# Appendix J –
# Preliminary Hydrology Study for the Sanctuary

# PRELIMINARY HYDROLOGY STUDY

# FOR

# THE SANCTUARY

**9 LOT RESIDENTIAL DEVELOPMENT**
**18-198 TM/ DR/ PRD/ EIA**

RANCH VIEW TERRACE
ENCINITAS, CA 92024

PREPARED FOR:

OLIVENHAIN HILLS, LLC
745 COLE RANCH ROAD
ENCINITAS, CA 92024
760-299-3344

PREPARED BY:

PASCO LARET SUITER & ASSOCIATES, INC.
535 N. HIGHWAY 101, SUITE A
SOLANA BEACH, CA 92075
(858) 259-8212

PREPARED: APRIL 17, 2019
REVISED: DECEMBER 15, 2020


12/15/20

BRIAN M. ARDOLINO, RCE 71651 DATE

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# 1.0 EXECUTIVE SUMMARY

## 1.1 Introduction

This Hydrology Study for the proposed Sanctuary development has been prepared to analyze the hydrologic characteristics of the existing and proposed project site. This report presents both the methodology and the calculations used for determining the storm water runoff from the project site in the pre-developed (existing) conditions, the post-developed unmitigated conditions, and the post-developed mitigated conditions produced by the 100-year, 6-hour storm event.

## 1.2 Existing Conditions

The 8.32-acre property is located at Ranch View Terrace, Olivenhain, and is bound by residential homes to the north, south, east, and west.

The existing property consists of undisturbed natural terrain. The drainage characteristics of the site consist generally of overland flow from northwest to east/ southeast, discharging to a small channel along Rancho Santa Fe Road, which flows southerly eventually discharging to Escondido Creek which flows southwesterly to San Elijo Lagoon and ultimately discharges to the Pacific Ocean.

The portion of the property being developed is approximately 3.42 acres in the eastern part of the property. Offsite stormwater runs onto the project site along the western project site boundary.

Per the Web Soil Survey application available through the United States Department of Agriculture, the site is categorized to have hydrologic group D soils. Refer to Appendix A for soil information.

Using the Rational Method Procedure outlined in the San Diego County Hydrology Manual dated June 2003 (SDCHM), the 100-year, 6-hour storm event peak flow rate was calculated for the project site in the existing condition. The table below summarizes the existing condition hydrologic analysis.

**Summary of Existing Condition 100-Yr Storm Event Hydrologic Analysis**

| Drainage Basin | Area (ac) | Q100 (cfs) |
|---|---|---|
| A | 9.7 | 22.44 |

Refer to the existing condition hydrologic calculations included in section 3.1 of this report for detailed analysis.

## 1.3 Proposed Project

The intent of the proposed project is to develop the existing project site into 9 residential lots, private streets, curb and pervious parking stalls, associated underground utilities, and two biofiltration basins to meet the requirements for hydromodification management flow control, storm water pollutant control and to mitigate for the 100-year 6-hour storm event.

In the proposed condition, there one onsite drainage basins, Drainage Basin A.

Drainage Basin A consists of the majority of the site including the northern and eastern portions of the project site. Stormwater flows overland and in proposed storm drain easterly and northerly to a proposed Hydromodification Management (HMP) Biofiltration with Partial Retention basin located in the northeastern corner of the site. The basin will discharge through a proposed PVC pipe to Ranch View Terrace.

In the existing condition, the westerly portion of the site currently drains into the man-made pond approximately 100 feet due north of APN 265-331-32. The overflow of said pond then flows southeasterly overland discharging in between APN's 265-331-33 and 34. The natural conveyance of water is via sheet flow making its way south onto Woodwind Drive into an existing concrete brow ditch. The existing brow ditch meanders south and east conveying the flow into an existing culvert on Rancho Santa Fe Road. The runoff generated by the easterly portion of the project site flows through the residential lots to the east and a smaller easterly portion of the site discharges onto Ranch View Terrace. The easterly flows travel east onto Rancho Santa Fe Road, then south, ultimately into the culvert located at the intersection of Woodwind Drive and Rancho Santa Fe Road.

In the proposed condition, stormwater discharging from the site will maintain similar patterns. The flows generated by the northerly and easterly portion of the site including runoff from BMP Basin A will discharge onto Ranch View Terrace via a stormdrain pipe, travel easterly along Ranch View Terrace via a new curb and gutter to Rancho Santa Fe Road. The flows then will travel southerly along a new rolled G-4 Type curb and gutter until it reaches the culvert located at the intersection of Woodwind Drive and Rancho Santa Fe Road.

Areas that lie within the property but outside the project site will continue to flow as in the existing condition.

The HMP Biofiltration basins will provide hydromodification management flow control and storm water pollutant control to meet the requirements the California Regional Water Quality Control Board San Diego Region municipal storm water permit (Order No. R9-2013-0001, referred to as MS4 Permit). The HMP Biofiltration basins will also provide mitigation for the 100-year storm event peak discharge. Refer to the Storm Water Quality Management Plan (SWQMP) for the project titled "Storm Water Quality

Management Plan for The Sanctuary Development" dated December 2020 prepared by Pasco Laret Suiter & Associates for the detailed HMP and storm water pollutant control analyses.

The table below summarizes the existing and proposed condition hydrologic analyses.

**Summary of 100-yr Storm Event Hydrologic Analyses**

| Condition | Drainage Basin | Area (ac) | Q100 (cfs) |
|---|---|---|---|
| Existing | A | 9.5 | 22.44 |
| Proposed | A | 9.7 | 26.23 |
| Proposed Detained | A | 9.7 | 21.71 |

Refer to the proposed condition hydrologic calculations and detailed detention analysis included in Section 3.2, 3.3, 3.4 and Appendix B.

### 1.4 Hydrologic Unit Contribution

As identified by the San Diego Basin Plan, the proposed project site drains within Carlsbad Hydrologic Unit, specifically the Escondido Creek Hydrologic Area and San Elijo Sub Area (904.61).

### 1.5 Conclusions

Based upon the analyses included in this report, the proposed HMP Biofiltration basins are sized to accommodate the increase in peak runoff in the proposed condition and are designed to meet the requirements of the MS4 Permit for both pollutant control and hydromodification management.

### 1.6 References

*"San Diego County Hydrology Manual",* revised June 2003, County of San Diego, Department of Public Works, Flood Control Section.

*"City of Encinitas Engineering Design Manual",* October 28, 2009, City of Encinitas, Engineering Department

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov.

## 2.0 METHODOLOGY

Pursuant to the San Diego County Hydrology Manual dated June 2003 (SDCHM), the Rational Method is recommended for analyzing the runoff response from drainage areas up to approximately 1 square mile in size. The proposed project and associated watershed basins are less than 1 square mile, therefore the Rational Method was used to analyze the project's hydrologic characteristics in the existing and proposed conditions.

### 2.1 Rational Method

The Rational Method (RM) formula estimates the peak rate of runoff based on the variables of area, runoff coefficient, and rainfall intensity. The rainfall intensity (I) is equal to:

$$I = 7.44 \times P_6 \times D^{-0.645}$$

Where:

I = Intensity (in/hr)
$P_6$ = 6-hour precipitation (in)
D = duration (min – use Tc)

Using the Time of Concentration (Tc) which is the time required for a given element of water that originates at the most remote point of the basin being analyzed to reach the point at which the runoff from the basin is being analyzed, the RM equation determines the storm water runoff rate (Q) for a given basin in terms of flow (typically in cubic feet per second (cfs). The RM equation is as follows:

$$Q = CIA$$

Where:

Q= flow (cfs)
C = runoff coefficient, ratio of rainfall that produces storm water runoff (runoff vs. infiltration/evaporation/absorption/etc)
I = average rainfall intensity for a duration equal to the Tc for the Area (in/hr)
A = drainage area contributing to the basin (ac)

The RM equation assumes that the storm event being analyzed delivers precipitation to the entire basin uniformly, and therefore the peak discharge rate will occur when a raindrop that falls at the most remote portion of the basin arrives at the point of analysis. The RM also assumes that the fraction of rainfall that becomes runoff or the runoff coefficient (C) is not affected by the storm intensity (I), or the precipitation zone number.

## 2.2 County of San Diego Criteria

The County of San Diego has developed tables, nomographs, and methodologies for analyzing storm water runoff for areas within the County. The County has also developed precipitation isopluvial contour maps that show even lines of rainfall anticipated from a given storm event (i.e. 100-year, 6-hour storm). The 100-year 6-hour storm event rainfall isopluvial map is included in Appendix A.

