Appendix E: Preliminary Hydrology, Hydraulics, and Stormwater Treatment Study

HYDROLOGY, HYDRAULICS,
& STORMWATER TREATMENT STUDY

FOR

ZONA GALE ESTATES
11 LOT RESIDENTIAL DEVELOPMENT
MULTI-003289-2019

ZONA GALE ROAD
CITY OF ENCINITAS, CA

PREPARED FOR:
ASPEN GROWTH PROPERTIES INC
8799 BALBOA AVENUE, SUITE 260
SAN DIEGO, CA 92123

DATE:
MAY 2020

PREPARED BY:

PASCO LARET SUITER & ASSOCIATES
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_____

BRIAN M. ARDOLINO, RCE 71651 DATE

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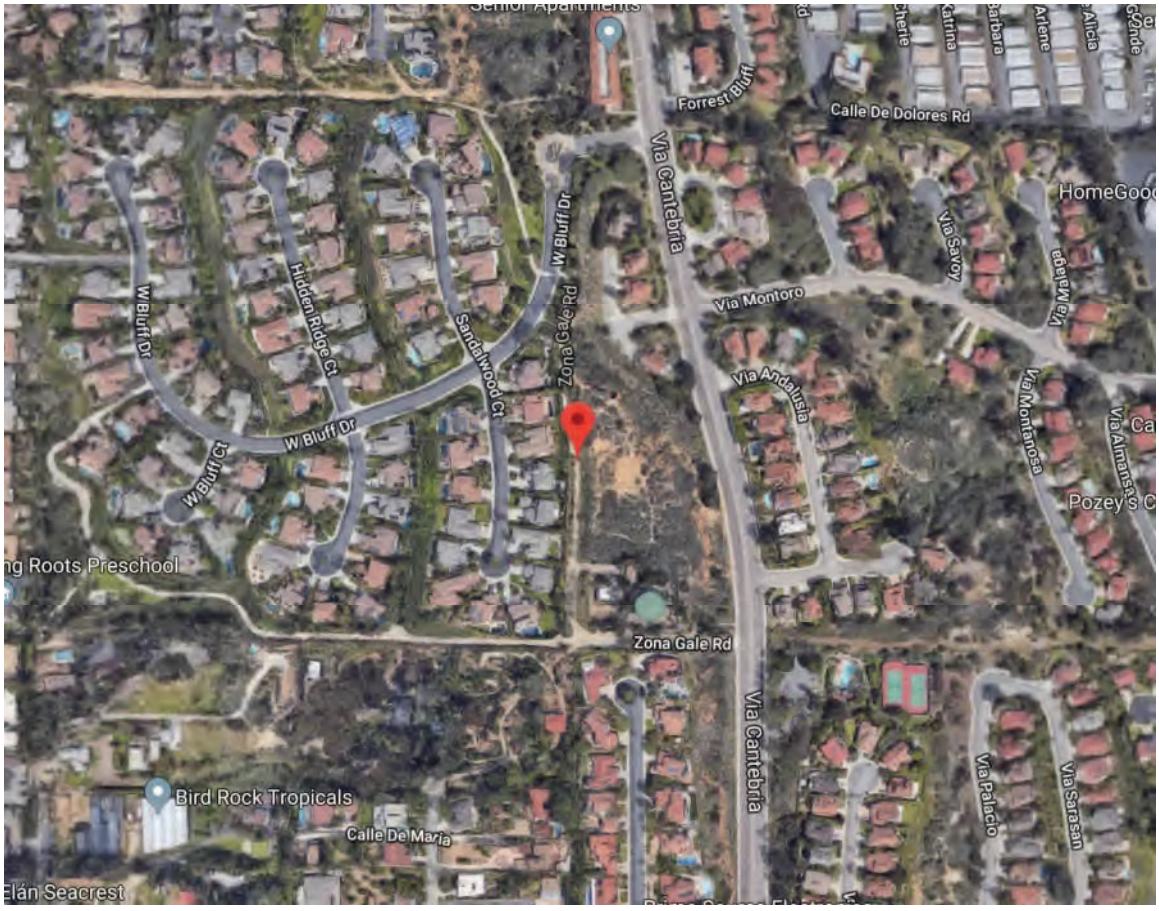
1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Hydrology Study for the Zona Gale Estates project has been prepared to analyze the hydrologic and hydraulic characteristics of the existing and proposed project site. This report intends to present both the methodology and the calculations used for determining the runoff from the project site in both the pre-developed (existing) conditions and the post-developed (proposed) conditions produced by the 100 year 6 hour storm. In addition this report will propose the sizing of all necessary storm drain facilities and storm drain piping necessary for the storm drain system to safely convey the runoff from the 100-year rainfall event.

1.2 Existing Conditions

The project site is located on Zona Gale Road and is bound vacant land to the east and north, water tank to the south, and residential homes to the west as shown on the Vicinity Map below.



In general, the site slopes from the south toward the north and west toward an existing concrete drainage ditch. There is an existing steep slope off-site to the east that slopes down to Via Cantebria. Stormwater from the site drains west to the existing concrete drainage ditch, then north along the ditch and outlets onto W. Bluff Drive. From there it

sheet flows along the street toward Via Cantebria, then south toward an existing public stormdrain curb inlet near the intersection of Via Cantebria and Via Montoro where it is ultimately conveyed to the Pacific Ocean.

1.3 Proposed Project

The intent of the proposed project is to develop the existing site into 11 lots, which include 9 residential single-family home lots, 1 private road lot and 1 stormwater treatment basin lot. The proposed development consists of grading to create pads suitable for the construction of the residences, private roadway access, stormwater treatment basin, associated landscape and hardscape, and associated underground utilities.

