BLUE PEAK ENGINEERING

DRAINAGE STUDY

For:
Commercial and Residential Development
SEC Alta Vista St. & Rose Drive.

Prepared by:
Blue Peak Engineering, Inc.
18543 Yorba Linda Blvd., #235
Yorba Linda, CA 92886
(714) 749-3077

Date: 12/18/2017

This study was prepared under my responsible charge:

12/18/2017

Kimberly Johnson, P.E. 81979 **Date**

Section I Project Description

INTRODUCTION

This report has been prepared to analyze the hydrological effects of the proposed commercial and residential development at the SEC of Alta Vista and Rose Dr.

IMPROVEMENTS

The subject property is currently undeveloped.

The proposed development includes a commercial and residential portion. The commercial lot includes two proposed shops, drive-thru, a proposed parking lot, and site landscape. The proposed residential lot includes 54 homes, with share common space, and a private residential street.

DRAINAGE PATTERNS

The existing site is lower than adjacent streets, and drains to a natural low point located at the center of the site creating a sump condition. Existing runoff is contained within the site. An existing 36" storm drain currently runs through the site, collecting the upstream catch basin on Alta Vista and connecting downstream to the 36" storm drain main in the residential tract just south of the site.

The proposed development will alter the onsite drainage pattern. The site will be raised to eliminate the sump condition. The site sheet flows via gutters to Modular Wetland Systems (MWS) with curb inlets located throughout both the commercial and residential portion of the site. All runoff is collected by MWS and discharged into the relocated 36" storm drain main on-site.

Storm drain improvements are not anticipated within the City right of way.

RUN-ON

Site curbs have been placed at the property line as necessary to protect from runon.

HYDROMODIFICATION

Per the Water Quality Management Plan and County Facility Mapping Tool, this site is not susceptible to hydromodification.

Section II Methodology

RUNOFF DETERMINATION METHODS

The two primary methods used in the Orange County area to determine design discharges are the Rational Method and the Unit Hydrograph method. The Rational method is generally intended for use on small watersheds of less than 300 to 500-acres while the Synthetic Unit Hydrograph method is intended for use on watersheds in excess of these limits.

However, per the Conditions of Approval, they hydrology study shall show the 25-year storm flow will be contained within the street curb to curb and the 100-year storm flow shall be contained within the street right-of-way. Additionally, drainage facilities with sump conditions shall be designed to convey the tributary 100-year storm flows. The drainage study will analyze both the 25-year and 100-year storm event.

RATIONAL METHOD

The Rational method is commonly used for determining peak discharge from relatively small drainage areas. The Rational method is based on the following equation:

$Q = C\ I\ A$

Where:
Q = peak discharge, in cubic feet per second (cfs)
C = runoff coefficient, proportion of the rainfall that runs off the surface (no units)
I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour (Note: If the computed Tc is less than 5 minutes, use 5 minutes for computing the peak discharge, Q)

$I = A * (t)^B$ (in/hr)

$C=0.90(ai+(I-Fp)ap)/I)$

t = Time of Concentration (min.)

A&B = factors in the Intensity regression equation from the Orange County Hydrology Manual

A = 11.995 for 25-year storm

B = -0.566 for 25-year storm

A = 15.560 for 100-year storm

B = -0.573 for 100-year storm

a_i = Impervious area percentage

a_p = Pervious area percentage

F_p = Loss rate for Soils Group D (in/hr) from O.C. Hydrology Manual (0.20 for soil group D)

$F_m = a_p * F_p$

A = drainage area contributing to the design location, in acres

AMC II:
Soil Type D
Urban Landscape CN=75
Barren CN=93
Impervious Area CN=98

Convert to AMC III: (Per Table C.1 in Hydrology Manual)
Urban Landscape CN=97
Barren CN=99
Impervious Area CN=100

Section III Hydrology Calculations

Runoff Calculations

Using the Orange County Hydrology Manual, the existing and proposed runoff for the project was calculated for the 25 and 100-Year Storm Events. The runoff calculations are shown in the following tables.

Soil Group D – see appendix for Soil Hydrologic Groups map

Existing Conditions:

Initial Subareas below. See Figure D-4 in the appendix for full data.

