E: Hydrology Report and Water Quality Management Plan

PRELIMINARY HYDROLOGY REPORT

MULTI-USE DEVELOPMENT AT FORMER IRWD SITE

Lake Forest, California

Prepared For
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full circle thinking®

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Date Prepared:

March 2010

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 GEOGRAPHIC SETTING

The Study area consists of 99 acres± and is located in the City of Lake Forest, California. It lies south of Commerce Centre Drive and is bound to the north and east by an existing commercial development, and to the south by the Baker water treatment facility. See Figure 1, Vicinity Map.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to accomplish the following objectives:

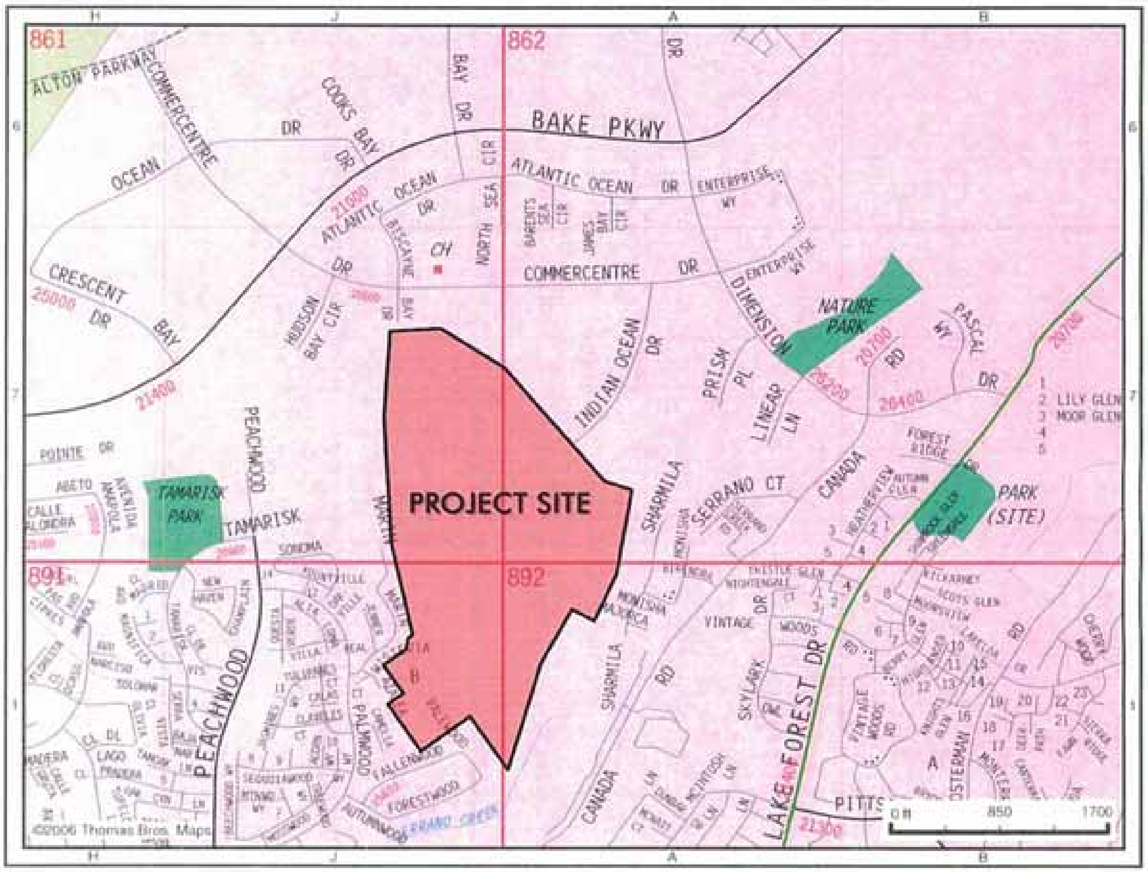
To determine the storm water discharges generated within the project under existing and proposed conditions. (see Appendices 2 and 3).

To evaluate discharges and comment on the design and make recommendations regarding the design and possible storm drain and hydrology related issues in regard to Serrano Creek.

1.3 REFERENCES

- O.C.E.M.A. Hydrology Manual
- O.C.E.M.A. Design Manual

1.4 PROJECT SITE LOCATION MAP



2.0 EXISTING TOPOGRAPHIC & HYDROLOGIC CONDITIONS

2.1 EXISTING TOPOGRAPHY

The site has been rough graded per the Los Alisos Water District (LAWD) plans "Zone 1 – Emergency Storage Reservoirs", 1989 record drawings. Los Alisos Water District has been taken over by Irvine Ranch Water District (IRWD).

The site slopes generally toward the east and Serrano Creek. The site was graded with a variety of basins, ridges and terraced slopes. Significant to the site is a deep ravine on the northeasterly portion of the property. A large portion of the development site drains to this heavily wooded and brushed tributary to Serrano Creek.

2.2 EXISTING DRAINAGE PATTERN

There is no run-on to the site from outside areas. The majority of the site currently flows easterly into Serrano Creek via three existing pipe discharge points. Three small areas also sheet flow directly to Serrano Creek. Those areas (designated OS-3, 4 & 5) are not a part of the development area and their drainage patterns will not be changed.

The current drive approach to the site from Biscayne Bay Drive (designated OS-1 & 2), sheet flows toward Biscayne Bay Drive where flow is picked up via an existing street catch basin.

Two small areas (designated OS-6 & 7), on the west side of the current IRWD buildings, flow to existing developed areas and their existing terrace drains. There areas are not part of the development area and their flow pattern will not change.

Two areas (designated OS-8 & 9), on the west side of the development site, sheet flow westerly into undeveloped land. There is a proposed tract over a portion of the undeveloped land.

2.3 EXISTING STORM DRAIN FACILITIES

Per the LAWD plans previously cited and per visual inspection of the site, there are a number of basins and attendant pipes that currently serve the site. Those basins, risers, outlets and pipes are in various states of repair. Many of the basins are overgrown with brush and several of the outlet pipes were found to be partially buried by silt build-up. There are three outlets to Serrano Creek from the site in addition to the small areas that sheet flow to the creek.

Pipe 'A' drains a large portion of the development site and drains the ravine on the northeasterly portion of the site.

Pipe 'B' drains the abandoned LAWD headquarters building site, a portion of the 'emergency storage reservoir' site and the northerly parts of the above ground tank site.

Pipe 'C' drains the southerly portion of the IRWD above ground tank site. Pipe C is not a part of the development area and is not addressed in this report.

2.4 EXISTING CONDITIONS

3.0 PROPOSED STORM DRAIN FACILITIES

Seven (7) local storm drain systems are proposed for this project as follows:

3.1 STORM DRAIN LINES "A" THROUGH "F"

This system will drain the majority of the site and flows to the proposed detention and water quality basin located adjacent to existing water tanks. Storm flow will be detained in this basin during periods of peak rainfall and released through a proposed culvert to Serrano Creek. The outlet in Serrano Creek will consist of an outlet structure with rip rap to reduce outlet velocities into the creek. The peak 100 year event discharge at this outlet is approximately 134 cfs.

3.2 STORM DRAIN LINE "G"

This system will drain the future Civic Center site adjacent to Serrano Creek. Flow will be directed to a proposed detention and water quality basin adjacent to existing outlet A before being released into Serrano Creek. The outlet of this basin will join the exist 72" pipe at outlet A. The peak 100 year event discharge at this outlet is approximately 33 cfs.

The total 100 year peak discharge from both outlets is approximately 167 cfs with detention. This is less than the existing flow of approximately 200 cfs into Serrano Creek.

4.0 HYDROLOGY STUDY

4.1 STORM FREQUENCY

For the purposes of this study, the 100-year hydrology was calculated. The existing hydrology was calculated for the two outlet points that will be affected by the development. Proposed hydrology for the rough grade state was calculated. Only a conceptual site plan was available for use in this study, therefore a proposed hydrology was calculated using the proposed uses of the various development areas using Alternative IX. No storm drain or street layouts were available, so only a very preliminary storm drain layout was used. Times of concentration could be expected to be longer in the developed condition with actual street and storm drain layouts.

In addition to the 100 year discharge the 2 year discharge under existing and proposed conditions was also calculated.

The 2 year discharge and volumes were used to evaluate the hydrologic conditions of concern to be evaluated in the Water Quality Management Plan (WQMP).

4.2 METHODOLOGY

The hydrology was prepared in conformance with the Orange County Hydrology Manual using AES software (Appendix 3).

Unit hydrographs were then developed using AES software to determine discharge volumes for the proposed condition. Hydrographs for 100 year flows were then routed through the proposed detention basins using HydroCAD modeling software (Appendix 4).

Unit hydrographs were also developed for the 2 year event using existing and proposed conditions. This analysis was done to determine the volume that may or may not need to be retained onsite as part of the new water quality requirements.

5.0 HYDRAULIC REPORT
(ANALYSIS OF THE MAIN LINE STORM DRAIN)

Hydraulic analysis of mainline storm drains will be determined during final plan preparation of the project site.

6.0 DESIGN CRITERIA

The proposed storm drain systems will be designed so as to be consistent with the following goals and guidelines:

A. All buildings shall be protected from flooding during a 100-year frequency storm.

B. 1. Onsite design storm is based on a 25-year frequency. In sump conditions for catch basins and the connecting storm drains also use a 25-year frequency.

   2. Offsite design storm frequency, subject to individual review by the City, should be in accordance with the O.C.E.M.A. Hydrology Manual.

C. 1. Velocity should not exceed 20 FPS in a standard wall R.C.P.

   2. Where velocity exceeds 20 FPS, a special wall R.C.P. with a minimum of 1½-inch steel clearance on the inside surface shall be used.

   3. Maximum velocity in special cover R.C.P. shall be 45 FPS.

D. On arterial highways, one (1) 12′ lane each direction should be clear of water, with a 10-year storm. In sump conditions, a 25-year storm event shall be used.

E. On local streets, flow should not exceed top of curb, for a 10-year storm event, and in sump conditions, a 25-year storm event shall be used.

Cross gutter is not allowed at any through street.

F. Catch basins are to be constructed at all four corners of arterial highway intersections.

G. Open cut is not allowed at any existing arterial highway. Pipe must be jacked across street.

H. Maximum W.S. in CB's for design conditions shall be 0.5′ below inlet (FL.) elevation.

I. Once water is picked up in a storm drain, it should remain in the system.

J. Pipe size may not be decreased downstream without the City's approval.

K. Branching of flow is not allowed.

L. Provide hydraulic and energy grade line calculations and plot of hydraulic grade line on plans with table of appropriate hydraulic data.

M. The ratio of normal velocity to critical velocity should be less than 0.9 or greater than 1.2.

N. All pipes and conduits laid parallel to the roadway shall be placed at least 30" below the roadway surface. However, when pipe depth is in excess of 10' (measured from top of pipe to ground surface), the City's approval is required prior to the initial design of the system.

O. Junction structures should be designed according to the O.C.F.C.D. "Design Manual" or utilize City of Orange Standard Plans.

P. Storm Drain Easement width shall be determined in the following manner:

1. D = 36" or smaller – Distance from top of pipe to ground level times 1.5 + diameter of pipe +2.0' (When cover exceeds 10', use 2 below.)

2. D = 39" or greater – a. Distance from bottom of pipe to ground level times 2.0 + diameter of pipe + 2.0'.

In any case, the width of easement shall not be less than 10.0' in width.

Q. Easement shall be exclusively for storm drain purposes.

R. Storm drain with high fills:

1. Fill Greater than 40 Feet

Storm drains which are installed with cover greater than 40 feet shall have a diameter a minimum of 12 inches larger than that required for hydraulic adequacy and shall be constructed using pre-stressed concrete pipe.*

2. Fill between 30 and 40 Feet

Storm drains which are installed with cover between 30 and 40 feet shall have a diameter a minimum of 12 inches larger than that required for hydraulic adequacy and shall be constructed using pre-stressed concrete pipe if the subgrade of the pipe is in a fill area.* If subgrade is in native soil, reinforced concrete pipe may be used.

3. Fill Between 20 and 30 Feet

Storm drains which are installed with cover between 20 and 30 feet shall be constructed using reinforced concrete pipe. A pipe diameter greater than that required for hydraulic adequacy may be required if, in the opinion of the City Engineer's staff, the particular conditions involved warrant the larger size.

4. Fill Less Than 20 Feet

Normal criteria for storm drain design shall be followed.

* Exceptions may be made for a roadway crossing of a natural watercourse which will remain undisturbed with future development.

7.0 RESULTS AND CONCLUSIONS

At outlet A to Serrano Creek the 100 year peak discharge is approximately 33 cfs. This is 112 cfs less than the existing condition due to site configuration and detention See Exhibit A on next page.

At outlet B to Serrano Creek the 100 year peak discharge is approximately 133 cfs after detention. This is approximately 78 cfs more than the existing condition.

Overall, flows discharged to Serrano Creek is approximately 33 cfs less than the existing condition. The reach of the creek upstream of outlet B will have flow reduced by approximately 112 cfs during the 100 year event. This will greatly reduce the potential for erosion in this reach. Downstream of outlet B the reduced total flow also reduces the potential for erosion, upstream of outlet A the flow in the creek Is not affected by the project. This includes the reach of the creek adjacent to homes on Sharmillo Drive. The table below summarizes these discharges to each existing outlet to Serrano Creek.

Existing Outlet	Exist. Q_{100}	Prop Q_{100}
A	145 cfs	33 cfs
B	55 cfs	134 cfs
TOTAL	200 cfs	167 cfs +/-

Under the 2 year event no more than 105% of the pre development volume and peak flow will be allowed to flow off site. This may be accomplished in a variety of ways which is discussed in more detail within the WQMP. Shown below is a table summarizing the 2 year event conditions.

Summary of 2 Year Event Conditions

Outlet A

Sub Area	Existing Conditon Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)	Proposed Condition Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)
Area A	59.6	38.38	20.96	4.02				
Civic Center					12.4	20.54	6.63	
Direct to Creek					2.95	1.3	25.39	
Totals	59.6	38.38	20.96	4.02	15.35	21.84	6.63	1.63

Outlet B

Sub Area	Existing Conditon Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)	Proposed Condition Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)
Area B	15.4	17.61	8.95	0.98				
Area A					63.4	73.06	8.36	
Tank Site					3.83	3.46	13.07	
Totals	15.4	17.61	8.95	0.98	67.23	76.52	8.36	6.69

Project Totals

	Existing Conditon Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)	Proposed Condition Area (ac)	Q (cfs)	TC (min)	Vol (ac-ft)
Difference In Area Is Due To Areas OS-8 & OS-9	75	55.99		5.0	82.58	98.36		8.32

5% of existing condition volume = 0.25 ac-ft

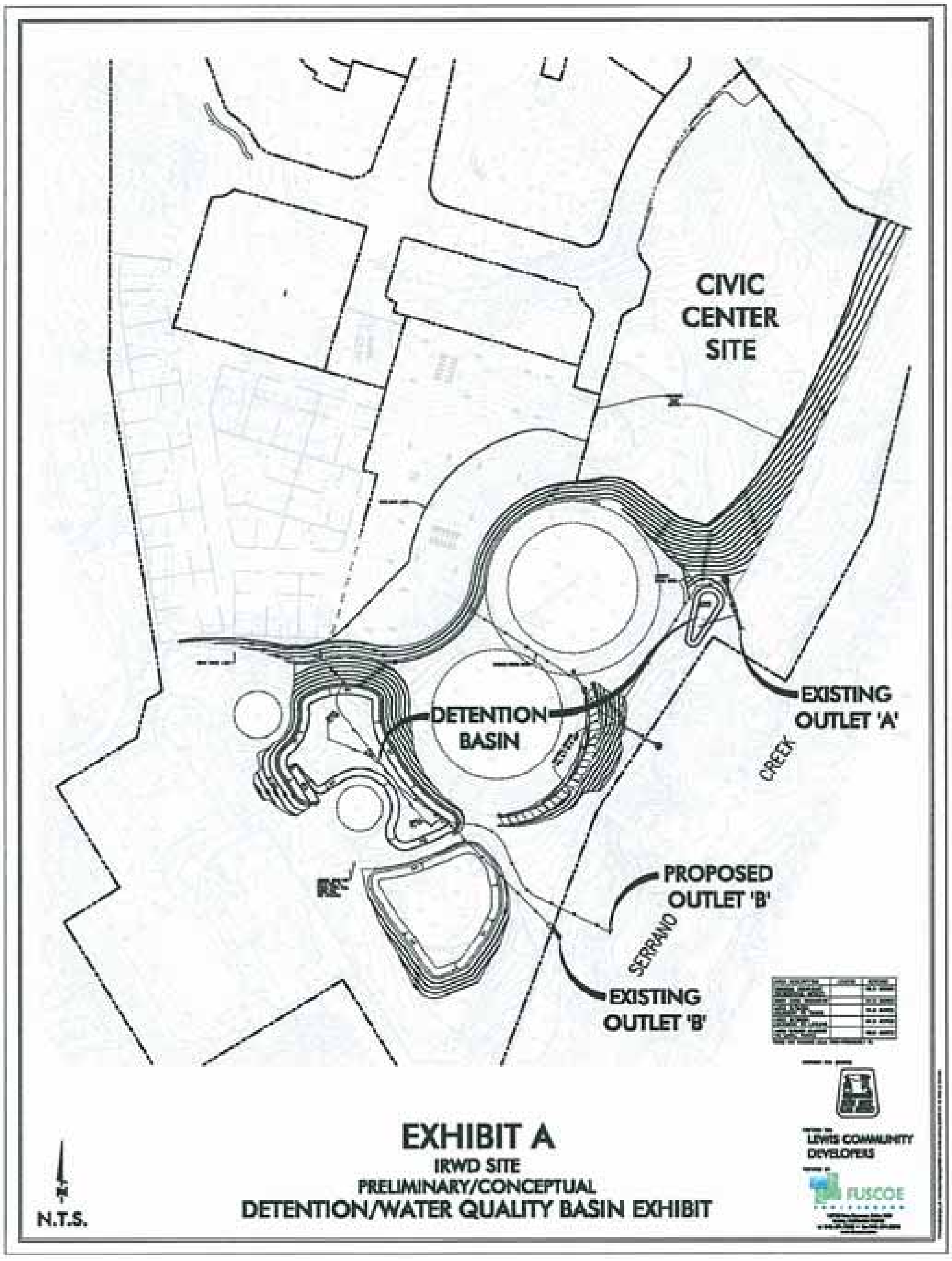
Therefore acceptable total volume = 5.25 ac-ft

Proposed condition total volume = 8.32 ac-ft

Therefore total volume to be retained onsite = 8.32-5.25=3.07 ac-ft

As shown in the table the total additional volume due to development is approximately 3.3 ac-ft. Additional discussion of retention alternatives is presented in the WQMP for the project.

7.1 DETENTION/WATER QUALITY BASIN – EXHIBIT A



8.0 APPENDICES

Appendix 1	*Storm Water Protection Goals*
Appendix 2	*Preliminary 100-Year Existing Hydrology*
Appendix 3	*Preliminary 100 year Proposed Hydrology*
Appendix 4	*Detention Calculations*
Appendix 5	*Hydromodification* a. 2 year existing hydrology and hydrograph b. 2 year proposed hydrology and hydrograph c. Upper retention site hydrograph d. Middle retention site hydrograph
Appendix 6	*Local Existing Hydrology Map (In Pocket)*
Appendix 7	*Local Proposed Hydrology Map (In Pocket)*

CHAPTER 1

DESIGN CRITERIA

The following design criteria shall be used for storm drain and local drainage structures built for dedication to the County of Orange, Orange County Flood Control District, or for private facilities within unincorporated Orange County.

Regional or Sub-Regional design storm frequencies are subject to individual review by the Agency and should be in accordance with the 1986 Hydrology Manual and Flood Protection Goals. This manual does not supersede any information contained within the Orange County Drainage Area Management Plan (DAMP), and is intended to be consistent with the DAMP.

I. PROTECTION LEVELS

A. Structures

The goal is to provide 100-year protection for all habitable structures pursuant to Public Services and Facilities Element of the General Plan.

B. Streets

Street criteria for 100-year storm flow is shown on the attached Figure 1-1, Flood Protection Goals.

1. Arterial Highway

   a. One travel lane (use 12 foot if not determined) shall be free from inundation in each direction in a 10-year storm.

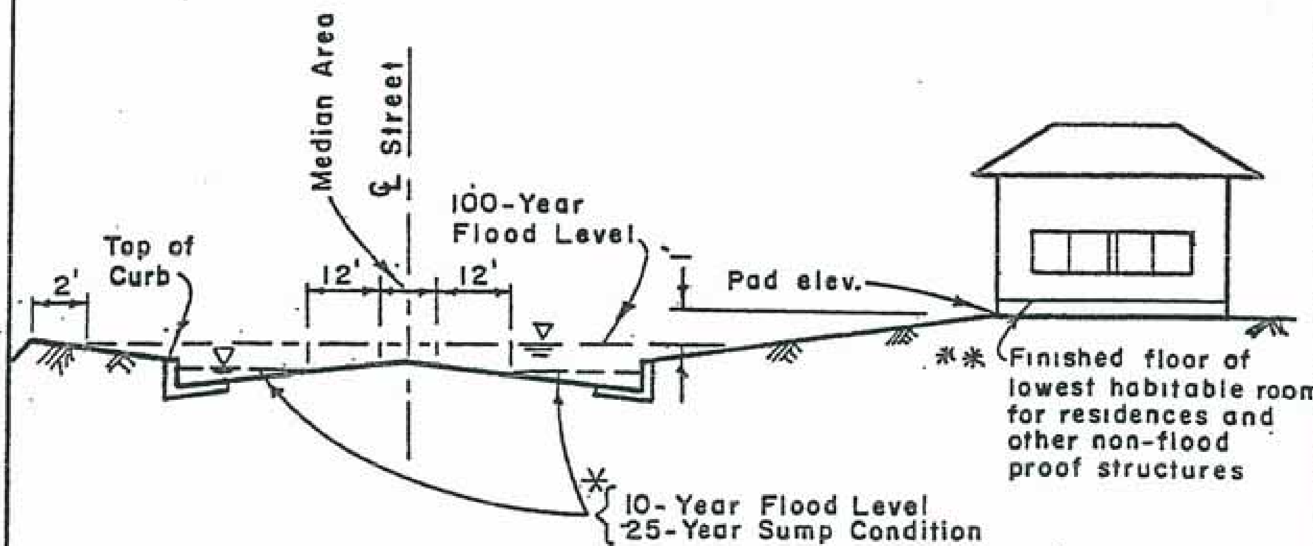
   b. In a sump condition, one travel lane (use 12 foot if not determined) shall be free from inundation in each direction in a 25-year storm.

   c. Median and left-turn pockets shall not be considered as a travel lane.

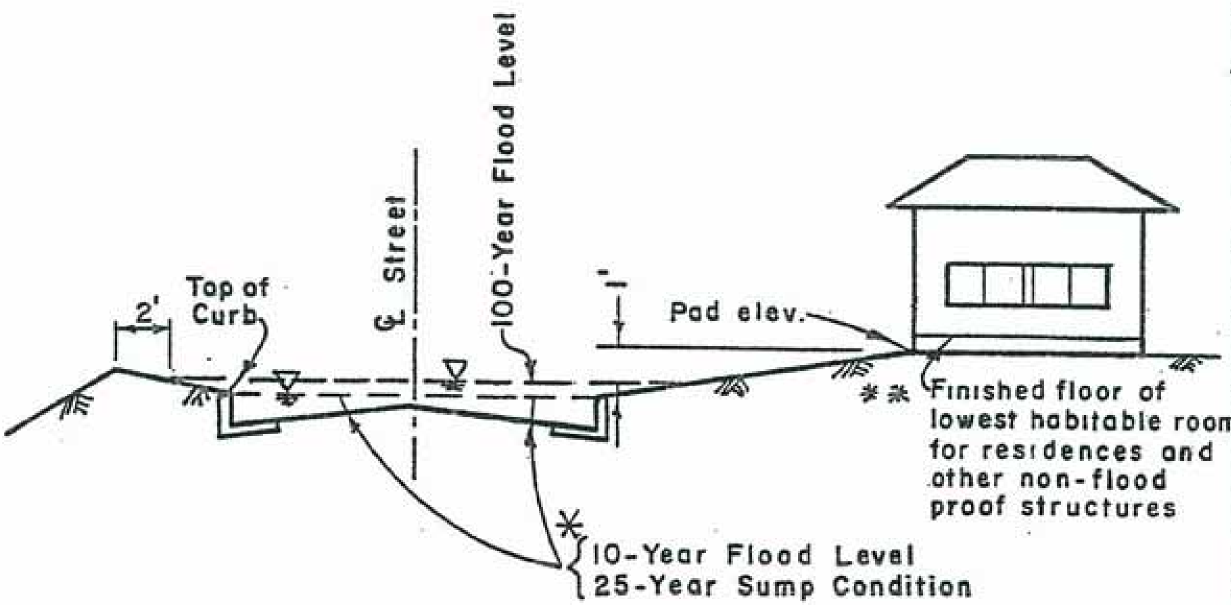
   d. In places where superelevation occurs on arterial highways an inlet shall be provided as necessary to preclude drainage across the travel lanes. The catch basin shall intercept a minimum of a 10-year storm. Local depressions are not to be used for inlets at medians; grate opening or side opening/grate combination (for which future paving overlap will not create a drop) are recommended. Flooding width from median curbs in superelevated sections shall not exceed two feet.

C. General Criteria

1. Storm drains with tributary areas of less than 640 acres are to be designed for a minimum of 10-year frequency below top of curb



ARTERIAL HIGHWAY



LOCAL STREET

NOTE

* For Artérial Hwy and Local Street, depth times velocity cannot exceed six

** The elevation of the lowest floor of buildings, including basements or cellars, must be at least 1 foot above the 100-year flood water surface elevation pursuant to Section 7-9-113.5 of the County Ordinance.

ORANGE COUNTY E.M.A.	
FLOOD PROTECTION GOALS	
1986	1 OF 1

Figure 1-1

using a combination of street and storm drain flow. In sump conditions, catch basins and the connecting storm drains should be designed to a 25-year frequency.

2. Regional or Sub-Regional design storm frequency are subject to individual review by the Agency and should be in accordance with the 1986 Hydrology Manual and Flood Protection Goals and must be designed to contain, as a minimum, the Federal Emergency Management Agency's (FEMA) 100-year discharges used for defining Flood Insurance Rate Map floodplains.

3. The product of the depth of water, y (ft.) at the curb times velocity, v (fps), shall not exceed six for any street. This criteria applies to storms up to a 25-year frequency.

4. Leveed channels are generally prohibited for local drainage applications. The use of leveed channels or floodwalls* in local drainage situations shall include appropriate justification.

II. FREEBOARD

A. Purpose

Freeboard is provided to insure that the desired degree of protection will not be reduced by unaccounted factors which may affect channel hydraulics but which are not required to be specifically analyzed in design. These factors include, but are not limited to, variations in Manning's "n" due to channel bottom conditions, uncertainties in the selection of Manning's "n", variation in stage-discharge relationships, variation in velocity from average velocity, sedimentation, debris, bulking, and air entertainment. When any of the above factors are expected to be significant, its effect shall be separately estimated and necessary provisions included in design to account for same.

B. Reference Elevations

Freeboard is the vertical distance from the design hydraulic grade line as defined below and as shown in Figure 1-2.

1. Top of levee in ultimate unlined earth levee channels.

2. Top of rock where riprap slope protection is utilized.

3. Top of wall or structural section in concrete channels.

4. Soffit where box-conduits or culverts are designed as open channels.

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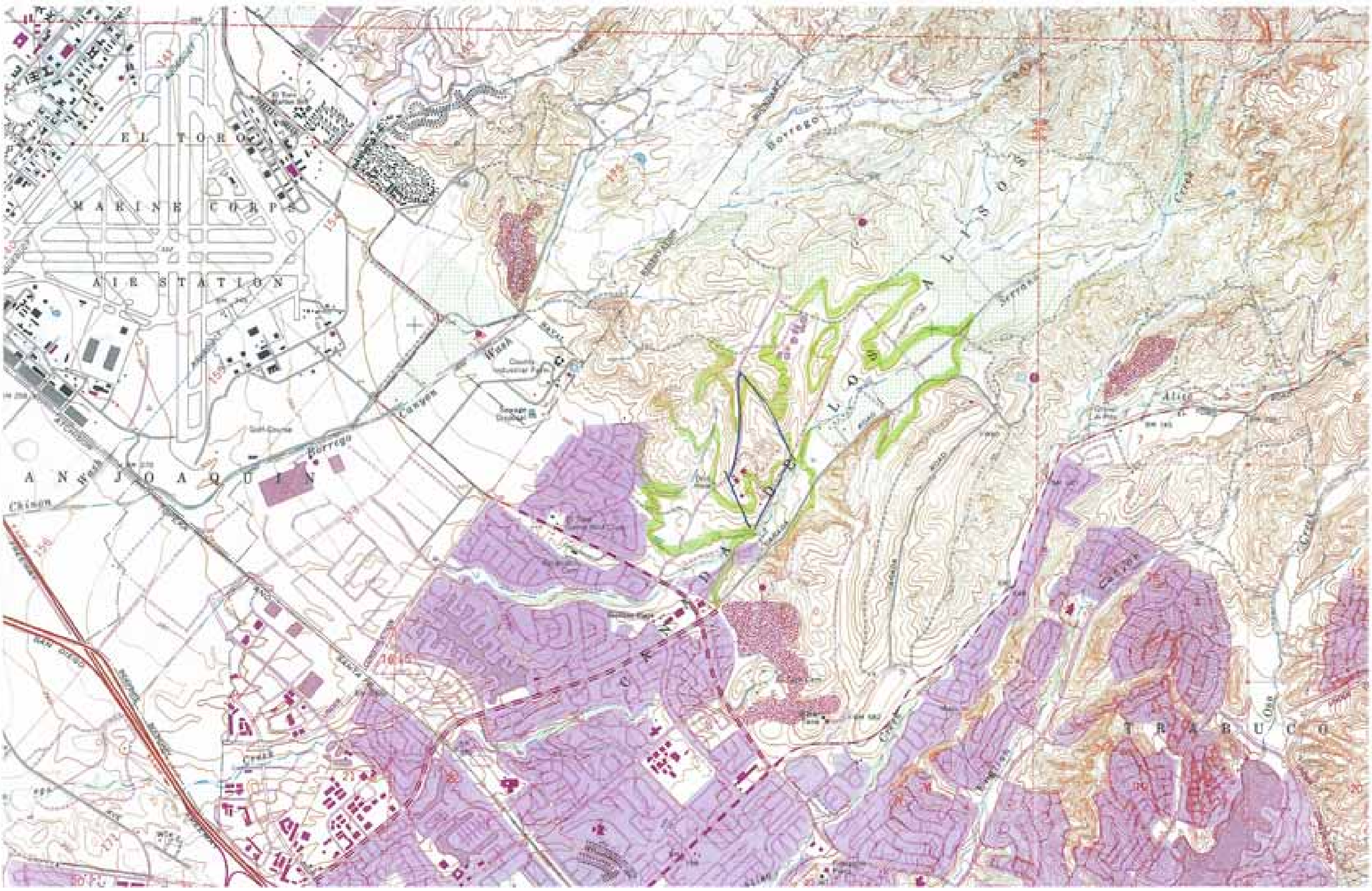
*A floodwall is a wall, in lieu of a levee, which projects above the surrounding ground for the purpose of conveying flood waters. See summary of FEMA's National Flood Insurance Program regulations § 65.10.44 CFR (revised October 1, 1993) in Appendix 2. Engineers designing flood control levees should refer to FEMA's latest regulations before commencing design.



EL TORO
MARINE CORPS
AIR STATION
SAN JOAQUIN
Borrego
Canyon
Wash
Serrano
Aliso
TRABUCO
Creek
Chiquita

EXISTING AREA A

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2007 Advanced Engineering Software (aes)
            Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                         Analysis prepared by:

                         Fuscoe Engineering, Inc
              16795 Von Karman Suite 100, Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA A                                                     *
 * 100 YEAR EXISTING HYDROLOGY                                            *
 * 6/9/08   JEL                                                           *
 **************************************************************************

  FILE NAME: IRWD00A.DAT
  TIME/DATE OF STUDY: 10:37 06/09/2008
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   14.0      9.0    0.020/0.020/0.050   0.33    2.00 0.0313 0.100 0.0140

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   252.00
  ELEVATION DATA: UPSTREAM(FEET) =    706.50  DOWNSTREAM(FEET) =    688.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     8.109
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.690
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
```

```
     LAND USE              GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
 NATURAL POOR COVER
 "GRASS"                     C        0.55      0.25     1.000    97    8.11
 NATURAL POOR COVER
 "GRASS"                     B        0.22      0.30     1.000    93    8.11
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      3.07
 TOTAL AREA(ACRES) =      0.77   PEAK FLOW RATE(CFS) =      3.07

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     688.30
 DOWNSTREAM NODE ELEVATION(FEET) =     658.40
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1247.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.07000
 MAXIMUM DEPTH(FEET) =   3.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.257
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                     B        9.28      0.30     1.000    93
 NATURAL POOR COVER
 "GRASS"                     C       18.28      0.25     1.000    97
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      34.36
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.88
 AVERAGE FLOW DEPTH(FEET) =   0.81   FLOOD WIDTH(FEET) =   26.39
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =    7.21   Tc(MIN.) =   15.32
 SUBAREA AREA(ACRES) =   27.56       SUBAREA RUNOFF(CFS) =   74.17
 EFFECTIVE AREA(ACRES) =   28.33     AREA-AVERAGED Fm(INCH/HR) =   0.27
 AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =        28.3         PEAK FLOW RATE(CFS) =       76.24

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  1.13   FLOOD WIDTH(FEET) =   35.50
 FLOW VELOCITY(FEET/SEC.) =   3.50   DEPTH*VELOCITY(FT*FT/SEC) =   3.95
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =   1499.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   643.00  DOWNSTREAM(FEET) =   636.00
 FLOW LENGTH(FEET) =   106.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  20.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  21.92
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       76.24
 PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   15.40
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =   1605.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     13.00 IS CODE =  82
```

```
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    753.00
  ELEVATION DATA: UPSTREAM(FEET) =    697.80  DOWNSTREAM(FEET) =    640.40

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.715
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.099
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap       SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      B         0.63      0.30      1.000     89   16.71
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      C         3.06      0.25      1.000     95   16.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     3.69   INITIAL SUBAREA RUNOFF(CFS) =     9.43

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =    15.40
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.247
  SUBAREA AREA(ACRES) =     3.69       SUBAREA RUNOFF(CFS) =     9.93
  EFFECTIVE AREA(ACRES) =      32.02   AREA-AVERAGED Fm(INCH/HR) =  0.27
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =        32.0       PEAK FLOW RATE(CFS) =       85.92

****************************************************************************
  FLOW PROCESS FROM NODE      13.00 TO NODE      13.50 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.00  DOWNSTREAM(FEET) =    615.00
  FLOW LENGTH(FEET) =    143.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  27.0 INCH PIPE IS  18.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  30.47
  ESTIMATED PIPE DIAMETER(INCH) =  27.00     NUMBER OF PIPES =    1
  PIPE-FLOW(CFS) =        85.92
  PIPE TRAVEL TIME(MIN.) =   0.08     Tc(MIN.) =    15.48
  LONGEST FLOWPATH FROM NODE      10.00 TO NODE      13.50 =    1748.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      13.50 TO NODE      14.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     615.00
  DOWNSTREAM NODE ELEVATION(FEET) =     596.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    194.00
  "V" GUTTER WIDTH(FEET) =    5.00    GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010    MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
  MAXIMUM DEPTH(FEET) =    3.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.216
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap       SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      A         0.53      0.40      1.000     75
  NATURAL FAIR COVER
```

```
 "CHAPARRAL,NARROWLEAF"     B         1.63      0.30     1.000    89
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C         0.03      0.25     1.000    95
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.32
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     88.77
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  17.41
 AVERAGE FLOW DEPTH(FEET) =   0.59   FLOOD WIDTH(FEET) =   13.51
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.19   Tc(MIN.) =   15.67
 SUBAREA AREA(ACRES) =    2.19       SUBAREA RUNOFF(CFS) =    5.70
 EFFECTIVE AREA(ACRES) =   34.21     AREA-AVERAGED Fm(INCH/HR) =   0.27
 AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =       34.2         PEAK FLOW RATE(CFS) =      90.71

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.60   FLOOD WIDTH(FEET) =   13.60
 FLOW VELOCITY(FEET/SEC.) =  17.53   DEPTH*VELOCITY(FT*FT/SEC) =  10.48
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =    1942.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     14.00 TO NODE     14.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.67
 RAINFALL INTENSITY(INCH/HR) =   3.22
 AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =      34.21
 TOTAL STREAM AREA(ACRES) =      34.21
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      90.71

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   365.00
 ELEVATION DATA: UPSTREAM(FEET) =    696.80  DOWNSTREAM(FEET) =    623.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.294
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.091
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap       SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     B         0.48      0.30     1.000    89   10.29
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C         1.87      0.25     1.000    95   10.29
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =       8.10
 TOTAL AREA(ACRES) =       2.35   PEAK FLOW RATE(CFS) =      8.10

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   618.00  DOWNSTREAM(FEET) =   601.00
  FLOW LENGTH(FEET) =   116.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  17.02
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =         8.10
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   10.41
  LONGEST FLOWPATH FROM NODE     31.00 TO NODE     33.00 =     481.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     14.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     601.00
  DOWNSTREAM NODE ELEVATION(FEET) =     596.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =     76.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
  MAXIMUM DEPTH(FEET) =   3.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.981
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      B        0.01      0.30     1.000    89
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.12
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    3.26
  AVERAGE FLOW DEPTH(FEET) =    0.37   FLOOD WIDTH(FEET) =     9.95
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.39   Tc(MIN.) =   10.80
  SUBAREA AREA(ACRES) =     0.01       SUBAREA RUNOFF(CFS) =     0.03
  EFFECTIVE AREA(ACRES) =     2.36     AREA-AVERAGED Fm(INCH/HR) =   0.26
  AREA-AVERAGED Fp(INCH/HR) =    0.26  AREA-AVERAGED Ap =    1.00
  TOTAL AREA(ACRES) =          2.4        PEAK FLOW RATE(CFS) =       8.10
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.37   FLOOD WIDTH(FEET) =     9.95
  FLOW VELOCITY(FEET/SEC.) =    3.26   DEPTH*VELOCITY(FT*FT/SEC) =   1.20
  LONGEST FLOWPATH FROM NODE     31.00 TO NODE     14.00 =     557.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     14.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    10.80
  RAINFALL INTENSITY(INCH/HR) =    3.98
  AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =        2.36
  TOTAL STREAM AREA(ACRES) =        2.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =        8.10
```

```
 ** CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1       90.71    15.67     3.216   0.27( 0.27) 1.00      34.2       10.00
     2        8.10    10.80     3.981   0.26( 0.26) 1.00       2.4       31.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1       86.84    10.80     3.981   0.27( 0.27) 1.00      25.9       31.00
     2       97.15    15.67     3.216   0.27( 0.27) 1.00      36.6       10.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       97.15     Tc(MIN.) =     15.67
 EFFECTIVE AREA(ACRES) =       36.57   AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       36.6
 LONGEST FLOWPATH FROM NODE      10.00 TO NODE      14.00 =    1942.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      14.00 TO NODE      15.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   596.00  DOWNSTREAM(FEET) =   590.00
 FLOW LENGTH(FEET) =     82.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  23.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  23.71
 ESTIMATED PIPE DIAMETER(INCH) =  30.00     NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       97.15
 PIPE TRAVEL TIME(MIN.) =    0.06     Tc(MIN.) =    15.72
 LONGEST FLOWPATH FROM NODE      10.00 TO NODE      15.00 =    2024.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      15.00 TO NODE      16.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     590.00
 DOWNSTREAM NODE ELEVATION(FEET) =     578.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =     29.00
 "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.00200
 MAXIMUM DEPTH(FEET) =   3.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.196
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap       SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "WOODLAND"                  B        0.01      0.30      1.000     75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      97.16
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.33
 AVERAGE FLOW DEPTH(FEET) =   0.27   FLOOD WIDTH(FEET) =  211.00
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =    0.11   Tc(MIN.) =    15.84
 SUBAREA AREA(ACRES) =     0.01       SUBAREA RUNOFF(CFS) =     0.03
 EFFECTIVE AREA(ACRES) =   36.58      AREA-AVERAGED Fm(INCH/HR) =   0.27
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  AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        36.6         PEAK FLOW RATE(CFS) =      97.15
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.26   FLOOD WIDTH(FEET) =  209.57
  FLOW VELOCITY(FEET/SEC.) =    4.39   DEPTH*VELOCITY(FT*FT/SEC) =   1.16
  LONGEST FLOWPATH FROM NODE      10.00 TO NODE      16.00 =    2053.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      16.00 TO NODE      16.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      50.00 TO NODE      51.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.00
  ELEVATION DATA: UPSTREAM(FEET) =    698.30  DOWNSTREAM(FEET) =    693.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.683
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.804
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
  NATURAL POOR COVER
  "GRASS"                    C        0.30      0.25      1.000     97   11.68
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =       0.96
  TOTAL AREA(ACRES) =       0.30   PEAK FLOW RATE(CFS) =       0.96

****************************************************************************
  FLOW PROCESS FROM NODE      51.00 TO NODE      52.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     693.50
  DOWNSTREAM NODE ELEVATION(FEET) =     666.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1046.00
  "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
  MAXIMUM DEPTH(FEET) =    3.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.235
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL POOR COVER
  "GRASS"                    C        2.50      0.25      1.000     97
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.10
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    4.56
  AVERAGE FLOW DEPTH(FEET) =    0.19   FLOOD WIDTH(FEET) =     6.28
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =    3.82   Tc(MIN.) =    15.51
  SUBAREA AREA(ACRES) =     2.50       SUBAREA RUNOFF(CFS) =     6.72
  EFFECTIVE AREA(ACRES) =     2.80     AREA-AVERAGED Fm(INCH/HR) =    0.25
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 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =         2.8        PEAK FLOW RATE(CFS) =       7.52

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.26    FLOOD WIDTH(FEET) =    6.96
 FLOW VELOCITY(FEET/SEC.) =   5.59   DEPTH*VELOCITY(FT*FT/SEC) =   1.43
 LONGEST FLOWPATH FROM NODE      50.00 TO NODE      52.00 =    1343.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      52.00 TO NODE      53.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     666.50
 DOWNSTREAM NODE ELEVATION(FEET) =     606.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    397.00
 "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010    MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =    3.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.168
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
      LAND USE             GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                     A         0.03       0.40      1.000    85
 NATURAL POOR COVER
 "GRASS"                     B         1.53       0.30      1.000    93
 NATURAL POOR COVER
 "GRASS"                     C         1.16       0.25      1.000    97
 NATURAL POOR COVER
 "GRASS"                     D         0.08       0.20      1.000    98
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.28
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.16
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  11.48
 AVERAGE FLOW DEPTH(FEET) =   0.20    FLOOD WIDTH(FEET) =     6.40
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =    0.58    Tc(MIN.) =    16.08
 SUBAREA AREA(ACRES) =      2.80        SUBAREA RUNOFF(CFS) =      7.28
 EFFECTIVE AREA(ACRES) =      5.60      AREA-AVERAGED Fm(INCH/HR) =   0.26
 AREA-AVERAGED Fp(INCH/HR) =   0.26  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =         5.6        PEAK FLOW RATE(CFS) =      14.64

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.23    FLOOD WIDTH(FEET) =    6.69
 FLOW VELOCITY(FEET/SEC.) =  12.61   DEPTH*VELOCITY(FT*FT/SEC) =   2.88
 LONGEST FLOWPATH FROM NODE      50.00 TO NODE      53.00 =    1740.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      53.00 TO NODE      16.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     606.00
 DOWNSTREAM NODE ELEVATION(FEET) =     578.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    398.00
 "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010    MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =    3.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.016
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
```

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    LAND USE              GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "WOODLAND"                 A       0.65      0.40      1.000    45
 NATURAL GOOD COVER
 "WOODLAND"                 B       2.13      0.30      1.000    75
 NATURAL GOOD COVER
 "WOODLAND"                 C       1.04      0.25      1.000    87
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     19.30
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.62
 AVERAGE FLOW DEPTH(FEET) =   0.58   FLOOD WIDTH(FEET) =   10.25
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.44   Tc(MIN.) =   17.52
 SUBAREA AREA(ACRES) =    3.82       SUBAREA RUNOFF(CFS) =    9.33
 EFFECTIVE AREA(ACRES) =     9.42    AREA-AVERAGED Fm(INCH/HR) =   0.28
 AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =         9.4        PEAK FLOW RATE(CFS) =      23.20

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.64   FLOOD WIDTH(FEET) =   10.79
 FLOW VELOCITY(FEET/SEC.) =   4.89   DEPTH*VELOCITY(FT*FT/SEC) =   3.12
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =    2138.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc     Intensity   Fp(Fm)       Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)            (ACRES)     NODE
     1       23.20   17.52     3.016   0.28( 0.28) 1.00        9.4        50.00
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =    2138.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q       Tc     Intensity   Fp(Fm)       Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)            (ACRES)     NODE
     1       86.84   10.97     3.945   0.27( 0.27) 1.00       25.9        31.00
     2       97.15   15.84     3.196   0.27( 0.27) 1.00       36.6        10.00
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     16.00 =    2053.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc     Intensity   Fp(Fm)       Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)            (ACRES)     NODE
     1      106.29   10.97     3.945   0.27( 0.27) 1.00       31.8        31.00
     2      119.50   15.84     3.196   0.27( 0.27) 1.00       45.1        10.00
     3      114.39   17.52     3.016   0.27( 0.27) 1.00       46.0        50.00
   TOTAL AREA(ACRES) =       46.0

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      119.50   Tc(MIN.) =   15.835
 EFFECTIVE AREA(ACRES) =     45.10   AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27   AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =        46.0
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =    2138.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      16.00 TO NODE      17.00 IS CODE =  91
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     578.00
  DOWNSTREAM NODE ELEVATION(FEET) =     558.83
  CHANNEL LENGTH THRU SUBAREA(FEET) =    466.00
  "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
  PAVEMENT LIP(FEET) =  0.010    MANNING'S N = .0500
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
  MAXIMUM DEPTH(FEET) =   6.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.060
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "WOODLAND"                  A        1.58      0.40      1.000    45
  NATURAL GOOD COVER
  "WOODLAND"                  B        0.24      0.30      1.000    75
  NATURAL GOOD COVER
  "WOODLAND"                  C        0.63      0.25      1.000    87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     122.49
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    6.24
  AVERAGE FLOW DEPTH(FEET) =   1.60   FLOOD WIDTH(FEET) =   20.35
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.24    Tc(MIN.) =   17.08
  SUBAREA AREA(ACRES) =    2.45       SUBAREA RUNOFF(CFS) =     5.97
  EFFECTIVE AREA(ACRES) =   47.55     AREA-AVERAGED Fm(INCH/HR) =   0.28
  AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   1.00
  TOTAL AREA(ACRES) =        48.5        PEAK FLOW RATE(CFS) =     119.50
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  1.58   FLOOD WIDTH(FEET) =   20.18
  FLOW VELOCITY(FEET/SEC.) =   6.20   DEPTH*VELOCITY(FT*FT/SEC) =   9.78
  LONGEST FLOWPATH FROM NODE      50.00 TO NODE      17.00 =    2604.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      17.00 TO NODE      17.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      40.00 TO NODE      41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    614.00
  ELEVATION DATA: UPSTREAM(FEET) =     681.80  DOWNSTREAM(FEET) =     594.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    13.599
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.487
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS    Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      A        0.33      0.40      1.000    75   13.60
  NATURAL FAIR COVER
```

```
 "CHAPARRAL,NARROWLEAF"     B         0.93      0.30     1.000    89   13.60
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C         1.30      0.25     1.000    95   13.60
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.29
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      7.37
 TOTAL AREA(ACRES) =      2.56   PEAK FLOW RATE(CFS) =      7.37

****************************************************************************
 FLOW PROCESS FROM NODE     41.00 TO NODE     42.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   594.50  DOWNSTREAM(FEET) =   567.10
 FLOW LENGTH(FEET) =   131.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  19.03
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      7.37
 PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   13.71
 LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =     745.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     45.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   322.00
 ELEVATION DATA: UPSTREAM(FEET) =    681.80  DOWNSTREAM(FEET) =    618.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.830
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.200
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     B         0.20      0.30     1.000    89    9.83
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C         2.51      0.25     1.000    95    9.83
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      9.63
 TOTAL AREA(ACRES) =      2.71   PEAK FLOW RATE(CFS) =      9.63

****************************************************************************
 FLOW PROCESS FROM NODE     45.00 TO NODE     46.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   615.00  DOWNSTREAM(FEET) =   609.29
 FLOW LENGTH(FEET) =   306.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.16
```

```
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =          9.63
  PIPE TRAVEL TIME(MIN.) =   0.62     Tc(MIN.) =   10.45
  LONGEST FLOWPATH FROM NODE      40.00 TO NODE      46.00 =     628.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      46.00 TO NODE      46.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.45
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.055
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap       SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.20      0.40      0.100    52
  COMMERCIAL                 B        0.58      0.30      0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.33
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =     0.78       SUBAREA RUNOFF(CFS) =     2.82
  EFFECTIVE AREA(ACRES) =       3.49   AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =         3.5       PEAK FLOW RATE(CFS) =      12.09

****************************************************************************
  FLOW PROCESS FROM NODE      46.00 TO NODE      47.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    609.29  DOWNSTREAM(FEET) =    571.50
  FLOW LENGTH(FEET) =    168.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS    7.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.92
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       12.09
  PIPE TRAVEL TIME(MIN.) =   0.13     Tc(MIN.) =   10.58
  LONGEST FLOWPATH FROM NODE      40.00 TO NODE      47.00 =     796.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      47.00 TO NODE      47.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    10.58
  RAINFALL INTENSITY(INCH/HR) =    4.03
  AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.80
  EFFECTIVE STREAM AREA(ACRES) =         3.49
  TOTAL STREAM AREA(ACRES) =         3.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       12.09

****************************************************************************
  FLOW PROCESS FROM NODE      48.00 TO NODE      48.50 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    529.00
  ELEVATION DATA: UPSTREAM(FEET) =    628.80  DOWNSTREAM(FEET) =    582.00
```

```
Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.476
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.050
SUBAREA Tc AND LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
NATURAL POOR COVER
"CHAPARRAL,NARROWLEAF"     A        1.10       0.40      1.000    88   10.48
NATURAL POOR COVER
"GRASS"                    B        0.49       0.30      1.000    93   10.48
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.37
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =        5.27
TOTAL AREA(ACRES) =        1.59   PEAK FLOW RATE(CFS) =       5.27

****************************************************************************
  FLOW PROCESS FROM NODE     48.50 TO NODE     47.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   577.00  DOWNSTREAM(FEET) =   571.50
  FLOW LENGTH(FEET) =   132.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.45
  ESTIMATED PIPE DIAMETER(INCH) =  12.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        5.27
  PIPE TRAVEL TIME(MIN.) =   0.23     Tc(MIN.) =   10.71
  LONGEST FLOWPATH FROM NODE     48.00 TO NODE     47.00 =     661.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     47.00 TO NODE     47.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    10.71
  RAINFALL INTENSITY(INCH/HR) =    4.00
  AREA-AVERAGED Fm(INCH/HR) =  0.37
  AREA-AVERAGED Fp(INCH/HR) =  0.37
  AREA-AVERAGED Ap =  1.00
  EFFECTIVE STREAM AREA(ACRES) =        1.59
  TOTAL STREAM AREA(ACRES) =        1.59
  PEAK FLOW RATE(CFS) AT CONFLUENCE =        5.27

  ** CONFLUENCE DATA **
   STREAM       Q       Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)    NODE
      1       12.09    10.58     4.026  0.26( 0.20) 0.80        3.5      40.00
      2        5.27    10.71     3.999  0.37( 0.37) 1.00        1.6      48.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q       Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)    NODE
      1       17.34    10.58     4.026  0.30( 0.26) 0.86        5.1      40.00
      2       17.27    10.71     3.999  0.30( 0.26) 0.86        5.1      48.00
```

```
COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       17.34     Tc(MIN.) =     10.58
EFFECTIVE AREA(ACRES) =        5.06   AREA-AVERAGED Fm(INCH/HR) =  0.26
AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.86
TOTAL AREA(ACRES) =         5.1
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     47.00 =     796.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     47.00 TO NODE     49.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   571.50  DOWNSTREAM(FEET) =   568.38
FLOW LENGTH(FEET) =   162.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   9.47
ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =        17.34
PIPE TRAVEL TIME(MIN.) =   0.29    Tc(MIN.) =   10.87
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     49.00 =     958.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     49.00 TO NODE     49.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =   10.87
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.966
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"      A        1.50      0.40     1.000    75
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"      B        0.28      0.30     1.000    89
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =     1.78       SUBAREA RUNOFF(CFS) =     5.74
EFFECTIVE AREA(ACRES) =        6.84   AREA-AVERAGED Fm(INCH/HR) =  0.29
AREA-AVERAGED Fp(INCH/HR) =  0.32  AREA-AVERAGED Ap =  0.90
TOTAL AREA(ACRES) =         6.9       PEAK FLOW RATE(CFS) =      22.64

****************************************************************************
FLOW PROCESS FROM NODE     49.00 TO NODE     42.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   568.38  DOWNSTREAM(FEET) =   567.10
FLOW LENGTH(FEET) =    58.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.2 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  10.77
ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =        22.64
PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =   10.96
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =    1016.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  11
----------------------------------------------------------------------------
>>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================
```

```
 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       22.64   10.96     3.947  0.32( 0.29) 0.90        6.8       40.00
     2       22.54   11.08     3.921  0.32( 0.29) 0.90        6.9       48.00
 LONGEST FLOWPATH FROM NODE      40.00 TO NODE      42.00 =    1016.00 FEET.

 ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1        7.37   13.71     3.471  0.29( 0.29) 1.00        2.6       40.00
 LONGEST FLOWPATH FROM NODE      40.00 TO NODE      42.00 =     745.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       29.41   10.96     3.947  0.31( 0.29) 0.92        8.9       40.00
     2       29.34   11.08     3.921  0.31( 0.29) 0.92        8.9       48.00
     3       27.11   13.71     3.471  0.31( 0.29) 0.93        9.4       40.00
   TOTAL AREA(ACRES) =             9.4

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        29.41  Tc(MIN.) =    10.957
 EFFECTIVE AREA(ACRES) =       8.89  AREA-AVERAGED Fm(INCH/HR) =  0.29
 AREA-AVERAGED Fp(INCH/HR) =  0.31  AREA-AVERAGED Ap =  0.92
 TOTAL AREA(ACRES) =         9.4
 LONGEST FLOWPATH FROM NODE      40.00 TO NODE      42.00 =    1016.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      42.00 TO NODE      42.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      42.00 TO NODE      17.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   567.10  DOWNSTREAM(FEET) =   558.83
 FLOW LENGTH(FEET) =    74.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  20.76
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       29.41
 PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =    11.02
 LONGEST FLOWPATH FROM NODE      40.00 TO NODE      17.00 =    1090.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      17.00 TO NODE      17.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       29.41   11.02     3.935  0.31( 0.29) 0.92        8.9       40.00
     2       29.34   11.14     3.909  0.31( 0.29) 0.92        8.9       48.00
     3       27.11   13.77     3.462  0.31( 0.29) 0.93        9.4       40.00
 LONGEST FLOWPATH FROM NODE      40.00 TO NODE      17.00 =    1090.00 FEET.
```

```
** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      106.29   12.25     3.703   0.28( 0.28) 1.00      34.3       31.00
    2      119.50   17.08     3.060   0.28( 0.28) 1.00      47.5       10.00
    3      114.40   18.78     2.899   0.28( 0.28) 1.00      48.5       50.00
LONGEST FLOWPATH FROM NODE      50.00 TO NODE      17.00 =    2604.00 FEET.

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      131.49   11.02     3.935   0.28( 0.28) 0.98      39.7       40.00
    2      131.86   11.14     3.909   0.28( 0.28) 0.98      40.1       48.00
    3      134.70   12.25     3.703   0.28( 0.28) 0.98      43.4       31.00
    4      137.58   13.77     3.462   0.28( 0.28) 0.99      47.9       40.00
    5      143.18   17.08     3.060   0.28( 0.28) 0.99      57.0       10.00
    6      136.70   18.78     2.899   0.28( 0.28) 0.99      57.9       50.00
  TOTAL AREA(ACRES) =          57.9

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       143.18  Tc(MIN.) =    17.080
EFFECTIVE AREA(ACRES) =      56.97  AREA-AVERAGED Fm(INCH/HR) =  0.28
AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap =  0.99
TOTAL AREA(ACRES) =        57.9
LONGEST FLOWPATH FROM NODE      50.00 TO NODE      17.00 =    2604.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      17.00 TO NODE      17.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      17.00 TO NODE      18.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    558.83  DOWNSTREAM(FEET) =    557.94
  FLOW LENGTH(FEET) =    160.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  57.0 INCH PIPE IS  42.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.00
  ESTIMATED PIPE DIAMETER(INCH) =  57.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      143.18
  PIPE TRAVEL TIME(MIN.) =   0.27     Tc(MIN.) =    17.35
  LONGEST FLOWPATH FROM NODE      50.00 TO NODE      18.00 =    2764.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      18.00 TO NODE      18.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    17.35
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.033
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap       SCS
       LAND USE             GROUP    (ACRES)  (INCH/HR)  (DECIMAL)   CN
  NATURAL GOOD COVER
  "CHAPARRAL,BROADLEAF"       A         1.71       0.40      1.000     51
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     1.71      SUBAREA RUNOFF(CFS) =     4.05
```

```
  EFFECTIVE AREA(ACRES) =      58.68   AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap =  0.99
  TOTAL AREA(ACRES) =        59.6      PEAK FLOW RATE(CFS) =     145.35
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =        59.6  TC(MIN.) =     17.35
  EFFECTIVE AREA(ACRES) =      58.68  AREA-AVERAGED Fm(INCH/HR)=  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap = 0.988
  PEAK FLOW RATE(CFS)    =      145.35

  ** PEAK FLOW RATE TABLE **
   STREAM        Q       Tc    Intensity   Fp(Fm)     Ap      Ae     HEADWATER
   NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
      1       134.10   11.29     3.879  0.29( 0.28) 0.98      41.4      40.00
      2       134.45   11.42     3.855  0.29( 0.28) 0.98      41.8      48.00
      3       137.00   12.52     3.656  0.29( 0.28) 0.98      45.1      31.00
      4       140.25   14.04     3.424  0.29( 0.28) 0.99      49.6      40.00
      5       145.35   17.35     3.033  0.28( 0.28) 0.99      58.7      10.00
      6       139.12   19.05     2.875  0.28( 0.28) 0.99      59.6      50.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

EXISTING AREA B

```
****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2007 Advanced Engineering Software (aes)
            Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                          Analysis prepared by:

                          Fuscoe Engineering, Inc
               16795 Von Karman Suite 100, Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA B                                                      *
 * 100 YEAR EXISTING HYDROLOGY                                             *
 * 6/9/08  JEL                                                             *
 **************************************************************************

  FILE NAME: IRWD00B.DAT
  TIME/DATE OF STUDY: 12:04 06/09/2008
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================= ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     61.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   240.00
  ELEVATION DATA: UPSTREAM(FEET) =    679.70  DOWNSTREAM(FEET) =    673.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     5.675
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.754
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 COMMERCIAL                   C        2.04      0.25     0.100    86    5.67
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      10.52
 TOTAL AREA(ACRES) =       2.04   PEAK FLOW RATE(CFS) =      10.52

****************************************************************************
 FLOW PROCESS FROM NODE     61.00 TO NODE     62.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   673.60  DOWNSTREAM(FEET) =   637.00
 FLOW LENGTH(FEET) =   540.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  14.20
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       10.52
 PIPE TRAVEL TIME(MIN.) =   0.63    Tc(MIN.) =    6.31
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.00 =     780.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     62.00 TO NODE     62.50 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    637.00
 DOWNSTREAM NODE ELEVATION(FEET) =    624.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    62.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
 MAXIMUM DEPTH(FEET) =   3.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.378
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                      B        0.11      0.30     1.000    93
 NATURAL POOR COVER
 "GRASS"                      C        1.36      0.25     1.000    97
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.91
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  13.22
 AVERAGE FLOW DEPTH(FEET) =   0.20   FLOOD WIDTH(FEET) =    7.29
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.08   Tc(MIN.) =    6.39
 SUBAREA AREA(ACRES) =    1.47      SUBAREA RUNOFF(CFS) =    6.78
 EFFECTIVE AREA(ACRES) =    3.51    AREA-AVERAGED Fm(INCH/HR) =   0.12
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.48
 TOTAL AREA(ACRES) =        3.5         PEAK FLOW RATE(CFS) =      16.61

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.22   FLOOD WIDTH(FEET) =    7.56
 FLOW VELOCITY(FEET/SEC.) =  14.07   DEPTH*VELOCITY(FT*FT/SEC) =   3.10
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.50 =     842.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     62.50 TO NODE     63.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
```

```
UPSTREAM NODE ELEVATION(FEET) =    624.00
DOWNSTREAM NODE ELEVATION(FEET) =    613.00
CHANNEL LENGTH THRU SUBAREA(FEET) =   192.00
"V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
MAXIMUM DEPTH(FEET) =   3.00
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.052
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
NATURAL POOR COVER
"GRASS"                    B        1.41      0.30     1.000    93
NATURAL POOR COVER
"GRASS"                    C        3.92      0.25     1.000    97
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       28.03
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    4.35
AVERAGE FLOW DEPTH(FEET) =   0.69   FLOOD WIDTH(FEET) =    15.03
"V" GUTTER FLOW TRAVEL TIME(MIN.) =    0.74   Tc(MIN.) =     7.12
SUBAREA AREA(ACRES) =     5.33       SUBAREA RUNOFF(CFS) =    22.97
EFFECTIVE AREA(ACRES) =     8.84     AREA-AVERAGED Fm(INCH/HR) =   0.21
AREA-AVERAGED Fp(INCH/HR) =    0.26  AREA-AVERAGED Ap =    0.79
TOTAL AREA(ACRES) =         8.8          PEAK FLOW RATE(CFS) =      38.55

END OF SUBAREA "V" GUTTER HYDRAULICS:
DEPTH(FEET) =  0.79   FLOOD WIDTH(FEET) =   16.75
FLOW VELOCITY(FEET/SEC.) =    4.72   DEPTH*VELOCITY(FT*FT/SEC) =   3.75
LONGEST FLOWPATH FROM NODE     60.00 TO NODE     63.00 =    1034.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     63.00 TO NODE     64.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   607.80
FLOW LENGTH(FEET) =   108.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  24.0 INCH PIPE IS  16.2 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  17.10
ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =       38.55
PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =     7.23
LONGEST FLOWPATH FROM NODE     60.00 TO NODE     64.00 =    1142.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     64.00 TO NODE     64.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =     7.23
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.009
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
NATURAL POOR COVER
"GRASS"                    B        0.01      0.30     1.000    93
NATURAL POOR COVER
"GRASS"                    C        0.77      0.25     1.000    97
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =     0.78      SUBAREA RUNOFF(CFS) =     3.34
```

```
  EFFECTIVE AREA(ACRES) =       9.62   AREA-AVERAGED Fm(INCH/HR) =  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.81
  TOTAL AREA(ACRES) =        9.6       PEAK FLOW RATE(CFS) =      41.55

****************************************************************************
  FLOW PROCESS FROM NODE     64.00 TO NODE     65.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   607.80  DOWNSTREAM(FEET) =   582.15
  FLOW LENGTH(FEET) =   416.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  19.17
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       41.55
  PIPE TRAVEL TIME(MIN.) =   0.36    Tc(MIN.) =    7.59
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     65.00 =    1558.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.59
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.871
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL POOR COVER
  "GRASS"                    B        0.99      0.30     1.000    93
  NATURAL POOR COVER
  "GRASS"                    C        0.30      0.25     1.000    97
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.29
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     1.29       SUBAREA RUNOFF(CFS) =     5.32
  EFFECTIVE AREA(ACRES) =      10.91   AREA-AVERAGED Fm(INCH/HR) =  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.83
  TOTAL AREA(ACRES) =       10.9       PEAK FLOW RATE(CFS) =      45.67

****************************************************************************
  FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =     7.59
  RAINFALL INTENSITY(INCH/HR) =    4.87
  AREA-AVERAGED Fm(INCH/HR) =  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.83
  EFFECTIVE STREAM AREA(ACRES) =      10.91
  TOTAL STREAM AREA(ACRES) =      10.91
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      45.67

****************************************************************************
  FLOW PROCESS FROM NODE     70.00 TO NODE     71.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   572.00
```

```
ELEVATION DATA: UPSTREAM(FEET) =    644.70  DOWNSTREAM(FEET) =    593.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.518
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.359
SUBAREA Tc AND LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
NATURAL FAIR COVER
"GRASS"                     B        1.93      0.30      1.000    86   14.52
NATURAL FAIR COVER
"GRASS"                     C        0.97      0.25      1.000    93   14.52
NATURAL FAIR COVER
"GRASS"                     D        0.04      0.20      1.000    96   14.52
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.28
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =       8.14
TOTAL AREA(ACRES) =       2.94   PEAK FLOW RATE(CFS) =       8.14

****************************************************************************
FLOW PROCESS FROM NODE     71.00 TO NODE     72.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   589.80  DOWNSTREAM(FEET) =   583.00
FLOW LENGTH(FEET) =   266.00   MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   9.25
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =         8.14
PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    15.00
LONGEST FLOWPATH FROM NODE     70.00 TO NODE     72.00 =     838.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     72.00 TO NODE     72.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =   15.00
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.297
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
NATURAL GOOD COVER
"GRASS"                     A        0.10      0.40      1.000    58
NATURAL GOOD COVER
"GRASS"                     B        1.19      0.30      1.000    80
NATURAL GOOD COVER
"GRASS"                     C        0.26      0.25      1.000    90
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =     1.55     SUBAREA RUNOFF(CFS) =     4.18
EFFECTIVE AREA(ACRES) =       4.49   AREA-AVERAGED Fm(INCH/HR) =  0.29
AREA-AVERAGED Fp(INCH/HR) =  0.29  AREA-AVERAGED Ap =  1.00
TOTAL AREA(ACRES) =         4.5      PEAK FLOW RATE(CFS) =      12.16

