1.000(Ac.)
Pervious area fraction = 0.350


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Process from Point/Station       34.000 to Point/Station       36.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =    50.000(Ft.)
End of street segment elevation =    45.000(Ft.)
Length of street segment  =   650.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.688(CFS)
Depth of flow =   0.280(Ft.), Average velocity =   1.767(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   8.004(Ft.)
Flow velocity =   1.77(Ft/s)
Travel time =    6.13 min.     TC =   18.73  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.720
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.127(In/Hr) for a    10.0 year storm
Subarea runoff =      1.225(CFS) for      0.800(Ac.)
Total runoff =      3.210(CFS)      Total area =       1.800(Ac.)
Street flow at end of street =      3.210(CFS)
Half street flow at end of street =      1.605(CFS)
Depth of flow =   0.294(Ft.), Average velocity =   1.837(Ft/s)
Flow width (from curb towards crown)=   8.680(Ft.)


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```
Process from Point/Station       36.000 to Point/Station       16.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
Top of street segment elevation =    45.000(Ft.)
End of street segment elevation =    42.000(Ft.)
Length of street segment  =   650.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      4.601(CFS)
Depth of flow =   0.347(Ft.), Average velocity =   1.639(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  11.331(Ft.)
Flow velocity =   1.64(Ft/s)
Travel time =    6.61 min.     TC =   25.34  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.707
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.780(In/Hr) for a    10.0 year storm
Subarea runoff =      2.641(CFS) for      2.100(Ac.)
Total runoff =      5.851(CFS)      Total area =       3.900(Ac.)
Street flow at end of street =      5.851(CFS)
Half street flow at end of street =      2.925(CFS)
Depth of flow =   0.370(Ft.), Average velocity =   1.734(Ft/s)
Flow width (from curb towards crown)=  12.517(Ft.)


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Process from Point/Station       36.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
----------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.900(Ac.)
Runoff from this stream =      5.851(CFS)
Time of concentration =   25.34 min.
Rainfall intensity =     1.780(In/Hr)
Program is now starting with Main Stream No. 3


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Process from Point/Station       20.000 to Point/Station       22.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
Initial area flow distance =   650.000(Ft.)
Top (of initial area) elevation =    55.000(Ft.)
Bottom (of initial area) elevation =    51.000(Ft.)
Difference in elevation =     4.000(Ft.)
Slope =    0.00615  s(percent)=       0.62
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   13.663 min.
Rainfall intensity =      2.562(In/Hr) for a    10.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.735
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Initial subarea runoff =      6.776(CFS)
Total initial stream area =        3.600(Ac.)
Pervious area fraction = 0.350


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Process from Point/Station       22.000 to Point/Station       26.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =    51.000(Ft.)
End of street segment elevation =    46.000(Ft.)
Length of street segment  =   550.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     11.246(CFS)
Depth of flow =   0.404(Ft.), Average velocity =   2.624(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.223(Ft.)
Flow velocity =   2.62(Ft/s)
Travel time =    3.49 min.     TC =   17.16  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.724
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
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```
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.240(In/Hr) for a    10.0 year storm
Subarea runoff =      8.759(CFS) for      5.400(Ac.)
Total runoff =     15.536(CFS)      Total area =       9.000(Ac.)
Street flow at end of street =     15.536(CFS)
Half street flow at end of street =      7.768(CFS)
Depth of flow =   0.443(Ft.), Average velocity =   2.849(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station       24.000 to Point/Station       26.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
UNDEVELOPED (good cover) subarea
Runoff Coefficient = 0.457
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
RI index for soil(AMC 2)  =  38.00
Pervious area fraction =  1.000; Impervious fraction =  0.000
Time of concentration =    17.16 min.
Rainfall intensity =      2.240(In/Hr) for a    10.0 year storm
Subarea runoff =      6.853(CFS) for      6.700(Ac.)
Total runoff =     22.389(CFS)      Total area =      15.700(Ac.)


