

HYDROLOGY STUDY

FOR

PROPOSED EXTRA SPACE STORAGE BUILDING

1761 W Katella Ave, Anaheim, CA 92804

Prepared for:

EXTRA SPACE STORAGE

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June 12, 2023

This Drainage Report was prepared under my supervision:

By:

Samir Khoury, P.E.
Coory Engineering
RCE # C30567, Exp. 3/31/24

Date: 6/12/23



INTRODUCTION

The proposed project is located at the northeast corner of Humor Drive and Katella Avenue, with a physical address at 1761 W Katella Avenue, Anaheim, CA 92804 (see map below Figure 1). The property is approximately 1.93 acres of fully developed land with existing single story storage structure on the south one-third of the property. The site is flat with an average slope of about 0.70% sloping towards Humor Drive from the north and east property line. The property is bounded by Katella Avenue to the south, Humor Drive to the west, and residential properties to the east and north sides of the property. There is a wall separation between the north and east property lines and therefore no offsite drainage is expected to contribute to the onsite stormwater runoff. The existing storage building structure along the south property line is serving as the barrier for surface flow and therefore onsite stormwater runoff is contained within the property. The topographic survey shows no storm drain onsite and surface runoff is draining towards Humor Drive via parkway drain at the west side of the property. Described below are site specific hydrologic conditions before and after the site improvements.

A. Existing Hydrologic Condition (A = 1.93 acres)

The site is currently used by the same property owner and will continue to be used for the same purpose. The land is covered with buildings and impervious surfaces all throughout. There are sporadic plant areas but not significantly large enough to impact reduction of site runoff. Pre-development condition is represented by DMA-A0, 1.93 acres, representing the entire site drainage management area.

B. Proposed Hydrologic Condition (DMA A = 1.20 acres, DMA B = 0.73 acre)

The proposed improvements will include capturing surface runoff at maximum practicable extent by directing surface runoff towards catch basins or installing catch basins where it is needed to direct the stormwater runoff to the proposed underground infiltration galleries. The proposed site improvements will create two (2) drainage management areas (DMA's). DMA-A covers the southern portion of the site constituting two-thirds of the lot area of approx. 1.20 acres and DMA-B covers the rest of the site to the north approx. 0.73 acres. DMA-A drain to catch basins

along the drive aisle south of the proposed new building and conveyed to south underground infiltration galleries. DMA-B drains to proposed catch basins along the drive aisle and parking lot to the north of the proposed new building and conveyed to the north underground infiltration galleries.

In accordance with FEMA, the site is located under Zone "X", map no. 06059C0137, categorized as areas determined to be outside the 0.2% annual chance flloodplain (see Attachment A).

The surrounding properties are developed single and multifamily homes and will not contribute offsite runoff to this property. The property falls within Soil Group "B" in accordance with Plate A (Hydrologic Classifications of Soils). The site is located within Orange County North Watershed Management Area.



VICINITY MAP

NTS

Figure 1

HYDROLOGY ANALYSIS

Hydrologic calculations were performed in accordance with Orange County Hydrology Manual (October 1986) guidelines. The Hydrology Manual was used to determine the existing and proposed peak flows for the 2-year, 10-year, 25-year, 50-year, and 100-year storm events as well as the runoff volumes generated for 100-year storm event.

The succeeding Tables 1 & 2 summarizes pre- and post-development flowrates and volumes generated by the proposed project.

This Drainage Report will determine both the pre- and post- development peak runoff and calculate stormwater detention volume required to mitigate the impacts of the development. The 2yr-24hr storm analysis will be used for sizing BMP's, 25yr storm will be used for sizing outlet, and the 100 yr storm will be the basis for building finish floor elevation.