One of the variables of the RM equation is the runoff coefficient (C) which is dependent upon land use and soil type. Table 3-1 Runoff Coefficients for Urban Areas in the SDCHM categorizes the land use, the associated development density (dwelling units per acre) and the percentage of impervious area. Each of the categories listed has an associated runoff coefficient for each soil type class. A composite runoff coefficient can also be calculated for an area based on soil type and impervious percentage using the following equation from Section 3.1.2 of the SDCHM:

$$C = 0.90 \times (\% \text{ Impervious}) + Cp \times (1 - \% \text{ Impervious})$$

Where: Cp = Pervious Coefficient Runoff Value for the soil type (shown in Table 3-1 as Undisturbed Natural Terrain/Permanent Open Space, 0% Impervious)

The calculations contained herein figure a composite runoff coefficient for the onsite project areas based on the percentage of impervious area and the percentage of pervious or landscape area. Refer to Appendix A for the composite runoff coefficient calculations.

## 2.3 AES Rational Method Computer Model

The Rational Method computer program developed by Advanced Engineering Software (AES) satisfies the County of San Diego design criteria, therefore it is the computer model used for this study. The AES hydrologic model is capable of creating independent node-link models of each interior drainage basin and linking these sub-models together at confluence points to determine peak flow rates. The program utilizes base information input by the user to perform calculations for up to 15 hydrologic processes. The required base information includes drainage basin area, storm water facility locations and sizes, land uses, flow patterns, and topographic elevations. The hydrologic conditions were analyzed in accordance with the SDCHM criteria as follows:

| | |
|---|---|
| Design Storm | 100-year, 6-hour |
| 100-year, 6-hour Precipitation | 2.7 inches |
| Rainfall Intensity | Based on the 2003 County of San Diego Hydrology Manual criteria |
| Runoff Coefficient* | D soil C = 0.35<br>Impervious C = 0.90 |

Soil Type D

*Composite runoff coefficients were calculated where appropriate. Refer to Appendix A.

## 3.0 HYDROLOGIC ANALYSIS

The table below summarizes the hydrologic calculations provided in Sections 3.1, 3.2 and 3.4.

**Summary of 100-yr Storm Event Hydrologic Analyses**

| Condition | Drainage Basin | Area (ac) | Q100 (cfs) |
|---|---|---|---|
| Existing | A | 9.5 | 22.44 |
| Proposed | A | 9.7 | 26.23 |
| Proposed Detained | A | 9.7 | 21.71 |

## 3.1 Existing Condition Hydrologic Model Output (100-Year Event)

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            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                              Analysis prepared by:

                        PASCO LARET SUITER & ASSOCIATES
                          535 NORTH HIGHWAY 101, STE A
                             SOLANA BEACH, CA 92075
                                  858-259-8212

 ************************** DESCRIPTION OF STUDY ************************
* PREDEVELOPED HYDROLOGIC ANALYSIS FOR OLIVENHAIN HILLS                    *
* 100 YEAR STORM EVENT                                                     *
* PLSA 3009 - 3/13/2019                                                    *
 ****************************************************************************

  FILE NAME: 3009PRE.DAT
  TIME/DATE OF STUDY: 09:57 01/23/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *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.*

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.05 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    300.60
  ELEVATION DIFFERENCE(FEET) =     23.40
```

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  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.271
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      3.63
  TOTAL AREA(ACRES) =      0.85   TOTAL RUNOFF(CFS) =      3.63

****************************************************************************
  FLOW PROCESS FROM NODE     10.05 TO NODE     10.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    300.60  DOWNSTREAM(FEET) =    156.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   915.00   CHANNEL SLOPE =  0.1580
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.63
  FLOW VELOCITY(FEET/SEC) =   6.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =    6.73
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     10.10 =    1165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.872
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3804
  SUBAREA AREA(ACRES) =    6.13   SUBAREA RUNOFF(CFS) =   12.60
  TOTAL AREA(ACRES) =       7.0   TOTAL RUNOFF(CFS) =      15.59
  TC(MIN.) =    6.73

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.05 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  UPSTREAM ELEVATION(FEET) =    244.00
  DOWNSTREAM ELEVATION(FEET) =    212.00
  ELEVATION DIFFERENCE(FEET) =     32.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.348
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.812
  SUBAREA RUNOFF(CFS) =      0.88
  TOTAL AREA(ACRES) =      0.28   TOTAL RUNOFF(CFS) =      0.88

****************************************************************************
  FLOW PROCESS FROM NODE     20.05 TO NODE     20.10 IS CODE =  52
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    212.00  DOWNSTREAM(FEET) =    169.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   440.00   CHANNEL SLOPE =  0.0977
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.88
  FLOW VELOCITY(FEET/SEC) =   4.69 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.56   Tc(MIN.) =    6.91
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     20.10 =     720.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.10 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.773
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3800
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3881
  SUBAREA AREA(ACRES) =    2.50   SUBAREA RUNOFF(CFS) =    5.48
  TOTAL AREA(ACRES) =        2.8   TOTAL RUNOFF(CFS) =       6.23
  TC(MIN.) =    6.91

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.10 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.) =    6.91
  RAINFALL INTENSITY(INCH/HR) =   5.77
  TOTAL STREAM AREA(ACRES) =     2.78
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.23

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     30.05 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    299.00
  ELEVATION DIFFERENCE(FEET) =     25.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.439
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      4.44
  TOTAL AREA(ACRES) =      1.04   TOTAL RUNOFF(CFS) =      4.44

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

```
 FLOW PROCESS FROM NODE     30.05 TO NODE     30.10 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    299.00  DOWNSTREAM(FEET) =    247.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.3250
 NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
 CHANNEL FLOW THRU SUBAREA(CFS) =       4.44
 FLOW VELOCITY(FEET/SEC) =   6.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =    4.85
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     30.10 =     460.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.10 TO NODE     30.10 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
 NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4756
 SUBAREA AREA(ACRES) =    1.03   SUBAREA RUNOFF(CFS) =    2.56
 TOTAL AREA(ACRES) =        2.1   TOTAL RUNOFF(CFS) =       7.00
 TC(MIN.) =    4.85

****************************************************************************
 FLOW PROCESS FROM NODE     30.10 TO NODE     30.15 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =    247.00  DOWNSTREAM(FEET) =    138.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1210.00   CHANNEL SLOPE =  0.0901
 CHANNEL FLOW THRU SUBAREA(CFS) =       7.00
 FLOW VELOCITY(FEET/SEC) =   6.86 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   2.94   Tc(MIN.) =    7.79
 LONGEST FLOWPATH FROM NODE     30.00 TO NODE     30.15 =    1670.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     30.15 TO NODE     30.15 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.345
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .4600
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4648
 SUBAREA AREA(ACRES) =    4.64   SUBAREA RUNOFF(CFS) =   11.41
 TOTAL AREA(ACRES) =        6.7   TOTAL RUNOFF(CFS) =      16.67
 TC(MIN.) =    7.79

****************************************************************************
 FLOW PROCESS FROM NODE     20.10 TO NODE     30.15 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.) =    7.79
  RAINFALL INTENSITY(INCH/HR) =   5.35
  TOTAL STREAM AREA(ACRES) =     6.71
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     16.67

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        6.23     6.91        5.773          2.78
      2       16.67     7.79        5.345          6.71

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       21.02     6.91       5.773
      2       22.44     7.79       5.345

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      22.44   Tc(MIN.) =    7.79
  TOTAL AREA(ACRES) =        9.5
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     30.15 =    1670.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.5  TC(MIN.) =      7.79
  PEAK FLOW RATE(CFS)   =      22.44
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

## 3.2 Proposed Undetained Condition Hydrologic Model Output (100-Year Event)

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                              Analysis prepared by:

                          PASCO LARET SUITER & ASSOCIATES
                            535 NORTH HIGHWAY 101, STE A
                               SOLANA BEACH, CA 92075
                                    858-259-8212

 ************************** DESCRIPTION OF STUDY **************************
* POSTEDEVELOPED HYDROLOGIC ANALYSIS FOR OLIVENHAIN HILLS                 *
* 100 YEAR STORM EVENT                                                    *
*                                                                         *
 *************************************************************************

  FILE NAME: 3009POST.DAT
  TIME/DATE OF STUDY: 12:39 12/09/2020
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *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   12.0      7.0    0.020/0.020/0.020   0.50    1.50 0.0100 0.125 0.0180

  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.*

**************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.05 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    300.60
  ELEVATION DIFFERENCE(FEET) =     23.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.271
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      3.63
  TOTAL AREA(ACRES) =      0.85   TOTAL RUNOFF(CFS) =      3.63

****************************************************************************
  FLOW PROCESS FROM NODE     10.05 TO NODE     10.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    300.60  DOWNSTREAM(FEET) =    156.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   915.00   CHANNEL SLOPE =  0.1580
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.63
  FLOW VELOCITY(FEET/SEC) =   6.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =    6.73
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     10.10 =    1165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.872
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3841
  SUBAREA AREA(ACRES) =    5.39   SUBAREA RUNOFF(CFS) =   11.08
  TOTAL AREA(ACRES) =        6.2   TOTAL RUNOFF(CFS) =      14.07
  TC(MIN.) =    6.73