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Process from Point/Station       26.000 to Point/Station       28.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    46.000(Ft.)
End of street segment elevation =    43.000(Ft.)
Length of street segment  =   550.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     23.958(CFS)
Depth of flow =   0.546(Ft.), Average velocity =   2.551(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.31(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
```

```
Flow velocity =   2.55(Ft/s)
Travel time =    3.59 min.     TC =   20.75  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.715
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.002(In/Hr) for a    10.0 year storm
Subarea runoff =      3.152(CFS) for      2.200(Ac.)
Total runoff =     25.541(CFS)      Total area =      17.900(Ac.)
Street flow at end of street =     25.541(CFS)
Half street flow at end of street =     12.770(CFS)
Depth of flow =   0.556(Ft.), Average velocity =   2.594(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    2.81(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


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Process from Point/Station       28.000 to Point/Station       16.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------
Top of street segment elevation =    43.000(Ft.)
End of street segment elevation =    42.000(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  40.000(Ft.)
Distance from crown to crossfall grade break  =  38.000(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 [2] side(s) of the street
Distance from curb to property line  =  12.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     26.968(CFS)
Depth of flow =   0.616(Ft.), Average velocity =   2.037(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    5.82(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  24.822(Ft.)
Flow velocity =   2.04(Ft/s)
Travel time =    2.45 min.     TC =   23.21  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.710
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
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Decimal fraction soil group D = 0.000
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.875(In/Hr) for a    10.0 year storm
Subarea runoff =      2.664(CFS) for      2.000(Ac.)
Total runoff =     28.204(CFS)      Total area =      19.900(Ac.)
Street flow at end of street =     28.204(CFS)
Half street flow at end of street =     14.102(CFS)
Depth of flow =   0.625(Ft.), Average velocity =   2.052(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    6.23(Ft.)
Flow width (from curb towards crown)=  25.226(Ft.)


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Process from Point/Station       28.000 to Point/Station       16.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =     19.900(Ac.)
Runoff from this stream =     28.204(CFS)
Time of concentration =   23.21 min.
Rainfall intensity =     1.875(In/Hr)
Summary of stream data:

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


1       38.454     27.14               1.709
2        5.851     25.34               1.780
3       28.204     23.21               1.875
Largest stream flow has longer time of concentration
Qp =     38.454 + sum of
        Qb         Ia/Ib
         5.851 *    0.960 =      5.618
        Qb         Ia/Ib
        28.204 *    0.912 =     25.714
Qp =     69.787

Total of 3 main streams to confluence:
Flow rates before confluence point:
      38.454       5.851      28.204
Area of streams before confluence:
       23.700        3.900       19.900


Results of confluence:
Total flow rate =     69.787(CFS)
Time of concentration =    27.140 min.
Effective stream area after confluence  =     47.500(Ac.)


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Process from Point/Station       16.000 to Point/Station       38.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
```