25-yr Storm Event

Area EX-1
A = 8.39 acres
Impervious % = 0%
a_i = 0.00

T_c = 14.5 min (see appendix for nomograph)

I = 2.9 in/hr

$C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.84$

$\mathbf{Q_{Y25}} = C * I * A = 0.84 * (2.9) * 8.39 = 20.44$ cfs

100-yr Storm Event

Area EX-1
A = 8.39 acres
Impervious % = 0%
a_i = 0.00

T_c = 14.5 min (see appendix for nomograph)

I = 3.6 in/hr

$C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.85$

$\mathbf{Q_{Y100}} = C * I * A = 0.85 * (3.6) * 8.39 = 25.67$ cfs

Proposed Conditions:

25-yr Storm Event

Area-A
A = 2.00 acres
Impervious % = 90%
a_i = 0.90

T_c = 10 min (see nomograph)

I = 3.3 in/hr

$C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.89$

Q_{Y25} = C * I * A = 0.89 * (3.3) * 2.0 = 5.87 cfs

Area-B-1
A = 0.29 acres
Impervious % = 60%
a_i = 0.60

T_c = 7 min (see nomograph)

I = 4.0 in/hr

$C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.90$

Q_{Y25} = C * I * A = 0.90 * (4.0) * 0.29= 1.044 cfs

Area-B-2
A = 2.58 acres
Impervious % = 60%
a_i = 0.60

T_c = 13 min (see nomograph)

I = 2.7 in/hr

$C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.86$

Q_{Y25} = C * I * A = 0.86 * (2.7) * 2.58 = 5.99 cfs

Area-B-3
A = 1.560 acres
Impervious % = 60%
a_i = 0.60

T_c = 9 min (see nomograph)

I = 3.4 in/hr

C = 0.9 * (a_i + (($I-F_p$) * a_p) / I) = 0.88

Q_{Y25} = C * I * A = 0.88 * (3.4) * 1.560 = 4.68 cfs

Area-B-4
A = 1.96 acres
Impervious % = 60%
a_i = 0.60

T_c = 13 min (see appendix for nomograph)

I = 2.7 in/hr

C = 0.9 * (a_i + (($I-F_p$) * a_p) / I) = 0.87

Q_{Y25} = C * I * A = 0.87 * (2.7) * 1.96 = 4.60 cfs

Total Post Development 25-Year Runoff = 22.18 cfs

100-yr Storm Event

Area-A
A = 2.00 acres
Impervious % = 90%
a_i = 0.90

T_c = 10 min (see appendix for nomograph)

I = 4.1 in/hr

C = 0.9 * (a_i + (($I-F_p$) * a_p) / I) = 0.90

Q_{Y100} = C * I * A = 0.90 * (4.1) * 2.0 = 7.4 cfs

Area-B-1
A = 0.29 acres
Impervious % = 60%
a_i = 0.60

T_c = 7 min (see appendix for nomograph)

I = 5.2 in/hr

C = 0.9 * (a_i + (($I-F_p$) * a_p) / I) = 0.90

$\mathbf{Q_{Y100}}$ = C * I * A = 0.90 * (5.2) * 0.29 = 1.36 cfs

Area-B-2
A = 2.58 acres
Impervious % = 60%
a_i = 0.60

T_c = 13 min (see appendix for nomograph)

I = 3.6 in/hr

C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.88

$\mathbf{Q_{Y100}}$ = C * I * A = 0.88 * (3.6) * 2.58 = 8.17 cfs

Area-B-3
A = 1.560 acres
Impervious % = 90%
a_i = 0.60

T_c = 19 min (see appendix for nomograph)

I = 4.5 in/hr

C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.88

$\mathbf{Q_{Y100}}$ = C * I * A = 0.88 * (4.5) * 1.560 = 6.18 cfs

Area-B-4
A = 1.96 acres
Impervious % = 60%
a_i = 0.60

T_c = 13 min (see appendix for nomograph)