****************************************************************************
FLOW PROCESS FROM NODE     72.00 TO NODE     65.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

change

change

```
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    583.00  DOWNSTREAM(FEET) =    582.15
 FLOW LENGTH(FEET) =    128.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =    5.96
 ESTIMATED PIPE DIAMETER(INCH) =  21.00     NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        12.16
 PIPE TRAVEL TIME(MIN.) =    0.36     Tc(MIN.) =    15.35
 LONGEST FLOWPATH FROM NODE      70.00 TO NODE      65.00 =      966.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      65.00 TO NODE      65.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    15.35
 RAINFALL INTENSITY(INCH/HR) =    3.25
 AREA-AVERAGED Fm(INCH/HR) =  0.29
 AREA-AVERAGED Fp(INCH/HR) =  0.29
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =        4.49
 TOTAL STREAM AREA(ACRES) =        4.49
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       12.16

 ** CONFLUENCE DATA **
  STREAM        Q       Tc   Intensity  Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
     1        45.67     7.59     4.871  0.26( 0.22) 0.83      10.9       60.00
     2        12.16    15.35     3.253  0.29( 0.29) 1.00       4.5       70.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM        Q       Tc   Intensity  Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
     1        54.97     7.59     4.871  0.27( 0.23) 0.86      13.1       60.00
     2        41.95    15.35     3.253  0.27( 0.24) 0.88      15.4       70.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       54.97    Tc(MIN.) =      7.59
 EFFECTIVE AREA(ACRES) =       13.13   AREA-AVERAGED Fm(INCH/HR) =  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.86
 TOTAL AREA(ACRES) =        15.4
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      65.00 =     1558.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      65.00 TO NODE      66.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    582.15  DOWNSTREAM(FEET) =    563.50
 FLOW LENGTH(FEET) =    278.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  18.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  20.70
 ESTIMATED PIPE DIAMETER(INCH) =  24.00     NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        54.97
 PIPE TRAVEL TIME(MIN.) =    0.22     Tc(MIN.) =     7.81
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      66.00 =     1836.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      66.00 TO NODE      67.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   563.50  DOWNSTREAM(FEET) =   562.00
  FLOW LENGTH(FEET) =   185.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  27.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.41
  ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       54.97
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =    8.14
  LONGEST FLOWPATH FROM NODE      60.00 TO NODE      67.00 =    2021.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)        =        15.4  TC(MIN.) =       8.14
  EFFECTIVE AREA(ACRES) =      13.13  AREA-AVERAGED Fm(INCH/HR)=  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap = 0.860
  PEAK FLOW RATE(CFS)     =       54.97

  ** PEAK FLOW RATE TABLE **
   STREAM       Q       Tc    Intensity  Fp(Fm)      Ap      Ae      HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
      1       54.97    8.14     4.679  0.27( 0.23) 0.86      13.1       60.00
      2       41.95   15.94     3.184  0.27( 0.24) 0.88      15.4       70.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

EXISTING OFFSITE 8

```
****************************************************************************
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                          Analysis prepared by:

                          Fuscoe Engineering, Inc
               16795 Von Karman Suite 100, Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA OFF-SITE 8 TO TRACT 15594                             *
 * 100 YEAR EXISTING HYDROLOGY                                            *
 * 6/9/08   JEL                                                           *
 **************************************************************************

  FILE NAME: IRW00OS8.DAT
  TIME/DATE OF STUDY: 15:47 06/09/2008
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =    8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)    (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   14.0      9.0    0.020/0.020/0.050   0.33    2.00 0.0313 0.100 0.0140

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE     91.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    332.00
  ELEVATION DATA: UPSTREAM(FEET) =    693.40  DOWNSTREAM(FEET) =    625.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.076
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.567
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap     SCS   Tc
```

```
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL GOOD COVER
 "OPEN BRUSH"               C        2.68      0.25      1.000    91   13.08
 NATURAL GOOD COVER
 "OPEN BRUSH"               D        1.62      0.20      1.000    95   13.08
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =     12.91
 TOTAL AREA(ACRES) =      4.30   PEAK FLOW RATE(CFS) =      12.91
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)       =         4.3  TC(MIN.) =     13.08
 EFFECTIVE AREA(ACRES) =      4.30  AREA-AVERAGED Fm(INCH/HR)=  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)     =      12.91
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

EXISTING OFFSITE 9

```
****************************************************************************
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                        Analysis prepared by:

                        Fuscoe Engineering, Inc
              16795 Von Karman Suite 100, Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA OFF-SITE 9 TO OFF-SITE AREA                            *
 * 100 YEAR EXISTING HYDROLOGY                                             *
 * 6/9/08  JEL                                                             *
 **************************************************************************

  FILE NAME: IRW00OS9.DAT
  TIME/DATE OF STUDY: 15:48 06/09/2008
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =    8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
    HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
    WIDTH  CROSSFALL  IN- / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
=== =====  =========  =================  ======  ===== ====== ===== =======
  1  30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2  14.0      9.0    0.020/0.020/0.050   0.33    2.00 0.0313 0.100 0.0140

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     95.00 TO NODE     96.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   587.00
  ELEVATION DATA: UPSTREAM(FEET) =    700.00  DOWNSTREAM(FEET) =    660.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   20.492
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.757
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap     SCS   Tc
```

```
     LAND USE              GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL GOOD COVER
 "OPEN BRUSH"                C        2.02      0.25     1.000    91   20.49
 NATURAL GOOD COVER
 "OPEN BRUSH"                D        0.08      0.20     1.000    95   20.49
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      4.74
 TOTAL AREA(ACRES) =      2.10   PEAK FLOW RATE(CFS) =      4.74
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        2.1  TC(MIN.) =     20.49
 EFFECTIVE AREA(ACRES) =       2.10  AREA-AVERAGED Fm(INCH/HR)=  0.25
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)    =       4.74
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

RATIONAL PROPOSED AREA A

```
****************************************************************************
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                          Analysis prepared by:

                            Fuscoe Engineering
               16795 Von Karman Suite 100 Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * I.R.W.D. - LAKE FOREST SITE                                              *
 * PROPOSED 100 YEAR HYDROLOGY STUDY RESIDENTIAL AREA "A"                   *
 * DEVELOPER: LEWIS OPERATING CORP                                          *
 **************************************************************************

  FILE NAME: IRWD100.DAT
  TIME/DATE OF STUDY: 10:46 07/14/2009
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
 1   18.0      13.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    295.00
  ELEVATION DATA: UPSTREAM(FEET) =    692.10  DOWNSTREAM(FEET) =    689.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.998
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.727
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE             GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        1.97      0.25      0.200    86    8.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      8.29
  TOTAL AREA(ACRES) =       1.97   PEAK FLOW RATE(CFS) =       8.29
```

```
****************************************************************************
  FLOW PROCESS FROM NODE       7.00 TO NODE       8.00 IS CODE =  56
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    689.30  DOWNSTREAM(FEET) =    683.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =    320.00   CHANNEL SLOPE =  0.0172
  GIVEN CHANNEL BASE(FEET) =  120.00   CHANNEL FREEBOARD(FEET) =  0.1
  "Z" FACTOR =    0.100   MANNING'S FACTOR = 0.030
  *ESTIMATED CHANNEL HEIGHT(FEET) =    0.22
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.844
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap       SCS
       LAND USE             GROUP    (ACRES)   (INCH/HR)  (DECIMAL)   CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C         7.10       0.25      0.200     86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       20.53
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    1.53
  AVERAGE FLOW DEPTH(FEET) =   0.11    TRAVEL TIME(MIN.) =    3.48
  Tc(MIN.) =    11.48
  SUBAREA AREA(ACRES) =      7.10         SUBAREA RUNOFF(CFS) =    24.24
  EFFECTIVE AREA(ACRES) =        9.07      AREA-AVERAGED Fm(INCH/HR) =    0.05
  AREA-AVERAGED Fp(INCH/HR) =    0.25  AREA-AVERAGED Ap =    0.20
  TOTAL AREA(ACRES) =          9.1          PEAK FLOW RATE(CFS) =       30.97
  GIVEN CHANNEL BASE(FEET) =  120.00   CHANNEL FREEBOARD(FEET) =  0.1
  "Z" FACTOR =    0.100   MANNING'S FACTOR = 0.030
  *ESTIMATED CHANNEL HEIGHT(FEET) =    0.24

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =   0.14   FLOW VELOCITY(FEET/SEC.) =    1.82
  LONGEST FLOWPATH FROM NODE       6.00 TO NODE       8.00 =     615.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE       8.00 TO NODE       9.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    676.70  DOWNSTREAM(FEET) =    654.30
  FLOW LENGTH(FEET) =    510.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  14.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.09
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =         30.97
  PIPE TRAVEL TIME(MIN.) =    0.56    Tc(MIN.) =    12.04
  LONGEST FLOWPATH FROM NODE       6.00 TO NODE       9.00 =    1125.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE       9.00 TO NODE       9.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    12.04
  RAINFALL INTENSITY(INCH/HR) =    3.74
  AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.25
  AREA-AVERAGED Ap =   0.20
  EFFECTIVE STREAM AREA(ACRES) =        9.07
  TOTAL STREAM AREA(ACRES) =        9.07
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       30.97
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
  ELEVATION DATA: UPSTREAM(FEET) =    691.00  DOWNSTREAM(FEET) =    689.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.487
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.330
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C        0.75      0.25      0.200    86    6.49
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =       3.56
  TOTAL AREA(ACRES) =       0.75   PEAK FLOW RATE(CFS) =       3.56

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     6.49
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.330
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C        0.98      0.25      0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     0.98      SUBAREA RUNOFF(CFS) =     4.66
  EFFECTIVE AREA(ACRES) =        1.73  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        1.7       PEAK FLOW RATE(CFS) =        8.22

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    654.70  DOWNSTREAM(FEET) =    654.30
  FLOW LENGTH(FEET) =     80.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =    4.77
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.22
  PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =     6.77
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE      9.00 =     266.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     6.77
  RAINFALL INTENSITY(INCH/HR) =    5.20
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
```

```
 EFFECTIVE STREAM AREA(ACRES) =        1.73
 TOTAL STREAM AREA(ACRES) =        1.73
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        8.22

 ** CONFLUENCE DATA **
  STREAM      Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER    (CFS)   (MIN.) (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1      30.97   12.04     3.740  0.25( 0.05) 0.20        9.1       6.00
     2       8.22    6.77     5.202  0.25( 0.05) 0.20        1.7      10.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM      Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER    (CFS)   (MIN.) (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1      32.53    6.77     5.202  0.25( 0.05) 0.20        6.8      10.00
     2      36.85   12.04     3.740  0.25( 0.05) 0.20       10.8       6.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       36.85     Tc(MIN.) =     12.04
 EFFECTIVE AREA(ACRES) =       10.80    AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =       10.8
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE       9.00 =    1125.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    654.30  DOWNSTREAM(FEET) =    652.00
 FLOW LENGTH(FEET) =    450.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  25.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =    6.97
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       36.85
 PIPE TRAVEL TIME(MIN.) =   1.08     Tc(MIN.) =   13.12
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      13.00 =    1575.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    13.12
 RAINFALL INTENSITY(INCH/HR) =    3.56
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       10.80
 TOTAL STREAM AREA(ACRES) =       10.80
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       36.85

****************************************************************************
 FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    279.00
 ELEVATION DATA: UPSTREAM(FEET) =    688.90  DOWNSTREAM(FEET) =    686.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.681
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.838
```

```
SUBAREA Tc AND LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS   Tc
     LAND USE             GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
RESIDENTIAL
"11+ DWELLINGS/ACRE"        C        0.98       0.25      0.200    86    7.68
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
SUBAREA RUNOFF(CFS) =      4.22
TOTAL AREA(ACRES) =      0.98   PEAK FLOW RATE(CFS) =      4.22

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     16.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.68
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.838
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        4.48       0.25      0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    4.48      SUBAREA RUNOFF(CFS) =   19.30
  EFFECTIVE AREA(ACRES) =      5.46   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        5.5       PEAK FLOW RATE(CFS) =      23.53

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.50  DOWNSTREAM(FEET) =   652.00
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  23.78
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       23.53
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    7.78
  LONGEST FLOWPATH FROM NODE     14.00 TO NODE     13.00 =    419.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     7.78
  RAINFALL INTENSITY(INCH/HR) =    4.80
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =        5.46
  TOTAL STREAM AREA(ACRES) =        5.46
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       23.53

  ** CONFLUENCE DATA **
   STREAM       Q      Tc    Intensity   Fp(Fm)     Ap       Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
      1      32.53    7.89     4.764  0.25( 0.05) 0.20       6.8      10.00
      1      36.85   13.12     3.560  0.25( 0.05) 0.20      10.8       6.00
      2      23.53    7.78     4.803  0.25( 0.05) 0.20       5.5      14.00
```

```
RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR)  (INCH/HR)           (ACRES)    NODE
    1       55.86    7.78    4.803   0.25( 0.05) 0.20      12.2      14.00
    2       55.86    7.89    4.764   0.25( 0.05) 0.20      12.3      10.00
    3       54.23   13.12    3.560   0.25( 0.05) 0.20      16.3       6.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      55.86   Tc(MIN.) =     7.89
EFFECTIVE AREA(ACRES) =      12.29   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =        16.3
LONGEST FLOWPATH FROM NODE      6.00 TO NODE     13.00 =    1575.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     17.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   652.00  DOWNSTREAM(FEET) =   648.00
 FLOW LENGTH(FEET) =   280.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  25.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  11.17
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       55.86
 PIPE TRAVEL TIME(MIN.) =   0.42    Tc(MIN.) =     8.31
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     17.00 =    1855.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.31
 RAINFALL INTENSITY(INCH/HR) =   4.62
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =      12.29
 TOTAL STREAM AREA(ACRES) =      16.26
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      55.86

****************************************************************************
 FLOW PROCESS FROM NODE     18.00 TO NODE     19.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   216.00
 ELEVATION DATA: UPSTREAM(FEET) =    667.00  DOWNSTREAM(FEET) =    663.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.796
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.685
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 D        0.37      0.20      0.100    91    5.80
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =       1.89
 TOTAL AREA(ACRES) =       0.37   PEAK FLOW RATE(CFS) =       1.89
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     19.00 TO NODE     20.00 IS CODE =  81
----------------------------------------------------------------------------

  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.80
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.685
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap       SCS
       LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 D        1.35      0.20     0.100     91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.35      SUBAREA RUNOFF(CFS) =    6.88
  EFFECTIVE AREA(ACRES) =       1.72  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =         1.7       PEAK FLOW RATE(CFS) =       8.77

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     17.00 IS CODE =  31
----------------------------------------------------------------------------

  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    654.50  DOWNSTREAM(FEET) =    648.00
  FLOW LENGTH(FEET) =   510.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.88
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        8.77
  PIPE TRAVEL TIME(MIN.) =   1.24    Tc(MIN.) =     7.03
  LONGEST FLOWPATH FROM NODE     18.00 TO NODE     17.00 =     726.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------

  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     7.03
  RAINFALL INTENSITY(INCH/HR) =   5.09
  AREA-AVERAGED Fm(INCH/HR) =  0.02
  AREA-AVERAGED Fp(INCH/HR) =  0.20
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =        1.72
  TOTAL STREAM AREA(ACRES) =        1.72
  PEAK FLOW RATE(CFS) AT CONFLUENCE =        8.77

  ** CONFLUENCE DATA **
   STREAM       Q       Tc    Intensity   Fp(Fm)      Ap       Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)     NODE
      1       55.86     8.20     4.661  0.25( 0.05) 0.20       12.2       14.00
      1       55.86     8.31     4.625  0.25( 0.05) 0.20       12.3       10.00
      1       54.23    13.54     3.497  0.25( 0.05) 0.20       16.3        6.00
      2        8.77     7.03     5.089  0.20( 0.02) 0.10        1.7       18.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q       Tc    Intensity   Fp(Fm)      Ap       Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)     NODE
      1       61.14     7.03     5.089  0.25( 0.05) 0.19       12.2       18.00
      2       63.89     8.20     4.661  0.25( 0.05) 0.19       13.9       14.00
      3       63.83     8.31     4.625  0.25( 0.05) 0.19       14.0       10.00
      4       60.25    13.54     3.497  0.25( 0.05) 0.19       18.0        6.00
```

```
 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      63.89    Tc(MIN.) =     8.20
 EFFECTIVE AREA(ACRES) =      13.91   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
 TOTAL AREA(ACRES) =       18.0
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     17.00 =    1855.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     21.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   648.00  DOWNSTREAM(FEET) =   637.70
 FLOW LENGTH(FEET) =   526.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  25.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  13.06
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        63.89
 PIPE TRAVEL TIME(MIN.) =   0.67    Tc(MIN.) =     8.87
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     21.00 =    2381.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   223.00
 ELEVATION DATA: UPSTREAM(FEET) =    691.00  DOWNSTREAM(FEET) =    687.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.297
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.421
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C         0.66      0.25     0.200    86    6.30
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =       3.19
 TOTAL AREA(ACRES) =      0.66   PEAK FLOW RATE(CFS) =       3.19

****************************************************************************
 FLOW PROCESS FROM NODE     23.00 TO NODE     24.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =     6.30
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.421
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C         7.32      0.25     0.200    86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =      7.32      SUBAREA RUNOFF(CFS) =    35.39
 EFFECTIVE AREA(ACRES) =       7.98   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        8.0       PEAK FLOW RATE(CFS) =       38.58
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     24.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   674.00  DOWNSTREAM(FEET) =   639.50
  FLOW LENGTH(FEET) =   160.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  28.60
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        38.58
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    6.39
  LONGEST FLOWPATH FROM NODE     22.00 TO NODE     25.00 =     383.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =     6.39
  RAINFALL INTENSITY(INCH/HR) =   5.38
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =        7.98
  TOTAL STREAM AREA(ACRES) =        7.98
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       38.58

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    264.00
  ELEVATION DATA: UPSTREAM(FEET) =    685.70  DOWNSTREAM(FEET) =    675.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.723
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.726
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        0.44      0.25      0.200     86    5.72
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =       2.25
  TOTAL AREA(ACRES) =       0.44   PEAK FLOW RATE(CFS) =       2.25

****************************************************************************
  FLOW PROCESS FROM NODE     41.00 TO NODE     25.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  675.00  DOWNSTREAM ELEVATION(FEET) =  650.00
  STREET LENGTH(FEET) =   760.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
```

```
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.48
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.34
  HALFSTREET FLOOD WIDTH(FEET) =   10.81
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.25
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.46
STREET FLOW TRAVEL TIME(MIN.) =   2.98    Tc(MIN.) =    8.70
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.505
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"11+ DWELLINGS/ACRE"       C         1.60      0.25     0.200     86
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
SUBAREA AREA(ACRES) =     1.60      SUBAREA RUNOFF(CFS) =    6.41
EFFECTIVE AREA(ACRES) =       2.04    AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =          2.0         PEAK FLOW RATE(CFS) =       8.18

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.38   HALFSTREET FLOOD WIDTH(FEET) =  12.79
FLOW VELOCITY(FEET/SEC.) =  4.66   DEPTH*VELOCITY(FT*FT/SEC.) =   1.78
LONGEST FLOWPATH FROM NODE     26.00 TO NODE     25.00 =    1024.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =     8.70
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.505
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
     LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"11+ DWELLINGS/ACRE"       C         2.23      0.25     0.200     86
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
SUBAREA AREA(ACRES) =     2.23      SUBAREA RUNOFF(CFS) =    8.94
EFFECTIVE AREA(ACRES) =       4.27   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =          4.3        PEAK FLOW RATE(CFS) =      17.12

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =    8.70
RAINFALL INTENSITY(INCH/HR) =   4.50
AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25
AREA-AVERAGED Ap =  0.20
EFFECTIVE STREAM AREA(ACRES) =       4.27
TOTAL STREAM AREA(ACRES) =       4.27
PEAK FLOW RATE(CFS) AT CONFLUENCE =      17.12

** CONFLUENCE DATA **
 STREAM       Q      Tc   Intensity   Fp(Fm)       Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
    1       38.58    6.39    5.376  0.25( 0.05) 0.20       8.0      22.00
    2       17.12    8.70    4.505  0.25( 0.05) 0.20       4.3      26.00
```

```
RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1       53.61    6.39     5.376   0.25( 0.05) 0.20      11.1       22.00
    2       49.39    8.70     4.505   0.25( 0.05) 0.20      12.2       26.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       53.61    Tc(MIN.) =     6.39
EFFECTIVE AREA(ACRES) =       11.12   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =        12.2
LONGEST FLOWPATH FROM NODE     26.00 TO NODE     25.00 =    1024.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     21.00 IS CODE =  31
----------------------------------------------------------------------------

  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   639.50  DOWNSTREAM(FEET) =   637.70
  FLOW LENGTH(FEET) =   240.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  39.0 INCH PIPE IS  26.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.85
  ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       53.61
  PIPE TRAVEL TIME(MIN.) =   0.45    Tc(MIN.) =     6.84
  LONGEST FLOWPATH FROM NODE     26.00 TO NODE     21.00 =    1264.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  11
----------------------------------------------------------------------------

  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

** MAIN STREAM CONFLUENCE DATA **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1       53.61    6.84     5.170   0.25( 0.05) 0.20      11.1       22.00
    2       49.39    9.17     4.372   0.25( 0.05) 0.20      12.2       26.00
LONGEST FLOWPATH FROM NODE     26.00 TO NODE     21.00 =    1264.00 FEET.

** MEMORY BANK #  1 CONFLUENCE DATA **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1       61.14    7.71     4.829   0.25( 0.05) 0.19      12.2       18.00
    2       63.89    8.87     4.455   0.25( 0.05) 0.19      13.9       14.00
    3       63.83    8.98     4.424   0.25( 0.05) 0.19      14.0       10.00
    4       60.25   14.21     3.401   0.25( 0.05) 0.19      18.0        6.00
LONGEST FLOWPATH FROM NODE      6.00 TO NODE     21.00 =    2381.00 FEET.

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
    1      111.75    6.84     5.170   0.25( 0.05) 0.19      21.9       22.00
    2      113.18    7.71     4.829   0.25( 0.05) 0.19      23.7       18.00
    3      113.82    8.87     4.455   0.25( 0.05) 0.19      26.0       14.00
    4      113.55    8.98     4.424   0.25( 0.05) 0.19      26.2       10.00
    5      113.08    9.17     4.372   0.25( 0.05) 0.19      26.4       26.00
    6       98.54   14.21     3.401   0.25( 0.05) 0.19      30.2        6.00
 TOTAL AREA(ACRES) =         30.2

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      113.82   Tc(MIN.) =     8.868
EFFECTIVE AREA(ACRES) =      26.01   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
```

```
  TOTAL AREA(ACRES) =        30.2
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE     21.00 =    2381.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     26.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   637.70  DOWNSTREAM(FEET) =   636.50
  FLOW LENGTH(FEET) =   160.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  39.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.40
  ESTIMATED PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     113.82
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =    9.12
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE     26.00 =    2541.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     26.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.12
  RAINFALL INTENSITY(INCH/HR) =   4.38
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.19
  EFFECTIVE STREAM AREA(ACRES) =      26.01
  TOTAL STREAM AREA(ACRES) =      30.23
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     113.82

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     28.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
  ELEVATION DATA: UPSTREAM(FEET) =    658.30  DOWNSTREAM(FEET) =    657.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.926
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.752
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        0.49      0.25     0.200     86    7.93
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.07
  TOTAL AREA(ACRES) =       0.49   PEAK FLOW RATE(CFS) =       2.07

****************************************************************************
  FLOW PROCESS FROM NODE     28.00 TO NODE     26.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  657.00  DOWNSTREAM ELEVATION(FEET) =  642.00
```

```
STREET LENGTH(FEET) =  1020.00   CURB HEIGHT(INCHES) =  6.0
STREET HALFWIDTH(FEET) = 18.00

DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
INSIDE STREET CROSSFALL(DECIMAL) =  0.020
OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.07
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.47
  HALFSTREET FLOOD WIDTH(FEET) =   16.96
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.70
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     1.72
STREET FLOW TRAVEL TIME(MIN.) =    4.60    Tc(MIN.) =   12.52
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.656
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp         Ap      SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"11+ DWELLINGS/ACRE"       C         5.50      0.25     0.200    86
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
SUBAREA AREA(ACRES) =     5.50      SUBAREA RUNOFF(CFS) =    17.85
EFFECTIVE AREA(ACRES) =       5.99    AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
TOTAL AREA(ACRES) =         6.0         PEAK FLOW RATE(CFS) =      19.44

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.49   HALFSTREET FLOOD WIDTH(FEET) =  18.00
FLOW VELOCITY(FEET/SEC.) =  3.85   DEPTH*VELOCITY(FT*FT/SEC.) =   1.87
LONGEST FLOWPATH FROM NODE     27.00 TO NODE     26.00 =    1245.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     26.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.52
  RAINFALL INTENSITY(INCH/HR) =   3.66
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =        5.99
  TOTAL STREAM AREA(ACRES) =        5.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       19.44

  ** CONFLUENCE DATA **
```

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	111.75	7.10	5.062	0.25(0.05)	0.19	21.9	22.00
1	113.18	7.96	4.739	0.25(0.05)	0.19	23.7	18.00
1	113.82	9.12	4.383	0.25(0.05)	0.19	26.0	14.00
1	113.55	9.24	4.353	0.25(0.05)	0.19	26.2	10.00
1	113.08	9.42	4.303	0.25(0.05)	0.19	26.4	26.00
1	98.54	14.47	3.365	0.25(0.05)	0.19	30.2	6.00
2	19.44	12.52	3.656	0.25(0.05)	0.20	6.0	27.00

```
  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

```
** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc    Intensity   Fp(Fm)       Ap       Ae      HEADWATER
 NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)            (ACRES)     NODE
    1      127.07    7.10      5.062   0.25( 0.05) 0.19       25.3       22.00
    2      129.25    7.96      4.739   0.25( 0.05) 0.19       27.5       18.00
    3      130.84    9.12      4.383   0.25( 0.05) 0.19       30.4       14.00
    4      130.66    9.24      4.353   0.25( 0.05) 0.19       30.6       10.00
    5      130.34    9.42      4.303   0.25( 0.05) 0.19       30.9       26.00
    6      123.59   12.52      3.656   0.25( 0.05) 0.20       34.7       27.00
    7      116.41   14.47      3.365   0.25( 0.05) 0.20       36.2        6.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =      130.84   Tc(MIN.) =      9.12
EFFECTIVE AREA(ACRES) =       30.38   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
TOTAL AREA(ACRES) =        36.2
LONGEST FLOWPATH FROM NODE      6.00 TO NODE      26.00 =    2541.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     29.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    636.50  DOWNSTREAM(FEET) =    636.00
  FLOW LENGTH(FEET) =    40.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  35.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.30
  ESTIMATED PIPE DIAMETER(INCH) =  48.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      130.84
  PIPE TRAVEL TIME(MIN.) =   0.05     Tc(MIN.) =     9.17
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE      29.00 =    2581.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     29.00 TO NODE     29.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =     9.17
  RAINFALL INTENSITY(INCH/HR) =   4.37
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.19
  EFFECTIVE STREAM AREA(ACRES) =        30.38
  TOTAL STREAM AREA(ACRES) =       36.22
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      130.84

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    190.00
  ELEVATION DATA: UPSTREAM(FEET) =     672.00  DOWNSTREAM(FEET) =     670.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     6.570
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.291
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp          Ap       SCS   Tc
       LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)    CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        0.40       0.25      0.200     86    6.57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
```

```
 SUBAREA RUNOFF(CFS) =      1.89
 TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      1.89

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =  670.00  DOWNSTREAM ELEVATION(FEET) =  652.00
 STREET LENGTH(FEET) =  1770.00   CURB HEIGHT(INCHES) =  6.0
 STREET HALFWIDTH(FEET) = 18.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      15.75
   ***STREET FLOW SPLITS OVER STREET-CROWN***
   FULL DEPTH(FEET) =    0.49   FLOOD WIDTH(FEET) =   18.00
   FULL HALF-STREET VELOCITY(FEET/SEC.) =    3.20
   SPLIT DEPTH(FEET) =    0.39   SPLIT FLOOD WIDTH(FEET) =   13.30
   SPLIT FLOW(CFS) =    5.00   SPLIT VELOCITY(FEET/SEC.) =    2.65
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.49
   HALFSTREET FLOOD WIDTH(FEET) =   18.00
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.20
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.56
 STREET FLOW TRAVEL TIME(MIN.) =    9.22   Tc(MIN.) =   15.79
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.201
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        9.60      0.25     0.200    86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =    9.60      SUBAREA RUNOFF(CFS) =   27.23
 EFFECTIVE AREA(ACRES) =     10.00    AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =       10.0         PEAK FLOW RATE(CFS) =      28.36

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.52   HALFSTREET FLOOD WIDTH(FEET) =  18.99
 FLOW VELOCITY(FEET/SEC.) =  3.57   DEPTH*VELOCITY(FT*FT/SEC.) =   1.86
 *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
        AND L = 1770.0 FT WITH ELEVATION-DROP =  18.0 FT, IS   26.9 CFS,
        WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE     32.00
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =    1960.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     29.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   644.00  DOWNSTREAM(FEET) =   636.00
 FLOW LENGTH(FEET) =   450.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  17.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.49
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      28.36
 PIPE TRAVEL TIME(MIN.) =   0.71    Tc(MIN.) =   16.50
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     29.00 =    2410.00 FEET.
```

```
****************************************************************************
 FLOW PROCESS FROM NODE      29.00 TO NODE      29.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =    16.50
 RAINFALL INTENSITY(INCH/HR) =    3.12
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       10.00
 TOTAL STREAM AREA(ACRES) =       10.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       28.36
```

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	127.07	7.15	5.041	0.25(0.05)	0.19	25.3	22.00
1	129.25	8.01	4.722	0.25(0.05)	0.19	27.5	18.00
1	130.84	9.17	4.370	0.25(0.05)	0.19	30.4	14.00
1	130.66	9.29	4.339	0.25(0.05)	0.19	30.6	10.00
1	130.34	9.47	4.290	0.25(0.05)	0.19	30.9	26.00
1	123.59	12.57	3.648	0.25(0.05)	0.20	34.7	27.00
1	116.41	14.52	3.359	0.25(0.05)	0.20	36.2	6.00
2	28.36	16.50	3.121	0.25(0.05)	0.20	10.0	30.00

```
 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.
```

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	147.03	7.15	5.041	0.25(0.05)	0.19	29.7	22.00
2	150.20	8.01	4.722	0.25(0.05)	0.19	32.4	18.00
3	153.01	9.17	4.370	0.25(0.05)	0.20	35.9	14.00
4	152.95	9.29	4.339	0.25(0.05)	0.20	36.2	10.00
5	152.81	9.47	4.290	0.25(0.05)	0.20	36.6	26.00
6	148.90	12.57	3.648	0.25(0.05)	0.20	42.4	27.00
7	143.30	14.52	3.359	0.25(0.05)	0.20	45.0	6.00
8	136.43	16.50	3.121	0.25(0.05)	0.20	46.2	30.00

```
 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      153.01    Tc(MIN.) =      9.17
 EFFECTIVE AREA(ACRES) =       35.94   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =         46.2
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      29.00 =     2581.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      29.00 TO NODE      42.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   636.00  DOWNSTREAM(FEET) =   610.00
 FLOW LENGTH(FEET) =    400.00    MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  28.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  25.28
 ESTIMATED PIPE DIAMETER(INCH) =  36.00     NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      153.01
 PIPE TRAVEL TIME(MIN.) =    0.26     Tc(MIN.) =     9.44
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      42.00 =     2981.00 FEET.
```

```
******************************************************************************
  FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =    9.44
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.299
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS
       LAND USE            GROUP    (ACRES)   (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "CHAPARRAL,BROADLEAF"       C          1.18       0.25     1.000     88
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     1.18      SUBAREA RUNOFF(CFS) =     4.30
  EFFECTIVE AREA(ACRES) =      37.12   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25   AREA-AVERAGED Ap =  0.22
  TOTAL AREA(ACRES) =        47.4      PEAK FLOW RATE(CFS) =     153.01
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

******************************************************************************
  FLOW PROCESS FROM NODE     42.00 TO NODE     33.00 IS CODE =  31
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   610.00  DOWNSTREAM(FEET) =   608.50
  FLOW LENGTH(FEET) =   270.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  57.0 INCH PIPE IS  45.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.04
  ESTIMATED PIPE DIAMETER(INCH) =  57.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      153.01
  PIPE TRAVEL TIME(MIN.) =   0.45     Tc(MIN.) =     9.89
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE     33.00 =    3251.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  10
------------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
==============================================================================

******************************************************************************
  FLOW PROCESS FROM NODE     34.00 TO NODE     35.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   254.00
  ELEVATION DATA: UPSTREAM(FEET) =    658.70  DOWNSTREAM(FEET) =    656.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     7.365
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.956
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE            GROUP    (ACRES)   (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C          1.34       0.25     0.200     86    7.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =       5.92
  TOTAL AREA(ACRES) =       1.34    PEAK FLOW RATE(CFS) =      5.92
```

AREA C3

```
****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     36.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     7.36
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.956
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C         2.58      0.25     0.200    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     2.58       SUBAREA RUNOFF(CFS) =    11.39
  EFFECTIVE AREA(ACRES) =        3.92   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         3.9        PEAK FLOW RATE(CFS) =      17.31

****************************************************************************
  FLOW PROCESS FROM NODE     36.00 TO NODE     37.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    645.30  DOWNSTREAM(FEET) =    638.90
  FLOW LENGTH(FEET) =    140.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.12
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       17.31
  PIPE TRAVEL TIME(MIN.) =    0.18     Tc(MIN.) =     7.54
  LONGEST FLOWPATH FROM NODE     34.00 TO NODE     37.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =     7.54
  RAINFALL INTENSITY(INCH/HR) =   4.89
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =        3.92
  TOTAL STREAM AREA(ACRES) =        3.92
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       17.31

****************************************************************************
  FLOW PROCESS FROM NODE     38.00 TO NODE     39.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    132.00
  ELEVATION DATA: UPSTREAM(FEET) =     651.30  DOWNSTREAM(FEET) =     650.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =     5.756
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.708
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C         1.08      0.25     0.200    86   5.76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
```

```
  SUBAREA RUNOFF(CFS) =       5.50
  TOTAL AREA(ACRES) =       1.08   PEAK FLOW RATE(CFS) =       5.50

****************************************************************************
  FLOW PROCESS FROM NODE     39.00 TO NODE     37.00 IS CODE =  81    AREA A19
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.76
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.708
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp          Ap       SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        3.24      0.25      0.200     86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     3.24      SUBAREA RUNOFF(CFS) =    16.50
  EFFECTIVE AREA(ACRES) =         4.32   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         4.3       PEAK FLOW RATE(CFS) =       22.00

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     5.76
  RAINFALL INTENSITY(INCH/HR) =   5.71
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =         4.32
  TOTAL STREAM AREA(ACRES) =        4.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       22.00

  ** CONFLUENCE DATA **
   STREAM       Q       Tc   Intensity   Fp(Fm)      Ap       Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
      1       17.31    7.54     4.889  0.25( 0.05) 0.20        3.9      34.00
      2       22.00    5.76     5.708  0.25( 0.05) 0.20        4.3      38.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q       Tc   Intensity   Fp(Fm)      Ap       Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
      1       37.44    5.76     5.708  0.25( 0.05) 0.20        7.3      38.00
      2       36.12    7.54     4.889  0.25( 0.05) 0.20        8.2      34.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       37.44   Tc(MIN.) =      5.76
  EFFECTIVE AREA(ACRES) =         7.31   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         8.2
  LONGEST FLOWPATH FROM NODE     34.00 TO NODE     37.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   638.90  DOWNSTREAM(FEET) =   608.50
  FLOW LENGTH(FEET) =    146.00    MANNING'S N =  0.013
```

```
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  28.06
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       37.44
 PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    5.84
 LONGEST FLOWPATH FROM NODE      34.00 TO NODE      33.00 =     540.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      33.00 TO NODE      33.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1       37.44     5.84     5.659  0.25( 0.05) 0.20        7.3      38.00
     2       36.12     7.63     4.856  0.25( 0.05) 0.20        8.2      34.00
 LONGEST FLOWPATH FROM NODE      34.00 TO NODE      33.00 =     540.00 FEET.

 ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1      147.03     7.86     4.774  0.25( 0.06) 0.23       30.8      22.00
     2      150.20     8.73     4.497  0.25( 0.06) 0.22       33.6      18.00
     3      153.01     9.89     4.186  0.25( 0.05) 0.22       37.1      14.00
     4      152.95    10.00     4.159  0.25( 0.05) 0.22       37.4      10.00
     5      152.81    10.19     4.115  0.25( 0.05) 0.22       37.8      26.00
     6      148.90    13.29     3.534  0.25( 0.05) 0.22       43.5      27.00
     7      143.30    15.24     3.267  0.25( 0.05) 0.22       46.2       6.00
     8      136.43    17.22     3.046  0.25( 0.05) 0.22       47.4      30.00
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      33.00 =    3251.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)     NODE
     1      167.21     5.84     5.659  0.25( 0.05) 0.22       30.2      38.00
     2      181.31     7.63     4.856  0.25( 0.05) 0.22       38.2      34.00
     3      182.53     7.86     4.774  0.25( 0.05) 0.22       39.1      22.00
     4      183.62     8.73     4.497  0.25( 0.05) 0.22       41.8      18.00
     5      184.10     9.89     4.186  0.25( 0.05) 0.22       45.4      14.00
     6      183.83    10.00     4.159  0.25( 0.05) 0.22       45.6      10.00
     7      183.37    10.19     4.115  0.25( 0.05) 0.22       46.1      26.00
     8      175.09    13.29     3.534  0.25( 0.05) 0.21       51.8      27.00
     9      167.47    15.24     3.267  0.25( 0.05) 0.21       54.4       6.00
    10      158.94    17.22     3.046  0.25( 0.05) 0.21       55.6      30.00
   TOTAL AREA(ACRES) =           55.6

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       184.10  Tc(MIN.) =     9.887
 EFFECTIVE AREA(ACRES) =      45.36  AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.22
 TOTAL AREA(ACRES) =         55.6
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      33.00 =    3251.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      33.00 TO NODE      33.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      33.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   608.50  DOWNSTREAM(FEET) =   590.00
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
```

```
 DEPTH OF FLOW IN  30.0 INCH PIPE IS  23.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  45.06
 ESTIMATED PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      184.10
 PIPE TRAVEL TIME(MIN.) =    0.03    Tc(MIN.) =     9.91
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     40.00 =    3321.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =     9.91
 RAINFALL INTENSITY(INCH/HR) =   4.18
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.22
 EFFECTIVE STREAM AREA(ACRES) =       45.36
 TOTAL STREAM AREA(ACRES) =       55.64
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      184.10

****************************************************************************
 FLOW PROCESS FROM NODE     43.00 TO NODE     44.00 IS CODE = 21     AREA C5
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    365.00
 ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    608.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.089
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.125
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN  (MIN.)
 COMMERCIAL                 C        3.24      0.25     0.100     86    5.09
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =     17.79
 TOTAL AREA(ACRES) =       3.24   PEAK FLOW RATE(CFS) =      17.79

****************************************************************************
 FLOW PROCESS FROM NODE     44.00 TO NODE     40.00 IS CODE = 81     AREA C6
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =     5.09
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.125
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN
 NATURAL GOOD COVER
 "GRASS"                    C        4.48      0.25     1.000     90
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA AREA(ACRES) =     4.48     SUBAREA RUNOFF(CFS) =    23.69
 EFFECTIVE AREA(ACRES) =       7.72   AREA-AVERAGED Fm(INCH/HR) =  0.16
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.62
 TOTAL AREA(ACRES) =          7.7       PEAK FLOW RATE(CFS) =      41.48
```

****

FLOW PROCESS FROM NODE 40.00 TO NODE 40.00 IS CODE = 1

\>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
\>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

===

TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 5.09
RAINFALL INTENSITY(INCH/HR) = 6.13
AREA-AVERAGED Fm(INCH/HR) = 0.16
AREA-AVERAGED Fp(INCH/HR) = 0.25
AREA-AVERAGED Ap = 0.62
EFFECTIVE STREAM AREA(ACRES) = 7.72
TOTAL STREAM AREA(ACRES) = 7.72
PEAK FLOW RATE(CFS) AT CONFLUENCE = 41.48

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	167.21	5.87	5.645	0.25(0.05)	0.22	30.2	38.00
1	181.31	7.66	4.847	0.25(0.05)	0.22	38.2	34.00
1	182.53	7.89	4.765	0.25(0.05)	0.22	39.1	22.00
1	183.62	8.75	4.489	0.25(0.05)	0.22	41.8	18.00
1	184.10	9.91	4.180	0.25(0.05)	0.22	45.4	14.00
1	183.83	10.02	4.153	0.25(0.05)	0.22	45.6	10.00
1	183.37	10.21	4.109	0.25(0.05)	0.22	46.1	26.00
1	175.09	13.31	3.530	0.25(0.05)	0.21	51.8	27.00
1	167.47	15.26	3.264	0.25(0.05)	0.21	54.4	6.00
1	158.94	17.25	3.043	0.25(0.05)	0.21	55.6	30.00
2	41.48	5.09	6.125	0.25(0.16)	0.62	7.7	43.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	198.93	5.09	6.125	0.25(0.08)	0.31	33.9	43.00
2	205.35	5.87	5.645	0.25(0.08)	0.30	37.9	38.00
3	213.91	7.66	4.847	0.25(0.07)	0.29	45.9	34.00
4	214.56	7.89	4.765	0.25(0.07)	0.29	46.8	22.00
5	213.73	8.75	4.489	0.25(0.07)	0.28	49.5	18.00
6	212.06	9.91	4.180	0.25(0.07)	0.28	53.1	14.00
7	211.61	10.02	4.153	0.25(0.07)	0.28	53.4	10.00
8	210.84	10.21	4.109	0.25(0.07)	0.27	53.8	26.00
9	198.53	13.31	3.530	0.25(0.07)	0.27	59.5	27.00
10	189.07	15.26	3.264	0.25(0.07)	0.26	62.2	6.00
11	179.00	17.25	3.043	0.25(0.07)	0.26	63.4	30.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 214.56 Tc(MIN.) = 7.89
EFFECTIVE AREA(ACRES) = 46.79 AREA-AVERAGED Fm(INCH/HR) = 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.29
TOTAL AREA(ACRES) = 63.4
LONGEST FLOWPATH FROM NODE 6.00 TO NODE 40.00 = 3321.00 FEET.

===

END OF STUDY SUMMARY:
TOTAL AREA(ACRES) = 63.4 TC(MIN.) = 7.89
EFFECTIVE AREA(ACRES) = 46.79 AREA-AVERAGED Fm(INCH/HR)= 0.07
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.287
PEAK FLOW RATE(CFS) = 214.56

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	198.93	5.09	6.125	0.25(0.08)	0.31	33.9	43.00
2	205.35	5.87	5.645	0.25(0.08)	0.30	37.9	38.00
3	213.91	7.66	4.847	0.25(0.07)	0.29	45.9	34.00
4	214.56	7.89	4.765	0.25(0.07)	0.29	46.8	22.00
5	213.73	8.75	4.489	0.25(0.07)	0.28	49.5	18.00
6	212.06	9.91	4.180	0.25(0.07)	0.28	53.1	14.00
7	211.61	10.02	4.153	0.25(0.07)	0.28	53.4	10.00
8	210.84	10.21	4.109	0.25(0.07)	0.27	53.8	26.00
9	198.53	13.31	3.530	0.25(0.07)	0.27	59.5	27.00
10	189.07	15.26	3.264	0.25(0.07)	0.26	62.2	6.00
11	179.00	17.25	3.043	0.25(0.07)	0.26	63.4	30.00

==

==

END OF RATIONAL METHOD ANALYSIS

PROPOSED CIVIC CENTER

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****************************************************************************
              RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                           Analysis prepared by:

                             Fuscoe Engineering
                  16795 Von Karman Suite 100 Irvine Ca 92606


 ************************** DESCRIPTION OF STUDY **************************
 * I.R.W.D. - LAKE FOREST SITE                                              *
 * PROPOSED 100 YEAR HYDROLOGY STUDY CIVIC CENTER/EXISTING TANK             *
 * DEVELOPER: LEWIS OPERATING CORP.                                         *
 ****************************************************************************

  FILE NAME: IRW100B.DAT
  TIME/DATE OF STUDY: 10:47 07/14/2009
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                      --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
 NO.  (FT)    (FT)     SIDE / SIDE/ WAY    (FT)   (FT)  (FT)   (FT)    (n)
 ===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    660.00  DOWNSTREAM(FEET) =    654.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.509
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.319
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       3.03      0.30      0.100     76    6.51
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =     14.42
  TOTAL AREA(ACRES) =       3.03   PEAK FLOW RATE(CFS) =      14.42
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      51.00 TO NODE      52.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     6.51
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.319
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 C        6.18      0.25     0.100    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =     6.18       SUBAREA RUNOFF(CFS) =    29.45
  EFFECTIVE AREA(ACRES) =       9.21   AREA-AVERAGED Fm(INCH/HR) =  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =         9.2       PEAK FLOW RATE(CFS) =      43.87

****************************************************************************
  FLOW PROCESS FROM NODE      52.00 TO NODE      53.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   636.80  DOWNSTREAM(FEET) =   573.00
  FLOW LENGTH(FEET) =   200.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  34.40
  ESTIMATED PIPE DIAMETER(INCH) =  18.00     NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        43.87
  PIPE TRAVEL TIME(MIN.) =   0.10     Tc(MIN.) =     6.61
  LONGEST FLOWPATH FROM NODE      50.00 TO NODE      53.00 =      500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      53.00 TO NODE      53.00 IS CODE =  81   AREA C2
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     6.61
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.275
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL GOOD COVER
  "GRASS"                    C        3.19      0.25     1.000    90
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     3.19       SUBAREA RUNOFF(CFS) =    14.43
  EFFECTIVE AREA(ACRES) =      12.40   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.33
  TOTAL AREA(ACRES) =        12.4       PEAK FLOW RATE(CFS) =      57.93
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1052.00
  ELEVATION DATA: UPSTREAM(FEET) =    638.80  DOWNSTREAM(FEET) =    560.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   25.393
  *  100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.438
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "OPEN BRUSH"               A        2.95      0.40      1.000     61   25.39
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
  SUBAREA RUNOFF(CFS) =      5.41
  TOTAL AREA(ACRES) =      2.95   PEAK FLOW RATE(CFS) =       5.41
```

AREA C1

```
****************************************************************************
  FLOW PROCESS FROM NODE     45.00 TO NODE     46.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   223.00
  ELEVATION DATA: UPSTREAM(FEET) =    628.80  DOWNSTREAM(FEET) =    608.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.067
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.568
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp          Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL GOOD COVER
  "GRASS"                    B        3.83      0.30      1.000     80   13.07
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 1.000
  SUBAREA RUNOFF(CFS) =     11.27
  TOTAL AREA(ACRES) =      3.83   PEAK FLOW RATE(CFS) =      11.27
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)       =          3.8  TC(MIN.) =     13.07
  EFFECTIVE AREA(ACRES) =       3.83  AREA-AVERAGED Fm(INCH/HR)=  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)     =      11.27
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

AREA C4

LOSS RATE AREA A

****
NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS

==

Analysis prepared by:

Fuscoe Engineering, Inc
16795 Von Karman Ave. Suite 100
Irvine, California 92606
PH: 949-474-1960 FAX: 949-474-5315

****

Problem Descriptions:
TENTATIVE TRACT 17331
SERRANO SUMMIT
PROPOSED CONDITION AREA - A

==

*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 5.63 (inches)

SOIL-COVER TYPE	AREA (Acres)	PERCENT OF PERVIOUS AREA	SCS CURVE NUMBER	LOSS RATE Fp(in./hr.)	YIELD
1	67.20	20.00	69	0.025	0.910

TOTAL AREA (Acres) = 67.20

AREA-AVERAGED LOSS RATE, $\overline{Fm}$ (in./hr.) = 0.005

AREA-AVERAGED LOW LOSS FRACTION, $\overline{Y}$ = 0.090

==

UNIT HYDROGRAPH AREA A

```
****************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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            Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                          Analysis prepared by:

                         Fuscoe Engineering, Inc
                     16795 Von Karman Ave. Suite 100
                         Irvine, California 92606
                 PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
 ---------------------------------------------------------------------------

  Problem Descriptions:
   TENTATIVE TRACT 17331
   SERRANO SUMMIT
   PROPOSED CONDITION AREA - A
 ---------------------------------------------------------------------------

     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.75
     TOTAL CATCHMENT AREA(ACRES) =   67.20
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.005
     LOW LOSS FRACTION = 0.090
     TIME OF CONCENTRATION(MIN.) =  7.89
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) = 100
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.52
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.09
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.43
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.36
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.63

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

     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =    22.97
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     8.56

****************************************************************************
   TIME     VOLUME       Q     0.        62.5      125.0     187.5     250.0
  (HOURS)    (AF)      (CFS)
 ---------------------------------------------------------------------------
   0.09     0.0152     4.15  Q         .         .         .         .
   0.22     0.0604     4.17  Q         .         .         .         .
   0.35     0.1058     4.20  Q         .         .         .         .
   0.48     0.1515     4.21  Q         .         .         .         .
   0.61     0.1975     4.24  Q         .         .         .         .
   0.75     0.2437     4.26  Q         .         .         .         .
```

0.88	0.2902	4.29	Q	.	.	.	.
1.01	0.3369	4.31	Q	.	.	.	.
1.14	0.3839	4.34	Q	.	.	.	.
1.27	0.4312	4.36	Q	.	.	.	.
1.40	0.4787	4.39	Q	.	.	.	.
1.54	0.5266	4.41	Q	.	.	.	.
1.67	0.5747	4.45	Q	.	.	.	.
1.80	0.6231	4.46	Q	.	.	.	.
1.93	0.6719	4.50	Q	.	.	.	.
2.06	0.7209	4.52	Q	.	.	.	.
2.19	0.7702	4.56	Q	.	.	.	.
2.32	0.8198	4.58	Q	.	.	.	.
2.46	0.8698	4.62	Q	.	.	.	.
2.59	0.9201	4.64	Q	.	.	.	.
2.72	0.9707	4.68	Q	.	.	.	.
2.85	1.0216	4.70	Q	.	.	.	.
2.98	1.0728	4.74	Q	.	.	.	.
3.11	1.1244	4.76	Q	.	.	.	.
3.24	1.1764	4.80	Q	.	.	.	.
3.38	1.2287	4.82	Q	.	.	.	.
3.51	1.2813	4.87	Q	.	.	.	.
3.64	1.3344	4.89	Q	.	.	.	.
3.77	1.3878	4.94	Q	.	.	.	.
3.90	1.4415	4.96	Q	.	.	.	.
4.03	1.4957	5.01	Q	.	.	.	.
4.16	1.5502	5.03	Q	.	.	.	.
4.30	1.6052	5.08	Q	.	.	.	.
4.43	1.6605	5.11	Q	.	.	.	.
4.56	1.7163	5.16	Q	.	.	.	.
4.69	1.7724	5.18	Q	.	.	.	.
4.82	1.8290	5.23	Q	.	.	.	.
4.95	1.8861	5.26	Q	.	.	.	.
5.09	1.9435	5.32	Q	.	.	.	.
5.22	2.0015	5.34	Q	.	.	.	.
5.35	2.0599	5.40	Q	.	.	.	.
5.48	2.1187	5.43	Q	.	.	.	.
5.61	2.1781	5.49	Q	.	.	.	.
5.74	2.2379	5.52	Q	.	.	.	.
5.87	2.2983	5.58	Q	.	.	.	.
6.01	2.3591	5.61	Q	.	.	.	.
6.14	2.4205	5.68	Q	.	.	.	.
6.27	2.4824	5.71	Q	.	.	.	.
6.40	2.5448	5.78	Q	.	.	.	.
6.53	2.6078	5.81	Q	.	.	.	.
6.66	2.6714	5.89	Q	.	.	.	.
6.80	2.7355	5.92	Q	.	.	.	.
6.93	2.8003	6.00	Q	.	.	.	.
7.06	2.8657	6.03	Q	.	.	.	.
7.19	2.9316	6.11	Q	.	.	.	.
7.32	2.9983	6.15	Q	.	.	.	.
7.45	3.0655	6.23	Q	.	.	.	.
7.58	3.1335	6.27	.Q	.	.	.	.
7.72	3.2021	6.36	.Q	.	.	.	.
7.85	3.2715	6.40	.Q	.	.	.	.
7.98	3.3415	6.49	.Q	.	.	.	.
8.11	3.4123	6.54	.Q	.	.	.	.
8.24	3.4839	6.63	.Q	.	.	.	.

8.37	3.5562	6.68	.Q	.	.	.	.
8.50	3.6294	6.78	.Q	.	.	.	.
8.64	3.7034	6.83	.Q	.	.	.	.
8.77	3.7782	6.94	.Q	.	.	.	.
8.90	3.8539	6.99	.Q	.	.	.	.
9.03	3.9306	7.11	.Q	.	.	.	.
9.16	4.0081	7.16	.Q	.	.	.	.
9.29	4.0866	7.28	.Q	.	.	.	.
9.43	4.1661	7.35	.Q	.	.	.	.
9.56	4.2466	7.47	.Q	.	.	.	.
9.69	4.3282	7.54	.Q	.	.	.	.
9.82	4.4109	7.68	.Q	.	.	.	.
9.95	4.4947	7.75	.Q	.	.	.	.
10.08	4.5797	7.89	.Q	.	.	.	.
10.21	4.6658	7.97	.Q	.	.	.	.
10.35	4.7533	8.12	.Q	.	.	.	.
10.48	4.8420	8.20	.Q	.	.	.	.
10.61	4.9321	8.37	.Q	.	.	.	.
10.74	5.0235	8.46	.Q	.	.	.	.
10.87	5.1165	8.64	.Q	.	.	.	.
11.00	5.2109	8.74	.Q	.	.	.	.
11.13	5.3070	8.94	.Q	.	.	.	.
11.27	5.4047	9.04	.Q	.	.	.	.
11.40	5.5041	9.26	.Q	.	.	.	.
11.53	5.6054	9.37	.Q	.	.	.	.
11.66	5.7085	9.61	.Q	.	.	.	.
11.79	5.8136	9.73	.Q	.	.	.	.
11.92	5.9208	10.00	.Q	.	.	.	.
12.05	6.0302	10.13	.Q	.	.	.	.
12.19	6.1565	13.12	. Q	.	.	.	.
12.32	6.3000	13.28	. Q	.	.	.	.
12.45	6.4462	13.63	. Q	.	.	.	.
12.58	6.5953	13.81	. Q	.	.	.	.
12.71	6.7474	14.19	. Q	.	.	.	.
12.84	6.9028	14.40	. Q	.	.	.	.
12.98	7.0616	14.83	. Q	.	.	.	.
13.11	7.2240	15.06	. Q	.	.	.	.
13.24	7.3904	15.56	. Q	.	.	.	.
13.37	7.5609	15.82	. Q	.	.	.	.
13.50	7.7359	16.39	. Q	.	.	.	.
13.63	7.9158	16.70	. Q	.	.	.	.
13.76	8.1009	17.37	. Q	.	.	.	.
13.90	8.2917	17.74	. Q	.	.	.	.
14.03	8.4888	18.54	. Q	.	.	.	.
14.16	8.6931	19.06	. Q	.	.	.	.
14.29	8.9056	20.05	. Q	.	.	.	.
14.42	9.1265	20.60	. Q	.	.	.	.
14.55	9.3571	21.83	. Q	.	.	.	.
14.68	9.5982	22.53	. Q	.	.	.	.
14.82	9.8518	24.15	. Q	.	.	.	.
14.95	10.1194	25.09	. Q	.	.	.	.
15.08	10.4043	27.34	. Q	.	.	.	.
15.21	10.7088	28.70	. Q	.	.	.	.
15.34	11.0394	32.14	. Q	.	.	.	.
15.47	11.3868	31.78	. Q	.	.	.	.
15.61	11.7562	36.20	. Q	.	.	.	.
15.74	12.1746	40.80	. Q	.	.	.	.

```
15.87    12.7123    58.16  .        Q.         .         .         .
16.00    13.4605    79.52  .         . Q       .         .         .
16.13    15.1987   240.37  .         .         .         .       Q .
16.26    16.7631    47.52  .      Q  .         .         .         .
16.39    17.1994    32.78  .    Q    .         .         .         .
16.53    17.5421    30.28  .   Q     .         .         .         .
16.66    17.8487    26.15  .   Q     .         .         .         .
16.79    18.1174    23.30  .  Q      .         .         .         .
16.92    18.3591    21.19  .  Q      .         .         .         .
17.05    18.5805    19.55  .  Q      .         .         .         .
17.18    18.7852    18.12  . Q       .         .         .         .
17.32    18.9762    17.03  . Q       .         .         .         .
17.45    19.1562    16.10  . Q       .         .         .         .
17.58    19.3269    15.30  . Q       .         .         .         .
17.71    19.4894    14.61  . Q       .         .         .         .
17.84    19.6448    14.00  . Q       .         .         .         .
17.97    19.7940    13.45  . Q       .         .         .         .
18.10    19.9321    11.96  .Q        .         .         .         .
18.24    20.0507     9.86  .Q        .         .         .         .
18.37    20.1558     9.49  .Q        .         .         .         .
18.50    20.2571     9.15  .Q        .         .         .         .
18.63    20.3548     8.84  .Q        .         .         .         .
18.76    20.4493     8.55  .Q        .         .         .         .
18.89    20.5408     8.29  .Q        .         .         .         .
19.02    20.6295     8.04  .Q        .         .         .         .
19.16    20.7157     7.82  .Q        .         .         .         .
19.29    20.7995     7.61  .Q        .         .         .         .
19.42    20.8811     7.41  .Q        .         .         .         .
19.55    20.9606     7.22  .Q        .         .         .         .
19.68    21.0382     7.05  .Q        .         .         .         .
19.81    21.1139     6.89  .Q        .         .         .         .
19.94    21.1879     6.73  .Q        .         .         .         .
20.08    21.2603     6.59  .Q        .         .         .         .
20.21    21.3311     6.45  .Q        .         .         .         .
20.34    21.4004     6.32  .Q        .         .         .         .
20.47    21.4684     6.19  Q         .         .         .         .
20.60    21.5350     6.07  Q         .         .         .         .
20.73    21.6004     5.96  Q         .         .         .         .
20.87    21.6645     5.85  Q         .         .         .         .
21.00    21.7276     5.75  Q         .         .         .         .
21.13    21.7895     5.65  Q         .         .         .         .
21.26    21.8503     5.55  Q         .         .         .         .
21.39    21.9101     5.46  Q         .         .         .         .
21.52    21.9690     5.37  Q         .         .         .         .
21.65    22.0270     5.29  Q         .         .         .         .
21.79    22.0840     5.21  Q         .         .         .         .
21.92    22.1402     5.13  Q         .         .         .         .
22.05    22.1955     5.05  Q         .         .         .         .
22.18    22.2501     4.98  Q         .         .         .         .
22.31    22.3038     4.91  Q         .         .         .         .
22.44    22.3568     4.84  Q         .         .         .         .
22.58    22.4091     4.78  Q         .         .         .         .
22.71    22.4607     4.72  Q         .         .         .         .
22.84    22.5117     4.66  Q         .         .         .         .
22.97    22.5619     4.60  Q         .         .         .         .
23.10    22.6116     4.54  Q         .         .         .         .
23.23    22.6606     4.48  Q         .         .         .         .
```

23.36	22.7090	4.43	Q	.	.	.	.
23.50	22.7569	4.38	Q	.	.	.	.
23.63	22.8042	4.33	Q	.	.	.	.
23.76	22.8509	4.28	Q	.	.	.	.
23.89	22.8971	4.23	Q	.	.	.	.
24.02	22.9428	4.18	Q	.	.	.	.
24.15	22.9655	0.00	Q	.	.	.	.

Summary for Pond 2P: Area A Detentiono Basin

Inflow Area = 67.200 ac, 0.00% Impervious, Inflow Depth = 4.17"
Inflow = 204.19 cfs @ 16.10 hrs, Volume= 23.363 af
Outflow = 133.55 cfs @ 16.19 hrs, Volume= 23.410 af, Atten= 35%, Lag= 5.3 min
Primary = 133.55 cfs @ 16.19 hrs, Volume= 23.410 af

Routing by Stor-Ind method, Time Span= 0.00-26.00 hrs, dt= 0.13 hrs
Peak Elev= 590.60' @ 16.19 hrs Surf.Area= 1.248 ac Storage= 0.735 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 1.1 min (835.4 - 834.3)

Volume	Invert	Avail.Storage	Storage Description
#1	590.00'	7.000 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
590.00	1.200	0.000	0.000
591.00	1.280	1.240	1.240
592.00	1.360	1.320	2.560
593.00	1.440	1.400	3.960
594.00	1.520	1.480	5.440
595.00	1.600	1.560	7.000

Device	Routing	Invert	Outlet Devices
#1	Primary	583.00'	**42.0" Round Culvert** L= 400.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 583.00' / 512.00' S= 0.1775 '/' Cc= 0.900 n= 0.013
#2	Primary	590.00'	**48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=127.45 cfs @ 16.19 hrs HW=590.53' (Free Discharge)
1=Culvert (Inlet Controls 111.41 cfs @ 11.58 fps)
2=Orifice/Grate (Weir Controls 16.04 cfs @ 2.39 fps)

LOSS RATE CIVIC CENTER

```
****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS

============================================================================
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                          Analysis prepared by:

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                  PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
 ---------------------------------------------------------------------------

  Problem Descriptions:
   TENTATIVE TRACT 17331
   SERRANO SUMMIT
   PROPOSED CONDITION CIVIC CENTER

============================================================================
 *** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
     AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

     TOTAL 24-HOUR DURATION RAINFALL DEPTH =     5.63 (inches)

 SOIL-COVER     AREA      PERCENT OF     SCS CURVE    LOSS RATE
   TYPE       (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
    1          12.40       12.00           69         0.250        0.929

     TOTAL AREA (Acres) =      12.40

     AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.030

     AREA-AVERAGED LOW LOSS FRACTION, Y = 0.071

============================================================================
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UNIT HYDROGRAPH CIVIC CENTER

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******************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL

==============================================================================
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            Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                         Analysis prepared by:

                        Fuscoe Engineering, Inc
                    16795 Von Karman Ave. Suite 100
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  Problem Descriptions:
   TENTATIVE TRACT 17331
   SERRANO SUMMIT
   PROPOSED CONDITION CIVIC CENTER
 -----------------------------------------------------------------------------


     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    12.40
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.030
     LOW LOSS FRACTION = 0.071
     TIME OF CONCENTRATION(MIN.) =  6.61
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) = 100
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.52
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  1.09
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.45
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  2.43
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  3.36
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  5.63

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     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      4.90
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      0.92

******************************************************************************
   TIME     VOLUME       Q    0.        15.0      30.0      45.0      60.0
  (HOURS)    (AF)      (CFS)
 -----------------------------------------------------------------------------
   0.03     0.0000      0.00  Q         .         .         .         .
   0.14     0.0041      0.91  Q         .         .         .         .
   0.25     0.0124      0.91  Q         .         .         .         .
   0.36     0.0207      0.91  Q         .         .         .         .
   0.47     0.0291      0.92  Q         .         .         .         .
   0.58     0.0375      0.92  Q         .         .         .         .
```

0.69	0.0459	0.93	Q	.	.	.	.
0.80	0.0543	0.93	Q	.	.	.	.
0.91	0.0628	0.94	Q	.	.	.	.
1.02	0.0714	0.94	Q	.	.	.	.
1.13	0.0800	0.95	Q	.	.	.	.
1.24	0.0886	0.95	Q	.	.	.	.
1.35	0.0972	0.95	Q	.	.	.	.
1.46	0.1059	0.96	Q	.	.	.	.
1.57	0.1147	0.96	Q	.	.	.	.
1.68	0.1235	0.97	Q	.	.	.	.
1.79	0.1323	0.97	Q	.	.	.	.
1.90	0.1412	0.98	Q	.	.	.	.
2.01	0.1501	0.98	Q	.	.	.	.
2.12	0.1590	0.99	Q	.	.	.	.
2.23	0.1680	0.99	Q	.	.	.	.
2.34	0.1771	1.00	Q	.	.	.	.
2.45	0.1861	1.00	Q	.	.	.	.
2.56	0.1953	1.01	Q	.	.	.	.
2.67	0.2045	1.01	Q	.	.	.	.
2.78	0.2137	1.02	Q	.	.	.	.
2.89	0.2230	1.02	Q	.	.	.	.
3.00	0.2323	1.03	Q	.	.	.	.
3.11	0.2417	1.03	Q	.	.	.	.
3.22	0.2511	1.04	Q	.	.	.	.
3.33	0.2606	1.04	Q	.	.	.	.
3.44	0.2701	1.05	Q	.	.	.	.
3.55	0.2797	1.06	Q	.	.	.	.
3.66	0.2893	1.06	Q	.	.	.	.
3.77	0.2990	1.07	Q	.	.	.	.
3.88	0.3088	1.07	Q	.	.	.	.
3.99	0.3186	1.08	Q	.	.	.	.
4.10	0.3284	1.08	Q	.	.	.	.
4.21	0.3383	1.09	Q	.	.	.	.
4.32	0.3483	1.10	Q	.	.	.	.
4.43	0.3583	1.11	Q	.	.	.	.
4.54	0.3684	1.11	Q	.	.	.	.
4.65	0.3785	1.12	Q	.	.	.	.
4.76	0.3888	1.12	Q	.	.	.	.
4.87	0.3990	1.13	Q	.	.	.	.
4.98	0.4094	1.14	Q	.	.	.	.
5.09	0.4198	1.15	Q	.	.	.	.
5.20	0.4302	1.15	Q	.	.	.	.
5.31	0.4408	1.16	Q	.	.	.	.
5.42	0.4514	1.17	Q	.	.	.	.
5.53	0.4620	1.18	Q	.	.	.	.
5.64	0.4728	1.18	Q	.	.	.	.
5.75	0.4836	1.19	Q	.	.	.	.
5.86	0.4945	1.20	Q	.	.	.	.
5.97	0.5054	1.21	Q	.	.	.	.
6.08	0.5164	1.21	Q	.	.	.	.
6.20	0.5275	1.23	Q	.	.	.	.
6.31	0.5387	1.23	Q	.	.	.	.
6.42	0.5500	1.24	Q	.	.	.	.
6.53	0.5613	1.25	Q	.	.	.	.
6.64	0.5728	1.26	Q	.	.	.	.
6.75	0.5843	1.27	Q	.	.	.	.
6.86	0.5959	1.28	Q	.	.	.	.