```
Top of street segment elevation =    42.000(Ft.)
End of street segment elevation =    40.000(Ft.)
Length of street segment  =   200.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  40.000(Ft.)
Distance from crown to crossfall grade break  =  38.000(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 [2] side(s) of the street
Distance from curb to property line  =  12.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     70.449(CFS)
Depth of flow =   0.693(Ft.), Average velocity =   3.809(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    9.63(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  28.634(Ft.)
Flow velocity =   3.81(Ft/s)
Travel time =    0.88 min.     TC =   28.02  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.702
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.677(In/Hr) for a    10.0 year storm
Subarea runoff =      1.178(CFS) for      1.000(Ac.)
Total runoff =     70.965(CFS)      Total area =      48.500(Ac.)
Street flow at end of street =     70.965(CFS)
Half street flow at end of street =     35.482(CFS)
Depth of flow =   0.694(Ft.), Average velocity =   3.815(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    9.70(Ft.)
Flow width (from curb towards crown)=  28.704(Ft.)
End of computations, total study area =           48.50 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.440
Area averaged RI index number =  32.8
```

b. STUDY AREA RUNOFF HYDROLOGIC CALCULATIONS

Riverside County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software,(c) 1989 - 2005 Version 7.1
Rational Hydrology Study Date: 12/13/07 File:laq10yr.out

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

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

Study Area-Downtown, 10-yr Storm

Program License Serial Number 6124

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

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

2 year, 1 hour precipitation = 0.700(In.)
100 year, 1 hour precipitation = 1.600(In.)

Storm event year = 10.0
Calculated rainfall intensity data:
1 hour intensity = 1.070(In/Hr)
Slope of intensity duration curve = 0.5900

++
Process from Point/Station 50.000 to Point/Station 52.000
**** INITIAL AREA EVALUATION ****

Initial area flow distance = 600.000(Ft.)
Top (of initial area) elevation = 56.000(Ft.)
Bottom (of initial area) elevation = 51.000(Ft.)
Difference in elevation = 5.000(Ft.)
Slope = 0.00833 s(percent)= 0.83
TC = k(0.370)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.454 min.
Rainfall intensity = 2.706(In/Hr) for a 10.0 year storm
CONDOMINIUM subarea type
Runoff Coefficient = 0.739
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
RI index for soil(AMC 2) = 32.00
Pervious area fraction = 0.350; Impervious fraction = 0.650
Initial subarea runoff = 7.999(CFS)
Total initial stream area = 4.000(Ac.)
Pervious area fraction = 0.350

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Process from Point/Station       52.000 to Point/Station       54.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    51.000(Ft.)
End of street segment elevation =    47.000(Ft.)
Length of street segment  =   400.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  16.000(Ft.)
Distance from crown to crossfall grade break  =  14.000(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 [2] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     12.617(CFS)
Depth of flow =   0.412(Ft.), Average velocity =   2.797(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  14.613(Ft.)
Flow velocity =   2.80(Ft/s)
Travel time =    2.38 min.     TC =   14.84  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.731
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.441(In/Hr) for a    10.0 year storm
Subarea runoff =      9.096(CFS) for      5.100(Ac.)
Total runoff =     17.095(CFS)      Total area =       9.100(Ac.)
Street flow at end of street =     17.095(CFS)
Half street flow at end of street =      8.547(CFS)
Depth of flow =   0.448(Ft.), Average velocity =   3.046(Ft/s)
Note:  depth of flow exceeds top of street crown.
Flow width (from curb towards crown)=  16.000(Ft.)


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Process from Point/Station       54.000 to Point/Station       56.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    47.000(Ft.)
End of street segment elevation =    45.000(Ft.)
Length of street segment  =   250.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     19.773(CFS)
Depth of flow =   0.485(Ft.), Average velocity =   2.867(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  18.245(Ft.)
Flow velocity =   2.87(Ft/s)
Travel time =    1.45 min.     TC =   16.29  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.726
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.310(In/Hr) for a    10.0 year storm
Subarea runoff =      5.202(CFS) for      3.100(Ac.)
Total runoff =     22.296(CFS)      Total area =      12.200(Ac.)
Street flow at end of street =     22.296(CFS)
Half street flow at end of street =     11.148(CFS)
Depth of flow =   0.503(Ft.), Average velocity =   2.941(Ft/s)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    0.16(Ft.)
Flow width (from curb towards crown)=  19.159(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       56.000 to Point/Station       58.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    45.000(Ft.)
End of street segment elevation =    43.000(Ft.)
Length of street segment  =   400.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     26.457(CFS)
```

```
Depth of flow =   0.569(Ft.), Average velocity =   2.536(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    3.45(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   2.54(Ft/s)
Travel time =    2.63 min.     TC =   18.92  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.720
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      2.115(In/Hr) for a    10.0 year storm
Subarea runoff =      8.217(CFS) for      5.400(Ac.)
Total runoff =     30.513(CFS)      Total area =      17.600(Ac.)
Street flow at end of street =     30.513(CFS)
Half street flow at end of street =     15.257(CFS)
Depth of flow =   0.593(Ft.), Average velocity =   2.632(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    4.65(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       58.000 to Point/Station       60.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    43.000(Ft.)
End of street segment elevation =    42.000(Ft.)
Length of street segment  =   300.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     33.429(CFS)
Depth of flow =   0.647(Ft.), Average velocity =   2.321(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    7.35(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   2.32(Ft/s)
```

```
Travel time =    2.15 min.     TC =   21.07  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.715
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.984(In/Hr) for a    10.0 year storm
Subarea runoff =      5.673(CFS) for      4.000(Ac.)
Total runoff =     36.186(CFS)      Total area =      21.600(Ac.)
Street flow at end of street =     36.186(CFS)
Half street flow at end of street =     18.093(CFS)
Depth of flow =   0.663(Ft.), Average velocity =   2.369(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    8.14(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       60.000 to Point/Station       62.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Top of street segment elevation =    42.000(Ft.)
End of street segment elevation =    40.000(Ft.)
Length of street segment  =   400.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  20.000(Ft.)
Distance from crown to crossfall grade break  =  18.000(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 [2] side(s) of the street
Distance from curb to property line  =  13.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =     38.920(CFS)
Depth of flow =   0.637(Ft.), Average velocity =   2.805(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    6.86(Ft.)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =  20.000(Ft.)
Flow velocity =   2.81(Ft/s)
Travel time =    2.38 min.     TC =   23.45  min.
 Adding area flow to street
CONDOMINIUM subarea type
Runoff Coefficient = 0.710
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
RI index for soil(AMC 2)  =  32.00
Pervious area fraction =  0.350; Impervious fraction =  0.650
Rainfall intensity =      1.863(In/Hr) for a    10.0 year storm
Subarea runoff =      5.291(CFS) for      4.000(Ac.)
Total runoff =     41.477(CFS)      Total area =      25.600(Ac.)
Street flow at end of street =     41.477(CFS)
Half street flow at end of street =     20.738(CFS)
Depth of flow =   0.650(Ft.), Average velocity =   2.852(Ft/s)
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =    7.48(Ft.)
Flow width (from curb towards crown)=  20.000(Ft.)
End of computations, total study area =           25.60 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.

Area averaged pervious area fraction(Ap) = 0.350
Area averaged RI index number =  32.0
```