The proposed residential lots and the proposed private access roads will drain to proposed stormwater infrastructure that will outlet into the proposed bioretention treatment basin. Stormwater will be caught in a subdrain system, or overflow into one of two proposed 36" grate inlets where it will all outlet to a proposed stormdrain pipe that flows east toward Via Cantebria, and down the existing slope and out a proposed curb outlet onto Via Cantebria, where it will sheet flow north to the existing curb inlet, as it does in the existing condition.

1.4 Hydrologic Unit Contribution

As identified by the San Diego Basin Plan, the proposed project site drains within the Carlsbad Hydrologic Unit, specifically the Batiquitos Sub Area (904.51).

According to the California 2010 USEPA 303d list published by the San Diego Regional Water Quality Control Board, there are impaired water bodies that are associated with Encinitas Creek and the Batiquitos Lagoon. The pollutants and stressors for Encinitas Creek are Benthic, phosphorus, selenium and toxicity. The pollutant and stressor listed for the Batiquitos Lagoon is toxicity.

The proposed project has a relatively low concern for toxicity pollutants and therefore will have a low impact. Any impact will be adequately handled by the proposed Biofiltration basin.

Drainage from the site ultimately discharges to the Pacific Ocean, but the site does not directly discharge into the ocean itself. The path of discharge from the pre-developed condition is as follows: initially collected and conveyed to the northwest corner of the site, conveyed north along an existing PCC drainage ditch and outlets onto W. Bluff Drive. From there it sheet flows along the street toward Via Cantebria, then south toward an existing public stormdrain curb inlet near the intersection of Via Cantebria and Via Montoro where it is ultimately conveyed to the Pacific Ocean. The path of discharge from the post-developed condition is as follows: initially collected and conveyed to the eastern edge of the site, conveyed east in a proposed PVC pipe to a proposed curb outlet along Via Cantebria, where it then sheet flows north toward the existing public

stormdrain curb inlet near the intersection of Via Cantebria and Via Montoro, where it is ultimately conveyed to the Pacific Ocean.

1.5 Preliminary Hydrology Calculations

The existing 100 year peak discharge from the site is 4.93 cfs, and is associated with a time of concentration (Tc) of 8.50 minutes and a total area of 2.6 acres. The post-developed un-mitigated condition peak discharge is 8.88 cfs, and is associated with a Tc of 6.91 minutes and a total area of 2.5 acres. The post-developed mitigated condition peak discharge is 2.56 cfs, and is associated with a time of concentration of 13.54 minutes and a total area of 2.5 acres.

1.6 Conclusions

The proposed development and proposed storm drain design will be capable of not only safely conveying the 100-year storm runoff flow, but has included many instruments into the storm drain system design to ensure that the discharge from the project site is of the best possible quality and will not pose any significant impact or threats to the water quality of the Pacific Ocean, or the public storm drain system. In addition, the proposed development and storm drain improvements will not significantly alter the existing drainage patterns. Any increase in storm water runoff will be mitigated and will not increase the potential for flooding or create an increase in erosion.

This project has been deemed a Priority Project and therefore is subject to Hydromodification criteria. Refer to project Storm Water Quality Management Plan (SWQMP) for a general cross-section of the HMP Biofiltration basin and supporting calculations.

It is with these above reasons that it can be concluded that there will be no negative impact to the downstream storm drain facilities or an increased potential of flooding. Since a major goal of this project is to ensure that all storm water quality issues are addressed to the maximum extent practical, the peak discharge for the proposed site will be utilized to adequately size the components of the storm drain system for this project.

1.7 References

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

"Drainage Design Manual", City of San Diego, April 1984, addendum March 1989.

"Grading, Erosion and Sediment Control Ordinance/Chapter", City of Encinitas, Engineering Services and Community Development Department, revised November 2002.

2.0 METHODOLOGY

2.1 Introduction

The hydrologic model used to perform the hydrologic analysis presented in this report utilizes the Ration Method (RM) equation, Q=CIA. The 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 (inches)
D = duration (minutes – 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) but sometimes as gallons per minute (gpm)). The RM equation is as follows:

$$Q = CIA$$

Where:

Q= flow (in 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 inches per hour.
A = drainage area contributing to the basin in acres.

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

As defined by the County Hydrology Manual dated June 2003, the rational method is the preferred equation for determining the hydrologic characteristics of basins up to approximately one square mile in size. The County of San Diego has developed its own 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).

One of the variables of the RM equation is the runoff coefficient, C. The runoff coefficient is dependent only upon land use and soil type and the County of San Diego has developed a table of Runoff Coefficients for Urban Areas to be applied to basin located within the County of San Diego. The table 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, C, for each soil type class.

The County has also illustrated in detail the methodology for determining the time of concentration, in particular the initial time of concentration. The County has adopted the Federal Aviation Agency's (FAA) overland time of flow equation. This equation essentially limits the flow path length for the initial time of concentration to lengths under 100 feet, and is dependent on land use and slope.

2.3 City of Encinitas Standards

The City of Encinitas has additional requirements for hydrology reports which are outlined in the Grading, Erosion and Sediment Control Ordinance. Please refer to this manual for further details.

2.4 Runoff Coefficient Determination

As stated in section 2.2, the runoff coefficient is dependent only upon land use and soil type and the County of San Diego has developed a table of Runoff Coefficients for Urban Areas to be applied to basin located within the County of San Diego. The table, included at the end of this section, categorizes the land use, the associated development density (dwelling units per acre) and the percentage of impervious area. Weighted runoff coefficients were calculated based on the existing and proposed impervious areas for each basin per the County Hydrology Manual section 3.1.2. See section 3.0 and hydrologic node maps for calculations.