6.97	0.6076	1.29	Q	.	.	.	.
7.08	0.6193	1.30	Q	.	.	.	.
7.19	0.6312	1.31	Q	.	.	.	.
7.30	0.6432	1.32	Q	.	.	.	.
7.41	0.6552	1.33	Q	.	.	.	.
7.52	0.6674	1.34	Q	.	.	.	.
7.63	0.6796	1.35	Q	.	.	.	.
7.74	0.6919	1.36	Q	.	.	.	.
7.85	0.7044	1.37	Q	.	.	.	.
7.96	0.7170	1.39	Q	.	.	.	.
8.07	0.7296	1.39	Q	.	.	.	.
8.18	0.7424	1.41	Q	.	.	.	.
8.29	0.7553	1.42	Q	.	.	.	.
8.40	0.7683	1.44	Q	.	.	.	.
8.51	0.7814	1.44	Q	.	.	.	.
8.62	0.7946	1.46	Q	.	.	.	.
8.73	0.8080	1.47	Q	.	.	.	.
8.84	0.8215	1.49	Q	.	.	.	.
8.95	0.8351	1.50	Q	.	.	.	.
9.06	0.8488	1.52	.Q	.	.	.	.
9.17	0.8627	1.53	.Q	.	.	.	.
9.28	0.8767	1.55	.Q	.	.	.	.
9.39	0.8909	1.56	.Q	.	.	.	.
9.50	0.9052	1.58	.Q	.	.	.	.
9.61	0.9196	1.59	.Q	.	.	.	.
9.72	0.9343	1.62	.Q	.	.	.	.
9.83	0.9490	1.63	.Q	.	.	.	.
9.94	0.9640	1.65	.Q	.	.	.	.
10.05	0.9791	1.67	.Q	.	.	.	.
10.16	0.9944	1.69	.Q	.	.	.	.
10.27	1.0098	1.70	.Q	.	.	.	.
10.38	1.0255	1.73	.Q	.	.	.	.
10.49	1.0413	1.75	.Q	.	.	.	.
10.60	1.0574	1.78	.Q	.	.	.	.
10.71	1.0736	1.79	.Q	.	.	.	.
10.82	1.0900	1.82	.Q	.	.	.	.
10.93	1.1067	1.84	.Q	.	.	.	.
11.04	1.1236	1.87	.Q	.	.	.	.
11.15	1.1407	1.89	.Q	.	.	.	.
11.26	1.1581	1.93	.Q	.	.	.	.
11.37	1.1757	1.94	.Q	.	.	.	.
11.48	1.1936	1.98	.Q	.	.	.	.
11.59	1.2117	2.00	.Q	.	.	.	.
11.70	1.2302	2.05	.Q	.	.	.	.
11.81	1.2489	2.07	.Q	.	.	.	.
11.92	1.2679	2.11	.Q	.	.	.	.
12.03	1.2872	2.14	.Q	.	.	.	.
12.14	1.3094	2.74	.Q	.	.	.	.
12.25	1.3345	2.77	.Q	.	.	.	.
12.36	1.3600	2.83	.Q	.	.	.	.
12.47	1.3858	2.86	.Q	.	.	.	.
12.58	1.4121	2.92	.Q	.	.	.	.
12.70	1.4389	2.95	.Q	.	.	.	.
12.81	1.4661	3.02	. Q	.	.	.	.
12.92	1.4938	3.06	. Q	.	.	.	.
13.03	1.5220	3.14	. Q	.	.	.	.
13.14	1.5507	3.18	. Q	.	.	.	.

```
  13.25      1.5800       3.26  . Q       .         .         .         .
  13.36      1.6100       3.31  . Q       .         .         .         .
  13.47      1.6406       3.41  . Q       .         .         .         .
  13.58      1.6718       3.46  . Q       .         .         .         .
  13.69      1.7039       3.57  . Q       .         .         .         .
  13.80      1.7367       3.63  . Q       .         .         .         .
  13.91      1.7703       3.76  . Q       .         .         .         .
  14.02      1.8049       3.83  . Q       .         .         .         .
  14.13      1.8406       4.00  . Q       .         .         .         .
  14.24      1.8774       4.09  . Q       .         .         .         .
  14.35      1.9155       4.27  . Q       .         .         .         .
  14.46      1.9548       4.37  . Q       .         .         .         .
  14.57      1.9956       4.60  .  Q      .         .         .         .
  14.68      2.0381       4.74  .  Q      .         .         .         .
  14.79      2.0826       5.04  .  Q      .         .         .         .
  14.90      2.1293       5.21  .  Q      .         .         .         .
  15.01      2.1784       5.60  .  Q      .         .         .         .
  15.12      2.2305       5.83  .  Q      .         .         .         .
  15.23      2.2860       6.38  .   Q     .         .         .         .
  15.34      2.3456       6.71  .   Q     .         .         .         .
  15.45      2.4061       6.59  .   Q     .         .         .         .
  15.56      2.4686       7.12  .   Q     .         .         .         .
  15.67      2.5403       8.62  .    Q    .         .         .         .
  15.78      2.6240       9.77  .     Q   .         .         .         .
  15.89      2.7323      14.02  .        Q.         .         .         .
  16.00      2.8838      19.26  .         . Q       .         .         .
  16.11      3.2391      58.78  .         .         .         .        Q.
  16.22      3.5586      11.41  .      Q  .         .         .         .
  16.33      3.6459       7.78  .    Q    .         .         .         .
  16.44      3.7133       7.02  .   Q     .         .         .         .
  16.55      3.7730       6.09  .   Q     .         .         .         .
  16.66      3.8252       5.39  .  Q      .         .         .         .
  16.77      3.8720       4.88  .  Q      .         .         .         .
  16.88      3.9146       4.48  . Q       .         .         .         .
  16.99      3.9540       4.17  . Q       .         .         .         .
  17.10      3.9908       3.91  . Q       .         .         .         .
  17.21      4.0254       3.70  . Q       .         .         .         .
  17.32      4.0583       3.52  . Q       .         .         .         .
  17.43      4.0896       3.36  . Q       .         .         .         .
  17.54      4.1195       3.22  . Q       .         .         .         .
  17.65      4.1483       3.10  . Q       .         .         .         .
  17.76      4.1760       2.99  .Q        .         .         .         .
  17.87      4.2027       2.89  .Q        .         .         .         .
  17.98      4.2286       2.80  .Q        .         .         .         .
  18.09      4.2523       2.42  .Q        .         .         .         .
  18.20      4.2728       2.09  .Q        .         .         .         .
  18.31      4.2916       2.02  .Q        .         .         .         .
  18.42      4.3097       1.96  .Q        .         .         .         .
  18.53      4.3273       1.91  .Q        .         .         .         .
  18.64      4.3445       1.86  .Q        .         .         .         .
  18.75      4.3611       1.81  .Q        .         .         .         .
  18.86      4.3774       1.76  .Q        .         .         .         .
  18.97      4.3932       1.72  .Q        .         .         .         .
  19.08      4.4087       1.68  .Q        .         .         .         .
  19.19      4.4238       1.64  .Q        .         .         .         .
  19.31      4.4386       1.61  .Q        .         .         .         .
  19.42      4.4530       1.57  .Q        .         .         .         .
```

19.53	4.4672	1.54	.Q	.	.	.	.
19.64	4.4811	1.51	.Q	.	.	.	.
19.75	4.4947	1.48	Q	.	.	.	.
19.86	4.5080	1.45	Q	.	.	.	.
19.97	4.5212	1.43	Q	.	.	.	.
20.08	4.5340	1.40	Q	.	.	.	.
20.19	4.5467	1.38	Q	.	.	.	.
20.30	4.5592	1.36	Q	.	.	.	.
20.41	4.5714	1.33	Q	.	.	.	.
20.52	4.5835	1.31	Q	.	.	.	.
20.63	4.5953	1.29	Q	.	.	.	.
20.74	4.6070	1.27	Q	.	.	.	.
20.85	4.6185	1.26	Q	.	.	.	.
20.96	4.6299	1.24	Q	.	.	.	.
21.07	4.6411	1.22	Q	.	.	.	.
21.18	4.6521	1.20	Q	.	.	.	.
21.29	4.6630	1.19	Q	.	.	.	.
21.40	4.6737	1.17	Q	.	.	.	.
21.51	4.6843	1.16	Q	.	.	.	.
21.62	4.6948	1.14	Q	.	.	.	.
21.73	4.7051	1.13	Q	.	.	.	.
21.84	4.7153	1.11	Q	.	.	.	.
21.95	4.7254	1.10	Q	.	.	.	.
22.06	4.7354	1.09	Q	.	.	.	.
22.17	4.7452	1.08	Q	.	.	.	.
22.28	4.7550	1.06	Q	.	.	.	.
22.39	4.7646	1.05	Q	.	.	.	.
22.50	4.7741	1.04	Q	.	.	.	.
22.61	4.7836	1.03	Q	.	.	.	.
22.72	4.7929	1.02	Q	.	.	.	.
22.83	4.8021	1.01	Q	.	.	.	.
22.94	4.8112	1.00	Q	.	.	.	.
23.05	4.8203	0.99	Q	.	.	.	.
23.16	4.8292	0.98	Q	.	.	.	.
23.27	4.8381	0.97	Q	.	.	.	.
23.38	4.8469	0.96	Q	.	.	.	.
23.49	4.8556	0.95	Q	.	.	.	.
23.60	4.8642	0.94	Q	.	.	.	.
23.71	4.8728	0.93	Q	.	.	.	.
23.82	4.8812	0.93	Q	.	.	.	.
23.93	4.8896	0.92	Q	.	.	.	.
24.04	4.8979	0.91	Q	.	.	.	.
24.15	4.9021	0.00	Q	.	.	.	.

Summary for Pond 2P: Civic Center Detention Basin

Inflow Area = 12.400 ac, 0.00% Impervious, Inflow Depth = 4.79"
Inflow = 52.55 cfs @ 16.16 hrs, Volume= 4.954 af
Outflow = 33.15 cfs @ 16.23 hrs, Volume= 4.945 af, Atten= 37%, Lag= 4.0 min
Primary = 33.15 cfs @ 16.23 hrs, Volume= 4.945 af

Routing by Stor-Ind method, Time Span= 0.00-25.00 hrs, dt= 0.05 hrs
Peak Elev= 576.21' @ 16.23 hrs Surf.Area= 0.158 ac Storage= 0.381 af

Plug-Flow detention time= 14.8 min calculated for 4.945 af (100% of inflow)
Center-of-Mass det. time= 13.7 min (849.6 - 835.9)

Volume	Invert	Avail.Storage	Storage Description
#1	573.00'	0.513 af	**30.00'W x 120.00'L x 4.00'H Prismatoid Z=3.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	573.00'	**30.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 573.00' / 571.00' S= 0.0400 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=32.65 cfs @ 16.23 hrs HW=576.16' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 32.65 cfs @ 6.65 fps)

AREA A EXISTING 2 YEAR HYDROLOGY AND HYDROGRAPH

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
        (c) Copyright 1983-2007 Advanced Engineering Software (aes)
          Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                         Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA A                                                       *
 * 2 YEAR EXISTING HYDROLOGY                                                *
 *                                                                          *
 **************************************************************************

  FILE NAME: IRWD02A.DAT
  TIME/DATE OF STUDY: 10:18 03/09/2010
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =     2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK- HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)    (FT)     SIDE / SIDE/ WAY   (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================= ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020  0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   252.00
  ELEVATION DATA: UPSTREAM(FEET) =    706.50  DOWNSTREAM(FEET) =    688.30
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.109
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.715
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "GRASS"                    C        0.55      0.25     1.000    86    8.11
 NATURAL POOR COVER
 "GRASS"                    B        0.22      0.30     1.000    78    8.11
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      1.01
 TOTAL AREA(ACRES) =       0.77   PEAK FLOW RATE(CFS) =       1.01

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     688.30
 DOWNSTREAM NODE ELEVATION(FEET) =     658.40
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1247.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.07000
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.081
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                    B        9.28      0.30     1.000    78
 NATURAL POOR COVER
 "GRASS"                    C       18.28      0.25     1.000    86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.27
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.05
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    2.07
 AVERAGE FLOW DEPTH(FEET) =   0.45   FLOOD WIDTH(FEET) =   16.26
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =  10.02   Tc(MIN.) =   18.13
 SUBAREA AREA(ACRES) =   27.56      SUBAREA RUNOFF(CFS) =   20.19
 EFFECTIVE AREA(ACRES) =   28.33    AREA-AVERAGED Fm(INCH/HR) =   0.27
 AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =       28.3        PEAK FLOW RATE(CFS) =      20.75

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.65   FLOOD WIDTH(FEET) =   21.92
 FLOW VELOCITY(FEET/SEC.) =   2.55   DEPTH*VELOCITY(FT*FT/SEC) =   1.66
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =    1499.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =   643.00  DOWNSTREAM(FEET) =   636.00
 FLOW LENGTH(FEET) =   106.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  15.76
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      20.75
 PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   18.24
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.00 =    1605.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     13.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   18.24
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.077
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "CHAPARRAL,NARROWLEAF"     B        0.63      0.30     1.000    82
 NATURAL POOR COVER
 "CHAPARRAL,NARROWLEAF"     C        3.06      0.25     1.000    88
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA AREA(ACRES) =    3.69      SUBAREA RUNOFF(CFS) =    2.72
 EFFECTIVE AREA(ACRES) =     32.02   AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       32.0       PEAK FLOW RATE(CFS) =      23.37

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     13.50 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   636.00  DOWNSTREAM(FEET) =   615.00
 FLOW LENGTH(FEET) =   143.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  22.20
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      23.37
 PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   18.35
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     13.50 =    1748.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.50 TO NODE     14.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    615.00
 DOWNSTREAM NODE ELEVATION(FEET) =    596.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   194.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
 MAXIMUM DEPTH(FEET) =   3.00
```

```
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.064
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     A        0.53      0.40      1.000    55
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     B        1.63      0.30      1.000    72
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C        0.03      0.25      1.000    81
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.32
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     24.10
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  12.08
 AVERAGE FLOW DEPTH(FEET) =   0.32   FLOOD WIDTH(FEET) =    9.12
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.27   Tc(MIN.) =   18.62
 SUBAREA AREA(ACRES) =    2.19       SUBAREA RUNOFF(CFS) =    1.46
 EFFECTIVE AREA(ACRES) =   34.21     AREA-AVERAGED Fm(INCH/HR) =   0.27
 AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =       34.2         PEAK FLOW RATE(CFS) =      24.47

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.32   FLOOD WIDTH(FEET) =    9.17
 FLOW VELOCITY(FEET/SEC.) =  12.11   DEPTH*VELOCITY(FT*FT/SEC) =   3.88
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     14.00 =   1942.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     14.00 TO NODE     14.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   18.62
 RAINFALL INTENSITY(INCH/HR) =   1.06
 AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =     34.21
 TOTAL STREAM AREA(ACRES) =     34.21
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     24.47

****************************************************************************
 FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   365.00
 ELEVATION DATA: UPSTREAM(FEET) =    696.80  DOWNSTREAM(FEET) =    623.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.294
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.496
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"     B         0.48      0.30     1.000    72   10.29
NATURAL FAIR COVER
"CHAPARRAL,NARROWLEAF"     C         1.87      0.25     1.000    81   10.29
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =       2.61
TOTAL AREA(ACRES) =       2.35   PEAK FLOW RATE(CFS) =       2.61

****************************************************************************
 FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   618.00  DOWNSTREAM(FEET) =   601.00
 FLOW LENGTH(FEET) =   116.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  12.85
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        2.61
 PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   10.44
 LONGEST FLOWPATH FROM NODE     31.00 TO NODE     33.00 =    481.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     33.00 TO NODE     14.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    601.00
 DOWNSTREAM NODE ELEVATION(FEET) =    596.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    76.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.440
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     B         0.01      0.30     1.000    72
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.62
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.30
 AVERAGE FLOW DEPTH(FEET) =   0.21   FLOOD WIDTH(FEET) =    7.47
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.55   Tc(MIN.) =   10.99
 SUBAREA AREA(ACRES) =     0.01       SUBAREA RUNOFF(CFS) =    0.01
 EFFECTIVE AREA(ACRES) =     2.36     AREA-AVERAGED Fm(INCH/HR) =   0.26
 AREA-AVERAGED Fp(INCH/HR) =   0.26  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =         2.4         PEAK FLOW RATE(CFS) =       2.61
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.21   FLOOD WIDTH(FEET) =     7.45
 FLOW VELOCITY(FEET/SEC.) =   2.32   DEPTH*VELOCITY(FT*FT/SEC) =   0.49
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```
 LONGEST FLOWPATH FROM NODE      31.00 TO NODE      14.00 =     557.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      14.00 TO NODE      14.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.99
 RAINFALL INTENSITY(INCH/HR) =   1.44
 AREA-AVERAGED Fm(INCH/HR) =  0.26
 AREA-AVERAGED Fp(INCH/HR) =  0.26
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       2.36
 TOTAL STREAM AREA(ACRES) =       2.36
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.61

 ** CONFLUENCE DATA **
  STREAM        Q       Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
     1        24.47   18.62    1.064  0.27( 0.27) 1.00       34.2      10.00
     2         2.61   10.99    1.440  0.26( 0.26) 1.00        2.4      31.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM        Q       Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
     1        23.90   10.99    1.440  0.27( 0.27) 1.00       22.6      31.00
     2        26.26   18.62    1.064  0.27( 0.27) 1.00       36.6      10.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       26.26   Tc(MIN.) =     18.62
 EFFECTIVE AREA(ACRES) =       36.57   AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       36.6
 LONGEST FLOWPATH FROM NODE      10.00 TO NODE      14.00 =    1942.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      14.00 TO NODE      15.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   596.00  DOWNSTREAM(FEET) =   590.00
 FLOW LENGTH(FEET) =     82.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  12.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  17.58
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      26.26
 PIPE TRAVEL TIME(MIN.) =    0.08     Tc(MIN.) =    18.69
 LONGEST FLOWPATH FROM NODE      10.00 TO NODE      15.00 =    2024.00 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE     15.00 TO NODE     16.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    590.00
 DOWNSTREAM NODE ELEVATION(FEET) =    578.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    29.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.00200
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.057
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "WOODLAND"                  B        0.01      0.30     1.000    55
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     26.26
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.23
 AVERAGE FLOW DEPTH(FEET) =   0.18   FLOOD WIDTH(FEET) =  126.30
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.15   Tc(MIN.) =   18.84
 SUBAREA AREA(ACRES) =     0.01      SUBAREA RUNOFF(CFS) =    0.01
 EFFECTIVE AREA(ACRES) =   36.58     AREA-AVERAGED Fm(INCH/HR) =   0.27
 AREA-AVERAGED Fp(INCH/HR) =   0.27  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =        36.6        PEAK FLOW RATE(CFS) =      26.26
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.18   FLOOD WIDTH(FEET) =  126.30
 FLOW VELOCITY(FEET/SEC.) =   3.23   DEPTH*VELOCITY(FT*FT/SEC) =   0.58
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     16.00 =    2053.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   297.00
 ELEVATION DATA: UPSTREAM(FEET) =    698.30  DOWNSTREAM(FEET) =    693.50

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    11.683
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.391
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "GRASS"                     C        0.30      0.25     1.000    86   11.68
```

```
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =       0.31
 TOTAL AREA(ACRES) =       0.30   PEAK FLOW RATE(CFS) =       0.31

****************************************************************************
 FLOW PROCESS FROM NODE     51.00 TO NODE     52.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    693.50
 DOWNSTREAM NODE ELEVATION(FEET) =    666.50
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1046.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.095
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
      LAND USE            GROUP    (ACRES)   (INCH/HR)   (DECIMAL)   CN
 NATURAL POOR COVER
 "GRASS"                    C        2.50       0.25      1.000     86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.16
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    2.89
 AVERAGE FLOW DEPTH(FEET) =    0.10   FLOOD WIDTH(FEET) =    5.44
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =    6.04   Tc(MIN.) =   17.72
 SUBAREA AREA(ACRES) =    2.50       SUBAREA RUNOFF(CFS) =    1.90
 EFFECTIVE AREA(ACRES) =    2.80     AREA-AVERAGED Fm(INCH/HR) =   0.25
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =         2.8         PEAK FLOW RATE(CFS) =       2.13

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.14   FLOOD WIDTH(FEET) =    5.77
 FLOW VELOCITY(FEET/SEC.) =    3.62   DEPTH*VELOCITY(FT*FT/SEC) =   0.49
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     52.00 =   1343.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     52.00 TO NODE     53.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    666.50
 DOWNSTREAM NODE ELEVATION(FEET) =    606.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   397.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.064
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
      LAND USE            GROUP    (ACRES)   (INCH/HR)   (DECIMAL)   CN
 NATURAL POOR COVER
 "GRASS"                    A        0.03       0.40      1.000     67
```

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 NATURAL POOR COVER
 "GRASS"                  B        1.53      0.30     1.000    78
 NATURAL POOR COVER
 "GRASS"                  C        1.16      0.25     1.000    86
 NATURAL POOR COVER
 "GRASS"                  D        0.08      0.20     1.000    89
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.28
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.12
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.31
 AVERAGE FLOW DEPTH(FEET) =   0.11   FLOOD WIDTH(FEET) =    5.48
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.91   Tc(MIN.) =   18.63
 SUBAREA AREA(ACRES) =    2.80       SUBAREA RUNOFF(CFS) =    1.98
 EFFECTIVE AREA(ACRES) =    5.60     AREA-AVERAGED Fm(INCH/HR) =   0.26
 AREA-AVERAGED Fp(INCH/HR) =   0.26  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =          5.6        PEAK FLOW RATE(CFS) =       4.03

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.12   FLOOD WIDTH(FEET) =     5.62
 FLOW VELOCITY(FEET/SEC.) =   7.96   DEPTH*VELOCITY(FT*FT/SEC) =   0.97
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     53.00 =    1740.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     53.00 TO NODE     16.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     606.00
 DOWNSTREAM NODE ELEVATION(FEET) =     578.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    398.00
 "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.000
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "WOODLAND"               A        0.65      0.40     1.000    25
 NATURAL GOOD COVER
 "WOODLAND"               B        2.13      0.30     1.000    55
 NATURAL GOOD COVER
 "WOODLAND"               C        1.04      0.25     1.000    70
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.23
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.10
 AVERAGE FLOW DEPTH(FEET) =   0.30   FLOOD WIDTH(FEET) =    7.43
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   2.14   Tc(MIN.) =   20.77
 SUBAREA AREA(ACRES) =    3.82       SUBAREA RUNOFF(CFS) =    2.39
 EFFECTIVE AREA(ACRES) =    9.42     AREA-AVERAGED Fm(INCH/HR) =   0.28
 AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =          9.4        PEAK FLOW RATE(CFS) =       6.10

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.33   FLOOD WIDTH(FEET) =     7.68
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 FLOW VELOCITY(FEET/SEC.) =   3.26   DEPTH*VELOCITY(FT*FT/SEC) =   1.07
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =   2138.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1        6.10   20.77    1.000  0.28( 0.28) 1.00       9.4      50.00
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =   2138.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       23.90   11.23    1.423  0.27( 0.27) 1.00      22.6      31.00
     2       26.26   18.84    1.057  0.27( 0.27) 1.00      36.6      10.00
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE     16.00 =   2053.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
     1       29.14   11.23    1.423  0.27( 0.27) 1.00      27.7      31.00
     2       32.23   18.84    1.057  0.27( 0.27) 1.00      45.1      10.00
     3       30.45   20.77    1.000  0.27( 0.27) 1.00      46.0      50.00
   TOTAL AREA(ACRES) =         46.0

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        32.23  Tc(MIN.) =   18.844
 EFFECTIVE AREA(ACRES) =     45.13  AREA-AVERAGED Fm(INCH/HR) =  0.27
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  1.00
 TOTAL AREA(ACRES) =       46.0
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     16.00 =   2138.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     16.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     16.00 TO NODE     17.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =     578.00
 DOWNSTREAM NODE ELEVATION(FEET) =     558.83
 CHANNEL LENGTH THRU SUBAREA(FEET) =    466.00
 "V" GUTTER WIDTH(FEET) =    5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.20000
 MAXIMUM DEPTH(FEET) =    6.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.004
 SUBAREA LOSS RATE DATA(AMC  II):
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```
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap       SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN
 NATURAL GOOD COVER
 "WOODLAND"                 A        1.58      0.40      1.000     25
 NATURAL GOOD COVER
 "WOODLAND"                 B        0.24      0.30      1.000     55
 NATURAL GOOD COVER
 "WOODLAND"                 C        0.63      0.25      1.000     70
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.35
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.95
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =    4.44
 AVERAGE FLOW DEPTH(FEET) =   0.86   FLOOD WIDTH(FEET) =   13.04
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.75   Tc(MIN.) =   20.59
 SUBAREA AREA(ACRES) =     2.45      SUBAREA RUNOFF(CFS) =    1.44
 EFFECTIVE AREA(ACRES) =   47.58     AREA-AVERAGED Fm(INCH/HR) =   0.28
 AREA-AVERAGED Fp(INCH/HR) =   0.28  AREA-AVERAGED Ap =   1.00
 TOTAL AREA(ACRES) =        48.5        PEAK FLOW RATE(CFS) =      32.23
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.86   FLOOD WIDTH(FEET) =   12.95
 FLOW VELOCITY(FEET/SEC.) =   4.41   DEPTH*VELOCITY(FT*FT/SEC) =   3.77
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     17.00 =   2604.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    614.00
 ELEVATION DATA: UPSTREAM(FEET) =    681.80  DOWNSTREAM(FEET) =    594.50

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.599
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.275
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap       SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)   CN  (MIN.)
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     A        0.33      0.40      1.000     55   13.60
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     B        0.93      0.30      1.000     72   13.60
 NATURAL FAIR COVER
 "CHAPARRAL,NARROWLEAF"     C        1.30      0.25      1.000     81   13.60
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.29
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =       2.27
 TOTAL AREA(ACRES) =       2.56   PEAK FLOW RATE(CFS) =       2.27
```

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****************************************************************************
  FLOW PROCESS FROM NODE      41.00 TO NODE      42.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    594.50  DOWNSTREAM(FEET) =    567.10
  FLOW LENGTH(FEET) =    131.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO  8.000
  DEPTH OF FLOW IN   8.0 INCH PIPE IS   3.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.16
  ESTIMATED PIPE DIAMETER(INCH) =   8.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =          2.27
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   13.75
  LONGEST FLOWPATH FROM NODE      40.00 TO NODE      42.00 =     745.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      42.00 TO NODE      42.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      40.00 TO NODE      45.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    322.00
  ELEVATION DATA: UPSTREAM(FEET) =    681.80  DOWNSTREAM(FEET) =    618.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.830
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.536
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      B        0.20       0.30     1.000    72    9.83
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      C        2.51       0.25     1.000    81    9.83
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =        3.13
  TOTAL AREA(ACRES) =       2.71   PEAK FLOW RATE(CFS) =       3.13

****************************************************************************
  FLOW PROCESS FROM NODE      45.00 TO NODE      46.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    615.00  DOWNSTREAM(FEET) =    609.29
  FLOW LENGTH(FEET) =    306.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =    6.17
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =        3.13
  PIPE TRAVEL TIME(MIN.) =   0.83    Tc(MIN.) =   10.66
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     46.00 =     628.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     46.00 TO NODE     46.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.66
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.466
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.20      0.40     0.100    32
  COMMERCIAL                 B        0.58      0.30     0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.33
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.78      SUBAREA RUNOFF(CFS) =     1.01
  EFFECTIVE AREA(ACRES) =      3.49   AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =        3.5       PEAK FLOW RATE(CFS) =       3.96

****************************************************************************
  FLOW PROCESS FROM NODE     46.00 TO NODE     47.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   609.29  DOWNSTREAM(FEET) =   571.50
  FLOW LENGTH(FEET) =   168.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.74
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        3.96
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   10.82
  LONGEST FLOWPATH FROM NODE     40.00 TO NODE     47.00 =     796.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     47.00 TO NODE     47.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.82
  RAINFALL INTENSITY(INCH/HR) =   1.45
  AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.26
  AREA-AVERAGED Ap =  0.80
  EFFECTIVE STREAM AREA(ACRES) =       3.49
  TOTAL STREAM AREA(ACRES) =       3.49
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.96

****************************************************************************
  FLOW PROCESS FROM NODE     48.00 TO NODE     48.50 IS CODE =  21
----------------------------------------------------------------------------
```

```
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    529.00
 ELEVATION DATA: UPSTREAM(FEET) =    628.80  DOWNSTREAM(FEET) =    582.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.476
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.481
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL POOR COVER
 "CHAPARRAL,NARROWLEAF"     A        1.10      0.40      1.000    71   10.48
 NATURAL POOR COVER
 "GRASS"                    B        0.49      0.30      1.000    78   10.48
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.37
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      1.59
 TOTAL AREA(ACRES) =      1.59   PEAK FLOW RATE(CFS) =      1.59

****************************************************************************
 FLOW PROCESS FROM NODE     48.50 TO NODE     47.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    577.00  DOWNSTREAM(FEET) =    571.50
 FLOW LENGTH(FEET) =   132.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.09
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.59
 PIPE TRAVEL TIME(MIN.) =   0.31    Tc(MIN.) =   10.79
 LONGEST FLOWPATH FROM NODE     48.00 TO NODE     47.00 =     661.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     47.00 TO NODE     47.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   10.79
 RAINFALL INTENSITY(INCH/HR) =   1.46
 AREA-AVERAGED Fm(INCH/HR) =  0.37
 AREA-AVERAGED Fp(INCH/HR) =  0.37
 AREA-AVERAGED Ap =  1.00
 EFFECTIVE STREAM AREA(ACRES) =       1.59
 TOTAL STREAM AREA(ACRES) =       1.59
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.59

 ** CONFLUENCE DATA **
  STREAM        Q       Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER      (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1        3.96    10.82     1.453  0.26( 0.20) 0.80        3.5       40.00
```

```
    2       1.59   10.79    1.456  0.37( 0.37) 1.00       1.6      48.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
      1       5.55   10.79    1.456  0.30( 0.26) 0.86       5.1      48.00
      2       5.55   10.82    1.453  0.30( 0.26) 0.86       5.1      40.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        5.55    Tc(MIN.) =    10.82
  EFFECTIVE AREA(ACRES) =        5.08   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap =  0.86
  TOTAL AREA(ACRES) =          5.1
  LONGEST FLOWPATH FROM NODE      40.00 TO NODE      47.00 =     796.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      47.00 TO NODE      49.00 IS CODE =  31
----------------------------------------------------------------------------

  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    571.50  DOWNSTREAM(FEET) =    568.38
  FLOW LENGTH(FEET) =   162.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS    9.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.23
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =         5.55
  PIPE TRAVEL TIME(MIN.) =   0.37     Tc(MIN.) =   11.20
  LONGEST FLOWPATH FROM NODE      40.00 TO NODE      49.00 =     958.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      49.00 TO NODE      49.00 IS CODE =  81
----------------------------------------------------------------------------

  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.20
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.425
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      A        1.50      0.40     1.000    55
  NATURAL FAIR COVER
  "CHAPARRAL,NARROWLEAF"      B        0.28      0.30     1.000    72
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.38
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    1.78      SUBAREA RUNOFF(CFS) =    1.67
  EFFECTIVE AREA(ACRES) =       6.86   AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.32  AREA-AVERAGED Ap =  0.90
  TOTAL AREA(ACRES) =          6.9       PEAK FLOW RATE(CFS) =       7.01

****************************************************************************
  FLOW PROCESS FROM NODE      49.00 TO NODE      42.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   568.38  DOWNSTREAM(FEET) =   567.10
FLOW LENGTH(FEET) =     58.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  15.0 INCH PIPE IS  10.1 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   8.00
ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =         7.01
PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   11.32
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =    1016.00 FEET.

******************************************************************************
FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  11
------------------------------------------------------------------------------
>>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
==============================================================================

** MAIN STREAM CONFLUENCE DATA **
 STREAM       Q       Tc   Intensity   Fp(Fm)      Ap     Ae      HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
    1        7.02   11.28     1.419  0.32( 0.29) 0.90       6.8      48.00
    2        7.01   11.32     1.416  0.32( 0.29) 0.90       6.9      40.00
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =    1016.00 FEET.

** MEMORY BANK #  2 CONFLUENCE DATA **
 STREAM       Q       Tc   Intensity   Fp(Fm)      Ap     Ae      HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
    1        2.27   13.75     1.266  0.29( 0.29) 1.00       2.6      40.00
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =     745.00 FEET.

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc   Intensity   Fp(Fm)      Ap     Ae      HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)     NODE
    1        9.17   11.28     1.419  0.31( 0.29) 0.92       8.9      48.00
    2        9.17   11.32     1.416  0.31( 0.29) 0.92       9.0      40.00
    3        8.35   13.75     1.266  0.31( 0.29) 0.93       9.4      40.00
  TOTAL AREA(ACRES) =          9.4

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =         9.17  Tc(MIN.) =    11.281
EFFECTIVE AREA(ACRES) =       8.95  AREA-AVERAGED Fm(INCH/HR) =  0.29
AREA-AVERAGED Fp(INCH/HR) =  0.31  AREA-AVERAGED Ap =  0.92
TOTAL AREA(ACRES) =        9.4
LONGEST FLOWPATH FROM NODE     40.00 TO NODE     42.00 =    1016.00 FEET.

******************************************************************************
FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  12
------------------------------------------------------------------------------
>>>>>CLEAR MEMORY BANK # 2 <<<<<
==============================================================================

******************************************************************************
FLOW PROCESS FROM NODE     42.00 TO NODE     17.00 IS CODE =  31
------------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
================================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   567.10  DOWNSTREAM(FEET) =   558.83
 FLOW LENGTH(FEET) =    74.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  15.66
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       9.17
 PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   11.36
 LONGEST FLOWPATH FROM NODE     40.00 TO NODE     17.00 =    1090.00 FEET.

********************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  11
--------------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
================================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1         9.17    11.36     1.413  0.31( 0.29) 0.92       8.9      48.00
    2         9.17    11.40     1.411  0.31( 0.29) 0.92       9.0      40.00
    3         8.35    13.83     1.262  0.31( 0.29) 0.93       9.4      40.00
 LONGEST FLOWPATH FROM NODE     40.00 TO NODE     17.00 =    1090.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q       Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1        29.14    13.03     1.307  0.28( 0.28) 1.00      30.1      31.00
    2        32.23    20.59     1.004  0.28( 0.28) 1.00      47.6      10.00
    3        30.45    22.55     0.954  0.28( 0.28) 1.00      48.5      50.00
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     17.00 =    2604.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc   Intensity   Fp(Fm)     Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)          (ACRES)    NODE
    1        37.22    11.36     1.413  0.29( 0.28) 0.98      35.2      48.00
    2        37.24    11.40     1.411  0.29( 0.28) 0.98      35.3      40.00
    3        37.76    13.03     1.307  0.29( 0.28) 0.98      39.4      31.00
    4        37.82    13.83     1.262  0.28( 0.28) 0.98      41.4      40.00
    5        38.38    20.59     1.004  0.28( 0.28) 0.99      57.0      10.00
    6        36.15    22.55     0.954  0.28( 0.28) 0.99      57.9      50.00
   TOTAL AREA(ACRES) =          57.9

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        38.38  Tc(MIN.) =   20.594
 EFFECTIVE AREA(ACRES) =      57.00  AREA-AVERAGED Fm(INCH/HR) =  0.28
 AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap =  0.99
 TOTAL AREA(ACRES) =        57.9
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     17.00 =    2604.00 FEET.

********************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =  12
--------------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
================================================================================

********************************************************************************
```

```
 FLOW PROCESS FROM NODE     17.00 TO NODE     18.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   558.83  DOWNSTREAM(FEET) =   557.94
 FLOW LENGTH(FEET) =   160.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  25.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.26
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      38.38
 PIPE TRAVEL TIME(MIN.) =   0.37    Tc(MIN.) =   20.96
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     18.00 =    2764.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     18.00 TO NODE     18.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   20.96
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.994
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
      LAND USE            GROUP    (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "CHAPARRAL,BROADLEAF"      A        1.71      0.40     1.000    31
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA AREA(ACRES) =     1.71       SUBAREA RUNOFF(CFS) =     0.91
 EFFECTIVE AREA(ACRES) =     58.71   AREA-AVERAGED Fm(INCH/HR) =  0.28
 AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap =  0.99
 TOTAL AREA(ACRES) =       59.6       PEAK FLOW RATE(CFS) =       38.38
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)       =       59.6  TC(MIN.) =      20.96
 EFFECTIVE AREA(ACRES) =     58.71  AREA-AVERAGED Fm(INCH/HR)=  0.28
 AREA-AVERAGED Fp(INCH/HR) =  0.28  AREA-AVERAGED Ap = 0.988
 PEAK FLOW RATE(CFS)     =      38.38

 ** PEAK FLOW RATE TABLE **
  STREAM        Q       Tc   Intensity   Fp(Fm)      Ap       Ae     HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       37.22    11.73     1.388  0.29( 0.29) 0.98       36.9       48.00
     2       37.24    11.77     1.385  0.29( 0.29) 0.98       37.0       40.00
     3       37.76    13.39     1.286  0.29( 0.28) 0.98       41.1       31.00
     4       37.82    14.20     1.243  0.29( 0.28) 0.98       43.1       40.00
     5       38.38    20.96     0.994  0.28( 0.28) 0.99       58.7       10.00
     6       36.15    22.93     0.944  0.28( 0.28) 0.99       59.6       50.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
        NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                          Analysis prepared by:

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                 PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  EXISTING OUTLET A
  2 YEAR
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1         59.60        95.00          83.        0.280       0.383

    TOTAL AREA (Acres) =     59.60

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.266

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.617
============================================================================
```

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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****************************************************************************
 ---------------------------------------------------------------------------

  Problem Descriptions:
   IRWD SITE
   EXISTING OUTLET A
   2 YEAR
 ---------------------------------------------------------------------------


     RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
     TOTAL CATCHMENT AREA(ACRES) =    59.60
     SOIL-LOSS RATE, Fm,(INCH/HR) =  0.266
     LOW LOSS FRACTION = 0.617
     TIME OF CONCENTRATION(MIN.) = 20.96
     SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
     ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
     RETURN FREQUENCY(YEARS) =   2
        5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
       30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
        1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
        3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
        6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
       24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

     TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      4.02
     TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      6.17

****************************************************************************
   TIME     VOLUME       Q     0.       10.0      20.0      30.0      40.0
  (HOURS)    (AF)      (CFS)
 ---------------------------------------------------------------------------
   0.28      0.0076      0.66  Q         .         .         .         .
   0.63      0.0267      0.66  Q         .         .         .         .
   0.98      0.0461      0.68  Q         .         .         .         .
   1.33      0.0657      0.68  Q         .         .         .         .
   1.68      0.0856      0.70  Q         .         .         .         .
```

```
    2.03      0.1059      0.70  Q         .         .         .         .
    2.38      0.1264      0.72  Q         .         .         .         .
    2.73      0.1473      0.73  Q         .         .         .         .
    3.07      0.1685      0.74  Q         .         .         .         .
    3.42      0.1900      0.75  Q         .         .         .         .
    3.77      0.2120      0.77  Q         .         .         .         .
    4.12      0.2343      0.78  Q         .         .         .         .
    4.47      0.2570      0.80  Q         .         .         .         .
    4.82      0.2801      0.81  Q         .         .         .         .
    5.17      0.3037      0.83  Q         .         .         .         .
    5.52      0.3278      0.84  Q         .         .         .         .
    5.87      0.3523      0.86  Q         .         .         .         .
    6.22      0.3774      0.87  Q         .         .         .         .
    6.57      0.4030      0.90  Q         .         .         .         .
    6.92      0.4292      0.91  Q         .         .         .         .
    7.27      0.4560      0.94  Q         .         .         .         .
    7.62      0.4835      0.96  Q         .         .         .         .
    7.97      0.5117      0.99  Q         .         .         .         .
    8.31      0.5406      1.01  .Q        .         .         .         .
    8.66      0.5704      1.05  .Q        .         .         .         .
    9.01      0.6010      1.07  .Q        .         .         .         .
    9.36      0.6325      1.11  .Q        .         .         .         .
    9.71      0.6650      1.14  .Q        .         .         .         .
   10.06      0.6987      1.19  .Q        .         .         .         .
   10.41      0.7335      1.22  .Q        .         .         .         .
   10.76      0.7697      1.29  .Q        .         .         .         .
   11.11      0.8074      1.32  .Q        .         .         .         .
   11.46      0.8466      1.40  .Q        .         .         .         .
   11.81      0.8877      1.44  .Q        .         .         .         .
   12.16      0.9317      1.61  .Q        .         .         .         .
   12.51      0.9829      1.94  .Q        .         .         .         .
   12.86      1.0411      2.08  . Q       .         .         .         .
   13.21      1.1025      2.17  . Q       .         .         .         .
   13.55      1.1679      2.37  . Q       .         .         .         .
   13.90      1.2379      2.49  . Q       .         .         .         .
   14.25      1.3150      2.85  . Q       .         .         .         .
   14.60      1.4007      3.09  .  Q      .         .         .         .
   14.95      1.4979      3.64  .  Q      .         .         .         .
   15.30      1.6090      4.05  .   Q     .         .         .         .
   15.65      1.7385      4.92  .   Q     .         .         .         .
   16.00      1.9060      6.68  .     Q   .         .         .         .
   16.35      2.5603     38.65  .         .         .         .       Q .
   16.70      3.1851      4.63  .   Q     .         .         .         .
   17.05      3.3001      3.33  .  Q      .         .         .         .
   17.40      3.3861      2.63  . Q       .         .         .         .
   17.75      3.4567      2.26  . Q       .         .         .         .
   18.10      3.5183      2.01  . Q       .         .         .         .
   18.45      3.5689      1.49  .Q        .         .         .         .
   18.79      3.6100      1.36  .Q        .         .         .         .
   19.14      3.6477      1.25  .Q        .         .         .         .
   19.49      3.6826      1.17  .Q        .         .         .         .
   19.84      3.7152      1.09  .Q        .         .         .         .
   20.19      3.7458      1.03  .Q        .         .         .         .
   20.54      3.7748      0.98  Q         .         .         .         .
   20.89      3.8023      0.93  Q         .         .         .         .
   21.24      3.8285      0.89  Q         .         .         .         .
   21.59      3.8536      0.85  Q         .         .         .         .
```

```
  21.94      3.8777      0.82  Q         .         .         .         .
  22.29      3.9008      0.79  Q         .         .         .         .
  22.64      3.9231      0.76  Q         .         .         .         .
  22.99      3.9447      0.73  Q         .         .         .         .
  23.34      3.9655      0.71  Q         .         .         .         .
  23.69      3.9858      0.69  Q         .         .         .         .
  24.03      4.0054      0.67  Q         .         .         .         .
  24.38      4.0151      0.00  Q         .         .         .         .
-----------------------------------------------------------------------
```

AREA B EXISTING 2 YEAR HYDROLOGY AND HYDROGRAPH

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
          (c) Copyright 1983-2007 Advanced Engineering Software (aes)
             Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                           Analysis prepared by:

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                          Irvine, California 92606
                 PH: 949-474-1960       FAX: 949-474-5315

 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA B                                                       *
 * 2 YEAR EXISTING HYDROLOGY                                                *
 *                                                                          *
 **************************************************************************

  FILE NAME: IRWD02B.DAT
  TIME/DATE OF STUDY: 10:46 03/09/2010
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     61.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   240.00
  ELEVATION DATA: UPSTREAM(FEET) =    679.70  DOWNSTREAM(FEET) =    673.60
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.675
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.105
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                  C        2.04      0.25      0.100    69    5.67
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      3.82
 TOTAL AREA(ACRES) =      2.04   PEAK FLOW RATE(CFS) =      3.82

****************************************************************************
 FLOW PROCESS FROM NODE     61.00 TO NODE     62.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   673.60  DOWNSTREAM(FEET) =   637.00
 FLOW LENGTH(FEET) =   540.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   4.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.71
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      3.82
 PIPE TRAVEL TIME(MIN.) =   0.84    Tc(MIN.) =    6.52
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.00 =     780.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     62.00 TO NODE     62.50 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    637.00
 DOWNSTREAM NODE ELEVATION(FEET) =    624.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =    62.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0150
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.926
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                     B        0.11      0.30      1.000    78
 NATURAL POOR COVER
 "GRASS"                     C        1.36      0.25      1.000    86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.93
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   9.35
 AVERAGE FLOW DEPTH(FEET) =   0.12   FLOOD WIDTH(FEET) =    6.02
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.11   Tc(MIN.) =    6.63
 SUBAREA AREA(ACRES) =     1.47      SUBAREA RUNOFF(CFS) =    2.21
 EFFECTIVE AREA(ACRES) =     3.51    AREA-AVERAGED Fm(INCH/HR) =   0.12
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.48
```

```
 TOTAL AREA(ACRES) =        3.5        PEAK FLOW RATE(CFS) =       5.70

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.13   FLOOD WIDTH(FEET) =    6.16
 FLOW VELOCITY(FEET/SEC.) =   9.84   DEPTH*VELOCITY(FT*FT/SEC) =   1.30
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.50 =    842.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     62.50 TO NODE     63.00 IS CODE =  91
----------------------------------------------------------------------------
 >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
 UPSTREAM NODE ELEVATION(FEET) =    624.00
 DOWNSTREAM NODE ELEVATION(FEET) =    613.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   192.00
 "V" GUTTER WIDTH(FEET) =   5.00   GUTTER HIKE(FEET) =  0.050
 PAVEMENT LIP(FEET) =  0.010   MANNING'S N = .0500
 PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.12500
 MAXIMUM DEPTH(FEET) =   3.00
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.778
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL POOR COVER
 "GRASS"                     B        1.41      0.30     1.000    78
 NATURAL POOR COVER
 "GRASS"                     C        3.92      0.25     1.000    86
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.26
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.31
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.23
 AVERAGE FLOW DEPTH(FEET) =   0.41   FLOOD WIDTH(FEET) =   10.57
 "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.99   Tc(MIN.) =    7.62
 SUBAREA AREA(ACRES) =    5.33       SUBAREA RUNOFF(CFS) =    7.26
 EFFECTIVE AREA(ACRES) =    8.84     AREA-AVERAGED Fm(INCH/HR) =   0.21
 AREA-AVERAGED Fp(INCH/HR) =   0.26  AREA-AVERAGED Ap =   0.79
 TOTAL AREA(ACRES) =        8.8        PEAK FLOW RATE(CFS) =      12.50

 END OF SUBAREA "V" GUTTER HYDRAULICS:
 DEPTH(FEET) =  0.47   FLOOD WIDTH(FEET) =   11.56
 FLOW VELOCITY(FEET/SEC.) =   3.50   DEPTH*VELOCITY(FT*FT/SEC) =   1.65
 LONGEST FLOWPATH FROM NODE     60.00 TO NODE     63.00 =   1034.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     63.00 TO NODE     64.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   613.00  DOWNSTREAM(FEET) =   607.80
 FLOW LENGTH(FEET) =    108.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS    9.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  13.05
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       12.50
 PIPE TRAVEL TIME(MIN.) =   0.14    Tc(MIN.) =    7.76
```

```
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      64.00 =    1142.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      64.00 TO NODE      64.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     7.76
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.759
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
       LAND USE             GROUP    (ACRES)   (INCH/HR)   (DECIMAL)  CN
  NATURAL POOR COVER
  "GRASS"                     B         0.01       0.30      1.000    78
  NATURAL POOR COVER
  "GRASS"                     C         0.77       0.25      1.000    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     0.78       SUBAREA RUNOFF(CFS) =     1.06
  EFFECTIVE AREA(ACRES) =       9.62   AREA-AVERAGED Fm(INCH/HR) =  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.26   AREA-AVERAGED Ap =  0.81
  TOTAL AREA(ACRES) =          9.6       PEAK FLOW RATE(CFS) =      13.41

****************************************************************************
  FLOW PROCESS FROM NODE      64.00 TO NODE      65.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   607.80  DOWNSTREAM(FEET) =   582.15
  FLOW LENGTH(FEET) =   416.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.58
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       13.41
  PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    8.23
  LONGEST FLOWPATH FROM NODE      60.00 TO NODE      65.00 =    1558.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      65.00 TO NODE      65.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     8.23
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.700
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap      SCS
       LAND USE             GROUP    (ACRES)   (INCH/HR)   (DECIMAL)  CN
  NATURAL POOR COVER
  "GRASS"                     B         0.99       0.30      1.000    78
  NATURAL POOR COVER
  "GRASS"                     C         0.30       0.25      1.000    86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.29
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =     1.29       SUBAREA RUNOFF(CFS) =     1.64
  EFFECTIVE AREA(ACRES) =      10.91   AREA-AVERAGED Fm(INCH/HR) =  0.22
```

```
 AREA-AVERAGED Fp(INCH/HR) =  0.26  AREA-AVERAGED Ap =  0.83
 TOTAL AREA(ACRES) =       10.9       PEAK FLOW RATE(CFS) =      14.54

****************************************************************************
 FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.23
 RAINFALL INTENSITY(INCH/HR) =   1.70
 AREA-AVERAGED Fm(INCH/HR) =  0.22
 AREA-AVERAGED Fp(INCH/HR) =  0.26
 AREA-AVERAGED Ap =  0.83
 EFFECTIVE STREAM AREA(ACRES) =      10.91
 TOTAL STREAM AREA(ACRES) =      10.91
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      14.54

****************************************************************************
 FLOW PROCESS FROM NODE     70.00 TO NODE     71.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    572.00
 ELEVATION DATA: UPSTREAM(FEET) =    644.70  DOWNSTREAM(FEET) =    593.80

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.518
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.228
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL FAIR COVER
 "GRASS"                    B        1.93      0.30     1.000    69   14.52
 NATURAL FAIR COVER
 "GRASS"                    C        0.97      0.25     1.000    79   14.52
 NATURAL FAIR COVER
 "GRASS"                    D        0.04      0.20     1.000    84   14.52
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.28
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =       2.50
 TOTAL AREA(ACRES) =       2.94   PEAK FLOW RATE(CFS) =       2.50

****************************************************************************
 FLOW PROCESS FROM NODE     71.00 TO NODE     72.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    589.80  DOWNSTREAM(FEET) =    583.00
 FLOW LENGTH(FEET) =    266.00    MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS    4.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =    6.69
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
```

```
PIPE-FLOW(CFS) =        2.50
PIPE TRAVEL TIME(MIN.) =   0.66    Tc(MIN.) =   15.18
LONGEST FLOWPATH FROM NODE     70.00 TO NODE     72.00 =     838.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     72.00 TO NODE     72.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =   15.18
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.197
SUBAREA LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
NATURAL GOOD COVER
"GRASS"                    A        0.10      0.40      1.000    38
NATURAL GOOD COVER
"GRASS"                    B        1.19      0.30      1.000    61
NATURAL GOOD COVER
"GRASS"                    C        0.26      0.25      1.000    74
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =    1.55     SUBAREA RUNOFF(CFS) =    1.25
EFFECTIVE AREA(ACRES) =      4.49   AREA-AVERAGED Fm(INCH/HR) =  0.29
AREA-AVERAGED Fp(INCH/HR) =  0.29  AREA-AVERAGED Ap =  1.00
TOTAL AREA(ACRES) =        4.5      PEAK FLOW RATE(CFS) =      3.67

****************************************************************************
FLOW PROCESS FROM NODE     72.00 TO NODE     65.00 IS CODE =  31
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =   583.00  DOWNSTREAM(FEET) =   582.15
FLOW LENGTH(FEET) =   128.00    MANNING'S N =  0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.4 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =   4.57
ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =        3.67
PIPE TRAVEL TIME(MIN.) =   0.47    Tc(MIN.) =   15.65
LONGEST FLOWPATH FROM NODE     70.00 TO NODE     65.00 =     966.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE     65.00 TO NODE     65.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =   15.65
RAINFALL INTENSITY(INCH/HR) =   1.18
AREA-AVERAGED Fm(INCH/HR) =  0.29
AREA-AVERAGED Fp(INCH/HR) =  0.29
AREA-AVERAGED Ap =  1.00
EFFECTIVE STREAM AREA(ACRES) =       4.49
```

```
 TOTAL STREAM AREA(ACRES) =       4.49
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.67

 ** CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
     1       14.54    8.23     1.700  0.26( 0.22) 0.83       10.9       60.00
     2        3.67   15.65     1.176  0.29( 0.29) 1.00        4.5       70.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
     1       17.61    8.23     1.700  0.27( 0.23) 0.86       13.3       60.00
     2       13.07   15.65     1.176  0.27( 0.24) 0.88       15.4       70.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       17.61     Tc(MIN.) =      8.23
 EFFECTIVE AREA(ACRES) =       13.27   AREA-AVERAGED Fm(INCH/HR) =  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.86
 TOTAL AREA(ACRES) =        15.4
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      65.00 =    1558.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      65.00 TO NODE      66.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   582.15  DOWNSTREAM(FEET) =   563.50
 FLOW LENGTH(FEET) =   278.00    MANNING'S N =  0.013
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  16.06
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       17.61
 PIPE TRAVEL TIME(MIN.) =    0.29    Tc(MIN.) =     8.52
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      66.00 =    1836.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      66.00 TO NODE      67.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   563.50  DOWNSTREAM(FEET) =   562.00
 FLOW LENGTH(FEET) =   185.00    MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  17.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.14
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       17.61
 PIPE TRAVEL TIME(MIN.) =    0.43    Tc(MIN.) =     8.95
 LONGEST FLOWPATH FROM NODE      60.00 TO NODE      67.00 =    2021.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)       =        15.4  TC(MIN.) =       8.95
```

```
EFFECTIVE AREA(ACRES) =      13.27  AREA-AVERAGED Fm(INCH/HR)=  0.23
AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap = 0.862
PEAK FLOW RATE(CFS)    =      17.61

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc   Intensity   Fp(Fm)      Ap      Ae     HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)    NODE
    1       17.61    8.95     1.620  0.27( 0.23) 0.86      13.3       60.00
    2       13.07   16.43     1.144  0.27( 0.24) 0.88      15.4       70.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
     NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                 AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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           Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                        Analysis prepared by:

                       Fuscoe Engineering, Inc
                   16795 Von Karman Ave. Suite 100
                       Irvine, California 92606
               PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  EXISTING OUTLET B
  2 YEAR
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF   SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA   NUMBER    Fp(in./hr.)    YIELD
         1        15.40       95.00          83.        0.270       0.383

    TOTAL AREA (Acres) =     15.40

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.257

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.617
============================================================================
```

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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        Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                         Analysis prepared by:

                        Fuscoe Engineering, Inc
                    16795 Von Karman Ave. Suite 100
                        Irvine, California 92606
                PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  EXISTING OUTLET B
  2 YEAR
----------------------------------------------------------------------------


   RATIONAL METHOD CALIBRATION COEFFICIENT = 0.85
   TOTAL CATCHMENT AREA(ACRES) =   15.40
   SOIL-LOSS RATE, Fm,(INCH/HR) =  0.257
   LOW LOSS FRACTION = 0.617
   TIME OF CONCENTRATION(MIN.) =  8.95
   SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
   ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
   RETURN FREQUENCY(YEARS) =   2
      5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
     30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
      1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
      3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
      6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
     24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

   TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      0.98
   TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      1.65

****************************************************************************
  TIME     VOLUME       Q     0.         5.0       10.0       15.0       20.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.04     0.0000     0.00  Q          .          .          .          .
  0.19     0.0010     0.16  Q          .          .          .          .
  0.34     0.0030     0.16  Q          .          .          .          .
  0.49     0.0050     0.16  Q          .          .          .          .
  0.64     0.0070     0.16  Q          .          .          .          .
  0.79     0.0090     0.16  Q          .          .          .          .
  0.93     0.0110     0.17  Q          .          .          .          .
  1.08     0.0131     0.17  Q          .          .          .          .
  1.23     0.0152     0.17  Q          .          .          .          .
```

1.38	0.0172	0.17	Q	.	.	.	.
1.53	0.0193	0.17	Q	.	.	.	.
1.68	0.0214	0.17	Q	.	.	.	.
1.83	0.0235	0.17	Q	.	.	.	.
1.98	0.0257	0.17	Q	.	.	.	.
2.13	0.0278	0.17	Q	.	.	.	.
2.28	0.0300	0.18	Q	.	.	.	.
2.43	0.0321	0.18	Q	.	.	.	.
2.58	0.0343	0.18	Q	.	.	.	.
2.72	0.0365	0.18	Q	.	.	.	.
2.87	0.0387	0.18	Q	.	.	.	.
3.02	0.0410	0.18	Q	.	.	.	.
3.17	0.0432	0.18	Q	.	.	.	.
3.32	0.0455	0.18	Q	.	.	.	.
3.47	0.0478	0.19	Q	.	.	.	.
3.62	0.0500	0.19	Q	.	.	.	.
3.77	0.0524	0.19	Q	.	.	.	.
3.92	0.0547	0.19	Q	.	.	.	.
4.07	0.0570	0.19	Q	.	.	.	.
4.22	0.0594	0.19	Q	.	.	.	.
4.37	0.0618	0.19	Q	.	.	.	.
4.51	0.0642	0.20	Q	.	.	.	.
4.66	0.0666	0.20	Q	.	.	.	.
4.81	0.0691	0.20	Q	.	.	.	.
4.96	0.0715	0.20	Q	.	.	.	.
5.11	0.0740	0.20	Q	.	.	.	.
5.26	0.0765	0.20	Q	.	.	.	.
5.41	0.0791	0.21	Q	.	.	.	.
5.56	0.0816	0.21	Q	.	.	.	.
5.71	0.0842	0.21	Q	.	.	.	.
5.86	0.0868	0.21	Q	.	.	.	.
6.01	0.0894	0.21	Q	.	.	.	.
6.16	0.0921	0.22	Q	.	.	.	.
6.30	0.0947	0.22	Q	.	.	.	.
6.45	0.0974	0.22	Q	.	.	.	.
6.60	0.1001	0.22	Q	.	.	.	.
6.75	0.1029	0.22	Q	.	.	.	.
6.90	0.1057	0.23	Q	.	.	.	.
7.05	0.1085	0.23	Q	.	.	.	.
7.20	0.1113	0.23	Q	.	.	.	.
7.35	0.1142	0.23	Q	.	.	.	.
7.50	0.1171	0.24	Q	.	.	.	.
7.65	0.1200	0.24	Q	.	.	.	.
7.80	0.1229	0.24	Q	.	.	.	.
7.95	0.1259	0.24	Q	.	.	.	.
8.09	0.1290	0.25	Q	.	.	.	.
8.24	0.1320	0.25	Q	.	.	.	.
8.39	0.1351	0.25	Q	.	.	.	.
8.54	0.1382	0.26	Q	.	.	.	.
8.69	0.1414	0.26	Q	.	.	.	.
8.84	0.1446	0.26	Q	.	.	.	.
8.99	0.1479	0.27	Q	.	.	.	.
9.14	0.1512	0.27	Q	.	.	.	.
9.29	0.1545	0.27	Q	.	.	.	.
9.44	0.1579	0.28	Q	.	.	.	.
9.59	0.1613	0.28	Q	.	.	.	.
9.74	0.1648	0.28	Q	.	.	.	.

```
  9.88      0.1684       0.29  Q         .         .         .         .
 10.03      0.1720       0.29  Q         .         .         .         .
 10.18      0.1756       0.30  Q         .         .         .         .
 10.33      0.1793       0.30  Q         .         .         .         .
 10.48      0.1831       0.31  Q         .         .         .         .
 10.63      0.1869       0.31  Q         .         .         .         .
 10.78      0.1908       0.32  Q         .         .         .         .
 10.93      0.1947       0.32  Q         .         .         .         .
 11.08      0.1988       0.33  Q         .         .         .         .
 11.23      0.2029       0.34  Q         .         .         .         .
 11.38      0.2071       0.34  Q         .         .         .         .
 11.52      0.2113       0.35  Q         .         .         .         .
 11.67      0.2157       0.36  Q         .         .         .         .
 11.82      0.2201       0.36  Q         .         .         .         .
 11.97      0.2247       0.37  Q         .         .         .         .
 12.12      0.2294       0.40  Q         .         .         .         .
 12.27      0.2348       0.48  Q         .         .         .         .
 12.42      0.2407       0.48  Q         .         .         .         .
 12.57      0.2468       0.50  Q         .         .         .         .
 12.72      0.2529       0.50  .Q        .         .         .         .
 12.87      0.2593       0.52  .Q        .         .         .         .
 13.02      0.2657       0.53  .Q        .         .         .         .
 13.17      0.2724       0.55  .Q        .         .         .         .
 13.32      0.2792       0.56  .Q        .         .         .         .
 13.46      0.2863       0.58  .Q        .         .         .         .
 13.61      0.2935       0.59  .Q        .         .         .         .
 13.76      0.3010       0.62  .Q        .         .         .         .
 13.91      0.3088       0.64  .Q        .         .         .         .
 14.06      0.3168       0.67  .Q        .         .         .         .
 14.21      0.3254       0.71  .Q        .         .         .         .
 14.36      0.3344       0.76  .Q        .         .         .         .
 14.51      0.3439       0.78  .Q        .         .         .         .
 14.66      0.3538       0.83  .Q        .         .         .         .
 14.81      0.3643       0.87  .Q        .         .         .         .
 14.96      0.3755       0.94  .Q        .         .         .         .
 15.10      0.3874       0.99  .Q        .         .         .         .
 15.25      0.4003       1.11  . Q       .         .         .         .
 15.40      0.4144       1.18  . Q       .         .         .         .
 15.55      0.4292       1.21  . Q       .         .         .         .
 15.70      0.4451       1.37  . Q       .         .         .         .
 15.85      0.4658       1.99  .  Q      .         .         .         .
 16.00      0.5010       3.72  .      Q  .         .         .         .
 16.15      0.6342      17.87  .         .         .         .    Q    .
 16.30      0.7542       1.61  .  Q      .         .         .         .
 16.45      0.7712       1.15  . Q       .         .         .         .
 16.60      0.7847       1.04  . Q       .         .         .         .
 16.75      0.7967       0.90  .Q        .         .         .         .
 16.90      0.8073       0.81  .Q        .         .         .         .
 17.04      0.8167       0.73  .Q        .         .         .         .
 17.19      0.8253       0.65  .Q        .         .         .         .
 17.34      0.8331       0.61  .Q        .         .         .         .
 17.49      0.8403       0.57  .Q        .         .         .         .
 17.64      0.8472       0.54  .Q        .         .         .         .
 17.79      0.8536       0.51  .Q        .         .         .         .
 17.94      0.8598       0.49  Q         .         .         .         .
 18.09      0.8657       0.47  Q         .         .         .         .
 18.24      0.8709       0.37  Q         .         .         .         .
```

18.39	0.8753	0.35	Q	.	.	.	.
18.54	0.8796	0.34	Q	.	.	.	.
18.68	0.8837	0.33	Q	.	.	.	.
18.83	0.8877	0.32	Q	.	.	.	.
18.98	0.8915	0.31	Q	.	.	.	.
19.13	0.8952	0.30	Q	.	.	.	.
19.28	0.8988	0.29	Q	.	.	.	.
19.43	0.9023	0.28	Q	.	.	.	.
19.58	0.9057	0.27	Q	.	.	.	.
19.73	0.9090	0.26	Q	.	.	.	.
19.88	0.9122	0.26	Q	.	.	.	.
20.03	0.9153	0.25	Q	.	.	.	.
20.18	0.9184	0.25	Q	.	.	.	.
20.33	0.9214	0.24	Q	.	.	.	.
20.48	0.9243	0.23	Q	.	.	.	.
20.62	0.9271	0.23	Q	.	.	.	.
20.77	0.9300	0.23	Q	.	.	.	.
20.92	0.9327	0.22	Q	.	.	.	.
21.07	0.9354	0.22	Q	.	.	.	.
21.22	0.9380	0.21	Q	.	.	.	.
21.37	0.9406	0.21	Q	.	.	.	.
21.52	0.9432	0.21	Q	.	.	.	.
21.67	0.9457	0.20	Q	.	.	.	.
21.82	0.9482	0.20	Q	.	.	.	.
21.97	0.9506	0.20	Q	.	.	.	.
22.12	0.9530	0.19	Q	.	.	.	.
22.27	0.9553	0.19	Q	.	.	.	.
22.41	0.9576	0.19	Q	.	.	.	.
22.56	0.9599	0.18	Q	.	.	.	.
22.71	0.9622	0.18	Q	.	.	.	.
22.86	0.9644	0.18	Q	.	.	.	.
23.01	0.9666	0.18	Q	.	.	.	.
23.16	0.9687	0.17	Q	.	.	.	.
23.31	0.9709	0.17	Q	.	.	.	.
23.46	0.9730	0.17	Q	.	.	.	.
23.61	0.9750	0.17	Q	.	.	.	.
23.76	0.9771	0.17	Q	.	.	.	.
23.91	0.9791	0.16	Q	.	.	.	.
24.06	0.9811	0.16	Q	.	.	.	.
24.20	0.9821	0.00	Q	.	.	.	.