c. STREETS AND CATCH BASIN CAPACITIES

AVENIDA BERMUDAS CAPACITY

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  CIVILCADD/CIVILDESIGN  Engineering Software, (c) 2004   Version 7.0
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Program License Serial Number 6124

------------------------------------------------------------------------
            *** Street Flow Analysis ***
                      AVENIDA BERMUDAS

      Upstream (headworks) Elevation =      0.710(Ft.)
      Downstream (outlet) Elevation =      0.000(Ft.)
      Runoff/Flow Distance =    100.000(Ft.)
      Maximum flow rate in channel(s) =     44.400(CFS)
------------------------------------------------------------------------


Top of street segment elevation =      0.710(Ft.)
End of street segment elevation =      0.000(Ft.)
Length of street segment  =   100.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  32.000(Ft.)
Distance from crown to crossfall grade break  =  20.000(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 [2] side(s) of the street
Distance from curb to property line  =  12.000(Ft.)
Slope from curb to property line (v/hz) =   0.020
Gutter width =   2.000(Ft.)
Gutter hike from flowline =  1.920(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150

Half street cross section data points:
   X-coordinate (Ft.)    Y-coordinate (Ft.)
            0.0000                0.7400 right of way
           12.0000                0.5000 top of curb
           12.0000                0.0000 flow line
           14.0000                0.1600 gutter end
           24.0000                0.3600 grade break
           44.0000                0.7600 crown
Depth of flow =   0.638(Ft.)
Average velocity =   3.036(Ft/s)
Total flow rate in 1/2 street =  22.200(CFS)
Warning: depth of flow exceeds top of curb
Distance that curb overflow reaches into property =    6.91(Ft.)
Streetflow hydraulics:
Halfstreet flow width (curb to crown) =  25.912(Ft.)
Average flow velocity =   3.04(Ft/s)