I = 3.2 in/hr

C = 0.9 * (a_i + ((I-F_p) * a_p) / I) = 0.88

$\mathbf{Q_{Y100}}$ = C * I * A = 0.88 * (3.6) * 1.96 = 6.21cfs

Total Post Development 100-Year Runoff = 29.32 cfs

Section VI Conclusion

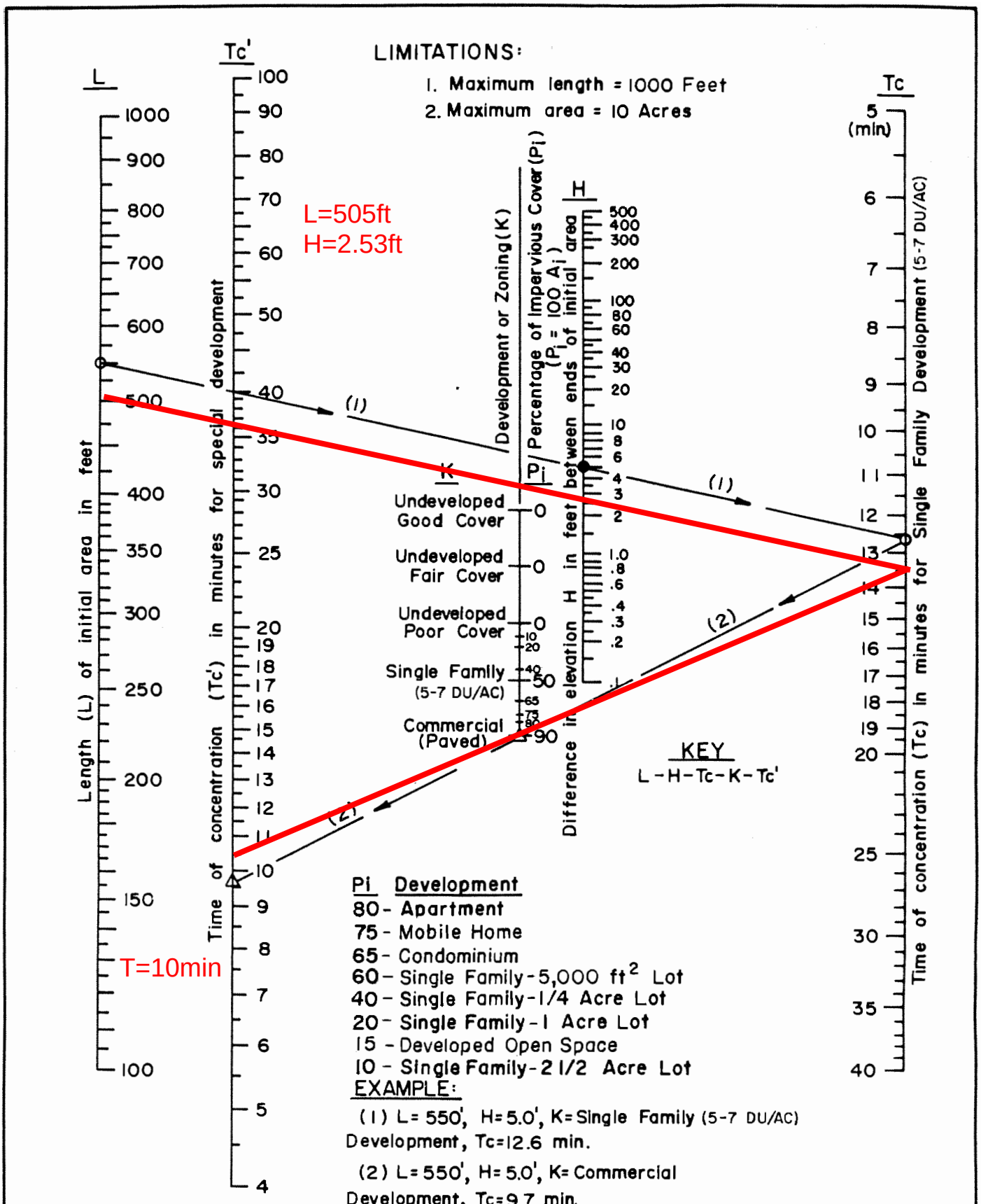
As set forth in the Conditions of Approval, the post development peak flow rate generated from the project site shall be less than or equal to the pre-development peak flow rate from the site for all frequency storms up to and including the 100-year return. Below is a summary of the above calculations.