AREA OFFSITE 8
2 YEAR HYDROLOGY

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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          Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                        Analysis prepared by:

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                   16795 Von Karman Ave. Suite 100
                       Irvine, California 92606
             PH: 949-474-1960       FAX: 949-474-5315

 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE -AREA OFF-SITE 8 TO TRACT 15594                                *
 * 2 YEAR EXISTING HYDROLOGY                                                *
 *                                                                          *
 **************************************************************************

  FILE NAME: IRW02OS8.DAT
  TIME/DATE OF STUDY: 11:08 03/09/2010
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK- HEIGHT WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY   (FT)   (FT)  (FT)   (FT)    (n)
===  =====  =========  ================= ======  ===== ====== ===== =======
  1   30.0      20.0    0.018/0.018/0.020  0.67    2.00 0.0313 0.167 0.0150
  2   14.0       9.0    0.020/0.020/0.050  0.33    1.50 0.0313 0.125 0.0180

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.33 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     90.00 TO NODE     91.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   332.00
  ELEVATION DATA: UPSTREAM(FEET) =    693.40  DOWNSTREAM(FEET) =    625.00
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.076
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.304
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 NATURAL GOOD COVER
 "OPEN BRUSH"                C        2.68      0.25      1.000    75   13.08
 NATURAL GOOD COVER
 "OPEN BRUSH"                D        1.62      0.20      1.000    81   13.08
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.23
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA RUNOFF(CFS) =      4.15
 TOTAL AREA(ACRES) =      4.30   PEAK FLOW RATE(CFS) =      4.15
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        4.3  TC(MIN.) =     13.08
 EFFECTIVE AREA(ACRES) =      4.30  AREA-AVERAGED Fm(INCH/HR)=  0.23
 AREA-AVERAGED Fp(INCH/HR) =  0.23  AREA-AVERAGED Ap = 1.000
 PEAK FLOW RATE(CFS)    =      4.15
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

AREA OFFSITE 9
2 YEAR HYDROLOGY

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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          Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                        Analysis prepared by:

                        Fuscoe Engineering, Inc
                   16795 Von Karman Ave. Suite 100
                       Irvine, California 92606
               PH: 949-474-1960        FAX: 949-474-5315

 ************************** DESCRIPTION OF STUDY **************************
 * IRWD SITE - AREA OFF-SITE 9 TO OFF-SITE AREA                           *
 * 2 YEAR EXISTING HYDROLOGY                                              *
 *                                                                        *
 **************************************************************************

  FILE NAME: IRW02OS9.DAT
  TIME/DATE OF STUDY: 11:16 03/09/2010
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   8.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-   HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)    (FT)      SIDE / SIDE/ WAY    (FT)   (FT)   (FT)  (FT)    (n)
===  =====  =========  =================  ======  =====  ====== ===== =======
  1   30.0    20.0     0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     95.00 TO NODE     96.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   587.00
  ELEVATION DATA: UPSTREAM(FEET) =    700.00  DOWNSTREAM(FEET) =    660.00
```

```
Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   20.492
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.007
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp          Ap     SCS   Tc
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
NATURAL GOOD COVER
"OPEN BRUSH"                C        2.02       0.25      1.000    75   20.49
NATURAL GOOD COVER
"OPEN BRUSH"                D        0.08       0.20      1.000    81   20.49
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =      1.43
TOTAL AREA(ACRES) =       2.10   PEAK FLOW RATE(CFS) =       1.43
============================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)      =          2.1  TC(MIN.) =     20.49
EFFECTIVE AREA(ACRES) =        2.10  AREA-AVERAGED Fm(INCH/HR)=  0.25
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS)    =        1.43
============================================================================
============================================================================
END OF RATIONAL METHOD ANALYSIS
```

AREA A PROPOSED 2 YEAR HYDROLOGY AND HYDROGRAPH

```
****************************************************************************
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                         Analysis prepared by:

                        Fuscoe Engineering, Inc
                    16795 Von Karman Ave. Suite 100
                        Irvine, California 92606
              PH: 949-474-1960       FAX: 949-474-5315

 ************************** DESCRIPTION OF STUDY **************************
 * IRWD LAKE FOREST SITE                                                  *
 * PROPOSED 2 YEAR HYDROLOGY                                              *
 * RESIDENTIAL AREA - A                                                   *
 **************************************************************************

  FILE NAME: IRW02A.DAT
  TIME/DATE OF STUDY: 13:07 03/09/2010
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)   (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   18.0     13.0    0.020/0.020/0.020   0.42    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   295.00
  ELEVATION DATA: UPSTREAM(FEET) =    692.10  DOWNSTREAM(FEET) =    689.30
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.998
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.729
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C        1.97      0.25     0.200    69    8.00
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      2.98
 TOTAL AREA(ACRES) =      1.97   PEAK FLOW RATE(CFS) =      2.98

****************************************************************************
 FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  56
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    689.30  DOWNSTREAM(FEET) =    683.80
 CHANNEL LENGTH THRU SUBAREA(FEET) =   320.00   CHANNEL SLOPE =  0.0172
 GIVEN CHANNEL BASE(FEET) =  120.00   CHANNEL FREEBOARD(FEET) =  0.1
 "Z" FACTOR =   0.100   MANNING'S FACTOR = 0.030
 *ESTIMATED CHANNEL HEIGHT(FEET) =   0.17
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.289
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C        7.10      0.25     0.200    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.99
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.00
 AVERAGE FLOW DEPTH(FEET) =   0.06   TRAVEL TIME(MIN.) =   5.33
 Tc(MIN.) =   13.33
 SUBAREA AREA(ACRES) =      7.10       SUBAREA RUNOFF(CFS) =     7.92
 EFFECTIVE AREA(ACRES) =       9.07     AREA-AVERAGED Fm(INCH/HR) =   0.05
 AREA-AVERAGED Fp(INCH/HR) =   0.25  AREA-AVERAGED Ap =   0.20
 TOTAL AREA(ACRES) =          9.1         PEAK FLOW RATE(CFS) =      10.12
 GIVEN CHANNEL BASE(FEET) =  120.00   CHANNEL FREEBOARD(FEET) =  0.1
 "Z" FACTOR =   0.100   MANNING'S FACTOR = 0.030
 *ESTIMATED CHANNEL HEIGHT(FEET) =   0.17

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.07   FLOW VELOCITY(FEET/SEC.) =   1.15
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE      8.00 =    615.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   676.70  DOWNSTREAM(FEET) =   654.30
 FLOW LENGTH(FEET) =   510.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
```

```
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   9.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  11.48
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       10.12
 PIPE TRAVEL TIME(MIN.) =   0.74    Tc(MIN.) =   14.07
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE      9.00 =    1125.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   14.07
 RAINFALL INTENSITY(INCH/HR) =   1.25
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       9.07
 TOTAL STREAM AREA(ACRES) =       9.07
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      10.12

****************************************************************************
 FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   186.00
 ELEVATION DATA: UPSTREAM(FEET) =    691.00  DOWNSTREAM(FEET) =    689.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.487
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.949
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        0.75      0.25     0.200    69    6.49
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =       1.28
 TOTAL AREA(ACRES) =       0.75   PEAK FLOW RATE(CFS) =       1.28

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.49
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.949
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        0.98      0.25     0.200    69
```

```
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =     0.98      SUBAREA RUNOFF(CFS) =    1.68
 EFFECTIVE AREA(ACRES) =       1.73   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =          1.7       PEAK FLOW RATE(CFS) =       2.96

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   654.70  DOWNSTREAM(FEET) =   654.30
 FLOW LENGTH(FEET) =     80.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   3.73
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =          2.96
 PIPE TRAVEL TIME(MIN.) =   0.36    Tc(MIN.) =    6.84
 LONGEST FLOWPATH FROM NODE     10.00 TO NODE      9.00 =     266.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =     6.84
 RAINFALL INTENSITY(INCH/HR) =   1.89
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       1.73
 TOTAL STREAM AREA(ACRES) =       1.73
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        2.96

 ** CONFLUENCE DATA **
  STREAM       Q       Tc   Intensity   Fp(Fm)      Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1       10.12    14.07     1.250  0.25( 0.05) 0.20       9.1       6.00
     2        2.96     6.84     1.890  0.25( 0.05) 0.20       1.7      10.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc   Intensity   Fp(Fm)      Ap     Ae     HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR)  (INCH/HR)          (ACRES)    NODE
     1       10.51     6.84     1.890  0.25( 0.05) 0.20       6.1      10.00
     2       12.05    14.07     1.250  0.25( 0.05) 0.20      10.8       6.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      12.05    Tc(MIN.) =     14.07
```

```
  EFFECTIVE AREA(ACRES) =      10.80   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       10.8
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE      9.00 =    1125.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   654.30  DOWNSTREAM(FEET) =   652.00
  FLOW LENGTH(FEET) =   450.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  16.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.28
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      12.05
  PIPE TRAVEL TIME(MIN.) =   1.42    Tc(MIN.) =   15.49
  LONGEST FLOWPATH FROM NODE      6.00 TO NODE     13.00 =    1575.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.49
  RAINFALL INTENSITY(INCH/HR) =   1.18
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =      10.80
  TOTAL STREAM AREA(ACRES) =      10.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.05

****************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     15.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   279.00
  ELEVATION DATA: UPSTREAM(FEET) =    688.90  DOWNSTREAM(FEET) =    686.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.681
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.769
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN   (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"       C        0.98      0.25      0.200    69    7.68
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.52
  TOTAL AREA(ACRES) =      0.98   PEAK FLOW RATE(CFS) =       1.52
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     16.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.68
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.769
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        4.48      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     4.48     SUBAREA RUNOFF(CFS) =    6.93
  EFFECTIVE AREA(ACRES) =       5.46   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        5.5       PEAK FLOW RATE(CFS) =      8.45

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     13.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   676.50  DOWNSTREAM(FEET) =   652.00
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   5.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  18.11
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.45
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =    7.81
  LONGEST FLOWPATH FROM NODE     14.00 TO NODE     13.00 =    419.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     13.00 TO NODE     13.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.81
  RAINFALL INTENSITY(INCH/HR) =   1.75
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       5.46
  TOTAL STREAM AREA(ACRES) =       5.46
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       8.45

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.51    8.30    1.692  0.25( 0.05) 0.20      6.1      10.00
```

```
     1        12.05   15.49    1.183  0.25( 0.05) 0.20      10.8        6.00
     2         8.45    7.81    1.752  0.25( 0.05) 0.20       5.5       14.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae    HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)          (ACRES)   NODE
     1       18.70    7.81    1.752  0.25( 0.05) 0.20      11.2       14.00
     2       18.65    8.30    1.692  0.25( 0.05) 0.20      11.6       10.00
     3       17.67   15.49    1.183  0.25( 0.05) 0.20      16.3        6.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      18.70    Tc(MIN.) =     7.81
 EFFECTIVE AREA(ACRES) =      11.24   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =       16.3
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     13.00 =    1575.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     17.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   652.00  DOWNSTREAM(FEET) =   648.00
 FLOW LENGTH(FEET) =   280.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.5 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.71
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      18.70
 PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =     8.35
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     17.00 =    1855.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    8.35
 RAINFALL INTENSITY(INCH/HR) =   1.69
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =      11.24
 TOTAL STREAM AREA(ACRES) =      16.26
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      18.70

****************************************************************************
 FLOW PROCESS FROM NODE     18.00 TO NODE     19.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
```

```
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   216.00
 ELEVATION DATA: UPSTREAM(FEET) =    667.00  DOWNSTREAM(FEET) =    663.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.796
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.080
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                  D       0.37      0.20     0.100    75    5.80
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =       0.69
 TOTAL AREA(ACRES) =       0.37   PEAK FLOW RATE(CFS) =       0.69

****************************************************************************
 FLOW PROCESS FROM NODE     19.00 TO NODE     20.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.80
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.080
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  D       1.35      0.20     0.100    75
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.20
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    1.35      SUBAREA RUNOFF(CFS) =    2.50
 EFFECTIVE AREA(ACRES) =       1.72   AREA-AVERAGED Fm(INCH/HR) =  0.02
 AREA-AVERAGED Fp(INCH/HR) =  0.20  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =         1.7       PEAK FLOW RATE(CFS) =       3.19

****************************************************************************
 FLOW PROCESS FROM NODE     20.00 TO NODE     17.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    654.50  DOWNSTREAM(FEET) =    648.00
 FLOW LENGTH(FEET) =    510.00    MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS    6.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =    5.37
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =    1
 PIPE-FLOW(CFS) =         3.19
 PIPE TRAVEL TIME(MIN.) =   1.58     Tc(MIN.) =    7.38
 LONGEST FLOWPATH FROM NODE     18.00 TO NODE     17.00 =     726.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
```

```
TIME OF CONCENTRATION(MIN.) =    7.38
RAINFALL INTENSITY(INCH/HR) =   1.81
AREA-AVERAGED Fm(INCH/HR) =  0.02
AREA-AVERAGED Fp(INCH/HR) =  0.20
AREA-AVERAGED Ap =  0.10
EFFECTIVE STREAM AREA(ACRES) =       1.72
TOTAL STREAM AREA(ACRES) =       1.72
PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.19

** CONFLUENCE DATA **
 STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
    1       18.70   8.35     1.687  0.25( 0.05) 0.20       11.2       14.00
    1       18.65   8.84     1.632  0.25( 0.05) 0.20       11.6       10.00
    1       17.67  16.03     1.160  0.25( 0.05) 0.20       16.3        6.00
    2        3.19   7.38     1.811  0.20( 0.02) 0.10        1.7       18.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
    1       20.96   7.38     1.811  0.25( 0.05) 0.19       11.7       18.00
    2       21.66   8.35     1.687  0.25( 0.05) 0.19       13.0       14.00
    3       21.53   8.84     1.632  0.25( 0.05) 0.19       13.3       10.00
    4       19.70  16.03     1.160  0.25( 0.05) 0.19       18.0        6.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       21.66    Tc(MIN.) =     8.35
EFFECTIVE AREA(ACRES) =      12.96   AREA-AVERAGED Fm(INCH/HR) =  0.05
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
TOTAL AREA(ACRES) =       18.0
LONGEST FLOWPATH FROM NODE       6.00 TO NODE     17.00 =    1855.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     21.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   648.00  DOWNSTREAM(FEET) =   637.70
  FLOW LENGTH(FEET) =   526.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  15.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.17
  ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      21.66
  PIPE TRAVEL TIME(MIN.) =   0.86    Tc(MIN.) =    9.21
  LONGEST FLOWPATH FROM NODE       6.00 TO NODE     21.00 =    2381.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     21.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
```

```
 FLOW PROCESS FROM NODE     22.00 TO NODE     23.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =    223.00
 ELEVATION DATA: UPSTREAM(FEET) =    691.00  DOWNSTREAM(FEET) =    687.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.297
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C        0.66      0.25     0.200    69    6.30
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      1.15
 TOTAL AREA(ACRES) =      0.66   PEAK FLOW RATE(CFS) =      1.15

****************************************************************************
 FLOW PROCESS FROM NODE     23.00 TO NODE     24.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.30
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C        7.32      0.25     0.200    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA AREA(ACRES) =     7.32       SUBAREA RUNOFF(CFS) =    12.73
 EFFECTIVE AREA(ACRES) =        7.98   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =           8.0       PEAK FLOW RATE(CFS) =      13.88

****************************************************************************
 FLOW PROCESS FROM NODE     24.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    674.00  DOWNSTREAM(FEET) =    639.50
 FLOW LENGTH(FEET) =    160.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  22.42
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      13.88
 PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =    6.42
 LONGEST FLOWPATH FROM NODE     22.00 TO NODE     25.00 =    383.00 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    6.42
 RAINFALL INTENSITY(INCH/HR) =   1.96
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =       7.98
 TOTAL STREAM AREA(ACRES) =       7.98
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      13.88

****************************************************************************
 FLOW PROCESS FROM NODE     26.00 TO NODE     41.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   264.00
 ELEVATION DATA: UPSTREAM(FEET) =    685.70  DOWNSTREAM(FEET) =    675.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.723
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.095
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        0.44      0.25      0.200    69    5.72
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =       0.81
 TOTAL AREA(ACRES) =       0.44   PEAK FLOW RATE(CFS) =       0.81

****************************************************************************
 FLOW PROCESS FROM NODE     41.00 TO NODE     25.00 IS CODE =  61
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =  675.00  DOWNSTREAM ELEVATION(FEET) =  650.00
 STREET LENGTH(FEET) =   760.00   CURB HEIGHT(INCHES) =  6.0
 STREET HALFWIDTH(FEET) = 18.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.91
```

```
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =     6.70
    AVERAGE FLOW VELOCITY(FEET/SEC.) =     3.37
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =     0.88
  STREET FLOW TRAVEL TIME(MIN.) =    3.76   Tc(MIN.) =     9.48
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.568
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        1.60      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     1.60      SUBAREA RUNOFF(CFS) =     2.19
  EFFECTIVE AREA(ACRES) =       2.04    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         2.0        PEAK FLOW RATE(CFS) =       2.79

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.29   HALFSTREET FLOOD WIDTH(FEET) =   8.02
  FLOW VELOCITY(FEET/SEC.) =  3.66   DEPTH*VELOCITY(FT*FT/SEC.) =   1.05
  LONGEST FLOWPATH FROM NODE     26.00 TO NODE     25.00 =    1024.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =     9.48
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.568
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        2.23      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     2.23      SUBAREA RUNOFF(CFS) =     3.05
  EFFECTIVE AREA(ACRES) =       4.27   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         4.3       PEAK FLOW RATE(CFS) =       5.83

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =     9.48
  RAINFALL INTENSITY(INCH/HR) =   1.57
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       4.27
```

```
 TOTAL STREAM AREA(ACRES) =       4.27
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.83

 ** CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1       13.88    6.42     1.962   0.25( 0.05) 0.20        8.0      22.00
     2        5.83    9.48     1.568   0.25( 0.05) 0.20        4.3      26.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1       18.86    6.42     1.962   0.25( 0.05) 0.20       10.9      22.00
     2       16.86    9.48     1.568   0.25( 0.05) 0.20       12.2      26.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =       18.86     Tc(MIN.) =      6.42
 EFFECTIVE AREA(ACRES) =      10.87    AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
 TOTAL AREA(ACRES) =        12.2
 LONGEST FLOWPATH FROM NODE      26.00 TO NODE      25.00 =    1024.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      25.00 TO NODE      21.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    639.50  DOWNSTREAM(FEET) =    637.70
 FLOW LENGTH(FEET) =    240.00    MANNING'S N =  0.013
 DEPTH OF FLOW IN  27.0 INCH PIPE IS  17.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   6.85
 ESTIMATED PIPE DIAMETER(INCH) =  27.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       18.86
 PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =     7.00
 LONGEST FLOWPATH FROM NODE      26.00 TO NODE      21.00 =    1264.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      21.00 TO NODE      21.00 IS CODE =  11
----------------------------------------------------------------------------
 >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1       18.86    7.00     1.866   0.25( 0.05) 0.20       10.9      22.00
     2       16.86   10.09     1.513   0.25( 0.05) 0.20       12.2      26.00
 LONGEST FLOWPATH FROM NODE      26.00 TO NODE      21.00 =    1264.00 FEET.

 ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)    NODE
     1       20.96    8.25     1.699   0.25( 0.05) 0.19       11.7      18.00
```

```
    2        21.66     9.21      1.594  0.25( 0.05) 0.19       13.0       14.00
    3        21.53     9.70      1.547  0.25( 0.05) 0.19       13.3       10.00
    4        19.70    16.94      1.124  0.25( 0.05) 0.19       18.0        6.00
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      21.00 =    2381.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM        Q       Tc    Intensity   Fp(Fm)      Ap      Ae     HEADWATER
  NUMBER      (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
    1        38.45     7.00      1.866  0.25( 0.05) 0.19       20.8       22.00
    2        39.01     8.25      1.699  0.25( 0.05) 0.19       23.1       18.00
    3        39.09     9.21      1.594  0.25( 0.05) 0.19       24.8       14.00
    4        38.63     9.70      1.547  0.25( 0.05) 0.19       25.4       10.00
    5        38.28    10.09      1.513  0.25( 0.05) 0.19       25.8       26.00
    6        32.07    16.94      1.124  0.25( 0.05) 0.19       30.2        6.00
   TOTAL AREA(ACRES) =         30.2

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        39.09  Tc(MIN.) =     9.208
 EFFECTIVE AREA(ACRES) =      24.81  AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
 TOTAL AREA(ACRES) =         30.2
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      21.00 =    2381.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      21.00 TO NODE      21.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      21.00 TO NODE      26.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    637.70  DOWNSTREAM(FEET) =    636.50
 FLOW LENGTH(FEET) =    160.00    MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  25.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =    8.07
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =        39.09
 PIPE TRAVEL TIME(MIN.) =    0.33    Tc(MIN.) =     9.54
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE      26.00 =    2541.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      26.00 TO NODE      26.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =     9.54
 RAINFALL INTENSITY(INCH/HR) =   1.56
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.19
 EFFECTIVE STREAM AREA(ACRES) =       24.81
```

```
 TOTAL STREAM AREA(ACRES) =      30.23
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      39.09

****************************************************************************
 FLOW PROCESS FROM NODE     27.00 TO NODE     28.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   225.00
 ELEVATION DATA: UPSTREAM(FEET) =    658.30  DOWNSTREAM(FEET) =    657.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.926
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.738
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        0.49      0.25     0.200    69    7.93
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =      0.74
 TOTAL AREA(ACRES) =      0.49   PEAK FLOW RATE(CFS) =       0.74

****************************************************************************
 FLOW PROCESS FROM NODE     28.00 TO NODE     26.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) =  657.00  DOWNSTREAM ELEVATION(FEET) =  642.00
 STREET LENGTH(FEET) =  1020.00   CURB HEIGHT(INCHES) =  5.0
 STREET HALFWIDTH(FEET) = 18.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.020
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

 SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
 STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
 Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
 Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.79
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.35
   HALFSTREET FLOOD WIDTH(FEET) =   10.97
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.87
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.99
 STREET FLOW TRAVEL TIME(MIN.) =   5.93   Tc(MIN.) =   13.85
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.261
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"       C        5.50      0.25     0.200    69
```

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA AREA(ACRES) = 5.50 SUBAREA RUNOFF(CFS) = 6.00
EFFECTIVE AREA(ACRES) = 5.99 AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.25 AREA-AVERAGED Ap = 0.20
TOTAL AREA(ACRES) = 6.0 PEAK FLOW RATE(CFS) = 6.53

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.40 HALFSTREET FLOOD WIDTH(FEET) = 13.71
FLOW VELOCITY(FEET/SEC.) = 3.27 DEPTH*VELOCITY(FT*FT/SEC.) = 1.31
LONGEST FLOWPATH FROM NODE 27.00 TO NODE 26.00 = 1245.00 FEET.

****

FLOW PROCESS FROM NODE 26.00 TO NODE 26.00 IS CODE = 1

>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

==

TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 13.85
RAINFALL INTENSITY(INCH/HR) = 1.26
AREA-AVERAGED Fm(INCH/HR) = 0.05
AREA-AVERAGED Fp(INCH/HR) = 0.25
AREA-AVERAGED Ap = 0.20
EFFECTIVE STREAM AREA(ACRES) = 5.99
TOTAL STREAM AREA(ACRES) = 5.99
PEAK FLOW RATE(CFS) AT CONFLUENCE = 6.53

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	38.45	7.33	1.817	0.25(0.05)	0.19	20.8	22.00
1	39.01	8.58	1.661	0.25(0.05)	0.19	23.1	18.00
1	39.09	9.54	1.562	0.25(0.05)	0.19	24.8	14.00
1	38.63	10.03	1.518	0.25(0.05)	0.19	25.4	10.00
1	38.28	10.42	1.485	0.25(0.05)	0.19	25.8	26.00
1	32.07	17.29	1.111	0.25(0.05)	0.19	30.2	6.00
2	6.53	13.85	1.261	0.25(0.05)	0.20	6.0	27.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	43.50	7.33	1.817	0.25(0.05)	0.19	23.9	22.00
2	44.39	8.58	1.661	0.25(0.05)	0.19	26.8	18.00
3	44.70	9.54	1.562	0.25(0.05)	0.19	28.9	14.00
4	44.36	10.03	1.518	0.25(0.05)	0.19	29.7	10.00
5	44.10	10.42	1.485	0.25(0.05)	0.19	30.3	26.00
6	41.71	13.85	1.261	0.25(0.05)	0.19	34.0	27.00
7	37.79	17.29	1.111	0.25(0.05)	0.20	36.2	6.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 44.70 Tc(MIN.) = 9.54
EFFECTIVE AREA(ACRES) = 28.94 AREA-AVERAGED Fm(INCH/HR) = 0.05

```
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
 TOTAL AREA(ACRES) =        36.2
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     26.00 =    2541.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     26.00 TO NODE     29.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   636.50  DOWNSTREAM(FEET) =   636.00
 FLOW LENGTH(FEET) =     40.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  33.0 INCH PIPE IS  22.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.24
 ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       44.70
 PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.60
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     29.00 =    2581.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     29.00 TO NODE     29.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    9.60
 RAINFALL INTENSITY(INCH/HR) =   1.56
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.19
 EFFECTIVE STREAM AREA(ACRES) =      28.94
 TOTAL STREAM AREA(ACRES) =      36.22
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      44.70

****************************************************************************
 FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
 ELEVATION DATA: UPSTREAM(FEET) =    672.00  DOWNSTREAM(FEET) =    670.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.570
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.935
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "11+ DWELLINGS/ACRE"        C        0.40      0.25     0.200    69    6.57
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
 SUBAREA RUNOFF(CFS) =       0.68
 TOTAL AREA(ACRES) =       0.40   PEAK FLOW RATE(CFS) =       0.68
```

```
******************************************************************************
  FLOW PROCESS FROM NODE      31.00 TO NODE      32.00 IS CODE =  62
------------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) =  670.00  DOWNSTREAM ELEVATION(FEET) =  652.00
  STREET LENGTH(FEET) =  1770.00   CURB HEIGHT(INCHES) =  5.0
  STREET HALFWIDTH(FEET) = 18.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  13.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.41
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.71
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.71
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.08
  STREET FLOW TRAVEL TIME(MIN.) =  10.89   Tc(MIN.) =   17.46
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.104
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        9.60      0.25     0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     9.60       SUBAREA RUNOFF(CFS) =    9.11
  EFFECTIVE AREA(ACRES) =      10.00    AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       10.0        PEAK FLOW RATE(CFS) =       9.49

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  19.70
  FLOW VELOCITY(FEET/SEC.) =  3.05   DEPTH*VELOCITY(FT*FT/SEC.) =   1.43
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1770.0 FT WITH ELEVATION-DROP =  18.0 FT, IS    9.5 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE     32.00
  LONGEST FLOWPATH FROM NODE      30.00 TO NODE      32.00 =    1960.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE      32.00 TO NODE      29.00 IS CODE =  31
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    644.00  DOWNSTREAM(FEET) =   636.00
  FLOW LENGTH(FEET) =   450.00    MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.98
```

```
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =         9.49
 PIPE TRAVEL TIME(MIN.) =   0.94    Tc(MIN.) =   18.40
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     29.00 =    2410.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     29.00 TO NODE     29.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   18.40
 RAINFALL INTENSITY(INCH/HR) =   1.07
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.20
 EFFECTIVE STREAM AREA(ACRES) =      10.00
 TOTAL STREAM AREA(ACRES) =      10.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =        9.49

 ** CONFLUENCE DATA **
  STREAM       Q       Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       43.50    7.40     1.808  0.25( 0.05) 0.19       23.9       22.00
     1       44.39    8.64     1.654  0.25( 0.05) 0.19       26.8       18.00
     1       44.70    9.60     1.556  0.25( 0.05) 0.19       28.9       14.00
     1       44.36   10.10     1.512  0.25( 0.05) 0.19       29.7       10.00
     1       44.10   10.49     1.480  0.25( 0.05) 0.19       30.3       26.00
     1       41.71   13.92     1.258  0.25( 0.05) 0.19       34.0       27.00
     1       37.79   17.35     1.108  0.25( 0.05) 0.20       36.2        6.00
     2        9.49   18.40     1.071  0.25( 0.05) 0.20       10.0       30.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q       Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)           (ACRES)     NODE
     1       50.06    7.40     1.808  0.25( 0.05) 0.19       28.0       22.00
     2       51.38    8.64     1.654  0.25( 0.05) 0.19       31.5       18.00
     3       52.01    9.60     1.556  0.25( 0.05) 0.19       34.2       14.00
     4       51.82   10.10     1.512  0.25( 0.05) 0.20       35.2       10.00
     5       51.67   10.49     1.480  0.25( 0.05) 0.20       36.0       26.00
     6       50.19   13.92     1.258  0.25( 0.05) 0.20       41.6       27.00
     7       47.06   17.35     1.108  0.25( 0.05) 0.20       45.7        6.00
     8       45.97   18.40     1.071  0.25( 0.05) 0.20       46.2       30.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        52.01    Tc(MIN.) =      9.60
 EFFECTIVE AREA(ACRES) =       34.15   AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.19
 TOTAL AREA(ACRES) =        46.2
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     29.00 =    2581.00 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE     29.00 TO NODE     42.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   636.00  DOWNSTREAM(FEET) =   610.00
 FLOW LENGTH(FEET) =   400.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS  19.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  19.29
 ESTIMATED PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      52.01
 PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    9.95
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE     42.00 =    2981.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     42.00 TO NODE     42.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =     9.95
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.525
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "CHAPARRAL,BROADLEAF"      C         1.18      0.25     1.000    71
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
 SUBAREA AREA(ACRES) =     1.18       SUBAREA RUNOFF(CFS) =     1.35
 EFFECTIVE AREA(ACRES) =      35.33   AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.22
 TOTAL AREA(ACRES) =        47.4       PEAK FLOW RATE(CFS) =      52.01
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
 FLOW PROCESS FROM NODE     42.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   610.00  DOWNSTREAM(FEET) =   608.50
 FLOW LENGTH(FEET) =   270.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  39.0 INCH PIPE IS  29.4 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.76
 ESTIMATED PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      52.01
 PIPE TRAVEL TIME(MIN.) =   0.58    Tc(MIN.) =   10.53
 LONGEST FLOWPATH FROM NODE       6.00 TO NODE     33.00 =    3251.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  10
----------------------------------------------------------------------------
 >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE     34.00 TO NODE     35.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   254.00
  ELEVATION DATA: UPSTREAM(FEET) =    658.70  DOWNSTREAM(FEET) =    656.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.365
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.812
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        1.34      0.25      0.200    69    7.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =       2.13
  TOTAL AREA(ACRES) =       1.34   PEAK FLOW RATE(CFS) =       2.13

****************************************************************************
  FLOW PROCESS FROM NODE     35.00 TO NODE     36.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    7.36
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.812
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        2.58      0.25      0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =     2.58      SUBAREA RUNOFF(CFS) =      4.09
  EFFECTIVE AREA(ACRES) =       3.92   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         3.9       PEAK FLOW RATE(CFS) =       6.22

****************************************************************************
  FLOW PROCESS FROM NODE     36.00 TO NODE     37.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   645.30  DOWNSTREAM(FEET) =   638.90
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.25
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =        6.22
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =     7.59
  LONGEST FLOWPATH FROM NODE     34.00 TO NODE     37.00 =    394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.59
  RAINFALL INTENSITY(INCH/HR) =   1.78
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =       3.92
  TOTAL STREAM AREA(ACRES) =       3.92
  PEAK FLOW RATE(CFS) AT CONFLUENCE =        6.22

****************************************************************************
  FLOW PROCESS FROM NODE     38.00 TO NODE     39.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   132.00
  ELEVATION DATA: UPSTREAM(FEET) =    651.30  DOWNSTREAM(FEET) =    650.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.756
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.088
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        1.08      0.25      0.200    69    5.76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.98
  TOTAL AREA(ACRES) =      1.08   PEAK FLOW RATE(CFS) =       1.98

****************************************************************************
  FLOW PROCESS FROM NODE     39.00 TO NODE     37.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.76
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.088
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA       Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "11+ DWELLINGS/ACRE"        C        3.24      0.25      0.200    69
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    3.24     SUBAREA RUNOFF(CFS) =     5.94
  EFFECTIVE AREA(ACRES) =      4.32   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        4.3       PEAK FLOW RATE(CFS) =       7.92

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     37.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    5.76
  RAINFALL INTENSITY(INCH/HR) =   2.09
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =        4.32
  TOTAL STREAM AREA(ACRES) =        4.32
  PEAK FLOW RATE(CFS) AT CONFLUENCE =        7.92

  ** CONFLUENCE DATA **
   STREAM       Q        Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
      1        6.22    7.59    1.781  0.25( 0.05) 0.20         3.9       34.00
      2        7.92    5.76    2.088  0.25( 0.05) 0.20         4.3       38.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q        Tc   Intensity   Fp(Fm)      Ap      Ae      HEADWATER
   NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)    NODE
      1       13.47    5.76    2.088  0.25( 0.05) 0.20         7.3       38.00
      2       12.95    7.59    1.781  0.25( 0.05) 0.20         8.2       34.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       13.47    Tc(MIN.) =     5.76
  EFFECTIVE AREA(ACRES) =        7.29   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =         8.2
  LONGEST FLOWPATH FROM NODE      34.00 TO NODE      37.00 =     394.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     37.00 TO NODE     33.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   638.90  DOWNSTREAM(FEET) =   608.50
  FLOW LENGTH(FEET) =   146.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.96
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       13.47
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =     5.87
  LONGEST FLOWPATH FROM NODE      34.00 TO NODE      33.00 =     540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 2 WITH THE MAIN-STREAM MEMORY<<<<<
```

```
================================================================================

 ** MAIN STREAM CONFLUENCE DATA **
  STREAM       Q        Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)     NODE
     1       13.47     5.87     2.065   0.25( 0.05) 0.20         7.3       38.00
     2       12.95     7.70     1.766   0.25( 0.05) 0.20         8.2       34.00
 LONGEST FLOWPATH FROM NODE       34.00 TO NODE      33.00 =     540.00 FEET.

 ** MEMORY BANK #  2 CONFLUENCE DATA **
  STREAM       Q        Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)     NODE
     1       50.06     8.33     1.689   0.25( 0.06) 0.23        29.1       22.00
     2       51.38     9.57     1.560   0.25( 0.06) 0.22        32.7       18.00
     3       52.01    10.53     1.476   0.25( 0.06) 0.22        35.3       14.00
     4       51.82    11.02     1.438   0.25( 0.06) 0.22        36.4       10.00
     5       51.67    11.42     1.409   0.25( 0.05) 0.22        37.2       26.00
     6       50.19    14.85     1.212   0.25( 0.05) 0.22        42.8       27.00
     7       47.06    18.29     1.075   0.25( 0.05) 0.22        46.8        6.00
     8       45.97    19.34     1.041   0.25( 0.05) 0.22        47.4       30.00
 LONGEST FLOWPATH FROM NODE        6.00 TO NODE      33.00 =    3251.00 FEET.

 ** PEAK FLOW RATE TABLE **
  STREAM       Q        Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
  NUMBER     (CFS)   (MIN.)  (INCH/HR)  (INCH/HR)           (ACRES)     NODE
     1       56.87     5.87     2.065   0.25( 0.05) 0.22        27.8       38.00
     2       61.46     7.70     1.766   0.25( 0.06) 0.22        35.2       34.00
     3       62.43     8.33     1.689   0.25( 0.06) 0.22        37.4       22.00
     4       62.77     9.57     1.560   0.25( 0.05) 0.22        40.9       18.00
     5       62.77    10.53     1.476   0.25( 0.05) 0.22        43.6       14.00
     6       62.29    11.02     1.438   0.25( 0.05) 0.22        44.6       10.00
     7       61.93    11.42     1.409   0.25( 0.05) 0.22        45.5       26.00
     8       58.96    14.85     1.212   0.25( 0.05) 0.22        51.0       27.00
     9       54.80    18.29     1.075   0.25( 0.05) 0.21        55.1        6.00
    10       53.45    19.34     1.041   0.25( 0.05) 0.21        55.6       30.00
   TOTAL AREA(ACRES) =          55.6

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =        62.77  Tc(MIN.) =      9.568
 EFFECTIVE AREA(ACRES) =      40.90  AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.22
 TOTAL AREA(ACRES) =        55.6
 LONGEST FLOWPATH FROM NODE        6.00 TO NODE      33.00 =    3251.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      33.00 TO NODE      33.00 IS CODE =  12
----------------------------------------------------------------------------
 >>>>>CLEAR MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
 FLOW PROCESS FROM NODE      33.00 TO NODE      40.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   608.50  DOWNSTREAM(FEET) =   590.00
```

```
 FLOW LENGTH(FEET) =    70.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  34.95
 ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       62.77
 PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =    9.60
 LONGEST FLOWPATH FROM NODE      6.00 TO NODE     40.00 =    3321.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =    9.60
 RAINFALL INTENSITY(INCH/HR) =   1.56
 AREA-AVERAGED Fm(INCH/HR) =  0.05
 AREA-AVERAGED Fp(INCH/HR) =  0.25
 AREA-AVERAGED Ap =  0.22
 EFFECTIVE STREAM AREA(ACRES) =      40.90
 TOTAL STREAM AREA(ACRES) =      55.64
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      62.77

****************************************************************************
 FLOW PROCESS FROM NODE     43.00 TO NODE     44.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   365.00
 ELEVATION DATA: UPSTREAM(FEET) =    645.00  DOWNSTREAM(FEET) =    608.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.089
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.241
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 C        3.24     0.25     0.100    69    5.09
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      6.46
 TOTAL AREA(ACRES) =      3.24   PEAK FLOW RATE(CFS) =      6.46

****************************************************************************
 FLOW PROCESS FROM NODE     44.00 TO NODE     40.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    5.09
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  2.241
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
 "GRASS"                    C        4.48     0.25     1.000    74
```

```
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =     4.48     SUBAREA RUNOFF(CFS) =    8.03
EFFECTIVE AREA(ACRES) =      7.72   AREA-AVERAGED Fm(INCH/HR) =  0.16
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.62
TOTAL AREA(ACRES) =        7.7      PEAK FLOW RATE(CFS) =      14.49

****************************************************************************
FLOW PROCESS FROM NODE     40.00 TO NODE     40.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =    5.09
RAINFALL INTENSITY(INCH/HR) =   2.24
AREA-AVERAGED Fm(INCH/HR) =  0.16
AREA-AVERAGED Fp(INCH/HR) =  0.25
AREA-AVERAGED Ap =  0.62
EFFECTIVE STREAM AREA(ACRES) =       7.72
TOTAL STREAM AREA(ACRES) =       7.72
PEAK FLOW RATE(CFS) AT CONFLUENCE =      14.49

** CONFLUENCE DATA **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)     NODE
    1       56.87    5.90     2.058  0.25( 0.05) 0.22       27.8       38.00
    1       61.46    7.74     1.762  0.25( 0.06) 0.22       35.2       34.00
    1       62.43    8.36     1.685  0.25( 0.06) 0.22       37.4       22.00
    1       62.77    9.60     1.557  0.25( 0.05) 0.22       40.9       18.00
    1       62.77   10.56     1.474  0.25( 0.05) 0.22       43.6       14.00
    1       62.29   11.06     1.435  0.25( 0.05) 0.22       44.6       10.00
    1       61.93   11.45     1.407  0.25( 0.05) 0.22       45.5       26.00
    1       58.96   14.89     1.210  0.25( 0.05) 0.22       51.0       27.00
    1       54.80   18.33     1.074  0.25( 0.05) 0.21       55.1        6.00
    1       53.45   19.38     1.040  0.25( 0.05) 0.21       55.6       30.00
    2       14.49    5.09     2.241  0.25( 0.16) 0.62        7.7       43.00

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR  2 STREAMS.

** PEAK FLOW RATE TABLE **
 STREAM       Q       Tc    Intensity   Fp(Fm)      Ap      Ae      HEADWATER
 NUMBER     (CFS)   (MIN.) (INCH/HR) (INCH/HR)            (ACRES)     NODE
    1       68.00    5.09     2.241  0.25( 0.08) 0.32       31.7       43.00
    2       70.09    5.90     2.058  0.25( 0.08) 0.31       35.5       38.00
    3       72.61    7.74     1.762  0.25( 0.07) 0.29       42.9       34.00
    4       73.06    8.36     1.685  0.25( 0.07) 0.29       45.1       22.00
    5       72.51    9.60     1.557  0.25( 0.07) 0.28       48.6       18.00
    6       71.93   10.56     1.474  0.25( 0.07) 0.28       51.3       14.00
    7       71.18   11.06     1.435  0.25( 0.07) 0.28       52.4       10.00
    8       70.62   11.45     1.407  0.25( 0.07) 0.28       53.2       26.00
    9       66.29   14.89     1.210  0.25( 0.07) 0.27       58.7       27.00
   10       61.18   18.33     1.074  0.25( 0.07) 0.26       62.8        6.00
   11       59.60   19.38     1.040  0.25( 0.07) 0.26       63.4       30.00
```

```
COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       73.06    Tc(MIN.) =      8.36
EFFECTIVE AREA(ACRES) =      45.09   AREA-AVERAGED Fm(INCH/HR) =  0.07
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.29
TOTAL AREA(ACRES) =       63.4
LONGEST FLOWPATH FROM NODE      6.00 TO NODE     40.00 =    3321.00 FEET.
============================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)      =      63.4  TC(MIN.) =       8.36
EFFECTIVE AREA(ACRES) =     45.09  AREA-AVERAGED Fm(INCH/HR)=  0.07
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap = 0.290
PEAK FLOW RATE(CFS)    =      73.06
```

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	68.00	5.09	2.241	0.25(0.08)	0.32	31.7	43.00
2	70.09	5.90	2.058	0.25(0.08)	0.31	35.5	38.00
3	72.61	7.74	1.762	0.25(0.07)	0.29	42.9	34.00
4	73.06	8.36	1.685	0.25(0.07)	0.29	45.1	22.00
5	72.51	9.60	1.557	0.25(0.07)	0.28	48.6	18.00
6	71.93	10.56	1.474	0.25(0.07)	0.28	51.3	14.00
7	71.18	11.06	1.435	0.25(0.07)	0.28	52.4	10.00
8	70.62	11.45	1.407	0.25(0.07)	0.28	53.2	26.00
9	66.29	14.89	1.210	0.25(0.07)	0.27	58.7	27.00
10	61.18	18.33	1.074	0.25(0.07)	0.26	62.8	6.00
11	59.60	19.38	1.040	0.25(0.07)	0.26	63.4	30.00

```
============================================================================
============================================================================
END OF RATIONAL METHOD ANALYSIS
```

```
******************************************************************************
        NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                  AND LOW LOSS FRACTION ESTIMATIONS
==============================================================================
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                        Analysis prepared by:

                      Fuscoe Engineering, Inc
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                      Irvine, California 92606
              PH: 949-474-1960       FAX: 949-474-5315

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  PROPOSED OUTLET B
  2 YEAR
==============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA       PERCENT OF    SCS CURVE    LOSS RATE
       TYPE       (Acres)   PERVIOUS AREA    NUMBER     Fp(in./hr.)    YIELD
        1          67.23       20.00           69.         0.250       0.735

    TOTAL AREA (Acres) =      67.23

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.050

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.265
==============================================================================
```

```
****************************************************************************
                     SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  PROPOSED OUTLET B
  2 YEAR
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.75
    TOTAL CATCHMENT AREA(ACRES) =    67.23
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.050
    LOW LOSS FRACTION = 0.265
    TIME OF CONCENTRATION(MIN.) =  8.36
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =    2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      6.69
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      4.80

****************************************************************************
  TIME     VOLUME       Q    0.        22.5       45.0       67.5       90.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.12      0.0068      1.19  Q          .          .          .          .
  0.26      0.0205      1.19  Q          .          .          .          .
  0.39      0.0343      1.20  Q          .          .          .          .
  0.53      0.0481      1.21  Q          .          .          .          .
  0.67      0.0620      1.21  Q          .          .          .          .
  0.81      0.0760      1.22  Q          .          .          .          .
  0.95      0.0901      1.22  Q          .          .          .          .
  1.09      0.1042      1.23  Q          .          .          .          .
  1.23      0.1185      1.24  Q          .          .          .          .
```

1.37	0.1328	1.25	Q	.	.	.	.
1.51	0.1472	1.25	Q	.	.	.	.
1.65	0.1617	1.26	Q	.	.	.	.
1.79	0.1763	1.27	Q	.	.	.	.
1.93	0.1909	1.28	Q	.	.	.	.
2.07	0.2057	1.28	Q	.	.	.	.
2.21	0.2206	1.29	Q	.	.	.	.
2.35	0.2355	1.30	Q	.	.	.	.
2.48	0.2505	1.31	Q	.	.	.	.
2.62	0.2657	1.32	Q	.	.	.	.
2.76	0.2809	1.33	Q	.	.	.	.
2.90	0.2962	1.33	Q	.	.	.	.
3.04	0.3117	1.35	Q	.	.	.	.
3.18	0.3272	1.35	Q	.	.	.	.
3.32	0.3428	1.36	Q	.	.	.	.
3.46	0.3586	1.37	Q	.	.	.	.
3.60	0.3744	1.38	Q	.	.	.	.
3.74	0.3904	1.39	Q	.	.	.	.
3.88	0.4065	1.40	Q	.	.	.	.
4.02	0.4227	1.41	Q	.	.	.	.
4.16	0.4390	1.42	Q	.	.	.	.
4.30	0.4554	1.43	Q	.	.	.	.
4.44	0.4720	1.44	Q	.	.	.	.
4.57	0.4887	1.45	Q	.	.	.	.
4.71	0.5055	1.47	Q	.	.	.	.
4.85	0.5224	1.47	Q	.	.	.	.
4.99	0.5395	1.49	Q	.	.	.	.
5.13	0.5567	1.50	Q	.	.	.	.
5.27	0.5740	1.51	Q	.	.	.	.
5.41	0.5915	1.52	Q	.	.	.	.
5.55	0.6091	1.54	Q	.	.	.	.
5.69	0.6269	1.55	Q	.	.	.	.
5.83	0.6448	1.56	Q	.	.	.	.
5.97	0.6629	1.57	Q	.	.	.	.
6.11	0.6811	1.59	Q	.	.	.	.
6.25	0.6995	1.60	Q	.	.	.	.
6.39	0.7180	1.62	Q	.	.	.	.
6.53	0.7367	1.63	Q	.	.	.	.
6.66	0.7556	1.65	Q	.	.	.	.
6.80	0.7747	1.66	Q	.	.	.	.
6.94	0.7939	1.68	Q	.	.	.	.
7.08	0.8133	1.69	Q	.	.	.	.
7.22	0.8329	1.71	Q	.	.	.	.
7.36	0.8527	1.73	Q	.	.	.	.
7.50	0.8727	1.75	Q	.	.	.	.
7.64	0.8929	1.76	Q	.	.	.	.
7.78	0.9133	1.79	Q	.	.	.	.
7.92	0.9340	1.80	Q	.	.	.	.
8.06	0.9548	1.82	Q	.	.	.	.
8.20	0.9759	1.84	Q	.	.	.	.
8.34	0.9972	1.86	Q	.	.	.	.
8.48	1.0188	1.88	Q	.	.	.	.
8.62	1.0406	1.91	Q	.	.	.	.
8.75	1.0626	1.92	Q	.	.	.	.
8.89	1.0849	1.95	Q	.	.	.	.
9.03	1.1075	1.97	Q	.	.	.	.
9.17	1.1304	2.00	Q	.	.	.	.

```
  9.31     1.1535      2.02  Q         .         .         .         .
  9.45     1.1770      2.05  Q         .         .         .         .
  9.59     1.2007      2.07  Q         .         .         .         .
  9.73     1.2248      2.11  Q         .         .         .         .
  9.87     1.2492      2.13  Q         .         .         .         .
 10.01     1.2740      2.17  Q         .         .         .         .
 10.15     1.2991      2.19  Q         .         .         .         .
 10.29     1.3246      2.23  Q         .         .         .         .
 10.43     1.3504      2.26  .Q        .         .         .         .
 10.57     1.3767      2.30  .Q        .         .         .         .
 10.71     1.4034      2.33  .Q        .         .         .         .
 10.84     1.4305      2.38  .Q        .         .         .         .
 10.98     1.4581      2.41  .Q        .         .         .         .
 11.12     1.4861      2.46  .Q        .         .         .         .
 11.26     1.5146      2.49  .Q        .         .         .         .
 11.40     1.5437      2.55  .Q        .         .         .         .
 11.54     1.5733      2.59  .Q        .         .         .         .
 11.68     1.6034      2.65  .Q        .         .         .         .
 11.82     1.6342      2.69  .Q        .         .         .         .
 11.96     1.6656      2.76  .Q        .         .         .         .
 12.10     1.6979      2.84  .Q        .         .         .         .
 12.24     1.7344      3.50  .Q        .         .         .         .
 12.38     1.7749      3.55  .Q        .         .         .         .
 12.52     1.8163      3.64  .Q        .         .         .         .
 12.66     1.8586      3.70  .Q        .         .         .         .
 12.80     1.9018      3.81  .Q        .         .         .         .
 12.93     1.9460      3.87  .Q        .         .         .         .
 13.07     1.9913      4.00  .Q        .         .         .         .
 13.21     2.0377      4.07  .Q        .         .         .         .
 13.35     2.0854      4.21  .Q        .         .         .         .
 13.49     2.1344      4.29  .Q        .         .         .         .
 13.63     2.1848      4.47  .Q        .         .         .         .
 13.77     2.2368      4.56  . Q       .         .         .         .
 13.91     2.2905      4.77  . Q       .         .         .         .
 14.05     2.3461      4.88  . Q       .         .         .         .
 14.19     2.4049      5.32  . Q       .         .         .         .
 14.33     2.4670      5.47  . Q       .         .         .         .
 14.47     2.5318      5.79  . Q       .         .         .         .
 14.61     2.5995      5.97  . Q       .         .         .         .
 14.75     2.6707      6.39  . Q       .         .         .         .
 14.89     2.7458      6.64  . Q       .         .         .         .
 15.02     2.8261      7.31  .  Q      .         .         .         .
 15.16     2.9131      7.80  .  Q      .         .         .         .
 15.30     3.0098      9.02  .   Q     .         .         .         .
 15.44     3.1164      9.49  .   Q     .         .         .         .
 15.58     3.2298     10.20  .   Q     .         .         .         .
 15.72     3.3566     11.82  .    Q    .         .         .         .
 15.86     3.5301     18.31  .       Q .         .         .         .
 16.00     3.7846     25.89  .         .Q        .         .         .
 16.14     4.4093     82.61  .         .         .         .     Q   .
 16.28     4.9677     14.38  .     Q   .         .         .         .
 16.42     5.1024      9.00  .  Q      .         .         .         .
 16.56     5.2023      8.36  .  Q      .         .         .         .
 16.70     5.2902      6.91  .  Q      .         .         .         .
 16.84     5.3655      6.17  . Q       .         .         .         .
 16.98     5.4334      5.62  . Q       .         .         .         .
 17.11     5.4952      5.11  . Q       .         .         .         .
```

17.25	5.5514	4.66	. Q	.	.	.	.
17.39	5.6035	4.38	.Q	.	.	.	.
17.53	5.6525	4.14	.Q	.	.	.	.
17.67	5.6990	3.93	.Q	.	.	.	.
17.81	5.7432	3.75	.Q	.	.	.	.
17.95	5.7855	3.59	.Q	.	.	.	.
18.09	5.8261	3.45	.Q	.	.	.	.
18.23	5.8617	2.73	.Q	.	.	.	.
18.37	5.8924	2.62	.Q	.	.	.	.
18.51	5.9220	2.52	.Q	.	.	.	.
18.65	5.9506	2.43	.Q	.	.	.	.
18.79	5.9782	2.35	.Q	.	.	.	.
18.93	6.0048	2.28	.Q	.	.	.	.
19.07	6.0307	2.21	Q	.	.	.	.
19.20	6.0558	2.15	Q	.	.	.	.
19.34	6.0802	2.09	Q	.	.	.	.
19.48	6.1040	2.04	Q	.	.	.	.
19.62	6.1272	1.99	Q	.	.	.	.
19.76	6.1497	1.94	Q	.	.	.	.
19.90	6.1718	1.89	Q	.	.	.	.
20.04	6.1934	1.85	Q	.	.	.	.
20.18	6.2144	1.81	Q	.	.	.	.
20.32	6.2351	1.77	Q	.	.	.	.
20.46	6.2553	1.74	Q	.	.	.	.
20.60	6.2751	1.70	Q	.	.	.	.
20.74	6.2945	1.67	Q	.	.	.	.
20.88	6.3136	1.64	Q	.	.	.	.
21.02	6.3323	1.61	Q	.	.	.	.
21.16	6.3507	1.58	Q	.	.	.	.
21.29	6.3687	1.56	Q	.	.	.	.
21.43	6.3865	1.53	Q	.	.	.	.
21.57	6.4040	1.51	Q	.	.	.	.
21.71	6.4212	1.48	Q	.	.	.	.
21.85	6.4381	1.46	Q	.	.	.	.
21.99	6.4548	1.44	Q	.	.	.	.
22.13	6.4712	1.42	Q	.	.	.	.
22.27	6.4874	1.40	Q	.	.	.	.
22.41	6.5034	1.38	Q	.	.	.	.
22.55	6.5191	1.36	Q	.	.	.	.
22.69	6.5347	1.34	Q	.	.	.	.
22.83	6.5500	1.32	Q	.	.	.	.
22.97	6.5651	1.31	Q	.	.	.	.
23.11	6.5801	1.29	Q	.	.	.	.
23.25	6.5948	1.27	Q	.	.	.	.
23.38	6.6094	1.26	Q	.	.	.	.
23.52	6.6238	1.24	Q	.	.	.	.
23.66	6.6381	1.23	Q	.	.	.	.
23.80	6.6521	1.22	Q	.	.	.	.
23.94	6.6660	1.20	Q	.	.	.	.
24.08	6.6798	1.19	Q	.	.	.	.
24.22	6.6866	0.00	Q	.	.	.	.

CIVIC CENTER PROPOSED 2 YEAR HYDROLOGY AND HYDROGRAPH

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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          Ver. 13.5  Release Date: 02/06/2007  License ID 1355

                         Analysis prepared by:

                       Fuscoe Engineering, Inc
                   16795 Von Karman Ave. Suite 100
                       Irvine, California 92606
               PH: 949-474-1960        FAX: 949-474-5315

 ************************** DESCRIPTION OF STUDY **************************
 * IRWD LAKE FOREST SITE                                                  *
 * PROPOSED 2 YEAR HYDROLOGY                                              *
 * CIVIC CENTER / EXISTING TANK                                           *
 **************************************************************************

  FILE NAME: IRW02B.DAT
  TIME/DATE OF STUDY: 13:21 03/09/2010
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO  STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL IN- / OUT-/PARK-  HEIGHT WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)   SIDE / SIDE/ WAY   (FT)   (FT)  (FT)   (FT)   (n)
=== =====  ========= ================= ====== ===== ====== ===== =======
  1  30.0     20.0   0.018/0.018/0.020  0.67   2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    660.00  DOWNSTREAM(FEET) =    654.00
```

```
 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.509
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.946
 SUBAREA Tc AND LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                  B       3.03      0.30      0.100    56    6.51
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      5.22
 TOTAL AREA(ACRES) =      3.03   PEAK FLOW RATE(CFS) =      5.22

****************************************************************************
 FLOW PROCESS FROM NODE     51.00 TO NODE     52.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.51
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.946
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  C       6.18      0.25      0.100    69
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =     6.18      SUBAREA RUNOFF(CFS) =    10.68
 EFFECTIVE AREA(ACRES) =       9.21   AREA-AVERAGED Fm(INCH/HR) =  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.27  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =          9.2       PEAK FLOW RATE(CFS) =      15.91

****************************************************************************
 FLOW PROCESS FROM NODE     52.00 TO NODE     53.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   636.80  DOWNSTREAM(FEET) =   573.00
 FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
 DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.6 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  26.83
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      15.91
 PIPE TRAVEL TIME(MIN.) =   0.12     Tc(MIN.) =     6.63
 LONGEST FLOWPATH FROM NODE     50.00 TO NODE     53.00 =    500.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     53.00 TO NODE     53.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    6.63
 *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.925
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 NATURAL GOOD COVER
```

```
"GRASS"                       C        3.19      0.25     1.000    74
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.25
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA AREA(ACRES) =     3.19      SUBAREA RUNOFF(CFS) =     4.81
EFFECTIVE AREA(ACRES) =      12.40   AREA-AVERAGED Fm(INCH/HR) =  0.08
AREA-AVERAGED Fp(INCH/HR) =  0.25  AREA-AVERAGED Ap =  0.33
TOTAL AREA(ACRES) =       12.4       PEAK FLOW RATE(CFS) =      20.54

****************************************************************************
FLOW PROCESS FROM NODE     54.00 TO NODE     55.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =  1052.00
ELEVATION DATA: UPSTREAM(FEET) =    638.80  DOWNSTREAM(FEET) =    560.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   25.393
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.891
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
NATURAL GOOD COVER
"OPEN BRUSH"                  A        2.95      0.40     1.000    41   25.39
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =      1.30
TOTAL AREA(ACRES) =      2.95   PEAK FLOW RATE(CFS) =      1.30

****************************************************************************
FLOW PROCESS FROM NODE     45.00 TO NODE     46.00 IS CODE =  21
----------------------------------------------------------------------------
>>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
INITIAL SUBAREA FLOW-LENGTH(FEET) =   223.00
ELEVATION DATA: UPSTREAM(FEET) =    628.80  DOWNSTREAM(FEET) =    608.00

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.067
*   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.304
SUBAREA Tc AND LOSS RATE DATA(AMC  II):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
NATURAL GOOD COVER
"GRASS"                       B        3.83      0.30     1.000    61   13.07
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
SUBAREA RUNOFF(CFS) =      3.46
TOTAL AREA(ACRES) =      3.83   PEAK FLOW RATE(CFS) =      3.46
============================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)       =        3.8  TC(MIN.) =      13.07
EFFECTIVE AREA(ACRES) =      3.83  AREA-AVERAGED Fm(INCH/HR)=  0.30
AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 1.000
PEAK FLOW RATE(CFS)     =      3.46
```

==
==
END OF RATIONAL METHOD ANALYSIS

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         NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                        Analysis prepared by:

                       Fuscoe Engineering, Inc
                   16795 Von Karman Ave. Suite 100
                       Irvine, California 92606
               PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  PROPOSED OUTLET A
  2 YEAR
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1          15.35       20.00           69.       0.250       0.735

    TOTAL AREA (Acres) =     15.35

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.050

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.265
============================================================================
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****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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           Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                          Analysis prepared by:

                        Fuscoe Engineering, Inc
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                        Irvine, California 92606
                PH: 949-474-1960        FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD SITE
  PROPOSED OUTLET A
  2 YEAR
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.80
    TOTAL CATCHMENT AREA(ACRES) =   15.35
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.050
    LOW LOSS FRACTION = 0.265
    TIME OF CONCENTRATION(MIN.) =  6.63
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.63
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.99

****************************************************************************
  TIME     VOLUME       Q     0.        7.5       15.0      22.5      30.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.09     0.0013      0.29  Q          .         .         .         .
  0.20     0.0040      0.29  Q          .         .         .         .
  0.31     0.0066      0.29  Q          .         .         .         .
  0.42     0.0093      0.29  Q          .         .         .         .
  0.53     0.0120      0.29  Q          .         .         .         .
  0.64     0.0146      0.30  Q          .         .         .         .
  0.75     0.0173      0.30  Q          .         .         .         .
  0.86     0.0201      0.30  Q          .         .         .         .
  0.97     0.0228      0.30  Q          .         .         .         .
```

1.08	0.0255	0.30	Q	.	.	.	.
1.19	0.0283	0.30	Q	.	.	.	.
1.30	0.0310	0.30	Q	.	.	.	.
1.41	0.0338	0.30	Q	.	.	.	.
1.52	0.0366	0.31	Q	.	.	.	.
1.63	0.0394	0.31	Q	.	.	.	.
1.75	0.0422	0.31	Q	.	.	.	.
1.86	0.0450	0.31	Q	.	.	.	.
1.97	0.0479	0.31	Q	.	.	.	.
2.08	0.0507	0.31	Q	.	.	.	.
2.19	0.0536	0.32	Q	.	.	.	.
2.30	0.0565	0.32	Q	.	.	.	.
2.41	0.0594	0.32	Q	.	.	.	.
2.52	0.0623	0.32	Q	.	.	.	.
2.63	0.0652	0.32	Q	.	.	.	.
2.74	0.0682	0.32	Q	.	.	.	.
2.85	0.0711	0.33	Q	.	.	.	.
2.96	0.0741	0.33	Q	.	.	.	.
3.07	0.0771	0.33	Q	.	.	.	.
3.18	0.0801	0.33	Q	.	.	.	.
3.29	0.0831	0.33	Q	.	.	.	.
3.40	0.0862	0.33	Q	.	.	.	.
3.51	0.0892	0.34	Q	.	.	.	.
3.62	0.0923	0.34	Q	.	.	.	.
3.73	0.0954	0.34	Q	.	.	.	.
3.84	0.0985	0.34	Q	.	.	.	.
3.96	0.1016	0.34	Q	.	.	.	.
4.07	0.1048	0.34	Q	.	.	.	.
4.18	0.1079	0.35	Q	.	.	.	.
4.29	0.1111	0.35	Q	.	.	.	.
4.40	0.1143	0.35	Q	.	.	.	.
4.51	0.1175	0.35	Q	.	.	.	.
4.62	0.1208	0.36	Q	.	.	.	.
4.73	0.1240	0.36	Q	.	.	.	.
4.84	0.1273	0.36	Q	.	.	.	.
4.95	0.1306	0.36	Q	.	.	.	.
5.06	0.1339	0.36	Q	.	.	.	.
5.17	0.1372	0.37	Q	.	.	.	.
5.28	0.1406	0.37	Q	.	.	.	.
5.39	0.1440	0.37	Q	.	.	.	.
5.50	0.1474	0.37	Q	.	.	.	.
5.61	0.1508	0.38	Q	.	.	.	.
5.72	0.1542	0.38	Q	.	.	.	.
5.83	0.1577	0.38	Q	.	.	.	.
5.94	0.1612	0.38	Q	.	.	.	.
6.05	0.1647	0.39	Q	.	.	.	.
6.17	0.1683	0.39	Q	.	.	.	.
6.28	0.1718	0.39	Q	.	.	.	.
6.39	0.1754	0.40	Q	.	.	.	.
6.50	0.1790	0.40	Q	.	.	.	.
6.61	0.1827	0.40	Q	.	.	.	.
6.72	0.1863	0.40	Q	.	.	.	.
6.83	0.1900	0.41	Q	.	.	.	.
6.94	0.1938	0.41	Q	.	.	.	.
7.05	0.1975	0.41	Q	.	.	.	.
7.16	0.2013	0.42	Q	.	.	.	.
7.27	0.2051	0.42	Q	.	.	.	.

7.38	0.2089	0.42	Q	.	.	.	.
7.49	0.2128	0.43	Q	.	.	.	.
7.60	0.2167	0.43	Q	.	.	.	.
7.71	0.2207	0.43	Q	.	.	.	.
7.82	0.2246	0.44	Q	.	.	.	.
7.93	0.2286	0.44	Q	.	.	.	.
8.04	0.2327	0.44	Q	.	.	.	.
8.15	0.2367	0.45	Q	.	.	.	.
8.27	0.2408	0.45	Q	.	.	.	.
8.38	0.2450	0.46	Q	.	.	.	.
8.49	0.2491	0.46	Q	.	.	.	.
8.60	0.2534	0.46	Q	.	.	.	.
8.71	0.2576	0.47	Q	.	.	.	.
8.82	0.2619	0.47	Q	.	.	.	.
8.93	0.2663	0.48	Q	.	.	.	.
9.04	0.2706	0.48	Q	.	.	.	.
9.15	0.2751	0.49	Q	.	.	.	.
9.26	0.2795	0.49	Q	.	.	.	.
9.37	0.2840	0.50	Q	.	.	.	.
9.48	0.2886	0.50	Q	.	.	.	.
9.59	0.2932	0.51	Q	.	.	.	.
9.70	0.2979	0.51	Q	.	.	.	.
9.81	0.3026	0.52	Q	.	.	.	.
9.92	0.3073	0.52	Q	.	.	.	.
10.03	0.3121	0.53	Q	.	.	.	.
10.14	0.3170	0.54	Q	.	.	.	.
10.25	0.3219	0.54	Q	.	.	.	.
10.36	0.3269	0.55	Q	.	.	.	.
10.48	0.3319	0.55	Q	.	.	.	.
10.59	0.3370	0.56	Q	.	.	.	.
10.70	0.3422	0.57	Q	.	.	.	.
10.81	0.3475	0.58	Q	.	.	.	.
10.92	0.3528	0.58	Q	.	.	.	.
11.03	0.3581	0.59	Q	.	.	.	.
11.14	0.3636	0.60	Q	.	.	.	.
11.25	0.3691	0.61	Q	.	.	.	.
11.36	0.3747	0.62	Q	.	.	.	.
11.47	0.3804	0.63	Q	.	.	.	.
11.58	0.3862	0.64	Q	.	.	.	.
11.69	0.3921	0.65	Q	.	.	.	.
11.80	0.3980	0.66	Q	.	.	.	.
11.91	0.4041	0.67	Q	.	.	.	.
12.02	0.4102	0.68	Q	.	.	.	.
12.13	0.4172	0.84	.Q	.	.	.	.
12.24	0.4249	0.85	.Q	.	.	.	.
12.35	0.4327	0.87	.Q	.	.	.	.
12.46	0.4407	0.88	.Q	.	.	.	.
12.57	0.4488	0.90	.Q	.	.	.	.
12.68	0.4571	0.91	.Q	.	.	.	.
12.80	0.4655	0.93	.Q	.	.	.	.
12.91	0.4740	0.94	.Q	.	.	.	.
13.02	0.4827	0.97	.Q	.	.	.	.
13.13	0.4916	0.98	.Q	.	.	.	.
13.24	0.5007	1.01	.Q	.	.	.	.
13.35	0.5100	1.02	.Q	.	.	.	.
13.46	0.5194	1.05	.Q	.	.	.	.
13.57	0.5291	1.07	.Q	.	.	.	.