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.10 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.) =    6.73
  RAINFALL INTENSITY(INCH/HR) =   5.87
  TOTAL STREAM AREA(ACRES) =     6.24
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.07

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     50.05 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   170.00
  UPSTREAM ELEVATION(FEET) =    188.00
  DOWNSTREAM ELEVATION(FEET) =    173.50
  ELEVATION DIFFERENCE(FEET) =     14.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.608
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.11   SUBAREA RUNOFF(CFS) =    0.23
  TOTAL AREA(ACRES) =        0.2   TOTAL RUNOFF(CFS) =       0.50
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.17
  TOTAL AREA(ACRES) =        0.3   TOTAL RUNOFF(CFS) =       0.67
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
```

```
  SUBAREA AREA(ACRES) =    0.22   SUBAREA RUNOFF(CFS) =    0.46
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.12
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     10.10 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.) =    6.61
  RAINFALL INTENSITY(INCH/HR) =   5.94
  TOTAL STREAM AREA(ACRES) =     0.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.12

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       14.07     6.73        5.872          6.24
      2        1.12     6.61        5.943          0.54

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       14.93     6.61       5.943
      2       15.18     6.73       5.872

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.18   Tc(MIN.) =    6.73
  TOTAL AREA(ACRES) =        6.8
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     10.10 =    1165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.05 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  UPSTREAM ELEVATION(FEET) =    244.00
  DOWNSTREAM ELEVATION(FEET) =    212.00
  ELEVATION DIFFERENCE(FEET) =     32.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.348
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.812
  SUBAREA RUNOFF(CFS) =      0.91
  TOTAL AREA(ACRES) =      0.29   TOTAL RUNOFF(CFS) =      0.91
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     20.05 TO NODE     20.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    212.00  DOWNSTREAM(FEET) =    180.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00   CHANNEL SLOPE =  0.0970
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.91
  FLOW VELOCITY(FEET/SEC) =   4.67 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.18   Tc(MIN.) =    6.53
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     20.10 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.991
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4600
  SUBAREA AREA(ACRES) =    0.70   SUBAREA RUNOFF(CFS) =    1.93
  TOTAL AREA(ACRES) =        1.0   TOTAL RUNOFF(CFS) =       2.73
  TC(MIN.) =    6.53

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.15 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    180.00  DOWNSTREAM(FEET) =    162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   210.00   CHANNEL SLOPE =  0.0857
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.73
  FLOW VELOCITY(FEET/SEC) =   5.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.65   Tc(MIN.) =    7.18
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     20.15 =     820.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 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.) =    7.18
  RAINFALL INTENSITY(INCH/HR) =   5.64
  TOTAL STREAM AREA(ACRES) =     0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.73

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     30.05 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    299.00
  ELEVATION DIFFERENCE(FEET) =     25.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.439
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      4.44
  TOTAL AREA(ACRES) =      1.04   TOTAL RUNOFF(CFS) =      4.44

****************************************************************************
  FLOW PROCESS FROM NODE     30.05 TO NODE     30.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    299.00  DOWNSTREAM(FEET) =    247.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.3250
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.44
  FLOW VELOCITY(FEET/SEC) =   6.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =    4.85
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     30.10 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.10 TO NODE     30.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4756
  SUBAREA AREA(ACRES) =    1.03   SUBAREA RUNOFF(CFS) =    2.56
  TOTAL AREA(ACRES) =       2.1   TOTAL RUNOFF(CFS) =       7.00
  TC(MIN.) =    4.85

****************************************************************************
  FLOW PROCESS FROM NODE     30.10 TO NODE     20.15 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    247.00  DOWNSTREAM(FEET) =    162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   895.00   CHANNEL SLOPE =  0.0950
  CHANNEL FLOW THRU SUBAREA(CFS) =       7.00
```

```
  FLOW VELOCITY(FEET/SEC) =   7.05 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.12   Tc(MIN.) =    6.97
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.15 =    1355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.744
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4648
  SUBAREA AREA(ACRES) =    4.68   SUBAREA RUNOFF(CFS) =   12.36
  TOTAL AREA(ACRES) =        6.8   TOTAL RUNOFF(CFS) =      18.02
  TC(MIN.) =    6.97

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 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.) =    6.97
  RAINFALL INTENSITY(INCH/HR) =   5.74
  TOTAL STREAM AREA(ACRES) =     6.75
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     18.02

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.73     7.18        5.635          0.99
      2       18.02     6.97        5.744          6.75

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       20.67     6.97       5.744
      2       20.41     7.18       5.635

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.67   Tc(MIN.) =    6.97
  TOTAL AREA(ACRES) =        7.7
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.15 =    1355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.20 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    162.00  DOWNSTREAM(FEET) =    158.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    50.00   CHANNEL SLOPE =  0.0800
  CHANNEL FLOW THRU SUBAREA(CFS) =      20.67
  FLOW VELOCITY(FEET/SEC) =   8.55 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =    7.06
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.20 =    1405.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.20 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.) =    7.06
  RAINFALL INTENSITY(INCH/HR) =   5.69
  TOTAL STREAM AREA(ACRES) =     7.74
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     20.67

****************************************************************************
  FLOW PROCESS FROM NODE     40.15 TO NODE     40.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.00
  UPSTREAM ELEVATION(FEET) =    210.00
  DOWNSTREAM ELEVATION(FEET) =    203.80
  ELEVATION DIFFERENCE(FEET) =      6.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.457
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.724
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.14   TOTAL RUNOFF(CFS) =      0.54

****************************************************************************
  FLOW PROCESS FROM NODE     40.20 TO NODE     40.25 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   201.00  DOWNSTREAM(FEET) =   200.00
  FLOW LENGTH(FEET) =   117.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.06
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.54
  PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    5.94
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.25 =     233.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.25 TO NODE     40.30 IS CODE =  62
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =  200.00  DOWNSTREAM ELEVATION(FEET) =  176.00
  STREET LENGTH(FEET) =   240.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 12.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   7.00
  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) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.38
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    6.50
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.10
  STREET FLOW TRAVEL TIME(MIN.) =   0.86   Tc(MIN.) =    6.79
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.838
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.525
  SUBAREA AREA(ACRES) =    1.21      SUBAREA RUNOFF(CFS) =    3.67
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       4.14

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   8.36
  FLOW VELOCITY(FEET/SEC.) =  5.27   DEPTH*VELOCITY(FT*FT/SEC.) =   1.43
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.30 =     473.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.30 TO NODE     40.30 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.838
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5333
  SUBAREA AREA(ACRES) =    0.41   SUBAREA RUNOFF(CFS) =    1.34
  TOTAL AREA(ACRES) =        1.8   TOTAL RUNOFF(CFS) =       5.48
  TC(MIN.) =    6.79

****************************************************************************
  FLOW PROCESS FROM NODE     40.30 TO NODE     40.35 IS CODE =  31
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =   170.70  DOWNSTREAM(FEET) =   170.55
  FLOW LENGTH(FEET) =     6.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.89
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.48
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.80
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.35 =     479.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.35 TO NODE     40.35 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.833
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5249
  SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.17
  TOTAL AREA(ACRES) =        1.8   TOTAL RUNOFF(CFS) =       5.65
  TC(MIN.) =    6.80

****************************************************************************
  FLOW PROCESS FROM NODE     40.40 TO NODE     40.45 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   164.00  DOWNSTREAM(FEET) =   159.50
  FLOW LENGTH(FEET) =   116.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.99
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.65
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    6.95
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.45 =     595.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.45 TO NODE     20.20 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   159.00  DOWNSTREAM(FEET) =   158.00
  FLOW LENGTH(FEET) =   105.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.66
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.65
  PIPE TRAVEL TIME(MIN.) =   0.23    Tc(MIN.) =    7.18
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     20.20 =     700.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.20 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.) =    7.18
  RAINFALL INTENSITY(INCH/HR) =   5.63
  TOTAL STREAM AREA(ACRES) =     1.85
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.65

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       20.67     7.06        5.692          7.74
      2        5.65     7.18        5.633          1.85

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       26.23     7.06       5.692
      2       26.10     7.18       5.633

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      26.23   Tc(MIN.) =    7.06
  TOTAL AREA(ACRES) =        9.6
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.20 =    1405.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.25 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.00  DOWNSTREAM(FEET) =    138.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   236.00   CHANNEL SLOPE =  0.0847
  CHANNEL FLOW THRU SUBAREA(CFS) =      26.23
  FLOW VELOCITY(FEET/SEC) =   9.39 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.42   Tc(MIN.) =    7.48
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.25 =    1641.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.25 TO NODE     20.25 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.485
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4744
  SUBAREA AREA(ACRES) =    0.11   SUBAREA RUNOFF(CFS) =    0.21
  TOTAL AREA(ACRES) =        9.7   TOTAL RUNOFF(CFS) =      26.23
  TC(MIN.) =    7.48
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
```

```
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.7  TC(MIN.) =      7.48
  PEAK FLOW RATE(CFS)   =      26.23
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

### 3.3 Detention Analysis

The HMP Biofiltration basins (BMPs) provide pollutant control, hydromodification management flow control and mitigation of the 100-year storm event peak flow rate. The 100-year storm event detention analysis was performed using HydroCAD Stormwater Modeling software. The inflow runoff hydrograph to each BMP was modeled using RatHydro which is a Rational Method Design Storm Hydrograph software that creates a hydrograph using the results of the Rational Method calculations. HydroCAD has the ability to route the 100-year 6-hour storm event inflow hydrograph through each BMP and based on the BMP cross sectional geometry, stage storage and outlet structure data, HydroCAD calculates the detained peak flow rate and detained time to peak.

