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

PRELIMINARY HYDROLOGY & HYDRAULIC STUDY
FOR

BERNARDO SHORES
IMPERIAL BEACH, CA

SITE ADDRESS:
500 Highway 75
Imperial Beach, CA 91932

APNs:
625-140-20 & 626-010-18

PREPARED FOR:
Bernardo Shores Project Owner, LLC
c/o Integral Communities
2235 Encinitas Blvd. Suite 216
Encinitas, CA 92024

DATE PREPARED:
AUGUST 21ST, 2014

8/25/14

WILLIAM G. MACK, RCE 73620 DATE

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Hydrology and Hydraulic Study for the proposed residential development to be located at 500 Highway 75, Imperial Beach, CA has been prepared to analyze the hydrologic and hydraulic characteristics of the existing and proposed project site and to address potential stormwater quality impacts of the proposed project. This report presents both the methodology and the calculations used for determining the stormwater runoff rate from the project site for both the pre-developed (existing) conditions and the post-developed (proposed) conditions produced by the 100 year, 6 hour storm event. Preliminary stormwater retention requirements and permanent BMP sizing calculations have been included as a part this report.

1.2 Existing Conditions

Site Description

The project site is approximately 10.07 acres in area and is located along the northerly edge of Imperial Beach between the Silver Strand (Highway 75) and the southerly limit of San Diego Bay. The site is within the Otay Hydrologic Unit and more specifically the Otay Valley Hydrologic Area 910.20. The 2010 California Clean Water Act 303d list identifies the Poggi Canyon Creek as an impaired waterbody for DDT within the Otay Valley Hydrologic Area. The site is bounded by Highway 75 to the west, a commercially zoned vacant site to the south, residential development to the east and an existing wetland known as Salt Pond 10A to the north. The project site is currently being used as a for rent recreational vehicle park. Existing onsite improvements onsite include PCC paving for drive aisles and RV parking, facility buildings, utility hookups, and a stormdrain system that collects onsite runoff and discharges to Salt Pond 10A. The existing site topography can be described as gently sloping terrain and generally slopes in the northerly direction, away from Highway 75 toward Salt Pond 10A. The project geotechnical report does not indicate a specific soil type to be used for determining runoff coefficients, however the Soils Classification Map contained in the San Diego County Hydrology Manual June 2003 Revision, the general vicinity of the project site contains Type D soils. Additionally, the 1973 San Diego Area Soils Survey prepared by the USDA also identifies Type D soils in the vicinity of the site. Based on these resources, Type D soils were used as a parameter for determining runoff coefficients for the project site.

Existing Offsite Drainage:

In the existing condition, there are two offsite drainage basins that flow onto the subject property. These basins area identified as Basin “A” and Basin “B” on the Existing Condition Hydrology Map (see Appendix A of this report).

Offsite Basin “A” is approximately 2.86 acres in area and includes the portion of Highway 75 between the existing drive aisle into the subject property and the existing high point located to the east of 7th Street along Highway 75. This section of roadway is

super elevated and slopes toward the subject property. Therefore, runoff from this basin collects in the existing curb & gutter along the north side of Highway 75 and flows into the site at the existing drive aisle entry. For the purposes of this study, a runoff coefficient of 0.9 was selected for this basin to determine offsite peak flow runoff directed into the subject property.

Offsite Basin "B" is approximately 1.36 acres in area and includes the vacant commercially zoned property to the south. Runoff from Basin "B" is collected by an existing 2.5 wide concrete spillway that discharges onto the subject property along the southerly property line. Although the site is currently vacant and any future development will be required to mitigation for increases in peak runoff rates, a runoff coefficient of 0.79 was selected for this basin as a conservative measure to determine offsite peak flow runoff directed onto the subject property.

Existing Onsite Drainage:

In the existing condition, the project site is divided into two onsite drainage basins. These basins are identified as Basin "C" and Basin "D" of the Developed Condition Hydrology Map (see Appendix A of this report).

Onsite Basin "C" is approximately 9.50 acres in areas and covers the majority of the project site. Offsite runoff from Basins "A" and "B" confluences with Basin "C" and is conveyed through the project site. Runoff from Basin "C" flows across the existing concrete paving and is collected by an existing stormdrain system which discharges directly to Salt Pond 10 A along the northerly property boundary. Based upon a review of the site topographic survey provided by Fuscoe Engineering, Inc., and a field inspection conducted by PLSA, the site contains a significant amount of existing impervious area. Since the property is commercially zoned and highly impervious, a runoff coefficient of 0.79 was selected from Table 3-1 of the San Diego County Hydrology Manual for "General Commercial" use and used for determining the peak flow generated from the basin.

Onsite Basin "D" is approximately 0.11 acres in area and includes the easterly most portion of the site that extends to the 7th Street right-of-way. Runoff from Basin "D" discharges directly to the existing 7th Street curb and gutter. A runoff coefficient of 0.79 was also used for this basin to determine peak flows.

See Section 1.4 for a summary of the peak flow rates for each drainage area for the pre development condition.

1.3 Proposed Project

Project Description

The intent of the proposed project is to remove the existing onsite improvements and redevelop the site for the construction of 193 townhome condominium units. The site redevelopment will include new street, utility, and drainage improvements typical to residential development projects. The proposed project has an overall density of about 19 du/ac, therefore a runoff coefficient of 0.71 was selected from Table 3-1 of the County of San Diego Hydrology Manual for high density residential (less than 24 du/ac) criteria. The site grading will not significantly alter the drainage patterns of the site, and onsite runoff will continue to flow north and discharge to Salt Pond 10A as it does in the existing condition.

Proposed Offsite Drainage:

A new concrete cross gutter is proposed along the project frontage at the entry drive aisle to prevent roadway drainage from Highway 75 from entering the project site as it does in the existing condition. This cross gutter will allow for the runoff to flow past the drive aisle entry and to be collected by the existing public stormdrain system located within the Highway 75 right-of-way approximately 200 ft north of the entry. The existing stormdrain system that will be receiving the runoff consists of 24" CMP pipe that discharges directly to Salt Pond 10A to the north of the project site.

The existing spillway that conveys runoff from the adjacent property to the south onto the subject property is to be extended into the project site and connected to the proposed drive aisle. This runoff will confluence with the onsite runoff and will be collected by the new onsite private stormdrain system which will ultimately discharge to Salt Pond 10A.

Proposed Onsite Drainage:

In the proposed condition, runoff from the project site will drain toward the centerline of the interior drive aisles throughout the site, where a P.C.C. ribbon gutter system will be constructed. The ribbon gutters will convey runoff from the property to the north end of the project where it will then be collected by an onsite private storm drain system. This private stormdrain system is to consist of SDRSD D-2 curb inlets, HDPE stormdrain pipe, rip-rap and concrete headwalls which will discharge directly to the proposed bioretention BMP basin to be located between the developed portion of the site and Salt Pond 10A. The bioretention basin will function as a priority treatment BMP for the majority of the project and will outlet directly to Salt Pond 10A at a location consistent with the existing stormdrain outfall for the site.

Hydromodification and Low Impact Development Requirements:

The proposed project is classified as a Priority Stormwater Project as determined using the City of Imperial Beach Storm Water Management Plan checklist. Since this project discharges directly to Salt Pond 10A which is a tidally influenced water body connected to San Diego Bay, it is exempt from Hydromodification Management Plan (HMP) requirements per the current County of San Diego SUSMP.

Although the project is exempt from HMP requirements, it is still subject to priority treatment BMP and low impact development design criteria. To satisfy these design requirements, the project has incorporated a 12,000 sf bioretention basin to be located along the north edge of the property into the site design. This bioretention basin has been designed to intercept onsite runoff prior to discharging to Salt Pond 10A. The basin has been sized to meet the minimum LID and priority BMP storm water treatment requirements outlined in the current County of San Diego SUSMP. Refer to Section 3.0 of this report for bioretention BMP sizing calculations.

See Section 1.4 below for a summary of the peak flow rates for each drainage area for the post development condition. A Post Development Hydrology Map showing the delineation of the ultimate drainage areas has been included in the Appendix of this report, which shows the proposed drainage concept for the project.

1.4 Summary of Results

Upon performing hydrologic analysis of the project site in both the existing condition and the proposed developed the following results were produced. The table below summarizes the peak flow rates calculated at each runoff point in the existing and developed condition. Refer to the Hydrology Maps located in the Appendix of this report for node locations, drainage basin delineation. Modified rational method hydrology calculations have been provided in section 3.0 of this report.

PREDEVELOPMENT SUMMARY

BASIN	NODE	TOTAL TRIBUTARY AREA	Q100	Tc
C	10	13.7 ACRES	39.4 CFS	12.6 MIN
D	21	0.1 ACRES	0.6 CFS	2.5 MIN

POST DEVELOPMENT SUMMARY

BASIN	NODE	TOTAL TRIBUTARY AREA	Q100	Tc
A	3.11	2.8 ACRES	10.6 CFS	10.1 MIN
D	2.60	0.1 ACRES	0.6 CFS	5 MIN
C	7	10.2 ACRES	28.0 CFS	18.1 MIN

1.5 Hydrologic Unit Contribution

As identified by the San Diego Basin Plan, the proposed project site is located within Otay Hydrologic Unit, specifically the Otay Valley Hydrologic Sub Area (910.20).

According to the California's Clean Water Act Section 303(d) list published by the San Diego Regional Water Quality Control Board, the Poggi Canyon Creek is listed as an impaired water body for DDT. The source of the DDT pollutant found within the Poggi Canyon Creek in unknown. The pollutants of concern for detached residential development includes sediments, nutrients, trash, debris, oxygen demanding substances, bacteria, viruses, and pesticides. The proposed bioretention basin is intended to provide adequate treatment of onsite stormwater runoff as a mitigation measure against the anticipated pollutants of concern.

1.6 Post-Development Anticipated Pollutants

The proposed project will most closely resemble the anticipated pollutants associated with attached and detached residential developments. Table 1.0 included at the end of this section, illustrates the pollutant categories typically associated with various categories of development. In this case the residential development priority project categories have been highlighted to illustrate the pollutant categories that will be addressed by the post-construction BMPs proposed for this project.