```
13.68      0.5391      1.10  .Q        .         .         .         .
13.79      0.5492      1.12  .Q        .         .         .         .
13.90      0.5597      1.16  .Q        .         .         .         .
14.01      0.5704      1.19  .Q        .         .         .         .
14.12      0.5817      1.28  .Q        .         .         .         .
14.23      0.5935      1.31  .Q        .         .         .         .
14.34      0.6057      1.36  .Q        .         .         .         .
14.45      0.6183      1.40  .Q        .         .         .         .
14.56      0.6313      1.47  .Q        .         .         .         .
14.67      0.6449      1.50  . Q       .         .         .         .
14.78      0.6590      1.59  . Q       .         .         .         .
14.90      0.6738      1.64  . Q       .         .         .         .
15.01      0.6895      1.78  . Q       .         .         .         .
15.12      0.7061      1.87  . Q       .         .         .         .
15.23      0.7242      2.09  . Q       .         .         .         .
15.34      0.7440      2.23  . Q       .         .         .         .
15.45      0.7638      2.13  . Q       .         .         .         .
15.56      0.7843      2.34  .  Q      .         .         .         .
15.67      0.8084      2.94  .  Q      .         .         .         .
15.78      0.8376      3.44  .   Q     .         .         .         .
15.89      0.8770      5.20  .     Q   .         .         .         .
16.00      0.9341      7.31  .        Q.         .         .         .
16.11      1.0731     23.13  .         .         .         Q         .
16.22      1.1976      4.14  .    Q    .         .         .         .
16.33      1.2284      2.61  .  Q      .         .         .         .
16.44      1.2511      2.36  .  Q      .         .         .         .
16.55      1.2709      1.98  . Q       .         .         .         .
16.66      1.2877      1.70  . Q       .         .         .         .
16.77      1.3025      1.55  . Q       .         .         .         .
16.88      1.3161      1.43  .Q        .         .         .         .
16.99      1.3287      1.33  .Q        .         .         .         .
17.11      1.3404      1.22  .Q        .         .         .         .
17.22      1.3511      1.14  .Q        .         .         .         .
17.33      1.3613      1.09  .Q        .         .         .         .
17.44      1.3710      1.04  .Q        .         .         .         .
17.55      1.3803      0.99  .Q        .         .         .         .
17.66      1.3892      0.95  .Q        .         .         .         .
17.77      1.3977      0.92  .Q        .         .         .         .
17.88      1.4060      0.89  .Q        .         .         .         .
17.99      1.4140      0.86  .Q        .         .         .         .
18.10      1.4212      0.73  Q         .         .         .         .
18.21      1.4276      0.66  Q         .         .         .         .
18.32      1.4335      0.64  Q         .         .         .         .
18.43      1.4393      0.62  Q         .         .         .         .
18.54      1.4449      0.61  Q         .         .         .         .
18.65      1.4504      0.59  Q         .         .         .         .
18.76      1.4557      0.57  Q         .         .         .         .
18.87      1.4608      0.56  Q         .         .         .         .
18.98      1.4659      0.55  Q         .         .         .         .
19.09      1.4708      0.53  Q         .         .         .         .
19.20      1.4756      0.52  Q         .         .         .         .
19.32      1.4803      0.51  Q         .         .         .         .
19.43      1.4849      0.50  Q         .         .         .         .
19.54      1.4895      0.49  Q         .         .         .         .
19.65      1.4939      0.48  Q         .         .         .         .
19.76      1.4982      0.47  Q         .         .         .         .
19.87      1.5025      0.46  Q         .         .         .         .
```

19.98	1.5066	0.45	Q	.	.	.	.
20.09	1.5107	0.45	Q	.	.	.	.
20.20	1.5148	0.44	Q	.	.	.	.
20.31	1.5188	0.43	Q	.	.	.	.
20.42	1.5227	0.42	Q	.	.	.	.
20.53	1.5265	0.42	Q	.	.	.	.
20.64	1.5303	0.41	Q	.	.	.	.
20.75	1.5340	0.40	Q	.	.	.	.
20.86	1.5377	0.40	Q	.	.	.	.
20.97	1.5413	0.39	Q	.	.	.	.
21.08	1.5449	0.39	Q	.	.	.	.
21.19	1.5484	0.38	Q	.	.	.	.
21.30	1.5518	0.38	Q	.	.	.	.
21.41	1.5553	0.37	Q	.	.	.	.
21.52	1.5586	0.37	Q	.	.	.	.
21.64	1.5620	0.36	Q	.	.	.	.
21.75	1.5653	0.36	Q	.	.	.	.
21.86	1.5685	0.35	Q	.	.	.	.
21.97	1.5717	0.35	Q	.	.	.	.
22.08	1.5749	0.35	Q	.	.	.	.
22.19	1.5781	0.34	Q	.	.	.	.
22.30	1.5812	0.34	Q	.	.	.	.
22.41	1.5842	0.33	Q	.	.	.	.
22.52	1.5873	0.33	Q	.	.	.	.
22.63	1.5903	0.33	Q	.	.	.	.
22.74	1.5933	0.32	Q	.	.	.	.
22.85	1.5962	0.32	Q	.	.	.	.
22.96	1.5991	0.32	Q	.	.	.	.
23.07	1.6020	0.31	Q	.	.	.	.
23.18	1.6049	0.31	Q	.	.	.	.
23.29	1.6077	0.31	Q	.	.	.	.
23.40	1.6105	0.31	Q	.	.	.	.
23.51	1.6133	0.30	Q	.	.	.	.
23.62	1.6160	0.30	Q	.	.	.	.
23.73	1.6187	0.30	Q	.	.	.	.
23.85	1.6214	0.29	Q	.	.	.	.
23.96	1.6241	0.29	Q	.	.	.	.
24.07	1.6268	0.29	Q	.	.	.	.
24.18	1.6281	0.00	Q	.	.	.	.

UPPER RETENTION SITE HYDROGRAPH

```
****************************************************************************
       NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                  AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                      Analysis prepared by:

                     Fuscoe Engineering, Inc
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                    Irvine, California 92606
              PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD UPPER SITE
  PROPOSED 2 YEAR

============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1         10.80       20.00           69.        0.250       0.735

    TOTAL AREA (Acres) =      10.80

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.050

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.265
============================================================================
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****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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            Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                          Analysis prepared by:

                         Fuscoe Engineering, Inc
                     16795 Von Karman Ave. Suite 100
                         Irvine, California 92606
                 PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD UPPER RETENTION SITE
  PROPOSED 2 YEAR

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


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.95
    TOTAL CATCHMENT AREA(ACRES) =   10.80
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.050
    LOW LOSS FRACTION = 0.265
    TIME OF CONCENTRATION(MIN.) = 14.07
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =      1.36
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =      0.48

****************************************************************************
  TIME     VOLUME       Q    0.         5.0       10.0       15.0       20.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.05     0.0000      0.00  Q          .          .          .          .
  0.29     0.0023      0.24  Q          .          .          .          .
  0.52     0.0071      0.24  Q          .          .          .          .
  0.76     0.0118      0.25  Q          .          .          .          .
  0.99     0.0166      0.25  Q          .          .          .          .
  1.23     0.0215      0.25  Q          .          .          .          .
  1.46     0.0264      0.25  Q          .          .          .          .
  1.70     0.0313      0.26  Q          .          .          .          .
  1.93     0.0363      0.26  Q          .          .          .          .
```

2.16	0.0414	0.26	Q	.	.	.	.
2.40	0.0465	0.26	Q	.	.	.	.
2.63	0.0516	0.27	Q	.	.	.	.
2.87	0.0568	0.27	Q	.	.	.	.
3.10	0.0621	0.27	Q	.	.	.	.
3.34	0.0674	0.28	Q	.	.	.	.
3.57	0.0728	0.28	Q	.	.	.	.
3.81	0.0783	0.28	Q	.	.	.	.
4.04	0.0838	0.29	Q	.	.	.	.
4.28	0.0894	0.29	Q	.	.	.	.
4.51	0.0950	0.29	Q	.	.	.	.
4.74	0.1007	0.30	Q	.	.	.	.
4.98	0.1065	0.30	Q	.	.	.	.
5.21	0.1124	0.30	Q	.	.	.	.
5.45	0.1184	0.31	Q	.	.	.	.
5.68	0.1244	0.31	Q	.	.	.	.
5.92	0.1305	0.32	Q	.	.	.	.
6.15	0.1367	0.32	Q	.	.	.	.
6.39	0.1430	0.33	Q	.	.	.	.
6.62	0.1494	0.33	Q	.	.	.	.
6.85	0.1559	0.34	Q	.	.	.	.
7.09	0.1625	0.34	Q	.	.	.	.
7.32	0.1692	0.35	Q	.	.	.	.
7.56	0.1760	0.35	Q	.	.	.	.
7.79	0.1830	0.36	Q	.	.	.	.
8.03	0.1900	0.37	Q	.	.	.	.
8.26	0.1972	0.38	Q	.	.	.	.
8.50	0.2045	0.38	Q	.	.	.	.
8.73	0.2120	0.39	Q	.	.	.	.
8.97	0.2196	0.40	Q	.	.	.	.
9.20	0.2274	0.41	Q	.	.	.	.
9.43	0.2353	0.41	Q	.	.	.	.
9.67	0.2434	0.42	Q	.	.	.	.
9.90	0.2517	0.43	Q	.	.	.	.
10.14	0.2601	0.44	Q	.	.	.	.
10.37	0.2688	0.45	Q	.	.	.	.
10.61	0.2777	0.47	Q	.	.	.	.
10.84	0.2869	0.48	Q	.	.	.	.
11.08	0.2963	0.49	Q	.	.	.	.
11.31	0.3060	0.50	.Q	.	.	.	.
11.54	0.3159	0.53	.Q	.	.	.	.
11.78	0.3262	0.54	.Q	.	.	.	.
12.01	0.3369	0.56	.Q	.	.	.	.
12.25	0.3486	0.65	.Q	.	.	.	.
12.48	0.3620	0.73	.Q	.	.	.	.
12.72	0.3763	0.75	.Q	.	.	.	.
12.95	0.3912	0.79	.Q	.	.	.	.
13.19	0.4066	0.81	.Q	.	.	.	.
13.42	0.4228	0.86	.Q	.	.	.	.
13.65	0.4397	0.89	.Q	.	.	.	.
13.89	0.4575	0.95	.Q	.	.	.	.
14.12	0.4763	0.99	.Q	.	.	.	.
14.36	0.4967	1.12	. Q	.	.	.	.
14.59	0.5189	1.17	. Q	.	.	.	.
14.83	0.5429	1.31	. Q	.	.	.	.
15.06	0.5692	1.40	. Q	.	.	.	.
15.30	0.5996	1.73	. Q	.	.	.	.

15.53	0.6347	1.89	. Q	.	.	.	.
15.77	0.6777	2.55	. Q	.	.	.	.
16.00	0.7387	3.75	. Q	.	.	.	.
16.23	0.8939	12.26	.	.	. Q	.	.
16.47	1.0319	1.98	. Q	.	.	.	.
16.70	1.0660	1.54	. Q	.	.	.	.
16.94	1.0930	1.24	. Q	.	.	.	.
17.17	1.1152	1.06	. Q	.	.	.	.
17.41	1.1344	0.92	.Q	.	.	.	.
17.64	1.1513	0.83	.Q	.	.	.	.
17.88	1.1668	0.77	.Q	.	.	.	.
18.11	1.1812	0.71	.Q	.	.	.	.
18.34	1.1934	0.55	.Q	.	.	.	.
18.58	1.2037	0.51	.Q	.	.	.	.
18.81	1.2134	0.49	Q	.	.	.	.
19.05	1.2226	0.46	Q	.	.	.	.
19.28	1.2313	0.44	Q	.	.	.	.
19.52	1.2395	0.42	Q	.	.	.	.
19.75	1.2475	0.40	Q	.	.	.	.
19.99	1.2551	0.38	Q	.	.	.	.
20.22	1.2624	0.37	Q	.	.	.	.
20.46	1.2695	0.36	Q	.	.	.	.
20.69	1.2763	0.35	Q	.	.	.	.
20.92	1.2829	0.34	Q	.	.	.	.
21.16	1.2893	0.33	Q	.	.	.	.
21.39	1.2955	0.32	Q	.	.	.	.
21.63	1.3015	0.31	Q	.	.	.	.
21.86	1.3074	0.30	Q	.	.	.	.
22.10	1.3131	0.29	Q	.	.	.	.
22.33	1.3187	0.28	Q	.	.	.	.
22.57	1.3242	0.28	Q	.	.	.	.
22.80	1.3295	0.27	Q	.	.	.	.
23.03	1.3347	0.27	Q	.	.	.	.
23.27	1.3398	0.26	Q	.	.	.	.
23.50	1.3448	0.26	Q	.	.	.	.
23.74	1.3497	0.25	Q	.	.	.	.
23.97	1.3545	0.25	Q	.	.	.	.
24.21	1.3592	0.24	Q	.	.	.	.
24.44	1.3616	0.00	Q	.	.	.	.

MIDDLE RETENTION SITE HYDROGRAPH

```
****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
       (C) Copyright 1989-2007 Advanced Engineering Software (aes)
          Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                         Analysis prepared by:

                        Fuscoe Engineering, Inc
                     16795 Von Karman Ave. Suite 100
                        Irvine, California 92606
                PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD MIDDLE RETENTION SITE
  PROPOSED 2 YEAR

============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1         10.00       20.00           69.        0.250       0.735

    TOTAL AREA (Acres) =      10.00

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.050

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.265
============================================================================
```

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
        (C) Copyright 1989-2007 Advanced Engineering Software (aes)
          Ver. 14.0  Release Date: 06/01/2007  License ID 1355

                         Analysis prepared by:

                        Fuscoe Engineering, Inc
                    16795 Von Karman Ave. Suite 100
                        Irvine, California 92606
                 PH: 949-474-1960       FAX: 949-474-5315

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  IRWD MIDDLE RETENTION SITE
  PROPOSED 2 YEAR

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


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =   10.00
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.050
    LOW LOSS FRACTION = 0.265
    TIME OF CONCENTRATION(MIN.) = 17.46
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

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

    TOTAL CATCHMENT  RUNOFF  VOLUME(ACRE-FEET) =     1.19
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.51

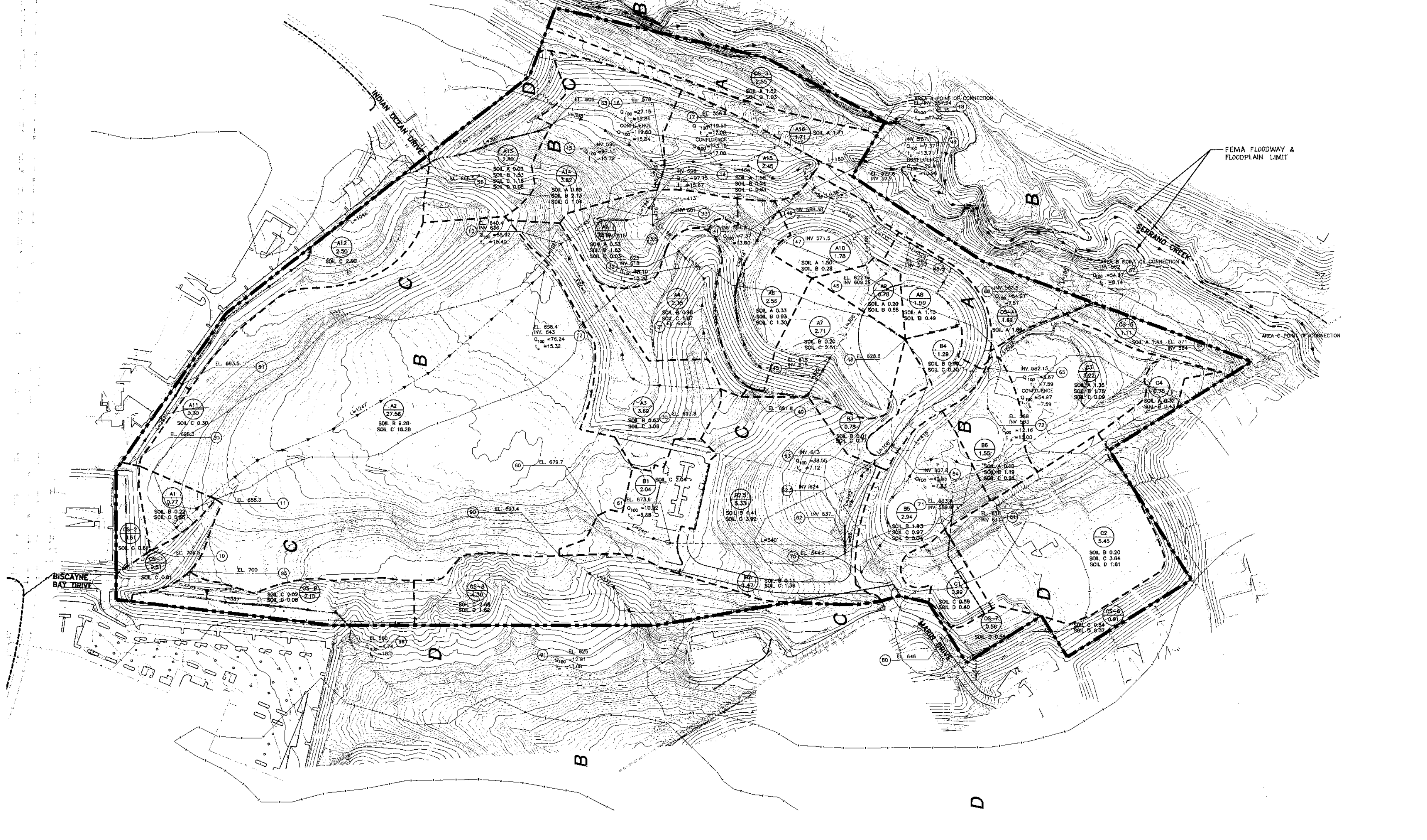
****************************************************************************
  TIME     VOLUME      Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.29     0.0025     0.21  Q         .         .         .         .
  0.58     0.0077     0.21  Q         .         .         .         .
  0.87     0.0129     0.22  Q         .         .         .         .
  1.16     0.0181     0.22  Q         .         .         .         .
  1.45     0.0234     0.22  Q         .         .         .         .
  1.74     0.0288     0.23  Q         .         .         .         .
  2.03     0.0342     0.23  Q         .         .         .         .
  2.32     0.0398     0.23  Q         .         .         .         .
  2.61     0.0453     0.23  Q         .         .         .         .
```

```
    2.91      0.0510      0.24  Q         .         .         .         .
    3.20      0.0567      0.24  Q         .         .         .         .
    3.49      0.0626      0.24  Q         .         .         .         .
    3.78      0.0685      0.25  Q         .         .         .         .
    4.07      0.0745      0.25  .Q        .         .         .         .
    4.36      0.0805      0.25  .Q        .         .         .         .
    4.65      0.0867      0.26  .Q        .         .         .         .
    4.94      0.0930      0.26  .Q        .         .         .         .
    5.23      0.0994      0.27  .Q        .         .         .         .
    5.52      0.1059      0.27  .Q        .         .         .         .
    5.82      0.1125      0.28  .Q        .         .         .         .
    6.11      0.1192      0.28  .Q        .         .         .         .
    6.40      0.1260      0.29  .Q        .         .         .         .
    6.69      0.1329      0.29  .Q        .         .         .         .
    6.98      0.1400      0.30  .Q        .         .         .         .
    7.27      0.1473      0.30  .Q        .         .         .         .
    7.56      0.1547      0.31  .Q        .         .         .         .
    7.85      0.1622      0.32  .Q        .         .         .         .
    8.14      0.1699      0.33  .Q        .         .         .         .
    8.43      0.1778      0.33  .Q        .         .         .         .
    8.73      0.1858      0.34  .Q        .         .         .         .
    9.02      0.1941      0.35  .Q        .         .         .         .
    9.31      0.2026      0.36  .Q        .         .         .         .
    9.60      0.2113      0.36  .Q        .         .         .         .
    9.89      0.2202      0.38  .Q        .         .         .         .
   10.18      0.2294      0.39  .Q        .         .         .         .
   10.47      0.2389      0.40  .Q        .         .         .         .
   10.76      0.2487      0.41  .Q        .         .         .         .
   11.05      0.2588      0.43  .Q        .         .         .         .
   11.34      0.2693      0.44  .Q        .         .         .         .
   11.64      0.2802      0.46  .Q        .         .         .         .
   11.93      0.2915      0.48  .Q        .         .         .         .
   12.22      0.3041      0.57  . Q       .         .         .         .
   12.51      0.3186      0.63  . Q       .         .         .         .
   12.80      0.3342      0.67  . Q       .         .         .         .
   13.09      0.3506      0.69  . Q       .         .         .         .
   13.38      0.3678      0.74  . Q       .         .         .         .
   13.67      0.3860      0.77  .  Q      .         .         .         .
   13.96      0.4054      0.84  .  Q      .         .         .         .
   14.25      0.4263      0.89  .  Q      .         .         .         .
   14.55      0.4493      1.03  .   Q     .         .         .         .
   14.84      0.4749      1.10  .   Q     .         .         .         .
   15.13      0.5038      1.31  .    Q    .         .         .         .
   15.42      0.5376      1.51  .     Q   .         .         .         .
   15.71      0.5786      1.90  .      Q  .         .         .         .
   16.00      0.6355      2.83  .         .Q        .         .         .
   16.29      0.7829      9.43  .         .         .         .      Q  .
   16.58      0.9161      1.65  .     Q   .         .         .         .
   16.87      0.9501      1.18  .   Q     .         .         .         .
   17.16      0.9760      0.97  .  Q      .         .         .         .
   17.45      0.9972      0.80  .  Q      .         .         .         .
   17.75      1.0155      0.72  . Q       .         .         .         .
   18.04      1.0319      0.65  . Q       .         .         .         .
   18.33      1.0456      0.49  .Q        .         .         .         .
   18.62      1.0570      0.45  .Q        .         .         .         .
   18.91      1.0675      0.42  .Q        .         .         .         .
   19.20      1.0773      0.39  .Q        .         .         .         .
```

19.49	1.0865	0.37	.Q	.	.	.	.
19.78	1.0952	0.35	.Q	.	.	.	.
20.07	1.1034	0.34	.Q	.	.	.	.
20.36	1.1113	0.32	.Q	.	.	.	.
20.66	1.1189	0.31	.Q	.	.	.	.
20.95	1.1261	0.29	.Q	.	.	.	.
21.24	1.1331	0.28	.Q	.	.	.	.
21.53	1.1398	0.27	.Q	.	.	.	.
21.82	1.1463	0.27	.Q	.	.	.	.
22.11	1.1525	0.26	.Q	.	.	.	.
22.40	1.1586	0.25	Q	.	.	.	.
22.69	1.1645	0.24	Q	.	.	.	.
22.98	1.1703	0.24	Q	.	.	.	.
23.27	1.1759	0.23	Q	.	.	.	.
23.57	1.1813	0.22	Q	.	.	.	.
23.86	1.1866	0.22	Q	.	.	.	.
24.15	1.1918	0.21	Q	.	.	.	.
24.44	1.1944	0.00	Q	.	.	.	.

SUBAREAS

AREA A MAIN PROPOSED DEVELOPMENT AREA
AREA B SECONDARY PROPOSED DEVELOPMENT AREA
AREA C EXISTING CONDITION NOT EFFECTED BY DEVELOPMENT
AREA OS OFF SITE FLOWS OTHER THAN MAIN LETTERED AREAS
AREA OS-1,2 EXISTING FLOWS TO BISCAYNE BAY DRIVE (APPROXIMATELY EQUAL)
AREA OS-3 EXISTING SLOPE DIRECTLY TRIBUTARY TO SERRANO CREEK – UNCHANGED
AREA OS-4,5 SHEET FLOW DIRECTLY TO TRAIL EAST OF SITE, THENCE TO SERRANO CREEK – UNCHANGED
AREA OS-6,7 SHEET FLOW OFF SITE TO DEVELOPED AREA TERRANCE DRAINS – UNCHANGED
AREA OS-8,9 SHEET FLOW TO AREA WEST OF SITE. ASSUMED INTO AREA B DUE TO GRADING AND WATER QUALITY ISSUES



LEGEND

EXISTING MAJOR WATERSHED BOUNDARY
EXISTING SUB DRAINAGE AREA BOUNDARY
EXISTING FLOW PATH
SOIL TYPE BOUNDARY
DIRECTION OF FLOW
C17 — DRAINAGE AREA DESIGNATION
70.21 — ACRES
340 NODE DESIGNATION
L=300' LENGTH OF EXISTING FLOW PATH
Q_{100} CALCULATED 100-YEAR STORM RUNOFF
Tc TIME OF CONCENTRATION (100-YEAR STORM)

N

100' 0' 50' 100' 200'
GRAPHIC SCALE: 1" = 100'

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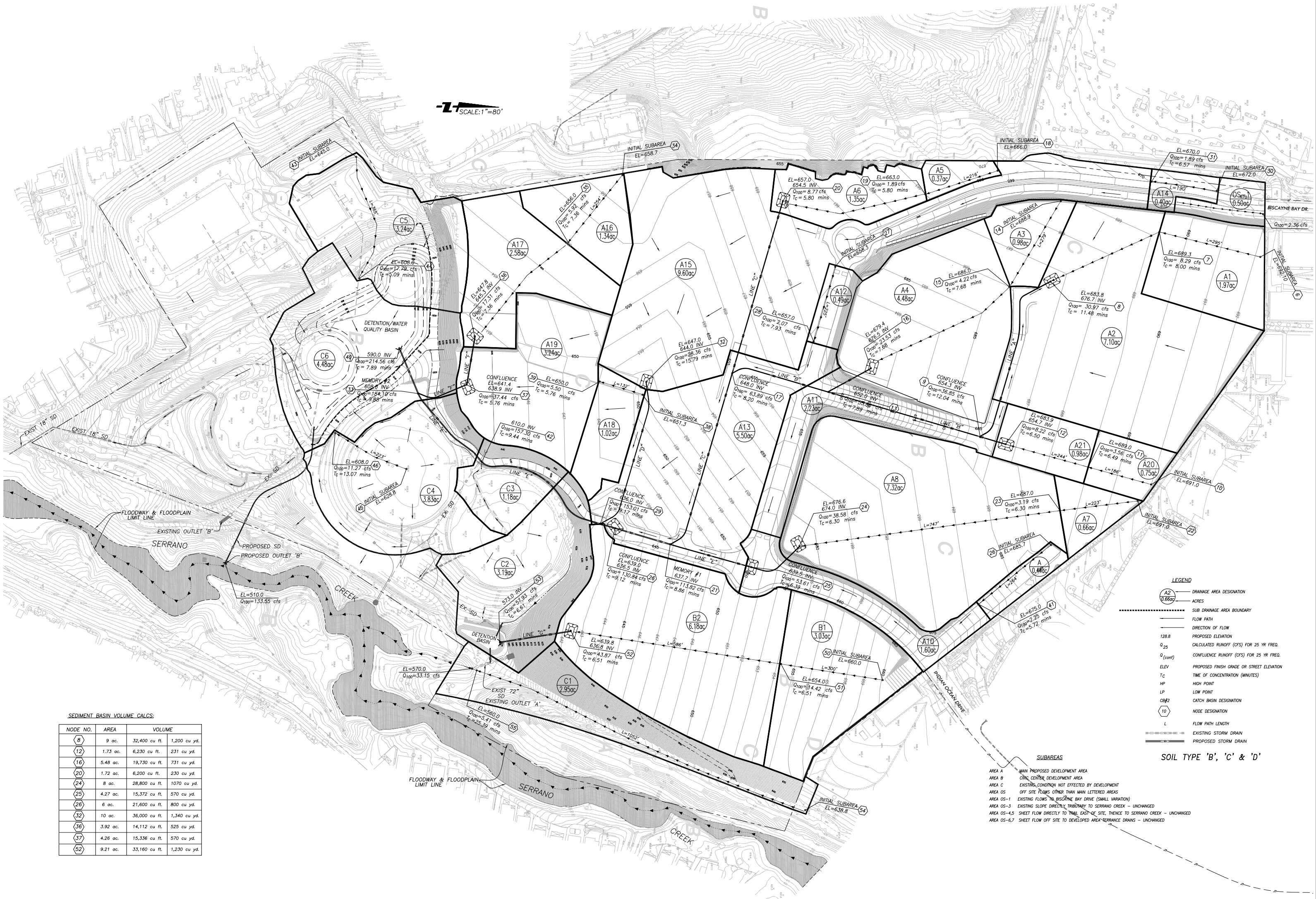
IRWD SITE
CITY OF LAKE FOREST, CA
EXISTING DRAINAGE HYDROLOGY MAP
(TRIBUTARY TO SERRANO CREEK)

SHEET 1 of 1

P:\Projects\658\02\Eng_File Cabinet\Reports\Hydrology



SEDIMENT BASIN VOLUME CALCS:

NODE NO.	AREA	VOLUME	
8	9 ac.	32,400 cu ft.	1,200 cu yd.
12	1.73 ac.	6,230 cu ft.	231 cu yd.
16	5.48 ac.	19,730 cu ft.	731 cu yd.
20	1.72 ac.	6,200 cu ft.	230 cu yd.
24	8 ac.	28,800 cu ft.	1070 cu yd.
25	4.27 ac.	15,372 cu ft.	570 cu yd.
26	6 ac.	21,600 cu ft.	800 cu yd.
32	10 ac.	36,000 cu ft.	1,340 cu yd.
36	3.92 ac.	14,112 cu ft.	525 cu yd.
37	4.26 ac.	15,336 cu ft.	570 cu yd.
52	9.21 ac.	33,160 cu ft.	1,230 cu yd.

LEGEND

A2	DRAINAGE AREA DESIGNATION
0.66ac	ACRES
	SUB DRAINAGE AREA BOUNDARY
	FLOW PATH
	DIRECTION OF FLOW
128.8	PROPOSED ELEVATION
Q_{25}	CALCULATED RUNOFF (CFS) FOR 25 YR FREQ.
$Q_{(conf)}$	CONFLUENCE RUNOFF (CFS) FOR 25 YR FREQ.
ELEV	PROPOSED FINISH GRADE OR STREET ELEVATION
T_C	TIME OF CONCENTRATION (MINUTES)
HP	HIGH POINT
LP	LOW POINT
CB#2	CATCH BASIN DESIGNATION
10	NODE DESIGNATION
L	FLOW PATH LENGTH
SD	EXISTING STORM DRAIN
SD	PROPOSED STORM DRAIN

SOIL TYPE 'B', 'C' & 'D'

SUBAREAS

AREA A MAIN PROPOSED DEVELOPMENT AREA
AREA B CIVIC CENTER DEVELOPMENT AREA
AREA C EXISTING CONDITION NOT EFFECTED BY DEVELOPMENT
AREA OS OFF SITE FLOWS OTHER THAN MAIN LETTERED AREAS
AREA OS-1 EXISTING FLOWS TO BISCAYNE BAY DRIVE (SMALL VARIATION)
AREA OS-3 EXISTING SLOPE DIRECTLY TRIBUTARY TO SERRANO CREEK – UNCHANGED
AREA OS-4,5 SHEET FLOW DIRECTLY TO TRAIL EAST OF SITE, THENCE TO SERRANO CREEK – UNCHANGED
AREA OS-6,7 SHEET FLOW OFF SITE TO DEVELOPED AREA TERRANCE DRAINS – UNCHANGED

DEVELOPER
LEWIS COMMUNITY DEVELOPERS
1156 N. MOUNTAIN AVENUE
UPLAND, CA. 91785

PREPARED BY:
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www.fuscoe.com

PROPOSED HYDROLOGY MAP
I.R.W.D. - LAKE FOREST SITE
SERRANO SUMMIT
LAKE FOREST, CA

SHEET 1 OF 1

P:\PROJECTS\658\02\ENG_FILE CABINET\REPORTS\HYDROLOGY\65802XH-PROP-HYDMAP01.DWG (07-28-10 4:28:55PM) Plotted by: Michelle Desai

FUSCOE
ENGINEERING

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

SERRANO SUMMIT

TENTATIVE TRACT MAP NO. 17331

Lake Forest, California

Prepared For
Irvine Ranch Water District
15600 Sand Canyon Avenue
Irvine, CA 92618

Prepared By

Fuscoe Engineering, Inc.
16795 Von Karman, Suite 100
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949.474.1960
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Project Manager:
Trevor Dodson

Date Prepared: June 12, 2009
Date Revised: November 4, 2009
2nd Revision: March 17, 2010
Job Number: 658.02.01

full circle thinking

PRELIMINARY
WATER QUALITY MANAGEMENT PLAN
(P-WQMP)

SERRANO SUMMIT

TENTATIVE TRACT MAP NO. 17331

Located south of Commercentre Drive and
Biscayne Bay Drive
in the
City of Lake Forest
County of Orange, California

Prepared for:

IRVINE RANCH WATER DISTRICT
15600 Sand Canyon Avenue
Irvine, CA 92618
949.453.5300

Prepared by:

FUSCOE ENGINEERING, INC.
16795 Von Karman Ave, Suite 100
Irvine, CA 92606
949.474.1960

Date Prepared: June 12, 2009
Revised: November 4, 2009
2nd Revision: March 17, 2010

OWNER'S CERTIFICATION

PRELIMINARY WATER QUALITY MANAGEMENT PLAN (P-WQMP)

City of Lake Forest Design Review No. ______
Tract/Parcel Number TBD

This Water Quality Management Plan has been prepared for IRWD by Fuscoe Engineering, Inc. This WQMP is intended to comply with the requirements of the City of Lake Forest, Municipal Code Chapter 15.14, requiring the preparation of a project-specific Water Quality Management Plan (WQMP).

The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with current Orange County Drainage Area Management Plan (DAMP) and the intent of the non-point source NPDES Permit for Waste Discharge Requirements for the County of Orange, Orange County Flood Control District and the incorporated cities of Orange County under the jurisdiction of the Santa Ana Regional Water Quality Control Board. A copy of this WQMP will be maintained at the project site or project office.

This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party having responsibility for implementing portions of this WQMP. At least one copy of the approved and certified copy of this WQMP shall be available on the subject property in perpetuity. Once the undersigned transfers its interest in the property, its successors-in-interest shall bear the aforementioned responsibility to implement and amend this WQMP.

______________________________ ______________________________
Signature Title

______________________________ ______________________________
Name Company

____
Address

______________________________ ______________________________
Phone Date

TABLE OF CONTENTS

APPENDICES

BMP TABLES

LOCATION MAP, SITE PLANS AND BMP DETAILS (INCLUDED IN SECTION 6.0)

EDUCATIONAL MATERIALS (INCLUDED IN APPENDIX 3):

- The Ocean Begins at Your Front Door
- Tips for Landscape & Gardening
- Tips for Pool Maintenance
- Waste Oil Collection Centers South OC
- Keeping Pest Control Products Out of Creeks, Rivers and the Ocean
- Permitted Lot & Pool Drains Pool Maintenance
- Tips for Pet Care
- Water Quality Guidelines for Car Wash Fund Raisers
- Sewage Spill Reference Guide
- Tips for Using Concrete and Mortar
- Household Tips
- Help Prevent Ocean Pollution: Proper Disposal of Household Hazardous Materials
- SC-10 Non-Stormwater Discharges
- SC-11 Spill Prevention, Control and Cleanup
- SC-41 Building and Grounds Maintenance
- SC-43 Parking/Storage Area Maintenance
- SC-70 Road and Street Maintenance
- SC-71 Plaza and Sidewalk Cleaning
- SC-72 Fountain & Pool Maintenance
- SC-73 Landscape Maintenance
- SC-74 Drainage System Maintenance
- SD-10 Site Design & Landscape Planning
- SD-11 Roof Runoff Controls
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage
- SD-32 Trash Storage Areas

POST-CONSTRUCTION BMP FACT SHEETS (INCLUDED IN APPENDIX 4)

- DF-1 Drainage System Operation & Maintenance
- FP-2 Landscape Maintenance, I
- FP-3 Street Sweeping
- FP-4 Sidewalk, Plaza, and Entry Monument, & Fountain Maintenance
- FP-6 Water & Sewer Utility Operation & Maintenance
- IC3 Building Maintenance
- IC7 Landscape Maintenance
- IC15 Parking & Storage Area Maintenance
- IC16 Pool and Fountain Cleaning
- IC17 Spill Prevention & Cleanup
- R-2 Automobile Washing
- R-3 Automobile Parking
- R-5 Disposal of Pet Waste
- R-6 Disposal of Green Waste
- R-7 Household Hazardous Waste
- R-8 Water Conservation

INTRODUCTION

This Preliminary Water Quality Management Plan (P-WQMP) has been prepared to provide specifications for the post-construction management of storm water runoff from the proposed project, Serrano Summit. Improperly managed runoff can be a significant source of water pollution causing impacts to aquatic habitat, wildlife, and water-dependent beneficial uses. The implementation of this plan ensures that such impacts are reduced to the Maximum Extent Practicable (MEP).

This P-WQMP covers the post-construction operations on Serrano Summit in the City of Lake Forest, California (see Vicinity Map in Section 6.0). It has been developed as required under State Water Resources Control Board (SWRCB) Municipal NPDES Storm Water Permit for the County of Orange and the Incorporated Cities of Orange County, and in accordance with good engineering practices. This P-WQMP describes this facility and its operations, identifies potential sources of storm water pollution at the facility, and recommends appropriate Best Management Practices (BMPs) or pollution control measures to reduce the discharge of pollutants in storm water runoff.

PROJECT CATEGORIES

In accordance with the OC DAMP and Countywide Model WQMP, a project is considered a "Priority Project" if it meets any of the following criteria:

CHECK IF APPLICABLE	PRIORITY PROJECT CATEGORY
	1. All significant redevelopment projects, where significant redevelopment is defined as the addition of 5,000 or more square feet of impervious surface on an already developed site
✓	2. New development projects that create 10,000 square feet or more of impervious surface (collectively over the entire project site) including commercial, industrial, residential housing subdivisions, mixed-use, and public projects
	3. Automotive repair shops (SIC codes 5013, 5014, 5541, 7532-7534, and 7536-7539)
	4. Restaurants where the land area of development is 5,000 square feet or more including parking area
	5. All hillside developments on 5,000 square feet or more, which are located on areas with known erosive soil conditions or where natural slope is twenty-five percent or more
	6. Developments of 2,500 square feet or more of impervious surface or more, adjacent to (within 200 feet) or discharging directly into environmentally sensitive areas, such as areas designated in the Ocean Plan as Areas of Special Biological Significance or water bodies listed on the CWA Section 303(d) list of impaired waters
	7. Parking Lots 5,000 square feet or more of impervious surface exposed to storm water runoff.
	8. Streets, roads, highways and freeways of 5,000 square feet or more of paved surface shall incorporate US EPA guidance, "Managing Wet Weather with Green Infrastructure: Green Streets" in a manner consistent with the MEP standard
	9. Retail gasoline outlets of 5,000 or more square feet with a projected average daily traffic of 100 or more vehicles per day.

The proposed Serrano Summit Project meets **Category 2**, and therefore, is considered a "Priority Project" in accordance with the OC DAMP.

1.0 DISCRETIONARY PERMIT(S) & WATER QUALITY CONDITIONS

The proposed project, designated Project/Application Number TBD by the City of Lake Forest, located in Tract Number 17331, is a subdivision of Parcels 1 & 2 of amended Parcel Map Number 89-218 in the City of Lake Forest, State of California, Office of the County Recorder, Orange County.

1.1 DISCRETIONARY PERMITS

Pending. To be documented in the Final WQMP.

1.2 RESOLUTIONS

Pending. To be documented in the Final WQMP.

1.3 CONDITIONS OF APPROVAL

Pending. To be documented in the Final WQMP.

2.0 PROJECT DESCRIPTION

2.1 FACILITY DESCRIPTION

The proposed Serrano Summit project site is an approximate 99-acre parcel located in the City of Lake Forest, CA. The project site is generally located south of Commercentre Drive, east of Biscayne Bay Drive, and west of the Serrano Creek trail. A vicinity map is provided in Section 6.0. The project site is currently owned by the Irvine Ranch Water District (IRWD); and will be developed by IRWD (herein referred to as "developer").

Under existing conditions, the majority of the project site is vacant, consisting of former agricultural fields. There are several IRWD facilities (Los Alisos Reclamation Plant) located in the southern portion of the site, including above ground and below ground storage tanks and associated facilities. In addition, there is one abandoned office building located in the center of the site with adjacent parking.

Adjacent land uses include commercial and industrial uses to the north and northwest along Commercentre Drive, Serrano Creek to the east, existing residential developments to the southeast and south, and vacant land to the west that is zoned for residential land uses in the Lake Forest General Plan.

The proposed project includes the development of a multi-use master planned community with additional park and public facility land uses. The majority of the existing IRWD storage tanks and facilities will remain in the southern portion of the site. The tank adjacent to the proposed water quality detention basin may be removed and/or relocated in order to help satisfy the infiltration/retention requirements for the proposed project. The development will include "walkable" medium density residential neighborhoods generally in the northern and western portions of the site, a Civic Center, and additional park and open space areas. The table below summarizes the proposed land uses. Refer to Section 6.0 for locations of the specific land use areas. Further details on the proposed development will be documented in the Final WQMP.

PROJECT LAND USE SUMMARY		
LOT #	LAND USE	GROSS ACREAGE
1-13	Residential	55.6 acres
14	Private Recreation Center	1.9 acres
15-17	Public Park	4.8 acres
18-19	Existing Facilities	24.1 acres
O	Open Space	3.9 acres
A-E	Private Streets	3.0 acres
--	Public Streets	5.6 acres
	Total	**98.9 acres**
13	Civic Center (Overlay)	11.9 acres
F-N	Landscaped Lot/Slope	8.8 acres

2.2 PROJECT FEATURES

PARKING FACILITIES

Parking will be provided throughout the project site as garages within the residential units, carports, along residential streets, and as surface lots. Further details on proposed parking will be documented in the Final WQMP.

LANDSCAPED AREAS

The project site will include landscaping along streets, sidewalks, paseos, pathways, and medians; within the residential areas; as planters within the parking lots; in addition to within the community parks, recreational areas, and Civic Center. Further details on landscaped area will be documented in the Final WQMP.

DRAINAGE AND RUNOFF ALTERATIONS

Prior to construction, approximately 10% of the site is impervious and the runoff coefficient is 0.23. After completion, the entire site will be approximately 55% impervious and the runoff coefficient will be 0.56.[1] These statistics are summarized in the figure below.

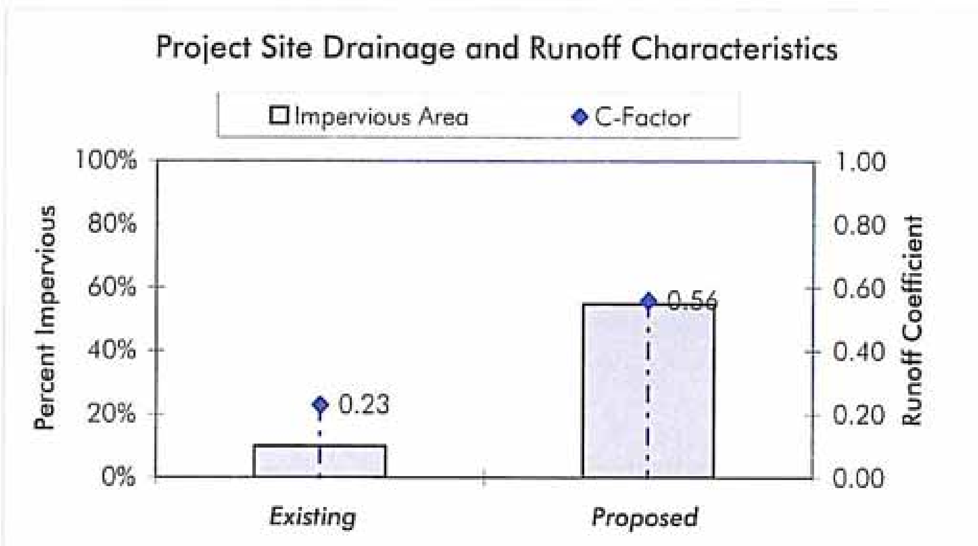

Chart 1. Changes in site drainage and the coefficient of runoff as a result of the proposed improvements.

[1] Runoff coefficients derived from Table A-1 of Attachment A of the Orange County Local WQMP (August 13, 2003).

ANTICIPATED AND POTENTIAL POLLUTANTS

As a result of the proposed project's alteration of existing conditions, the project site may create new pollutant sources, and in turn, change the makeup of pollutant constituents generated by Serrano Summit's operations. But because storm water runoff pollution is diffuse in nature, the composition, level, and cumulative effects of specific pollutants generated by the project cannot be appropriately quantified. Based on the proposed land uses for Serrano Summit, however, this P-WQMP can predict the anticipated and potential pollutants generally associated with the project's post-construction operations. With this information in hand, this will allow the project WQMP to appropriately assign BMPs to effectively mitigate storm water pollution prior to the runoff discharging off-site.

The table below, derived from the Countywide Model WQMP, summarizes the categories of land use or project features of concern and the general pollutant categories associated with them. The types of project features listed below that are proposed for Serrano Summit are: Detached Residential Development, Attached Residential Development, Commercial/Industrial Development, and Streets. As a result, anticipated pollutants include: Bacteria/Virus, Heavy Metals, Nutrients, Pesticides, Organic Compounds, Sediments, Trash & Debris, Oxygen Demanding Substances, and Oil & Grease. There are no additional potential pollutants of concern for this project.

	GENERAL POLLUTANT CATEGORIES								
Priority Project Categories and/or Project Features	BACTERIA/ VIRUS	HEAVY METALS	NUTRIENTS	PESTICIDES	ORGANIC COMPOUNDS	SEDIMENTS	TRASH & DEBRIS	OXYGEN DEMANDING SUBSTANCES	OIL & GREASE
Detached Residential Development	X		X	X		X	X	X	X
Attached Residential Development	P		X	X		X	X	P(1)	P(2)
Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	X	P(1)	X
Parking Lots	P (6)	X	P (1)	P (1)	X (4)	P (1)	X	P (1)	X
Streets, Highways & Freeways	P (6)	X	P (1)	P (1)	X (4)	X	X	P (1)	X

Notes:
X = Anticipated
P = Potential
(1) A potential pollutant if landscaping or open area exist on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.
(6) Analyses of pavement runoff routinely exhibit bacterial indicators.

Source: County of Orange Flood Control District, *2003 Drainage Area Master Plan*, Table 7-1.3, July 1, 2003.

OWNERSHIP OF SITE

The table provided below describes the ownership of all land space within the project site once the construction of the project has been completed.

SITE FEATURE	OWNER
Private Streets	Master HOA or Sub-HOA
Recreation Center	Master HOA
Landscape (Lot H)	City of Lake Forest
Private Landscaped Areas & Lots D-G, J-M	Master HOA or Sub-HOA
Public Parks	City of Lake Forest
Public Buildings (Civic Center Site)	City of Lake Forest
Public Streets	City of Lake Forest
Public Facilities (IRWD Facilities)	IRWD
Residential Areas	Master HOA or Sub-HOA
Water Quality/Detention Basin (Lot L)	Master HOA
Detention Basin (Lot H)	City of Lake Forest

A Master Home Owners Association (HOA) will be formed upon project completion. The HOA will be responsible for inspecting and maintaining all BMPs prescribed for Serrano Summit residential areas, private recreation center, streets, and landscaping. At such time as the HOA contact information becomes available it will be incorporated into this WQMP. Until a HOA is formally established and public improvements accepted by the City, the developer shall assume all BMP maintenance and inspection responsibilities for the proposed project. The City of Lake Forest shall be responsible for inspecting and maintaining any BMPs within the public streets. Maintenance contact information is provided under Section 5.1 of this P-WQMP.

2.3 SPECIFIC INDUSTRIAL / COMMERCIAL DETAILS

The Serrano Summit project will include commercial land uses with the inclusion of a Civic Center, Recreational Center, as well as multiple neighborhood and passive parks. These uses are summarized in the table below.

COMMERCIAL DEVELOPMENT SUMMARY			
LOT	USE	GROSS ACREAGE	FEATURES
13	Civic Center	11.9	City hall, community center, sheriff/ police facilities, outdoor plaza, government offices, surface and structured parking

COMMERCIAL DEVELOPMENT SUMMARY			
LOT	USE	GROSS ACREAGE	FEATURES
14	Recreation Center	1.9	Clubhouse, restrooms, showers, swimming pool, tot lot, open play areas, parking
15	Neighborhood Park	0.5	Seating areas, volleyball and/or basketball courts, shade structures, tot lots
16	Neighborhood Park	0.5	
17	Passive/Nature Park	3.8	Tables, benches, shade structure for group activities, trails, hitching posts, watering troughs
18	Public Facilities	19.9	IRWD Facilities
19	Public Facility	8.1	IRWD Facilities
n/a	Street Rights-of-Way	8.6	Public & private streets w/ associated landscaping and infrastructure.

No outdoor storage of materials is anticipated (materials will be stored indoors). Materials anticipated to be stored on-site include those associated with residential and park developments (i.e. cleaning products, maintenance, etc.); however, no hazardous wastes will be stored on-site. The project is not anticipated to generate any wastes that would be considered hazardous. All wastes shall be collected and properly disposed of off-site (see Section 4.2 for source control BMPs related to these features).

Operations associated with the existing IRWD plant operations and reservoirs in the south and southwest portions of the site are covered under separate NPDES permits, and therefore are not discussed in this P-WQMP.

New developments and significant redevelopments generally incorporate certain site features that may potentially impact storm water runoff quality if proper site design is not considered. These features include, but are not limited to, trash enclosures, loading docks, maintenance bays, vehicle or equipment wash areas, outdoor processing areas, fueling areas, food preparation areas, and community car wash areas. The following table provides a breakdown of specific features proposed for the project site.

SITE FEATURES SUMMARY		
SITE FEATURE	NUMBER	POLLUTANTS OF CONCERN
Trash Enclosures	TBD	Trash and debris, bacteria
Loading Docks	TBD	Organic compounds, trash and debris, oil and grease, heavy metals, wash water
Maintenance Bays	TBD	Trash and debris, oil and grease, heavy metals

SITE FEATURES SUMMARY		
SITE FEATURE	NUMBER	POLLUTANTS OF CONCERN
Fueling Areas	TBD	Oil and grease, heavy metals, organic compounds
Equipment / Vehicle Wash Areas	TBD	Trash, sediment, oil and grease, washing compounds (soap)
Food Preparation Areas	TBD	Oil and grease, bacteria/virus
Outdoor Processing Areas	TBD	Trash and debris, heavy metals, oil and grease
Community Car Wash Racks	TBD	Trash, sediment, oil and grease, washing compounds (soap)

An appropriate number of trash enclosures will be located within each of the planning areas of the project site. Specific number and locations of the trash enclosures will be documented in the Final WQMP. Trash enclosures will be covered and walled on 3 sides to preclude rainfall and runoff (gate comprising the fourth side).

The proposed Civic Center will not contain any vehicle/equipment wash or maintenance areas, other than day-to-day maintenance and upkeep of City and police/sheriff vehicles. Further details will be provided in the Final WQMP.

In the event site features are added to the proposed Project that are not identified in this P-WQMP, these features will be designed in accordance with the Orange County Drainage Area Management Plan (OC DAMP, 2003) requirements and City LIP and verified during the precise grade plan check review process.

2.4 SPECIFIC RESIDENTIAL DETAILS

The Serrano Summit project will include 524 single and multi–family residential units. The following table summarizes the proposed residential units for the project.

RESIDENTIAL DEVELOPMENT SUMMARY			
LOT	USE	GROSS ACREAGE	DENSITY
1	Townhomes	6.7	12.2 du/ac
2	Rear-Loaded Duplexes	1.0	16 du/ac
3	Rear-Loaded Duplexes	2.0	16 du/ac
4	Rear-Loaded Duplexes	1.4	15.7 du/ac
5	Townhomes	7.2	18.5 du/ac

RESIDENTIAL DEVELOPMENT SUMMARY			
LOT	USE	GROSS ACREAGE	DENSITY
6	Townhomes	6.6	11.8 du/ac
7	Rear-Loaded Single Family Detached	1.7	14.1 du/ac
8	Rear-Loaded Single Family Detached	1.5	11.3 du/ac
9	Rear-Loaded Single Family Detached	1.5	12.7 du/ac
10	Stacked Flat Condos	2.1	15.7 du/ac
11	Stacked Flat Condos	3.5	17.7 du/ac
12	Motor Court/Green Court	8.5	10.6 du/ac
13	SFA/Apartments*	11.9	18.9 du/ac

** The Public Facilities Overlay allows for the development of a Civic Center in Lot 13.

The following table provides a breakdown of specific features proposed for the project site.

SITE FEATURES SUMMARY		
SITE FEATURE	NUMBER	POLLUTANTS OF CONCERN
Trash Enclosures	TBD	Trash and debris, bacteria
Loading Docks	0	Organic compounds, trash and debris, oil and grease, heavy metals, wash water
Maintenance Bays	0	Trash and debris, oil and grease, heavy metals
Fueling Areas	0	Oil and grease, heavy metals, organic compounds
Vehicle Wash Areas	0	Trash, sediment, oil and grease, washing compounds (soap)
Food Preparation Areas	0	Oil and grease, bacteria/virus
Outdoor Processing Areas	0	Trash and debris, heavy metals, oil and grease
Community Car Wash Racks	0	Trash, sediment, oil and grease, washing compounds (soap)

As previously mentioned, an appropriate number of trash enclosures will be located within each of the planning areas of the project site. Specific number and locations of the trash enclosures will be documented in the Final WQMP. Trash enclosures will be covered and walled on 3 sides to preclude rainfall and runoff (gate comprising the fourth side).

For the locations of these site features identified above, please refer to the Site Plan Exhibit provided in Section 6.0 of this P-WQMP. In the event site features are added to the proposed Project that are not identified in this P-WQMP, these features will be designed in accordance with the Orange County Drainage Area Management Plan (OC DAMP, 2003) requirements and City LIP and verified during the precise grade plan check review process.

3.0 SITE DESCRIPTION

3.1 WATERSHED

The project site is located within the larger San Diego Creek watershed. The San Diego Creek Watershed covers 112.2 square miles in central Orange County. It includes portions of the cities of Costa Mesa, Irvine, Laguna Woods, Lake Forest, Newport Beach, Orange, Santa Ana, and Tustin. Its main tributary, San Diego Creek, drains into Upper Newport Bay. Smaller tributaries include Serrano Creek, Borrego Canyon Wash, Agua Chinon Wash, Bee Canyon Wash, Peters Canyon Wash, Sand Canyon Wash, Bonita Canyon Creek, and the Santa Ana Delhi Channel. Watershed uses are generally comprised of agricultural, vacant, developed and recreational land uses. The entire western portion of the watershed is developed, with development spreading to the east and south.

More specifically, the project drains into Serrano Creek downstream of the 241 Toll Road and upstream of Trabuco Road. The Creek is located along the south edge of the project.

303(d) LISTED WATER QUALITY LIMITED SEGMENTS

The project site ultimately drains into Serrano Creek within the larger San Diego Creek watershed. According to the California 2006 303(d) list published by the San Diego Regional Water Quality Control Board, Serrano Creek is not listed as impaired. However, Reach 2 of the San Diego Creek is listed as impaired for metals, and Reach 1 is impaired for fecal coliform, selenium, and toxaphene.

TMDLs

Once a water body has been listed as impaired, a Total Maximum Daily Load (TMDL) for the constituent of concern (pollutant) must be developed for that water body. A TMDL is an estimate of the daily load of pollutants that a water body may receive from point sources, non-point sources, and natural background conditions (including an appropriate margin of safety), without exceeding its water quality standard. Those facilities and activities that are discharging into the water body, collectively, must not exceed the TMDL.

Total Maximum Daily Loads (TMDLs) have not been set for the San Diego Creek watercourse. TMDLs, however, have been developed jointly for the San Diego Creek Watershed and the Newport Bay, of which the watercourse and the project's five other tributaries are a part. These pollutants include toxics, nutrients, and sediments.

The Santa Ana Regional Water Quality Control Board (RWQCB) established the nutrient TMDL in 1998 and the sediment TMDL in 1999. The nutrient TMDL establishes targets for reducing the annual loading of nitrogen and phosphorus to Newport Bay by 50% and meeting the numeric and narrative water quality objectives by 2012. The sediment TMDL has similar objectives, to reduce the annual average sediment load in the San Diego Creek watershed from a total of 250,000 tons per year to 125,000 tons per year, calculated over a ten year period (a 50% reduction).

Moreover, EPA Region 9 established the TMDL for toxics in 2002. It covers 14 different constituents – chlorpyrifos and diazinon (organophosphate pesticides); chlordane, dieldrin, DDT, PCBs, and toxaphene (organochlorinated compounds); cadmium, copper, lead and zinc (metals); selenium; chromium and mercury (metals, specific to Rhine Channel only). Currently, only 2 constituents have been considered for approval by the Santa Ana RWQCB: the organophosphate pesticides.

HYDROLOGIC CONCERNS

The purpose of this section is to identify any hydrologic conditions of concern with respect to downstream flooding, erosion potential of natural channels downstream, impacts of increased flows on natural habitat, etc. Hydrologic conditions of concern are typically directed to those developments that discharge directly into receiving water bodies (natural drainage courses or partially improved channels).

The recently updated MS4 Storm Water Permit requires that the 2-year storm event be analyzed for pre- and post-condition to determine hydrologic conditions of concern (Section XII.D) Based on the requirements of the Permit, the project would not have a hydrologic condition of concern if the volume and the time of concentration of storm water runoff for the post-development condition does not significantly exceed those of the pre-development condition for a 2-year frequency storm event (a difference of 5% or less is considered insignificant).[2] The following tables provide a summary of the 2-year calculations for the existing vs post-development condition.

HYDROLOGY SUMMARY FOR OUTLET A			
Parameter	2-YEAR, 24 HOUR		
	Pre-Development	Post-Development	% Change
Q (cfs)	38.4	21.8	-43%
Volume (acre-feet)	4.02	1.63	-59%
Time of Concentration (Tc)	20.96	6.63	-68%

HYDROLOGY SUMMARY FOR OUTLET B			
Parameter	2-YEAR, 24 HOUR		
	Pre-Development	Post-Development	% Change
Q (cfs)	17.6	76.5	+434%
Volume (acre-feet)	1.0	6.7	+670%
Time of Concentration (Tc)	8.95	8.36	-6.5%

[2] Section XII.D.2.a of Order No. R8-2009-0030.

HYDROLOGY SUMMARY FOR OVERALL PROJECT			
Parameter	2-YEAR, 24 HOUR		
	Pre-Development	Post-Development	% Change
Q (cfs)	56.0	98.3	+76%
Volume (acre-feet)	5.0	8.3	+66%
Time of Concentration	N/A	N/A	N/A

Based on the analysis provided in the tables above, the results demonstrate the post-development 2-year storm event volume well exceeds the pre-development volume and does not fall within the 5% threshold. The net change in volume is approximately 3.3 ac-ft. In order to comply with hydromodification requirements, the proposed project will implement a combined system of features to either infiltrate and/or mitigate the flows to the creek in a highly controlled manner up to this design volume. Flow rates from larger storm events will also be mitigated through the use of on-site detention basins.

In order to control runoff to meet the pre-development 2-year volume conditions, the proposed project will utilize underground storage and infiltration reservoirs within the project site to reduce runoff volumes. These infiltration systems may also be designed with a drywell system to improve infiltration and decrease draw down times. During the detailed site plan design, the use of porous landscaping retention and porous pavement may also be utilized to account for a portion of the 2-year volume difference between pre- and post-project conditions. The specific amount of infiltration with each feature or facility will be determined upon site specific infiltration testing and the forthcoming infiltration criteria currently being updated in the County-wide Model WQMP (expected Fall 2010). In the event site specific soil conditions and the criteria do not allow for full infiltration of the 2-year volume difference, the remainder will be discharged to the creek under the critical rate for adverse impact as defined by forthcoming hydromodification criteria in the Model WQMP. In addition, the use of the multi-functional water quality and detention basins at the downstream end of the project will also be used to manage and control flow rates from the 100-year storm event through the use of outlet structures. Further details including basin design will be included in the Final WQMP.

3.2 SITE LOCATION

PLANNING AREA/ COMMUNITY NAME	Serrano Summit
GENERAL LOCATION	South of Commercentre Drive, west of Serrano Creek and Indian Ocean Drive, and east of Biscayne Bay Drive in the City of Lake Forest.
ADDRESS	N/A
PROJECT SIZE	~99 acres

SOIL CHARACTERISTICS

A preliminary geotechnical investigation was conducted by Leighton and Associates, Inc. in May 2008 for the project site.[3] Based on the borings performed on-site, soils within the project site generally consist of documented and undocumented artificial fill, quaternary-aged alluvium, colluvium, and sandstone from the Oso member of the Capistrano Formation. Within the northern portion of the site, artificial fill consisted of medium dense to dense, brown to grayish brown, dry to slightly moist, fine to coarse grained sand to clayey, silty sand to depths ranging from approximately 1 to 75.2 feet. Within the areas of the water treatment facility tanks, fill was not documented, however is expected to consist of onsite derived sand and silty sands with a trace of clay and concretions. Within the southern portion of the site, undocumented fill was encountered, consisting of loose, dark brown to grey, dry to moist, fine to coarse grained sand to silty clayey sand, with fine to coarse gravel, cobbles and small boulder sized concretionary sandstone and concrete debris. The alluvium encountered generally consists of loose zones of moist, fine to coarse grained sand with gravel sized sandstone connections.

Groundwater was not encountered at any borings or test pits to the maximum depth of 80.4. Historically high groundwater table is estimated to be at a depth of approximately 10 to 20 feet below ground surface within the canyon bottoms.

EXISTING DRAINAGE CONDITIONS

Under existing conditions, the majority of the site slopes generally toward the east and southeast, towards Serrano Creek along the southeastern project boundary. The site previously was graded with a variety of basins, ridges and terraced slopes. Significant to the site is a deep ravine on the northeasterly portion of the property. A large portion of the development site drains to this heavily wooded and brushed tributary to Serrano Creek. A small drainage area in the northern portion of the site, the current drive approach to the site from Biscayne Bay Drive, sheet flows toward Biscayne Bay Drive where flow is picked up via an existing street catch basin. Two areas on the west side of the development site sheet flow westerly into undeveloped land. There is a proposed tract over a portion of the undeveloped land.

There is no run-on to the site from outside areas. The majority of the site currently flows to the east and empties into Serrano Creek via three existing pipe discharge points. Three small areas also sheet flow directly to Serrano Creek. Those areas are not a part of the development area and their drainage patterns will not be changed. In addition, a portion of the west side of the current IRWD buildings flows to existing developed areas and their existing terrace drains. There areas are not part of the development area and their flow pattern will not change.

Per the Los Alisos Water District plans previously cited and per visual inspection of the site, there are a number of basins and attendant pipes that currently serve the site. Those basins, risers, outlets and pipes are in various states of repair. Many of the basins are overgrown with brush and several of the outlet pipes were found to be partially buried by silt build-up. There are three outlets to Serrano Creek from the site in addition to the small areas that sheet flow to the creek. The majority of these facilities will be demolished; however several will be utilized in the development plan.

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[3] Leighton and Associates, Inc. (2008, May 7). DRAFT Preliminary Geotechnical Exploration Report for the Proposed Residential Development, Civic Center, and Park at Former IRWD Site, City of Lake Forest, California.

PROPOSED DRAINAGE CONDITIONS

Under proposed conditions, new storm drain facilities will be constructed to drain runoff from the new development areas and connect to the existing facilities located in the southern portion of the site. The proposed system will include approximately 2 areas for underground storage and infiltration within the park areas to reduce runoff and provide treatment of the water quality design capture volume. Additional areas may be added pending geotechnical investigations and identification of favorable infiltration areas. One dual purpose water quality-detention basin will be located in the southern portion of the site between the existing storage reservoirs to reduce peak flow runoff from the site as well as provide water quality benefits. This basin will also include dry wells to maximize infiltration of the 2-year volume increase while providing additional water quality benefits. A second detention basin will be located immediately south of the proposed civic Center site. An underground storage system for infiltration and potential reuse is also being considered within the Civic Center site to provide runoff reduction for the 2-year storm flow and water quality design capture volume. Further details on the proposed detention basins and their hydrologic function will be documented in the Final WQMP.

The existing storm drain system draining the existing emergency storage reservoirs and other existing areas not included in the development areas will stay 'as is' and continue to drain as in the existing hydrology to the ravine. An existing storm drain pipe drains the ravine into Serrano Creek.

LAND USE AND ZONING

Under existing conditions, the project site is zoned for general agriculture (A1). Under proposed conditions, the project site will be zoned for medium-density residential and open space uses.

3.3 EXISTING WATER QUALITY ISSUES

As discussed in Section 2.2, the project will result in an increase in impervious surfaces as compared to existing conditions, from 10% to approximately 45% impervious. Although the project site is located near the upper reaches of Serrano Creek, the Creek is not designated as an Environmentally Sensitive Area (ESA) according to the OC DAMP. However, since San Diego Creek is listed as impaired on the 303(d) list of impaired water bodies, it is designated as an Environmentally Sensitive Area (ESA) according to the OC DAMP. There are no designated Areas of Special Biological Significance (ASBS) within the vicinity of the project site.

If any additional water quality issues or problems are discovered at any stage of the project's improvements, this condition will be evaluated and mitigated. In conformance with the Countywide Water Quality Management Plan (WQMP) and National Pollutant Discharge Elimination System (NPDES) Drainage Area Management Plan (DAMP), the Serrano Summit Project will require the incorporation and implementation of site design, source control, and treatment control Best Management Practices (BMPs) to adequately address all anticipated and potential pollutants, if any, within the site, including any water quality issues mentioned above. The proposed BMPs for the Project are discussed further in Section 4 of this WQMP.

4.0 BEST MANAGEMENT PRACTICES

The WQMP shall identify Best Management Practices (BMPs) that will be used on-site to control predictable pollutant runoff, and shall identify, at a minimum, the measures specified in the Countywide Water Quality Management Plan (WQMP) and NPDES Drainage Area Management Plan (DAMP), the assignment of long-term maintenance responsibilities (specifying the developer, parcel owner, maintenance association, lessee, etc.) and the locations of all structural BMPs.

Projects designated as Priority Projects are required to incorporate and implement site design, source control, and treatment control BMPs, unless not applicable due to the project characteristics. Site design BMPs help minimize the introduction or generation of potential pollutants from a facility's operations. Source control BMPs are operational practices that reduce potential pollutants at the source, and include both structural and routine non-structural practices. Treatment control BMPs remove pollutants of concern from storm water runoff and must be located and designed appropriately so as to infiltrate, filter, and/or treat the required runoff volume or flow prior to discharging into receiving waters. Selection of treatment control BMPs is based on the pollutants of concern of the project site (identified under Section 2.2) and the BMP's ability to effectively mitigate those pollutants, in consideration of site conditions and constraints. Further details on the Project's selected treatment control BMPs are provided in Section 4.3.

The approach to water quality treatment for the Project includes incorporation of site design/low impact development (LID) strategies and source control measures throughout the site in a systematic manner that maximizes the use of LID features to provide treatment of storm water and reduce runoff. In accordance with the 4th Term MS4 Storm Water Permit (Order R8-2009-0030), the use of LID features will be consistent with the prescribed hierarchy of treatment provided in the Permit, including infiltration, evapotranspiration, harvest/re-use and bio-treatment. Infiltration within the development area will be promoted within the proposed park areas as well within and adjacent to the large water quality / detention basin. Proposed features include underground infiltration units and drywells. Exact volumes infiltrated by these BMPs will be based on the infiltration feasibility criteria currently in development by the County of Orange and Co-Permittees associated with the Model WQMP updates with the 4th Term MS4 Permit re-issuance.

Where feasible, LID features will be designed to infiltrate and/or reuse treated runoff on-site in accordance with feasibility criteria as defined in the new Model WQMP (expected July 1, 2010). Infiltration on-site will be limited based on a number of factors that will influence the amount of allowable infiltration of the design capture volume (SQDV) including measured percolation rate of soil, location of building foundations, and other geotech concerns (e.g., expansive soils, presence of clay layers, etc.). If the site specific infiltration rates do not provide sufficient ability infiltrate the design capture volume and 2-year volume control requirements (approximately 3.3 acre-ft), these flows will be discharged to Serrano Creek below critical thresholds to avoid downstream harm to habitats or channel stability. Critical thresholds will be identified through the use of regional hydromodification studies being developed by the County of Orange to determine maximum low flow discharges to local creeks to avoid impacts (i.e. controlled discharge of no more than 110% of the 2-year existing flow rate) or site specific studies on Serrano Creek which will define recommended low flow discharge rates.

All LID features identified in this report are preliminary in nature but have been sized to show their relative footprint requirements for technical planning purposes (siting, treatment volumes, typical profiles, etc.). Detailed drainage calculations, grading, and confirmation of sizing to occur during the detailed design phase and subsequent WQMP documentation.

4.1 SITE DESIGN BMPs

The following table describes the site design BMPs used in this project and the methods used to incorporate them. Careful consideration of site design is a critical first step in storm water pollution prevention from new developments and redevelopments. Details on site design BMPs implemented at the project will be supported by construction level documents in the final WQMP and prior to grading permit(s) issuance by the City.

DESIGN CONSIDERED:	YES	NO	DESCRIPTION
MINIMIZE IMPERVIOUS AREA / MAXIMIZE PERMEABILITY (C-FACTOR REDUCTION)	☒	☐	Impervious surfaces have been minimized by incorporating landscaped areas over substantial portions of the site including common areas, parkways, medians, in addition to larger parks and open space areas. The streets and sidewalks will be designed with minimum width requirements to minimize impervious surfaces where feasible.
MINIMIZE DIRECTLY CONNECTED IMPERVIOUS AREAS (DCIAs) (C-FACTOR REDUCTION)	☒	☐	All dry weather flows and low flows from the residential areas and streets will be routed through water quality basins to minimize the direct connection of runoff from impervious areas to downstream off-site areas.
CREATE REDUCED OR "ZERO DISCHARGE" AREAS (RUNOFF VOLUME REDUCTION)	☒	☐	Underground storage areas for infiltration and dry wells are proposed to provide runoff reduction benefits. In addition, water quality basins that combine extended detention, wetland vegetation and bottom stage filter drain will be utilized to promote reduced runoff volumes and attenuated flow rates. Lastly, where acceptable, porous pavement and porous landscape retention/detention will also utilized in the detailed site design to provide additional runoff reduction measures.
CONSERVE NATURAL AREAS (C-FACTOR REDUCTION)	☒	☐	Native trees and shrubs will be preserved in natural open space areas and native or drought tolerant plants will be used in development plant palettes.