Channel including Gutter and area towards property line:
      Flow Width =      8.912(Ft.)   Flow Area =      1.594(Sq.Ft)
      Velocity =      2.275(Ft/s)  Flow Rate =      3.627(CFS)
      Froude No. = 0.9480
```

Channel from outside edge of gutter towards grade break:
Flow Width = 10.000(Ft.) Flow Area = 3.782(Sq.Ft)
Velocity = 3.889(Ft/s) Flow Rate = 14.709(CFS)
Froude No. = 1.1143

Channel from grade break to crown:
Flow Width = 13.912(Ft.) Flow Area = 1.935(Sq.Ft)
Velocity = 1.996(Ft/s) Flow Rate = 3.864(CFS)
Froude No. = 0.9432

Total flow rate in street = 44.400(CFS)

DESERT CLUB DRIVE CAPACITY

CIVILCADD/CIVILDESIGN Engineering Software, (c) 2004 Version 7.0

Program License Serial Number 6124

*** Street Flow Analysis ***
DESERT CLUB DRIVE
Upstream (headworks) Elevation = 0.500(Ft.)
Downstream (outlet) Elevation = 0.000(Ft.)
Runoff/Flow Distance = 100.000(Ft.)
Maximum flow rate in channel(s) = 41.500(CFS)

Top of street segment elevation = 0.500(Ft.)
End of street segment elevation = 0.000(Ft.)
Length of street segment = 100.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 20.000(Ft.)
Distance from crown to crossfall grade break = 12.000(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 [2] side(s) of the street
Distance from curb to property line = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 1.920(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150

Half street cross section data points:

X-coordinate (Ft.)	Y-coordinate (Ft.)	
0.0000	0.7400	right of way
12.0000	0.5000	top of curb
12.0000	0.0000	flow line
14.0000	0.1600	gutter end
20.0000	0.2800	grade break
32.0000	0.5200	crown

Depth of flow = 0.650(Ft.)
Average velocity = 2.852(Ft/s)
Total flow rate in 1/2 street = 20.750(CFS)
Warning: depth of flow exceeds top of curb
Note: depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property = 7.49(Ft.)
Streetflow hydraulics:
Halfstreet flow width (curb to crown) = 20.000(Ft.)
Average flow velocity = 2.85(Ft/s)

Channel including Gutter and area towards property line:
Flow Width = 9.486(Ft.) Flow Area = 1.700(Sq.Ft)
Velocity = 2.004(Ft/s) Flow Rate = 3.407(CFS)
Froude No. = 0.8345

Channel from outside edge of gutter towards grade break:
Flow Width = 6.000(Ft.) Flow Area = 2.578(Sq.Ft)
Velocity = 3.718(Ft/s) Flow Rate = 9.585(CFS)
Froude No. = 0.9994

Channel from grade break to crown:
Flow Width = 12.000(Ft.) Flow Area = 2.997(Sq.Ft)
Velocity = 2.589(Ft/s) Flow Rate = 7.758(CFS)
Froude No. = 0.9130

Total flow rate in street = 41.500(CFS)

CALLE TAMPICO AND CATCH BASIN CAPACITIES

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Program License Serial Number 6124

*** Street Flow +Inlet Analysis ***
CALLE TAMPICO

Upstream (headworks) Elevation = 0.120(Ft.)
Downstream (outlet) Elevation = 0.000(Ft.)
Runoff/Flow Distance = 100.000(Ft.)
Maximum flow rate in channel(s) = 71.000(CFS)

Top of street segment elevation = 0.120(Ft.)
End of street segment elevation = 0.000(Ft.)
Length of street segment = 100.000(Ft.)
Height of curb above gutter flowline = 6.0(In.)
Width of half street (curb to crown) = 40.000(Ft.)
Distance from crown to crossfall grade break = 38.000(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 = 12.000(Ft.)
Slope from curb to property line (v/hz) = 0.020
Gutter width = 2.000(Ft.)
Gutter hike from flowline = 1.920(In.)
Manning's N in gutter = 0.0150
Manning's N from gutter to grade break = 0.0150
Manning's N from grade break to crown = 0.0150

Half street cross section data points:

X-coordinate (Ft.)	Y-coordinate (Ft.)	
0.0000	0.7400	right of way
12.0000	0.5000	top of curb
12.0000	0.0000	flow line