Pollutants of concern, listed in Table 1.0, are grouped in the following categories:

***Sediment* –** sediment is defined as rock or soil particles that characterized as materials that are susceptible to erosion and are then transported and or deposited by wind, water, ice, or gravity. Sediment becomes a condition of concern when the concentration of sediment in a liquid causes the turbidity (concentration of suspended solids in a liquid) to increase. The potential results of high turbidity in our rivers, streams, and other receiving waters include the reduction of spawning habitat, smothering bottom dwelling organisms, the suppression of aquatic vegetative growth, and fish kills due to clogging of fish gills.

***Nutrients* –** nutrients are defined as substances that an organism must obtain from its surroundings for growth and the sustainment of life. Nutrients are typically inorganic substances, which are most commonly found as mineral salts such as nitrogen and phosphorous. The primary sources of nutrients in urban runoff are eroded soils and fertilizers. High concentrations of nutrients can result in loss of dissolved oxygen in water, the release of toxins from sediment, decay of organic matter at an accelerated rate all which can be detrimental to aquatic life. Another result of the discharge of nutrients to receiving water is excessive aquatic plant and algae growth, which is also defined as eutrophication.

***Metals* –** metals are defined as chemical elements that are various opaque, fusible, ductile, and typically lustrous substances; which are good conductors of electricity and heat, form cations by loss of electrons, and yield basic oxides and hydroxides. Metals of

concern are lead, copper, mercury, zinc, chromium and cadmium. Primary sources of metals of concern are raw materials that are constituents of non-metal products such as adhesives, paints, other coatings and fuels. High metal concentrations in storm water can interfere with reproduction and be toxic to aquatic organisms and other wild life.

Trash and Debris – trash and debris are defined as substances such as paper, plastics, food and or yard wastes that have been haphazardly discarded. Trash and debris can be forms of organic matter and the degradation of which can result in a high biochemical oxygen demand (BOD). Water with a high concentration of BOD result in low water quality and in worst case scenarios can result in septic conditions.

Oxygen Demanding Substances – oxygen demanding substances are defined as anything that can be oxidized in the receiving water with the consumption of dissolved molecular oxygen. These materials are usually biodegradable organic matter but also include certain inorganic compounds. The consumption of dissolved oxygen (DO) poses a threat to higher forms of aquatic life that must have oxygen to survive. The levels at which the DO concentration becoming threatening to aquatic life varies drastically between various species.

Oil and Grease – oil and grease are defined as organic compounds with high molecular weight. Primary sources of oil and grease as pollutants of concern are motor oils, waxes, and fats and grease from restaurants and food processing operations. High concentrations of oil and grease result in low water quality as well as poor water aesthetics.

Bacteria and Viruses - Bacteria and viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed. Water, containing excessive bacteria and viruses can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste causes increased growth of undesirable organisms in the water.

Pesticides—Pesticides (including herbicides) are chemical compounds commonly used to control nuisance growth or prevalence of organisms. Excessive application of a pesticide may result in runoff containing toxic levels of its active component.

Table 1.0 -Anticipated and Potential Pollutants from the Project Area

	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >100,000 ft^2	P(1)	P(1)		X	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft^2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets, Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		
Retail Gas Outlets			X	X(4)	X		X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

1.7 References

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

"San Diego County Drainage Design Manual", County of San Diego, May 2005

"California State Water Quality Control Board Order No. 2009-0009-DWQ,"

"Hydromodification Management Plan", Brown and Caldwell, March 2011

2.0 METHODOLOGY

2.1 Introduction

The hydrologic model used to perform the hydrologic analysis presented in this report utilizes the Rational 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 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.

In addition to the above Rational Method assumptions, the conservative assumption that all runoff coefficients utilized for this report are based on type “D” soils.

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. Runoff coefficients can be determined using one of two methods. In the first method, pervious and impervious surfaces are assigned a weighted value. For this project pervious surfaces were assigned a value of 0.35 and impervious areas assigned 0.90. The runoff coefficient is then determined by calculating the weighted average for the given surfaces present on site. The second method uses land use and soil types to determine a runoff coefficient. The County of San Diego has developed a table of Runoff Coefficients for Urban Areas to be applied to basins 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 of 100 feet or less, and is dependent on land use and slope.

Where junctions of independent drainage streams are reached, the Modified Rational Method (MRM) is used to calculate the peak Q, Tc, and I for the combined system in accordance with section 3.4.1 of the San Diego County Hydrology Manual, June 2003 revision. Once the independent drainage systems have been combined, the Rational Method calculations are continued downstream.

2.3 Runoff Coefficient Determination

Runoff Coefficients used in this analysis contained in this report were taken from Table 3-1 of the County of San Diego Hydrology Manual, June 2003 Revision.

3.0 MODIFIED RATIONAL METHOD CALCULATIONS

3.1 PRE DEVELOPMENT HYDROLOGY CALCULATIONS

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****************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2010 Advanced Engineering Software (aes)
             Ver. 17.0 Release Date: 07/01/2010  License ID 1452

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* EXISTING CONDITION HYDROLOGY CALCULATIONS                               *
* TENTATIVE MAP FOR BERNARDO SHORES                                       *
* PLSA 2045                                                               *
 **************************************************************************

  FILE NAME: 2045EX.DAT
  TIME/DATE OF STUDY: 10:15 01/20/2014
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  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

  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      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =     22.10
  DOWNSTREAM ELEVATION(FEET) =     19.70
  ELEVATION DIFFERENCE(FEET) =      2.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.602
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    83.24
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.47
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.47

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.70  DOWNSTREAM(FEET) =     15.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0098
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.47
  FLOW VELOCITY(FEET/SEC.) =   1.18   FLOW DEPTH(FEET) =   0.06
  TRAVEL TIME(MIN.) =   6.06   Tc(MIN.) =    9.66
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.308
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    1.27   SUBAREA RUNOFF(CFS) =    4.32
  TOTAL AREA(ACRES) =        1.4   TOTAL RUNOFF(CFS) =       4.63
  TC(MIN.) =    9.66

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     15.50  DOWNSTREAM(FEET) =     14.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   100.00   CHANNEL SLOPE =  0.0110
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.63
  FLOW VELOCITY(FEET/SEC.) =   2.31   FLOW DEPTH(FEET) =   0.17
  TRAVEL TIME(MIN.) =   0.72   Tc(MIN.) =   10.38
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     615.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.38
  RAINFALL INTENSITY(INCH/HR) =   4.11
  TOTAL STREAM AREA(ACRES) =     1.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.63

****************************************************************************
  FLOW PROCESS FROM NODE     11.10 TO NODE     11.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     19.20
  DOWNSTREAM ELEVATION(FEET) =     18.80
  ELEVATION DIFFERENCE(FEET) =      0.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.250
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.78
  TOTAL AREA(ACRES) =      0.15   TOTAL RUNOFF(CFS) =      0.78

****************************************************************************
  FLOW PROCESS FROM NODE     11.20 TO NODE      4.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   18.80  DOWNSTREAM ELEVATION(FEET) =   14.10
  STREET LENGTH(FEET) =   340.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.80
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.55
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.51
  STREET FLOW TRAVEL TIME(MIN.) =   2.22   Tc(MIN.) =    6.47
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.578
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .7900
S.C.S. CURVE NUMBER (AMC II) =   0
AREA-AVERAGE RUNOFF COEFFICIENT =  0.790
SUBAREA AREA(ACRES) =    0.01      SUBAREA RUNOFF(CFS) =    0.04
TOTAL AREA(ACRES) =        0.2        PEAK FLOW RATE(CFS) =       0.78

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
FLOW VELOCITY(FEET/SEC.) =  2.55   DEPTH*VELOCITY(FT*FT/SEC.) =   0.51
LONGEST FLOWPATH FROM NODE     11.10 TO NODE      4.00 =     390.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.578
*USER SPECIFIED(SUBAREA):
USER-SPECIFIED RUNOFF COEFFICIENT = .7900
S.C.S. CURVE NUMBER (AMC II) =   0
AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
SUBAREA AREA(ACRES) =    1.34   SUBAREA RUNOFF(CFS) =    5.90
TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       6.61
TC(MIN.) =    6.47

****************************************************************************
FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =   1
----------------------------------------------------------------------------
>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =    6.47
RAINFALL INTENSITY(INCH/HR) =   5.58
TOTAL STREAM AREA(ACRES) =     1.50
PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.61

** CONFLUENCE DATA **
STREAM     RUNOFF       Tc      INTENSITY      AREA
NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
    1        4.63    10.38        4.112          1.36
    2        6.61     6.47        5.578          1.50

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        9.49     6.47       5.578
    2        9.50    10.38       4.112

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       9.50   Tc(MIN.) =   10.38
```

```
  TOTAL AREA(ACRES) =        2.9
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     615.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     14.40  DOWNSTREAM(FEET) =     12.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   150.00   CHANNEL SLOPE =  0.0140
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       9.50
  FLOW VELOCITY(FEET/SEC.) =   2.94   FLOW DEPTH(FEET) =   0.23
  TRAVEL TIME(MIN.) =   0.85   Tc(MIN.) =   11.23
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =     765.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.23
  RAINFALL INTENSITY(INCH/HR) =   3.91
  TOTAL STREAM AREA(ACRES) =     2.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.50

****************************************************************************
  FLOW PROCESS FROM NODE     12.10 TO NODE     12.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     17.20
  DOWNSTREAM ELEVATION(FEET) =     16.90
  ELEVATION DIFFERENCE(FEET) =      0.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.678
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.11   TOTAL RUNOFF(CFS) =      0.57

****************************************************************************
  FLOW PROCESS FROM NODE     12.20 TO NODE      5.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     16.90  DOWNSTREAM(FEET) =     12.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0107
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
```

