

# CA ENGINEERING, INC.

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## PRELIMINARY HYDROLOGY REPORT

FOR

T.T.M. 19447

9822 Russell Avenue

City of Garden Grove, CA

Date: October 28th, 2025



PLANS PREPARED UNDER THE SUPERVISION OF:

A handwritten signature in blue ink, appearing to read "Fred Cornwell", written over a horizontal line.

Fred Cornwell, P.E. - R.C.E 45591

10/28/25  
Date

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## **1.0 INTRODUCTION**

The purpose of this report is to present the hydrology analysis and drainage calculations for a proposed residential development located at 9822 Russell Avenue, in the City of Garden Grove, California. The site proposes to construct 26 townhomes and related improvements on approximately 1.80 acres. This report will determine the existing and proposed storm water runoff rates from the project site and determine the impact on the existing surrounding drainage facilities,

## **2.0 EXISTING DRAINAGE CONDITIONS**

The project site is located in the City of Garden Grove, California, and is comprised of approximately 1.80 acres (78,537 square feet), and is located in a predominantly residential development area. The rectangular site is bounded by Russell Avenue to the north (beyond which are residential buildings), Sunnyside Elementary School to the east, Kerry Street to the west (beyond which are residential buildings), and residential buildings and a church to the south.

The northwest portion of the site is currently occupied by buildings housing a church and a preschool, and there is a small storage shed located near the southwest corner of the site. The remainder of the site is covered in asphalt drive aisles and parking areas, concrete hardscape, and landscaping.

The project site is rectangular in shape and has a relatively flat topography that generally slopes southwesterly with elevations ranging from about 74 to 72 feet above mean sea level (msl). Surface drainage sheet flows to either Russell Avenue or Kerry Street and is conveyed westerly and southerly until entering the storm drain system downstream via a catch basin on Donegal Drive near the Trask Avenue intersection. The project area currently has no water quality or drainage mitigation devices installed on-site.

## **3.0 PROPOSED DRAINAGE CONDITIONS**

The drainage for the proposed project generally follows the existing flow characteristics. The site has been divided into four drainage areas, identified as Areas 1-4. Storm flows from each area will be collected via curb & gutters in the drive aisles and drain to one of four curb-opening catch basins. Drainage in the non-drive aisle areas will be captured via proposed area drains. All of the captured drainage will be directed to one of three underground infiltration BMP facilities that will be sized to treat the Design Capture Volume (DCV) as defined in the Technical Guidance Document for the WQMP.

During larger storm events, as with existing conditions, drainage for the proposed project will outlet onto either Russell Avenue or Kerry Street. In Area 1, the excess flows will bubble out of the Area 1 catch basin and be discharged to Russell Avenue via a parkway culvert. In Area 2, the excess flows will bubble out of the Area 2 catch basin and be discharged to Russell Avenue via the project driveway entrance. Overflow drainage for Areas 3 and 4 will bubble out of the Area 3 catch basin and be discharged to Kerry Street via a parkway culvert.

## **4.0 METHODOLOGY**

The hydrology calculations for the study were completed using AES software based on the Orange County Hydrology Manual methodology. The Rational Method was used to determine the peak discharges for the pre-and post-developed conditions and can be found in Appendix "A" (existing ) & Appendix "B" (proposed).

These peak flow rates for the 2, 10 and 100 year storm events will be compared in the results section of this report found below. The hydrologic sub areas and flow paths that produce these rates are shown on the Existing (Exhibit A) & Proposed (Exhibit B) hydrology maps.

## 5.0 HYDRAULICS

Note, the hydraulic calculations including the catch basin and pipe sizing will be analyzed in the Final Hydrology Report.

## 6.0 WATER QUALITY

The BMP facilities will be sized to capture and treat the Design Capture Volume (DCV) per the Technical Guidance Document as published by the County of Orange. The underground infiltration BMP facilities will be sized to store a total of 5,760 cubic feet of stormwater, which is in excess of the total DCV of 3,736 cubic feet.

Since there are no hydraulic conditions of concern (HCOC's), the flow will not have to be detained. When a larger storm event occurs that increases the runoff to a point where the underground infiltration BMP facilities are full, the excess flows be discharged to Russell Avenue or Kerry Street via parkway culverts or the driveway entrance.

## 7.0 FLOOD PLAIN DESIGNATION

The site falls within a Zone "X" designation under the FEMA Map 06059C0138J, dated December 3, 2009. Zone X (Shaded Orange Area) represents areas determined 0.2% annual chance flood hazard, area of 1% annual chance flood with average depth less than one foot or with drainage areas less than one square mile.

## 8.0 RESULTS

The results of the Existing and Proposed conditions for the existing site outlet location as shown on the hydrology maps are as follows:

	Existing Condition			Proposed Condition					Increase/ (Decrease)	%
	A1	ΣA2/A3	TOTAL	A1	A2	A3	A4	TOTAL		
Area	0.54 AC	1.26 AC	<b>1.80 AC</b>	0.48 AC	0.73 AC	0.42 AC	0.17 AC	<b>1.80 AC</b>	-	-
2 Year Storm	0.94 CFS	1.66 CFS	<b>2.60 CFS</b>	0.83 CFS	1.13 CFS	0.73 CFS	0.31 CFS	<b>3.00 CFS</b>	0.40 CFS	15.4%
10 Year Storm	1.69 CFS	3.01 CFS	<b>4.70 CFS</b>	1.51 CFS	2.05 CFS	1.33 CFS	0.56 CFS	<b>5.45 CFS</b>	0.75 CFS	16.0%
100 Year Storm	2.58 CFS	4.63 CFS	<b>7.21 CFS</b>	2.31 CFS	3.15 CFS	2.05 CFS	0.85 CFS	<b>8.36 CFS</b>	1.15 CFS	16.0%

Under proposed conditions, flows for the 2 year storm is increased by 15.4%, flows for the 10 year storm is increased 16.0%, and flows for the 100 year storm is increase by 16.0% when compared to existing conditions.