4.2 SOURCE CONTROL BMPs

The table below indicates all BMPs to be incorporated in the project. For those designated as not applicable (N/A), a brief explanation why is provided.

INCORPORATED ROUTINE NON-STRUCTURAL BMP:		YES	N/A	DESCRIPTION
N1	HOMEOWNER/ TENANT EDUCATION	☒	☐	The HOA will ensure that all homeowners will be given a copy of the recorded CC&Rs which will contain details on educational materials and restrictions to reduce pollutants from reaching the storm drain system. The developer shall establish requirements that these educational materials are distributed by the HOA to all members of the HOA, and periodically thereafter by the HOA after the first sale of the units. Examples of the environmental awareness materials are provided in Section 7.
N2	ACTIVITY RESTRICTIONS	☒	☐	Within the Master CC&Rs created by the developer, language shall be included to restrict activities that have the potential to create adverse impacts on water quality. Activities include but are not limited to: the handling and disposal of contaminants, trash management and litter control, irrigation and landscaping practices, fertilizer applications and household waste management practices.
N3	COMMON AREA LANDSCAPE MANAGEMENT	☒	☐	Management programs will be designed and implemented by the HOA to maintain all the common areas within the project site. These programs will cover how to reduce the potential pollutant sources of fertilizer and pesticide uses, utilization of water-efficient landscaping practices and proper disposal of landscape wastes by the HOA and/or contractors.

INCORPORATED ROUTINE NON-STRUCTURAL BMP:		YES	N/A	DESCRIPTION
N4	BMP MAINTENANCE	☒	☐	The HOA will be responsible for the implementation and maintenance of each applicable non-structural BMP, as well as scheduling inspections and maintenance of all applicable structural BMP facilities through its staff, landscape contractor, and/or any other necessary maintenance contractors. The City shall be responsible for maintenance of BMPs within the public areas of the project. See Section 5.0 for further details.
N5	TITLE 22 CCR COMPLIANCE	☐	☒	Not applicable. The project site will not require Title 22 CCR compliance since the operation of the project site will not generate of hazardous wastes as part of its routine operation. As previously mentioned, operations associated with the existing IRWD facilities are covered under separate NPDES permits and are not documented in this WQMP.
N6	LOCAL WATER QUALITY PERMIT COMPLIANCE	☐	☒	The City of Lake Forest does not issue water quality permits.
N7	SPILL CONTINGENCY PLAN	☐	☒	Not applicable. The project site will not handle or dispose of hazardous materials as part of its routine operations. See previous notes regarding IRWD operations.
N8	UNDERGROUND STORAGE TANK COMPLIANCE	☐	☒	Not applicable. The project site will not handle or dispose of hazardous materials as part of its routine operations. See previous notes regarding IRWD operations.
N9	HAZ-MAT DISCLOSURE COMPLIANCE	☐	☒	Not applicable. The project site will not handle or dispose of hazardous materials as part of its routine operations. See previous notes regarding IRWD operations.
N10	UNIFORM FIRE CODE IMPLEMENTATION	☐	☒	Not applicable. The project site will not handle or dispose of hazardous materials as part of its routine operations. See previous notes regarding IRWD operations.

INCORPORATED ROUTINE NON-STRUCTURAL BMP:		YES	N/A	DESCRIPTION
N11	COMMON AREA LITTER CONTROL	☒	☐	The HOA will be responsible for performing trash pick up and sweeping of littered common areas on a weekly basis or whenever necessary. Responsibilities will also include noting improper disposal materials by the public and reporting such violations for investigation. The City shall be responsible for common area litter control within the public areas of the project.
N12	EMPLOYEE TRAINING	☒	☐	All employees of the HOA and any contractors will require training to ensure that employees are aware of maintenance activities that may result in pollutants reaching the storm drain. Training will include, but not be limited to, spill cleanup procedures, proper waste disposal, housekeeping practices, etc.
N13	HOUSEKEEPING OF LOADING DOCKS	☐	☒	There are no loading docks proposed for the site.
N14	CATCH BASIN INSPECTION	☒	☐	All catch basin inlets shall be inspected and maintained by the HOA at least once a year, prior to the rainy season, no later than October 1P^st^P of each year. The City shall be responsible for inspecting and maintaining all public catch basins and drainage facilities.
N15	STREET SWEEPING PRIVATE STREETS AND PARKING LOTS	☒	☐	The HOA shall be responsible for the street sweeping of all private drive aisles and parking areas within the project quarterly, and prior to the rainy season, no later than October 1st of each year. The City shall be responsible for sweeping all public streets and parking lots.
N17[4]	RETAIL GASOLINE OUTLETS	☐	☒	No retail gasoline outlets are proposed.

[4] There is no BMP with the designation N16.

INCORPORATED ROUTINE STRUCTURAL BMP:	YES	N/A	DESCRIPTION
STORM DRAIN STENCILING AND SIGNAGE	☒	☐	The developer will be responsible for the stenciling of all catch basins to include a legible message such as "Drains to Ocean" or "Drains to Santa Ana River." The HOA will be responsible for maintaining and replacement of signage when necessary.
PROPER OUTDOOR HAZARDOUS MATERIAL STORAGE DESIGN	☐	☒	No outdoor hazardous material storage areas are proposed.
PROPER TRASH STORAGE DESIGN	☒	☐	All trash and waste shall be stored in containers that have lids or tarps to minimize direct precipitation into the containers. The storage areas will be paved, covered, and either be sloped or include a barrier to keep drainage out of the storm drain. Locations will be provided in the Final WQMP.
EFFICIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGN	☒	☐	The developer will be responsible for the installation and maintenance of all common landscape areas utilizing similar planting materials with similar water requirements to reduce excess irrigation runoff. The developer will be responsible for implementing all efficient irrigation systems for common area landscaping including but not limited to provisions for water sensors and programmable irrigation cycles. The irrigation systems shall be in conformance with water use efficiency guidelines.
PROTECT SLOPES AND CHANNELS	☒	☐	The developer will be responsible for the vegetative establishment on all manufactured or disturbed slopes with a mixture of native species and approved ornamentals by the City of Lake Forest.
SPECIFIC LAND USE/ PROJECT TYPE BMPs			
LOADING DOCK AREAS	☐	☒	No loading dock areas are proposed.
MAINTENANCE BAYS	☐	☒	No maintenance bays are proposed.
EQUIPMENT WASH AREAS	☐	☒	No equipment wash areas are proposed.
VEHICLE WASH AREAS	☐	☒	No vehicle wash areas are proposed.

INCORPORATED ROUTINE STRUCTURAL BMP:	YES	N/A	DESCRIPTION
OUTDOOR PROCESSING AREAS	☐	☒	No outdoor processing areas are proposed.
FUELING AREAS	☐	☒	No fueling areas are proposed.
HILLSIDE LANDSCAPING	☒	☐	The developer will be responsible for the vegetative establishment on all manufactured or disturbed slopes with a mixture of native species and approved ornamentals by the City of Lake Forest.
WASH WATER CONTROLS FOR FOOD PREPARATIONS AREAS	☐	☒	No food preparation areas are proposed.
COMMUNITY CAR WASH RACKS	☐	☒	No community car wash racks are proposed.

The routine structural and non-structural BMPs have been selected in the above tables to address the anticipated and potential pollutants generated by the project site's land uses. The implementation of these BMPs is designed to reduce the pollutants associated with the land uses discussed in Section 2.3 and shown in the table below. With the implementation of these routine source control BMPs, the Project area will effectively minimize its potential to generate pollutants that may potentially cause water quality impacts to the downstream receiving water body.

SOURCE CONTROL BMP	TARGET POLLUTANTS
ACTIVITY RESTRICTIONS AND TENANT EDUCATION	Heavy metals, oil & grease, bacteria, nutrients
COMMON AREA LANDSCAPE MANAGEMENT	Nutrients, pesticides, sediments, oxygen demanding substances
SPILL CONTINGENCY PLAN	Metals, oil and grease, organics
COMMON AREA LITTER CONTROL AND TRASH STORAGE AREAS	Trash and debris, organics
EMPLOYEE TRAINING	Heavy metals, trash and debris, oil and grease, oxygen demanding substances.
CATCH BASIN INSPECTION	Sediment, particulates, heavy metals, trash and debris
STREET SWEEPING	All pollutants, particularly trash and debris
STORM DRAIN SIGNAGE	All pollutants, particularly trash and debris
EFFICIENT IRRIGATION AND LANDSCAPE DESIGN	Nutrients, pesticides, sediments, oxygen demanding substances
SLOPE PROTECTION AND HILLSIDE LANDSCAPING	Sediment and debris, nutrients and pesticides (used in conjunction with landscape design)

4.3 TREATMENT CONTROL BMPs

The following table describes the treatment control BMPs that will be incorporated into this project. The treatment BMPs in this table are included in the project design to mitigate any pollutants of concern that were identified in the water quality planning process. The table also describes why a BMP was not chosen for the project. If necessary, details describing the design of the BMPs will be provided below.

INCORPORATED TREATMENT CONTROL BMP:	YES	NO	IF NO, DESCRIBE WHY
VEGETATED (GRASS) STRIPS	☐	☒	Other treatment BMP chosen.
VEGETATED (GRASS) SWALES	☒	☐	Bioswales are proposed to provide pre-treatment of runoff from the disturbed areas of the Passive Park. Treatment will be provided in conjunction with rain gardens, discussed below. Areas left undisturbed will retain native vegetation and therefore will not require treatment.
PROPRIETARY CONTROL MEASURES	☒	☐	Hydrodynamic separators (e.g., CDS Units or equivalent) will be placed within the on-site storm drain system to provide pre-treatment of flows prior to discharging into the downstream water quality / detention basin for further treatment.
WATER QUALITY / DETENTION BASINS	☒	☐	One dual purpose water quality / detention basin will be located in the southern portion of the site between the existing IRWD reservoirs to provide treatment and detention of storm water runoff from the residential development areas. A second basin will also be located south of the proposed Civic Center Site. Both basins will include a bottom stage filter drain with sub-drain system to improve the treatment removal efficiencies. In addition, underground detention and infiltration reservoirs will be located below the proposed neighborhood parks as well as within the Civic Center for additional storage and infiltration of runoff.
CONSTRUCTED WETLAND	☐	☒	Other treatment BMP chosen.

INCORPORATED TREATMENT CONTROL BMP:	YES	NO	IF NO, DESCRIBE WHY
SAND FILTER	☐	☒	Other treatment BMP chosen.
BIORETENTION/RAIN GARDENS	☒	☐	Rain gardens are proposed to provide treatment of runoff from the disturbed areas of the Passive Park. Treatment will be provided in conjunction with bioswales discussed above. Areas left undisturbed will retain native vegetation and therefore will not require treatment.
POROUS PAVEMENT DETENTION	☒	☐	To be determined under final site design
POROUS LANDSCAPE DETENTION	☒	☐	To be determined under final site design.
INFILTRATION BASIN	☒	☐	Underground storage reservoirs with infiltration capacity will be utilized in the park areas to manage runoff from the development areas.
INFILTRATION TRENCH	☐	☒	Other treatment BMP chosen.
MEDIA FILTER	☐	☒	Other treatment BMP chosen.
DRYWELLS	☒	☐	Drywells are proposed located within and adjacent to the residential water quality / detention basin to allow infiltration of first-flush runoff from the development.

The table below lists the general pollutant removal efficiencies for Treatment Control BMP Categories (from the Orange County Model WQMP).

TREATMENT CONTROL BMP SELECTION MATRIX								
	SEDIMENT/ TURBIDITY	NUTRIENTS	ORGANIC COMPOUNDS	TRASH & DEBRIS	OXYGEN DEMANDING SUBSTANCES	BACTERIA & VIRUSES	OIL AND GREASE	PESTICIDES
Biofilters / Vegetated Swales	H/M	L	U	L	L	U	H/M	U
Detention Basins[1]	M	M	U	M	M	U	M	U
Infiltration Basins[2]	H/M	H/M	U	U	H/M	H/M	U	U
Wet Ponds / Wetlands[3]	H/M	H/M	U	U	H/M	U	U	U

TREATMENT CONTROL BMP SELECTION MATRIX	SEDIMENT/ TURBIDITY	NUTRIENTS	ORGANIC COMPOUNDS	TRASH & DEBRIS	OXYGEN DEMANDING SUBSTANCES	BACTERIA & VIRUSES	OIL AND GREASE	PESTICIDES
Sand Filter/ Filtration[4]	H/M	L/M	H/M	H/M	H/M	H/M	H/M	U
Water Quality Inlets	L	L	L	M	L	L	M	L
Hydrodynamic Separators[5]	H/M*	L	L	H/M	L	L	L/M	L

L: Low removal efficiency
M: Medium removal efficiency
H: High removal efficiency
U: Unknown removal efficiency
* L for turbidity

1 Includes extended/dry detention basins with 36-48-hour drawdown time
2 Includes infiltration basins, infiltration trenches, and porous pavements
3 Includes permanent pool wet ponds and constructed wetlands
4 Includes media filters
5 Also known as hydrodynamic devices, baffle boxes, swirl concentrators

Source: Excerpted, with minor revision, from the Orange County Model Water Quality Management Plan, 2003.

HYDRODYNAMIC SEPARATION PRE-TREATMENT

Two hydrodynamic separation devices (CDS unit or equivalent) will be located within the proposed storm drain system to pre-treat runoff prior to discharging into the underground storage & infiltration features and water quality detention basin, thereby reducing the amount of trash, debris, and sediment discharging into the basin. A CDS unit is a pre-cast vortex separation system that removes debris, trash, oil/grease, sediment and parking lot particulates from storm water. As water enters the underground storm drain system, it filters through the CDS unit and flows through a vortex sieve which traps sediment and debris while oil/grease floats to the top where an US EPA approved absorbent removes the oil and grease from the storm water. CDS units are effective at removing 80% TSS and 100% of floatables and neutrally buoyant materials, plus oil and grease.

WATER QUALITY / DETENTION BASIN

A multi-functional water quality and detention basin is proposed at the downstream end of the project located adjacent to the existing IRWD reservoirs. A second detention basin will be located along the eastern project boundary, south of the proposed Civic Center site. Detention basins are areas where excess storm water is stored or held temporarily and then slowly drains via infiltration, evaporation, and via a controlled outlet. As site runoff collects in the basin, contaminants such as nutrients, trash, and metals are settled or filtered out via infiltration, creating added benefit. The basin will have a water quality storage depth of 3 feet, and will be vegetated with drought tolerant species such as alkali heath, saltgrass, alkali mallow, and saltbush shrubs. Temporary irrigation would likely be utilized to establish the vegetation due to long periods without rainfall. A portion of the basin floor near the outlet structure will also incorporate a bottom stage filter drain to provide additional treatment of the design capture volume prior to discharge into Serrano Creek. A typical filter drain is located at the low end of the water quality basin and includes an approximately 20" sand layer over an 8" gravel layer. Treated water is collected into a sub-drain system before ultimately discharging into the creek. The use of the filter drain provides additional high level treatment and additional flow attenuation. Further details on the basin design will be provided in the Final WQMP.

UNDERGROUND STORAGE & INFILTRATION

Runoff from portions of the residential areas of the project site will be directed to underground storage systems (e.g., StormTech, Contech ChamberMaxx or equivalent) located below the proposed neighborhood parks (Lots 15 & 16). These systems consist of bottomless HDPE storm water chambers that collect water and slowly release a portion into the storm drain system and allow the remaining portion to infiltrate into the subsoils. In addition, underground storage and infiltration will be provided at the Civic Center site for treatment of flows. Infiltration within the Civic Center site drainage area will likely be limited to protect the large manufactured slope at the southern end but storage and reuse options are also available for this area. This method in conjunction with the CDS units for pre-treatment should adequately treat anticipated pollutants such as sediments, nutrients, organic compounds, trash and debris, hydrocarbons (i.e., oil and grease), and metals.

DRYWELL INFILTRATION

Drywells are underground storage facilities that receive runoff and allows it to infiltrate to soil via gravity. Drywells typically consist of a structural chamber or vertical perforated pipe. Specifically, the MaxWell Plus system incorporates pretreatment of runoff through a separate settling chamber that traps trash, floating debris, oil and grease, and large sediment. A debris shield and screens prevent trapped pollutants from re-suspension and from entering the lower well. Pre-treated flows are then diverted to a secondary settling chamber and treated runoff is diverted to the drywell and surrounding soil. One standard MaxWell Plus system can treat up to 2 acres of contributing impervious area drainage and 5 acres of pervious area tributary, with pre-treatment flow rate of 0.25 cfs. With the incorporation of pretreatment and infiltration, drywells have high removal effectiveness for all storm water pollutants of concern.

An estimated 3-5 drywells (Maxwell Plus or equivalent) are proposed for the project site located within and adjacent to the residential water quality / detention basin, providing treatment of runoff from the development not previously infiltrated by the underground infiltration units. Higher flows will bypass the drywell units and discharge into the water quality / detention basin for additional treatment and detention. Drywell units may also be designed into the storage and infiltration sub-surface features to assist with the infiltration of project runoff.

Final number, locations, and design of the systems will be documented in the final WQMP based on results of percolation testing and infiltration feasibility screening criteria.

BIOSWALES & RAIN GARDENS

A combination of vegetated bioswales and rain gardens are proposed to provide treatment of the disturbed areas within the Passive Park (PA17). Areas that are left undisturbed will remain as under existing conditions, including native vegetation areas, and therefore will not require treatment. Specific locations and sizing of the bioswales and rain gardens is pending, and will be provided in the Final WQMP.

Bioswales are treatment BMPs that provide filtration through a grassed or vegetated bottom and the vegetation provides a mechanism for retarding surface runoff and filtering flows to drop sediments, fines, debris, and organics. Swales also provide treatment of runoff within the upper soil zone where biological and chemical reactions occur to absorb pollutants entering from the top soil. Due to the slow velocity of runoff through the swale, fine particulates can settle in the bottom of the channel and the runoff will infiltrate into the soil profile where the vegetation will uptake nutrients (e.g. nitrogen and phosphorous), microbial contaminants, oil and grease, and pesticides. Bioswales upstream of rain gardens provide a effective filtering mechanism for flows prior to infiltrating through the rain garden soil profile.

Rain gardens are small, vegetated depressions that promote filtration and infiltration of storm water runoff. They combine shrubs, grasses, and flowering perennials in depressions (approximately 6 to 8 inches deep) that allow water to pool, infiltrate or evaporate and/or slowly drain out within 48 to 72 hours. Additional design details include a soil planting depth between 18 inches to 4 feet deep (depending on plants selected), with a 2-3 inch mulch layer on top to protect from erosion. Perforated underdrains may be provided for soils with low infiltration rates and in areas with high groundwater levels to discharge treated water back into the storm drain system.

FLOW-BASED TREATMENT BMP SIZING

In accordance to the Countywide Model WQMP, the flow-based treatment BMPs will be sized to treat the maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour for each hour of a storm event, as determined from the local historical rainfall record. This is termed the Stormwater Quality Design Flow. The Stormwater Quality Design Flow (SQDF), is thus determined by the following equation:

$$SQDF = C * I * A_{TOTAL}$$

Where:

	C	=	coefficient of runoff (see Appendix 1)
	I	=	rainfall intensity per OC DAMP (see Appendix 1)
	A_{TOTAL}	=	total area to be treated

Calculations are summarized in the tables below.

SQDF[1] SUMMARY – CDS UNITS					
BMP Location	Runoff Coefficient	Intensity (in/hr)	Drainage Area (acres)	Unit Conversion[2]	SQDF (cfs)
CDS Unit #1	0.68	0.2	14.6	1.008	1.99
CDS Unit #2	0.68	0.2	13.4	1.008	1.83

(1) Calculations are based on Per Orange County Drainage Area Management Plan (DAMP), Table A-1, Exhibit 7.11 - Attachment A.
(2) Converts inches per hour to feet per second

SQDF[1] SUMMARY – PASSIVE PARK BIOSWALES					
BMP Location	Runoff Coefficient	Intensity (in/hr)	Drainage Area (acres)	Unit Conversion[2]	SQDF (cfs)
Passive Park	0.23	0.2	2 [(3)]	1.008	0.1

(1) Calculations are based on Per Orange County Drainage Area Management Plan (DAMP), Table A-1, Exhibit 7.11 – Attachment A.
(2) Converts inches per hour to feet per second
(3) Estimated disturbed area of Passive Park. ~1.5 acres will retain native vegetation as under existing conditions.

VOLUME-BASED TREATMENT BMP SIZING

In accordance to the Countywide Model WQMP, the volume-based treatment BMPs will be sized to treat the volume of runoff produced from a 24-hour 85th percentile storm event, as determined from the local historical rainfall record. This is termed the Stormwater Quality Design Volume. The Stormwater Quality Design Volume (SQDV), is thus determined by the following equation:

$$SQDV = C * I * A_{TOTAL}$$

Where:
- C = coefficient of runoff (see Appendix 1)
- I = rainfall intensity per OC DAMP (see Appendix 1)
- A_{TOTAL} = total area to be treated

The calculations are provided in the table below.

SQDV[1] SUMMARY – WATER QUALITY / DETENTION BASIN					
BMP Location	Runoff Coefficient	Rainfall Intensity (in)	Drainage Area (acres)	Unit Conversion[2]	SQDV (ft^3)
Residential WQ Detention Basin + Drywells	0.68	0.85	59	3,630	123,153
Civic Center WQ Detention Basin	0.75	0.85	9.2	3,630	21,356
Total Design Capture Volume for the Proposed Project:					144,509

(1) Calculations are based on Per Orange County Drainage Area Management Plan (DAMP), Table A-1, Exhibit 7.11 – Attachment A.
(2) Converts acre-inches to cubic feet

The total design capture volume represents the entire treatment volume for the proposed project that must be either (in sequential order): infiltrated, harvested and reused and/or bio-treated and released. This volume is equivalent to the 2-year volume increase for the proposed development condition (approximately 3.3 ac-ft).

SQDV[1] SUMMARY – UNDERGROUND STORAGE & INFILTRATION				
BMP Name / Location	Runoff Coefficient	Rainfall Intensity (in)	Drainage Area (acres)	SQDV (ft^3)
Underground Storage & Infiltration @ Lot 15	0.68	0.85	13	27,135
Underground Storage & Infiltration @ Lot 16	0.68	0.85	14.6	30,475
Underground Storage & Infiltration @ Civic Center	0.75	0.85	5.2	12,208

(1) Calculations are based on Per Orange County Drainage Area Management Plan (DAMP), Table A-1, Exhibit 7.11 – Attachment A.
(2) Converts acre-inches to cubic feet

The underground storage and infiltration volumes identified in the table above identify infiltration objectives consistent with the 4[th] term Storm Water Permit. Site specific soil testing and infiltration criteria set forth in the forthcoming Model WQMP will determine the actual amount of infiltration allowable for each area. In the event the allowable infiltration is less than the design intent stated above, the remaining volume will be either reused on site for irrigation purposes or bio-treated within the proposed water quality basins and slowly discharged to Serrano Creek.

For the Civic Center development area, approximately 12,208 cubic feet of the design capture volume for the drainage area must be incorporated and treated upstream of the proposed water quality basin.

SQDV[1] SUMMARY – PASSIVE PARK BIOSWALES & RAIN GARDEN					
BMP Location	Runoff Coefficient	Rainfall Intensity (in)	Drainage Area (acres)	Unit Conversion[2]	SQDV (ft^3)
Passive Park	0.23	0.85	2 [3]	3,630	1,398

(1) Calculations are based on Per Orange County Drainage Area Management Plan (DAMP), Table A-1, Exhibit 7.11 – Attachment A.
(2) Converts acre-inches to cubic feet
(3) Estimated disturbed area of Passive Park. ~1.5 acres will retain native vegetation as under existing conditions.

The implementation of the bioswales with rain gardens for the passive park area will serve to self-mitigate the low flow runoff from the park.

TREATMENT BMP SUMMARY

The table on the following page summarizes the preliminary design of the treatment control BMPs. Additional details and maintenance information is provided in Section 6.0. Further details on BMP design will be documented in the Final WQMP upon final design of the project.

SUMMARY OF TREATMENT BMP SIZING		
BMP NAME	DIMENSIONS	TREATMENT DESIGN CAPACITY
	PRE-TREATMENT BMPS	
CDS Unit #1	Model CDS3020 72" Manhole	2.0 cfs
CDS Unit #2	Model CDS3020 72" Manhole	2.0 cfs
	INFILTRATION BMPS	
Underground Storage/ Infiltration @ Lot 15	~185 ft x 70 ft 14 Rows, 25 Chambers Each	~27,135 ft³
Underground Storage/ Infiltration @ Lot 16	~100 ft x 150 ft 14 Rows, 20 Chambers Each	~30,475 ft³
Civic Center Underground Storage/Infiltration	~93 ft x 70 ft 14 Rows, 11 Chambers Each	~12,208 ft³
Drywells	5 Maxwell Plus (estimated number)	~41,038 ft³
	PRIMARY TREATMENT BMPS*	
Residential Water Quality Detention Basin	Bottom Footprint = 0.95 ac Top Footprint (WQ) = 1.3 ac WQ Depth = 3 ft Total Depth = 6 ft	> 2.8 acre feet (124,146 ft³)
Civic Center Water Quality Detention Basin**	Bottom Footprint = 0.07 ac Top Footprint (WQ) = 0.17 ac WQ Depth = 3 ft Total Depth = 4 ft	>0.21 acre feet (9,148 ft³) (Note: Civic Center area requires upstream treatment amount of 12,208 ft³)
Passive Park Bioswales & Rain Gardens	Design Pending – Will be designed in accordance with OC DAMP and CASQA standards.	≥ 1,398 ft³ for Rain Garden ≥ 0.1 cfs for Bioswales

* Implementation of infiltration/storage reuse BMPs upstream will reduce volume requirements for treatment control BMPs.

** There is a small tributary area just west of this basin between the basin and existing underground tank. This area does not need treatment as it remains undisturbed in its natural condition

The use of upstream infiltration/storage BMPs combined with the bio-treat water quality basins at the downstream end will provide runoff reduction benefits to control excess volume for the 2-year storm and be consistent with the design capture volume hierarchy of treatment requirements of the recently updated MS4 Storm Water Permit. In addition, the water quality basins will provide for attenuation of low flow discharges to Serrano Creek to minimize hydromodification impacts.

Maintenance requirements and frequencies for the treatment control BMPs are discussed in Section 5.0 (BMP Inspection & Maintenance) of this report.

5.0 BMP INSPECTION & MAINTENANCE (O&M PLAN)

It has been determined that the developer, via HOA, shall assume all BMP inspection and maintenance responsibilities for the Serrano Summit project. The City of Lake Forest shall assume all BMP inspection and maintenance responsibilities for public streets, Civic Center, and the Passive Park portions of the Project.

CONTACT NAME	Pending. To be provided in the Final WQMP
TITLE	
COMPANY	Irvine Ranch Water District
ADDRESS	15600 Sand Canyon Avenue Irvine, Ca 92618
PHONE	949.453.5300

Should the maintenance responsibility be transferred at any time during the operational life of Serrano Summit, such as when an HOA or POA is formed for a project, a formal notice of transfer shall be submitted to the City of Lake Forest at the time responsibility of the property subject to this WQMP is transferred. The transfer of responsibility shall be incorporated into this WQMP as an amendment.

ANNUAL CERTIFICATION OF BMP MAINTENANCE

The HOA shall verify BMP implementation and ongoing maintenance through inspection, self-certification, survey, or other equally effective measure. The certification shall verify that, at a minimum, the inspection and maintenance of all structural BMPs including inspection and performance of any required maintenance in the late summer / early fall, prior to the start of the rainy season. The form that will be used to record implementation, maintenance, and inspection of BMPs is included in Appendix 6.

The City of Lake Forest may conduct verifications to assure that implementation and appropriate maintenance of structural and non-structural BMPs prescribed within this WQMP is taking place at the project site. The HOA shall retain operations, inspections and maintenance records of these BMPs and they will be made available to the City or County upon request. All records must be maintained for at least five (5) years after the recorded inspection date for the lifetime of the project.

LONG-TERM FUNDING FOR BMP MAINTENANCE

Long-term funding for BMP maintenance shall be funded through fees paid into the HOA. Lewis Community Developers, which will set up the HOA shall oversee that adequate funding for BMP maintenance is included within the HOA fee structure including annual maintenance fees and long-term maintenance reserve funds.

ACCESS EASEMENT FOR CITY/COUNTY INSPECTION

If a private entity retains or assumes responsibility for operation and maintenance of structural BMPs, the City shall be able access for inspection through a formal agreement.

5.1 MAINTENANCE OF SOURCE CONTROLS

The post development BMP maintenance responsibility and frequency matrices provided in this section detail the specific party to perform the inspection and maintenance of each BMP for Serrano Summit and details the maintenance and inspection activities to be performed, and the frequency with which each shall be performed.

NON-STRUCTURAL BMPs		RESPONSIBLE PARTY	MINIMUM MAINTENANCE FREQUENCY
N1	HOMEOWNER/ TENANT EDUCATION	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Educational materials shall be provided upon tenant occupancy, and annually thereafter. Frequency: ANNUALLY
N2	ACTIVITY RESTRICTIONS	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Lewis Community Developers shall develop CC&Rs to minimize the threat of hazardous waste or contamination into the storm drain system. Frequency: ONGOING
N3	COMMON AREA LANDSCAPE MANAGEMENT	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Maintenance shall be consistent with City requirements, plus fertilizer and/or pesticide usage shall be consistent with County Management Guidelines for Use of Fertilizers (OC DAMP Section 5.5). Frequency: MONTHLY
N4	BMP MAINTENANCE	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Maintenance of BMPs implemented at the project site shall be performed at the frequency prescribed in this WQMP. Frequency: ONGOING

NON-STRUCTURAL BMPs		RESPONSIBLE PARTY	MINIMUM MAINTENANCE FREQUENCY
N11	COMMON AREA LITTER CONTROL	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Litter pick-up, patrol, violations, investigation, reporting and other litter control activities shall be performed on a daily basis and in conjunction with maintenance activities. Frequency: WEEKLY
N12	EMPLOYEE TRAINING	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	The HOA shall educate all new employees/ managers on storm water pollution prevention, particularly good housekeeping practices, prior to the start of the rainy season (October 1). Refresher courses shall be conducted on an as needed basis. Frequency: ANNUALLY
N14	CATCH BASIN INSPECTION	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Catch basin inlets shall be inspected and, if necessary, cleaned prior to the storm season, no later than October 1st each year. Frequency: ANNUALLY
N15	STREET SWEEPING PRIVATE STREETS AND PARKING LOTS	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Private streets and parking lots must be swept at least quarterly (every 3 months), including prior to the start of the rainy season (October 1st). Frequency: QUARTERLY

STRUCTURAL BMPs	RESPONSIBLE PARTY	MINIMUM MAINTENANCE FREQUENCY
STORM DRAIN STENCILING AND SIGNAGE	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Storm drain stencils shall be inspected for legibility, at minimum, once prior to the storm season, no later than October 1st each year. Those determined to be illegible will be re-stenciled as soon as possible. Frequency: ANNUALLY
PROPER TRASH STORAGE DESIGN	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	Sweep trash areas at least once per week and before October 1st each year. Maintain area clean of trash and debris at all times. Frequency: WEEKLY
EFFICIENT IRRIGATION SYSTEMS AND LANDSCAPE DESIGN	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	In conjunction with routine maintenance activities, verify that landscape design continues to function properly by adjusting properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather, and day or night time temperatures. Frequency: MONTHLY

STRUCTURAL BMPs	RESPONSIBLE PARTY	MINIMUM MAINTENANCE FREQUENCY
PROTECT SLOPES AND CHANNELS	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	To be maintained in conjunction with routine maintenance activities. Slopes included within the daylight line of the grading plan and site plan will be landscaped with native drought resistant plants. Temporary irrigation will be provided until established. Biennial inspection & evaluation will be provided and any remediation performed by the HOA. <u>Frequency</u>: MONTHLY
HILLSIDE LANDSCAPING	Private Areas: HOA Enforced Civic Center & Passive Park: City of Lake Forest	To be performed in conjunction with maintenance activities. Maintain vegetative cover and/or mulch to eliminate exposed soils. Any eroded surfaces to be repaired immediately. Inspections to be performed twice each year (spring and fall) and after major storm events to check for signs of erosion, gullies, and sloughing. <u>Frequency</u>: MONTHLY

Any waste generated from maintenance activities will be disposed of properly. Wash water and other waste from maintenance activities is not to be discharged or disposed of into the storm drain system. Clippings from landscape maintenance (i.e. prunings) will be collected and disposed of properly off-site, and will not be washed into the streets, local area drains/conveyances, or catch basin inlets.

5.2 MAINTENANCE OF TREATMENT CONTROLS

The post development BMP maintenance responsibility and frequency matrix provided in this section detail the specific party to perform the inspection and maintenance of each BMP for Serrano Summit and details the maintenance and inspection activities to be performed, and the frequency with which each shall be performed.

TREATMENT BMPs	RESPONSIBLE PARTY	MINIMUM INSPECTION / MAINTENANCE FREQUENCY
VEGETATED BIOSWALES (Located in Lot 17)	City of Lake Forest (Located in Lot 17) (PA 17)	Vegetated swale should be inspected post-construction after seeding and after first major storm event for damages. Afterwards, inspection/ maintenance should occur semi-annually, at the beginning and end of rainy season, for erosion or visible damage or debris. Inspection and maintenance of clogging and sand/soil bed should occur on an annual basis. <u>Frequency</u>: 2x PER YEAR
PROPRIETARY CONTROL MEASURES: CDS UNITS (To be Located within private property)	HOA Enforced (Located in Lot 10 and Lot 18) (PA 10 & PA 18)	During the rainy season (October 1 – April 29), the CDS units should be inspected twice per rainy season, and cleaned out at least once per year at a minimum, prior to the start of the rainy season. It is recommended that the units be cleaned out again at the end of the rainy season to maintain function during summer months. Manufacturer's specifications may recommend additional maintenance. <u>Frequency</u>: MANUFACTURER'S RECOMMENDATIONS

TREATMENT BMPs	RESPONSIBLE PARTY	MINIMUM INSPECTION / MAINTENANCE FREQUENCY
WATER QUALITY / DETENTION BASIN	Residential Basin: HOA Enforced Civic Center Basin: City of Lake Forest (Located in Lot H) (PA 13)	Maintained in conjunction with regular landscaping activities, including removal of trash/debris/sediment, moving, weed control, and watering during drought conditions. Damaged or dead plant areas shall be repaired upon detection. Frequency: 2x PER YEAR
BIORETENTION/ RAIN GARDENS	City of Lake Forest (Located in Lot 17) (PA 17)	Routine maintenance of vegetation and irrigation should be conducted as part of the overall landscaping/irrigation schedule. Inspections should occur semi-annually or after major storm events to check for the following and remove accordingly: standing water, sediment, and trash & debris. In addition, inspections should look for potential clogging and clean planters or, if necessary, replace the entire filter bed. Frequency: 2x PER YEAR
UNDERGROUND STORAGE & INFILTRATION	Residential Areas: HOA Enforced Civic Center: City of Lake Forest (Located in Lot 13) (PA 13)	Units shall be inspected quarterly and after major storm events, and cleaned at a minimum of once per year, prior to the start of the rainy season (October 1st). Cleaning and maintenance will be performed per manufacturer's specifications, and will typically include removal of any trash and debris and excess sediment within the pipes. Frequency: MANUFACTURER'S RECOMMENDATIONS

TREATMENT BMPs	RESPONSIBLE PARTY	MINIMUM INSPECTION / MAINTENANCE FREQUENCY
DRYWELLS	Residential Areas: HOA Enforced	Typical maintenance includes inspections for accumulation and cleaning/pollutant removal as necessary from the settling chambers. Quarterly inspections will help maintain optimal performance and to determine typical accumulation levels during both dry-weather and wet-weather flows. Cleanout of sediment and debris is performed as needed, based on accumulation in well. Manufacture's specifications may require additional maintenance. Frequency: ANNUALLY

VEGETATED BIOSWALES

Proper maintenance for the operation of swales should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary.

Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover.

CDS UNITS

The CDS unit should be cleaned out on average 2-4 times per year, depending on site conditions. Frequent inspections should be performed to determine the proper maintenance frequency for the unit, generally when the sump is 75% full. Generally, the unit should be inspected after every runoff event during the first 30 days of operation, and every 30 days during the rainy season to ensure functionality and determine proper maintenance frequency.

Typical maintenance includes removal of trash and debris, removal of floatables and settleable solids, and replacement of oil sorbents if used. These units shall be located on private property.

WATER QUALITY / DETENTION BASINS

Operation and maintenance activities for the water quality detention basins would include site inspections, temporary irrigation system inspection and adjustment, minor vegetation removal and thinning, snag removal, and integrated pest/plan management. The treatment basins may periodically require major maintenance and possibly repairs to ensure that the basins operate at their maximum efficiency and treatment capacity. Major activities would include structural modifications and repairs, major vegetation removal and planting, and major sediment removal.

The water quality basins should be inspected at a minimum of twice per year, prior to the start of the storm season (October 1st) and at the end of the storm season. Basins should be inspected for standing water (in excess of 48 hours after a storm event), excess sediment, trash, and debris accumulation, possible vector harborage, and for the condition of safety features (such as fences and signs). Trash and debris should be removed in the basin and around the outlet during the inspections. In the water quality detention basins, weeding will be performed on a monthly basis during the first six months of the project, and quarterly during years 2 and 3 as directed by the professional biologist/restoration specialist employed for the inspections. Excess sediment shall be removed and disposed of properly when the debris component of the basin exceeds 10% of the basin volume. It is recommended that the professional biologist evaluate the water quality basin for plant survival, species coverage and species composition on an annual basis.

RAIN GARDENS

Site inspections shall occur on an annual basis by qualified personnel to observe the integrity of the facility over time. Trash and debris removal shall occur on an as needed basis and after all rain events. At least once per year in the spring, the rain garden should be inspected for standing dead plant debris, and any observed plant debris shall be removed with replanting occurring with the approved plant palette options when necessary. The rain gardens shall be inspected for sediment trapped in the garden, at least once in late summer or early fall, prior to the start of the rainy season (October 1) and cleaned out as necessary. Shrubs shall be pruned as necessary to keep a neat appearance.

In the first year, rain gardens require vigilant weeding. The need for weeding will decrease as plants become established. Therefore, monthly weeding shall be conducted during the first year of rain garden establishment. After the first year, weeding shall be conducted on an as needed basis but no less than 4 times per year.

UNDERGROUND STORAGE & INFILTRATION

The underground infiltration units shall be inspected through the risers quarterly and after major storm events, and cleaned at a minimum of once per year, prior to the start of the rainy season (October 1st). Cleaning and maintenance will be performed per manufacturer's specifications, and will typically include removal of any trash and debris and excess sediment within the pipes. Sediment shall be removed when deposits approach within 6 inches of the invert heights of the connecting pipes between the rows or inlet structures.

DRYWELLS

The units shall be cleaned when sediment accumulations is at or above the "cleanout line" marked inside of the units, and at a minimum of once per year, prior to the start of the storm season. Care should be taken to prevent spills during pollutant removal and cleaning. Oil and other hydrocarbons shall be cleaned out routinely as needed.

6.0 PLOT PLAN AND BMP DETAILS

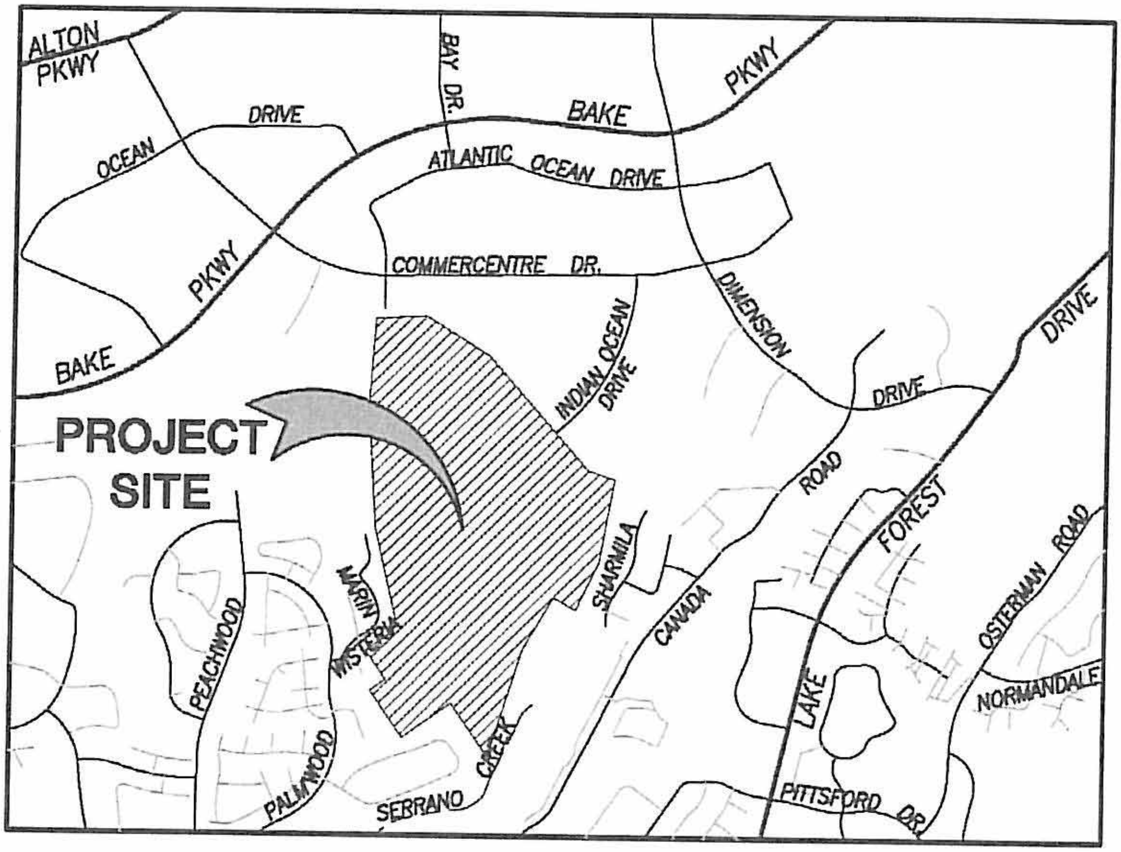
The exhibits provided in this section are to illustrate the post construction BMPs prescribed within this P-WQMP. Drainage flow information of the proposed project, such as general surface flow lines, concrete or other surface drainage conveyances, and storm drain facilities are also depicted. All structural source control and treatment control BMPs are shown as well.

PLOT PLANS

- Vicinity Map
- Site Plan Exhibit
- Water Quality Management Plan Exhibit

BMP DETAILS

- Extended Detention Basins (TC-22)
- CDS Units
- Underground Storage & Infiltration
- Drywells
- Vegetated Swales (TC-30)
- Bioretention/Rain Gardens (TC-32)



VICINITY MAP

N.T.S.

TENTATIVE TRACT NO. 17331

EXISTING EASEMENTS

1. A LICENSE OF RIGHT-OF-WAY AFFECTING SAID LAND FOR THE PURPOSE OF MAINTAINING A MOTOR-WAY AND FIRE-BREAK OVER AND ACROSS A STRIP OF LAND 50 FEET IN WIDTH EXTENDING ACROSS A PORTION OF SAID LAND AS PROVIDED BY AGREEMENT ENTERED INTO ON JULY 30, 1934, BY AND BETWEEN THE WHITING COMPANY, AS LICENSOR, AND THE STATE OF CALIFORNIA, AS LICENSEE, RECORDED SEPTEMBER 29, 1934 IN BOOK 705, PAGE 237 OF OFFICIAL RECORDS.
REFERENCE IS HEREBY MADE TO SAID DOCUMENT FOR FULL PARTICULARS.
NOTE: NOT PLOTTABLE

2. PERMANENT NON-EXCLUSIVE EASEMENTS OVER ALL ROADS NOW IN EXISTENCE ON SAID LAND AND OVER ALL EXISTING EASEMENTS FOR UTILITY PURPOSES ON SUCH PROPERTY, FOR THE PURPOSE OF UTILITIES AND OF INGRESS AND EGRESS TO AND FROM REAL PROPERTY OWNED BY GRANTOR IN THE PORTION OF SAID RANCHO CANADA DE LOS ALISOS NOT NOW INCLUDED IN THE ORANGE COUNTY MUNICIPAL WATER DISTRICT, PROVIDED, HOWEVER, THAT SUCH ROADS AND/OR UTILITY EASEMENTS MAY BE RELOCATED OR ABANDONED AT ANY TIME BY GRANTEE, ITS SUCCESSORS AND ASSIGNS, IF A SUBSTANTIALLY EQUIVALENT ROAD OR EASEMENT, AS THE CASE MAY BE, FOR SUCH PURPOSES SHALL BE SUBSTITUTED THEREFOR, ANY SUCH SUBSTITUTE ROAD OR EASEMENT SHALL SERVE THE PURPOSES SERVED BY THE ABANDONED EASEMENT IN A REASONABLE AND SATISFACTORY MANNER. IN THE EXERCISE OF THE REGULATIONS OF GRANTEE WITH RESPECT TO THE LOCKING OF GATES AND KEEPING THE PUBLIC FROM ACQUIRING EASEMENTS, AS RESERVED BY THE EL TORO COMPANY, A PARTNERSHIP, THEIR SUCCESSORS AND ASSIGNS IN DEEDS RECORDED DECEMBER 31, 1958 IN BOOK 4533, PAGES 588, 590 AND 593 OF OFFICIAL RECORDS AND IN DEED RECORDED JANUARY 20, 1961 IN BOOK 5598, PAGE 393 OF OFFICIAL RECORDS.
REFERENCE IS HEREBY MADE TO SAID DOCUMENT FOR FULL PARTICULARS.
NOTE: NOT PLOTTABLE – BLANKET IN NATURE OVER SUBJECT PROPERTY.

3. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: LOS ALISOS WATER DISTRICT AND EL TORO WATER DISTRICT
PURPOSE: PIPE LINES
RECORDED: MARCH 22, 1963 IN BOOK 6478, PAGE 511 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF SAID LAND AS DESCRIBED THEREIN

4. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SANTA ANA MOUNTAINS COUNTY WATER DISTRICT, A COUNTY WATER DISTRICT
PURPOSE: PIPE LINES
RECORDED: JANUARY 6, 1965 IN BOOK 7374, PAGE 655 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF SAID LAND AS DESCRIBED THEREIN

5. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SOUTHERN CALIFORNIA EDISON COMPANY
PURPOSE: POLE LINES AND CONDUITS
RECORDED: OCTOBER 9, 1970 IN BOOK 9427, PAGE 326 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF PARCEL 2 AS SHOWN ON SAID MAP

6. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SOUTHERN CALIFORNIA EDISON
PURPOSE: EITHER OR BOTH POLE LINES, CONDUITS AND PURPOSES INCIDENTAL THERETO
RECORDED: IN BOOK 10071, PAGE 684 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF PARCEL 2 AS SHOWN ON SAID MAP

7. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SOUTHERN CALIFORNIA EDISON COMPANY
PURPOSE: OVERHEAD AND UNDERGROUND ELECTRICAL SUPPLY AND COMMUNICATION SYSTEMS
RECORDED: MAY 7, 1975 IN BOOK 11395, PAGE 1751 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF PARCEL 2 AS SHOWN ON SAID MAP

8. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: MUNICIPAL WATER DISTRICT OF ORANGE COUNTY
PURPOSE: WATER TRANSMISSION
RECORDED: JANUARY 11, 1983 AS INSTRUMENT NO. 83-013710 OF OFFICIAL RECORDS
AFFECTS: A PORTION OF PARCEL 2 AS SHOWN ON SAID MAP

10. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS DELINEATED OR AS OFFERED FOR DEDICATION, ON THE RECORDED MAP SHOWN BELOW:
MAP OF: PARCEL MAP 89-218
GRANTED TO: THE COUNTY OF ORANGE
PURPOSE: AIRCRAFT OPERATIONS, SOUND, AIR SPACE AND AVIGATION, SUBJECT TO THE SAME CONDITIONS AND LIMITATIONS AS SHOWN ON THAT CERTAIN EASEMENT RECORDED JULY 2, 1979 IN BOOK 13213, PAGE 1111 OF OFFICIAL RECORDS
AFFECTS: SAID LAND
NOTE: BLANKET IN NATURE OVER SUBJECT PROPERTY–FROM 1500 FEET ABOVE MEAN SEA LEVEL TO INDEFINITE HEIGHT ABOVE 1500 FEET MEAN SEA LEVEL.

11. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS DELINEATED OR AS OFFERED FOR DEDICATION, ON THE RECORDED MAP SHOWN BELOW:
MAP OF: PARCEL MAP 89-218
GRANTED TO: THE COUNTY OF ORANGE
PURPOSE: SCENIC PRESERVATION PURPOSES
AFFECTS: SAID LAND

12. AN IRREVOCABLE OFFER TO DEDICATE A PORTION OF SAID LAND FOR THE PURPOSES STATED HEREIN, AS OFFERED ON THE MAP SHOWN BELOW:
IN FAVOR OF: LOS ALISOS WATER DISTRICT
PURPOSE: RIDING AND HIKING PURPOSES
AFFECTS: A PORTION OF PARCEL 2
SAID OFFER WAS ACCEPTED FOR PUBLIC USE BY A RESOLUTION, EXECUTED BY BOARD OF SUPERVISORS AND RECORDED APRIL 6, 1994 AS INSTRUMENT NO. 94-0238398 AND APRIL 8, 1994 AS INSTRUMENT NO. 94-0248194, BOTH OF OFFICIAL RECORDS.

13. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SOUTHERN CALIFORNIA EDISON COMPANY, A CORPORATION
PURPOSE: UNDERGROUND ELECTRICAL SUPPLY SYSTEMS AND COMMUNICATION SYSTEMS
RECORDED: JUNE 4, 1991 AS INSTRUMENT NO. 91-277708 OF OFFICIAL RECORDS
AFFECTS: THAT PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED THEREIN
AMONG OTHER THINGS, SAID DOCUMENT PROVIDES:
THE GRANTOR AGREES FOR ITSELF, ITS SUCCESSORS AND ASSIGNS, NOT TO ERECT, PLACE OR MAINTAIN, NOR TO PERMIT THE ERECTION, PLACEMENT OR MAINTENANCE OF ANY BUILDING, PLANTER BOXES, EARTH FILL OR OTHER STRUCTURES EXCEPT WALLS AND FENCES ON THE ABOVE DESCRIBED REAL PROPERTY.
NOTE: AFFECTS BUT IS NOT PLOTTABLE.

14. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: SOUTHERN CALIFORNIA GAS COMPANY, A CORPORATION
PURPOSE: PIPELINES, WITH METERING, MEASURING, REGULATING AND OTHER EQUIPMENT, FOR THE TRANSPORTATION OF GAS, PETROLEUM PRODUCTS AND OTHER SUBSTANCES, WITH THE RIGHT OF INGRESS AND EGRESS TO AND FROM THE SAME
RECORDED: JULY 10, 1991 AS INSTRUMENT NO. 91-355245 OF OFFICIAL RECORDS
AFFECTS: THAT PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED THEREIN
AMONG OTHER THINGS, SAID DOCUMENT PROVIDES:
GRANTOR SHALL NOT CONSTRUCT OR MAINTAIN ON THE PREMISES, OVER WHICH THIS RIGHT OF WAY IS GRANTED, ANY BUILDINGS OR OTHER STRUCTURES, PLANT TREES, INUNDATE, OR CHANGE THE GRADE OF THE PREMISES.

15. THE MATTERS CONTAINED IN THAT CERTAIN "AMENDED MAJOR THOROUGHFARE AND BRIDGE FEE PROGRAM FOR FOOTHILL CIRCULATION PHASING PLAN" AS DISCLOSED BY RESOLUTION NO. 92-614 OF THE BOARD OF SUPERVISORS OF ORANGE COUNTY, A CERTIFIED COPY OF WHICH WAS RECORDED JUNE 2, 1992 AS INSTRUMENT NO. 92-369892 OF OFFICIAL RECORDS.
REFERENCE IS HEREBY MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

16. MATTERS CONTAINED IN THAT CERTAIN DOCUMENT ENTITLED "AMENDED AND RESTATED ALLEN-McCOLLOCH PIPELINE SUBLEASE" EXECUTED BY AND BETWEEN MUNICIPAL WATER DISTRICT OF ORANGE COUNTY AND LOS ALISOS WATER DISTRICT, RECORDED AUGUST 27, 1992 AS INSTRUMENT NO. 92-569777 OF OFFICIAL RECORDS.
REFERENCE IS HEREBY MADE TO SAID DOCUMENT FOR FULL PARTICULARS.

17. AN EASEMENT FOR THE PURPOSE SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT.
GRANTED TO: MUNICIPAL WATER DISTRICT OF ORANGE COUNTY, A MUNICIPAL WATER DISTRICT
PURPOSE: ACCESS
RECORDED: JANUARY 23, 1996 AS INSTRUMENT NO. 1996033543 OF OFFICIAL RECORDS
AFFECTS: THAT PORTION OF SAID LAND AS MORE PARTICULARLY DESCRIBED THEREIN

18. WATER RIGHTS, CLAIMS OR TITLE TO WATER, WHETHER OR NOT DISCLOSED BY THE PUBLIC RECORDS.

NOTES

1. PROPERTY AREA:
GROSS ACREAGE: 98.9 Acres
2. ZONING:
EXISTING ZONING: MEDIUM DENSITY RESIDENTIAL R2-PD/PUBLIC FACILITIES/ PUBLIC FACILITIES OVERLAY
3. LAND USE DESIGNATION:
MEDIUM DENSITY RESIDENTIAL WITH PUBLIC FACILITIES OVERLAY (82 ACRES); AND PUBLIC FACILITY (FOR THE REMAINDER ACREAGE – APPROXIMATELY 17 ACRES). THIS CORRESPONDS TO THE GENERAL PLAN DESIGNATIONS OF THE SITE RESULTING FROM GENERAL PLAN AMENDMENT 2008-02(c). (PLANNING)
4. PARKING:
TO BE SHOWN ON B MAPS.
5. PROJECT SITE IS WITHIN THE SADDLEBACK VALLEY UNIFIED SCHOOL DISTRICT
6. SANITARY SEWER SERVICES PROVIDED BY: IRVINE RANCH WATER DISTRICT
7. DOMESTIC WATER SERVICES PROVIDED BY: IRVINE RANCH WATER DISTRICT
8. RECLAIMED WATER SERVICES PROVIDED BY: IRVINE RANCH WATER DISTRICT
9. ALL PROPOSED UTILITIES ARE TO BE UNDERGROUND:
GAS: SOUTHERN CALIFORNIA GAS COMPANY
ELECTRIC: SOUTHERN CALIFORNIA EDISON
TELEPHONE: COX COMMUNICATION
CABLE: COX COMMUNICATION
10. TRASH WILL BE COLLECTED BY WASTE MANAGEMENT OF ORANGE COUNTY.
11. ALL SLOPES SHALL BE CONSTRUCTED AT A MAXIMUM SLOPE RATIO OF 2:1 UNLESS OTHERWISE NOTED.
12. MULTIPLE FINAL MAPS MAY BE RECORDED FROM THIS TENTATIVE TRACT MAP PER SECTION 66454.1 OF THE STATE OF CALIFORNIA GOVERNMENT CODE (SUBDIVISION MAP ACT) AS AMENDED JANUARY, 2001
13. FUTURE DEVELOPMENT OF PROJECT AREA SHALL BE SUBJECT TO THE REQUIREMENTS OF SERRANO SUMMIT AREA PLAN.
14. DRAINAGE SYSTEMS WILL BE DEVELOPED IN ACCORDANCE WITH THE CITY OF LAKE FOREST AND FLOOD CONTROL DISTRICT STANDARDS.
15. GRADING FOR TENTATIVE TRACT MAP NO. 17331 MAY BE ACCOMPLISHED IN MULTIPLE PHASES.
16. ALL PROPOSED STORM DRAINS SHOWN ARE PRELIMINARY, STORM DRAIN PLANS WILL BE PREPARED PRIOR TO RECORDATION OF THE FINAL MAP.
17. BACKBONE AND OFF-SITE FACILITIES FOR TENTATIVE TRACT MAP NO. 17331 MAY BE PHASED AND COORDINATED WITH THE INITIAL GRADING AND DEVELOPMENT.
18. PUBLIC EASEMENTS (IF NECESSARY) FOR SIDEWALK PURPOSES WILL BE REFLECTED ON THE FINAL MAPS.
19. ESTIMATED EARTHWORK:
CUT: 860,000 ±CY
FILL: 860,000 ±CY
20. LANDSCAPING WITHIN MEDIAN AREAS, STREET ISLANDS AND PARKWAYS WILL BE MAINTAINED BY THE CITY OF LAKE FOREST.
21. THIS MAP IS AN APPLICATION FOR A DEVELOPMENT PERMIT PURSUANT TO SECTION 65493 OF THE CALIFORNIA GOVERNMENT CODE, AND ITEM SECTION 5.3 PER THE DEVELOPMENT AGREEMENT, WHICH STATES, "'A' MAP' SHALL MEAN THE FIRST CONVEYANCE SUBDIVISION MAP FOR WHICH FINAL APPROVAL IS ISSUED BY THE CITY COUNCIL FOLLOWING THE EFFECTIVE DATE OR THE FIRST TENTATIVE MAP FOR THE PROJECT WHICH IS APPROVED BY THE CITY FOLLOWING THE EFFECTIVE DATE OF THIS AGREEMENT, WHICHEVER IS APPROVED FIRST."
22. ALL LOT AND PAD GRADIENTS TO BE 2% MINIMUM, UNLESS OTHERWISE NOTED. MASS GRADED PADS CAN BE GRADED AT 1% MINIMUM. (DEVIATION TO GRADING CODE AND MANUAL).
23. PROPOSED UTILITY LOCATIONS AND EASEMENTS ARE APPROXIMATE. ACTUAL LOCATIONS AND EASEMENT WIDTHS WILL BE SHOWN ON THE FINAL MAPS.
24. SEE FUEL MODIFICATION PLAN FOR FUEL MODIFICATION LIMITS AND DETAILS.
25. THERE IS A DEVELOPMENT AGREEMENT AND AREA PLAN FOR THIS PROPERTY.
26. LOTS H AND 13 WILL BE OFFERED AS AN "IRREVOCABLE OFFER OF DEDICATION" TO THE CITY OF LAKE FOREST ON THE FINAL TRACT MAP OR BY SEPARATE INSTRUMENT.
27. MSE WALL IS A MECHANICALLY STABILIZED EARTH WALL.
28. REGARDING THE CUL-DE-SAC ON INDIAN OCEAN, THE OWNER/DEVELOPER HAS THE RIGHT TO CONVERT INTO A CONTINUOUS STREET BY EXTENDING THE STREET OR MAKING A FULL TURN KNUCKLE
29. ALL PROPOSED STORM DRAIN FACILITIES WILL BE MAINTAINED BY THE H.O.A.
30. CONCRETE MASONRY RETAINING WALL ADJACENT TO THE STREETS SHALL BE DECORATIVE UNITS.
31. ANY GRADING INVOLVING ANOTHER PARCEL MUST HAVE THE PERMISSION OF ALL APPLICABLE PROPERTY OWNERS AND APPROPRIATE EASEMENT DOCUMENTS.
32. ALL SEWER AND WATER FACILITIES TO BE MAINTAINED BY THE IRVINE RANCH WATER DISTRICT.
33. UNLESS OTHERWISE NOTED ALL CURB ONLY WILL BE 6" HIGH; CURB AND GUTTER WILL BE 6" HIGH AND HAVE A 'W'-VALUE OF 18" PER THE CITY OF LAKE FOREST STANDARD CRITERIA. ROLLED CURB WILL BE 4" HIGH AND WILL OCCUR AT THE ROUND-A-BOUTS INNER CIRCLE.
34. PUBLIC UTILITY EASEMENTS ARE LOCATED ADJACENT TO PRIVATE STREETS A, B & C, 3' OUTSIDE OF THE PROPERTY LINES

PROPOSED LAND USE SUMMARY

LOTS	LAND USE	SQ. FT.	PAD ACREAGE	LANDSCAPE LOT ACREAGE	TOTAL ACREAGE	MAINTENANCE RESPONSIBILITY
1	RESIDENTIAL	268,394	6.2	0.5 (G)	6.7	H.O.A.
2	RESIDENTIAL	45,556	1.0	–	1.0	H.O.A.
3	RESIDENTIAL	87,314	2.0	–	2.0	H.O.A.
4	RESIDENTIAL	61,530	1.4	–	1.4	H.O.A.
5	RESIDENTIAL	312,877	7.2		7.2	H.O.A.
6	RESIDENTIAL	237,575	5.5	1.1 (I)	6.6	H.O.A.
7	RESIDENTIAL	73,933	1.7	–	1.7	H.O.A.
8	RESIDENTIAL	64,567	1.5	–	1.5	H.O.A.
9	RESIDENTIAL	66,555	1.5	–	1.5	H.O.A.
10	RESIDENTIAL	92,846	2.1	–	2.1	H.O.A.
11	RESIDENTIAL	153,499	3.5	–	3.5	H.O.A.
12	RESIDENTIAL	357,563	8.2	0.3 (F)	8.5	H.O.A.
13	RESIDENTIAL	405,555	9.3	2.6 (H)	11.9	H.O.A.
	TOTAL:	2,227,764	51.1	4.5	55.6	
COMMUNITY SERVICES:						
13	CIVIC CENTER (OVERLAY)	405,555	9.3	2.6 (H)	–	CITY OF LAKE FOREST
	TOTAL:	405,555	9.3	2.6	–	
PARKS/RECREATION:						
14	PRIVATE RECREATION CENTER	70,452	1.6	0.3 (N)	1.9	H.O.A.
15	PUBLIC PARK	20,711	0.5	–	0.5	H.O.A.
16	PUBLIC PARK	22,173	0.5	–	0.5	H.O.A.
17	PUBLIC PARK	165,168	3.8	–	3.8	CITY OF LAKE FOREST
	TOTAL:	278,504	6.4	0.3	6.7	
EXISTING FACILITIES:						
18	EXISTING WATER TANKS	534,959	12.2	0.8(K), 2.7(L), 0.3(M)	16.0	I.R.W.D./H.O.A.
19	EXISTING I.R.W.D. FACILITY	352,930	8.1	–	8.1	I.R.W.D./H.O.A.
O	OPEN SPACE	171,033	3.9	–	3.9	I.R.W.D./H.O.A.
	TOTAL:	1,058,922	24.2	3.8	28.0	
PRIVATE STREETS:						
A	PRIVATE DRIVE A	22,789	0.5	–	0.5	H.O.A.
B	PRIVATE DRIVE B	23,373	0.5	–	0.5	H.O.A.
C	PRIVATE DRIVE C	24,415	0.6	0.2 (J)	0.8	H.O.A.
D	PRIVATE DRIVE D	38,020	0.9	–	0.9	H.O.A.
E	PRIVATE DRIVE E	14,737	0.3	–	0.3	H.O.A.
	TOTAL:	123,334	2.8	0.2	3.0	
PUBLIC STREETS:						
	"A" STREET	108,639	2.5	–	2.5	CITY OF LAKE FOREST (1)
	"B" STREET	56,219	1.3	–	1.3	CITY OF LAKE FOREST (1)
	INDIAN OCEAN DRIVE	76,808	1.8	–	1.8	CITY OF LAKE FOREST (2)
	TOTAL:	241,666	5.6	–	5.6	
LANDSCAPE LOTS (SLOPES):						
F	LANDSCAPE LOT	11,419	–	0.3	–	H.O.A.
G	LANDSCAPE LOT	23,533	–	0.5	–	H.O.A.
H	LANDSCAPE LOT	112,747	–	2.6	–	CITY OF LAKE FOREST
I	LANDSCAPE LOT	46,590	–	1.1	–	H.O.A.
J	LANDSCAPE LOT	7,133	–	0.2	–	H.O.A.
K	LANDSCAPE LOT	33,692	–	0.8	–	H.O.A.
L	LANDSCAPE LOT	118,685	–	2.7	–	H.O.A.
M	LANDSCAPE LOT	12,105	–	0.3	–	H.O.A.
N	LANDSCAPE LOT	11,509	–	0.3	–	H.O.A.
	TOTAL:	377,413	–	8.8	–	

TOTAL: 98.9 ACRES

NOTE:
MINIMUM 9.0 USEABLE NET ACRES REQUIRED FOR THE CIVIC CENTER AND MINIMUM 2.95 USEABLE NET ACRES REQUIRED FOR THE PASSIVE PARK PER D.A.

(1) H.O.A. TO MAINTAIN PARKWAYS AND MEDIANS
(2) H.O.A. TO MAINTAIN PARKWAYS ON THE WEST SIDE OF THE STREET.

FLOOD ZONE:

PROJECT SITE LIES WITHIN ZONE X OF THE FIRM MAP ORANGE COUNTY, CALIFORNIA AND INCORPORATED AREAS, PANELS 316 & 318 OF 550. MAP NO's. 06059C0316H AND 06059C0318H PER MAP REVISED FEBRUARY 18, 2004. ZONE X DESIGNATION IS DEFINED AS AREAS DETERMINED TO BE OUTSIDE THE 0.20% ANNUAL CHANCE FLOODPLAIN.

LEGAL DESCRIPTION:

PARCELS 1 AND 2 OF AMENDED PARCEL MAP NO. 89-218, IN THE CITY OF LAKE FOREST, COUNTY OF ORANGE, STATE OF CALIFORNIA, AS SHOWN ON MAP FILED IN BOOK 274, PAGES 27 THROUGH 29, INCLUSIVE OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

EXCEPTING THEREFROM THAT PORTION OF SAID LAND CONVEYED TO MUNICIPAL WATER DISTRICT OF ORANGE COUNTY, A MUNICIPAL DISTRICT BY DEED RECORDED JANUARY 23, 1996 AS INSTRUMENT NO. 19960033544, OF OFFICIAL RECORDS.