```
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.57
  FLOW VELOCITY(FEET/SEC.) =   1.22   FLOW DEPTH(FEET) =   0.07
  TRAVEL TIME(MIN.) =   5.89   Tc(MIN.) =   10.57
  LONGEST FLOWPATH FROM NODE     12.10 TO NODE      5.00 =     480.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.065
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    1.39   SUBAREA RUNOFF(CFS) =    4.46
  TOTAL AREA(ACRES) =        1.5   TOTAL RUNOFF(CFS) =       4.82
  TC(MIN.) =   10.57

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      5.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.57
  RAINFALL INTENSITY(INCH/HR) =   4.06
  TOTAL STREAM AREA(ACRES) =     1.50
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.82

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        9.50    11.23        3.908          2.86
      2        4.82    10.57        4.065          1.50

  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       13.95    10.57       4.065
      2       14.13    11.23       3.908

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      14.13   Tc(MIN.) =   11.23
  TOTAL AREA(ACRES) =        4.4
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =     765.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
```

```
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     12.30  DOWNSTREAM(FEET) =     12.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    30.00   CHANNEL SLOPE =  0.0100
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =      14.13
  FLOW VELOCITY(FEET/SEC.) =   2.87   FLOW DEPTH(FEET) =   0.29
  TRAVEL TIME(MIN.) =   0.17   Tc(MIN.) =   11.41
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     795.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
================================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.41
  RAINFALL INTENSITY(INCH/HR) =   3.87
  TOTAL STREAM AREA(ACRES) =     4.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     14.13

****************************************************************************
  FLOW PROCESS FROM NODE     13.10 TO NODE     13.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
================================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     25.20
  DOWNSTREAM ELEVATION(FEET) =     24.60
  ELEVATION DIFFERENCE(FEET) =      0.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.789
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.71
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.71