14.0000	0.1600	gutter end
14.0000	0.1600	grade break
52.0000	0.9200	crown

CURB INLET TYPE STREET DRAIN, Opening Height = 8.000(In.)

Street Inlet Calculations:
Street flow in street inlet depression = 71.000(CFS)
Gutter depression depth = 4.000(In.)
Gutter depression width = 2.000(Ft.)
Depth of flow = 1.447(Ft.)
Average velocity = 2.357(Ft/s)
Total flow rate in 1/2 street = 71.000(CFS)
!!Warning: Water is above left or right bank elevations

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U.S. DOT Hydraulic Engineering Circular No. 12 inlet calculations:
 Street flow half width at start of inlet =     40.000(Ft.)
 Flow rate in gutter section of street = Qw =     19.376(CFS)
 Given inlet length  L =      7.000(Ft.)
 Ratio of frontal flow to total flow = E0 =  0.2729
Street slope is less than 0.5% ,
Depth of flow indicates an orifice flow
condition exists for an opening height of    8.00(In.)
Using equation Qi = .67hL(2gd0)^.5
Maximum inlet flow capacity =     26.478(CFS)

Half street cross section data points through curb inlet:
             X-coordinate (Ft.)   Y-coordinate (Ft.)
             0.0000                 1.0733 right of way
            12.0000                 0.8333 top of curb
            12.0000                 0.0000 flow line
            14.0000                 0.4933 gutter/depression end
            14.0000                 0.4933 grade break
            52.0000                 1.2533 crown

Remaining flow in street below inlets =     44.522(CFS)
Depth of flow =   0.977(Ft.)
Average velocity =   1.962(Ft/s)
Total flow rate in 1/2 street =  44.522(CFS)
!!Warning: Water is above left or right bank elevations
Warning: depth of flow exceeds top of curb
Note:  depth of flow exceeds top of street crown.
Distance that curb overflow reaches into property =   23.86(Ft.)
Streetflow hydraulics:
Halfstreet flow width (curb to crown) =  40.000(Ft.)
Average flow velocity =   1.96(Ft/s)

Channel including Gutter and area towards property line:
      Flow Width =     14.000(Ft.)   Flow Area =      6.081(Sq.Ft)
      Velocity =      1.922(Ft/s)  Flow Rate =     11.686(CFS)
      Froude No. = 0.5138

Channel from outside edge of gutter towards grade break:
      Flow Width =      0.000(Ft.)   Flow Area =      0.000(Sq.Ft)
      Velocity =      0.000(Ft/s)  Flow Rate =      0.000(CFS)
      Froude No. = 0.0000

Channel from grade break to crown:
      Flow Width =     38.000(Ft.)   Flow Area =     16.615(Sq.Ft)
      Velocity =      1.976(Ft/s)  Flow Rate =     32.836(CFS)
      Froude No. = 0.5267

Total flow rate in street =     44.522(CFS)
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d. REINFORCED CONCRETE BOXES AND PIPES CAPACITIES

LINE DESIGNATION	***66" RCP in Avenue 52***	***60" RCP in Desert Club Drive***			
FLOW REGIME	NORMAL	FULL			
DESIGN FLOW "Q_{25}" (cfs) (BSI Master Drainage Plan)	96.30 cfs	100.00 cfs			
PIPE DIAMETER "d" (inches)	66"	60"			
PIPE MATERIAL	RCP	RCP			
MANNINGS "n" VALUE	0.013	0.013			
PIPE SLOPE "S" (feet/feet)	0.0034	0.0010			
FRICTION SLOPE "S_f" (feet/feet)	0.0034	0.0015			
DEPTH OF FLOW "D" (feet)	2.72'	5.00'			
CALCULATED FLOW (cfs)	96.3 cfs	100.0 cfs			
FLOW AREA "A" (square feet)	11.69 sf	19.63 sf			
WETTED PERIMETER "P"	8.57'	15.71'			
HYDRAULIC RADIUS "R" (A/P)	1.36'	1.25'			
FLOW TOP WIDTH, T (feet)	5.50'	0.00'			
FLOW VELOCITY "V" (feet/second)	8.23 fps	5.09 fps			
VELOCITY HEAD ($V^2/2G$) (feet)	1.05'	0.40'			
SPECIFIC ENERGY (D+ $V^2/2G$) (lb-ft/lb)	3.77'	5.40'			
FLOW CAPACITY DEPTH RATIO "D/d"	1.00	1.00			
PIPE FLOW CAPACITY (cfs)	196.67 cfs	82.36 cfs			

HYDROLOGY MAP

a. DOWNTOWN DRAINAGE STUDY HYDROLOGY MAP