RUNOFF FLOWRATES

Table 1: Modified Rational Method Peak Flow (see Attachment B)

Tributary Area	Pre-Development	Post-Development	
	DMA-A0	DMA-A	DMA-B
Acreage	1.93	1.20	0.73
Slope	0.70%	0.80%	0.80%
Flow Path Length, ft	300	300	380
% Impervious	100	100	100
Time of Concentration Tc (min)	9	9	10
2yr-1hr Flowrate in cfs; Q ₂	0.959	0.596	0.363
10yr-1hr Flowrate in cfs; Q ₁₀	1.496	0.930	0.566
25yr-1hr Flowrate in cfs; Q ₂₅	1.824	1.134	0.690
50yr-1hr Flowrate in cfs; Q ₅₀	2.084	1.296	0.788
100yr-1hr Flowrate in cfs; Q ₅₀	2.362	1.469	0.894

RUNOFF VOLUMES

Table 2: Modified Rational Method Peak Volume (see Attachment B)

Tributary Area	Pre-Development	Post-Development	
	DMA-A0	DMA-A	DMA-B
Acreage	1.93	1.20	0.73
Slope	0.70%	0.80%	0.80%
Flow Path Length, ft	300	300	380
% Impervious	100	100	100
Time of Concentration Tc (min)	9	9	10
2yr-24hr Flowrate in cfs; V ₂	0.228	0.142	0.086
10yr-24hr Flowrate in cfs; V ₁₀	0.427	0.265	0.161
25yr-24hr Flowrate in cfs; V ₂₅	0.555	0.345	0.210
50yr-24hr Flowrate in cfs; V ₅₀	0.656	0.408	0.248
100yr-24hr Flowrate in cfs; V ₅₀	0.761	0.473	0.288