****************************************************************************
  FLOW PROCESS FROM NODE     13.20 TO NODE      6.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) =   24.60  DOWNSTREAM ELEVATION(FEET) =   12.00
  STREET LENGTH(FEET) =  1160.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
```

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.71
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    2.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.26
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.45
  STREET FLOW TRAVEL TIME(MIN.) =   8.54   Tc(MIN.) =   11.33
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.886
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
  SUBAREA AREA(ACRES) =    0.00      SUBAREA RUNOFF(CFS) =    0.00
  TOTAL AREA(ACRES) =        0.1        PEAK FLOW RATE(CFS) =       0.71

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   2.00
  FLOW VELOCITY(FEET/SEC.) =  2.26   DEPTH*VELOCITY(FT*FT/SEC.) =   0.45
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      6.00 =    1220.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.886
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.9000
  SUBAREA AREA(ACRES) =    2.74   SUBAREA RUNOFF(CFS) =    9.58
  TOTAL AREA(ACRES) =        2.9   TOTAL RUNOFF(CFS) =      10.00
  TC(MIN.) =   11.33

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.33
  RAINFALL INTENSITY(INCH/HR) =   3.89
  TOTAL STREAM AREA(ACRES) =     2.86
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     10.00

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       14.13    11.41        3.869          4.36
      2       10.00    11.33        3.886          2.86

  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       24.07    11.33       3.886
      2       24.09    11.41       3.869

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      24.09   Tc(MIN.) =   11.41
  TOTAL AREA(ACRES) =        7.2
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      6.00 =    1220.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     12.00  DOWNSTREAM(FEET) =     10.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   110.00   CHANNEL SLOPE =  0.0136
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =      24.09
  FLOW VELOCITY(FEET/SEC.) =   3.69   FLOW DEPTH(FEET) =   0.33
  TRAVEL TIME(MIN.) =   0.50   Tc(MIN.) =   11.90
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      7.00 =    1330.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.90
  RAINFALL INTENSITY(INCH/HR) =   3.76
  TOTAL STREAM AREA(ACRES) =     7.22
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     24.09

****************************************************************************
  FLOW PROCESS FROM NODE     14.10 TO NODE     14.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     16.30
  DOWNSTREAM ELEVATION(FEET) =     16.00
  ELEVATION DIFFERENCE(FEET) =      0.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.678
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.62
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.62

****************************************************************************
  FLOW PROCESS FROM NODE     14.20 TO NODE      7.00 IS CODE =  51
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     16.00  DOWNSTREAM(FEET) =     10.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   450.00   CHANNEL SLOPE =  0.0122
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.62
  FLOW VELOCITY(FEET/SEC.) =   1.33   FLOW DEPTH(FEET) =   0.07
  TRAVEL TIME(MIN.) =   5.65   Tc(MIN.) =   10.33
  LONGEST FLOWPATH FROM NODE     14.10 TO NODE      7.00 =     500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.126
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    1.88   SUBAREA RUNOFF(CFS) =    6.13
  TOTAL AREA(ACRES) =        2.0   TOTAL RUNOFF(CFS) =       6.52
  TC(MIN.) =   10.33

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.33
  RAINFALL INTENSITY(INCH/HR) =   4.13
  TOTAL STREAM AREA(ACRES) =     2.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.52

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       24.09    11.90        3.764          7.22
      2        6.52    10.33        4.126          2.00

  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       28.50    10.33       4.126
      2       30.04    11.90       3.764

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      30.04   Tc(MIN.) =   11.90
```

```
  TOTAL AREA(ACRES) =        9.2
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      7.00 =    1330.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     10.50  DOWNSTREAM(FEET) =      8.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   135.00   CHANNEL SLOPE =  0.0185
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =      30.04
  FLOW VELOCITY(FEET/SEC.) =   4.41   FLOW DEPTH(FEET) =   0.34
  TRAVEL TIME(MIN.) =   0.51   Tc(MIN.) =   12.42
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      8.00 =    1465.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.42
  RAINFALL INTENSITY(INCH/HR) =   3.66
  TOTAL STREAM AREA(ACRES) =     9.22
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     30.04

****************************************************************************
  FLOW PROCESS FROM NODE     15.10 TO NODE     15.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     12.90
  DOWNSTREAM ELEVATION(FEET) =     12.60
  ELEVATION DIFFERENCE(FEET) =      0.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.678
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.68
  TOTAL AREA(ACRES) =      0.13   TOTAL RUNOFF(CFS) =      0.68

****************************************************************************
  FLOW PROCESS FROM NODE     15.20 TO NODE      8.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     12.60  DOWNSTREAM(FEET) =      8.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   480.00   CHANNEL SLOPE =  0.0096
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
```

```
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.68
  FLOW VELOCITY(FEET/SEC.) =   1.23   FLOW DEPTH(FEET) =   0.08
  TRAVEL TIME(MIN.) =   6.51   Tc(MIN.) =   11.19
  LONGEST FLOWPATH FROM NODE     15.10 TO NODE      8.00 =     530.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.917
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    1.49   SUBAREA RUNOFF(CFS) =    4.61
  TOTAL AREA(ACRES) =        1.6   TOTAL RUNOFF(CFS) =       5.01
  TC(MIN.) =   11.19

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.19
  RAINFALL INTENSITY(INCH/HR) =   3.92
  TOTAL STREAM AREA(ACRES) =     1.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.01

****************************************************************************
  FLOW PROCESS FROM NODE     16.10 TO NODE     16.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =      8.50
  DOWNSTREAM ELEVATION(FEET) =      8.30
  ELEVATION DIFFERENCE(FEET) =      0.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.971
  WARNING: THE MINIMUM OVERLAND FLOW SLOPE, 0.5%, IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      1.46
  TOTAL AREA(ACRES) =      0.28   TOTAL RUNOFF(CFS) =      1.46

****************************************************************************
  FLOW PROCESS FROM NODE     16.20 TO NODE      8.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =      8.30  DOWNSTREAM(FEET) =      8.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   130.00   CHANNEL SLOPE =  0.0023
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.46
  FLOW VELOCITY(FEET/SEC.) =   0.93   FLOW DEPTH(FEET) =   0.15
  TRAVEL TIME(MIN.) =   2.33   Tc(MIN.) =    7.31
  LONGEST FLOWPATH FROM NODE     16.10 TO NODE      8.00 =     180.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  5.158
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    0.42   SUBAREA RUNOFF(CFS) =    1.71
  TOTAL AREA(ACRES) =        0.7   TOTAL RUNOFF(CFS) =       2.85
  TC(MIN.) =    7.31

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.31
  RAINFALL INTENSITY(INCH/HR) =   5.16
  TOTAL STREAM AREA(ACRES) =     0.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.85

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       30.04    12.42        3.664          9.22
      2        5.01    11.19        3.917          1.62
      3        2.85     7.31        5.158          0.70

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       27.46     7.31       5.158
      2       35.27    11.19       3.917
      3       36.75    12.42       3.664

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      36.75   Tc(MIN.) =   12.42
  TOTAL AREA(ACRES) =       11.5
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      8.00 =    1465.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      8.00  DOWNSTREAM(FEET) =      6.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =    55.00   CHANNEL SLOPE =  0.0255
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =      36.75
  FLOW VELOCITY(FEET/SEC.) =   5.17   FLOW DEPTH(FEET) =   0.35
  TRAVEL TIME(MIN.) =   0.18   Tc(MIN.) =   12.59
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      9.00 =    1520.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.59
  RAINFALL INTENSITY(INCH/HR) =   3.63
  TOTAL STREAM AREA(ACRES) =    11.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     36.75

****************************************************************************
  FLOW PROCESS FROM NODE     11.10 TO NODE     17.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     19.20
  DOWNSTREAM ELEVATION(FEET) =     18.50
  ELEVATION DIFFERENCE(FEET) =      0.70
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.527
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.21
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.21

****************************************************************************
  FLOW PROCESS FROM NODE     17.20 TO NODE      9.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     18.50  DOWNSTREAM(FEET) =      6.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1075.00   CHANNEL SLOPE =  0.0111
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =  50.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  CHANNEL FLOW THRU SUBAREA(CFS) =       0.21
```

```
  FLOW VELOCITY(FEET/SEC.) =   1.01   FLOW DEPTH(FEET) =   0.04
  TRAVEL TIME(MIN.) =  17.83   Tc(MIN.) =   21.35
  LONGEST FLOWPATH FROM NODE     11.10 TO NODE      9.00 =    1125.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.582
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7900
  SUBAREA AREA(ACRES) =    2.14   SUBAREA RUNOFF(CFS) =    4.37
  TOTAL AREA(ACRES) =        2.2   TOTAL RUNOFF(CFS) =       4.45
  TC(MIN.) =   21.35

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   21.35
  RAINFALL INTENSITY(INCH/HR) =   2.58
  TOTAL STREAM AREA(ACRES) =     2.18
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.45

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1       36.75    12.59        3.630         11.54
      2        4.45    21.35        2.582          2.18

  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       39.38    12.59       3.630
      2       30.59    21.35       2.582

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      39.38   Tc(MIN.) =   12.59
  TOTAL AREA(ACRES) =       13.7
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE      9.00 =    1520.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE     10.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
```

```
  ELEVATION DATA: UPSTREAM(FEET) =     5.60  DOWNSTREAM(FEET) =     5.00
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  33.0 INCH PIPE IS  22.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.07
  ESTIMATED PIPE DIAMETER(INCH) =  33.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      39.38
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =   12.63
  LONGEST FLOWPATH FROM NODE     13.10 TO NODE     10.00 =    1540.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    75.00
  UPSTREAM ELEVATION(FEET) =     20.00
  DOWNSTREAM ELEVATION(FEET) =     14.70
  ELEVATION DIFFERENCE(FEET) =      5.30
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.518
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.11   TOTAL RUNOFF(CFS) =      0.57
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.1  TC(MIN.) =      2.52
  PEAK FLOW RATE(CFS)   =       0.57
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.2 POST DEVELOPMENT HYDROLOGY CALCULATIONS

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

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
         (c) Copyright 1982-2008 Advanced Engineering Software (aes)
             Ver. 15.0 Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      Pasco Laret Suiter & Associates
                           535 N Hwy 101 Suite A
                           Solana Beach, CA 92075
                                858-259-8212

 ************************** DESCRIPTION OF STUDY **************************
* DEVELOPED CONDITION HYDROLOGY CALCULATIONS                               *
* TENTATIVE MAP FOR BERNARDO SHORES                                        *
* PLSA 2045 - JUNE 2014                                                    *
 ***************************************************************************

  FILE NAME: 2045-BC.DAT
  TIME/DATE OF STUDY: 14:07 06/10/2014
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   2.500
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  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   12.0      6.0    0.020/0.020/ ---    0.50    3.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.50 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    85.00
  UPSTREAM ELEVATION(FEET) =     22.10
  DOWNSTREAM ELEVATION(FEET) =     19.70
```

```
  ELEVATION DIFFERENCE(FEET) =      2.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.602
  WARNING: INITIAL SUBAREA FLOW PATH LENGTH IS GREATER THAN
           THE MAXIMUM OVERLAND FLOW LENGTH =    83.24
           (Reference: Table 3-1B of Hydrology Manual)
           THE MAXIMUM OVERLAND FLOW LENGTH IS USED IN Tc CALCULATION!
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.57
  TOTAL AREA(ACRES) =      0.11   TOTAL RUNOFF(CFS) =      0.57

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     19.70  DOWNSTREAM(FEET) =     15.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   430.00   CHANNEL SLOPE =  0.0098
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.157
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7900
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.68
  AVERAGE FLOW DEPTH(FEET) =   0.28   TRAVEL TIME(MIN.) =   1.95
  Tc(MIN.) =    5.55
  SUBAREA AREA(ACRES) =     1.25       SUBAREA RUNOFF(CFS) =    6.08
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.790
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       6.62

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.39   FLOW VELOCITY(FEET/SEC.) =   4.46
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     15.50  DOWNSTREAM(FEET) =     14.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0075
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   5.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.62
  FLOW VELOCITY(FEET/SEC.) =   4.34   FLOW DEPTH(FEET) =   0.51
  TRAVEL TIME(MIN.) =   0.77   Tc(MIN.) =    6.32
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     715.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.32
```

```
  RAINFALL INTENSITY(INCH/HR) =   5.66
  TOTAL STREAM AREA(ACRES) =     1.36
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.62

****************************************************************************
  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 = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     18.00
  DOWNSTREAM ELEVATION(FEET) =     17.10
  ELEVATION DIFFERENCE(FEET) =      0.90
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.081
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.47
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.47

****************************************************************************
  FLOW PROCESS FROM NODE      1.20 TO NODE      4.00 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     17.10
  DOWNSTREAM NODE ELEVATION(FEET) =     16.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =    50.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.125
  PAVEMENT LIP(FEET) =  0.050   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.47
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.85
  AVERAGE FLOW DEPTH(FEET) =   0.17   FLOOD WIDTH(FEET) =    3.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   0.29   Tc(MIN.) =    4.37
  SUBAREA AREA(ACRES) =    0.00       SUBAREA RUNOFF(CFS) =    0.00
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.710
  TOTAL AREA(ACRES) =        0.1         PEAK FLOW RATE(CFS) =       0.47

         NOTE:TRAVEL TIME ESTIMATES BASED ON NORMAL
         DEPTH EQUAL TO [GUTTER-HIKE + PAVEMENT LIP]

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.17   FLOOD WIDTH(FEET) =    3.00
  FLOW VELOCITY(FEET/SEC.) =   2.85   DEPTH*VELOCITY(FT*FT/SEC) =   0.50
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      4.00 =     100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
```

```
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    4.37
  RAINFALL INTENSITY(INCH/HR) =   6.59
  TOTAL STREAM AREA(ACRES) =     0.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.47

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        6.62     6.32        5.663          1.36
      2        0.47     4.37        6.587          0.10

  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        5.05     4.37       6.587
      2        7.02     6.32       5.663

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.02   Tc(MIN.) =    6.32
  TOTAL AREA(ACRES) =        1.5
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =     715.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
==============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     16.30
  DOWNSTREAM NODE ELEVATION(FEET) =     10.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   373.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.125
  PAVEMENT LIP(FEET) =  0.050   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   0.50
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.816
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      9.62
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.45
  AVERAGE FLOW DEPTH(FEET) =   0.37   FLOOD WIDTH(FEET) =   22.36
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   1.80   Tc(MIN.) =    8.12
  SUBAREA AREA(ACRES) =    1.52       SUBAREA RUNOFF(CFS) =    5.20
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.747
  TOTAL AREA(ACRES) =        3.0         PEAK FLOW RATE(CFS) =      10.71

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOOD WIDTH(FEET) =   23.50
  FLOW VELOCITY(FEET/SEC.) =   3.51   DEPTH*VELOCITY(FT*FT/SEC) =   1.33
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      5.00 =    1088.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    10.80  DOWNSTREAM(FEET) =     8.50
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   9.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.99
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.71
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    8.14
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =    1108.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      8.50  DOWNSTREAM(FEET) =      8.49
  CHANNEL LENGTH THRU SUBAREA(FEET) =   113.00   CHANNEL SLOPE =  0.0001
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =      10.71
  FLOW VELOCITY(FEET/SEC.) =   0.40   FLOW DEPTH(FEET) =   0.84
  TRAVEL TIME(MIN.) =   4.70   Tc(MIN.) =   12.84
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      7.00 =    1221.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      4.10 TO NODE      4.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     20.30
  DOWNSTREAM ELEVATION(FEET) =     19.80
  ELEVATION DIFFERENCE(FEET) =      0.50
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.964
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.19
  TOTAL AREA(ACRES) =      0.04   TOTAL RUNOFF(CFS) =      0.19

****************************************************************************
  FLOW PROCESS FROM NODE      4.20 TO NODE      4.30 IS CODE =  92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     19.80
  DOWNSTREAM NODE ELEVATION(FEET) =     11.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   674.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.125
```

```
  PAVEMENT LIP(FEET) =  0.050   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.493
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.64
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.75
  AVERAGE FLOW DEPTH(FEET) =   0.29   FLOOD WIDTH(FEET) =   14.36
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   4.08   Tc(MIN.) =    9.05
  SUBAREA AREA(ACRES) =    2.14       SUBAREA RUNOFF(CFS) =    6.83
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.710
  TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       6.96

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOOD WIDTH(FEET) =   20.16
  FLOW VELOCITY(FEET/SEC.) =   2.99   DEPTH*VELOCITY(FT*FT/SEC) =   1.04
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE      4.30 =     724.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.30 TO NODE     11.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    11.90  DOWNSTREAM(FEET) =     8.50
  FLOW LENGTH(FEET) =    68.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  12.0 INCH PIPE IS   8.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.19
  ESTIMATED PIPE DIAMETER(INCH) =  12.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.96
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =    9.15
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE     11.00 =     792.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     10.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      8.50  DOWNSTREAM(FEET) =      8.49
  CHANNEL LENGTH THRU SUBAREA(FEET) =   163.00   CHANNEL SLOPE =  0.0001
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.96
  FLOW VELOCITY(FEET/SEC.) =   0.30   FLOW DEPTH(FEET) =   0.73
  TRAVEL TIME(MIN.) =   8.96   Tc(MIN.) =   18.11
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE     10.00 =     955.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   18.11
  RAINFALL INTENSITY(INCH/HR) =   2.87
  TOTAL STREAM AREA(ACRES) =     2.18
```

```
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.96

****************************************************************************
  FLOW PROCESS FROM NODE      3.10 TO NODE      3.20 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     20.00
  DOWNSTREAM ELEVATION(FEET) =     18.90
  ELEVATION DIFFERENCE(FEET) =      1.10
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    3.817
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.47
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.47

****************************************************************************
  FLOW PROCESS FROM NODE      3.20 TO NODE      3.30 IS CODE = 92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     18.90
  DOWNSTREAM NODE ELEVATION(FEET) =     12.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.125
  PAVEMENT LIP(FEET) =  0.050   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.904
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.77
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.57
  AVERAGE FLOW DEPTH(FEET) =   0.30   FLOOD WIDTH(FEET) =   15.33
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   4.08   Tc(MIN.) =    7.90
  SUBAREA AREA(ACRES) =    1.88       SUBAREA RUNOFF(CFS) =    6.55
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.710
  TOTAL AREA(ACRES) =        2.0         PEAK FLOW RATE(CFS) =       6.89

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOOD WIDTH(FEET) =   20.97
  FLOW VELOCITY(FEET/SEC.) =   2.77   DEPTH*VELOCITY(FT*FT/SEC) =   0.98
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      3.30 =     680.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.30 TO NODE     10.00 IS CODE = 31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    10.50  DOWNSTREAM(FEET) =    10.10
  FLOW LENGTH(FEET) =    19.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   9.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.18
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =       6.89
  PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =    7.94
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE     10.00 =     699.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE      9.00 IS CODE = 51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      8.50  DOWNSTREAM(FEET) =      8.49
  CHANNEL LENGTH THRU SUBAREA(FEET) =    99.00   CHANNEL SLOPE =  0.0001
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       6.89
  FLOW VELOCITY(FEET/SEC.) =   0.35   FLOW DEPTH(FEET) =   0.62
  TRAVEL TIME(MIN.) =   4.66   Tc(MIN.) =   12.60
  LONGEST FLOWPATH FROM NODE      3.10 TO NODE      9.00 =     798.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      9.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   12.60
  RAINFALL INTENSITY(INCH/HR) =   3.63
  TOTAL STREAM AREA(ACRES) =     1.98
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.89

****************************************************************************
  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 = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    50.00
  UPSTREAM ELEVATION(FEET) =     19.40
  DOWNSTREAM ELEVATION(FEET) =     18.50
  ELEVATION DIFFERENCE(FEET) =      0.90
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.081
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.47
  TOTAL AREA(ACRES) =      0.10   TOTAL RUNOFF(CFS) =      0.47

****************************************************************************
  FLOW PROCESS FROM NODE      2.20 TO NODE      2.30 IS CODE = 92
----------------------------------------------------------------------------
  >>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<
============================================================================
  UPSTREAM NODE ELEVATION(FEET) =     18.50
  DOWNSTREAM NODE ELEVATION(FEET) =     10.70
  CHANNEL LENGTH THRU SUBAREA(FEET) =   633.00
  "V" GUTTER WIDTH(FEET) =   3.00   GUTTER HIKE(FEET) =  0.125
  PAVEMENT LIP(FEET) =  0.050   MANNING'S N = .0150
  PAVEMENT CROSSFALL(DECIMAL NOTATION) = 0.02000
```

```
  MAXIMUM DEPTH(FEET) =   1.00
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.952
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      4.04
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.85
  AVERAGE FLOW DEPTH(FEET) =   0.30   FLOOD WIDTH(FEET) =   15.00
  "V" GUTTER FLOW TRAVEL TIME(MIN.) =   3.70   Tc(MIN.) =    7.78
  SUBAREA AREA(ACRES) =    2.02       SUBAREA RUNOFF(CFS) =    7.10
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.710
  TOTAL AREA(ACRES) =        2.1         PEAK FLOW RATE(CFS) =       7.45

  END OF SUBAREA "V" GUTTER HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOOD WIDTH(FEET) =   20.64
  FLOW VELOCITY(FEET/SEC.) =   3.08   DEPTH*VELOCITY(FT*FT/SEC) =   1.08
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      2.30 =     683.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.30 TO NODE      9.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     9.10  DOWNSTREAM(FEET) =     8.50
  FLOW LENGTH(FEET) =    15.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.69
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.45
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =    7.81
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      9.00 =     698.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE      7.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =      8.50  DOWNSTREAM(FEET) =      8.49
  CHANNEL LENGTH THRU SUBAREA(FEET) =   200.00   CHANNEL SLOPE =  0.0001
  CHANNEL BASE(FEET) =   30.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  CHANNEL FLOW THRU SUBAREA(CFS) =       7.45
  FLOW VELOCITY(FEET/SEC.) =   0.29   FLOW DEPTH(FEET) =   0.81
  TRAVEL TIME(MIN.) =  11.39   Tc(MIN.) =   19.20
  LONGEST FLOWPATH FROM NODE      2.10 TO NODE      7.00 =     898.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   19.20
  RAINFALL INTENSITY(INCH/HR) =   2.77
  TOTAL STREAM AREA(ACRES) =     2.12
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      7.45
```

```
  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        6.96    18.11        2.872          2.18
      2        6.89    12.60        3.629          1.98
      3        7.45    19.20        2.766          2.12

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF      Tc      INTENSITY
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)
      1       16.62    12.60       3.629
      2       19.44    18.11       2.872
      3       19.40    19.20       2.766

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      19.44   Tc(MIN.) =   18.11
  TOTAL AREA(ACRES) =        6.3
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE      7.00 =     955.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  11
----------------------------------------------------------------------------
  >>>>>CONFLUENCE MEMORY BANK # 1 WITH THE MAIN-STREAM MEMORY<<<<<
============================================================================

  ** MAIN STREAM CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       19.44    18.11       2.872        6.28
  LONGEST FLOWPATH FROM NODE      4.10 TO NODE      7.00 =     955.00 FEET.

  ** MEMORY BANK #  1 CONFLUENCE DATA **
  STREAM     RUNOFF      Tc      INTENSITY     AREA
  NUMBER      (CFS)    (MIN.)   (INCH/HOUR)   (ACRE)
      1       10.71    12.84       3.584        2.98
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      7.00 =    1221.00 FEET.

  ** PEAK FLOW RATE TABLE **
  STREAM    RUNOFF       Tc      INTENSITY
  NUMBER     (CFS)     (MIN.)   (INCH/HOUR)
      1      24.50      12.84        3.584
      2      28.02      18.11        2.872

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      28.02   Tc(MIN.) =   18.11
  TOTAL AREA(ACRES) =        9.3

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  2.872
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
```

```
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.7207
  SUBAREA AREA(ACRES) =    0.92   SUBAREA RUNOFF(CFS) =    1.88
  TOTAL AREA(ACRES) =       10.2   TOTAL RUNOFF(CFS) =      28.02
  TC(MIN.) =   18.11
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =     9.30  DOWNSTREAM(FEET) =     6.50
  FLOW LENGTH(FEET) =    12.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS  11.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  28.13
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      28.02
  PIPE TRAVEL TIME(MIN.) =   0.01    Tc(MIN.) =   18.12
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      8.00 =    1233.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 2 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      8.00 IS CODE =  13
----------------------------------------------------------------------------
  >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      1.50 TO NODE      2.50 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    73.00
  UPSTREAM ELEVATION(FEET) =     18.70
  DOWNSTREAM ELEVATION(FEET) =     16.50
  ELEVATION DIFFERENCE(FEET) =      2.20
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    4.153
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.42
  TOTAL AREA(ACRES) =      0.09   TOTAL RUNOFF(CFS) =      0.42

****************************************************************************
  FLOW PROCESS FROM NODE      2.50 TO NODE      2.60 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   16.50  DOWNSTREAM ELEVATION(FEET) =   14.30
  STREET LENGTH(FEET) =    45.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 12.00
```

```
  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   6.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       0.54
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.20
    HALFSTREET FLOOD WIDTH(FEET) =    3.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.92
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.98
  STREET FLOW TRAVEL TIME(MIN.) =   0.15   Tc(MIN.) =    4.31
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .7100
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.710
  SUBAREA AREA(ACRES) =    0.05      SUBAREA RUNOFF(CFS) =    0.23
  TOTAL AREA(ACRES) =        0.1        PEAK FLOW RATE(CFS) =       0.65

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.20   HALFSTREET FLOOD WIDTH(FEET) =   3.00
  FLOW VELOCITY(FEET/SEC.) =  4.92   DEPTH*VELOCITY(FT*FT/SEC.) =   0.98
  LONGEST FLOWPATH FROM NODE      1.50 TO NODE      2.60 =     118.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      2.60 TO NODE      2.60 IS CODE =  10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 3 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      2.60 TO NODE      2.60 IS CODE =  13
----------------------------------------------------------------------------
  >>>>>CLEAR THE MAIN-STREAM MEMORY<<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      1.10 TO NODE      2.11 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     25.20
  DOWNSTREAM ELEVATION(FEET) =     24.60
  ELEVATION DIFFERENCE(FEET) =      0.60
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    2.789
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.587
  NOTE: RAINFALL INTENSITY IS BASED ON Tc = 5-MINUTE.
  SUBAREA RUNOFF(CFS) =      0.71
  TOTAL AREA(ACRES) =      0.12   TOTAL RUNOFF(CFS) =      0.71

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