The HMP Biofiltration facilities consists of a basin with 18 inches of engineered soil and 12 inches of gravel. Runoff will be biofiltered through the engineered soil and gravel layers, then collected in a series of small PVC drainpipes and directed to a catch basin located in the HMP Biofiltration basin where runoff will be mitigated via a small HMP orifice to comply with HMP requirements. In larger storm events, runoff not filtered through the engineered soil and gravel layers will be conveyed via an overflow outlet structure. Runoff conveyed via the outlet structure will bypass the small HMP orifice and be conveyed directly to the proposed discharge outlet. Refer to Appendix B for cross-sections of the HMP Biofiltration basins.

Based on the results of the HydroCAD analysis, the HMP Biofiltration facilities provide mitigation for the 100-year storm event peak flow rate, detaining the proposed condition to below the existing condition. Refer to Section 3.4 for the proposed detained condition hydrologic calculations and to Appendix B for the HydroCAD detention detailed output.

## 3.4 Proposed Detained Condition Hydrologic Model Output (100-Year Event)

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2016 Advanced Engineering Software (aes)
              Ver. 23.0 Release Date: 07/01/2016  License ID 1452

                              Analysis prepared by:

                          PASCO LARET SUITER & ASSOCIATES
                            535 NORTH HIGHWAY 101, STE A
                               SOLANA BEACH, CA 92075
                                    858-259-8212

 ************************** DESCRIPTION OF STUDY **************************
* POSTEDEVELOPED HYDROLOGIC ANALYSIS FOR OLIVENHAIN HILLS                 *
* 100 YEAR STORM EVENT                                                    *
* DETAINED                                                                *
 **************************************************************************

  FILE NAME: 3009PD00.DAT
  TIME/DATE OF STUDY: 13:45 12/09/2020
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.700
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   4.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *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   12.0      7.0    0.020/0.020/0.020   0.50    1.50 0.0100 0.125 0.0180

  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.*

**************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.05 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
```

```
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    300.60
  ELEVATION DIFFERENCE(FEET) =     23.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.271
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      3.63
  TOTAL AREA(ACRES) =      0.85   TOTAL RUNOFF(CFS) =      3.63

****************************************************************************
  FLOW PROCESS FROM NODE     10.05 TO NODE     10.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    300.60  DOWNSTREAM(FEET) =    156.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   915.00   CHANNEL SLOPE =  0.1580
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.63
  FLOW VELOCITY(FEET/SEC) =   6.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.46   Tc(MIN.) =    6.73
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     10.10 =    1165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.872
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3841
  SUBAREA AREA(ACRES) =    5.39   SUBAREA RUNOFF(CFS) =   11.08
  TOTAL AREA(ACRES) =        6.2   TOTAL RUNOFF(CFS) =      14.07
  TC(MIN.) =    6.73

****************************************************************************
  FLOW PROCESS FROM NODE     10.10 TO NODE     10.10 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.) =    6.73
  RAINFALL INTENSITY(INCH/HR) =   5.87
  TOTAL STREAM AREA(ACRES) =     6.24
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.07

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     50.05 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   170.00
  UPSTREAM ELEVATION(FEET) =    188.00
  DOWNSTREAM ELEVATION(FEET) =    173.50
  ELEVATION DIFFERENCE(FEET) =     14.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.608
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.11   SUBAREA RUNOFF(CFS) =    0.23
  TOTAL AREA(ACRES) =        0.2   TOTAL RUNOFF(CFS) =       0.50
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
  SUBAREA AREA(ACRES) =    0.08   SUBAREA RUNOFF(CFS) =    0.17
  TOTAL AREA(ACRES) =        0.3   TOTAL RUNOFF(CFS) =       0.67
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     50.05 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.943
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3500
```

```
  SUBAREA AREA(ACRES) =    0.22   SUBAREA RUNOFF(CFS) =    0.46
  TOTAL AREA(ACRES) =        0.5   TOTAL RUNOFF(CFS) =       1.12
  TC(MIN.) =    6.61

****************************************************************************
  FLOW PROCESS FROM NODE     50.05 TO NODE     10.10 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.) =    6.61
  RAINFALL INTENSITY(INCH/HR) =   5.94
  TOTAL STREAM AREA(ACRES) =     0.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.12

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       14.07     6.73        5.872          6.24
      2        1.12     6.61        5.943          0.54

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       14.93     6.61       5.943
      2       15.18     6.73       5.872

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      15.18   Tc(MIN.) =    6.73
  TOTAL AREA(ACRES) =        6.8
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     10.10 =    1165.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     20.05 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   280.00
  UPSTREAM ELEVATION(FEET) =    244.00
  DOWNSTREAM ELEVATION(FEET) =    212.00
  ELEVATION DIFFERENCE(FEET) =     32.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.348
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.812
  SUBAREA RUNOFF(CFS) =      0.91
  TOTAL AREA(ACRES) =      0.29   TOTAL RUNOFF(CFS) =      0.91
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     20.05 TO NODE     20.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    212.00  DOWNSTREAM(FEET) =    180.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00   CHANNEL SLOPE =  0.0970
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.91
  FLOW VELOCITY(FEET/SEC) =   4.67 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.18   Tc(MIN.) =    6.53
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     20.10 =     610.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.991
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4600
  SUBAREA AREA(ACRES) =    0.70   SUBAREA RUNOFF(CFS) =    1.93
  TOTAL AREA(ACRES) =        1.0   TOTAL RUNOFF(CFS) =       2.73
  TC(MIN.) =    6.53

****************************************************************************
  FLOW PROCESS FROM NODE     20.10 TO NODE     20.15 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    180.00  DOWNSTREAM(FEET) =    162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   210.00   CHANNEL SLOPE =  0.0857
  CHANNEL FLOW THRU SUBAREA(CFS) =       2.73
  FLOW VELOCITY(FEET/SEC) =   5.38 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.65   Tc(MIN.) =    7.18
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     20.15 =     820.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 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.) =    7.18
  RAINFALL INTENSITY(INCH/HR) =   5.64
  TOTAL STREAM AREA(ACRES) =     0.99
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.73

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     30.05 IS CODE =  21
----------------------------------------------------------------------------
```

```
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  UPSTREAM ELEVATION(FEET) =    324.00
  DOWNSTREAM ELEVATION(FEET) =    299.00
  ELEVATION DIFFERENCE(FEET) =     25.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.439
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      4.44
  TOTAL AREA(ACRES) =      1.04   TOTAL RUNOFF(CFS) =      4.44

****************************************************************************
  FLOW PROCESS FROM NODE     30.05 TO NODE     30.10 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    299.00  DOWNSTREAM(FEET) =    247.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   160.00   CHANNEL SLOPE =  0.3250
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.44
  FLOW VELOCITY(FEET/SEC) =   6.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.41   Tc(MIN.) =    4.85
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     30.10 =     460.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.10 TO NODE     30.10 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.114
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4756
  SUBAREA AREA(ACRES) =    1.03   SUBAREA RUNOFF(CFS) =    2.56
  TOTAL AREA(ACRES) =       2.1   TOTAL RUNOFF(CFS) =       7.00
  TC(MIN.) =    4.85

****************************************************************************
  FLOW PROCESS FROM NODE     30.10 TO NODE     20.15 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    247.00  DOWNSTREAM(FEET) =    162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   895.00   CHANNEL SLOPE =  0.0950
  CHANNEL FLOW THRU SUBAREA(CFS) =       7.00
```

```
  FLOW VELOCITY(FEET/SEC) =   7.05 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   2.12   Tc(MIN.) =    6.97
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.15 =    1355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.744
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .4600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4648
  SUBAREA AREA(ACRES) =    4.68   SUBAREA RUNOFF(CFS) =   12.36
  TOTAL AREA(ACRES) =        6.8   TOTAL RUNOFF(CFS) =      18.02
  TC(MIN.) =    6.97

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.15 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.) =    6.97
  RAINFALL INTENSITY(INCH/HR) =   5.74
  TOTAL STREAM AREA(ACRES) =     6.75
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     18.02

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.73     7.18        5.635          0.99
      2       18.02     6.97        5.744          6.75

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       20.67     6.97       5.744
      2       20.41     7.18       5.635