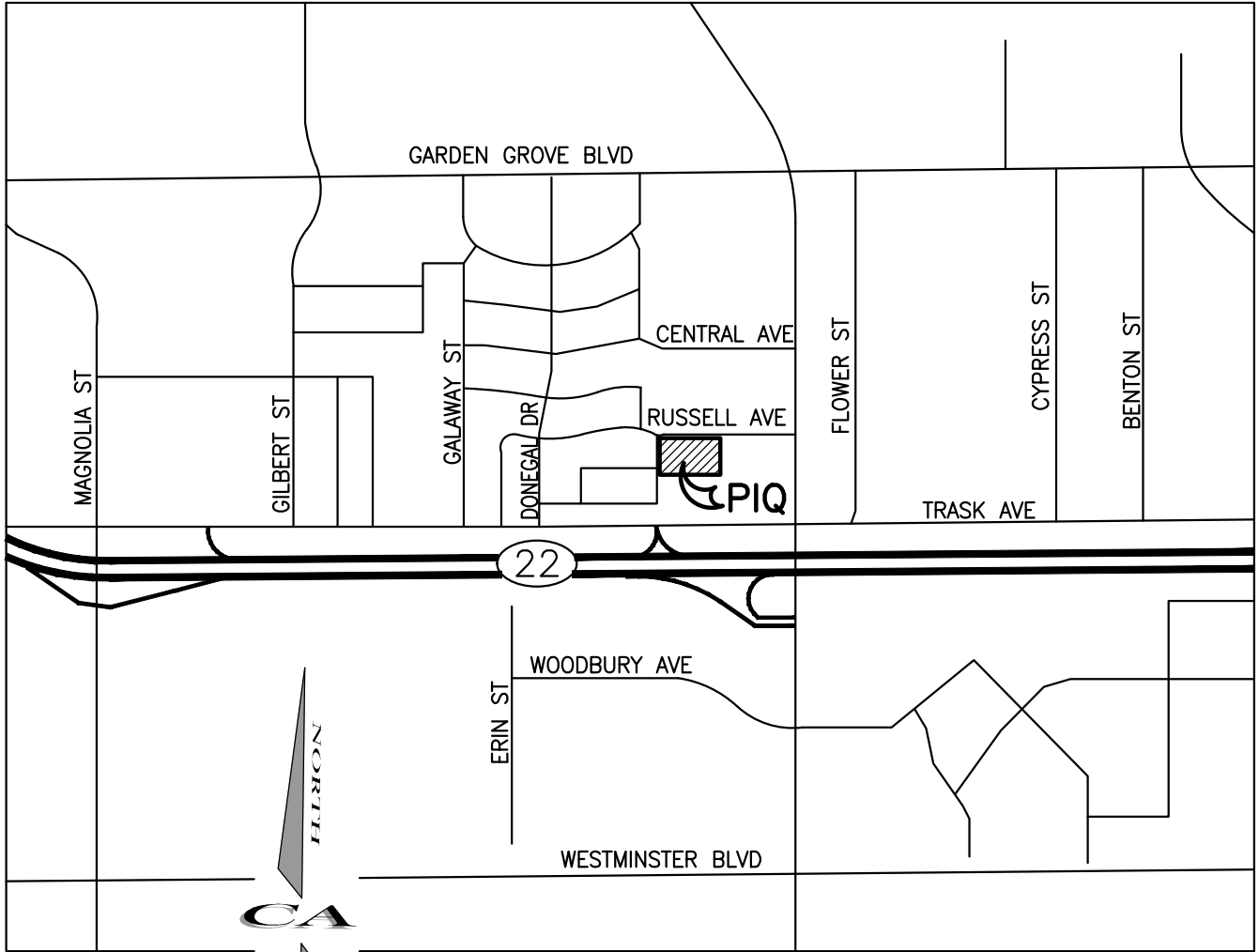
## **9.0 CONCLUSION**

To meet water quality requirements, the DCV will be captured onsite with four curb inlet catch basins and treated in underground infiltration BMP facilities. During larger storm events, as with existing conditions, drainage for the proposed project will outlet onto Russell Avenue & Kerry Street.

During a 100 year storm event, existing flows (7.21 CFS) will be increase by 1.15 CFS under proposed conditions (8.36 CFS). For the 10 year storm event, existing flows (4.70 CFS) will be increased by 0.75 CFS under proposed conditions (5.45 CFS). For the 2 year storm event, existing flows (2.60 CFS) will be increased by 0.40 CFS under proposed conditions (3.00 CFS).

Since proposed flows are slightly increased from the existing flows, the proposed project site will have no significant impact on the existing surrounding drainage facilitates.

## 10.0 VICINITY MAP



# VICINITY MAP

NOT TO SCALE

**11.0 SOIL MAP**

Hydrologic Soil Group—Orange County and Part of Riverside County, California



Map Scale: 1:1,010 if printed on A landscape (11" x 8.5") sheet.




Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

**Warning:** Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Orange County and Part of Riverside County, California  
 Survey Area Data: Version 19, Sep 8, 2025

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 1, 2024—Jul 1, 2024

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
163	Metz loamy sand	B	4.8	100.0%
<b>Totals for Area of Interest</b>			<b>4.8</b>	<b>100.0%</b>

### Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

### Rating Options

*Aggregation Method: Dominant Condition*

*Component Percent Cutoff: None Specified*

*Tie-break Rule:* Higher

## APPENDICES

**APPENDIX A: EXISTING RATIONAL METHOD, 2, 10, & 100 YEAR STORM FREQUENCY OUTPUT FILES.**

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
 (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)  
 (c) Copyright 1983-2008 Advanced Engineering Software (aes)  
 Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
 \* EXISTING CONDITION \*  
 \* 2 YR STORM \*  
 \* \*  
 \*\*\*\*\*

FILE NAME: 491-22EX.DAT  
 TIME/DATE OF STUDY: 13:24 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 2.00  
 SPECIFIED MINIMUM PIPE SIZE (INCH) = 6.00  
 SPECIFIED PERCENT OF GRADIENTS (DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
 \*DATA BANK RAINFALL USED\*  
 \*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROSSFALL (FT)	IN- / OUT- / SIDE / SIDE / WAY	STREET-CROSSFALL: CURB HEIGHT (FT)	GUTTER GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

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

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 173.00  
 ELEVATION DATA: UPSTREAM (FEET) = 73.40 DOWNSTREAM (FEET) = 72.20

$$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$$

SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.455  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 1.955  
 SUBAREA Tc AND LOSS RATE DATA (AMC I):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
COMMERCIAL	B	0.54	0.30	0.100	36	6.45

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100  
 SUBAREA RUNOFF (CFS) = 0.94  
 TOTAL AREA (ACRES) = 0.54 PEAK FLOW RATE (CFS) = 0.94

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 300.00  
 ELEVATION DATA: UPSTREAM (FEET) = 74.00 DOWNSTREAM (FEET) = 72.80

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
 SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 8.981  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 1.617  
 SUBAREA Tc AND LOSS RATE DATA (AMC I):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
COMMERCIAL	B	0.91	0.30	0.100	36	8.98

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100  
 SUBAREA RUNOFF (CFS) = 1.30  
 TOTAL AREA (ACRES) = 0.91 PEAK FLOW RATE (CFS) = 1.30

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 4.00 TO NODE 5.00 IS CODE = 91  
 -----

>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 =====

UPSTREAM NODE ELEVATION (FEET) = 72.80  
 DOWNSTREAM NODE ELEVATION (FEET) = 71.70  
 CHANNEL LENGTH THRU SUBAREA (FEET) = 149.00  
 "V" GUTTER WIDTH (FEET) = 5.00 GUTTER HIKE (FEET) = 0.050  
 PAVEMENT LIP (FEET) = 0.050 MANNING'S N = .0140  
 PAVEMENT CROSSFALL (DECIMAL NOTATION) = 0.01000  
 MAXIMUM DEPTH (FEET) = 0.50  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 1.491  
 SUBAREA LOSS RATE DATA (AMC I):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN
COMMERCIAL	B	0.35	0.30	0.100	36