```
  FLOW PROCESS FROM NODE      2.11 TO NODE      3.11 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =   24.60  DOWNSTREAM ELEVATION(FEET) =   18.00
  STREET LENGTH(FEET) =  1160.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF = 1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0120

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.01
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   14.72
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.63
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.11
  STREET FLOW TRAVEL TIME(MIN.) =   7.35   Tc(MIN.) =   10.13
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.176
  *USER SPECIFIED(SUBAREA):
  USER-SPECIFIED RUNOFF COEFFICIENT = .9000
  S.C.S. CURVE NUMBER (AMC II) =   0
  AREA-AVERAGE RUNOFF COEFFICIENT =  0.900
  SUBAREA AREA(ACRES) =    2.70      SUBAREA RUNOFF(CFS) =   10.15
  TOTAL AREA(ACRES) =        2.8        PEAK FLOW RATE(CFS) =      10.60

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.49   HALFSTREET FLOOD WIDTH(FEET) =  18.39
  FLOW VELOCITY(FEET/SEC.) =  3.03   DEPTH*VELOCITY(FT*FT/SEC.) =   1.50
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1160.0 FT WITH ELEVATION-DROP =   6.6 FT, IS   16.0 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE      3.11
  LONGEST FLOWPATH FROM NODE      1.10 TO NODE      3.11 =    1220.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.11 TO NODE      3.11 IS CODE = 12
----------------------------------------------------------------------------
  >>>>>CLEAR MEMORY BANK # 1 <<<<<
============================================================================

****************************************************************************
  FLOW PROCESS FROM NODE      3.11 TO NODE      3.11 IS CODE = 10
----------------------------------------------------------------------------
  >>>>>MAIN-STREAM MEMORY COPIED ONTO MEMORY BANK # 1 <<<<<
============================================================================
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.8  TC(MIN.) =     10.13
  PEAK FLOW RATE(CFS)   =      10.60
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