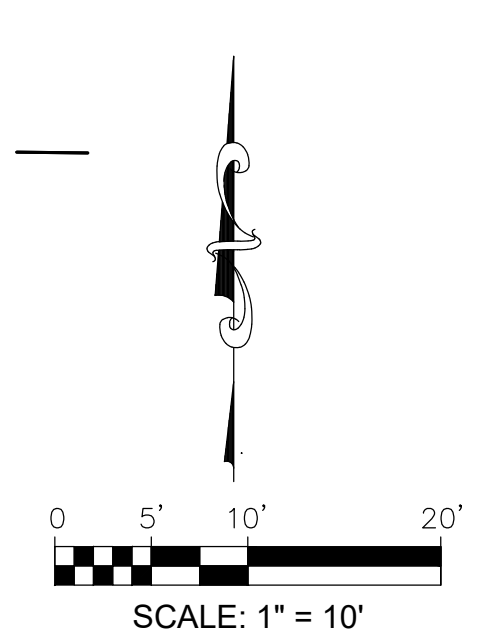
CONCLUSION

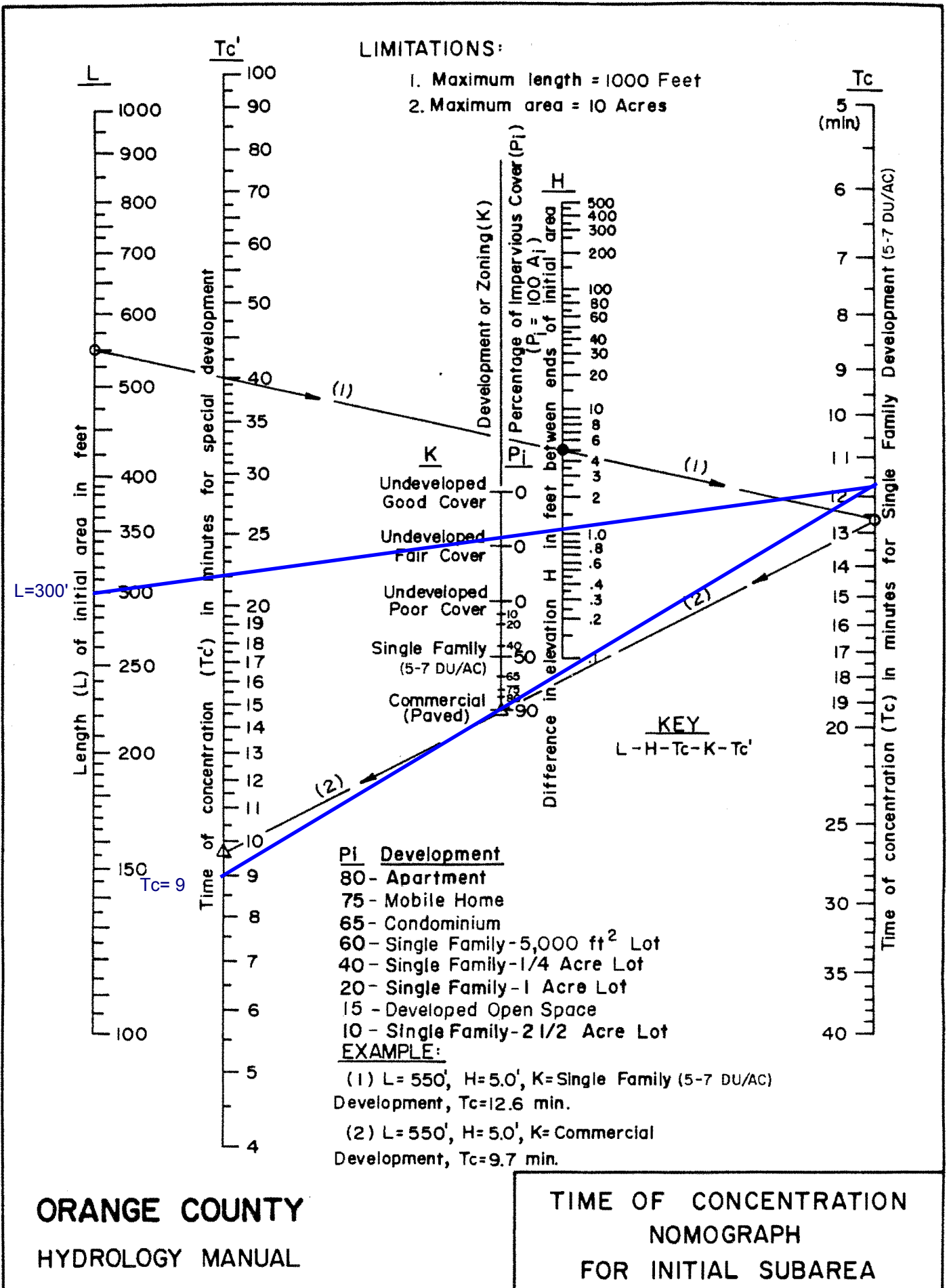
The proposed improvements will mimic the existing condition and will not increase or decrease surface runoff. The addition of underground infiltration galleries will comply with water quality and at the same time retain the