3.0 HYDROLOGY MODEL OUTPUT

Rational Method Parameters

Runoff Coefficient C= 0.9 x (% Impervious) + Cp (1-% Impervious)*
Cp=0.35* for existing condition pervious type "D" soils
100 Year 6 Hour Storm Precipitation (P_6)=2.6 in (see rainfall isopluvial*)

*From San Diego County Hydrology Manual, June 2003 Revision Section 3

3.1 Pre-Developed 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 **************************
* ZONA GALE - ENCINITAS CA                                                *
* PRE-DEVELOPEMENT CONDITION                                              *
* 100-YEAR STORM                                                          *
 ************************************************************************

  FILE NAME: 2897E100.DAT
  TIME/DATE OF STUDY: 11:49 07/30/2019
------------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: CONSIDER ALL CONFLUENCE STREAM COMBINATIONS
        FOR ALL DOWNSTREAM ANALYSES
  *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      1.10 TO NODE      1.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5600
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   160.00
  UPSTREAM ELEVATION(FEET) =    396.20
  DOWNSTREAM ELEVATION(FEET) =    387.30
  ELEVATION DIFFERENCE(FEET) =      8.90
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.486
  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) =  6.452
  SUBAREA RUNOFF(CFS) =      0.27
  TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.27

****************************************************************************
  FLOW PROCESS FROM NODE      1.20 TO NODE      1.30 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    387.30  DOWNSTREAM(FEET) =    373.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   467.00   CHANNEL SLOPE =  0.0296
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.27
  FLOW VELOCITY(FEET/SEC) =   2.58 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   3.02   Tc(MIN.) =    8.50
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.30 =     627.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.30 TO NODE      1.30 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.863
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .3900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3950
  SUBAREA AREA(ACRES) =    2.49   SUBAREA RUNOFF(CFS) =    4.72
  TOTAL AREA(ACRES) =       2.6   TOTAL RUNOFF(CFS) =       4.93
  TC(MIN.) =    8.50
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.6  TC(MIN.) =      8.50
  PEAK FLOW RATE(CFS)   =       4.93
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.2 Post-Developed Un-Mitigated Hydrologic Model Output Basin A (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 **************************
* ZONA GALE - ENCINITAS CA                                                *
* POST-DEVELOPMENT CONDITION                                              *
* 100-YEAR STORM                                                          *
 ************************************************************************

  FILE NAME: 2897P100.DAT
  TIME/DATE OF STUDY: 10:33 04/27/2020
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  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   10.0      5.0    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      1.10 TO NODE      1.20 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   197.00
```

```
  UPSTREAM ELEVATION(FEET) =    390.20
  DOWNSTREAM ELEVATION(FEET) =    383.90
  ELEVATION DIFFERENCE(FEET) =      6.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.254
  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) =  6.635
  SUBAREA RUNOFF(CFS) =      0.58
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.58

****************************************************************************
  FLOW PROCESS FROM NODE      1.20 TO NODE      1.30 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  383.90  DOWNSTREAM ELEVATION(FEET) =  377.60
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 10.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  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) =       1.93
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    7.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.80
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.73
  STREET FLOW TRAVEL TIME(MIN.) =   1.25   Tc(MIN.) =    6.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.782
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.645
  SUBAREA AREA(ACRES) =    0.73      SUBAREA RUNOFF(CFS) =    2.70
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       3.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   9.65
  FLOW VELOCITY(FEET/SEC.) =  3.15   DEPTH*VELOCITY(FT*FT/SEC.) =   0.94
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.30 =     407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.30 TO NODE      1.40 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   377.60  DOWNSTREAM(FEET) =   377.56
  FLOW LENGTH(FEET) =     4.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.77
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.20
```

```
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.51
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.40 =     411.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.50 TO NODE      1.50 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.776
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6500
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.6476
  SUBAREA AREA(ACRES) =    1.10   SUBAREA RUNOFF(CFS) =    4.13
  TOTAL AREA(ACRES) =        2.0   TOTAL RUNOFF(CFS) =       7.33
  TC(MIN.) =    6.51

****************************************************************************
  FLOW PROCESS FROM NODE      1.50 TO NODE      1.60 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   375.00  DOWNSTREAM(FEET) =   374.80
  FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.85
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.33
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.53
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.60 =     420.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.60 TO NODE      1.60 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.768
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .5300
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.6233
  SUBAREA AREA(ACRES) =    0.51   SUBAREA RUNOFF(CFS) =    1.56
  TOTAL AREA(ACRES) =        2.5   TOTAL RUNOFF(CFS) =       8.88
  TC(MIN.) =    6.53

****************************************************************************
  FLOW PROCESS FROM NODE      1.60 TO NODE      1.70 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   374.80  DOWNSTREAM(FEET) =   373.00
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.07
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.88
  PIPE TRAVEL TIME(MIN.) =   0.28    Tc(MIN.) =    6.81
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.70 =     574.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.70 TO NODE      1.80 IS CODE =  31
```

```
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   372.30  DOWNSTREAM(FEET) =   338.55
  FLOW LENGTH(FEET) =   136.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN   9.0 INCH PIPE IS   5.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  28.93
  ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.88
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =    6.89
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.80 =     710.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.80 TO NODE      1.90 IS CODE =  31
--------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   338.55  DOWNSTREAM(FEET) =   338.35
  FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.70
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.88
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    6.91
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.90 =     719.00 FEET.
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.5  TC(MIN.) =      6.91
  PEAK FLOW RATE(CFS)   =       8.88
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.3 Post-Developed Un-Mitigated Hydrologic Model Output Basin B (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:




 ************************** DESCRIPTION OF STUDY **************************
* ZONA GALE - ENCINITAS CA                                                *
* POST-DEVELOPMENT CONDITION                                              *
* BASIN 2 - 100-YEAR STORM                                                *
 ****************************************************************************

  FILE NAME: 2897B100.DAT
  TIME/DATE OF STUDY: 14:19 04/24/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: CONSIDER ALL CONFLUENCE STREAM COMBINATIONS
        FOR ALL DOWNSTREAM ANALYSES
  *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      2.10 TO NODE      2.20 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) =   408.00
```

```
  UPSTREAM ELEVATION(FEET) =    389.60
  DOWNSTREAM ELEVATION(FEET) =    389.00
  ELEVATION DIFFERENCE(FEET) =      0.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =   12.027
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    50.00
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.889
  SUBAREA RUNOFF(CFS) =      0.22
  TOTAL AREA(ACRES) =      0.16   TOTAL RUNOFF(CFS) =      0.22

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.30 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    389.00  DOWNSTREAM(FEET) =    373.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =    48.00   CHANNEL SLOPE =  0.3229
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  NOTE: CHANNEL SLOPE OF .1 WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.22
  FLOW VELOCITY(FEET/SEC) =   4.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.17   Tc(MIN.) =   12.20
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.30 =     456.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.30 TO NODE      2.30 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.854
  *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) =    0.14   SUBAREA RUNOFF(CFS) =    0.19
  TOTAL AREA(ACRES) =        0.3   TOTAL RUNOFF(CFS) =       0.40
  TC(MIN.) =   12.20
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.3  TC(MIN.) =     12.20
  PEAK FLOW RATE(CFS)   =       0.40
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.4 Post-Developed Mitigated Hydrologic Model Output Basin A (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 **************************
* ZONA GALE - ENCINITAS CA                                                *
* POST-DEVELOPMENT CONDITION   DETAINED                                   *
* 100-YEAR STORM                                                          *
 ************************************************************************

  FILE NAME: 2897PD00.DAT
  TIME/DATE OF STUDY: 10:40 04/27/2020
------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.600
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  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   10.0      5.0    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      1.10 TO NODE      1.20 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
========================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6700
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   197.00
  UPSTREAM ELEVATION(FEET) =    390.20
  DOWNSTREAM ELEVATION(FEET) =    383.90
```

```
  ELEVATION DIFFERENCE(FEET) =      6.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    5.254
  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) =  6.635
  SUBAREA RUNOFF(CFS) =      0.58
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.58

****************************************************************************
  FLOW PROCESS FROM NODE      1.20 TO NODE      1.30 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  383.90  DOWNSTREAM ELEVATION(FEET) =  377.60
  STREET LENGTH(FEET) =   210.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 10.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   5.00
  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) =       1.93
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.26
    HALFSTREET FLOOD WIDTH(FEET) =    7.77
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.80
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.73
  STREET FLOW TRAVEL TIME(MIN.) =   1.25   Tc(MIN.) =    6.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.782
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .6400
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.645
  SUBAREA AREA(ACRES) =    0.73      SUBAREA RUNOFF(CFS) =    2.70
  TOTAL AREA(ACRES) =        0.9        PEAK FLOW RATE(CFS) =       3.20

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   9.65
  FLOW VELOCITY(FEET/SEC.) =  3.15   DEPTH*VELOCITY(FT*FT/SEC.) =   0.94
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.30 =     407.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.30 TO NODE      1.40 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   377.60  DOWNSTREAM(FEET) =   377.56
  FLOW LENGTH(FEET) =     4.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.77
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.20
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =    6.51
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.40 =     411.00 FEET.
```

```
****************************************************************************
 FLOW PROCESS FROM NODE      1.50 TO NODE      1.50 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.776
 *USER SPECIFIED(SUBAREA):
 USER-SPECIFIED RUNOFF COEFFICIENT = .6500
 S.C.S. CURVE NUMBER (AMC II) =   0
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.6476
 SUBAREA AREA(ACRES) =    1.10   SUBAREA RUNOFF(CFS) =    4.13
 TOTAL AREA(ACRES) =        2.0   TOTAL RUNOFF(CFS) =       7.33
 TC(MIN.) =    6.51

****************************************************************************
 FLOW PROCESS FROM NODE      1.50 TO NODE      1.50 IS CODE =   7
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN) =  13.01   RAIN INTENSITY(INCH/HOUR) =  3.70
 TOTAL AREA(ACRES) =     2.00   TOTAL RUNOFF(CFS) =      1.56

****************************************************************************
 FLOW PROCESS FROM NODE      1.50 TO NODE      1.60 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   375.00  DOWNSTREAM(FEET) =   374.80
 FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.009
 DEPTH OF FLOW IN   9.0 INCH PIPE IS   4.2 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   7.65
 ESTIMATED PIPE DIAMETER(INCH) =   9.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       1.56
 PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   13.03
 LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.60 =     420.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      1.60 TO NODE      1.60 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   13.03
 RAINFALL INTENSITY(INCH/HR) =   3.69
 TOTAL STREAM AREA(ACRES) =     2.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.56