3.3 BIORETENTION BMP CALCULATIONS

Parameters
Vwq= Water Quality Volume
P_{85TH}= 85TH percentile rainfall (inches) = 0.55 in
Total Impervious Area = 6.66 acres
Total Pervious Area = 2.31 acres
C= Runoff Coefficient = 0.71

Priority Treatment Control BMP sizing

Required Vwq=$CP_{85th}A$ per equation 6-1 of the San Diego County Hydrology Manual

Required Vwq= 0.71 x 0.55 in x 8.97 acres x 1 ft / 12 in x 43,560 sf / acres

Vwq = 12,715 cf

Per Tentative Map Actual Bioretention Volume = 24,000 cf > required Vwq

Low Impact Development Requirements

Sizing Factor for LID facilities = 0.04 *(County of San Diego Model SUSMP Chapter 4 Table 4-6)*
Runoff Factor for Impervious areas = 1.0
Runoff Factor for landscape areas = 0.1

Required Treatment Area for LID = 0.4 x Runoff Factor x Area
(*County of San Diego Model SUSMP equation Table 4-7)*

Required Treatment Area = 0.27 acres = 11,844 sf

Proposed Treatment Area = 12,000 sf > required treatment area

4.1 INLET SIZING CALCULATIONS

```
****************************************************************************
                  HYDRAULIC ELEMENTS - I  PROGRAM PACKAGE
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      Pasco Laret Suiter & Associates
                           535 N Hwy 101 Suite A
                           Solana Beach, CA 92075
                                858-259-8212

----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 16:00 06/10/2014
============================================================================
 Problem Descriptions:
  INLET A
  CAPACITY CALCULATION
  PLSA 2045 - PROPOSED HYDROLOGY
****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------


    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.


    BASIN INFLOW(CFS) =    5.20
    BASIN OPENING(FEET) =  0.50
    DEPTH OF WATER(FEET) =  0.50

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       4.76

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

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

                      Pasco Laret Suiter & Associates
                           535 N Hwy 101 Suite A
                           Solana Beach, CA 92075
                                858-259-8212

----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 16:06 06/10/2014
============================================================================
 Problem Descriptions:
  INLET B
  CAPACITY CALCULATION
  PLSA 2045 - PROPOSED HYDROLOGY
****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------


    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.


    BASIN INFLOW(CFS) =    7.45
    BASIN OPENING(FEET) =  0.50
    DEPTH OF WATER(FEET) =  0.50

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       6.83

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

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

                      Pasco Laret Suiter & Associates
                           535 N Hwy 101 Suite A
                           Solana Beach, CA 92075
                                858-259-8212

----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 16:07 06/10/2014
============================================================================
 Problem Descriptions:
  INLET C
  CAPACITY CALCULATION
  PLSA 2045 - PROPOSED HYDROLOGY
****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------


    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.


    BASIN INFLOW(CFS) =    6.89
    BASIN OPENING(FEET) =  0.50
    DEPTH OF WATER(FEET) =  0.50

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       6.31

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

```
****************************************************************************
                  HYDRAULIC ELEMENTS - I  PROGRAM PACKAGE
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1452

                           Analysis prepared by:

                      Pasco Laret Suiter & Associates
                           535 N Hwy 101 Suite A
                           Solana Beach, CA 92075
                                858-259-8212

----------------------------------------------------------------------------
  TIME/DATE OF STUDY: 16:08 06/10/2014
============================================================================
 Problem Descriptions:
  INLET D
  CAPACITY CALCULATION
  PLSA 2045 - PROPOSED HYDROLOGY
****************************************************************************
>>>>SUMP TYPE BASIN INPUT INFORMATION<<<<
----------------------------------------------------------------------------


    Curb Inlet Capacities are approximated based on the Bureau of
    Public Roads nomograph plots for flowby basins and sump basins.


    BASIN INFLOW(CFS) =    6.96
    BASIN OPENING(FEET) =  0.50
    DEPTH OF WATER(FEET) =  0.50

    >>>>CALCULATED ESTIMATED SUMP BASIN WIDTH(FEET) =       6.38

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

INLET SIZING CALCULATIONS

INLET	TYPE	Q100 (CFS)	WIDTH	STATUS
A	SDRSD D-2 Curb Inlet	5.20	4.76	OK
B	SDRSD D-2 Curb Inlet	7.45	6.83	OK
C	SDRSD D-2 Curb Inlet	6.89	6.31	OK
D	SDRSD D-2 Curb Inlet	6.96	6.38	OK

See Developed Condition Hydrology Map for Corresponding Inlet locations

4.2 STORM DRAIN CAPACITY CALCULATIONS

PIPE NUMBER	UP NODE	DOWN NODE	Q 100(CFS)	SLOPE (FT/FT)	PIPE MATERIAL	n	REQUIRED DIAMETER (IN)	ACTUAL DIAMETER (IN)	CHECK
1	5	6	10.71	0.03	HDPE	0.012	14	14	OK
2	2.3	9	7.45	0.02	HDPE	0.012	13	14	OK
3	3.3	10	6.89	0.015	HDPE	0.012	14	14	OK
4	4.3	11	6.96	0.025	HDPE	0.012	13	14	OK

The 18" outlet pipe exiting the Bioretention Basin is for emergency overflow only, and will not ever have to convey the 100 year storm.
The 100 year storm will be stored in the above surface and subsurface storage area provided within the Bioretention Basin.

EQUATION (3-4) SAN DIEGO COUNTY DRAINAGE DESIGN MANUAL
Required Pipe Diameter $D_r=[2.16nQ/(S_o^{1/2})]^{3/8}$

10" HDPE 1.6%
Worksheet for Circular Channel

Project Description	
Project File	m:\haested student\haested student\haested\academic\fmw\2045.fm2
Worksheet	10" HDPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.016000	ft/ft
Diameter	10.00	in

Results		
Depth	0.83	ft
Discharge	4.00	cfs
Flow Area	0.55	ft²
Wetted Perimeter	2.62	ft
Top Width	0.00	ft
Critical Depth	0.80	ft
Percent Full	100.00	
Critical Slope	0.013977	ft/ft
Velocity	7.34	ft/s
Velocity Head	0.84	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	4.31	cfs
Full Flow Capacity	4.00	cfs
Full Flow Slope	0.016000	ft/ft

12" HDPE 1.0%
Worksheet for Circular Channel

Project Description	
Project File	m:\haested student\haested student\haested\academic\fmw\2045.fm2
Worksheet	12" HDPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.010000	ft/ft
Diameter	12.00	in

Results		
Depth	1.00	ft
Discharge	5.15	cfs
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Top Width	0.00	ft
Critical Depth	0.92	ft
Percent Full	100.00	
Critical Slope	0.008666	ft/ft
Velocity	6.55	ft/s
Velocity Head	0.67	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	5.54	cfs
Full Flow Capacity	5.15	cfs
Full Flow Slope	0.010000	ft/ft

18" RCP
Worksheet for Circular Channel

Project Description	
Project File	m:\haested student\haested student\haested\academic\fmw\2045.fm2
Worksheet	18" RCP
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.091000	ft/ft
Diameter	18.00	in

Results		
Depth	1.50	ft
Discharge	31.69	cfs
Flow Area	1.77	ft²
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.49	ft
Percent Full	100.00	
Critical Slope	0.086572	ft/ft
Velocity	17.93	ft/s
Velocity Head	5.00	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	34.08	cfs
Full Flow Capacity	31.69	cfs
Full Flow Slope	0.091000	ft/ft

12" HDPE 1.6%
Worksheet for Circular Channel

Project Description	
Project File	m:\haested student\haested student\haested\academic\fmw\2045.fm2
Worksheet	12" HDPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.009	
Channel Slope	0.016000	ft/ft
Diameter	12.00	in

Results		
Depth	1.00	ft
Discharge	6.51	cfs
Flow Area	0.79	ft^2
Wetted Perimeter	3.14	ft
Top Width	0.00	ft
Critical Depth	0.97	ft
Percent Full	100.00	
Critical Slope	0.014035	ft/ft
Velocity	8.29	ft/s
Velocity Head	1.07	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	7.00	cfs
Full Flow Capacity	6.51	cfs
Full Flow Slope	0.016000	ft/ft