design capture volume (DCV). Proposed underground infiltration galleries were designed to retain and infiltrate captured volume.

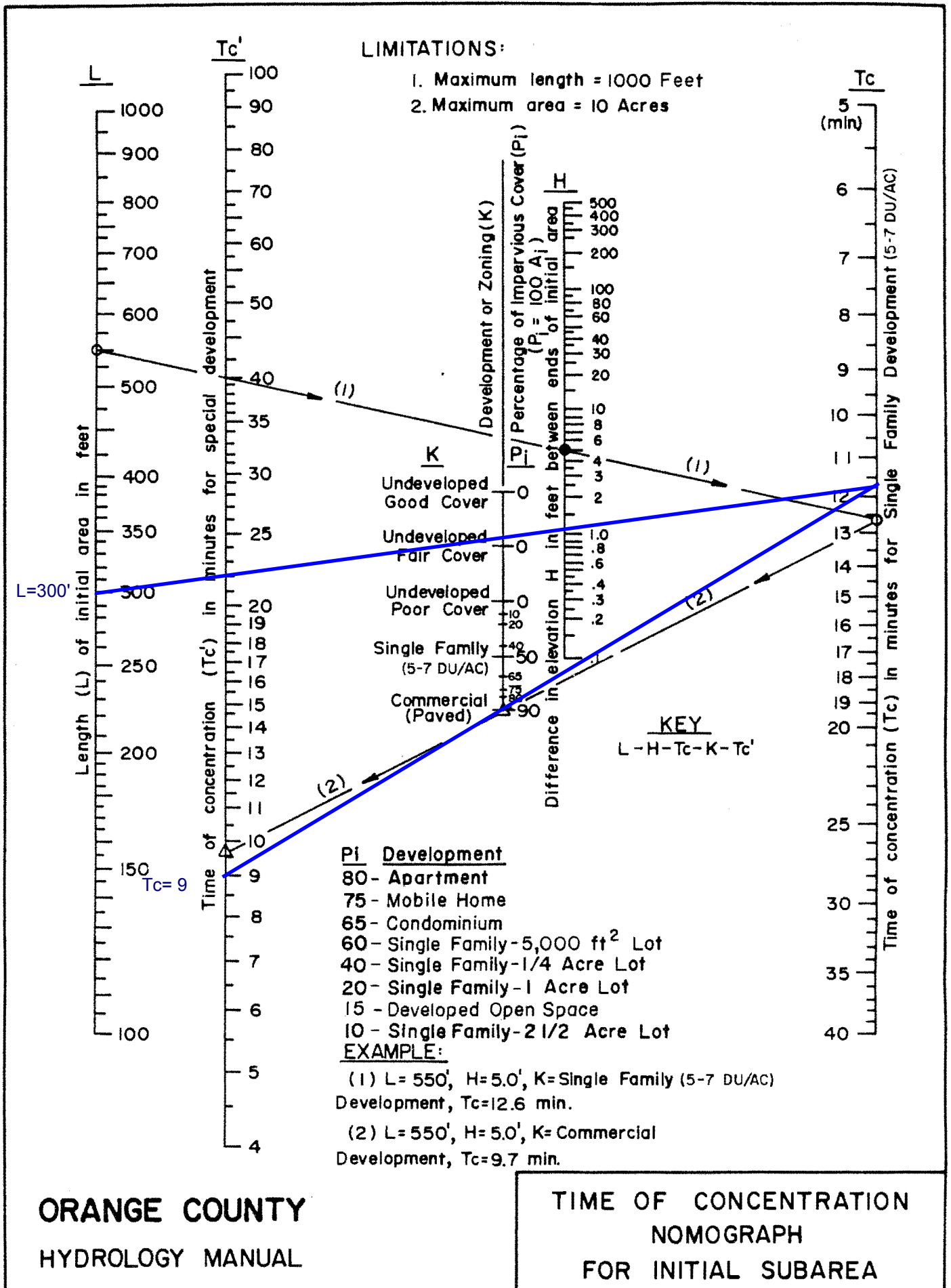
During heavy storm events, surface runoff will by-pass the underground infiltration galleries through a proposed parkway drain under the sidewalk.