	25-yr (cfs)	100-yr (cfs)
Existing Condition	20.44	25.67
Proposed Condition	22.18	29.32
Difference	1.74 (8.5%)	3.65 (14%)

The post development condition does increase the site runoff; however, the 100-year flow is contained fully within the proposed residential streets. Sub-Area B-2 was analyzed as this is the greatest sub-area with the largest contributing runoff. Using FHWA software a cross section of the street was taken an analyzed for the 100-year storm event. This is a conservative approach as the entire 100-year storm event will not be detained within the street (only approximately 14% per calculation above), and instead be conveyed and piped via proposed 36" storm drain. The depth of this flow was calculated at 0.448', below the 6" curb face. Therefore, in conclusion additional on-site detention is not required as the entire storm event will not exceed the street capacity as provided in Condition of Approval 27.

Appendix

Proposed Site - AREA A



ORANGE COUNTY
HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

Figure D-1

Proposed Site - AREA B1

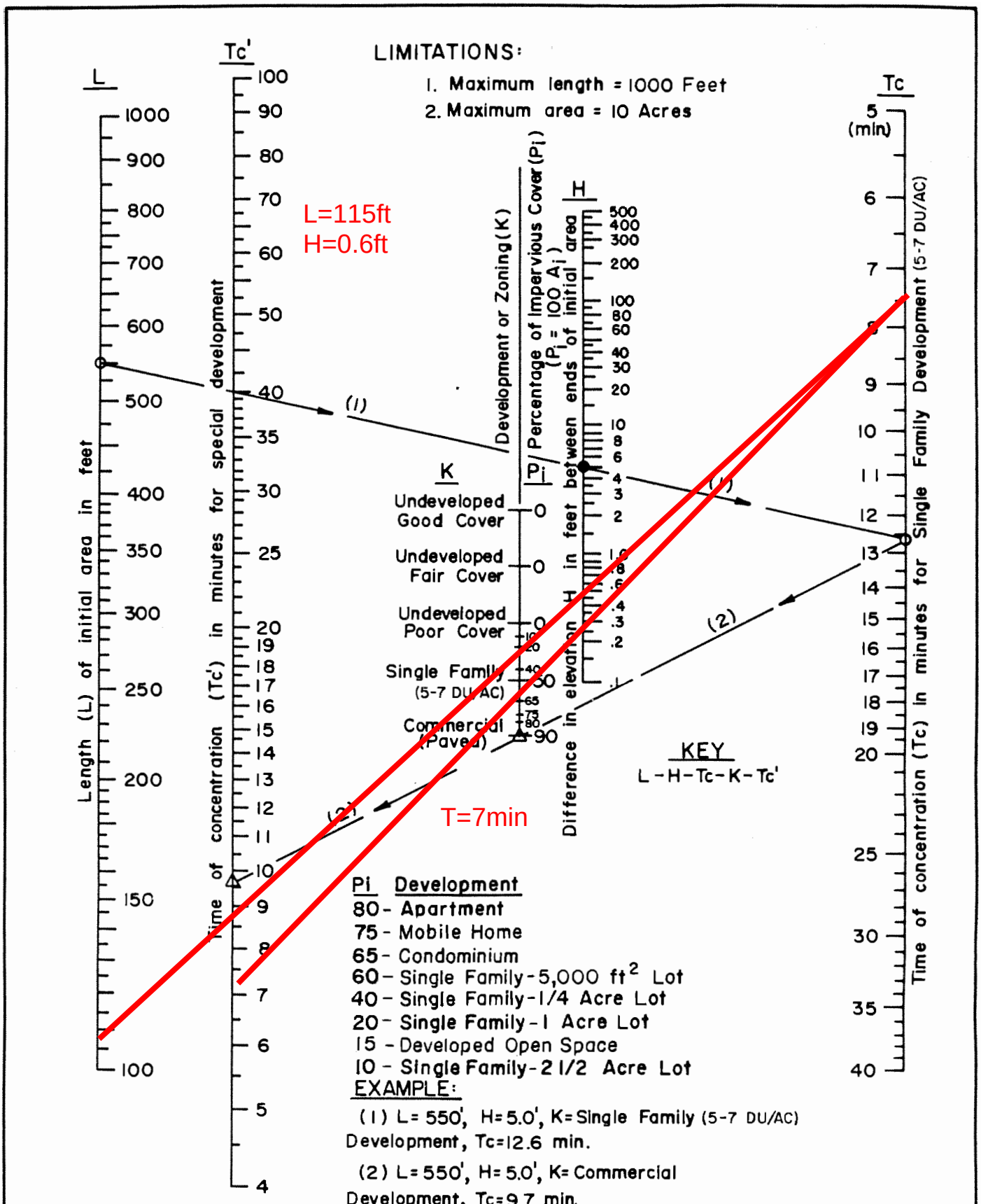


Figure D-1

Proposed Site - AREA B2

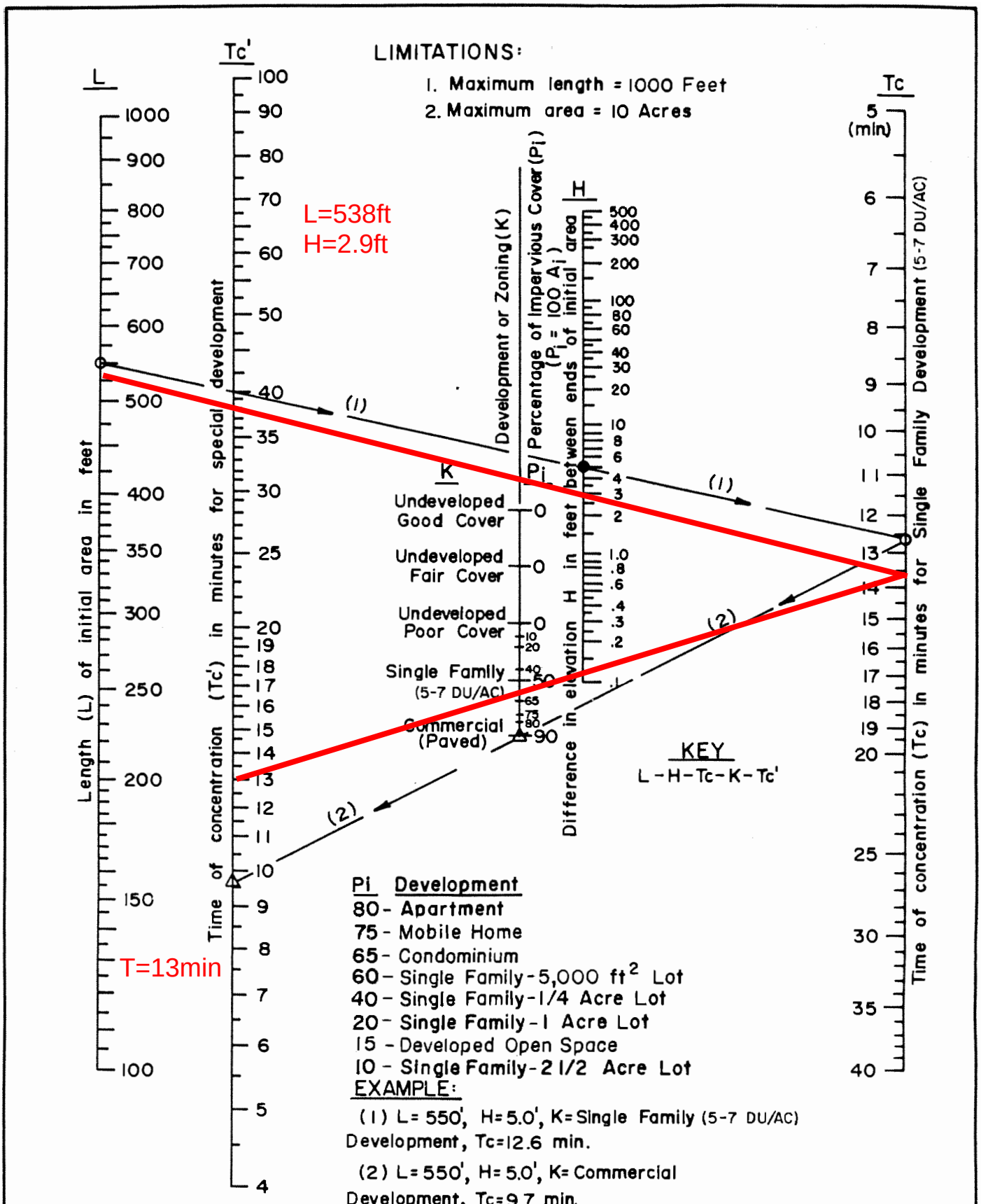