4.3 BIORETENTION BASIN ROUTING CALCULATIONS

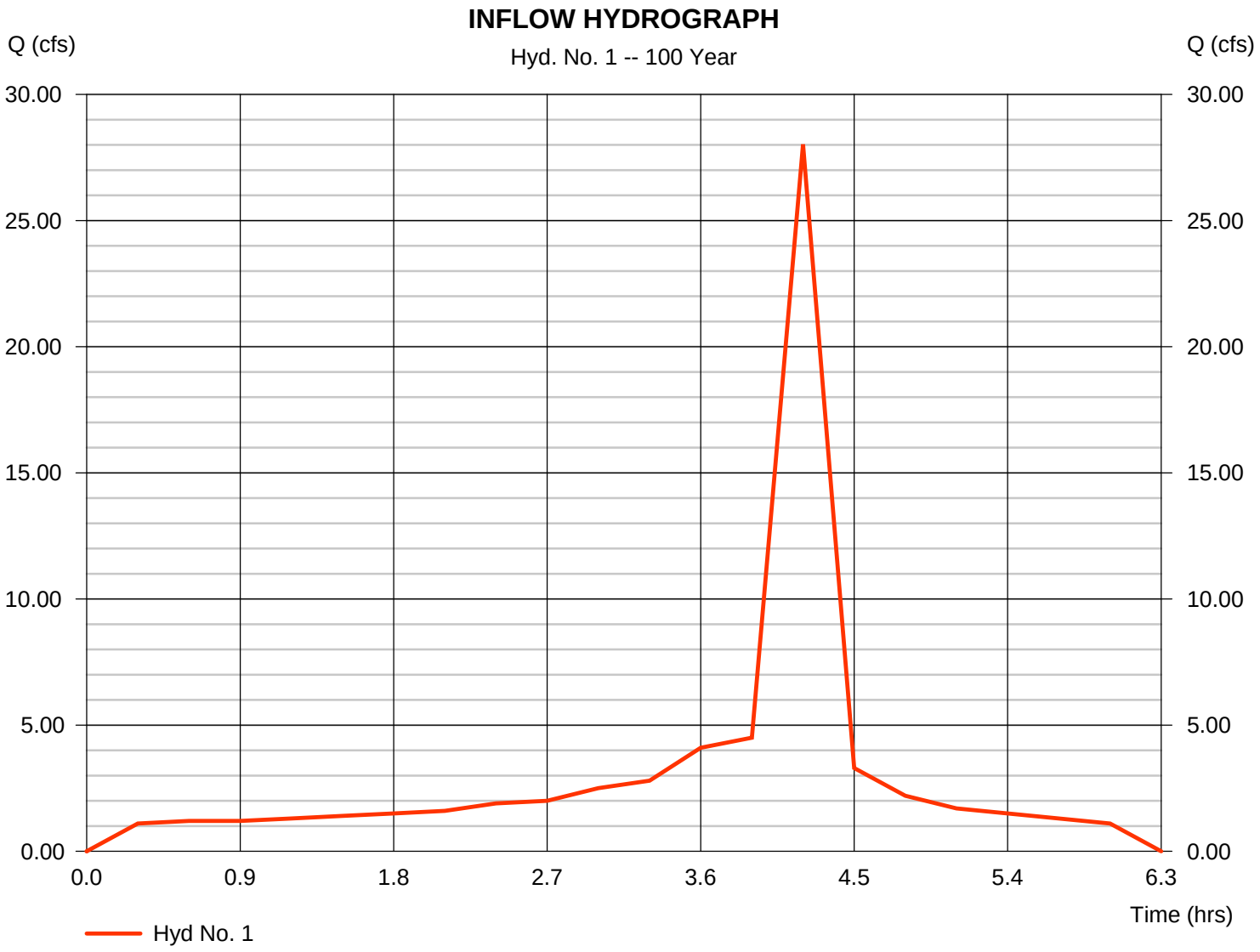
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Thursday, 08 / 21 / 2014

Hyd. No. 1

INFLOW HYDROGRAPH

Hydrograph type	=	Manual	Peak discharge	=	28.02 cfs
Storm frequency	=	100 yrs	Time to peak	=	4.20 hrs
Time interval	=	18 min	Hyd. volume	=	71,518 cuft



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Thursday, 08 / 21 / 2014

Pond No. 1 - BIORETENTION BASIN

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 6.80 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	6.80	4,800	0	0
0.25	7.05	4,800	1,200	1,200
0.50	7.30	4,800	1,200	2,400
0.75	7.55	4,800	1,200	3,600
1.00	7.80	4,800	1,200	4,800
1.25	8.05	4,800	1,200	5,999
1.50	8.30	4,800	1,200	7,199
1.75	8.55	12,000	2,032	9,232
2.00	8.80	12,600	3,074	12,306
2.25	9.05	13,200	3,224	15,530
2.50	9.30	13,800	3,374	18,905
2.75	9.55	14,400	3,524	22,429
3.00	9.80	15,000	3,674	26,103
3.25	10.05	15,600	3,824	29,928
3.50	10.30	16,200	3,974	33,902

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	6.00	Inactive	Inactive
Span (in)	= 18.00	6.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 6.80	6.80	0.00	0.00
Length (ft)	= 15.00	0.50	0.00	0.00
Slope (%)	= 2.00	2.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

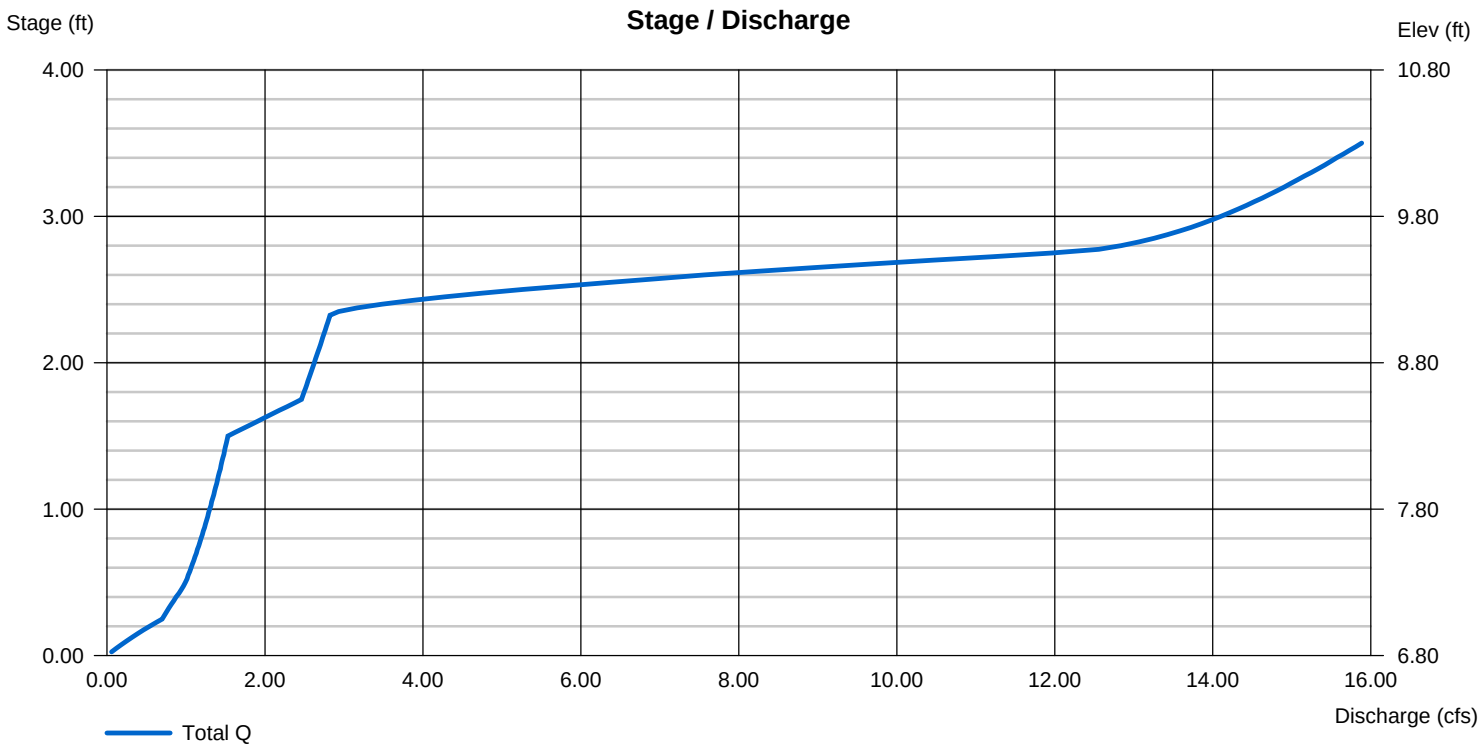
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.60	0.00	0.00	0.00
Crest El. (ft)	= 9.13	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 5.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Thursday, 08 / 21 / 2014

Pond No. 1 - BIORETENTION BASIN

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 6.80 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	6.80	4,800	0	0
0.25	7.05	4,800	1,200	1,200
0.50	7.30	4,800	1,200	2,400
0.75	7.55	4,800	1,200	3,600
1.00	7.80	4,800	1,200	4,800
1.25	8.05	4,800	1,200	5,999
1.50	8.30	4,800	1,200	7,199
1.75	8.55	12,000	2,032	9,232
2.00	8.80	12,600	3,074	12,306
2.25	9.05	13,200	3,224	15,530
2.50	9.30	13,800	3,374	18,905
2.75	9.55	14,400	3,524	22,429
3.00	9.80	15,000	3,674	26,103
3.25	10.05	15,600	3,824	29,928
3.50	10.30	16,200	3,974	33,902

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	6.00	Inactive	Inactive
Span (in)	= 18.00	6.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 6.80	6.80	0.00	0.00
Length (ft)	= 15.00	0.50	0.00	0.00
Slope (%)	= 2.00	2.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

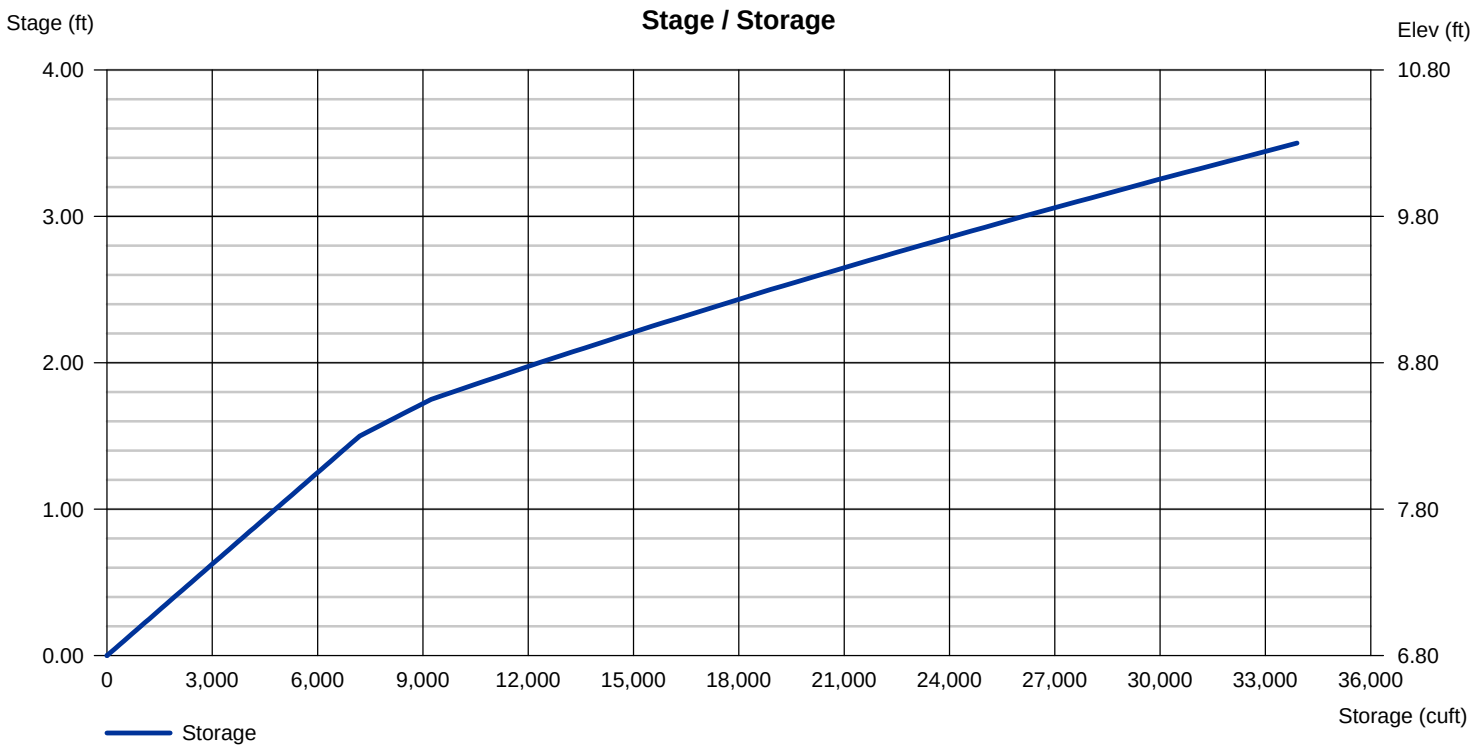
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 10.60	0.00	0.00	0.00
Crest El. (ft)	= 9.13	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 5.000 (by Contour)