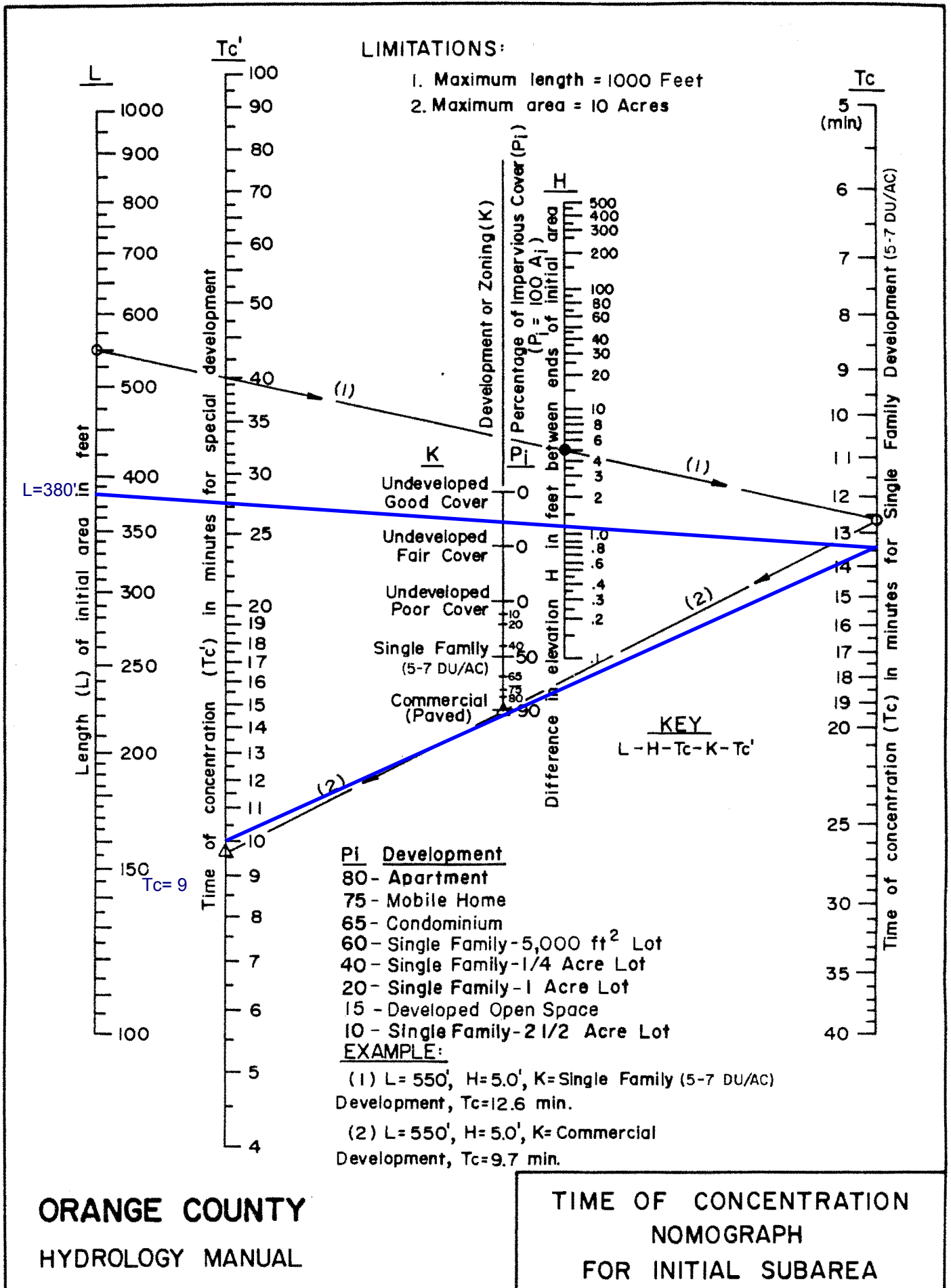
Attachment A

Figures / Maps



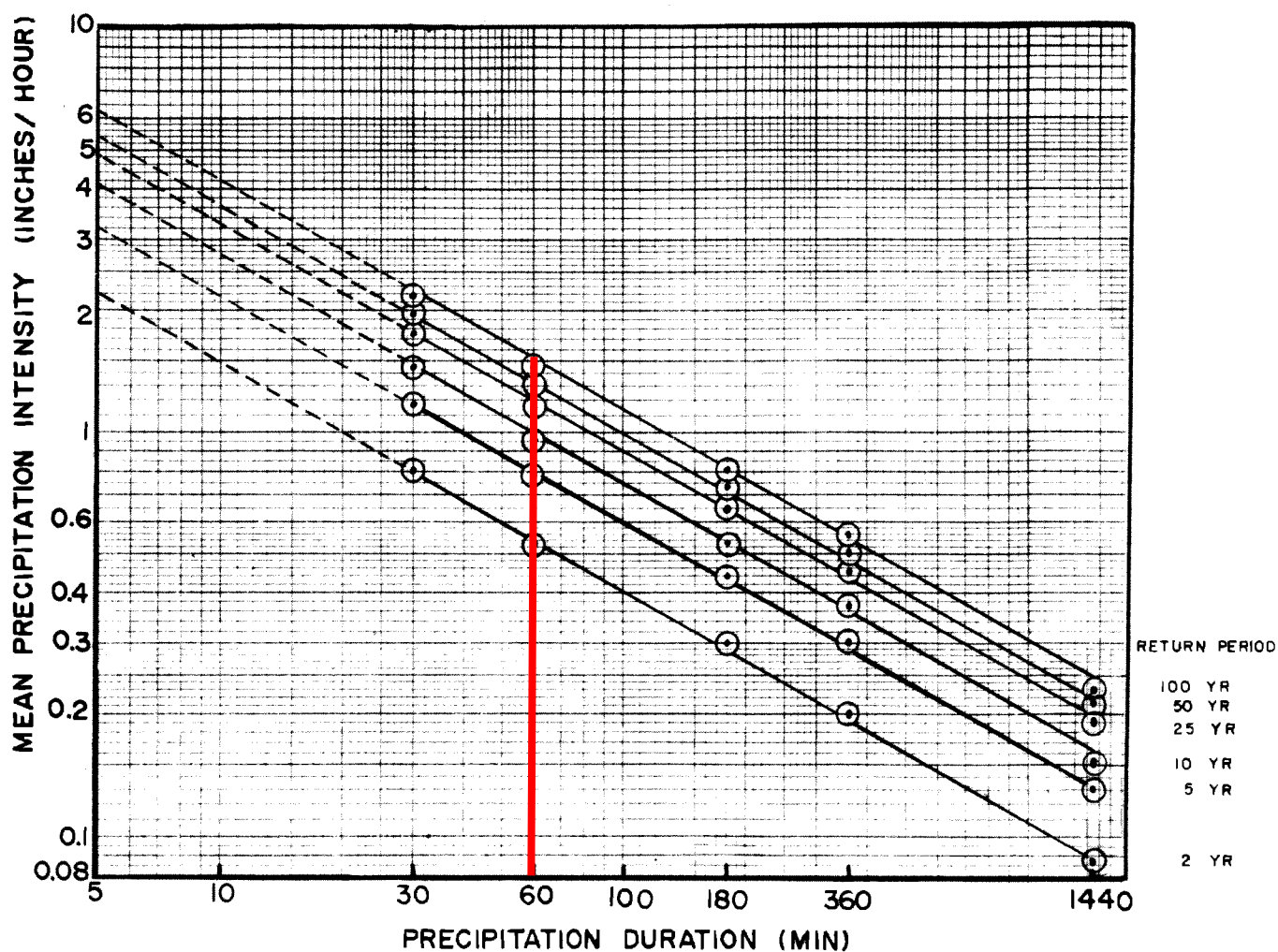






Regression Equations: $I(t) = at^b$
 (I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b	I
2	5.702	-0.574	0.54 in/hr
5	7.870	-0.562	0.79 in/hr
10	10.209	-0.573	1.01 in/hr
25	11.995	-0.566	1.18 in/hr
50	13.521	-0.566	1.33 in/hr
100	15.560	-0.573	1.49 in/hr