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100  
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW (CFS) = 1.53  
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY (FEET/SEC.) = 1.82  
 AVERAGE FLOW DEPTH (FEET) = 0.15 FLOOD WIDTH (FEET) = 14.53  
 "V" GUTTER FLOW TRAVEL TIME (MIN.) = 1.36 Tc (MIN.) = 10.34  
 SUBAREA AREA (ACRES) = 0.35 SUBAREA RUNOFF (CFS) = 0.46  
 EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED Fm (INCH/HR) = 0.03  
 AREA-AVERAGED Fp (INCH/HR) = 0.30 AREA-AVERAGED Ap = 0.10  
 TOTAL AREA (ACRES) = 1.3 PEAK FLOW RATE (CFS) = 1.66

END OF SUBAREA "V" GUTTER HYDRAULICS:  
 DEPTH (FEET) = 0.15 FLOOD WIDTH (FEET) = 15.47  
 FLOW VELOCITY (FEET/SEC.) = 1.82 DEPTH\*VELOCITY (FT\*FT/SEC) = 0.28

LONGEST FLOWPATH FROM NODE 3.00 TO NODE 5.00 = 449.00 FEET.

=====  
END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.3 TC (MIN.) = 10.34  
EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.03  
AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.100  
PEAK FLOW RATE (CFS) = 1.66  
=====

=====  
END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
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Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* EXISTING CONDITION \*  
\* 10 YR STORM \*  
\* \*  
\*\*\*\*\*

FILE NAME: 491-22EX.DAT  
TIME/DATE OF STUDY: 13:28 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 10.00  
SPECIFIED MINIMUM PIPE SIZE (INCH) = 6.00  
SPECIFIED PERCENT OF GRADIENTS (DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*DATA BANK RAINFALL USED\*  
\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GUTTER-GEOMETRIES LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

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

\*\*\*\*\*  
FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 173.00  
ELEVATION DATA: UPSTREAM (FEET) = 73.40 DOWNSTREAM (FEET) = 72.20

Tc = K\*[(LENGTH\*\* 3.00)/(ELEVATION CHANGE)]\*\*0.20  
SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.455  
\* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 3.507  
SUBAREA Tc AND LOSS RATE DATA (AMC II):  
DEVELOPMENT TYPE/ LAND USE      SCS SOIL GROUP      AREA (ACRES)      Fp (INCH/HR)      Ap (DECIMAL)      SCS CN      Tc (MIN.)  
COMMERCIAL      B      0.54      0.30      0.100      56      6.45  
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100  
SUBAREA RUNOFF (CFS) = 1.69  
TOTAL AREA (ACRES) = 0.54      PEAK FLOW RATE (CFS) = 1.69

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 300.00  
 ELEVATION DATA: UPSTREAM (FEET) = 74.00 DOWNSTREAM (FEET) = 72.80

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$  (MIN.) = 8.981

\* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.902

SUBAREA  $T_c$  AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
COMMERCIAL	B	0.91	0.30	0.100	56	8.98

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.30

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

SUBAREA RUNOFF (CFS) = 2.35

TOTAL AREA (ACRES) = 0.91 PEAK FLOW RATE (CFS) = 2.35

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 4.00 TO NODE 5.00 IS CODE = 91  
 -----

>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 =====

UPSTREAM NODE ELEVATION (FEET) = 72.80

DOWNSTREAM NODE ELEVATION (FEET) = 71.70

CHANNEL LENGTH THRU SUBAREA (FEET) = 149.00

"V" GUTTER WIDTH (FEET) = 5.00 GUTTER HIKE (FEET) = 0.050

PAVEMENT LIP (FEET) = 0.050 MANNING'S N = .0140

PAVEMENT CROSSFALL (DECIMAL NOTATION) = 0.01000

MAXIMUM DEPTH (FEET) = 0.50

\* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 2.685

SUBAREA LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN
COMMERCIAL	B	0.35	0.30	0.100	56

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.30

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

TRAVEL TIME COMPUTED USING ESTIMATED FLOW (CFS) = 2.77

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY (FEET/SEC.) = 1.90

AVERAGE FLOW DEPTH (FEET) = 0.18 FLOOD WIDTH (FEET) = 21.41

"V" GUTTER FLOW TRAVEL TIME (MIN.) = 1.31  $T_c$  (MIN.) = 10.29

SUBAREA AREA (ACRES) = 0.35 SUBAREA RUNOFF (CFS) = 0.84

EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.03

AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.10

TOTAL AREA (ACRES) = 1.3 PEAK FLOW RATE (CFS) = 3.01

END OF SUBAREA "V" GUTTER HYDRAULICS:

DEPTH (FEET) = 0.19 FLOOD WIDTH (FEET) = 22.34

FLOW VELOCITY (FEET/SEC.) = 1.93 DEPTH\*VELOCITY (FT\*FT/SEC) = 0.36

LONGEST FLOWPATH FROM NODE 3.00 TO NODE 5.00 = 449.00 FEET.  
 =====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.3  $T_c$  (MIN.) = 10.29

EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.03

AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.100

PEAK FLOW RATE (CFS) = 3.01  
 =====

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
(Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)  
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Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* EXISTING CONDITION \*  
\* 100 YR STORM \*  
\* \*  
\*\*\*\*\*

FILE NAME: 491-22EX.DAT  
TIME/DATE OF STUDY: 13:28 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE (INCH) = 6.00  
SPECIFIED PERCENT OF GRADIENTS (DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*DATA BANK RAINFALL USED\*  
\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL IN- / OUT- / PARK- SIDE / SIDE / WAY	CURB HEIGHT (FT)	GUTTER WIDTH (FT)	GUTTER GEOMETRIES LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

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

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 173.00  
ELEVATION DATA: UPSTREAM (FEET) = 73.40 DOWNSTREAM (FEET) = 72.20

Tc = K\*[(LENGTH\*\* 3.00)/(ELEVATION CHANGE)]\*\*0.20  
SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.455  
\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 5.345  
SUBAREA Tc AND LOSS RATE DATA (AMC III):  
DEVELOPMENT TYPE/ LAND USE      SCS SOIL GROUP      AREA (ACRES)      Fp (INCH/HR)      Ap (DECIMAL)      SCS CN      Tc (MIN.)  
COMMERCIAL      B      0.54      0.30      0.100      76      6.45  
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.100  
SUBAREA RUNOFF (CFS) = 2.58  
TOTAL AREA (ACRES) = 0.54      PEAK FLOW RATE (CFS) = 2.58

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 300.00  
 ELEVATION DATA: UPSTREAM (FEET) = 74.00 DOWNSTREAM (FEET) = 72.80