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      20.67   Tc(MIN.) =    6.97
  TOTAL AREA(ACRES) =        7.7
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.15 =    1355.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.15 TO NODE     20.20 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =    162.00  DOWNSTREAM(FEET) =    158.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    50.00   CHANNEL SLOPE =  0.0800
  CHANNEL FLOW THRU SUBAREA(CFS) =      20.67
  FLOW VELOCITY(FEET/SEC) =   8.55 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.10   Tc(MIN.) =    7.06
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.20 =    1405.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.20 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.) =    7.06
  RAINFALL INTENSITY(INCH/HR) =   5.69
  TOTAL STREAM AREA(ACRES) =     7.74
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     20.67

****************************************************************************
  FLOW PROCESS FROM NODE     40.15 TO NODE     40.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   116.00
  UPSTREAM ELEVATION(FEET) =    210.00
  DOWNSTREAM ELEVATION(FEET) =    203.80
  ELEVATION DIFFERENCE(FEET) =      6.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.457
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =   100.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.724
  SUBAREA RUNOFF(CFS) =      0.54
  TOTAL AREA(ACRES) =      0.14   TOTAL RUNOFF(CFS) =      0.54

****************************************************************************
  FLOW PROCESS FROM NODE     40.20 TO NODE     40.25 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   201.00  DOWNSTREAM(FEET) =   200.00
  FLOW LENGTH(FEET) =   117.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.06
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.54
  PIPE TRAVEL TIME(MIN.) =   0.48    Tc(MIN.) =    5.94
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.25 =     233.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.25 TO NODE     40.30 IS CODE =  62
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
========================================================================
  UPSTREAM ELEVATION(FEET) =  200.00  DOWNSTREAM ELEVATION(FEET) =  176.00
  STREET LENGTH(FEET) =   240.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 12.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   7.00
  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) =   0.0180
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.38
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.24
    HALFSTREET FLOOD WIDTH(FEET) =    6.50
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.67
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.10
  STREET FLOW TRAVEL TIME(MIN.) =   0.86   Tc(MIN.) =    6.79
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.838
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5200
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.525
  SUBAREA AREA(ACRES) =    1.21      SUBAREA RUNOFF(CFS) =    3.67
  TOTAL AREA(ACRES) =        1.4        PEAK FLOW RATE(CFS) =       4.14

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.27   HALFSTREET FLOOD WIDTH(FEET) =   8.36
  FLOW VELOCITY(FEET/SEC.) =  5.27   DEPTH*VELOCITY(FT*FT/SEC.) =   1.43
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.30 =     473.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     40.30 TO NODE     40.30 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.838
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5600
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.5333
  SUBAREA AREA(ACRES) =    0.41   SUBAREA RUNOFF(CFS) =    1.34
  TOTAL AREA(ACRES) =        1.8   TOTAL RUNOFF(CFS) =       5.48
  TC(MIN.) =    6.79

****************************************************************************
  FLOW PROCESS FROM NODE     40.30 TO NODE     40.35 IS CODE =  31
------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
========================================================================
```

```
 ELEVATION DATA: UPSTREAM(FEET) =   170.70  DOWNSTREAM(FEET) =   170.55
 FLOW LENGTH(FEET) =     6.00   MANNING'S N =  0.009
 DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.3 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  10.89
 ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       5.48
 PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.80
 LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.35 =     479.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.35 TO NODE     40.35 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.833
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .3500
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.5249
 SUBAREA AREA(ACRES) =    0.09   SUBAREA RUNOFF(CFS) =    0.17
 TOTAL AREA(ACRES) =        1.8   TOTAL RUNOFF(CFS) =       5.65
 TC(MIN.) =    6.80

****************************************************************************
 FLOW PROCESS FROM NODE     40.35 TO NODE     40.35 IS CODE =   7
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN) =  13.40   RAIN INTENSITY(INCH/HOUR) =  3.77
 TOTAL AREA(ACRES) =     1.85   TOTAL RUNOFF(CFS) =      1.26

****************************************************************************
 FLOW PROCESS FROM NODE     40.40 TO NODE     40.45 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   164.00  DOWNSTREAM(FEET) =   159.50
 FLOW LENGTH(FEET) =   116.00   MANNING'S N =  0.009
 DEPTH OF FLOW IN   6.0 INCH PIPE IS   4.1 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   8.82
 ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.26
 PIPE TRAVEL TIME(MIN.) =   0.22    Tc(MIN.) =   13.62
 LONGEST FLOWPATH FROM NODE     40.15 TO NODE     40.45 =     595.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     40.45 TO NODE     20.20 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   159.00  DOWNSTREAM(FEET) =   158.00
 FLOW LENGTH(FEET) =   105.00   MANNING'S N =  0.009
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.8 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   5.27
```

```
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.26
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =   13.95
  LONGEST FLOWPATH FROM NODE     40.15 TO NODE     20.20 =     700.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.20 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.) =   13.95
  RAINFALL INTENSITY(INCH/HR) =   3.67
  TOTAL STREAM AREA(ACRES) =     1.85
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.26

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       20.67     7.06        5.692          7.74
      2        1.26    13.95        3.670          1.85

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       21.31     7.06       5.692
      2       14.59    13.95       3.670

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      21.31   Tc(MIN.) =    7.06
  TOTAL AREA(ACRES) =        9.6
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.20 =    1405.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.20 TO NODE     20.25 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.00  DOWNSTREAM(FEET) =    138.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   236.00   CHANNEL SLOPE =  0.0847
  CHANNEL FLOW THRU SUBAREA(CFS) =      21.31
  FLOW VELOCITY(FEET/SEC) =   8.87 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.44   Tc(MIN.) =    7.51
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     20.25 =    1641.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.25 TO NODE     20.25 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.473
```

```
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4088
  SUBAREA AREA(ACRES) =    0.11   SUBAREA RUNOFF(CFS) =    0.21
  TOTAL AREA(ACRES) =        9.7   TOTAL RUNOFF(CFS) =      21.71
  TC(MIN.) =    7.51
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        9.7  TC(MIN.) =      7.51
  PEAK FLOW RATE(CFS)   =      21.71
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

### 3.5 Hydromodification Analysis

To satisfy the requirements of the MS4 Permit, a hydromodification management strategy has been developed for the project based on the Final Hydromodification Management Plan dated March 2011, (Final HMP). A continuous simulation model, the Environmental Protection Agency (EPA) Storm Water Management Model (SWMM) version 5.1, was selected to size mitigation measures. The SWMM model is capable of modeling hydromodification management facilities to mitigate the effects of increased runoff from the post-development conditions and use changes that may cause negative impacts (i.e. erosion) to downstream channels. Refer to the Stormwater Quality Management Plan (SWQMP) for the project titled "Stormwater Quality Management Plan for The Sanctuary Development" dated December 2020 prepared by Pasco Laret Suiter & Associates for the detailed HMP analysis.

### 3.6 Storm Water Pollutant Control

To meet the requirements of the MS4 Permit, the HMP Biofiltration facility is designed to treat onsite storm water pollutants contained in the volume of runoff from a 24-hour, $85^{th}$ percentile storm event by slowly infiltrating runoff through an engineered soil layer and gravel layer. Refer to the Stormwater Quality Management Plan (SWQMP) for the project titled "Stormwater Quality Management Plan for The Sanctuary Development" dated December 2020 prepared by Pasco Laret Suiter & Associates for the detailed pollutant control calculations.

# APPENDIX A

## Hydrology Support Material

## Table 3-1
## RUNOFF COEFFICIENTS FOR URBAN AREAS

| Land Use | | Runoff Coefficient "C" | | | | |
|---|---|---|---|---|---|---|
| | | | Soil Type | | | |
| NRCS Elements | County Elements | % IMPER. | A | B | C | D |
| Undisturbed Natural Terrain (Natural) | Permanent Open Space | 0* | 0.20 | 0.25 | 0.30 | 0.35 |
| Low Density Residential (LDR) | Residential, 1.0 DU/A or less | 10 | 0.27 | 0.32 | 0.36 | 0.41 |
| Low Density Residential (LDR) | Residential, 2.0 DU/A or less | 20 | 0.34 | 0.38 | 0.42 | 0.46 |
| Low Density Residential (LDR) | Residential, 2.9 DU/A or less | 25 | 0.38 | 0.41 | 0.45 | 0.49 |
| Medium Density Residential (MDR) | Residential, 4.3 DU/A or less | 30 | 0.41 | 0.45 | 0.48 | 0.52 |
| Medium Density Residential (MDR) | Residential, 7.3 DU/A or less | 40 | 0.48 | 0.51 | 0.54 | 0.57 |
| Medium Density Residential (MDR) | Residential, 10.9 DU/A or less | 45 | 0.52 | 0.54 | 0.57 | 0.60 |
| Medium Density Residential (MDR) | Residential, 14.5 DU/A or less | 50 | 0.55 | 0.58 | 0.60 | 0.63 |
| High Density Residential (HDR) | Residential, 24.0 DU/A or less | 65 | 0.66 | 0.67 | 0.69 | 0.71 |
| High Density Residential (HDR) | Residential, 43.0 DU/A or less | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (N. Com) | Neighborhood Commercial | 80 | 0.76 | 0.77 | 0.78 | 0.79 |
| Commercial/Industrial (G. Com) | General Commercial | 85 | 0.80 | 0.80 | 0.81 | 0.82 |
| Commercial/Industrial (O.P. Com) | Office Professional/Commercial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (Limited I.) | Limited Industrial | 90 | 0.83 | 0.84 | 0.84 | 0.85 |
| Commercial/Industrial (General I.) | General Industrial | 95 | 0.87 | 0.87 | 0.87 | 0.87 |