TW Elev. (ft) = 0.00

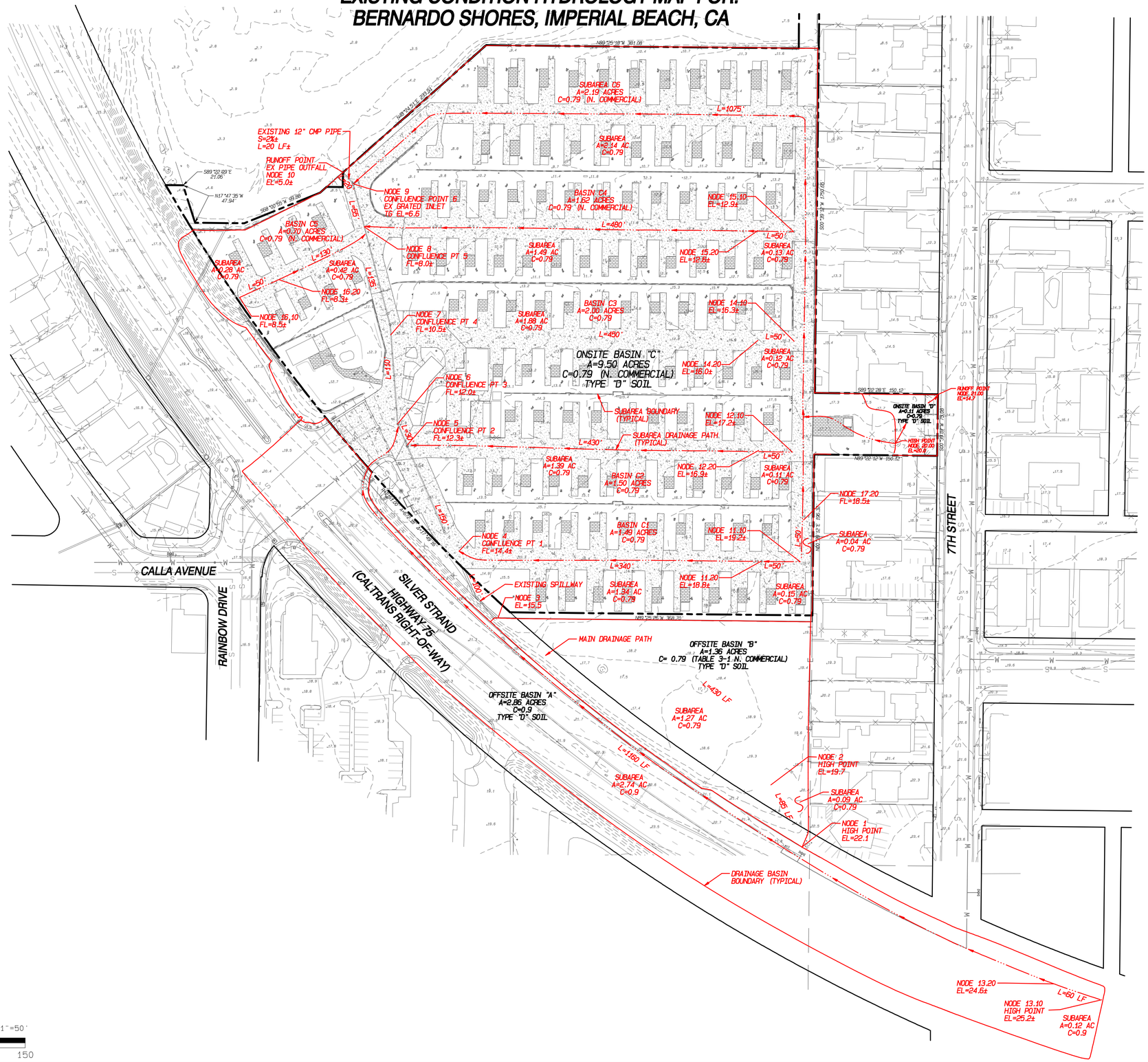
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



5.0 APPENDIX

DATE: AUGUST 20, 2014

EXISTING CONDITION HYDROLOGY MAP FOR: BERNARDO SHORES, IMPERIAL BEACH, CA



PREPARED FOR:

INTEGRAL COMMUNITIES
2235 ENCINITAS BLVD., SUITE 216
ENCINITAS, CA 92024

APN'S

625-140-20, 626-010-18

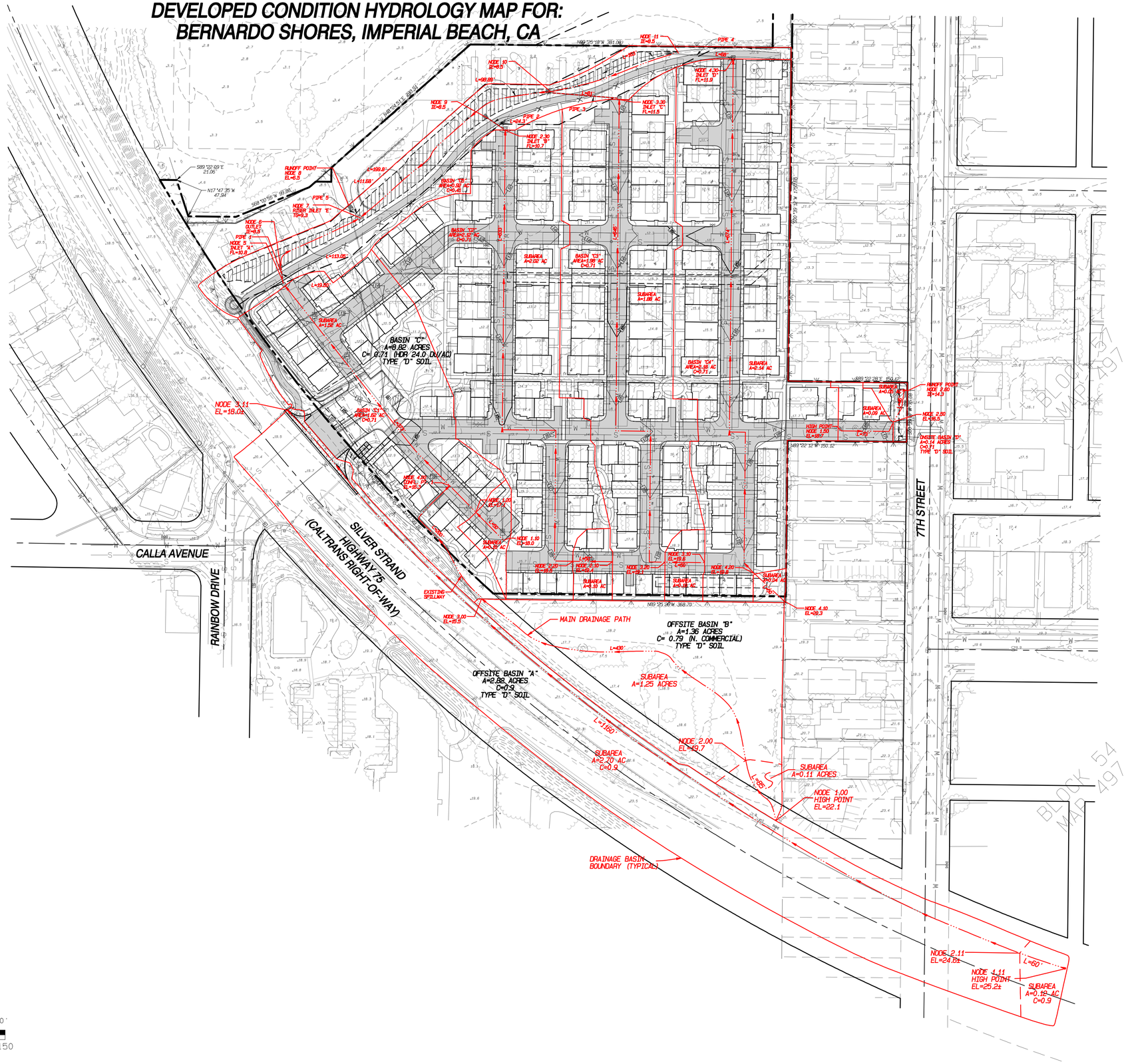
PREPARED BY:

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

PLSA 2045

DATE: AUGUST 20, 2014

DEVELOPED CONDITION HYDROLOGY MAP FOR: BERNARDO SHORES, IMPERIAL BEACH, CA



GRAPHIC SCALE 1"=50'

0 50 100 150

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