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$  (MIN.) = 8.981

\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.423

SUBAREA  $T_c$  AND LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
COMMERCIAL	B	0.91	0.30	0.100	76	8.98

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.30

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

SUBAREA RUNOFF (CFS) = 3.60

TOTAL AREA (ACRES) = 0.91 PEAK FLOW RATE (CFS) = 3.60

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 4.00 TO NODE 5.00 IS CODE = 91  
 -----

>>>>COMPUTE "V" GUTTER FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 =====

UPSTREAM NODE ELEVATION (FEET) = 72.80

DOWNSTREAM NODE ELEVATION (FEET) = 71.70

CHANNEL LENGTH THRU SUBAREA (FEET) = 149.00

"V" GUTTER WIDTH (FEET) = 5.00 GUTTER HIKE (FEET) = 0.050

PAVEMENT LIP (FEET) = 0.050 MANNING'S N = .0140

PAVEMENT CROSSFALL (DECIMAL NOTATION) = 0.01000

MAXIMUM DEPTH (FEET) = 0.50

\* 100 YEAR RAINFALL INTENSITY (INCH/HR) = 4.110

SUBAREA LOSS RATE DATA (AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN
COMMERCIAL	B	0.35	0.30	0.100	76

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.30

SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.100

TRAVEL TIME COMPUTED USING ESTIMATED FLOW (CFS) = 4.24

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY (FEET/SEC.) = 2.02

AVERAGE FLOW DEPTH (FEET) = 0.21 FLOOD WIDTH (FEET) = 26.72

"V" GUTTER FLOW TRAVEL TIME (MIN.) = 1.23  $T_c$  (MIN.) = 10.21

SUBAREA AREA (ACRES) = 0.35 SUBAREA RUNOFF (CFS) = 1.29

EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.03

AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.10

TOTAL AREA (ACRES) = 1.3 PEAK FLOW RATE (CFS) = 4.63

END OF SUBAREA "V" GUTTER HYDRAULICS:

DEPTH (FEET) = 0.21 FLOOD WIDTH (FEET) = 27.97

FLOW VELOCITY (FEET/SEC.) = 2.04 DEPTH\*VELOCITY (FT\*FT/SEC) = 0.44

LONGEST FLOWPATH FROM NODE 3.00 TO NODE 5.00 = 449.00 FEET.  
 =====

END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 1.3  $T_c$  (MIN.) = 10.21

EFFECTIVE AREA (ACRES) = 1.26 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.03

AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.100

PEAK FLOW RATE (CFS) = 4.63  
 =====

END OF RATIONAL METHOD ANALYSIS

**APPENDIX B: PROPOSED RATIONAL METHOD, 2, 10 & 100 YEAR STORM FREQUENCY OUTPUT FILES.**

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
 (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)  
 (c) Copyright 1983-2008 Advanced Engineering Software (aes)  
 Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
 \* PROPOSED CONDITION \*  
 \* 2 YR STORM \*  
 \* \*  
 \*\*\*\*\*

FILE NAME: 491-22PR.DAT  
 TIME/DATE OF STUDY: 16:44 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 2.00  
 SPECIFIED MINIMUM PIPE SIZE (INCH) = 6.00  
 SPECIFIED PERCENT OF GRADIENTS (DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
 \*DATA BANK RAINFALL USED\*  
 \*ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/ SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

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

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 186.00  
 ELEVATION DATA: UPSTREAM (FEET) = 75.50 DOWNSTREAM (FEET) = 73.20

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.308  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 1.981  
 SUBAREA Tc AND LOSS RATE DATA (AMC I):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)  
 RESIDENTIAL  
 "11+ DWELLINGS/ACRE" B 0.48 0.30 0.200 36 6.31  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200  
 SUBAREA RUNOFF (CFS) = 0.83  
 TOTAL AREA (ACRES) = 0.48 PEAK FLOW RATE (CFS) = 0.83

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 3.00 TO NODE 4.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 253.00  
 ELEVATION DATA: UPSTREAM (FEET) = 75.50 DOWNSTREAM (FEET) = 73.30

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
 SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 7.655  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 1.773  
 SUBAREA Tc AND LOSS RATE DATA (AMC I):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)  
 RESIDENTIAL  
 "11+ DWELLINGS/ACRE" B 0.73 0.30 0.200 36 7.65  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200  
 SUBAREA RUNOFF (CFS) = 1.13  
 TOTAL AREA (ACRES) = 0.73 PEAK FLOW RATE (CFS) = 1.13

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 5.00 TO NODE 6.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 178.00  
 ELEVATION DATA: UPSTREAM (FEET) = 75.00 DOWNSTREAM (FEET) = 72.80

Tc = K \* [(LENGTH\*\* 3.00) / (ELEVATION CHANGE)] \*\* 0.20  
 SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.199  
 \* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 2.001  
 SUBAREA Tc AND LOSS RATE DATA (AMC I):  
 DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc  
 LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)  
 RESIDENTIAL  
 "11+ DWELLINGS/ACRE" B 0.42 0.30 0.200 36 6.20  
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp (INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200  
 SUBAREA RUNOFF (CFS) = 0.73  
 TOTAL AREA (ACRES) = 0.42 PEAK FLOW RATE (CFS) = 0.73

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 7.00 TO NODE 8.00 IS CODE = 21  
 -----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<  
 =====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 162.00

ELEVATION DATA: UPSTREAM(FEET) = 75.40 DOWNSTREAM(FEET) = 73.30

$T_c = K * [(LENGTH ** 3.00) / (ELEVATION CHANGE)] ** 0.20$

SUBAREA ANALYSIS USED MINIMUM  $T_c$  (MIN.) = 5.913

\* 2 YEAR RAINFALL INTENSITY (INCH/HR) = 2.056

SUBAREA  $T_c$  AND LOSS RATE DATA (AMC I):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	$F_p$ (INCH/HR)	$A_p$ (DECIMAL)	SCS CN	$T_c$ (MIN.)
RESIDENTIAL "11+ DWELLINGS/ACRE"	B	0.17	0.30	0.200	36	5.91

SUBAREA AVERAGE PERVIOUS LOSS RATE,  $F_p$  (INCH/HR) = 0.30  
SUBAREA AVERAGE PERVIOUS AREA FRACTION,  $A_p$  = 0.200  
SUBAREA RUNOFF (CFS) = 0.31  
TOTAL AREA (ACRES) = 0.17 PEAK FLOW RATE (CFS) = 0.31

=====  
END OF STUDY SUMMARY:

TOTAL AREA (ACRES) = 0.2 TC (MIN.) = 5.91  
EFFECTIVE AREA (ACRES) = 0.17 AREA-AVERAGED  $F_m$  (INCH/HR) = 0.06  
AREA-AVERAGED  $F_p$  (INCH/HR) = 0.30 AREA-AVERAGED  $A_p$  = 0.200  
PEAK FLOW RATE (CFS) = 0.31  
=====