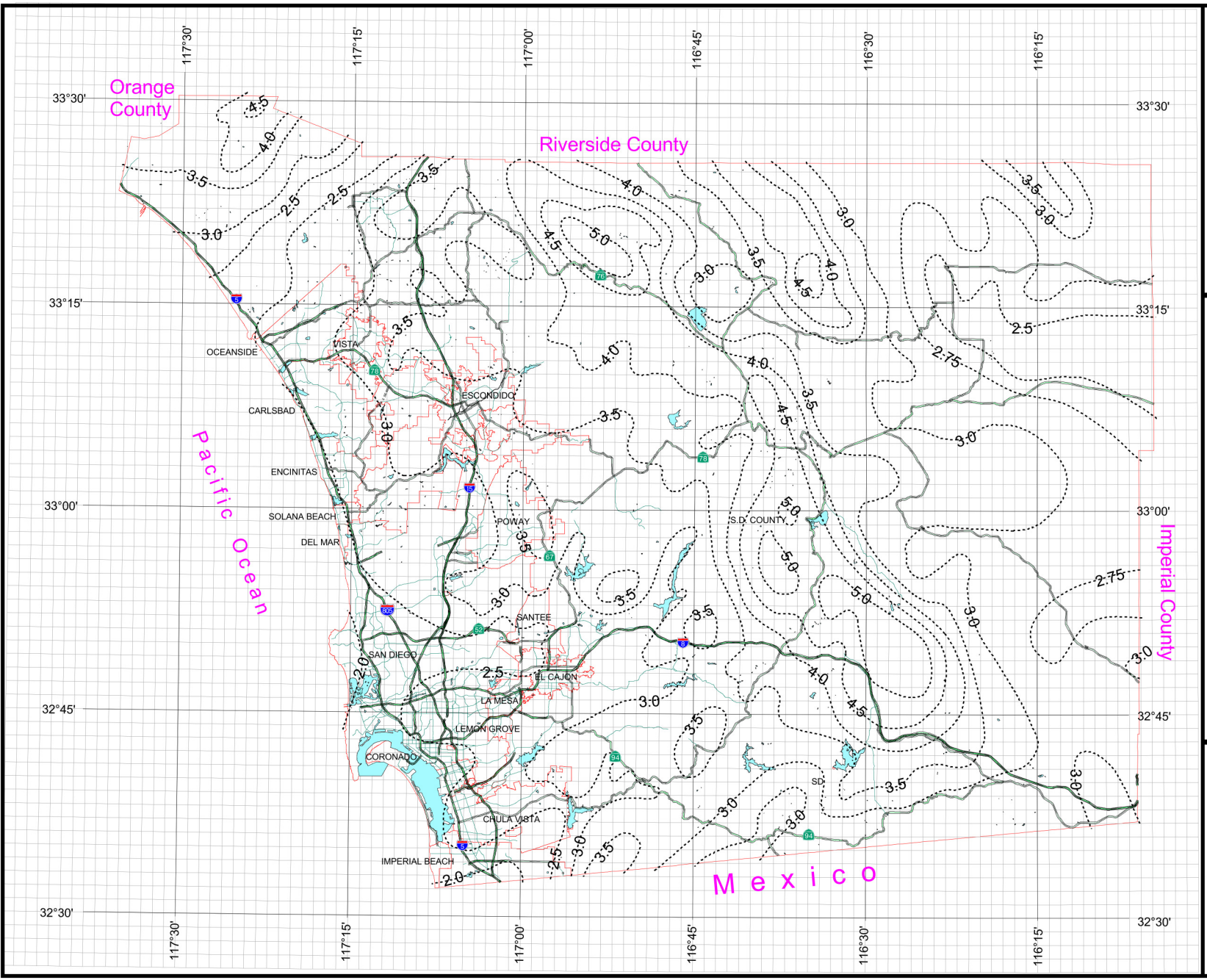
*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

# County of San Diego Hydrology Manual

*Rainfall Isopluvials*

**100 Year Rainfall Event - 6 Hours**

Isopluvial (inches)



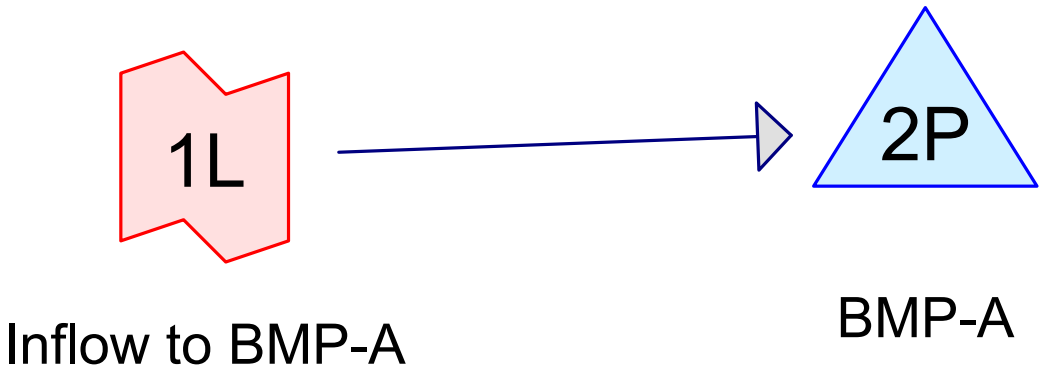



N W E S

3 0 3 Miles

# APPENDIX B

## Detention Support Material




Subcat Reach Pond Link

**Routing Diagram for 3009**
Prepared by Pasco Laret Suiter & Associates, Printed 12/9/2020

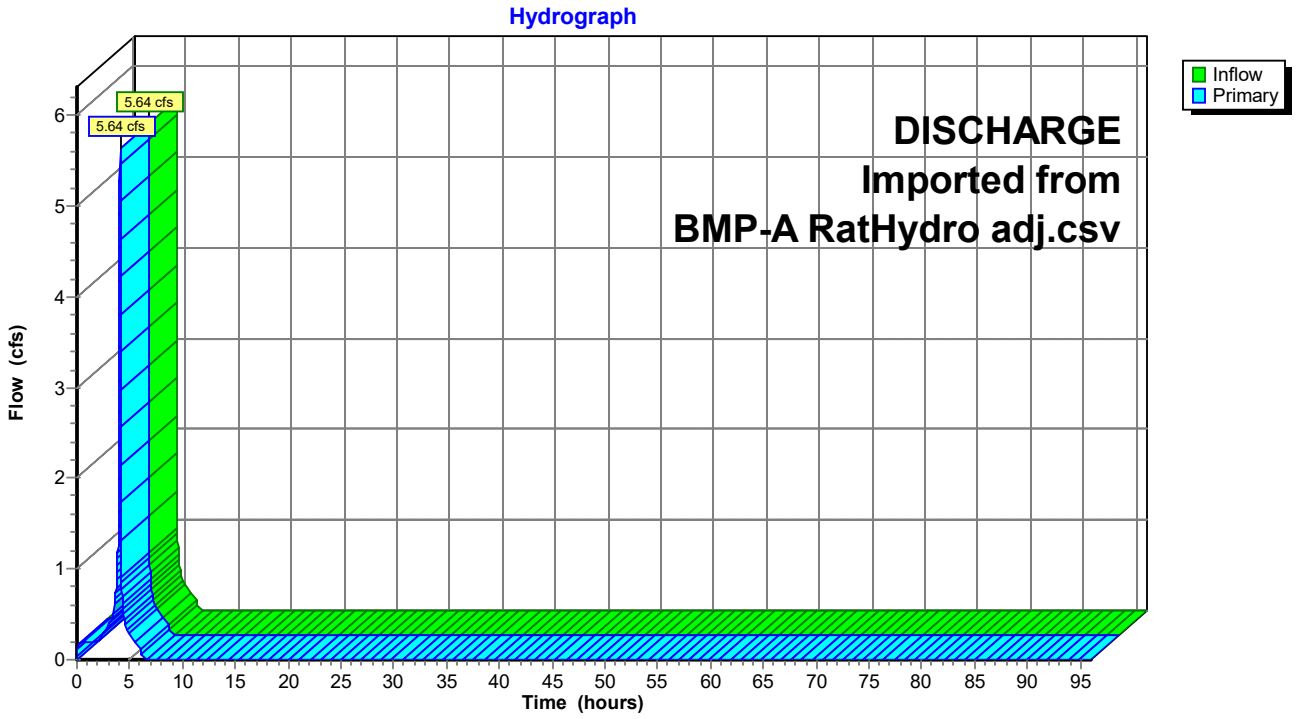
## Summary for Link 1L: Inflow to BMP-A

Inflow = 5.64 cfs @ 4.08 hrs, Volume= 0.222 af
Primary = 5.64 cfs @ 4.08 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