****************************************************************************
 FLOW PROCESS FROM NODE      1.60 TO NODE      1.60 IS CODE =   7
----------------------------------------------------------------------------
 >>>>>USER SPECIFIED HYDROLOGY INFORMATION AT NODE<<<<<
============================================================================
 USER-SPECIFIED VALUES ARE AS FOLLOWS:
 TC(MIN) =   6.53   RAIN INTENSITY(INCH/HOUR) =  5.77
 TOTAL AREA(ACRES) =     0.51   TOTAL RUNOFF(CFS) =      1.56

****************************************************************************
 FLOW PROCESS FROM NODE      1.60 TO NODE      1.60 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.) =    6.53
  RAINFALL INTENSITY(INCH/HR) =   5.77
  TOTAL STREAM AREA(ACRES) =     0.51
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      1.56

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        1.56    13.03        3.693          2.00
      2        1.56     6.53        5.767          0.51

  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        2.34     6.53       5.767
      2        2.56    13.03       3.693

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       2.56   Tc(MIN.) =   13.03
  TOTAL AREA(ACRES) =        2.5
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.60 =     420.00 FEET.

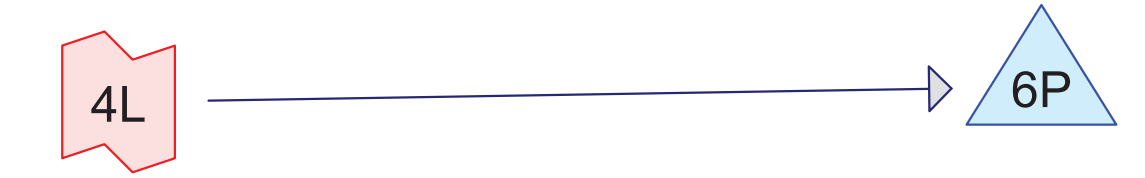
****************************************************************************
  FLOW PROCESS FROM NODE      1.60 TO NODE      1.70 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   374.80  DOWNSTREAM(FEET) =   373.00
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   5.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.81
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.56
  PIPE TRAVEL TIME(MIN.) =   0.38    Tc(MIN.) =   13.41
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.70 =     574.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.70 TO NODE      1.80 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   372.30  DOWNSTREAM(FEET) =   338.55
  FLOW LENGTH(FEET) =   136.00   MANNING'S N =  0.009
  DEPTH OF FLOW IN   6.0 INCH PIPE IS   3.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.33
  ESTIMATED PIPE DIAMETER(INCH) =   6.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.56
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   13.51
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.80 =     710.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      1.80 TO NODE      1.90 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   338.55  DOWNSTREAM(FEET) =   338.35
  FLOW LENGTH(FEET) =     9.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   6.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.58
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.56
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   13.54
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      1.90 =     719.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.5  TC(MIN.) =     13.54
  PEAK FLOW RATE(CFS)   =       2.56
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.5 Hydraulic Output & Calculations



Inflow BMP-A

BMP-A Alt 4

Subcat Reach Pond Link

Routing Diagram for 2897

Prepared by Pasco Laret Suiter & Associates, Printed 4/27/2020

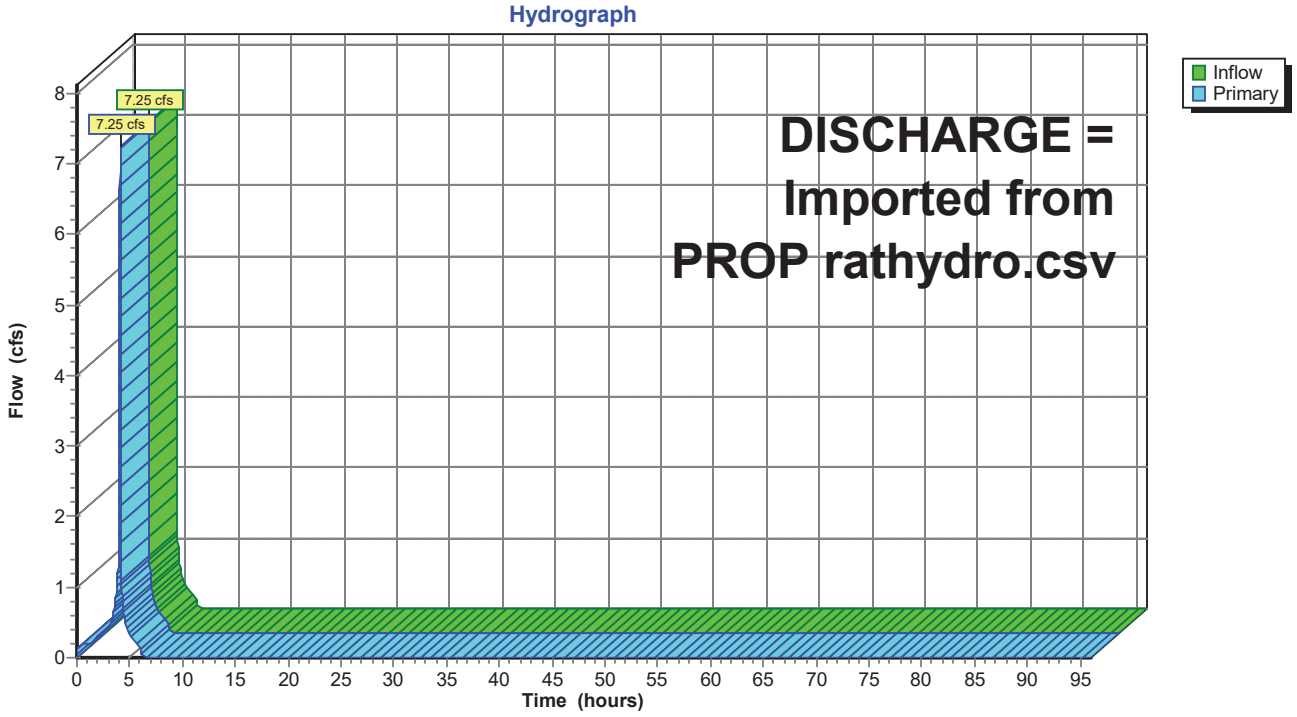
Summary for Link 4L: Inflow BMP-A

Inflow = 7.25 cfs @ 4.08 hrs, Volume= 0.263 af
Primary = 7.25 cfs @ 4.08 hrs, Volume= 0.263 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-96.00 hrs, dt= 0.005 hrs