ASSESSOR PARCEL NUMBERS:

104-132-36, -65 AND -84

TITLE REPORT:

THE BOUNDARY AND EASEMENTS SHOWN HEREON ARE PER CHICAGO TITLE COMPANY ORDER NUMBER 810015144-X14 DATED AS OF MAY 18, 2009

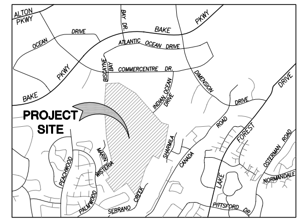
DEVIATIONS:

1. STREET WIDTHS, INCLUDING OVERALL R/W TO R/W, PARKWAY WIDTHS, CURB TO CURB WIDTHS, SIDEWALK WIDTHS AND PL TO PL WIDTHS MAYBE AS SHOWN ON THIS TENTATIVE TRACT MAP.
2. DEAD END TURNAROUNDS MAYBE AS SHOWN ON THIS TENTATIVE TRACT MAP.
3. WHEN PUBLIC STREET CENTERLINE GRADES ARE 1%, CURB FLOWLINE GRADES MAY DROP TO 0.85% ON THE OUTSIDE RADIUS.
4. PRIVATE INTERNAL STREETS MAY HAVE GUTTER FLOWLINES OF 0.50% MINIMUM.
5. CURVED LOCAL STREET RADII MAY BE AS SHOWN ON THIS TENTATIVE TRACT MAP.
6. PRIVATE STREET "C" MAY BE EXTENDED TO A TOTAL LENGTH OF UP TO 1,250 LINEAL FEET.
7. CORNER CUT-OFFS FOR LOCAL COLLECTOR STREETS THAT INTERSECTS LOCAL COLLECTOR OR LOCAL STREETS MAY BE CIRCULAR, EXCEPT AS SHOWN ON MAP.
8. SIDEWALKS AND PEDESTRIAN WAYS SHALL BE AS SHOWN ON THIS TENTATIVE TRACT MAP.
9. SHEET FLOW GRADING FOR THE INTERIM MASS GRADED PADS MAYBE AT 1% MINIMUM AS SHOWN ON THIS TENTATIVE TRACT MAP.

TOTAL LOTS: 35 LOTS
TOTAL DWELLING UNITS: 608 DU
TOTAL SITE ACREAGE: 98.9 Acres

OVERVIEW SUMMARY

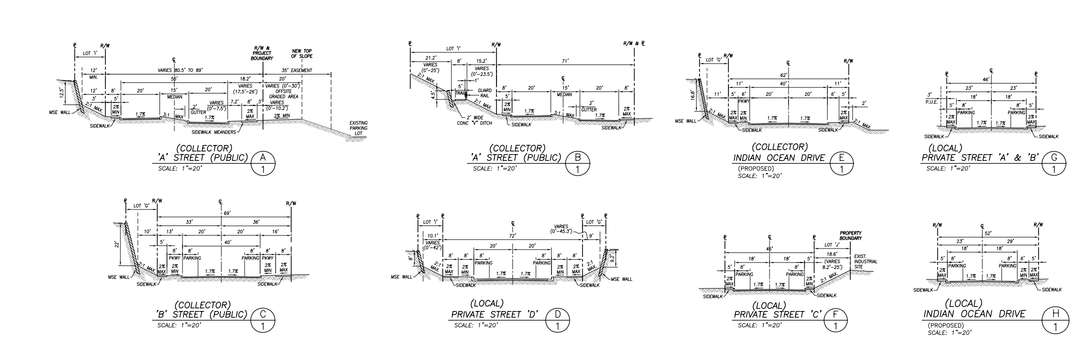
TOTAL RESIDENTIAL........13 LOTS
TOTAL PARKS/RECREATION........4 LOT
TOTAL CIVIC CENTER........1 LOT(OVERLAY)
TOTAL EXISTING I.R.W.D........2 LOTS
TOTAL LANDSCAPE........9 LOTS
TOTAL STREET........7 LOTS



VICINITY MAP
N.T.S.

SLOPES:

1. ALL SLOPES TO HAVE TERRACE AND DOWNDRAINS AS REQUIRED BY THE CITY OF LAKE FOREST BUT ARE NOT SHOWN HEREON FOR CLARITY.
2. ALL SLOPES TO BE MAINTAINED AS FOLLOWS:
   - A TO BE MAINTAINED BY THE CITY OF LAKE FOREST
   - B TO BE MAINTAINED BY MASTER H.O.A.
   - C TO BE MAINTAINED BY PROPERTY OWNER (SUB-H.O.A.)
3. SLOPE TYPES ARE DEFINED, PER CITY OF LAKE FOREST ORDINANCE NO. 84 AS FOLLOWS:
   - TYPE 'A' THOSE PROPOSED TO BE MAINTAINED BY A PUBLIC AGENCY OR BY A GROUP, SUCH AS A HOMEOWNERS' ASSOCIATION, AND WHICH ARE LOCATED EITHER ADJACENT TO AN ARTERIAL HIGHWAY OR WITHIN A PARK, GREENBELT, OR OTHER PUBLIC COMMON OPEN SPACE AREA
   - TYPE 'B' THOSE PROPOSED TO BE MAINTAINED BY A GROUP, SUCH AS A HOMEOWNERS' ASSOCIATION, AND WHICH ARE LOCATED WITHIN OR ADJACENT TO INDIVIDUAL LOTS AND WHICH ARE NOT WITHIN A PARK, GREENBELT, OR OTHER PUBLIC OR COMMON OPEN SPACE AREA.
   - TYPE 'C' THOSE PROPOSED TO BE MAINTAINED BY INDIVIDUALS AND WHICH ARE LOCATED WITHIN INDIVIDUAL LOTS IN SUCH A MANNER THAT THEY ARE INAPPROPRIATE FOR MAINTENANCE BY A GROUP SUCH AS A HOMEOWNERS' ASSOCIATION.



(COLLECTOR) 'A' STREET (PUBLIC) A/1 — SCALE: 1"=20'

(COLLECTOR) 'A' STREET (PUBLIC) B/1 — SCALE: 1"=20'

(COLLECTOR) INDIAN OCEAN DRIVE E/1 — (PROPOSED) SCALE: 1"=20'

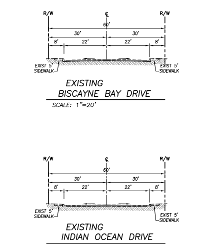
(LOCAL) PRIVATE STREET 'A' & 'B' G/1 — SCALE: 1"=20'

(COLLECTOR) 'B' STREET (PUBLIC) C/1 — SCALE: 1"=20'

(LOCAL) PRIVATE STREET 'D' D/1 — SCALE: 1"=20'

(LOCAL) PRIVATE STREET 'C' F/1 — SCALE: 1"=20'

(LOCAL) INDIAN OCEAN DRIVE H/1 — (PROPOSED) SCALE: 1"=20'



EXISTING BISCAYNE BAY DRIVE
SCALE: 1"=20'

EXISTING INDIAN OCEAN DRIVE
SCALE: 1"=20'

STATEMENT OF OWNERSHIP:

WE, IRVINE RANCH WATER DISTRICT, DO HEREBY STATE THAT WE ARE THE OWNERS OF THE PROPERTY COMPRISING THIS TENTATIVE TRACT MAP AND THAT WE HAVE CONSENTED TO THE SUBMISSION OF SAID MAP. (LOS ALISOS WATER DISTRICT PREVIOUSLY OWNED THE SUBJECT PROPERTY AND SUBSEQUENTLY IRVINE RANCH WATER DISTRICT AND LOS ALISOS WATER DISTRICT HAVE MERGED).

DATED: ____________

BY: ____________

PRINTED NAME: ____________

TITLE: ____________

NO.	DATE	REVISIONS	APP'D.

Prepared for (Owner): IRVINE RANCH WATER DISTRICT

PREPARED UNDER THE SUPERVISION OF:
SIGNATURE: TREVOR S. DODSON
R.C.E. NO. C42029 EXP. DATE 03/31/10

Plans prepared by: FUSCOE ENGINEERING
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 • fax 949.474.5315
www.fuscoe.com

REGISTERED PROFESSIONAL ENGINEER TREVOR S. DODSON NO. C42029 EXP. 03/31/10 CIVIL STATE OF CALIFORNIA

TENTATIVE TRACT NO. 17331
CITY OF LAKE FOREST, CALIFORNIA

DESIGNED BY: DB | CHECKED BY: TSD
DRAWN BY: MLD/NSM | JOB NO.: 658.02
DATE PREPARED: 7/13/09
SHEET 1 OF 4
FIELD BOOK

PLAN SET: E
TENTATIVE TRACT MAP
I.R.W.D.-SERRANO SUMMIT, LAKE FOREST
01/07/10
3rd SUBMITTAL

PROPOSED EASEMENTS:

- (A) EASEMENT FOR PIPELINES AND ACCESS FOR I.R.W.D.
- (B) EASEMENT FOR EMERGENCY ACCESS & PUBLIC SERVICE FOR THE CITY

PLAN SET: E

01/07/10

TENTATIVE TRACT MAP
I.R.W.D.—SERRANO SUMMIT, LAKE FORREST

NO.	DATE	REVISIONS	APP'D.

Prepared for (Owner): IRVINE RANCH WATER DISTRICT

PREPARED UNDER THE SUPERVISION OF:

SIGNATURE: TREVOR S. DODSON

R.C.E. NO. C42029 EXP. DATE 03/31/10

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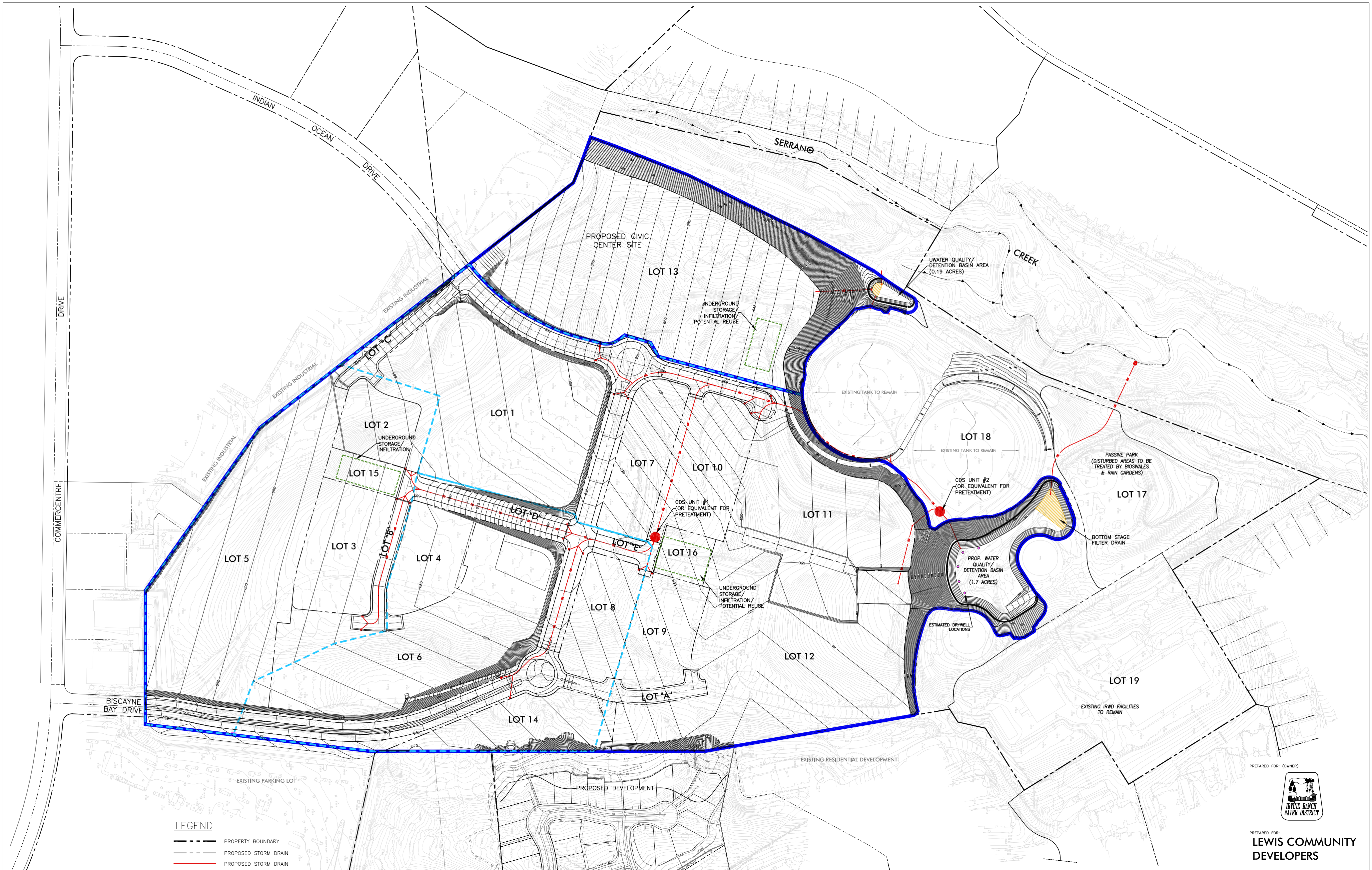
TENTATIVE TRACT NO. 17331

CITY OF LAKE FOREST, CALIFORNIA

DESIGNED BY: DB	CHECKED BY: TSD
DRAWN BY: MLD/NSM	JOB NO.: 658.02
DATE PREPARED: 7/13/09	
SHEET 3 OF 4	
FIELD BOOK	



LEGEND

- PROPERTY BOUNDARY
- PROPOSED STORM DRAIN
- PROPOSED STORM DRAIN
- WATER QUALITY/DETENTION BASIN DRAINAGE BOUNDARY
- BMP SUB-DRAINAGE BOUNDARY
- PROPOSED WATER QUALITY/DETENTION BASIN
- WQ BASIN BOTTOM STAGE FILTER DRAIN
- UNDERGROUND STORAGE/INFILTRATION APPROX. FOOTPRINT & LOCATION
- PROPOSED CDS UNIT (OR EQUIVALENT) LOCATION
- PROPOSED DRYWELL APPROX. LOCATION

N

100' 0' 50' 100'

SCALE: 1" = 100'

IRWD SITE
PRELIMINARY WATER QUALITY MANAGEMENT PLAN

PREPARED FOR: (OWNER)

IRVINE RANCH WATER DISTRICT

PREPARED FOR:

LEWIS COMMUNITY DEVELOPERS

PREPARED BY:

FUSCOE ENGINEERING

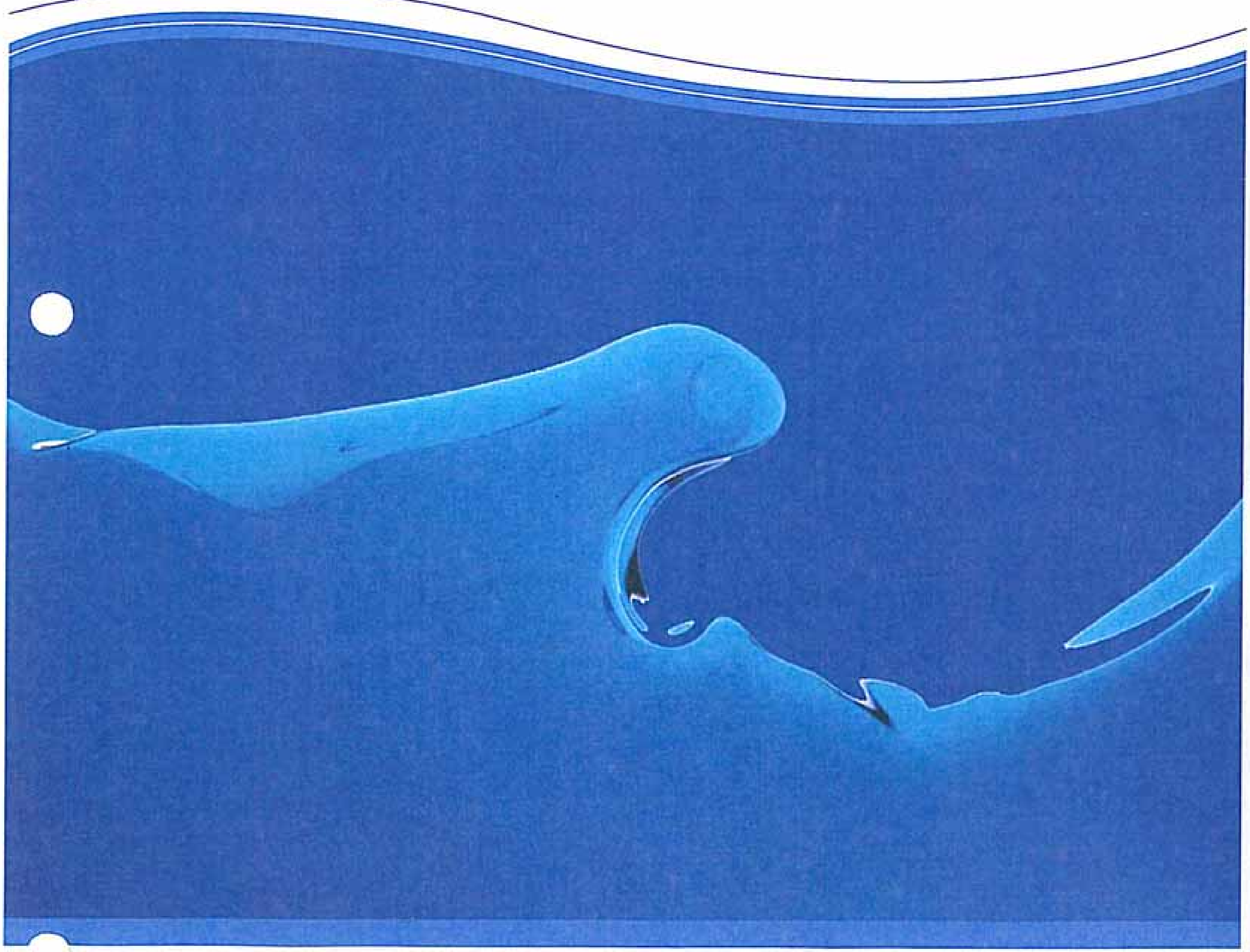
16795 Von Karman, Suite 100
Irvine, California 92606
tel 949.474.1960 ◆ fax 949.474.5315
www.fuscoe.com

ORIGINAL DATE: MAY 15, 2009
REVISED DATE: JUNE 12, 2009
2ND REVISION: MARCH 17, 2010

P:\Projects\658\02\Wat\Graphics\65802-XH-Water Quality Mgmt Plan_100315.dwg (3/17/2010 10:52 AM) Plotted by: April McMillan

CONTECH® CONSTRUCTION PRODUCTS INC.

Hydrodynamic Separation Products Overview



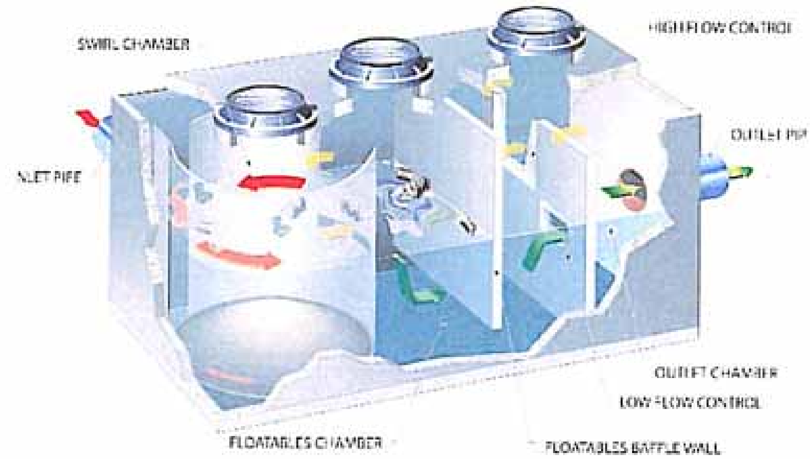
CDS® Vortechs® VortSentry® VortSentry® HS

Vortechs®

High performance hydrodynamic separation

The Vortechs system is a high-performance hydrodynamic separator that effectively removes finer sediment, oil and grease, and floating and sinking debris. Its swirl concentrator and flow controls work together to minimize turbulence and provide stable storage of captured pollutants. The design also allows for easy inspection and unobstructed maintenance access. With comprehensive lab and field testing, the system delivers proven results and site-specific solutions.

Precast models can treat peak design flows up to 25 cfs; cast-in-place models handle even greater flows. A typical system is sized to provide an 80% load reduction based on laboratory-verified removal efficiencies for varying particle size distributions such as 50-micron sediment particles.



How does it work?

Water enters the swirl chamber at a tangent, inducing a gentle swirling flow pattern and enhancing gravitational separation. Sinking pollutants stay in the swirl chamber while floating pollutants are stopped at the baffle wall. Typically Vortechs systems are sized such that 80% or more of runoff through the system will be controlled exclusively by the low flow control. This orifice effectively reduces inflow velocity and turbulence by inducing a slight backwater appropriate to the site.

During larger storms, the water level rises above the low flow control and begins to flow through the high flow control. The layer of floating pollutants is elevated above the influent pipe, preventing re-entrainment. Swirling action increases in relation to the storm intensity, which helps prevent re-suspension. When the storm drain is flowing at peak capacity, the water surface in the system approaches the top of the high flow control. The Vortechs system will be sized large enough so that previously captured pollutants are retained in the system even during these infrequent events.

As a storm subsides, treated runoff decants out of the Vortechs system at a controlled rate, restoring the water level to a dry-weather level equal to the invert of the inlet and outlet pipes. The low water level facilitates easier inspection and cleaning, and significantly reduces maintenance costs by reducing pump-out volume.

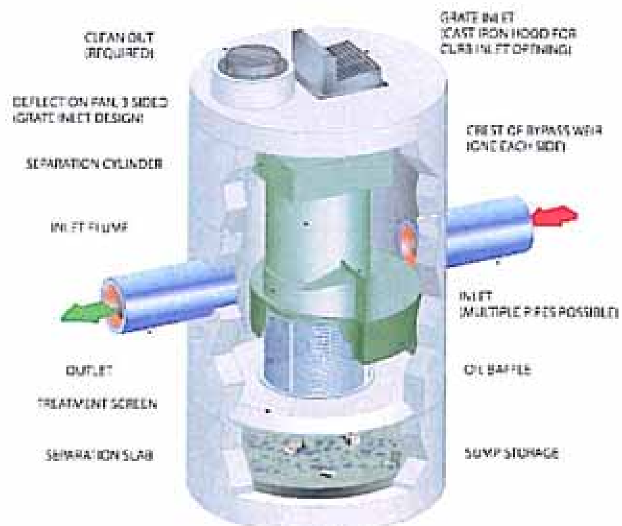
Vortechs

- Proven performance speeds approval process
- Treats peak flows without bypassing
- Flow controls reduce inflow velocity and increase residence time
- Unobstructed access simplifies maintenance
- Shallow system profile makes installation easier and less expensive
- Very low headloss
- Flexible design fits multiple site constraints

Vortechs®

CDS®

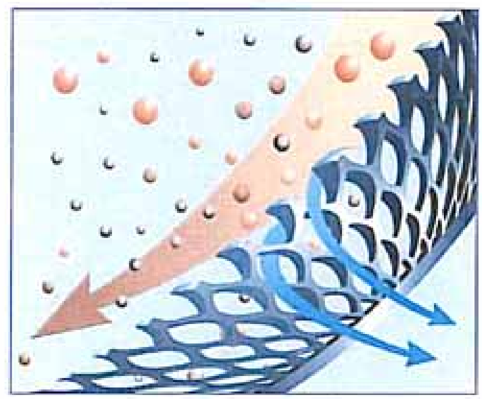
Patented continuous deflection separation (CDS) technology



Using patented continuous deflective separation technology, the CDS system screens, separates and traps sediment, debris, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Available in precast or cast-in-place. Offline units can treat flows from 30 to 8500 L/s (1 to 300 cfs). Inline units can treat up to 170 L/s (7.5 cfs), and internally bypass larger flows in excess of 1420 L/s (50 cfs). The pollutant removal capability of the CDS system has been proven in the lab and field.

How does it work?

Stormwater enters the CDS unit's diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed. All flows up to the system's treatment design capacity enter the separation chamber.



Swirl concentration and screen deflection forces floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During flow events exceeding the design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants will not wash out.

CDS

- Removes sediment, trash, and free oil and grease
- Patented screening technology captures and retains 100% of floatables, including neutrally buoyant and all other material larger than the screen aperture
- Operation independent of flow
- Performance verified through lab and field testing
- Unobstructed maintenance access
- Customizable/flexible design and multiple configurations available
- Separates and confines pollutants from outlet flow
- Inline, offline, grate inlet and drop inlet configurations available
- Multiple screen aperture sizes available

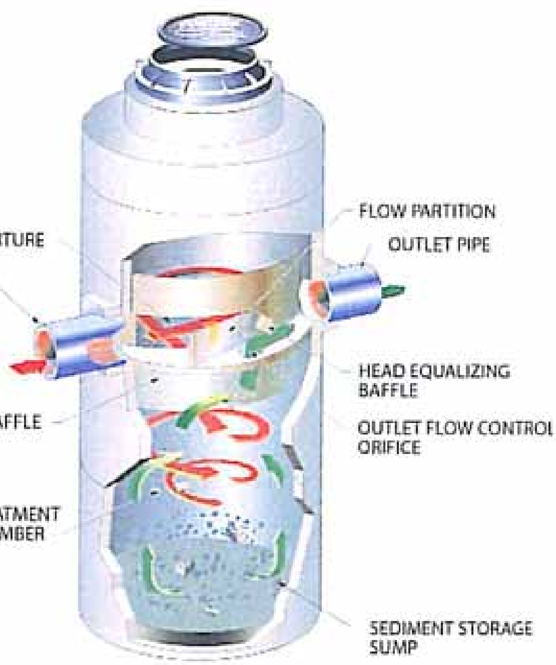
CDS

VortSentry®

Hydrodynamic separation with internal bypass

The VortSentry is a hydrodynamic separator with a small footprint that makes it an effective treatment option for projects where space is at a premium and effective removal of floating and sinking pollutants is critical. The internal bypass ensures treatment chamber velocities remain low, which improves performance and eliminates the risk of resuspension.

In addition to standalone applications, the VortSentry is an ideal pretreatment device. The system is housed inside a concrete manhole structure for easy installation (often without the use of a crane) and unobstructed maintenance access.



How does it work?

Stormwater runoff enters the unit tangentially to promote a gentle swirling motion in the treatment chamber. As stormwater circles within the chamber, settleable solids fall into the sump and are retained. Buoyant debris and oil and grease rise to the surface and are separated from the water as it flows under the baffle wall. Treated water exits the treatment chamber through a flow control orifice located behind the baffle wall.

During low-flow conditions all runoff is diverted into the treatment chamber by the flow partition. At higher flow rates, a portion of the runoff spills over the flow partition and is diverted around the treatment chamber, filling the head equalization chamber. This collapses the head differential between the treatment chamber and the outlet, resulting in a relatively constant flow rate in the treatment chamber even with a substantial increase in total flow through the system. This further reduces the potential for resuspension or washout of captured pollutants.

VortSentry

- Treatment and internal bypass in one structure
- Compact design ideal for congested sites
- Unobstructed maintenance access
- Round, lightweight construction for easy installation

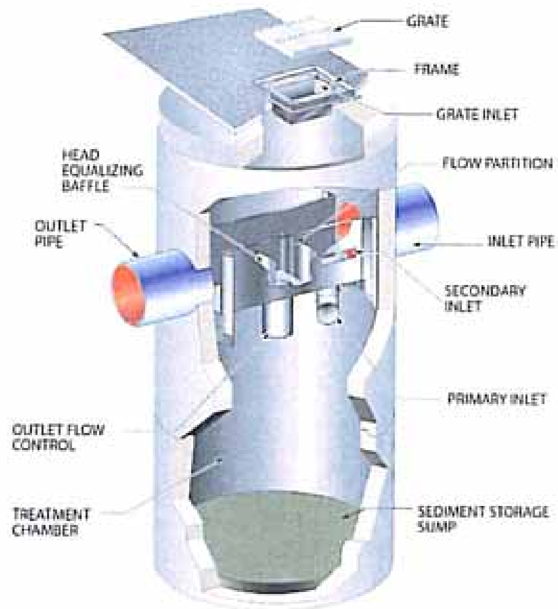
VortSentry® HS

Engineered performance and installation simplicity

The VortSentry HS system employs a helical flow pattern that enhances trapping and containment of pollutants and provides effective removal of settleable solids and floating contaminants from urban runoff.

With the ability to accept a wide range of pipe sizes, the VortSentry HS can treat and convey flows from small to large sites. A unique internal bypass design means higher flows can be diverted without the use of external bypass structures. The design of the VortSentry HS minimizes adverse velocities or turbulence in the treatment chamber. This helps to prevent the washout of previously captured pollutants even during peak conditions.

The VortSentry HS is also available in a grate inlet configuration, which is ideal for retrofits.



How does it work?

Flows from low intensity storms, which are most frequent, are directed into the treatment chamber through the primary inlet. The tangentially oriented downward pipe induces a swirling motion in the treatment chamber that increases capture and containment abilities. Moderate storm flows are directed into the treatment chamber through the secondary inlet, which allows for capture of floating trash and debris. The secondary inlet also provides for treatment of higher flows without significantly increasing the velocity or turbulence in the treatment chamber. This allows for a more quiescent separation environment. Settleable solids and floating pollutants are captured and contained in the treatment chamber.

Flow exits the treatment chamber through the outlet flow control, which manages the amount of flow that is treated and helps maintain the helical flow patterns developed within the treatment chamber.

Flows exceeding the system's rated treatment flow are diverted away from the treatment chamber by the flow partition. Internal diversion of high flows eliminates the need for external bypass structures. During bypass, the head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber. This helps prevent re-suspension of previously captured pollutants.

VortSentry HS

- Helical flow pattern enhances trapping and containment of pollutants
- High treatment and bypass capacities
- Compact footprint ideal for congested sites
- Lightweight design easy to install
- Available in both inline and grate inlet configurations
- Quick manufacturing turnaround time

Available Models

		CDS Model	Typical Internal MH Diameter or Equivalent ID[1] ft	m	Typical Depth[2] Below Pipe Invert ft	m	Water Quality Flow[3] 125 μm cfs	L/s	Screen Diameter/Height ft	m	Typical Sump Capacity yd³	m³
Precast**	Inline	CDS2015-4	4	1.2	3.5	1.1	0.7	19.8	2.0/1.5	0.6/0.5	0.5	0.4
		CDS2015	5	1.5	5.2	1.6	0.7	19.8	2.0/1.5	0.6/0.5	1.3	1.0
		CDS2020	5	1.5	5.7	1.7	1.1	31.2	2.0/2.0	0.6/0.6	1.3	1.0
		CDS2025	5	1.5	6.0	1.8	1.6	45.3	2.0/2.5	0.6/0.8	1.3	1.0
		CDS3020	6	1.8	6.2	1.9	2.0	56.6	3.0/2.0	0.9/0.6	2.1	1.6
		CDS3030	6	1.8	7.1	2.2	3.0	85.0	3.0/3.0	0.9/0.9	2.1	1.6
		CDS3035	6	1.8	7.6	2.3	3.8	106.2	3.0/3.5	0.9/1.1	2.1	1.6
		CDS4030	8	2.4	8.6	2.6	4.5	127.4	4.0/3.0	1.2/0.9	5.6	4.3
		CDS4040	8	2.4	9.7	3.0	6.0	169.9	4.0/4.0	1.2/1.2	5.6	4.3
		CDS4045	8	2.4	10.3	3.1	7.5	212.4	4.0/4.5	1.2/1.4	5.6	4.3
	Offline	CDS3020-D	6	1.8	6.2	1.9	2.0	56.6	3.0/2.0	0.9/0.6	2.1	1.6
		CDS3030-DV	6	1.8	6.9	2.1	3.0	85.0	3.0/3.0	0.9/0.9	2.1	1.6
		CDS3030-D	6	1.8	7.1	2.2	3.0	85.0	3.0/3.0	0.9/0.9	2.1	1.6
		CDS3035-D	6	1.8	8.7	2.6	3.8	106.2	3.0/3.5	0.9/1.1	2.1	1.6
		CDS4030-D	7	2.1	8.6	2.6	4.5	127.4	4.0/3.0	1.2/0.9	4.3	3.3
		CDS4040-D	7	2.1	9.6	2.9	6.0	169.9	4.0/4.0	1.2/1.2	4.3	3.3
		CDS4045-D	7	2.1	10.1	3.1	7.5	212.4	4.0/4.5	1.2/1.4	4.3	3.3
		CDS5042-DV	9.5	2.9	9.6	2.9	9.0	254.9	5.0/4.2	1.5/1.3	1.9	1.5
		CDS5640-D	8	2.4	9.5	2.9	9.0	254.9	5.6/4.0	1.7/1.2	5.6	4.3
		CDS5050-DV	9.5	2.9	10.3	3.1	11	311.5	5.0/5.0	1.5/1.5	1.9	1.5
		CDS5653-D	8	2.4	10.9	3.3	14	396.5	5.6/5.3	1.7/1.6	5.6	4.3
		CDS5668-D	8	2.4	12.4	3.8	19	538.1	5.6/6.8	1.7/2.1	5.6	4.3
		CDS5678-D	8	2.4	13.4	4.1	25	708.0	5.6/7.8	1.7/2.4	5.6	4.3
		CDS7070-DV	12	3.7	14	4.3	26	736.3	7.0/7.0	2.1/2.1	3.3	2.5
		CDS10060-DV	17.5	5.3	12	3.7	30	849.6	10.0/6.0	3.0/1.8	5.0 or 10.2	3.8 or 7.8
		CDS10080-DV	17.5	5.3	14	4.3	50	1416.0	10.0/8.0	3.0/2.4	5.0 or 10.2	3.8 or 7.8
		CDS100100-DV	17.5	5.3	16	4.9	64	1812.5	10.0/10.0	3.0/3.0	5.0 or 10.2	3.8 or 7.8
Cast In Place	Offline	CDS150134-DC	22	6.7**	22	6.7**	148	4191.4	15.0/13.4	4.6/4.1	20.4	15.6
		CDS200164-DC	26	7.9**	26	7.9**	270	7646.6	20.0/16.4	6.1/5.0	20.4	15.6
		CDS240160-DC	32	9.8**	25	7.6**	300	8496.2	24.0/16.0	7.3/4.9	20.4	15.6

**Sump Capacities and Depth Below Pipe Invert can vary due to specific site design

1. Structure diameter represents the typical inside dimension of the concrete structure. Offline systems will require additional concrete diversion components.
2. Depth Below Pipe and Sump Capacities can vary to accommodate specific site design.
3. Water Quality Flow is based on 80% removal of a Particle Size Distribution (PSD) having a mean particle size: d50=125-μm, which is a typical PSD gradation characterizing particulate matter (TSS/SSC) in urban rainfall runoff.

Water Quality Flow, Particle Size & Performance Notes:

- 80% removal (Re=80%) performance forecasts of the PSD having a d50=125-μm is derived from controlled tests of a unit equipped with 2400-μm screen. Performance forecasts for specific particle size gradations or d50s=50, 75, 125, 150 & 200-μm are also available. Removal forecasts based on unit evaluations conducted in accordance with the Technology Assessment Protocol - Ecology (TAPE) protocols, Washington Department of Ecology (WASDOE).
- Units can be sized to achieve specific Re performance for peak flow rates for specific Water Quality Flows, over the hydrograph of a Water Quality Storm Event or sized to meet a specific removal on an average basis using accepted probabilistic methods. When sizing based on a specific water quality flow rate, the required flow to be treated should be equal to or less than the listed water quality flow for the selected system.

Contact our support staff for the most cost effective sizing for your area.

Vortechs Model	Swirl Chamber Diameter		Internal Length		Water Quality Flow[1] cfs / L/s			Peak Treatment Flow[2]		Sediment Storage	
	ft	m	ft	m	50 μm	110 μm	200 μm	cfs	L/s	yd³	m³
1000	3	0.9	9	2.7	0.21/5.9	0.59/16.7	0.98/27.8	1.6	45.3	0.7	0.5
2000	4	1.2	10	3.0	0.36/10.2	1.0/28.3	1.7/48.1	2.8	79.3	1.2	0.9
3000	5	1.5	11	3.4	0.59/16.7	1.7/48.1	2.7/76.5	4.5	127.4	1.8	1.4
4000	6	1.8	12	3.7	0.78/22.1	2.2/62.3	3.7/104.8	6.0	169.9	2.4	1.8
5000	7	2.1	13	4.0	1.1/31.1	3.1/87.8	5.2/147.2	8.5	240.7	3.2	2.4
7000	8	2.4	14	4.3	1.4/39.6	4.1/116.1	6.7/189.7	11.0	311.5	4.0	3.1
9000	9	2.7	15	4.6	1.8/51.0	5.2/147.2	8.5/240.7	14.0	396.4	4.8	3.7
11000	10	3.0	16	4.9	2.3/65.1	6.5/184.1	10.7/303.0	17.5	495.5	5.6	4.3
16000	12	3.7	18	5.5	3.3/93.4	9.3/263.3	15.3/433.2	25.0	707.9	7.1	5.4

1. Water Quality Flow Rates are based on 80% removal for the particle size distributions (PSD) listed above with d50 = 50, 110 & 200-μm. Particle size should be chosen based on anticipated sediment load.
2. Peak Treatment Flow is maximum flow treated for each unit listed. This flow represents an infrequent storm event such as a 10 or 25 yr storm.

Standard Vortechs System depth below invert is 3' for all precast models.

Cast-in-place system are available to treat higher flows. Check with your local representatives for specifications.

VortSentry Model	Swirl Chamber Diameter		Typical Depth Below Invert		Water Quality Flow[1] 110 μm		Max. Size Inlet/Outlet		Sediment Storage	
	ft	m	ft	m	cfs	L/s	in	mm	yd³	m³
VS30*	3	0.9	5.8	1.8	0.26	7.4	12	300	0.8	0.6
VS40	4	1.2	7.0	2.1	0.58	16.4	18	460	1.4	1.1
VS50*	5	1.5	8.0	2.4	1.1	31.1	18	460	2.2	1.7
VS60	6	1.8	8.9	2.7	1.8	51.0	24	600	3.1	2.4
VS70*	7	2.1	9.7	3.0	2.7	76.5	30	750	4.3	3.3
VS80	8	2.4	10.1	3.1	3.9	110.4	36	600	5.6	4.3

* Denotes models may not be manufactured in your area. Check with your local representative for availability.

1. Water Quality Flow is based on 80% removal of a particle size distribution with an average particle size of 110-μm. This flow also represents the maximum flow prior to which bypass occurs.

VortSentry HS Model	Swirl Chamber Diameter		Typical Depth Below Invert		Water Quality Flow[1] 240 μm		Max. Size Inlet/Outlet		Sediment Storage	
	ft	m	ft	m	cfs	L/s	in	mm	yd³	m³
HS36*	3	0.9	5.6	1.7	0.55	15.6	18	460	0.5	0.4
HS48	4	1.2	6.8	2.1	1.2	34.0	24	600	0.9	0.7
HS60*	5	1.5	8.0	2.4	2.2	62.3	30	760	1.5	1.1
HS72	6	1.8	9.2	2.8	3.7	104.8	36	900	2.1	1.6
HS84*	7	2.1	10.4	3.2	5.6	158.6	42	1050	2.8	2.1
HS96	8	2.4	11.5	3.5	8.1	229.4	48	1200	3.7	2.8

* Models may not be manufactured in your area. Check with your local representative for availability.

1. Water Quality Flow is based on 80% removal of a particle size distribution with an average particle size of 240-μm. This flow also represents the maximum flow prior to which bypass occurs.

Notes: Systems can be sized based on a water quality flow (e.g. 1 inch storm) or on a net annual basis depending on the local regulatory requirement.

When sizing based on a water quality storm, the required flow to be treated should be equal or less than the listed water quality flow for the selected system. Systems sized based on a water quality storm are generally more conservatively sized.

Additional particle size distributions are available for sizing purposes upon request.

Depth below invert is measured to the inside bottom of the system. This depth can be adjusted to meet specific storage or maintenance requirements.

Contact our support staff for the most cost effective sizing for your area.

Customer Support

Installation

CONTECH Stormwater Solutions' products are some of the easiest to install in the industry. We provide comprehensive installation drawings, details and instructions, as well as full technical support on every project.

Maintenance

Maintenance of CONTECH Stormwater Solutions products is cost effective, straightforward and efficient. We offer a complete range of engineering planning, design and drawing, and construction services that can be tailored to your specific site needs.

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our professional engineering staff engineers.

800.338.1122
contech-cpi.com

CONTECH Construction Products Inc is your single source for hassle-free specifying and purchasing of comprehensive site solutions. CONTECH's portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer, soil stabilization and stormwater solutions.

HDS Products-3 6M 07/08

OPERATIONS AND MAINTENANCE GUIDELINES

CDS Stormwater Treatment Unit

INTRODUCTION

The CDS unit is an important and effective component of your storm water management program and proper operation and maintenance of the unit are essential to demonstrate your compliance with local, state and federal water pollution control requirements.

The CDS technology features a patented non-blocking, indirect screening technique developed in Australia to treat water runoff. The unit is highly effective in the capture of suspended solids, fine sands and larger particles. Because of its non-blocking screening capacity, the CDS unit is un-matched in its ability to capture and retain gross pollutants such as trash and debris. In short, CDS units capture a very wide range of organic and in-organic solids and pollutants that typically result in tons of captured solids each year such as: Total suspended solids (TSS) and other sedimentitious materials, oil and greases, trash, and other debris (including floatables, neutrally buoyant, and negatively buoyant debris). These pollutants will be captured even under very high flow rate conditions.

CDS units are equipped with conventional oil baffles to capture and retain oil and grease. Laboratory evaluations show that the CDS units are capable of capturing up to 70% of the free oil and grease from storm water. CDS units can also accommodate the addition of oil sorbents within their separation chambers. The addition of the oil sorbents can ensure the permanent removal of 80% to 90% of the free oil and grease from the storm water runoff.

OPERATIONS

The CDS unit is a non-mechanical self-operating system and will function any time there is flow in the storm drainage system. The unit will continue to effectively capture pollutants in flows up to the design capacity even during extreme rainfall events when the design capacity may be exceeded. Pollutants captured in the CDS unit's separation chamber and sump will be retained even when the units design capacity is exceeded.

CDS UNIT INSPECTION

Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection (and clean out) of the separation chamber (screen/cylinder) & sump and another allows inspection (and cleanout) of sediment captured and retained behind the screen.

The unit should be periodically inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load being processed by the CDS unit. The unit should be periodically inspected for indications of vector infestation, as well. The recommended cleanout of solids within the CDS unit's sump should occur at 75% to 85% of the sump capacity. However, the sump may be completely full with no impact to the CDS unit's performance.

CONTECH Stormwater Solutions (previously CDS Technologies) recommends the following inspection guidelines: For new initial operation, check the condition of the unit after every runoff event for the first 30 days. For ongoing operations, the unit should be inspected after the first six inches of rainfall at the beginning of the rainfall season and at approximately 30-day intervals. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or separation screen), evidence of vector infestation, and to measure the amount of solid materials that have accumulated in the sump, fine sediment accumulated behind the screen, and floating trash and debris in the separation chamber. This can be done with a calibrated dipstick, tape measure or other measuring instrument so that the depth of deposition in the sump can be tracked.

CDS UNIT CLEANOUT

The frequency of cleaning the CDS unit will depend upon the generation of trash and debris and sediments in your application. Cleanout and preventive maintenance schedules will be determined based on operating experience unless precise pollutant loadings have been determined.

Access to the CDS unit is typically achieved through two manhole access covers – one allows cleanout of the separation chamber (screen/cylinder) & sump and another allows cleanout of sediment captured and retained behind the screen. For units possessing a sizable depth below grade (depth to pipe), a single manhole access point would allow both sump cleanout and access behind the screen.

CONTECH Stormwater Solutions Recommends The Following:

<u>NEW INSTALLATIONS</u>: Check the condition of the unit after every runoff event for the first 30 days. The visual inspection should ascertain that the unit is functioning properly (no blockages or obstructions to inlet and/or separation screen), measuring the amount of solid materials that have accumulated in the sump, the amount of fine sediment accumulated behind the screen, and determining the amount of floating trash and debris in the separation chamber. This can be done with a calibrated "dip stick" so that the depth of deposition can be tracked. Refer to the "Cleanout Schematic" **(Appendix B) f**or allowable deposition depths and critical distances. Schedules for inspections and cleanout should be based on storm events and pollutant accumulation.

<u>ONGOING OPERATION:</u> During the rainfall season, the unit should be inspected at least once every 30 days. The floatables should be removed and the sump cleaned when the sump is 75-85% full. If floatables accumulate more rapidly than the settleable solids, the floatables should be removed using a vactor truck or dip net before the layer thickness exceeds approximately one foot.

Cleanout of the CDS unit at the end of a rainfall season is recommended because of the nature of pollutants collected and the potential for odor generation from the decomposition of material collected and retained. This end of season cleanout will assist in preventing the discharge of pore water from the CDS ® unit during summer months.

USE OF SORBENTS –The addition of sorbents is **not a requirement** for CDS units to effectively control oil and grease from storm water. The conventional oil baffle within a unit assures satisfactory oil and grease removal. However, the addition of sorbents is a unique enhancement capability unique to CDS units, enabling increased oil and grease capture efficiencies beyond that obtainable by conventional oil baffle systems.

Under normal operations, CDS units will provide effluent concentrations of oil and grease that are less than 15 parts per million (ppm) for all dry weather spills where the volume is less than or equal to the spill capture volume of the CDS unit. During wet weather flows, the oil baffle system can be expected to remove between 40 and 70% of the free oil and grease from the storm water runoff.

CONTECH Stormwater Solutions only recommends the addition of sorbents to the separation chamber if there are specific land use activities in the catchment watershed that could produce exceptionally large concentrations of oil and grease in the runoff, concentration levels well above typical amounts. If site evaluations merit an increased control of free oil and grease then oil sorbents can be added to the CDS unit to thoroughly address these particular pollutants of concern.

Recommended Oil Sorbents

Rubberizer® Particulate 8-4 mesh or OARS ™ Particulate for Filtration, HPT4100 or equal. Rubberizer is supplied by Haz-Mat Response Technologies, Inc. 4626 Santa Fe Street, San Diego, CA 92109 (800) 542-3036. OARS is supplied by AbTech Industries, 4110 N. Scottsdale Road, Suite 235, Scottsdale, AZ 85251 (800) 545-8999.

The amount of sorbent to be added to the CDS separation chamber can be determined if sufficient information is known about the concentration of oil and grease in the runoff. Frequently the actual concentrations of oil and grease are too variable and the amount to be added and frequency of cleaning will be determined by periodic observation of the sorbent. As an initial application, CDS recommends that approximately 4 to 8 pounds of sorbent material be added to the separation chamber of the CDS units per acre of parking lot or road surface per year. Typically this amount of sorbent results in a ½ inch to one (1") inch depth of sorbent material on the liquid surface of the separation chamber. The oil and grease loading of the sorbent material should be observed after major storm events. Oil Sorbent material may also be furnished in pillow or boom configurations.

The sorbent material should be replaced when it is fully discolored by skimming the sorbent from the surface. The sorbent may require disposal as a special or hazardous waste, but will depend on local and state regulatory requirements.

CLEANOUT AND DISPOSAL

A vactor truck is recommended for cleanout of the CDS unit and can be easily accomplished in less than 30-40 minutes for most installations. Standard vactor operations should be employed in the cleanout of the CDS unit. Disposal of material from the CDS unit should be in accordance with the local municipality's requirements. Disposal of the decant material to a POTW is recommended. Field decanting to the storm drainage system is not recommended. Solids can be disposed of in a similar fashion as those materials collected from street sweeping operations and catch-basin cleanouts.

MAINTENANCE

The CDS unit should be pumped down at least once a year and a thorough inspection of the separation chamber (inlet/cylinder and separation screen) and oil baffle performed. The unit's internal components should not show any signs of damage or any loosening of the bolts used to fasten the various components to the manhole structure and to each other. Ideally, the screen should be power washed for the inspection. If any of the internal components is damaged or if any fasteners appear to be damaged or missing, please contact CONTECH at 800.338.2211 to make arrangements to have the damaged items repaired or replaced.

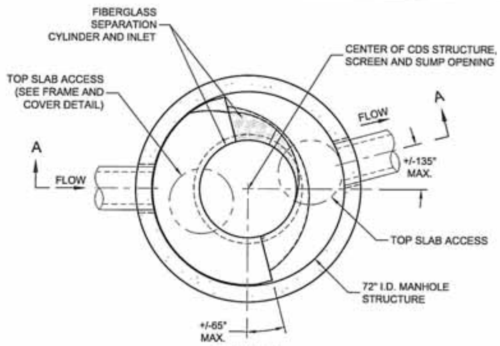
The screen assembly is fabricated from Type 316 stainless steel and fastened with Type 316 stainless steel fasteners that are easily removed and/or replaced with conventional hand tools. The damaged screen assembly should be replaced with the new screen assembly placed in the same orientation as the one that was removed.

CONFINED SPACE

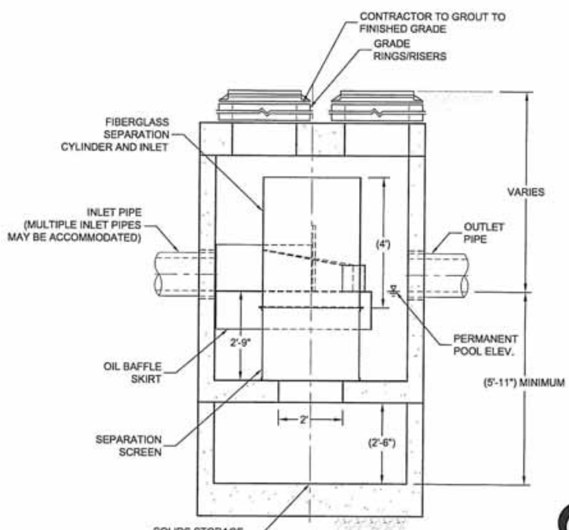
The CDS unit is a confined space environment and only properly trained personnel possessing the necessary safety equipment should enter the unit to perform particular maintenance and/or inspection activities beyond normal procedure. Inspections of the internal components can, in most cases, be accomplished by observations from the ground surface.

VECTOR CONTROL

Most CDS units do not readily facilitate vector infestation. However, for CDS units that may experience extended periods of non-operation (stagnant flow conditions for more than approximately one week) there may be the potential for vector infestation. In the event that these conditions exist, the CDS unit may be designed to minimize potential vector habitation through the use of physical barriers (such as seals, plugs and/or netting) to seal out potential vectors. The CDS unit may also be configured to allow drain-down under favorable soil conditions where infiltration of storm water runoff is permissible. For standard CDS units that show evidence of mosquito infestation, the



PLAN VIEW
N.T.S.



SECTION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING

CDS3020 DESIGN NOTES

CDS3020 RATED TREATMENT CAPACITY IS 2.0 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 20.0 CFS. IF THE SITE CONDITIONS EXCEED 20.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS3020 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRATED INLET ONLY (NO INLET PIPE)
GP	GRATED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES
B	SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
W	SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS

FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE AND CASTINGS SHALL MEET AASHTO HS20 LOAD RATING.

INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH STORMWATER SOLUTIONS
contechstormwater.com

CDS3020 PRECAST CONCRETE WATER QUALITY SYSTEM STANDARD DETAIL

application of larvicide is one control strategy that is recommended. Typical larvicide applications are as follows:

SOLID B.t.i. LARVICIDE: ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) or as directed by manufacturer.

SOLID METHOPRENE LARVICIDE (not recommended for some locations): ½ to 1 briquet (typically treats 50-100 sq. ft.) one time per month (30-days) to once every 4-½ to 5-months (150-days) or as directed by manufacturer.

RECORDS OF OPERATION AND MAINTENANCE

CONTECH Stormwater Solutions recommends that the owner maintain annual records of the operation and maintenance of the CDS unit to document the effective maintenance of this important component of your storm water management program. The attached **Annual Record of Operations and Maintenance** form (see **Appendix A**) is suggested and should be retained for a minimum period of three years.

APPENDIX A

ANNUAL RECORDS OF
OPERATIONS & MAINTENANCE
AND INSPECTION CHECKLISTS

ANNUAL RECORD OF
OPERATION AND MAINTENANCE

OWNER ______________________________
ADDRESS ______________________________
OWNER REPRESENTATIVE ____________________ **PHONE** ____________________

INSTALLATION:
MODEL DESIGNATION ____________________ DATE ____________________
SITE LOCATION ______________________________

INSPECTIONS:

DATE/ INSPECTOR	SCREEN/INLET INTEGRITY	FLOATABLES DEPTH	DEPTH TO SEDIMENT (inches)	SEDIMENT VOLUME* (CUYDS)	SORBENT DISCOLORATION

DEPTH FROM COVER TO BOTTOM OF SUMP (SUMP INVERT) ____________________

DEPTH FROM COVER TO SUMP @ 75% FULL ____________________

VOLUME OF SUMP @ 75% FULL = ________ CUYD

VOLUME/INCH DEPTH ____________ CUFT/IN OF SUMP

VOLUME/FOOT DEPTH ____________ CUYD/FT OF SUMP

***Calculate Sediment Volume = (Depth to Sump Invert – Depth to Sediment)*(Volume/inch)**
OBSERVATIONS OF FUNCTION: ______________________________

____

____

CLEANOUT:

DATE	VOLUME FLOATABLES	VOLUME SEDIMENTS	METHOD OF DISPOSAL OF FLOATABLES, SEDIMENTS, DECANT AND SORBENTS

OBSERVATIONS:

____

____

____

____

SCREEN MAINTENANCE:
DATE OF POWER WASHING, INSPECTION AND OBSERVATIONS:

____

____

CERTIFICATION: ____________________ **TITLE:** ____________ **DATE:** ________

INSPECTION CHECKLIST

1. During the rainfall season, inspect and check condition of unit at east once every 30 days ☐
2. Ascertain that the unit is funcioning properly (no blockages or obstructions to inlet and/or separation screen) ☐
3. Measure amount of solid material s that have accumulated in the sump (Unit should be cleaned when the sump is 75-85% full) ☐
4. Measure amount of fine sediment accumulated behind the screen ☐
5. Measure amount of floating trash and debris in the separation chamber ☐

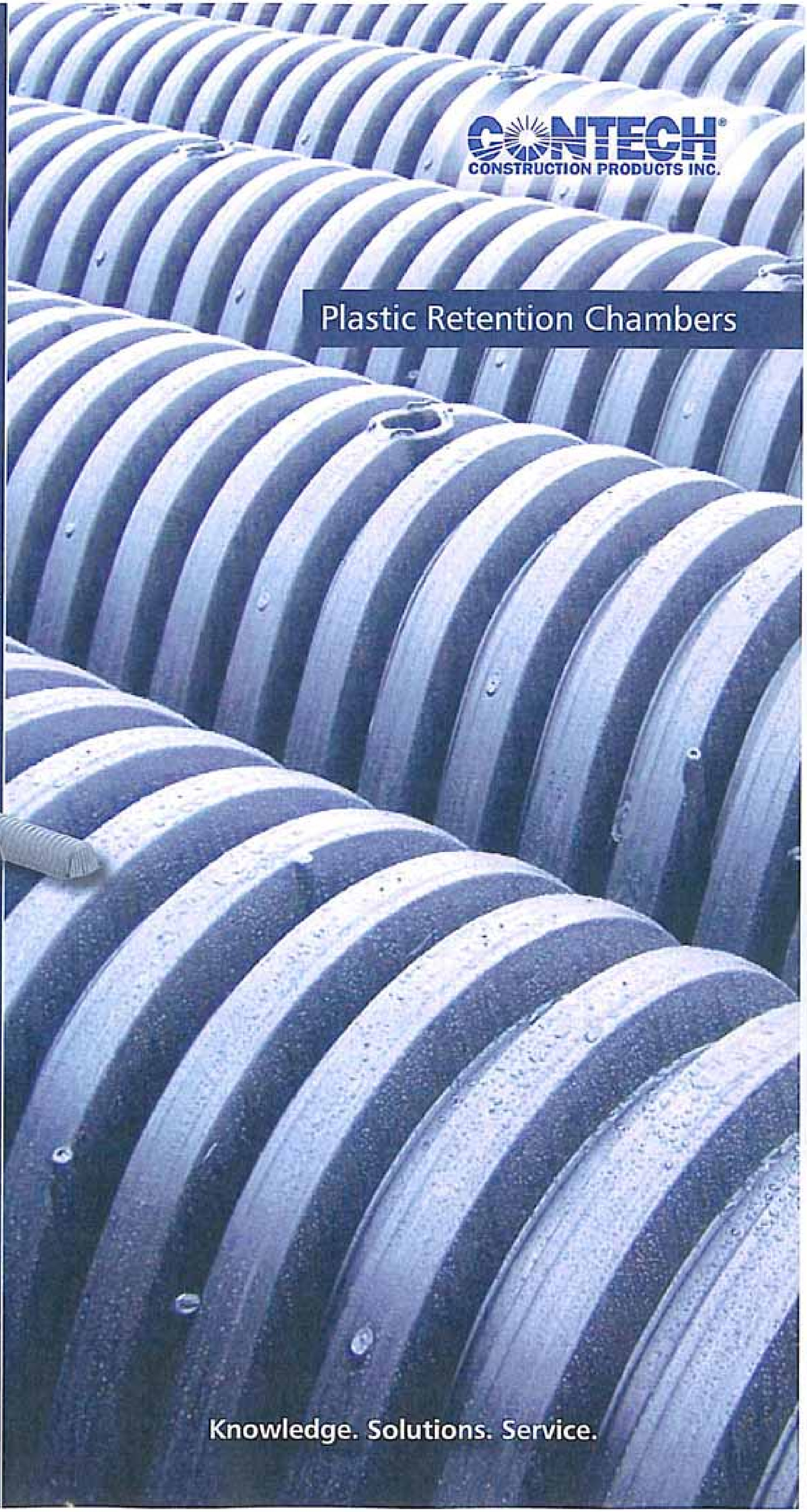
MAINTENANCE CHECKLIST

1. Cleanout unit at the end and beginning of the rainfall season ☐
2. Pump down unit (at least once a year) and thoroughly inspect separation chamber, separation screen and oil baffle ☐
3. No visible signs of damage or loosening of bolts to internal components observed * ☐

*** If there is any damage to the internal components or any fasteners are damaged or missing please contact CONTECH (800.338.1122).**

Retention/Detention

CHAMBERMaxx™



ChamberMaxx™

ChamberMaxx is the latest in corrugated, open-bottom arch systems designed to economically collect, detain, retain and infiltrate stormwater runoff. The below-grade system maximizes available land for development, and can support traffic loading for installation under parking lots and roadways. The chambers are injection molded using structurally efficient and corrosive-resistant polypropylene resin.

In retention applications, the ChamberMaxx system effectively recharges groundwater to achieve reduced discharge objectives, including **Low Impact Development (LID)**, and **Leadership Energy and Environmental Design (LEED)**. The system is most effective on sites where the depth from finished grade to storm sewer outlet is less than 54-inches (1.37-meters). For sites with deeper applications refer to the other CONTECH family of retention/detention products, such as concrete arches and corrugated metal pipe systems.

With 49 ft³ (1.39 m³) of available storage per chamber, ChamberMaxx is the most cost efficient of its kind. Innovative sub-corrugations provide greater strength and the chambers utilize a resin efficient design. A short height profile optimizes stormwater storage on shallow sites. Lightweight chambers allow for placement without the use of heavy equipment.

Install a CONTECH pre-treatment water quality unit, upstream of the ChamberMaxx system for the highest level of performance at the lowest cost. This combined water quality and quantity system reduces maintenance costs by capturing the pollutants in one confined location, and extends the performance life of the overall system by reducing occlusion of the void space within the surrounding stone.

CONTECH also offers the optional ChamberMaxx Containment Row. Contact your local representative for assistance in selecting the most efficient pre-treatment solution.

Going Green?
Looking for LID Solutions?
Need LEED Credits?

Specify ChamberMaxx on Your Next Project!

Performance Testing

ChamberMaxx has undergone a thorough structural analysis by structural engineers and full scale in-ground field burial tests have been performed. The chambers are structurally designed to exceed HS-20/HS-25 live loads in accordance with AASHTO (Section 12) LRFD design specifications for stormwater chambers. Structural performance is dependent on proper installation per the ChamberMaxx installation guidelines.

Design

ChamberMaxx has a multitude of layout and configuration options. Contact your local representative for assistance optimizing your system to meet your site specific design requirements.

For flow routing see the ChamberMaxx stage-storage curve (available in this brochure) or download the ChamberMaxx stage-storage calculator at www.contechstormwater.com.

Design Your Own Detention System

Our DYODS™ (Design Your Own Detention System) sizing calculator, makes it is easy to design the right ChamberMaxx for your site.

Visit www.contechstormwater.com/dyods to:

- Size system and lay out footprint
- Quantify construction materials
- Receive graphic plan view layout

HydroCAD®

ChamberMaxx is supported in HydroCAD — a computer aided design tool for modeling stormwater runoff available from our partners at HydroCAD Software LLC.

- Download at www.hydrocad.net
- Easy modeling for stormwater flows — automatic storage calculations
- Simple to use — just select CONTECH products from drop-down menu
- Effortlessly compare systems with real time evaluation of hydraulic differences

DYODS™
Design Your Own Detention System

HydroCAD
Stormwater Modeling

Make your job easier with our design tools!

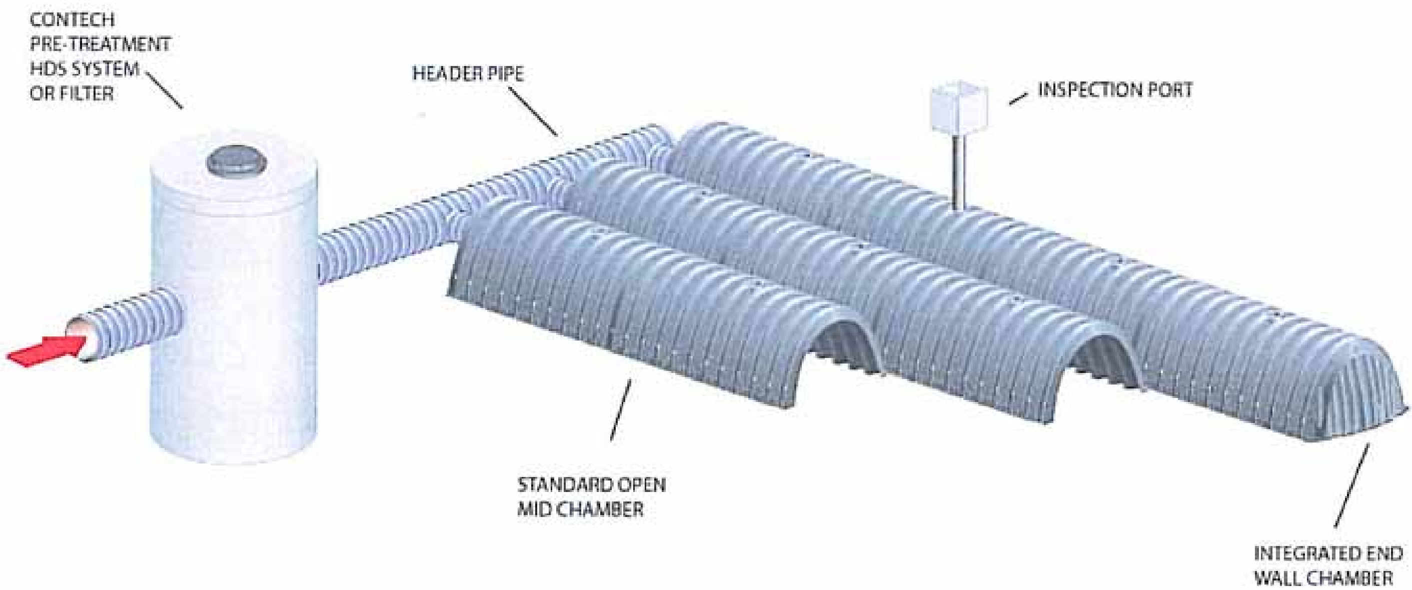
Sizing

The ChamberMaxx system combines middle chambers, which are open on both ends, with start and end chambers, which include an integral end wall. All chambers have sidewall perforations that allows water to equalize throughout the system.

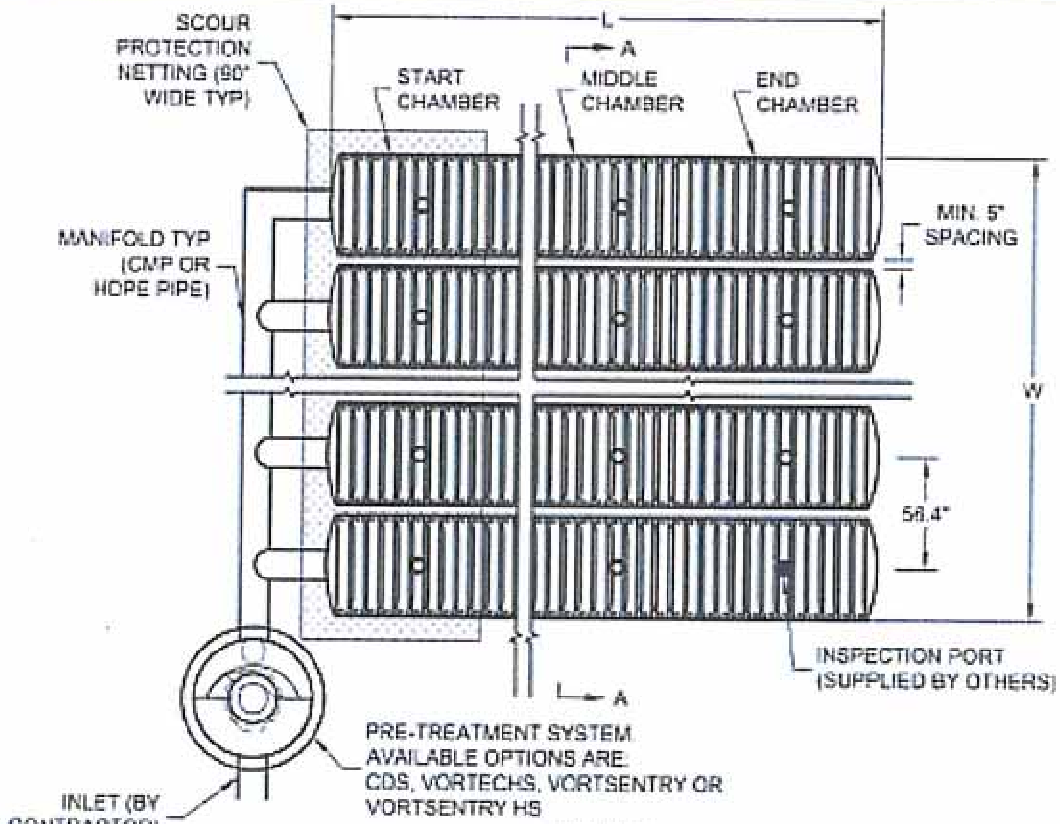
ChamberMaxx utilizes a header manifold system that can be manufactured from various materials. Commonly utilized header pipe materials are corrugated metal pipe (CMP) and HDPE pipe, and are available from CONTECH in a single package. The start and end chambers can accept up to a 24-inch diameter (0.61 meter) inlet pipe.