=====  
END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
(Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)  
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Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* PROPOSED CONDITION \*  
\* 10 YR STORM \*  
\* \*  
\*\*\*\*\*

FILE NAME: 491-22PR.DAT  
TIME/DATE OF STUDY: 16:50 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT (YEAR) = 10.00  
SPECIFIED MINIMUM PIPE SIZE (INCH) = 6.00  
SPECIFIED PERCENT OF GRADIENTS (DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*DATA BANK RAINFALL USED\*  
\*ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/ SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

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

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH (FEET) = 186.00  
ELEVATION DATA: UPSTREAM (FEET) = 75.50 DOWNSTREAM (FEET) = 73.20

Tc = K\*[(LENGTH\*\* 3.00)/(ELEVATION CHANGE)]\*\*0.20  
SUBAREA ANALYSIS USED MINIMUM Tc (MIN.) = 6.308  
\* 10 YEAR RAINFALL INTENSITY (INCH/HR) = 3.553  
SUBAREA Tc AND LOSS RATE DATA (AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
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RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.48      0.30      0.200      56      6.31
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      1.51
TOTAL AREA(ACRES) =      0.48      PEAK FLOW RATE(CFS) =      1.51

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 253.00
ELEVATION DATA: UPSTREAM(FEET) = 75.50 DOWNSTREAM(FEET) = 73.30

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.655
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 3.180
SUBAREA Tc AND LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
LAND USE              GROUP      (ACRES)  (INCH/HR)  (DECIMAL)  CN      (MIN.)
RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.73      0.30      0.200      56      7.65
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      2.05
TOTAL AREA(ACRES) =      0.73      PEAK FLOW RATE(CFS) =      2.05

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 178.00
ELEVATION DATA: UPSTREAM(FEET) = 75.00 DOWNSTREAM(FEET) = 72.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.199
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 3.589
SUBAREA Tc AND LOSS RATE DATA(AMC II):
DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
LAND USE              GROUP      (ACRES)  (INCH/HR)  (DECIMAL)  CN      (MIN.)
RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.42      0.30      0.200      56      6.20
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      1.33
TOTAL AREA(ACRES) =      0.42      PEAK FLOW RATE(CFS) =      1.33

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 162.00
ELEVATION DATA: UPSTREAM(FEET) = 75.40 DOWNSTREAM(FEET) = 73.30

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.913
* 10 YEAR RAINFALL INTENSITY(INCH/HR) = 3.688

```

SUBAREA Tc AND LOSS RATE DATA(AMC II):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
RESIDENTIAL "11+ DWELLINGS/ACRE"	B	0.17	0.30	0.200	56	5.91

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30  
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200  
 SUBAREA RUNOFF(CFS) = 0.56  
 TOTAL AREA(ACRES) = 0.17 PEAK FLOW RATE(CFS) = 0.56

=====  
 END OF STUDY SUMMARY:

TOTAL AREA(ACRES) = 0.2 TC(MIN.) = 5.91  
 EFFECTIVE AREA(ACRES) = 0.17 AREA-AVERAGED Fm(INCH/HR) = 0.06  
 AREA-AVERAGED Fp(INCH/HR) = 0.30 AREA-AVERAGED Ap = 0.200  
 PEAK FLOW RATE(CFS) = 0.56  
 =====

=====  
 END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE  
(Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)  
(c) Copyright 1983-2008 Advanced Engineering Software (aes)  
Ver. 15.0 Release Date: 04/01/2008 License ID 1420

Analysis prepared by:

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* PROPOSED CONDITION \*  
\* 100 YR STORM \*  
\* \*  
\*\*\*\*\*

FILE NAME: 491-22PR.DAT  
TIME/DATE OF STUDY: 16:51 10/27/2025

=====

USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:

=====

--\*TIME-OF-CONCENTRATION MODEL\*--

USER SPECIFIED STORM EVENT(YEAR) = 100.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 6.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.85  
\*DATA BANK RAINFALL USED\*  
\*ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD\*

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/ SIDE / SIDE/ WAY	STREET-CROSSFALL: CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0313	0.167	0.0150

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

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

\*\*\*\*\*

FLOW PROCESS FROM NODE 1.00 TO NODE 2.00 IS CODE = 21

-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<  
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<

=====

INITIAL SUBAREA FLOW-LENGTH(FEET) = 186.00  
ELEVATION DATA: UPSTREAM(FEET) = 75.50 DOWNSTREAM(FEET) = 73.20

Tc = K\*[(LENGTH\*\* 3.00)/(ELEVATION CHANGE)]\*\*0.20  
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.308  
\* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 5.416  
SUBAREA Tc AND LOSS RATE DATA(AMC III):  
DEVELOPMENT TYPE/ SCS SOIL AREA Fp Ap SCS Tc  
LAND USE GROUP (ACRES) (INCH/HR) (DECIMAL) CN (MIN.)

```

RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.48      0.30      0.200      76      6.31
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      2.31
TOTAL AREA(ACRES) =      0.48      PEAK FLOW RATE(CFS) =      2.31

*****
FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 253.00
ELEVATION DATA: UPSTREAM(FEET) = 75.50 DOWNSTREAM(FEET) = 73.30

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 7.655
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 4.847
SUBAREA Tc AND LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
LAND USE      GROUP      (ACRES)      (INCH/HR)      (DECIMAL)      CN      (MIN.)
RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.73      0.30      0.200      76      7.65
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      3.15
TOTAL AREA(ACRES) =      0.73      PEAK FLOW RATE(CFS) =      3.15

*****
FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 178.00
ELEVATION DATA: UPSTREAM(FEET) = 75.00 DOWNSTREAM(FEET) = 72.80

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 6.199
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 5.470
SUBAREA Tc AND LOSS RATE DATA(AMC III):
DEVELOPMENT TYPE/      SCS SOIL      AREA      Fp      Ap      SCS      Tc
LAND USE      GROUP      (ACRES)      (INCH/HR)      (DECIMAL)      CN      (MIN.)
RESIDENTIAL
"11+ DWELLINGS/ACRE"      B      0.42      0.30      0.200      76      6.20
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200
SUBAREA RUNOFF(CFS) =      2.05
TOTAL AREA(ACRES) =      0.42      PEAK FLOW RATE(CFS) =      2.05

*****
FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
>>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=====
INITIAL SUBAREA FLOW-LENGTH(FEET) = 162.00
ELEVATION DATA: UPSTREAM(FEET) = 75.40 DOWNSTREAM(FEET) = 73.30

Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) = 5.913
* 100 YEAR RAINFALL INTENSITY(INCH/HR) = 5.620

```

SUBAREA Tc AND LOSS RATE DATA(AMC III):

DEVELOPMENT TYPE/ LAND USE	SCS SOIL GROUP	AREA (ACRES)	Fp (INCH/HR)	Ap (DECIMAL)	SCS CN	Tc (MIN.)
RESIDENTIAL "11+ DWELLINGS/ACRE"	B	0.17	0.30	0.200	76	5.91

SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) = 0.30  
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap = 0.200  
SUBAREA RUNOFF(CFS) = 0.85  
TOTAL AREA(ACRES) = 0.17 PEAK FLOW RATE(CFS) = 0.85

=====

END OF STUDY SUMMARY:

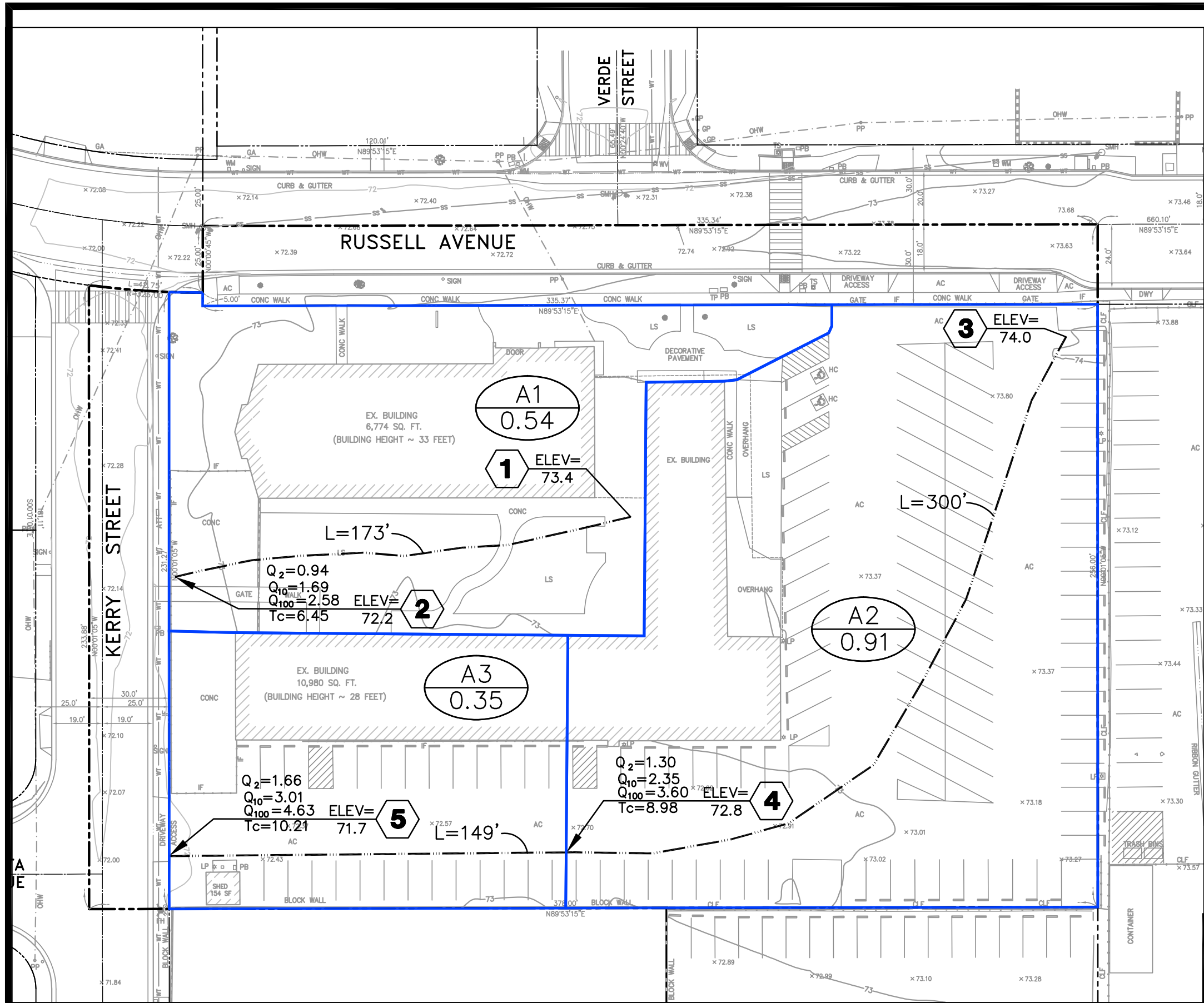
TOTAL AREA(ACRES) = 0.2 TC(MIN.) = 5.91  
EFFECTIVE AREA(ACRES) = 0.17 AREA-AVERAGED Fm(INCH/HR) = 0.06  
AREA-AVERAGED Fp(INCH/HR) = 0.30 AREA-AVERAGED Ap = 0.200  
PEAK FLOW RATE(CFS) = 0.85

=====

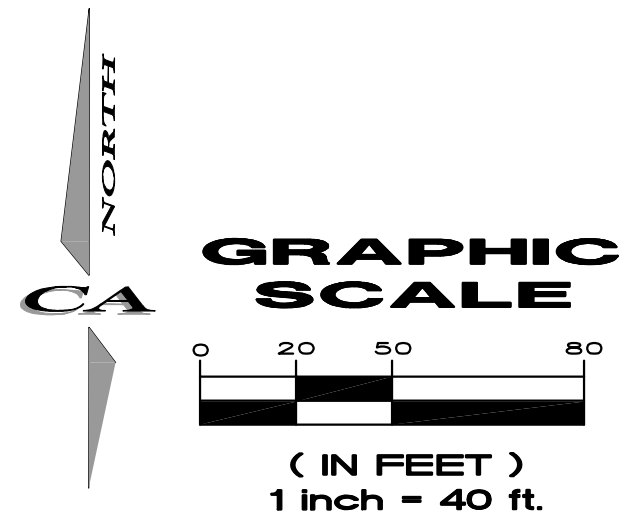
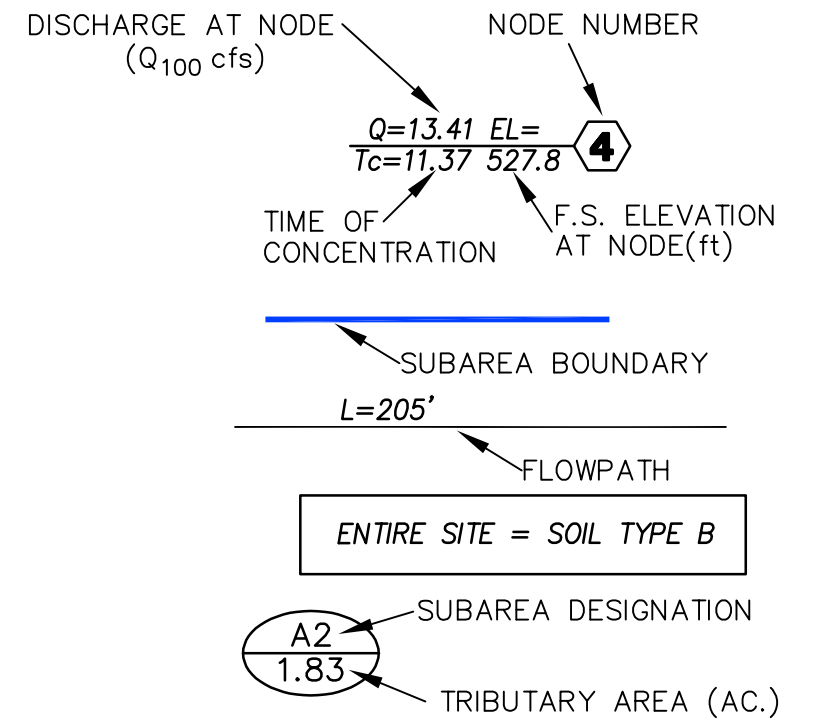
END OF RATIONAL METHOD ANALYSIS