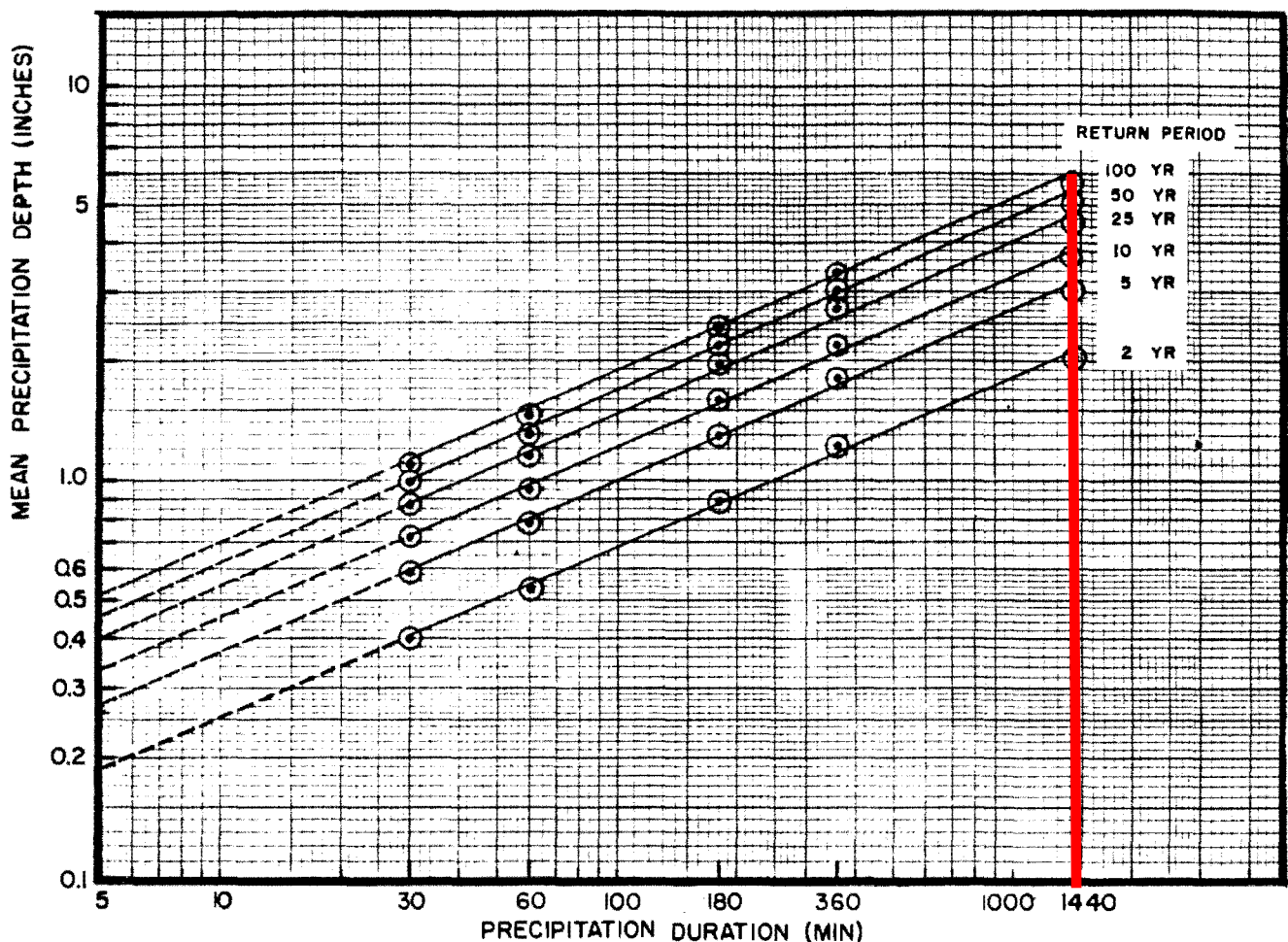


ORANGE COUNTY
 HYDROLOGY MANUAL

**MEAN PRECIPITATION
 INTENSITIES FOR
 NONMOUNTAINOUS AREAS**

Regression Equations: $D(t) = at^b$
 (D= Depth in inches, t= duration in minutes)

Return Frequency (years)	a	b	D
2	0.095	0.426	2.10 in
5	0.131	0.438	3.17 in
10	0.170	0.427	3.79 in
25	0.200	0.434	4.70 in
50	0.225	0.434	5.28 in
100	0.259	0.427	5.78 in



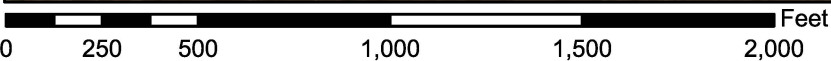
ORANGE COUNTY
HYDROLOGY MANUAL

**MEAN PRECIPITATION
 DEPTHS FOR
 NONMOUNTAINOUS AREAS**

National Flood Hazard Layer FIRMette



117°56'58"W 33°48'27"N



1:6,000

117°56'20"W 33°47'58"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		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 Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		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 6/12/2023 at 12:07 PM 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.

Attachment B

Rational Method Calculations

Runoff Flow & Velocities Calculations

$$Q = 0.9(I - F_m)A \quad (\text{Formula D.4})$$

Where :

Q = runoff in cubic feet per second (cfs) from a given area.

$$F_m = a_p F_p \quad (\text{Formula C.7})$$

a_p = is the pervious area fraction (See the Hydrology Map)

F_p = is the maximum loss rate for the pervious area based on Soils Group (See Table C-2)

I = the time-averaged rainfall intensity (inches/hour) - Hydrology Manual

A = Drainage area (acres)

A_p = pervious area for a given drainage area (See Hydrology Map)

Soils Maps: [OC TGD XIV-2a](#)Return Frequency = **2 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A0	1.93	0.000	0.00	B	0.40	0.0000	5	0.552	0.959
1.93									TOTAL 0.959

POST-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A	1.20	0.000	0.00	B	0.40	0.0000	5	0.552	0.596
DMA-B	0.73	0.000	0.00	B	0.40	0.0000	5	0.552	0.363
1.93 TOTAL									0.959

(Percent Increase/Decrease in Flowrate) 0.00%

Return Frequency = **10 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A0	1.93	0.000	0.00	B	0.40	0.0000	5	0.861	1.496
1.93									TOTAL 1.496

POST-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A	1.20	0.000	0.00	B	0.40	0.0000	5	0.861	0.930
DMA-B	0.73	0.000	0.00	B	0.40	0.0000	5	0.861	0.566
1.93		TOTAL							1.496
(Percent Increase/Decrease in Flowrate)									0.00%

(Percent Increase/Decrease in Flowrate) 0.00%

Return Frequency = **25 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A0	1.93	0.000	0.00	B	0.40	0.0000	5	1.050	1.824
1.93									TOTAL 1.824