DISCHARGE Imported from BMP-A RatHydro adj.csv

### Link 1L: Inflow to BMP-A



## Summary for Pond 2P: BMP-A

| | | | | |
|---|---|---|---|---|
| Inflow | = | 5.64 cfs @ | 4.08 hrs, Volume= | 0.222 af |
| Outflow | = | 1.26 cfs @ | 4.19 hrs, Volume= | 0.222 af, Atten= 78%, Lag= 6.6 min |
| Primary | = | 1.26 cfs @ | 4.19 hrs, Volume= | 0.222 af |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs
Peak Elev= 101.10' @ 4.19 hrs Surf.Area= 3,708 sf Storage= 6,657 cf

Plug-Flow detention time= 497.9 min calculated for 0.222 af (100% of inflow)
Center-of-Mass det. time= 497.9 min ( 709.1 - 211.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 97.50' | 8,158 cf | **Custom Stage Data (Conic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Voids (%) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|---|
| 97.50 | 3,708 | 0.0 | 0 | 0 | 3,708 |
| 98.50 | 3,708 | 40.0 | 1,483 | 1,483 | 3,924 |
| 100.00 | 3,708 | 20.0 | 1,112 | 2,596 | 4,248 |
| 101.50 | 3,708 | 100.0 | 5,562 | 8,158 | 4,571 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 97.50' | **12.0" Round Culvert**<br>L= 116.0' RCP, groove end projecting, Ke= 0.200<br>Inlet / Outlet Invert= 97.50' / 86.50' S= 0.0948 '/' Cc= 0.900<br>n= 0.013, Flow Area= 0.79 sf |
| #2 | Device 1 | 97.50' | **1.5" Vert. Orifice** C= 0.600 Limited to weir flow at low heads |
| #3 | Device 1 | 101.00' | **36.0" x 36.0" Horiz. Grate**<br>C= 0.600 in 36.0" x 36.0" Grate (100% open area)<br>Limited to weir flow at low heads |

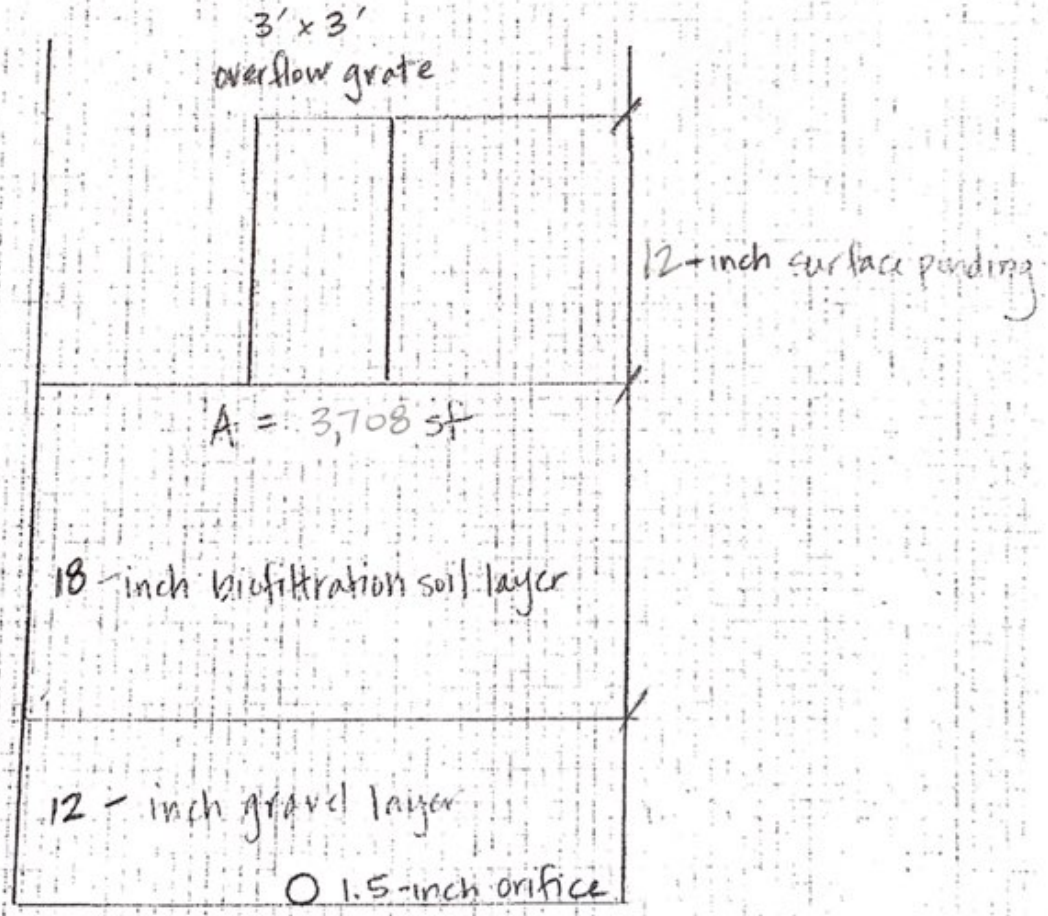
**Primary OutFlow** Max=1.26 cfs @ 4.19 hrs HW=101.09' (Free Discharge)
└**1=Culvert** (Passes 1.26 cfs of 8.32 cfs potential flow)
  └**2=Orifice** (Orifice Controls 0.11 cfs @ 9.05 fps)
  └**3=Grate** (Weir Controls 1.15 cfs @ 1.01 fps)