Chamber Part	Width		Height		Weight		Actual Length		*Installed Length		Storage Volume		*Installed Storage Volume	
	in	(m)	in	(m)	lbs	(kg)	in	(m)	in	(m)	cf	(m^3)	cf	(m^3)
Start	51.4	(1.31)	30.3	(0.77)	85.0	(38.55)	98.4	(2.50)	96.2	(2.44)	52.5	(1.48)	78.7	(2.22)
Middle	51.4	(1.31)	30.3	(0.77)	77.0	(34.92)	91.0	(2.31)	85.4	(2.17)	49.3	(1.40)	76.7	(2.17)
End	51.4	(1.31)	30.3	(0.77)	76.0	(34.47)	92.0	(2.34)	88.5	(2.25)	48.2	(1.36)	76.1	(2.15)

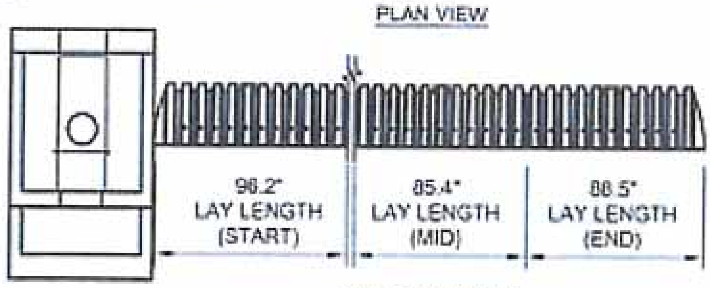
*Six-inches (0.15 meters) of stone below and above chamber and 5-inch (0.13 meters) chamber spacing and 40% stone porosity.



CHAMBERMaxx™



PLAN VIEW

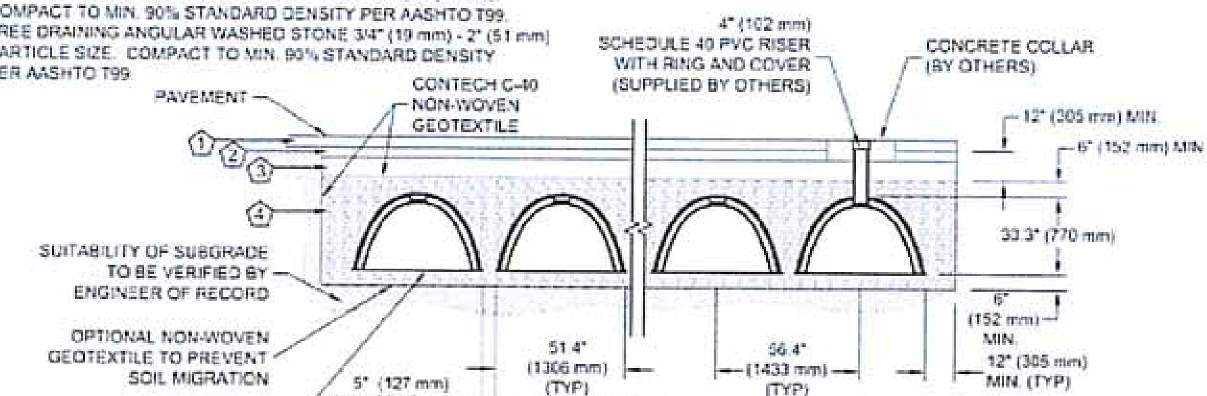


ELEVATION VIEW

TYPICAL LAYOUT

KEY

1. FLEXIBLE PAVEMENT.
2. GRANULAR ROAD BASE.
3. WELL GRADED GRANULAR FILL. AASHTO M145 A1, A2, OR A3. COMPACT TO MIN. 90% STANDARD DENSITY PER AASHTO T99.
4. FREE DRAINING ANGULAR WASHED STONE 3/4" (19 mm) - 2" (51 mm) PARTICLE SIZE. COMPACT TO MIN. 90% STANDARD DENSITY PER AASHTO T99.



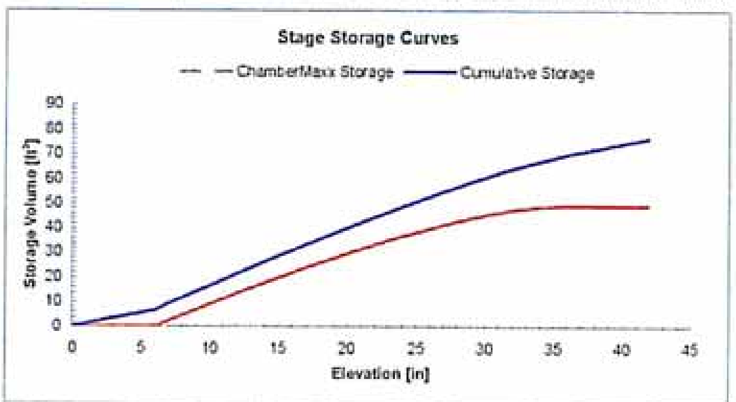
SECTION A-A
(H20/H25 LIVE LOAD) PER AASHTO 12

ChamberMaxx Flow Routing

Stage Storage Table

Elevation			Storage Volume Including 12" of Stone		Chamber Storage Volume		Cumulative Volume Increment		*Cumulative Storage Volume	
in	(m)		ft³	(m³)	ft³	(m³)	ft³	(m³)	ft³	(m³)
42.0	(1.07)	Standard 6" Stone	62.6	(1.77)	49.3	(1.40)	1.3	(0.04)	76.7	(2.17)
40.8	(1.04)		61.3	(1.74)	49.3	(1.40)	1.3	(0.04)	75.3	(2.13)
39.6	(1.01)		59.9	(1.70)	49.3	(1.40)	1.3	(0.04)	74.0	(2.10)
38.4	(0.98)		58.6	(1.66)	49.3	(1.40)	1.3	(0.04)	72.6	(2.06)
37.2	(0.94)		57.3	(1.62)	49.3	(1.40)	1.3	(0.04)	71.3	(2.02)
36.0	(0.91)		55.9	(1.58)	49.3	(1.40)	0.2	(0.01)	70.0	(1.98)
34.8	(0.88)		55.7	(1.58)	49.0	(1.39)	0.5	(0.01)	68.2	(1.93)
33.6	(0.85)		55.2	(1.56)	48.6	(1.38)	0.7	(0.02)	66.5	(1.88)
32.4	(0.82)		54.5	(1.54)	47.8	(1.35)	1.1	(0.03)	64.8	(1.84)
31.2	(0.79)		53.5	(1.52)	46.8	(1.33)	1.3	(0.04)	62.8	(1.78)
30.0	(0.76)		52.2	(1.48)	45.5	(1.29)	1.5	(0.04)	60.7	(1.72)
28.8	(0.73)		50.7	(1.44)	44.0	(1.25)	1.6	(0.05)	58.5	(1.66)
27.6	(0.70)		49.0	(1.39)	42.4	(1.20)	1.8	(0.05)	56.1	(1.59)
26.4	(0.67)		47.3	(1.34)	40.6	(1.15)	1.9	(0.05)	53.8	(1.52)
25.2	(0.64)		45.4	(1.29)	38.8	(1.10)	1.9	(0.05)	51.3	(1.45)
24.0	(0.61)		43.5	(1.23)	36.8	(1.04)	2.0	(0.06)	48.8	(1.38)
22.8	(0.58)		41.5	(1.18)	34.8	(0.99)	2.1	(0.06)	46.3	(1.31)
21.6	(0.55)		39.4	(1.12)	32.7	(0.93)	2.2	(0.06)	43.7	(1.24)
20.4	(0.52)		37.2	(1.05)	30.5	(0.86)	2.2	(0.06)	41.0	(1.16)
19.2	(0.49)		35.0	(0.99)	28.3	(0.80)	2.3	(0.07)	38.3	(1.09)
18.0	(0.46)		32.7	(0.93)	26.0	(0.74)	2.4	(0.07)	35.6	(1.01)
16.8	(0.43)		30.3	(0.86)	23.6	(0.67)	2.4	(0.07)	32.9	(0.93)
15.6	(0.40)		27.9	(0.79)	21.2	(0.60)	2.5	(0.07)	30.1	(0.85)
14.4	(0.37)		25.4	(0.72)	18.7	(0.53)	2.5	(0.07)	27.2	(0.77)
13.2	(0.34)		22.8	(0.65)	16.2	(0.46)	2.6	(0.07)	24.4	(0.69)
12.0	(0.30)		20.3	(0.58)	13.6	(0.39)	2.6	(0.07)	21.5	(0.61)
10.8	(0.27)		17.6	(0.50)	10.9	(0.31)	2.7	(0.08)	18.6	(0.53)
9.6	(0.24)		14.9	(0.42)	8.3	(0.24)	2.7	(0.08)	15.6	(0.44)
8.4	(0.21)		12.2	(0.35)	5.6	(0.16)	2.8	(0.08)	12.7	(0.36)
7.2	(0.18)		9.5	(0.27)	2.8	(0.08)	2.8	(0.08)	9.7	(0.28)
6.0	(0.15)	Standard 6" Stone	6.7	(0.19)	0.0	(0.00)	1.3	(0.04)	6.7	(0.19)
4.8	(0.12)		5.3	(0.15)	0.0	(0.00)	1.3	(0.04)	5.3	(0.15)
3.6	(0.09)		4.0	(0.11)	0.0	(0.00)	1.3	(0.04)	4.0	(0.11)
2.4	(0.06)		2.7	(0.08)	0.0	(0.00)	1.3	(0.04)	2.7	(0.08)
1.2	(0.03)		1.3	(0.04)	0.0	(0.00)	1.3	(0.04)	1.3	(0.04)
0.0	(0.00)		0.0	(0.00)	0.0	(0.00)	-	-	0.0	(0.00)

*Six-inches (0.15 meters) of stone below and above chamber and 5-inch (0.13 meters) chamber spacing and 40% stone porosity.



Proper design of any detention system typically requires that flow routing be performed. Engineers at CONTECH can be a valuable resource when designing a ChamberMaxx retention system. Typically stage-storage curves like those shown are utilized in the analysis. CONTECH stage-storage calculator is available for download on www.contechstormwater.com. This information can simply be inserted into common hydrology/hydraulic software such as HydroCAD, HydroFlow, PondPack, or TR20. This makes a flow routing design with ChamberMaxx just as simple as an above-ground pond design.

Installation

ChamberMaxx retention systems require adherence to the installation procedure for the structural integrity of the system to be maintained. Full installation instructions are available at www.contechstormwater.com, or contact your local CONTECH representative.

ChamberMaxx systems include chambers, fabricated header/manifold components, scour protection netting, inspection port materials, and C-40 NW geotextile material.

Typical Installation Sequence:

1. Excavate and prepare
2. Install pre-treatment system
3. Prepare foundation & bedding
4. Set header pipe/manifold system
5. Place scour protection netting underneath all chambers with inlet pipes
6. Set Start, Mid and End chambers into place by hand
7. Connect header and other required inlet and outlet piping
8. Place geotextile fabrics
9. Backfill and complete

Maintenance

Each chamber is manufactured with inspection portals. Location of inspection portals to be specified by the project design Engineer.

It is recommend that the system is inspected annually and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities rather than the size or configuration of the system.

For more details please refer to the ChamberMaxx operations and maintenance guideline at www.contechstormwater.com or contact your local CONTECH representative.

CONTECH CONSTRUCTION PRODUCTS INC.

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800.338.1122
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Knowledge. Solutions. Service.

Provider of: Bridge, [illegible]ge, Erosio[illegible], Retaining [illegible], Soil Stabiliz[illegible]rmwater Solution[illegible]

ChamberMaxx-Rev2 7M 12/08 MC

TORRENT RESOURCES

INDUSTRY SERVICES

Site Drainage Systems

Technical Analysis

Recharge Systems

Environmental Applications

Drainage Resources

Drainage Maintenance

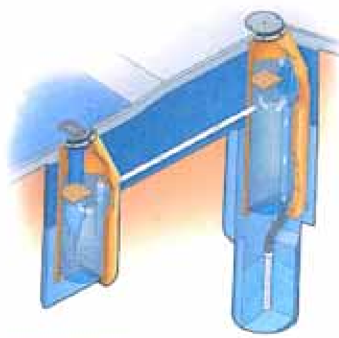
TORRENT RESOURCES INCORPORATED

www.TorrentResources.com

MaxWell™ Plus DRAINAGE SYSTEM

TORRENT RESOURCES

The **MaxWell™ Plus**, as manufactured and installed exclusively by Torrent Resources Incorporated, is the industry standard for draining large paved surfaces, nuisance water and other demanding applications. This patented system incorporates state-of-the-art pre-treatment technology.



THE ULTIMATE IN DESIGN

Since 1974, over 40,000 MaxWell™ Systems have proven their value as a cost-effective solution in a wide variety of drainage applications. They are accepted by state and municipal agencies and are a standard detail in numerous drainage manuals. Many municipalities have recognized the inherent benefits of the MaxWell Plus and now require it for drainage of all paved surfaces.

SUPERIOR PRE-TREATMENT

Industry research, together with Torrent Resource's own experience, has shown that initial storm drainage flows have the greatest impact on system performance. This "first flush" occurs during the first few minutes of runoff and carries the majority of sediment and debris. Larger paved surfaces or connecting pipes from catch basins, underground storage, etc. can also generate high peak flows which may strain system function. In addition, nuisance water flows require controlled processing separate from normal storm runoff demands.

In the **MaxWell Plus**, preliminary treatment is provided through collection and separation in deep large-volume settling chambers. The standard MaxWell Plus system has over 2,500 gallons of capacity to contain sediment and debris carried by incoming water. Floating trash, paper, pavement oil, etc. is effectively stopped by the **PureFlo™ Debris Shields** in each chamber. These shielding devices are equipped with an effective screen to filter suspended material and are vented to prevent siphoning of floating surface debris as the system drains.

EFFECTIVE PROCESSING

Incoming water from the surface grated inlets or connecting pipes is received in the Primary Settling Chamber where silt and other heavy particles settle to the bottom. A PureFlo™ Debris Shield ensures containment by trapping floating debris and pavement oil. The pre-treated flow is then regulated to a design rate of up to 0.25cfs and directed to a secondary settling chamber. The settling and containment process is repeated, thereby effectively achieving controlled, uniform treatment. The system is drained as water rises under the PureFlo Debris Shield and spills into the top of the overflow pipe. The drainage assembly returns the cleaned water to the surrounding soil through the **FloFast™ Drainage Screen.**

ABSORBENT TECHNOLOGY

To provide prompt removal of pavement oils, both **MaxWell Plus** settling chambers are equipped with absorbent sponges. These floating pillow-like devices are 100% water repellent and literally wick petrochemical compounds from the water. Each sponge has a capacity of over 128 ounces to accommodate effective, long-term treatment. The absorbent is completely inert and will safely remove runoff constituents down to rainbow sheens which are typically no more than one molecule thick.

SECURITY FEATURES

MaxWell Plus Systems include bolted, theft-resistance, cast iron gratings and covers as standard security features. Special inlet castings which are resistant to loosening from accidental impact are available for use in landscaped applications. Machined mating surfaces and "Storm Water Only" wording are standard.

THE MAXWELL FIVE-YEAR WARRANTY

Innovative engineering, quality materials and workmanship are standard with every MaxWell system produced and installed by Torrent Resources Incorporated. The MaxWell Drainage System Warranty is the best in the industry and guarantees against failure due to workmanship or materials for a period of five years from date of completion.

Manufactured and Installed Exclusively by Torrent Resources Incorporated
Please see reverse side for additional information
U.S. Patent No. [illegible] ™Trademark 1974, 1987, 2004

MAXWELL™ PLUS DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

CALCULATING MAXWELL PLUS REQUIREMENTS:

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained storm water, use **one standard MaxWell Plus per the instructions below** for up to 5 acres of landscaped contributing area, and up to 2 acres of paved surface. To drain nuisance water flows in storm runoff systems, **add a remote inlet** to the System. For smaller drainage needs, refer to our ***Type IV MaxWell***. For industrial drainage, our ***EnviroSorb™ System*** may be recommended. For additional considerations, please refer to **"Design Suggestions for Retention And Drainage Systems"** or consult our Design Staff.

COMPLETING THE MAXWELL PLUS DRAWING

To apply the ***MaxWell Plus*** drawing to your specific project, simply fill in the blue boxes per the following instructions. For assistance, please consult our Design Staff.

PRIMARY SETTLING CHAMBER DEPTH

The overall depth of the Primary Settling Chamber is determined by the amount of surface area being drained. Use a standard depth of **10 feet** for the initial acre of contributing drainage area, **plus 2 feet** for each additional acre, up to the design limits of the property type noted in "Calculating MaxWell Plus Requirements" noted above. Other conditions that would require increased chamber depths are property usage, maintenance scheduling, and severe or unusual service conditions. Connecting Pipe Depth may dictate deeper chambers so as to maintain the effectiveness of the settling process.

ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate total system depth required to achieve 10 continuous feet of penetration into permeable soils, based upon known soil information. Torrent's specialized **"crowd"** equipped rigs get through the difficult cemented soils to reach clean drainage soils at depths up to **180 feet** and their extensive drilling log database is available to use as a reference.

SETTLING CHAMBER DEPTH

On **MaxWell Plus Systems** of over 30 feet overall depth and up to 0.25cfs design rate, the standard Settling Chamber Depth is **18 feet.**

OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. An overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet.**

DRAINAGE PIPE

This dimension also applies to the ***PureFlo™*** Debris Shields, the ***FloFast™*** Drainage Screen, and fittings. The size is based upon system design rates, multiple primary settling chambers, soil conditions, and need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to our company's **"Design Suggestions for Retention and Drainage Systems"** for recommendations on which size best matches your application.

BOLTED RING & GRATE/COVER

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

INLET PIPE INVERT

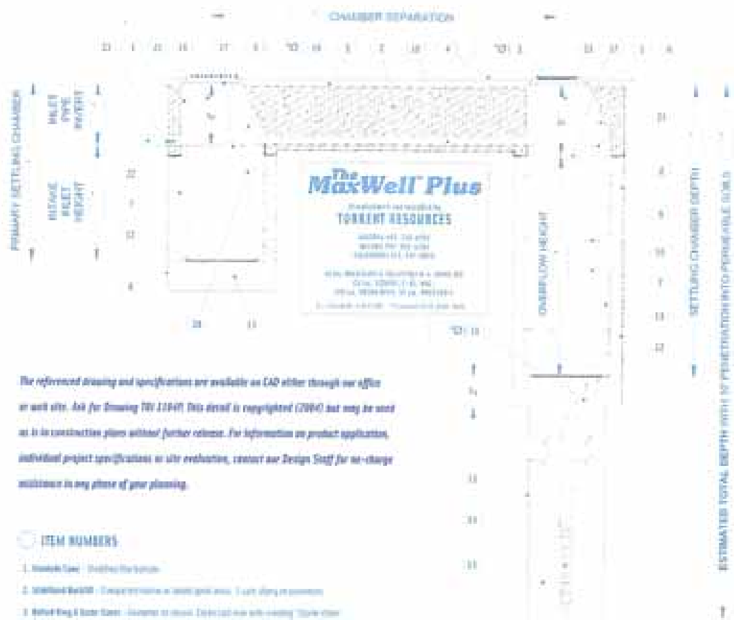
Pipes up to 24" in diameter from catch basins, underground storage, etc. may be connected into the primary settling chamber. Inverts deeper than 4 feet will require additional depth in both system settling chambers to maintain respective effective settling capacities.

INTAKE INLET HEIGHT

The Intake Inlet Height determines the effectiveness of the settling process in the Primary Settling Chamber. A minimum inlet height of **6 feet** is used with the standard primary settling chamber depth of 10 feet. Greater inlet heights would be required with increased system demands as noted in Primary Settling Chamber Depth.

CHAMBER SEPARATION

The standard separation between chambers is **15 feet** from center to center for inlet pipe inverts up to 7 feet. For deep inlet pipes or underground storage systems that result in a deeper Connector Pipe, add 5 feet of separation for each 3 feet of additional Connector Pipe depth. Maximum Connector Pipe depths and Chamber separations are 13 feet and 25 feet, respectively. A pump and lift station is recommended for systems with deeper requirements.



The referenced drawing and specifications are available on CAD either through our office or web site. Ask for Drawing TRI 1104P. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.

ITEM NUMBERS

1. Manhole Cover – [illegible]
2. Stabilized Backfill – [illegible]
3. Bolted Ring & Grate/Cover – [illegible]
4. Graded Basin or Paving (by Others)
5. Compacted Base Material (by Others)
6. PureFlo™ Debris Shield – [illegible]
7. Pre-cast Liner – 4000 PSI concrete 48" ID x 54" OD. [illegible]
8. Min. 4' Ø Drilled Shaft
9. Support Bracket – Formed 12 Ga. steel. [illegible]
10. Overflow Pipe – Sch. 40 PVC [illegible]
11. Drainage Pipe – [illegible]
12. Base Seal – [illegible]
13. Rock – [illegible]
14. FloFast™ Drainage Screen – [illegible]
15. Min. 4' Ø Shaft – [illegible]
16. Fabric Seal – [illegible]
17. Absorbent – [illegible]
18. Connector Pipe – 4" Ø Sch. 40 PVC
19. Vent [illegible]
20. Intake Screen – [illegible]
21. Predicted Depth Varies [illegible]
22. Optional Inlet Pipe (by Others)
23. [illegible]

MaxWell™ DRAINAGE SYSTEMS

TORRENT RESOURCES INCORPORATED
AZ Lic. ROC070465 A, ROC047067 B-4; ADWR 363
CA Lic. 528080 A, C-42, HAZ - *NV Lic.* 0035350 A - *NM Lic.* 90504 GF04

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An evolution of McGuckin Drilling

California
661-947-9836
Nevada
702-366-1234

TORRENT RESOURCES

IMPORTANT MAINTENANCE DATA AND WARRANTY INFORMATION

This property is equipped with the finest on-site drainage system ever designed. With regular inspection and maintenance, it will last for many years. The reverse of this sheet has an illustration that shows just how the standard *MaxWell*™ works to trap silt and trash, and dispose of surplus surface water.

MAINTENANCE

Once each year, and after every major storm, you can check the debris level in your *MaxWell* settling chamber by dropping a weighted tape measure through the surface grate. On MaxWell Plus™ systems, the primary settling chamber can be checked the same way.

When the measurement to the bottom of the chamber is less than specified under "cleanout depth," or if the floating absorbent pillow is submerged, the *MaxWell* should be serviced.

MaxWell drainage systems are designed to efficiently dispose of retained stormwater. Drainage time is normally dependent upon site design, user convenience or rainfall intensity. If drainage appears slow, or if water is standing for more than 36 hours, the system should be inspected.

For your convenience, Torrent Resources offers a complete Maintenance Program including Service Maintenance Agreements. Please call us for information on this valuable service.

PROJECT ______________________ DATE INSTALLED ______________

ADDRESS ______________________

____

MAXWELL #	MAXWELL TYPE	COMPONENT SIZE	TOTAL	SETTLING CHAMBER DEPTH	CLEANOUT DEPTH SETTLING CHAMBER

Extended Detention Basin

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

- ● Low
- ■ High
- ▲ Medium

CASQA

relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).

- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.

- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.

- Outlet designed to discharge the capture volume over a period of hours.

- Length to width ratio of at least 1.5:1 where feasible.

- Basin depths optimally range from 2 to 5 feet.

- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.

- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.

- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.

- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

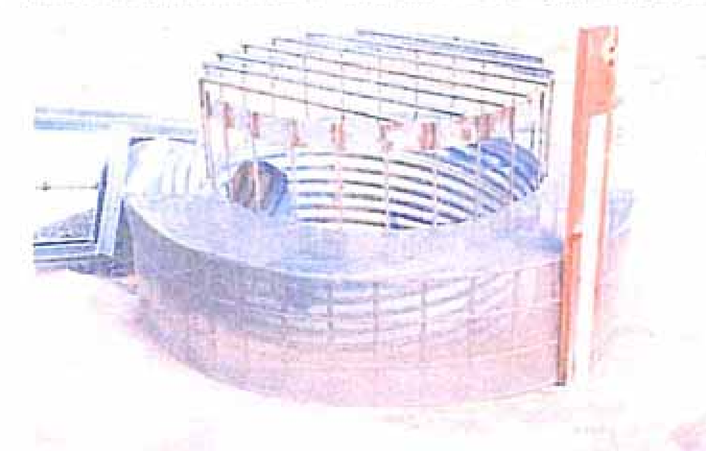

Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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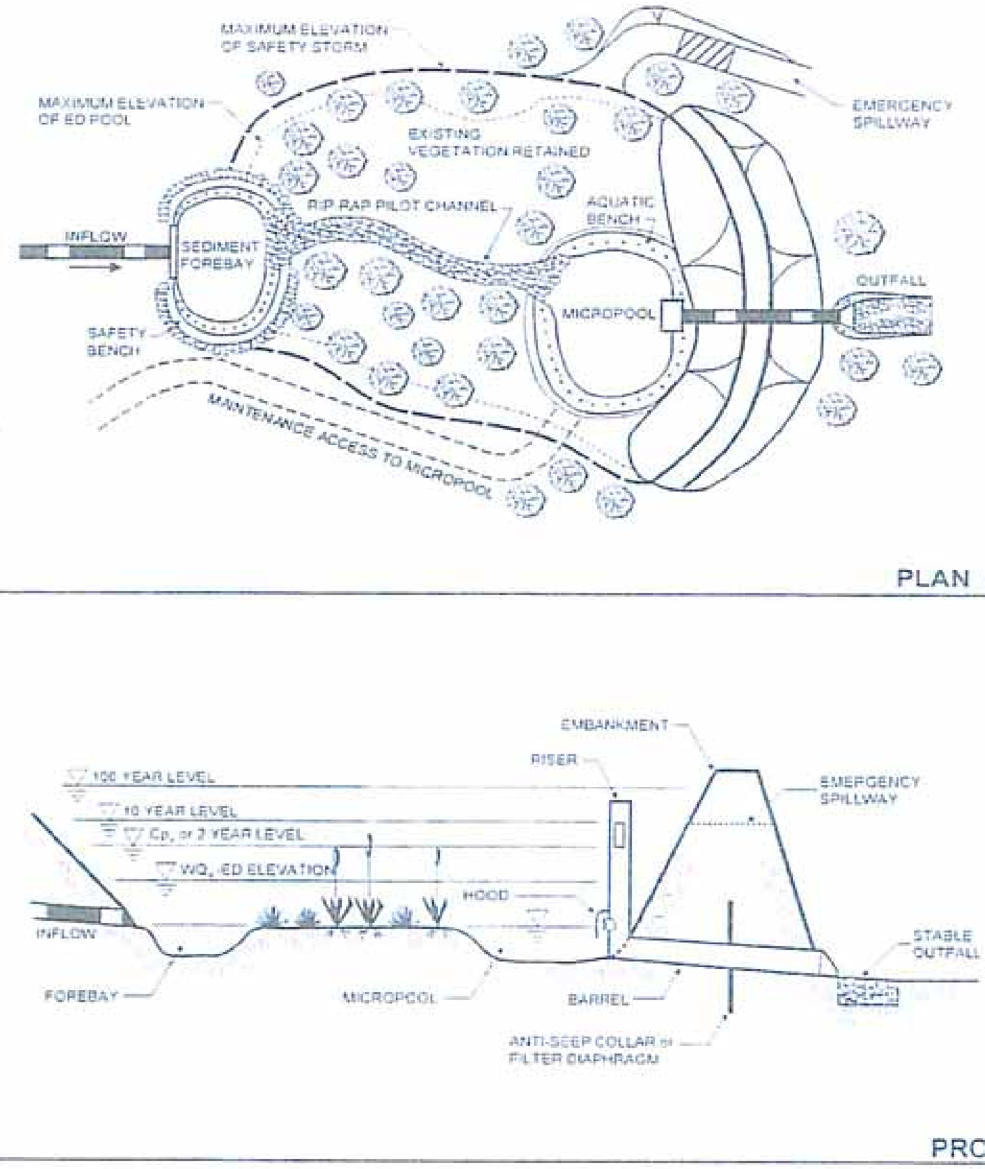
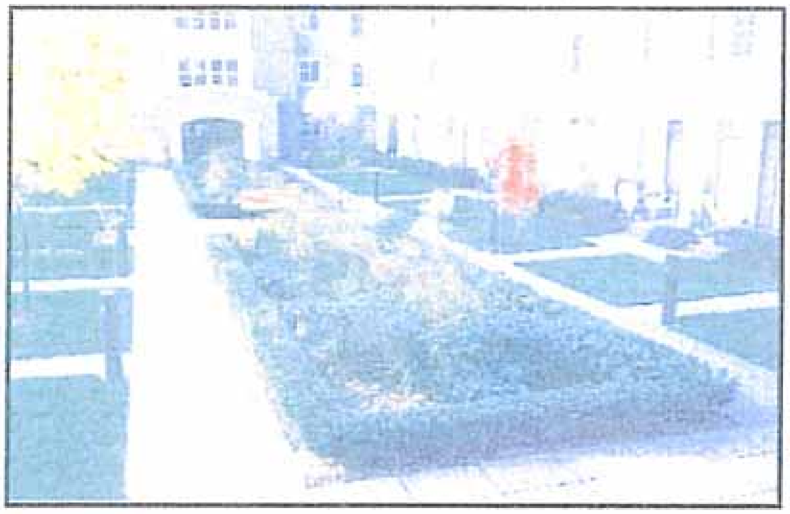


Schematic of an Extended Detention Basin (MDE, 2000)



Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).

- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft² of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

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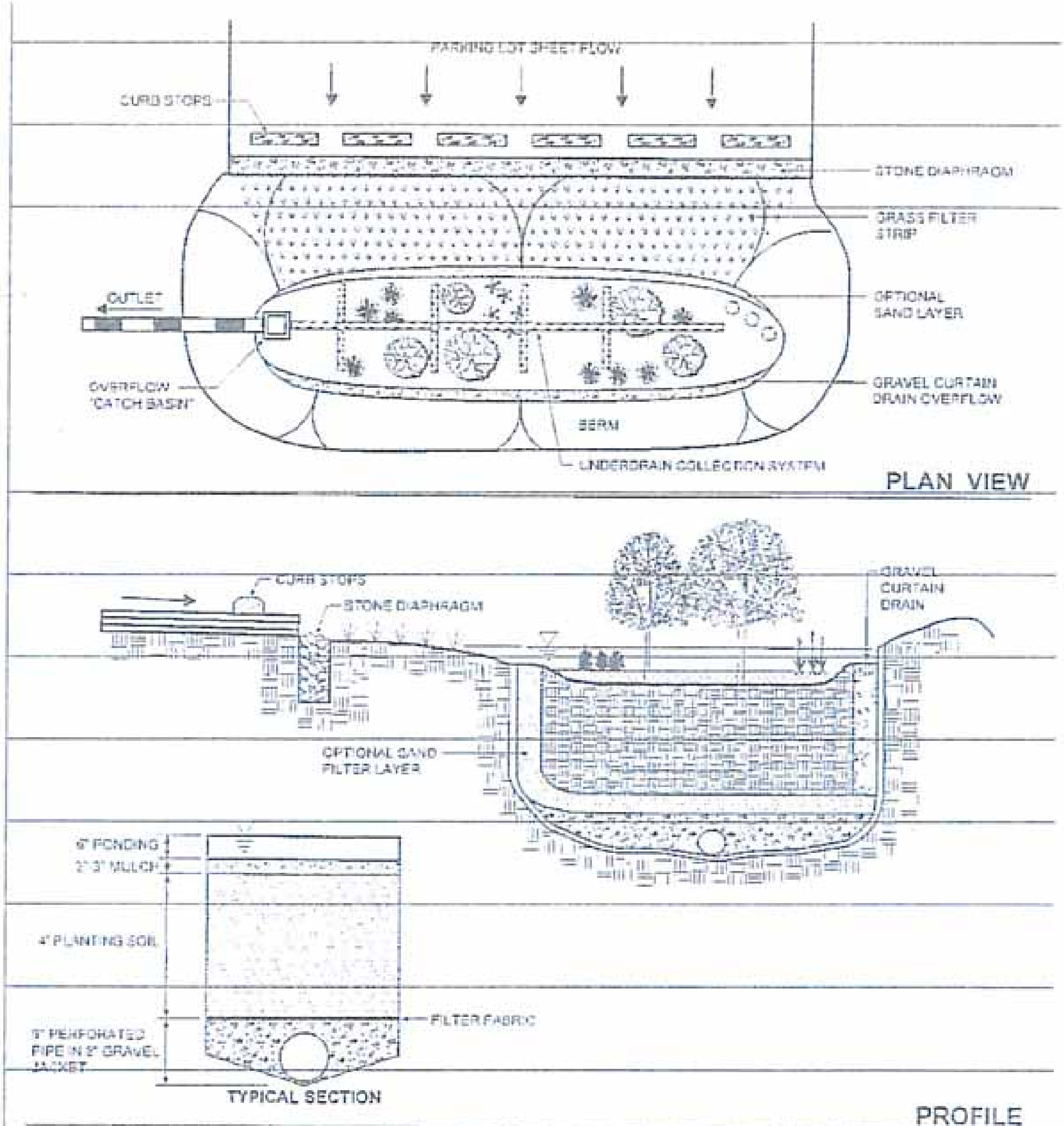

Schematic of a Bioretention Facility (MDE, 2000)

Vegetated Swale

TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.

- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.

- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.

- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.

- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data

Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
	Removal Efficiencies (% Removal)						
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately \$0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately \$0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd³	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd²	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd²	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd²	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,366	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = (top width + $\frac{8(\text{swale depth}^2)}{3(\text{top width})}$) x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft^2 / mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft^2 / year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd^2	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	\$0.58 / linear foot	\$0.75 / linear foot	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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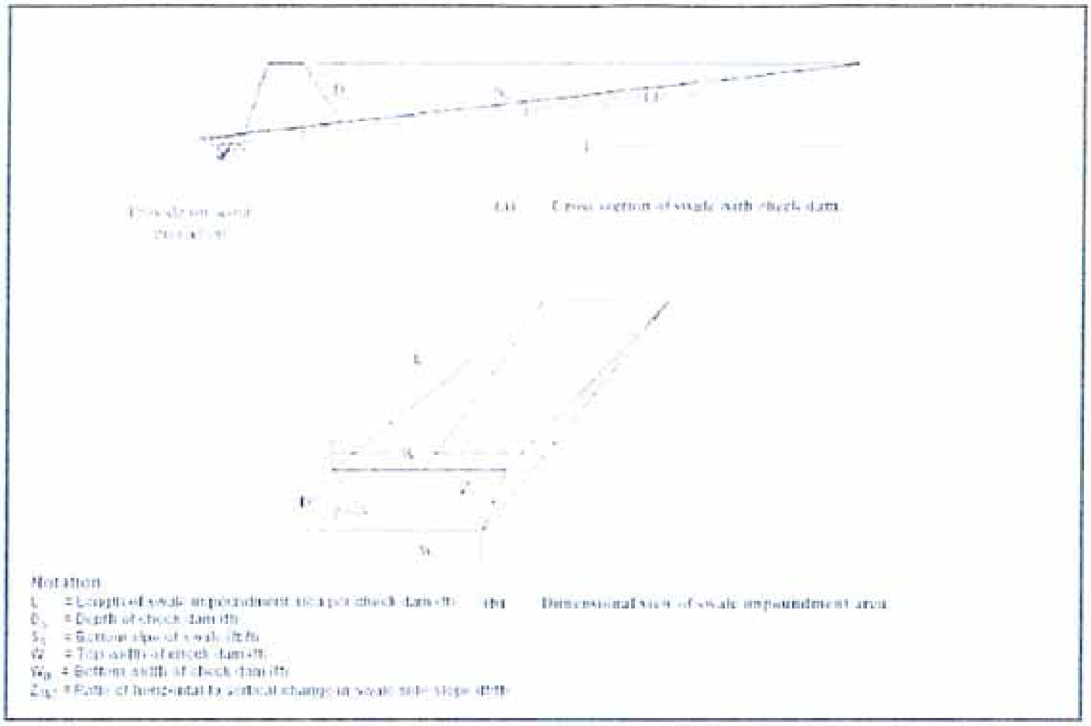

(a) Cross section of swale with check dam
Notation
L = Length of swale impoundment area per check dam (ft)
D_s = Depth of check dam (ft)
S_s = Bottom slope of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (dim)
(b) Dimensional view of swale impoundment area

7.0 PUBLIC EDUCATION

The educational materials included in this P-WQMP are provided to inform people involved in future uses, activities, or ownership of the site about the potential pitfalls associated with careless storm water management. "The Ocean Begins at Your Front Door" provides users with information about storm water that is/ will be generated on site, what happens when water enters a storm drain, and its ultimate fate, discharging into the ocean. Also included are activities guidelines, such as "Tips for Landscape & Gardening", to educate anyone who is or will be associated with activities that have a potential to impact storm water runoff quality. These guidelines generally provide a menu of BMPs to effectively reduce the generation of storm water runoff pollutants from a variety of activities. The educational materials to be used for the proposed project are included in Appendix 3 of this P-WQMP and are listed below.

BROCHURES

- The Ocean Begins at Your Front Door
- Tips for Landscape & Gardening
- Tips for Pool Maintenance
- Waste Oil Collection Centers South OC
- Keeping Pest Control Products Out of Creeks, Rivers and the Ocean
- Permitted Lot & Pool Drains Pool Maintenance
- Tips for Pet Care
- Water Quality Guidelines for Car Wash Fund Raisers
- Sewage Spill Reference Guide
- Tips for Using Concrete and Mortar
- Household Tips
- Help Prevent Ocean Pollution: Proper Disposal of Household Hazardous Materials

BMP FACT SHEETS

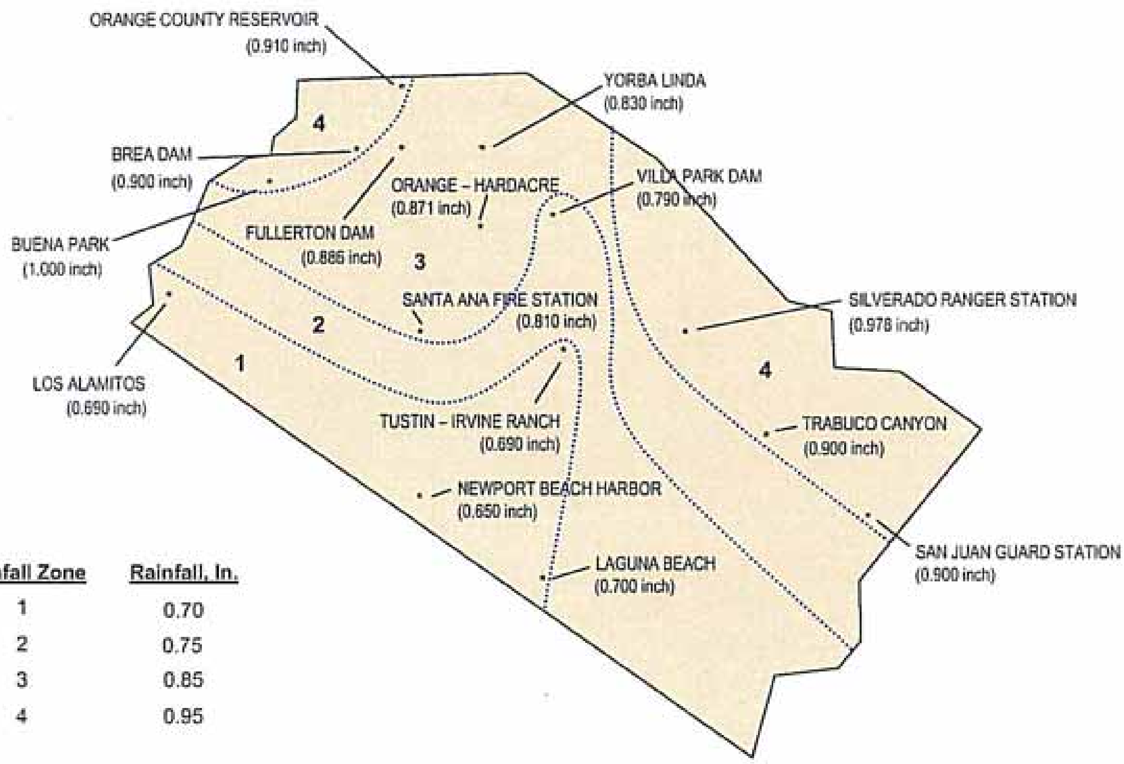
- SC-10 Non-Stormwater Discharges
- SC-11 Spill Prevention, Control and Cleanup
- SC-41 Building and Grounds Maintenance
- SC-43 Parking/Storage Area Maintenance
- SC-70 Road and Street Maintenance
- SC-71 Plaza and Sidewalk Cleaning
- SC-72 Fountain & Pool Maintenance
- SC-73 Landscape Maintenance
- SC-74 Drainage System Maintenance
- SD-10 Site Design & Landscape Planning
- SD-11 Roof Runoff Controls
- SD-12 Efficient Irrigation
- SD-13 Storm Drain Signage
- SD-32 Trash Storage Areas

8.0 APPENDICES

APPENDIX 1

RUNOFF COEFFICIENT REFERENCES

RUNOFF COEFFICIENT REFERENCES



Rainfall Zone	Rainfall, In.
1	0.70
2	0.75
3	0.85
4	0.95

Figure A-1
Orange County California
Precipitation Stations
24-hour, 85th percentile rainfall

Table A-1

C Values Based on Impervious/Pervious Area Ratios

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

Serrano Summit - Preliminary BMP Sizing Calculations

3/15/2010

Storm Water Quality Design Flow (SQDF)

SQDV = C * I * A

C = Runoff Coefficient
I = Rainfall Intensity
conversion = (1/12)*(1/60)*(1/60)*(43560)

depth = volume / area
I = volume / C * A * conversion

Row #	Drainage Area Name	% Impervious	Runoff Coefficient	Rainfall Intensity (in)	Drainage Area (acres)	Conversion Factor	Treatment Required (cfs)
1	Lot 15	70%	0.68	0.2	13	1.00833	1.77
2	CDS #2 / Lot 16	70%	0.68	0.2	14.6	1.00833	1.99
3	CDS #3	70%	0.68	0.2	13.4	1.00833	1.83
4	Total WQ Basin	70%	0.68	0.2	59	1.00833	8.05
5	Civic Center	80%	0.75	0.2	9.21	1.00833	1.40
6	Passive Park	10%	0.23	0.2	2	1.00833	0.09
7	Drywells	70%	0.68	0.2	28.89	1.00833	3.94

Storm Water Quality Design Volume (SQDV)

SQDV = C * I * A * (Conversion)

C = Runoff Coefficient
I = Rainfall Intensity
conversion = (1/12)*(43560)

depth = volume / area
I = volume / C * A * conversion

Row #	BMP Name	% impervious	Runoff Coefficient	Rainfall Intensity (in)	Drainage Area (acres)	Conversion Factor	Treatment Required (ft^3)	Treatment Required (ac-ft)
1	Lot 15	70%	0.68	0.85	13	3630	27,135.4	0.62
2	CDS #2 / Lot 16	70%	0.68	0.85	14.6	3630	30,475.2	0.70
3	CDS #3	70%	0.68	0.85	13.4	3630	27,970.4	0.64
4	Total WQ Basin	70%	0.68	0.85	59	3630	123,153.1	2.83
5	Civic Center	80%	0.75	0.85	9.21	3630	21,355.7	0.49
6	Passive Park	10%	0.23	0.85	2	3631	1,398.1	0.03
7	Drywells	70%	0.68	1.85	28.89	3632	131,320.6	3.01

Water Quality Basin Sizing

Row #	BMP Name	Treatment Required (ft^3)	Treatment Volume Required (acre-ft)	Sizing Depth (ft)	Original Basin Footprint (SF)	Volume @ 20% Contingency (acre-ft)	Footprint @ 20% Contingency (acres)	Footprint @ 20% Contingency (SF)
1	Lot 15	27,135.4	0.623	3.0	9,045.1	0.75	0.25	10,854.2
2	CDS #2 / Lot 16	30,475.2	0.700	3.0	10,158.4	0.84	0.28	12,190.1
3	CDS #3	27,970.4	0.642	3.0	9,323.5	0.77	0.26	11,188.1
4	Total WQ Basin	123,153.1	2.827	3.0	41,051.0	3.39	1.13	49,261.2
5	Civic Center	21,355.7	0.490	3.0	7,118.6	0.59	0.20	8,542.3
6	Passive Park	1,398.1	0.032	3.0	466.0	0.04	0.01	559.2
7	Drywells	131,320.6	3.015	4.0	32,830.2	3.62	0.90	39,396.2

DYODS™
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CHAMBERMaxx™

CONTECH CONSTRUCTION PRODUCTS INC.

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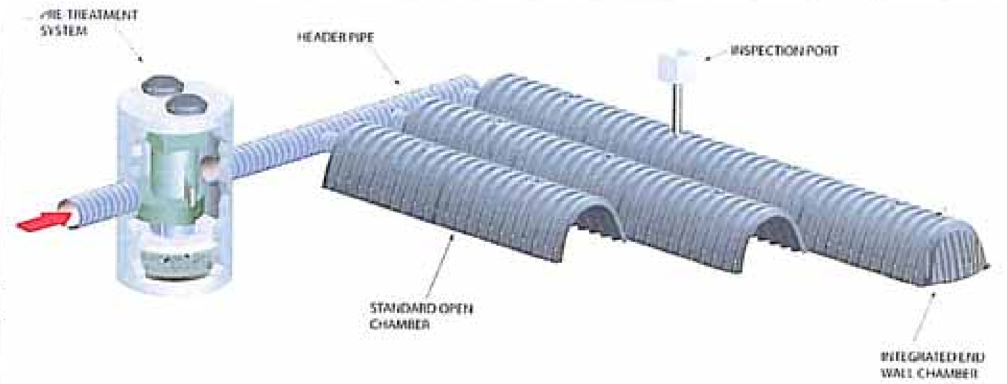
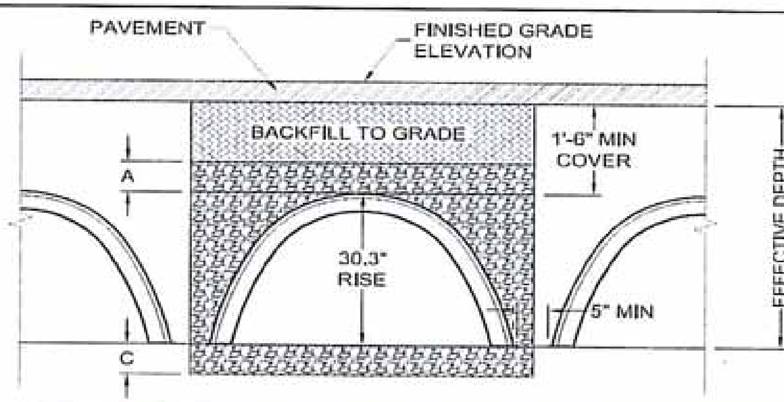
and pricing send completed worksheet to:
dyods@contech-cpi.com



Project Summary

Date:	Lot 15 - Preliminary Sizing Only
Project Name:	
City, State:	
County:	
Designed By:	
Company:	
Telephone:	

Enter Information in Blue Cells



ChamberMaxx Calculator

Storage Volume Required (cf):	27,135
Chamber Invert Depth Below Asphalt (ft):	5.00
Limiting Width (ft):	72
Porous Stone Backfill Included For Storage:	Yes
Depth A: Porous Stone Above Chamber (in):	6
Depth C: Porous Stone Below Chamber (in):	6
Stone Porosity (0 to 40%):	40

Waterway Area (ft^2)
10.78

System Sizing

Use Custom Layout (at right) for layout adjustment

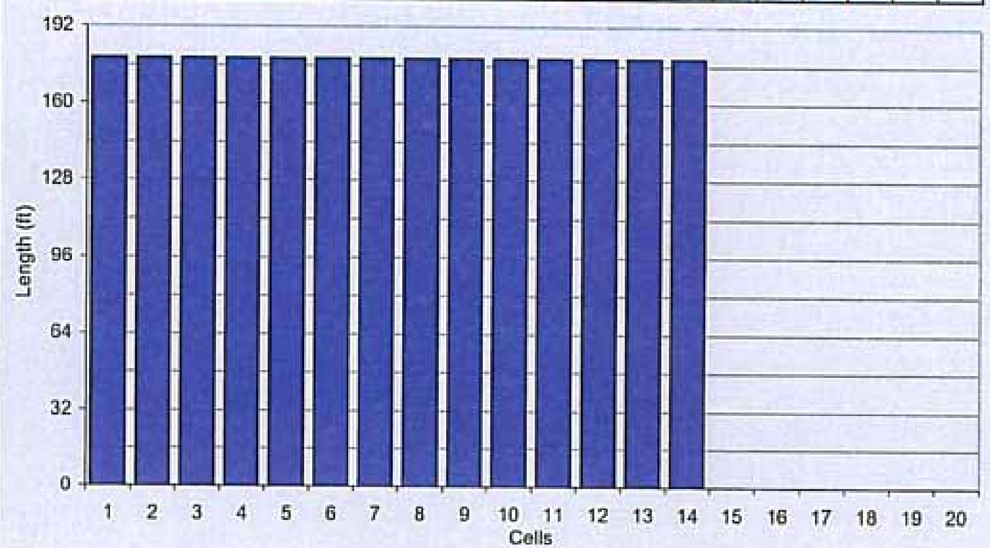
Required Chambers:	350 Chambers	
Chamber Storage:	17,287 cf	
Porous Stone Storage:	10,337 cf	
Total Storage Provided:	27,624 cf	101.8% of Req'd Storage
Rectangular Footprint (W x L):	67.4 ft x 185.4 ft	

Custom Layout

Additional Units Required = 0

To adjust layout, select the appropriate number of chambers in the light blue boxes below.

25	25	25	25	25	25	25	25	25	25	25	25	25	25						



CONTECH Materials

ChamberMaxx Middle Units:	322	Chambers @ 7'1" installed length
ChamberMaxx Start Units:	14	Chambers @ 8' installed length
ChamberMaxx End Units:	14	Chambers @ 7'5" installed length
Manifold Fittings (1 manifold):	13	ea Tees and 1ea Elbow
Scour Protection Netting:	68	ft long x 7.5' wide
Approximate Truckloads:	2	Trucks

Construction Quantities

Total Excavation:	2698	cy (assumes 4" asphalt)
Stone Backfill:	957	cy stone
Remaining Backfill To Asphalt:	948	cy backfill per specifications
Non-Woven Geotextile:	1745	sy for top and sides of excavation

***Construction Quantities are approximate and should be verified upon final design*

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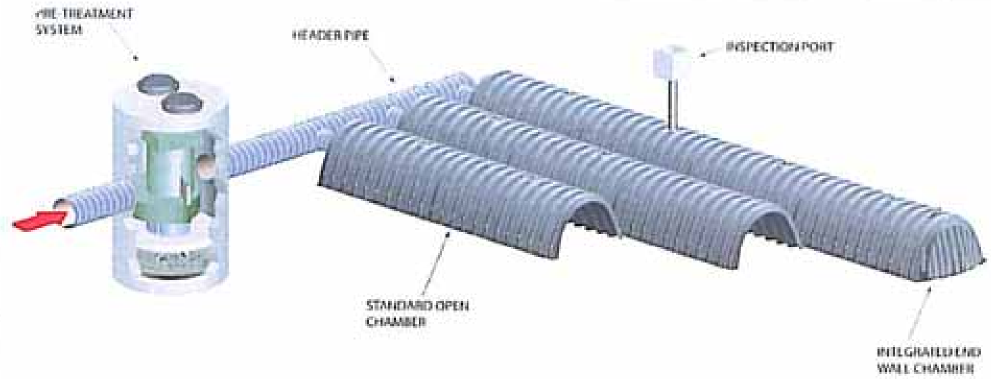


Project Summary

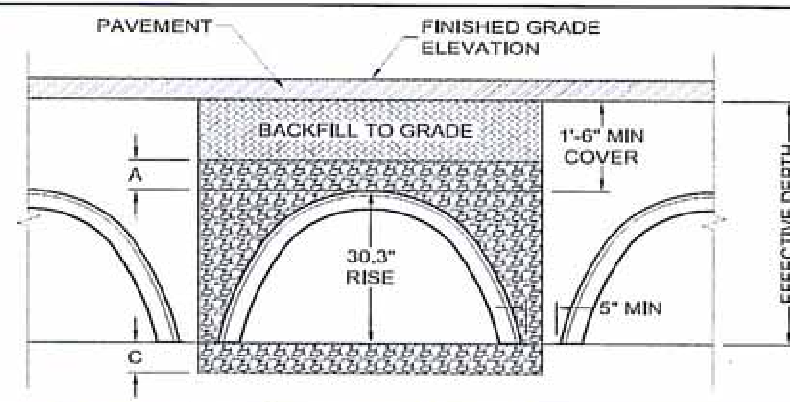
Date:	Lot 16 - Preliminary Sizing Only
Project Name:	
City, State:	
County:	
Designed By:	
Company:	
Telephone:	

Enter Information in Blue Cells

ChamberMaxx Calculator

Storage Volume Required (cf):	30,475
Chamber Invert Depth Below Asphalt (ft):	5.00
Limiting Width (ft):	100
Porous Stone Backfill Included For Storage:	Yes
Depth A: Porous Stone Above Chamber (in):	6
Depth C: Porous Stone Below Chamber (in):	6
Stone Porosity (0 to 40%):	40

Waterway Area (ft^2)
10.78



System Sizing

Use Custom Layout (at right) for layout adjustment

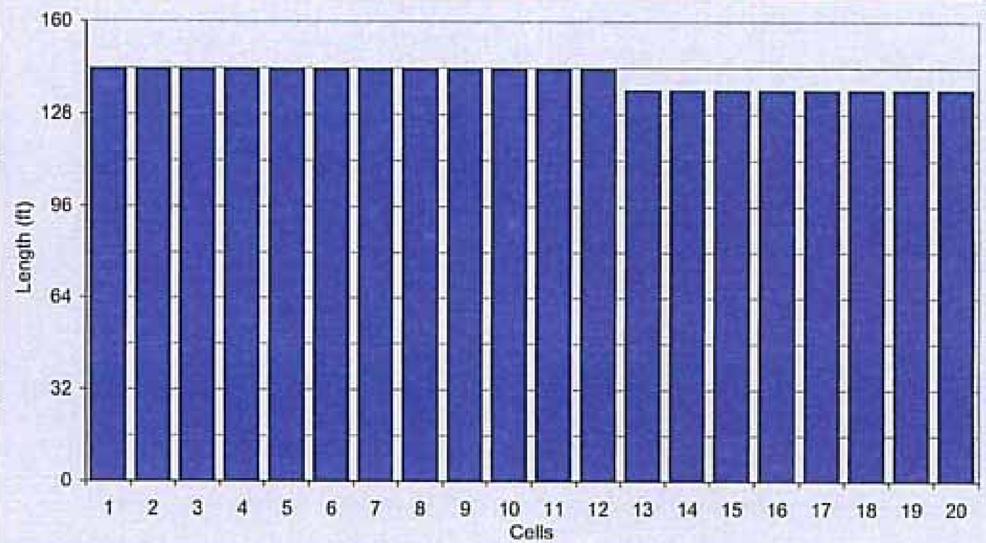
Required Chambers:	392	Chambers
Chamber Storage:	19,372	cf
Porous Stone Storage:	11,544	cf
Total Storage Provided:	30,916	cf — 101.4% of Req'd Storage
Rectangular Footprint (W x L):	95.6 ft x 149.8 ft	

Additional Units Required = 0

Custom Layout

To adjust layout, select the appropriate number of chambers in the light blue boxes below.

20	20	20	20	20	20	20	20	20	20	20	20	19	19	19	19	19	19	19	19



CONTECH Materials

ChamberMaxx Middle Units:	352	Chambers @ 7'1" installed length
ChamberMaxx Start Units:	20	Chambers @ 8' installed length
ChamberMaxx End Units:	20	Chambers @ 7'5" installed length
Manifold Fittings (1 manifold):	19	ea Tees and 1ea Elbow
Scour Protection Netting:	96	ft long x 7.5' wide
Approximate Truckloads:	2	Trucks

Construction Quantities

Total Excavation:	3092	cy (assumes 4" asphalt)
Stone Backfill:	1069	cy stone
Remaining Backfill To Asphalt:	1131	cy backfill per specifications
Non-Woven Geotextile:	1962	sy for top and sides of excavation

***Construction Quantities are approximate and should be verified upon final design*

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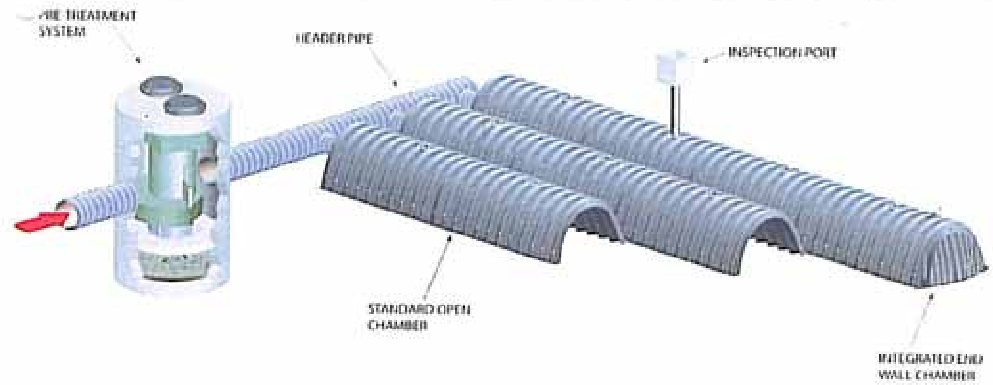


Project Summary

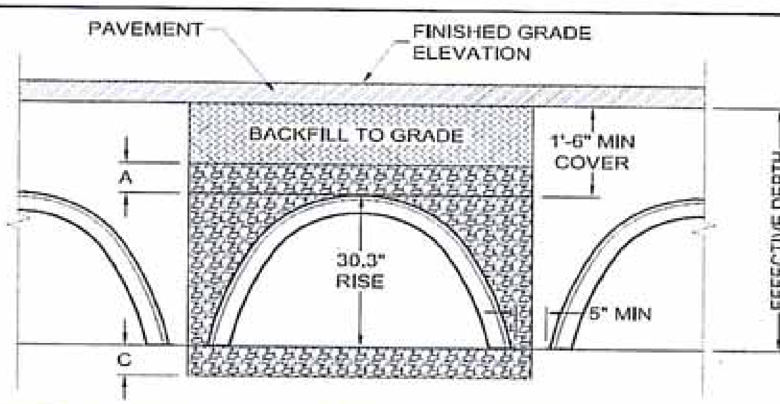
Date:	Civic Ctr - Preliminary Sizing Only
Project Name:	
City, State:	
County:	
Designed By:	
Company:	
Telephone:	

Enter Information in Blue Cells

ChamberMaxx Calculator

Storage Volume Required (cf):	12,208
Chamber Invert Depth Below Asphalt (ft):	5.00
Limiting Width (ft):	70
Porous Stone Backfill Included For Storage:	Yes
Depth A: Porous Stone Above Chamber (in):	6
Depth C: Porous Stone Below Chamber (in):	6
Stone Porosity (0 to 40%):	40

Waterway Area (ft^2)
10.78



System Sizing

Use Custom Layout (at right) for layout adjustment

Required Chambers:	156 Chambers	
Chamber Storage:	7,723 cf	
Porous Stone Storage:	4,808 cf	
Total Storage Provided:	12,531 cf	102.6% of Req'd Storage
Rectangular Footprint (W x L):	67.4 ft x 92.9 ft	

CONTECH Materials

ChamberMaxx Middle Units:	128 Chambers @ 7'1" installed length
ChamberMaxx Start Units:	14 Chambers @ 8' installed length
ChamberMaxx End Units:	14 Chambers @ 7'5" installed length
Manifold Fittings (1 manifold):	13 ea Tees and 1ea Elbow
Scour Protection Netting:	68 ft long x 7.5' wide
Approximate Truckloads:	1 Trucks

Construction Quantities

Total Excavation:	1352 cy (assumes 4" asphalt)
Stone Backfill:	445 cy stone
Remaining Backfill To Asphalt:	544 cy backfill per specifications
Non-Woven Geotextile:	903 sy for top and sides of excavation

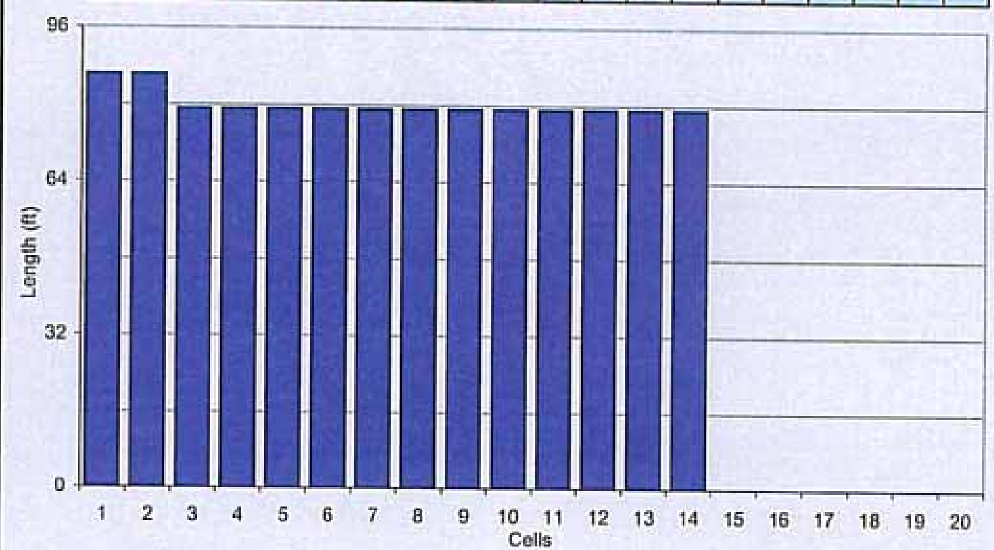
***Construction Quantities are approximate and should be verified upon final design*

Additional Units Required = 0

Custom Layout

To adjust layout, select the appropriate number of chambers in the light blue boxes below.

12	12	11	11	11	11	11	11	11	11	11	11	11	11						



APPENDIX 2

NOTICE OF TRANSFER OF RESPONSIBILITY

NOTICE OF TRANSFER OF RESPONSIBILITY

WATER QUALITY MANAGEMENT PLAN

Serrano Summit – City of Lake Forest
Tract No. TBD

Submission of this Notice Of Transfer of Responsibility constitutes notice to the City of Lake Forest that responsibility for the Water Quality Management Plan ("WQMP") for the subject property identified below, and implementation of that plan, is being transferred from the Previous Owner (and his/her agent) of the site (or a portion thereof) to the New Owner, as further described below.

I. Previous Owner/ Previous Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

II. Information about Site Transferred

Name of Project (if applicable):	
Title of WQMP Applicable to site:	
Street Address of Site (if applicable):	
Planning Area (PA) and/ or Tract Number(s) for Site:	Lot Numbers (if Site is a portion of a tract):
Date WQMP Prepared (and revised if applicable):	

III. New Owner/ New Responsible Party Information

Company/ Individual Name:		Contact Person:	
Street Address:		Title:	
City:	State:	ZIP:	Phone:

IV. Ownership Transfer Information

General Description of Site Transferred to New Owner:	General Description of Portion of Project/ Parcel Subject to WQMP Retained by Owner (if any):

Lot/ Tract Numbers of Site Transferred to New Owner:
Remaining Lot/ Tract Numbers Subject to WQMP Still Held by Owner (if any):
Date of Ownership Transfer:

Note: When the Previous Owner is transferring a Site that is a portion of a larger project/ parcel addressed by the WQMP, as opposed to the entire project/parcel addressed by the WQMP, the General Description of the Site transferred and the remainder of the project/ parcel no transferred shall be set forth as maps attached to this notice. These maps shall show those portions of a project/ parcel addressed by the WQMP that are transferred to the New Owner (the Transferred Site), those portions retained by the Previous Owner, and those portions previously transferred by Previous Owner. Those portions retained by Previous Owner shall be labeled as "Previously Transferred".

V. Purpose of Notice of Transfer

The purposes of this Notice of Transfer of Responsibility are: 1) to track transfer of responsibility for implementation and amendment of the WQMP when property to which the WQMP is transferred from the Previous Owner to the New Owner, and 2) to facilitate notification to a transferee of property subject to a WQMP that such New Order is now the Responsible Party of record for the WQMP for those portions of the site that it owns.

VI. Certifications

A. Previous Owner

I certify under penalty of law that I am no longer the owner of the Transferred Site as described in Section II above. I have provided the New Owner with a copy of the WQMP applicable to the Transferred Site that the New Owner is acquiring from the Previous Owner.

Printed Name of Previous Owner Representative:	Title:
Signature of Previous Owner Representative:	Date:

B. New Owner

I certify under penalty of law that I am the owner of the Transferred Site, as described in Section II above, that I have been provided a copy of the WQMP, and that I have informed myself and understand the New Owner's responsibilities related to the WQMP, its implementation, and Best Management Practices associated with it. I understand that by signing this notice, the New Owner is accepting all ongoing responsibilities for implementation and amendment of the WQMP for the Transferred Site, which the New Owner has acquired from the Previous Owner.

Printed Name of New Owner Representative:	Title:
Signature:	Date:

APPENDIX 3

PUBLIC EDUCATION MATERIALS

(Pending – To be provided in the Final WQMP)

APPENDIX 4

POST-CONSTRUCTION BMP FACT SHEETS

(Pending – To be provided in the Final WQMP)

APPENDIX 5

FINAL RESOLUTIONS / CONDITIONS OF APPROVAL

(Pending – To be provided in the Final WQMP)

APPENDIX 6

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP NAME (AS SHOWN IN O&M PLAN)	BRIEF DESCRIPTION OF IMPLEMENTATION, MAINTENANCE, AND INSPECTION ACTIVITY PERFORMED

RECORD OF BMP IMPLEMENTATION, MAINTENANCE, AND INSPECTION

Today's Date: ______________________________

Name of Person Performing Activity (Printed): ______________________________

Signature: ______________________________

BMP NAME (AS SHOWN IN O&M PLAN)	BRIEF DESCRIPTION OF IMPLEMENTATION, MAINTENANCE, AND INSPECTION ACTIVITY PERFORMED