DISCHARGE = Imported from PROP rathydro.csv

Link 4L: Inflow BMP-A



Summary for Pond 6P: BMP-A Alt 4

Inflow	=	7.25 cfs @	4.08 hrs,	Volume=	0.263 af
Outflow	=	1.56 cfs @	4.19 hrs,	Volume=	0.263 af, Atten= 79%, Lag= 6.5 min
Primary	=	1.56 cfs @	4.19 hrs,	Volume=	0.263 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.005 hrs
Peak Elev= 101.57' @ 4.19 hrs Surf.Area= 2,000 sf Storage= 4,540 cf

Plug-Flow detention time= 52.3 min calculated for 0.263 af (100% of inflow)
Center-of-Mass det. time= 52.4 min (265.3 - 212.8)

Volume	Invert	Avail.Storage	Storage Description
#1	97.50'	5,400 cf	**BMP-A (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	2,000	0.0	0	0	2,000
98.50	2,000	40.0	800	800	2,159
100.00	2,000	20.0	600	1,400	2,396
102.00	2,000	100.0	4,000	5,400	2,713

Device	Routing	Invert	Outlet Devices
#1	Primary	97.50'	**12.0" Round Culvert** L= 100.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 97.50' / 96.50' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	97.50'	**4.0" Vert. Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	101.50'	**36.0" x 36.0" Horiz. Grate X 0.50** C= 0.600 in 36.0" x 36.0" Grate (100% open area) Limited to weir flow at low heads
#4	Device 1	101.50'	**36.0" x 36.0" Horiz. Grate X 0.50** C= 0.600 in 36.0" x 36.0" Grate (100% open area) Limited to weir flow at low heads

Primary OutFlow Max=1.55 cfs @ 4.19 hrs HW=101.57' (Free Discharge)
└**1=Culvert** (Passes 1.55 cfs of 6.10 cfs potential flow)
  ├**2=Orifice** (Orifice Controls 0.83 cfs @ 9.51 fps)
  ├**3=Grate** (Weir Controls 0.36 cfs @ 0.43 fps)
  └**4=Grate** (Weir Controls 0.36 cfs @ 0.43 fps)