**PASCO LARET SUITER & ASSOCIATES**

Melamed

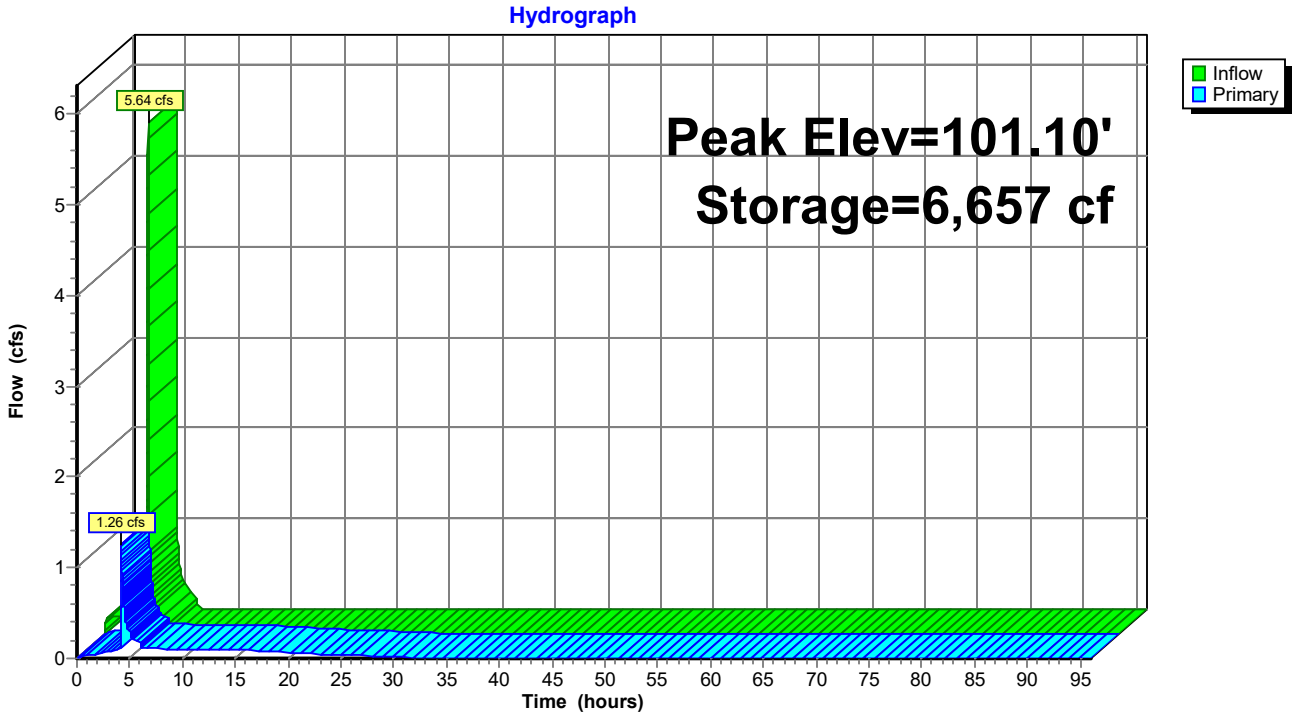
Date 12/9/2020 Job# 3009

# HMP. Partial Infiltration Basin BMP-A




not to scale

## Pond 2P: BMP-A

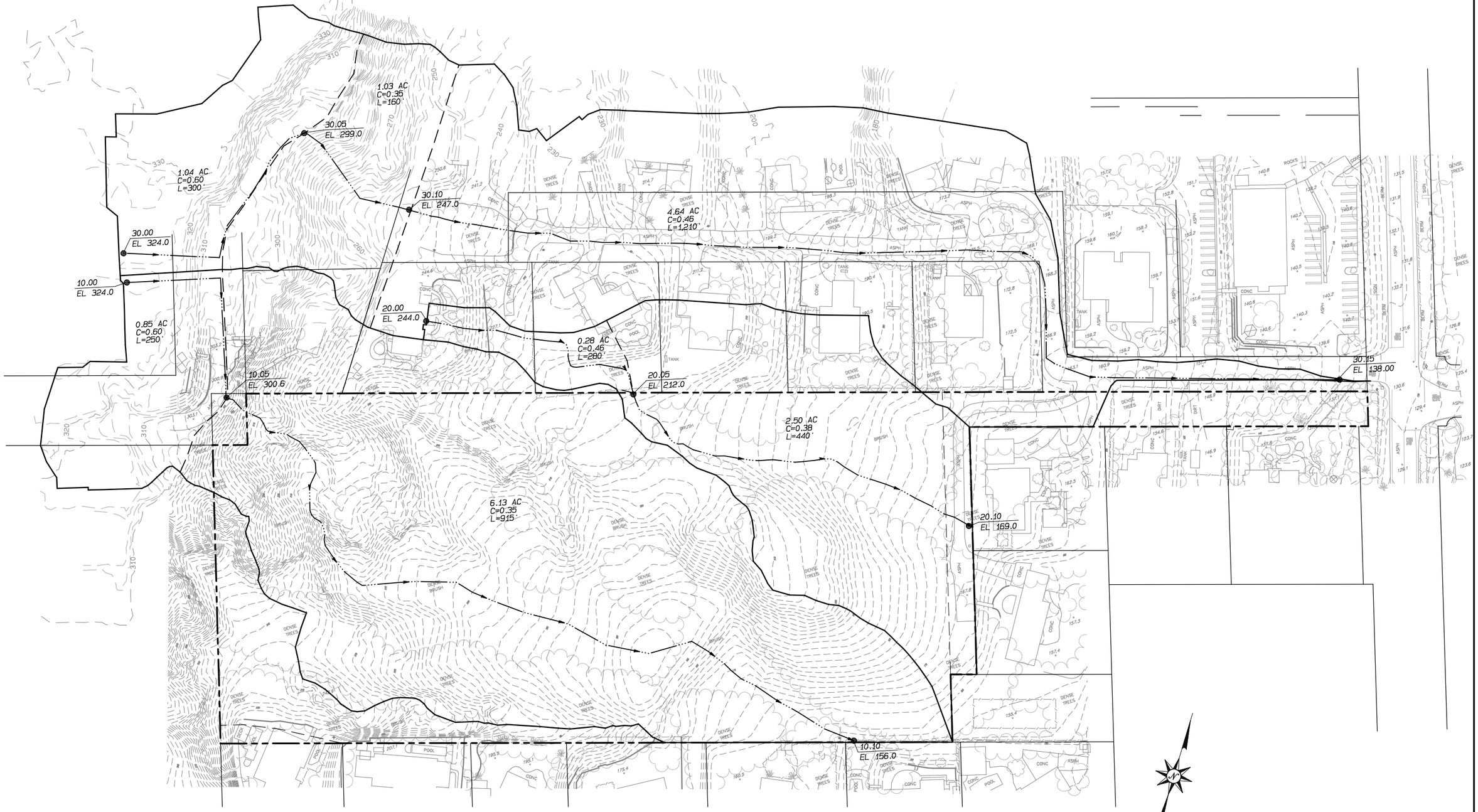

Hydrograph
Inflow
Primary
5.64 cfs
1.26 cfs
Peak Elev=101.10'
Storage=6,657 cf
Flow (cfs)
Time (hours)
0
1
2
3
4
5
6
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95

# APPENDIX C

## Existing and Proposed Hydrology Maps

# PREDEVELOPED HYDROLOGIC NODE MAP
# THE SANCTUARY
# 18-198 TM/DR/PRD/EIA

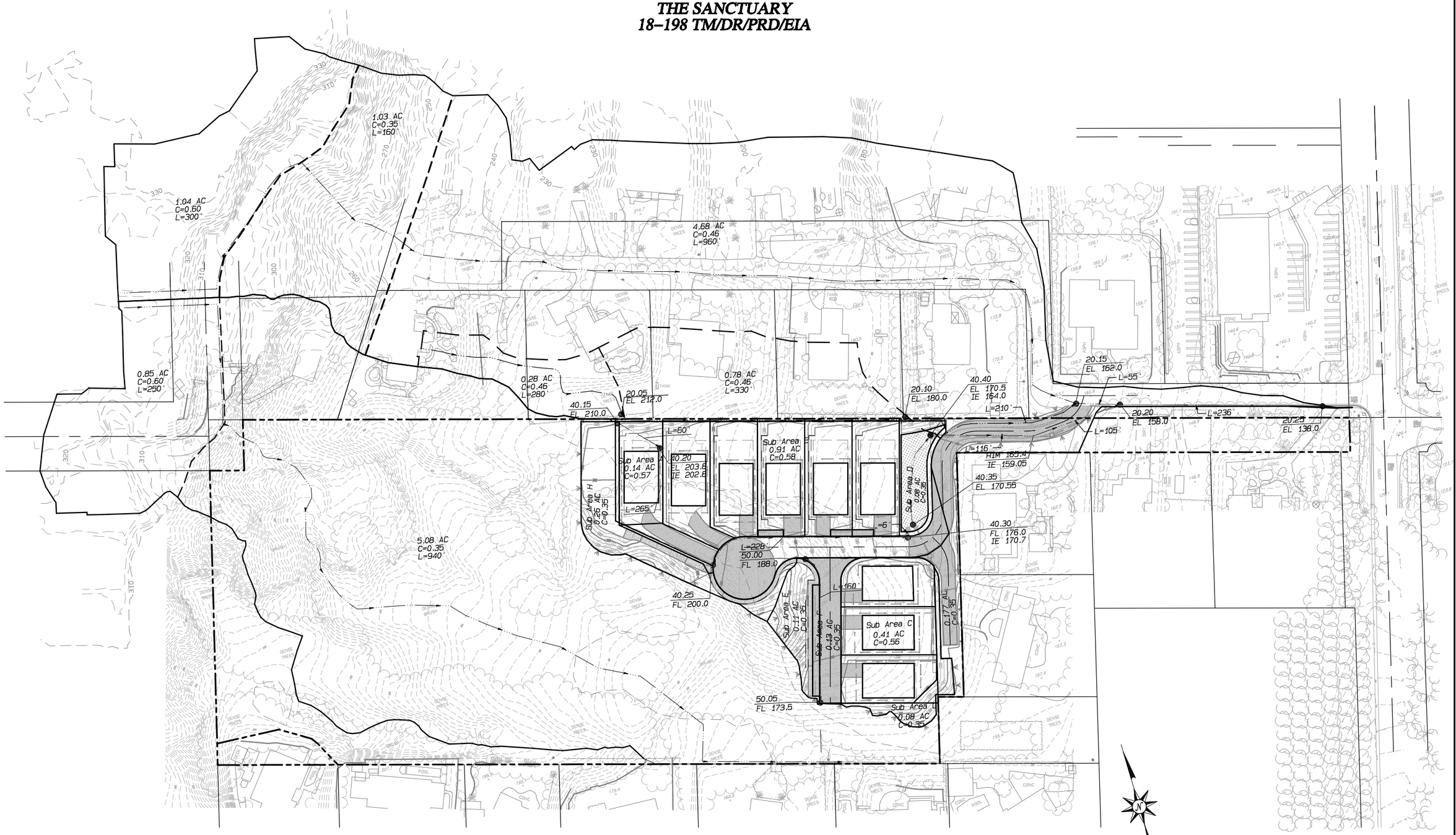





PREPARED BY:
**PASCO LARET SUITER & ASSOCIATES**
CIVIL ENGINEERING + LAND PLANNING + LAND SURVEYING
535 North Highway 101, Ste A, Solana Beach, CA 92075
ph 858.259.8212 | fx 858.259.4812 | plsaengineering.com

# POSTDEVELOPED HYDROLOGIC NODE MAP
# THE SANCTUARY
# 18-198 TM/DR/PRD/EIA



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