POST-DEVELOPMENT										
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)	
DMA-A	1.20	0.000	0.00	B	0.40	0.0000	5	1.050	1.134	
DMA-B	0.73	0.000	0.00	B	0.40	0.0000	5	1.050	0.690	
1.93									TOTAL	1.824
(Percent Increase/Decrease in Flowrate)									0.00%	

Return Frequency = **50 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A0	1.93	0.000	0.00	B	0.40	0.0000	5	1.200	2.084
1.93									TOTAL 2.084

POST-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A	1.20	0.000	0.00	B	0.40	0.0000	5	1.200	1.296
DMA-B	0.73	0.000	0.00	B	0.40	0.0000	5	1.200	0.788
1.93		TOTAL							2.084
(Percent Increase/Decrease in Flowrate)									0.00%

Return Frequency = **100 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A0	1.93	0.000	0.00	B	0.40	0.0000	5	1.360	2.362
1.93									TOTAL 2.362

POST-DEVELOPMENT									
Drainage Area	A (acres)	A _p (acres)	a _p	Soils Group	F _p	F _m	T _c (min)	I* (in/hr)	Q (cfs)
DMA-A	1.20	0.000	0.00	B	0.40	0.0000	5	1.360	1.469
DMA-B	0.73	0.000	0.00	B	0.40	0.0000	5	1.360	0.894
1.93									TOTAL 2.362
(Percent Increase/Decrease in Flowrate)									0.00%

Runoff Volume Calculations

$$V = \frac{Y \cdot A \cdot P_{24}}{12}$$

Where :

V= Volume in acre-ft.

Y = 24-hour storm runoff yield factor for subarea A

$$Y = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S)P_{24}} \quad \text{Formula C.3}$$

P₂₄ = 24-hour storm rainfall from Figures B-1 and B-2

I_a = initial abstraction

$$= 0.2S$$

Formula C.1

$$S = \frac{1000}{CN} - 10$$

Formula C.2

A= Drainage area in acres

Return Frequency = 2 Years

PRE-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A0	1.93	B	98	90	1.111	0.222	2.37	0.597	0.228
1.93									TOTAL 0.228

POST-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A	1.20	B	98	90	1.111	0.222	2.37	0.597	0.142
DMA-B	0.73	B	98	90	1.111	0.222	2.37	0.597	0.086
1.93									TOTAL 0.228

(Percent Increase/Decrease in Volume) 0.00%

Return Frequency = 10 Years

PRE-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A0	1.93	B	98	90	1.111	0.222	3.72	0.714	0.427
1.93									TOTAL 0.427

POST-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A	1.20	B	98	90	1.111	0.222	3.72	0.714	0.265
DMA-B	0.73	B	98	90	1.111	0.222	3.72	0.714	0.161
1.93									TOTAL 0.427

(Percent Increase/Decrease in Volume) 0.00%

Return Frequency = 25 Years

PRE-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A0	1.93	B	98	90	1.111	0.222	4.56	0.757	0.555
1.93									TOTAL 0.555

POST-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A	1.20	B	98	90	1.111	0.222	4.56	0.757	0.345
DMA-B	0.73	B	98	90	1.111	0.222	4.56	0.757	0.210
1.93									TOTAL 0.555

(Percent Increase/Decrease in Volume) 0.00%

Return Frequency = **50 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A0	1.93	B	98	90	1.111	0.222	5.21	0.783	0.656
1.93									TOTAL 0.656

POST-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A	1.20	B	98	90	1.111	0.222	5.21	0.783	0.408
DMA-B	0.73	B	98	90	1.111	0.222	5.21	0.783	0.248
1.93									TOTAL 0.656

(Percent Increase/Decrease in Volume) 0.00%

Return Frequency = **100 Years**

PRE-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A0	1.93	B	98	90	1.111	0.222	5.88	0.804	0.761
1.93									TOTAL 0.761

POST-DEVELOPMENT									
Drainage Area	A (acres)	Soils Group	CN AMC II	CN AMC I	S	I _a	P ₂₄	Y	V (Ac-ft)
DMA-A	1.20	B	98	90	1.111	0.222	5.88	0.804	0.473
DMA-B	0.73	B	98	90	1.111	0.222	5.88	0.804	0.288
1.93									TOTAL 0.761

(Percent Increase/Decrease in Volume) 0.00%