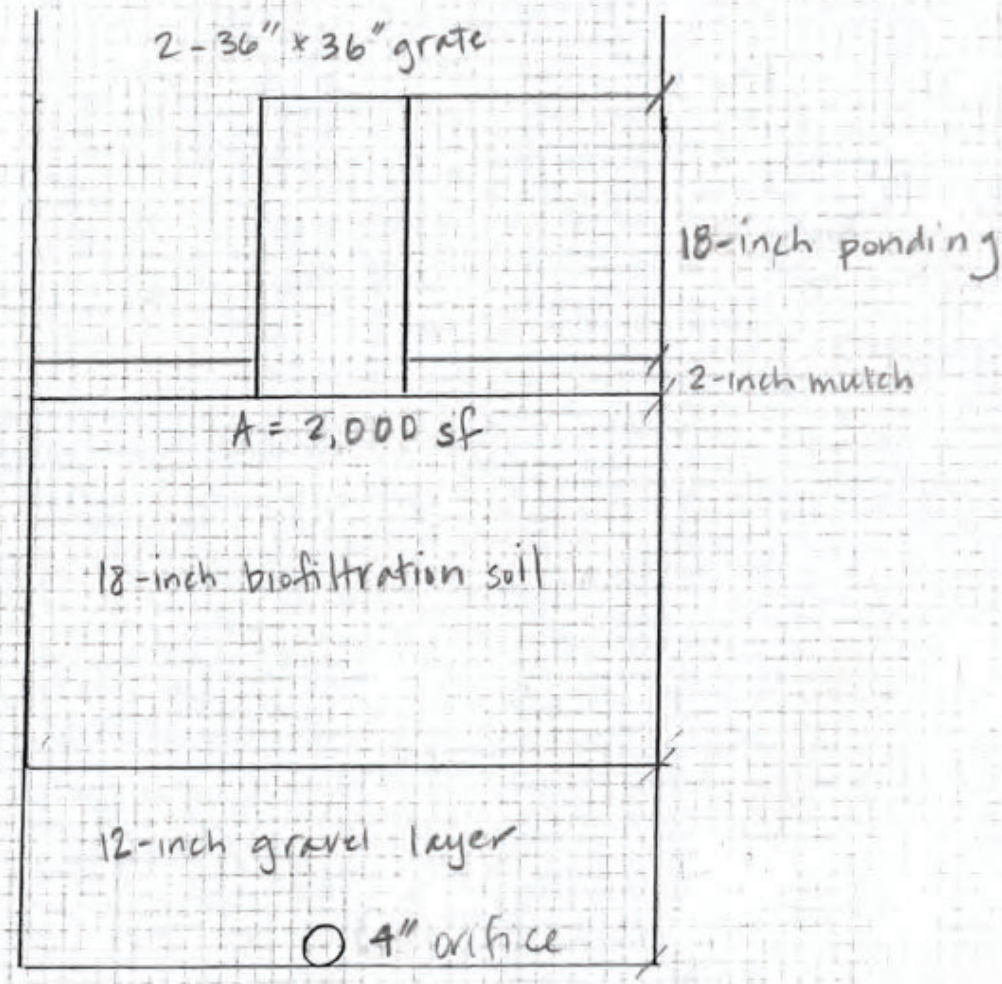
PASCO LARET SUITER & ASSOCIATES

Zona Gale

Date 4/27/2020

Job# 2897

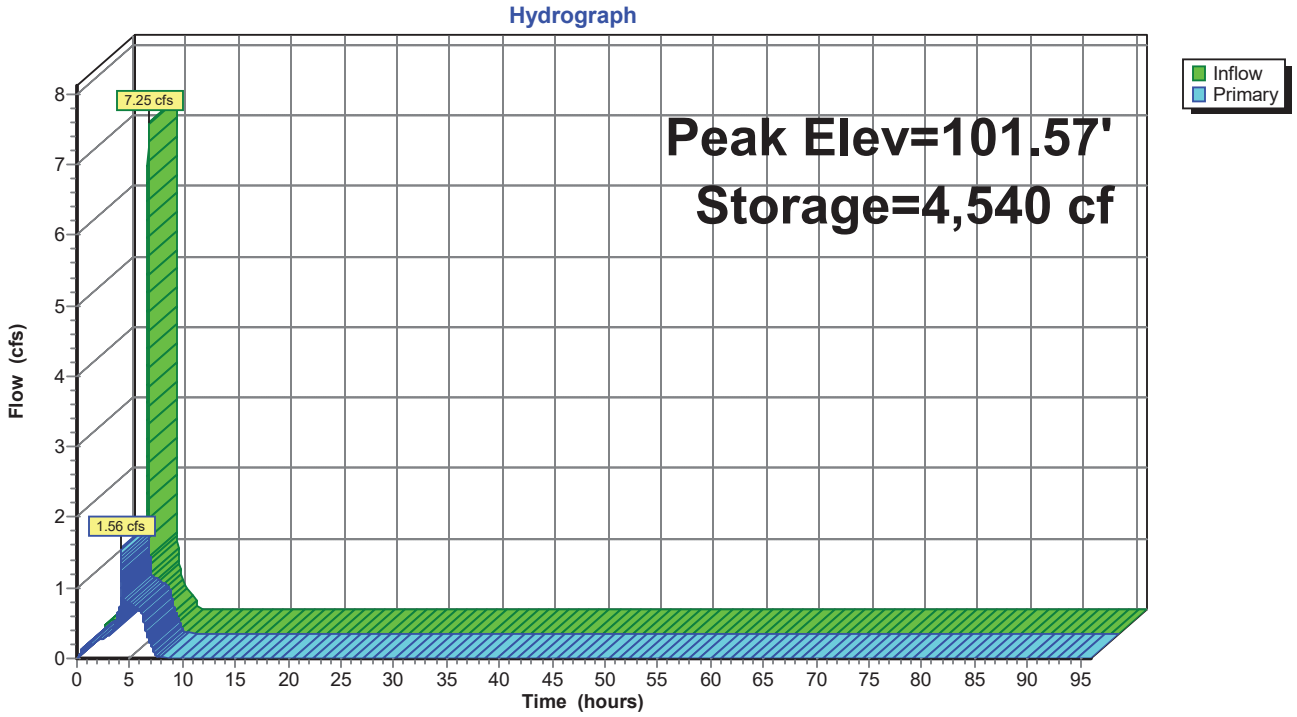
HMP Biofiltration Basin BMP-A



Not to scale

A11 #4
D Soil

Pond 6P: BMP-A Alt 4



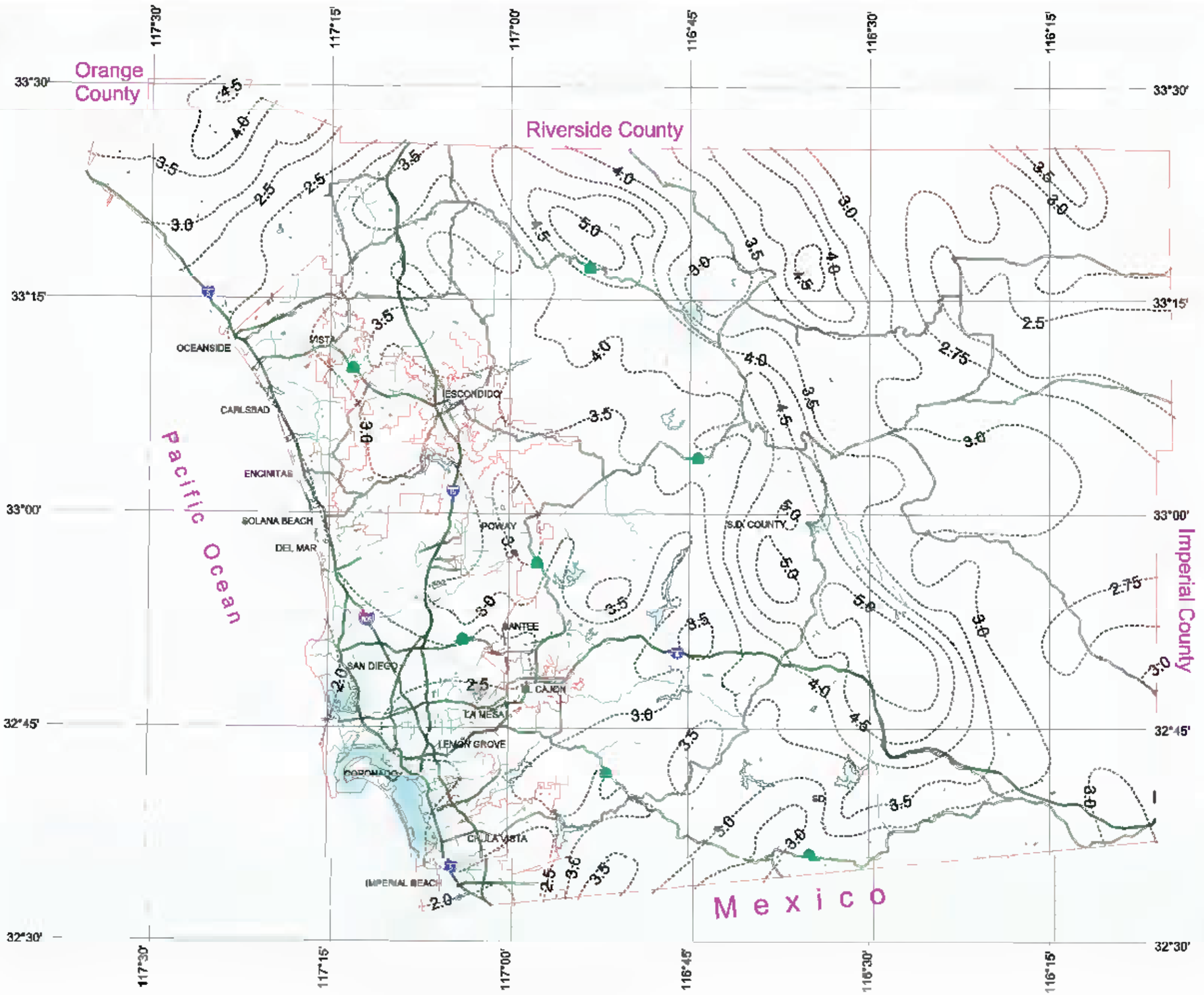
4.0 ATTACHMENTS

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)



DPW GIS — Department of Public Works Geographic Information Services

SanGIS — We Have San Diego Covered!

N W E S

3 0 3 Miles

HYDROLOGIC NODE MAP
PRE-DEVELOPMENT CONDITION

'C' CALCULATIONS

PER COUNTY HYDROLOGY MANUAL 3.1.2
C=0.9 X (% IMPERVIOUS) + Cp x (1-% IMPERVIOUS)

Cp = 0.35 FOR TYPE 'D' SOIL

SUB-AREA A
C=0.9 X 0.39 + [(1-0.39)X0.35]
C=0.56

SUB-AREA B
C=0.9 X 0.08 + [(1-0.08)X0.35]
C=0.39

GRAPHIC SCALE 1"=20'
0 20 40 60

LEGEND
BASIN BOUNDARY
SUB-AREA BOUNDARY
FLOW LINE
IMPERVIOUS AREA — 9,901 SF (617 SF ON-SITE + 9,284 SF OFF-SITE)

SUB-AREA B
A= 108,626 SF (2.49 AC)
C=0.39

SUB-AREA A
A= 3,256 SF (0.075 AC)
C=0.56

NODE 1.1
EL 396.2

NODE 1.2
EL 387.3

NODE 1.3
EL 373.5

L=160'

L=467'

TANK

HYDROLOGIC NODE MAP