## EXHIBITS

**EXHIBIT A: EXISTING CONDITION HYDROLOGY MAP**



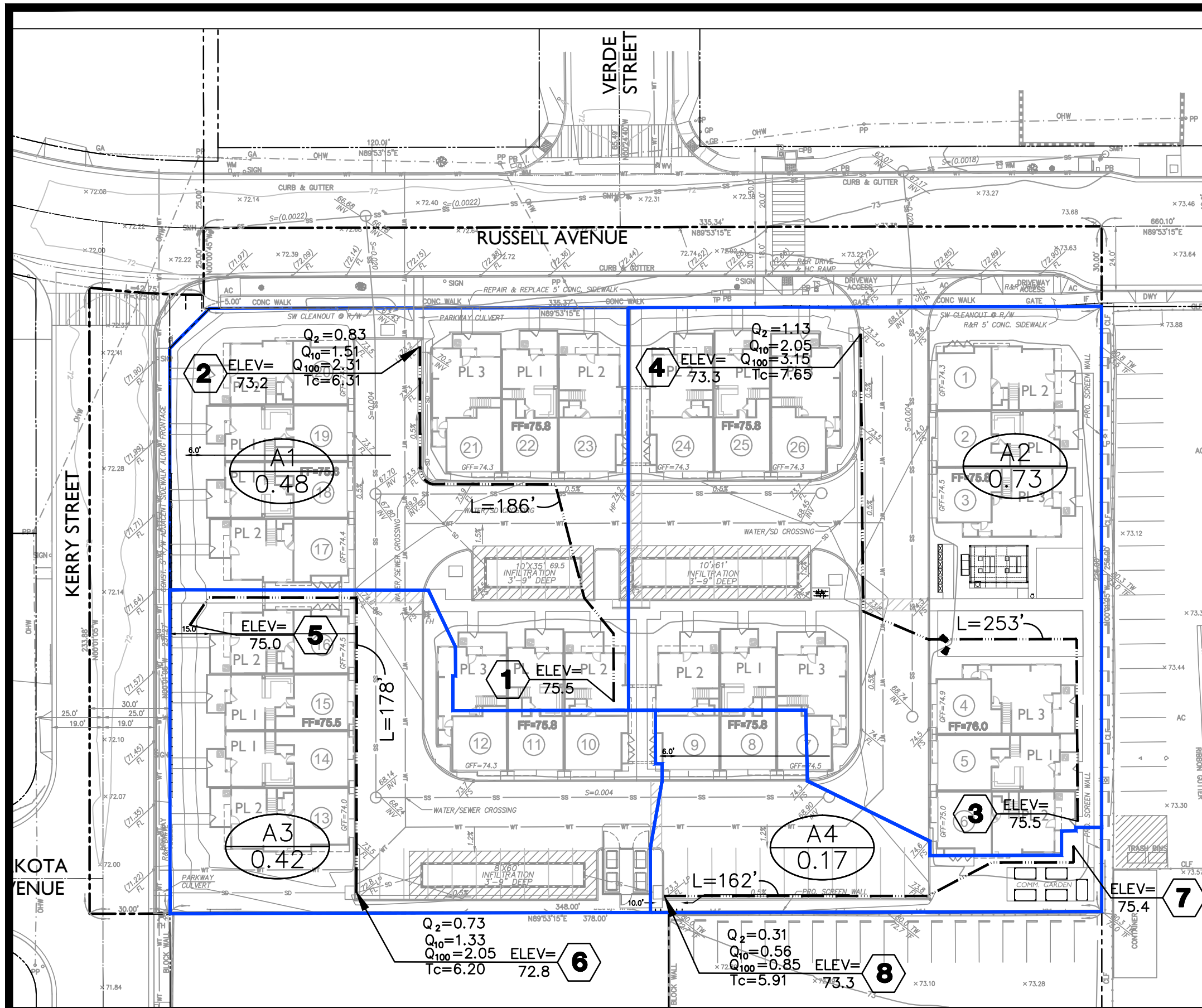
**LEGEND:**



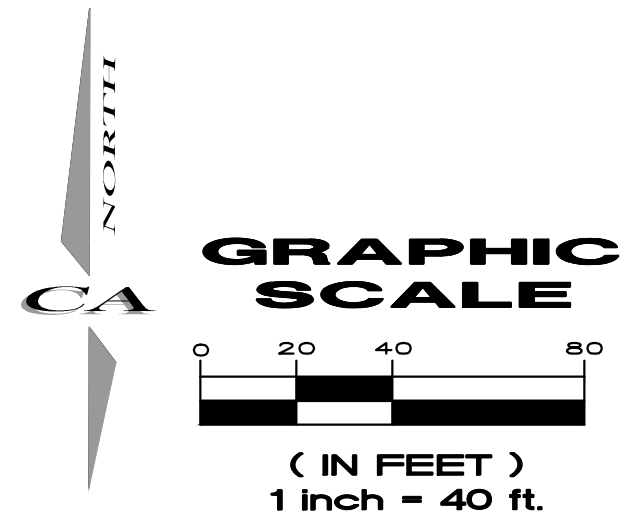
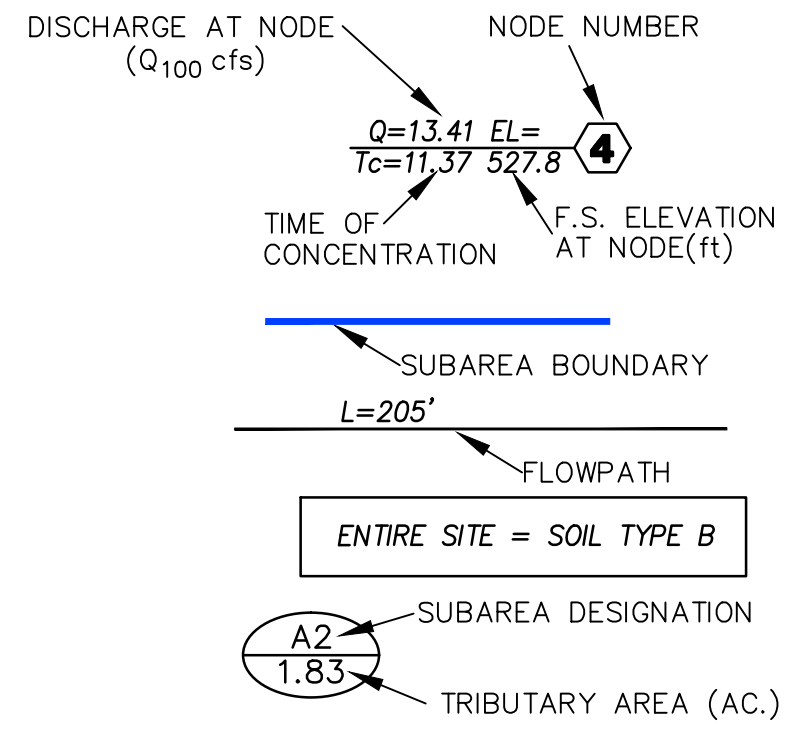
**CITY OF GARDEN GROVE**

**HYDROLOGY MAP**  
**(EXISTING CONDITION)**  
**9822 RUSSELL AVENUE**  
**GARDEN GROVE, CA 92844**

**EXHIBIT B: PROPOSED CONDITION HYDROLOGY MAP**



**LEGEND:**



**CITY OF GARDEN GROVE**

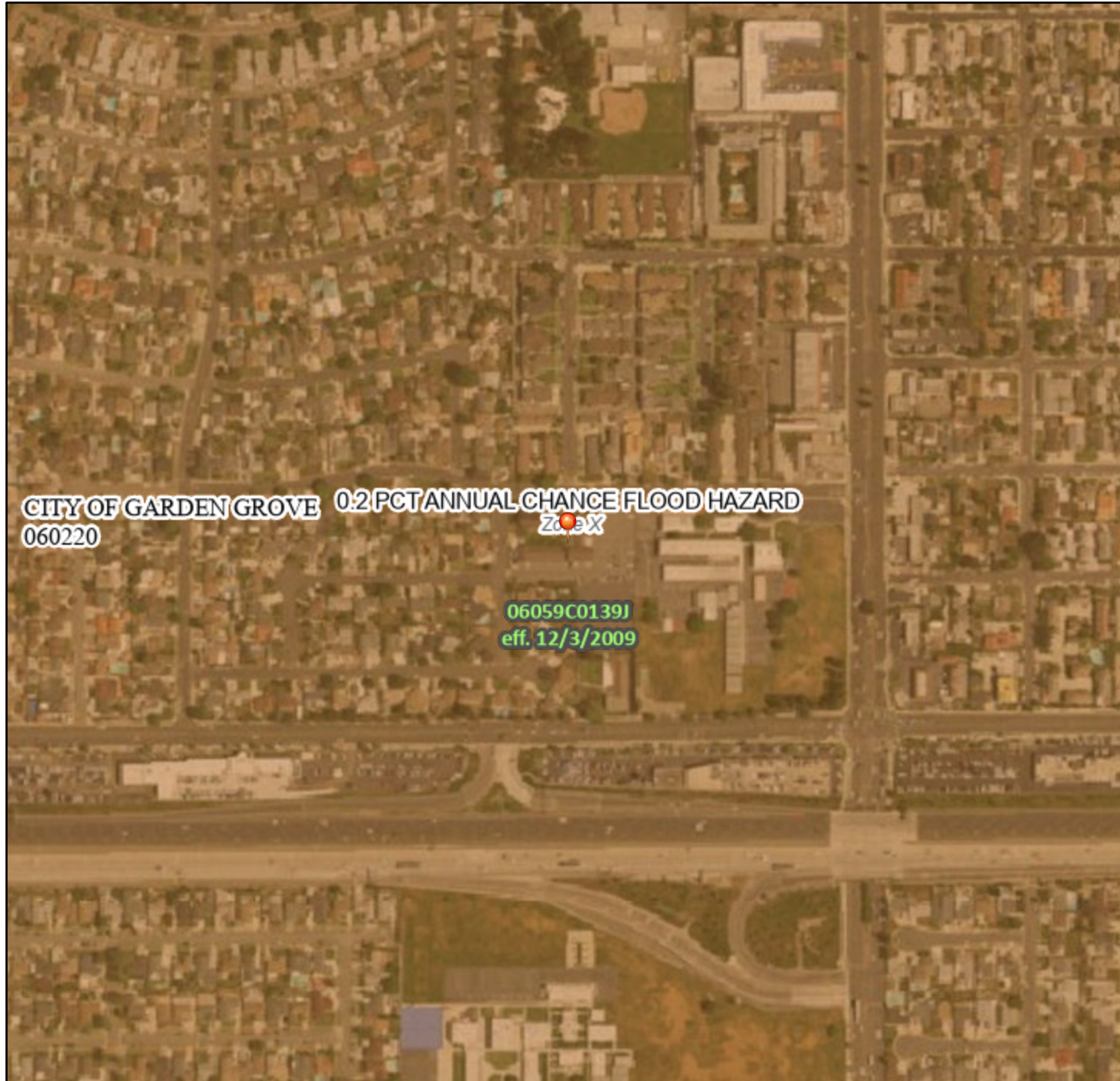
**HYDROLOGY MAP**  
**(PROPOSED CONDITION)**  
**9822 RUSSELL AVENUE**  
**GARDEN GROVE, CA 92844**

**EXHIBIT C: FIRM MAP**

# National Flood Hazard Layer FIRMette

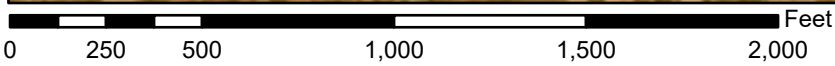


117°57'47"W 33°46'20"N



**CITY OF GARDEN GROVE 0.2 PCT ANNUAL CHANCE FLOOD HAZARD**  
060220

**06059C0139I**  
eff. 12/3/2009



1:6,000

117°57'9"W 33°45'51"N

Basemap Imagery Source: USGS National Map 2023

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

<b>SPECIAL FLOOD HAZARD AREAS</b>		Without Base Flood Elevation (BFE) <i>Zone A, V, A99</i>
		With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i> Regulatory Floodway
<b>OTHER AREAS OF FLOOD HAZARD</b>		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile <i>Zone X</i>
		Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i>
		Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i>
		Area with Flood Risk due to Levee <i>Zone D</i>
<b>OTHER AREAS</b>		NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i>
		Effective LOMRs
<b>GENERAL STRUCTURES</b>		Area of Undetermined Flood Hazard <i>Zone D</i>
		Channel, Culvert, or Storm Sewer
<b>OTHER FEATURES</b>		Levee, Dike, or Floodwall
		20.2 Cross Sections with 1% Annual Chance 17.5 Water Surface Elevation
<b>MAP PANELS</b>		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
<b>MAP PANELS</b>		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **10/29/2025 at 1:33 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

**EXHIBIT D: WQMP SITE PLAN**