POST-DEVELOPMENT CONDITION

'C' CALCULATIONS

PER COUNTY HYDROLOGY MANUAL 3.1.2
C=0.9 X (% IMPERVIOUS) + Cp X (1-% IMPERVIOUS)

Cp = 0.35 FOR TYPE 'D' SOIL

SUB-AREA A
C=0.9 X 0.588 + [(1-0.588)X0.35]
C=0.67

SUB-AREA B
C=0.9 X 0.529 + [(1-0.529)X0.35]
C=0.64

SUB-AREA C
C=0.9 X 0.544 + [(1-0.544)X0.35]
C=0.65

SUB-AREA D
C=0.9 X 0.324 + [(1-0.324)X0.35]
C=0.53

BASIN 2
C=0.9 X 0.00 + [(1-0.00)X0.35]
C=0.35

GRAPHIC SCALE 1"=20'
0 20 40 60

LEGEND
BASIN BOUNDARY
SUB-AREA BOUNDARY
FLOW LINE
IMPERVIOUS AREA — 53,189 SF (46,040 SF ON-SITE + 7,149 SF OFF-SITE)

NODE 1.9
EL 338.35
L=9'
NODE 1.8
EL 338.55
L=136'
NODE 2.1
EL 389.6
NODE 1.7
EL 373.0
EL 372.3
SUB-AREA C
A= 47,741 SF (1.10 AC)
C=0.65
BASIN 2A
A= 6,927 SF (0.16 AC)
C=0.35
L=408'
L=154'
NODE 1.6
EL 374.8
9'
NODE 1.5
EL 377.55
EL 375.0
NODE 1.4
EL 377.56
L=4'
NODE 1.3
EL 377.6
SUB-AREA B
A= 31,662 SF (0.73 AC)
C=0.64
SUB-AREA D
A= 22,036 SF (0.51 AC)
C=0.53
NODE 1.1
EL 390.2
SUB-AREA A
A= 5,625 SF (0.13 AC)
C=0.67
L=210'
NODE 1.2
EL 383.9
L=197'
NODE 2.2
EL 389.0
L=48'
BASIN 2B
A= 6,220 SF (0.14 AC)
C=0.35
NODE 2.3
EL 373.5