Figure D-1

Proposed Site - AREA B3

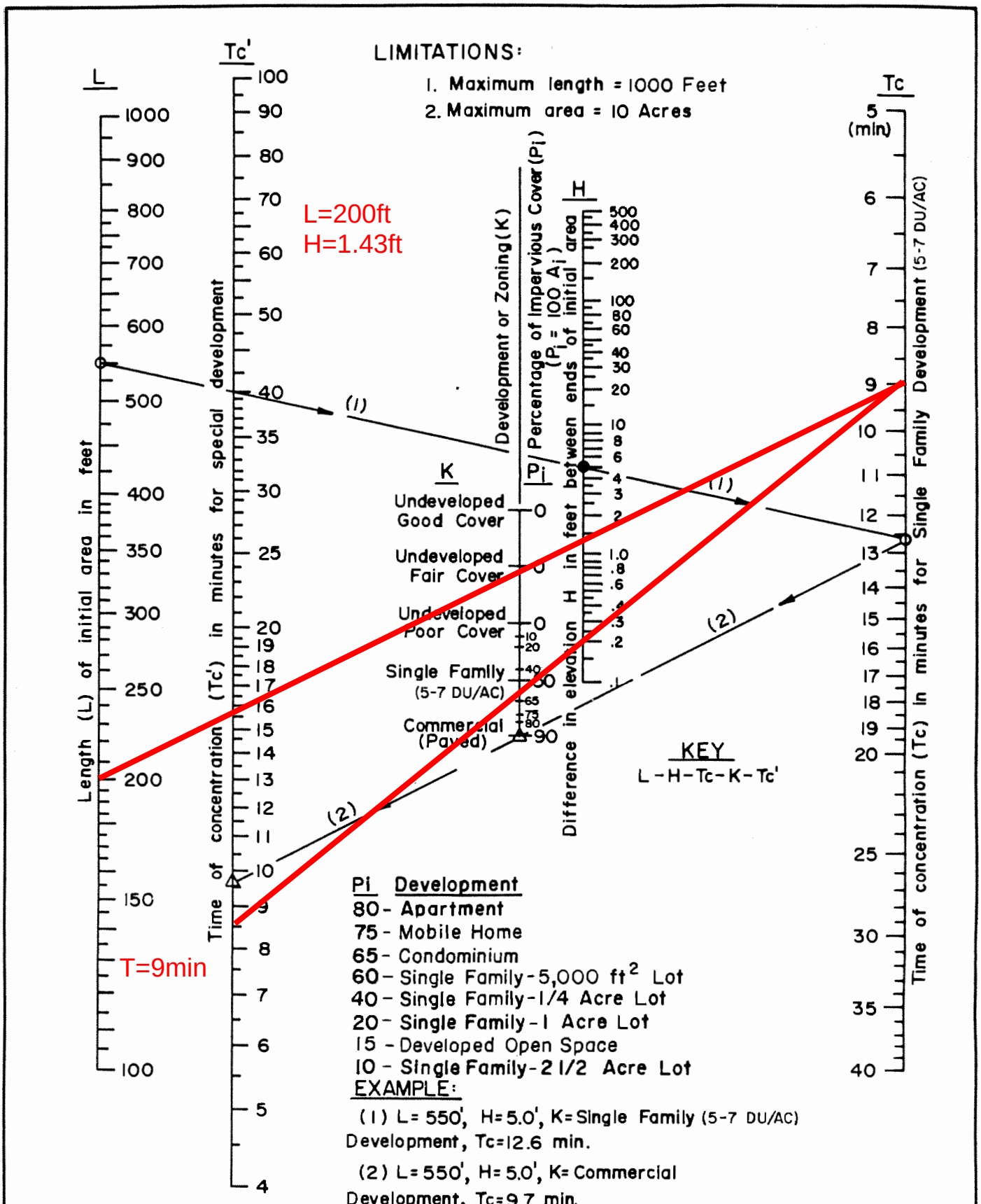


Figure D-1

Proposed Site - AREA B4

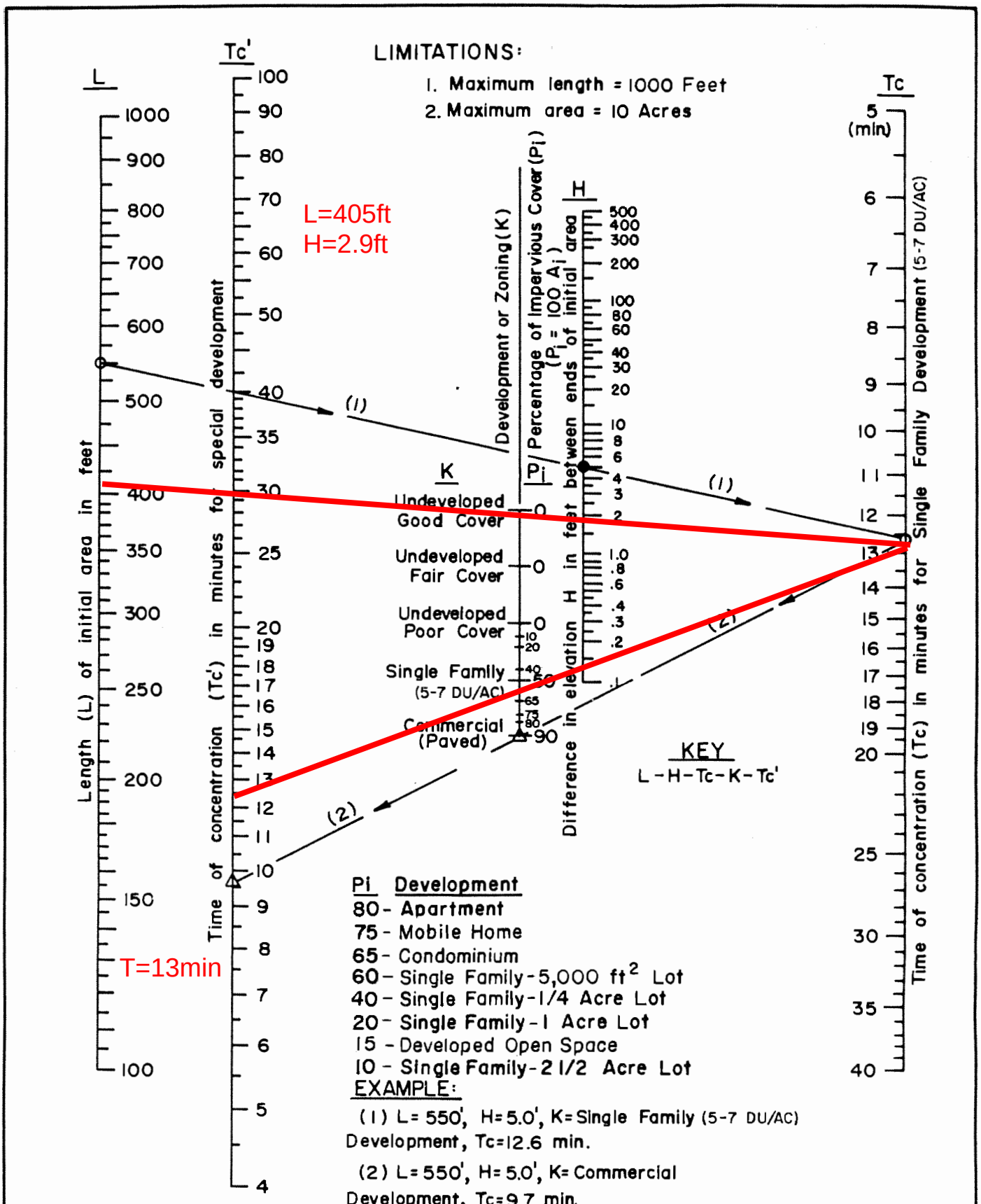


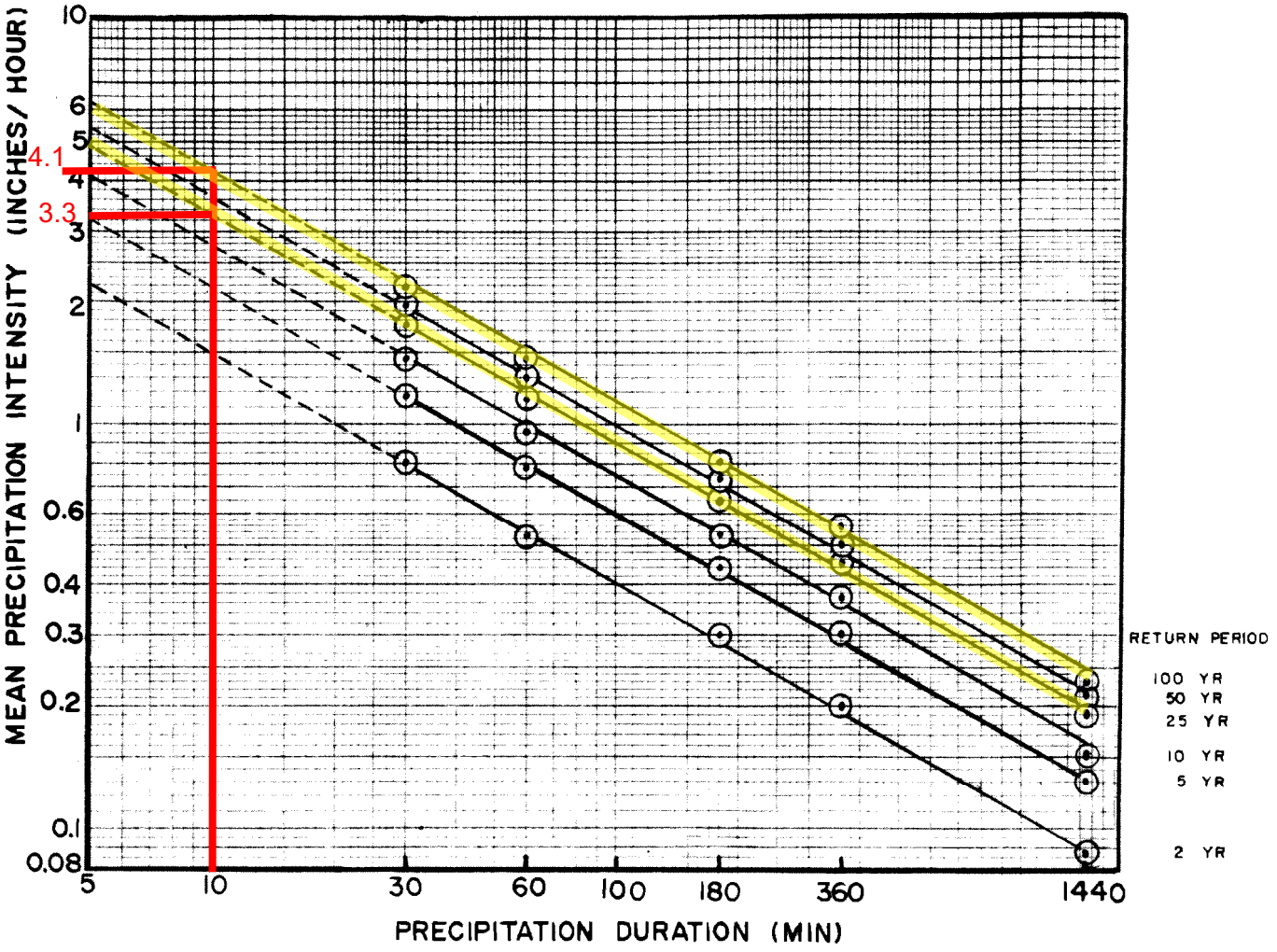
Figure D-1

AREA A

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

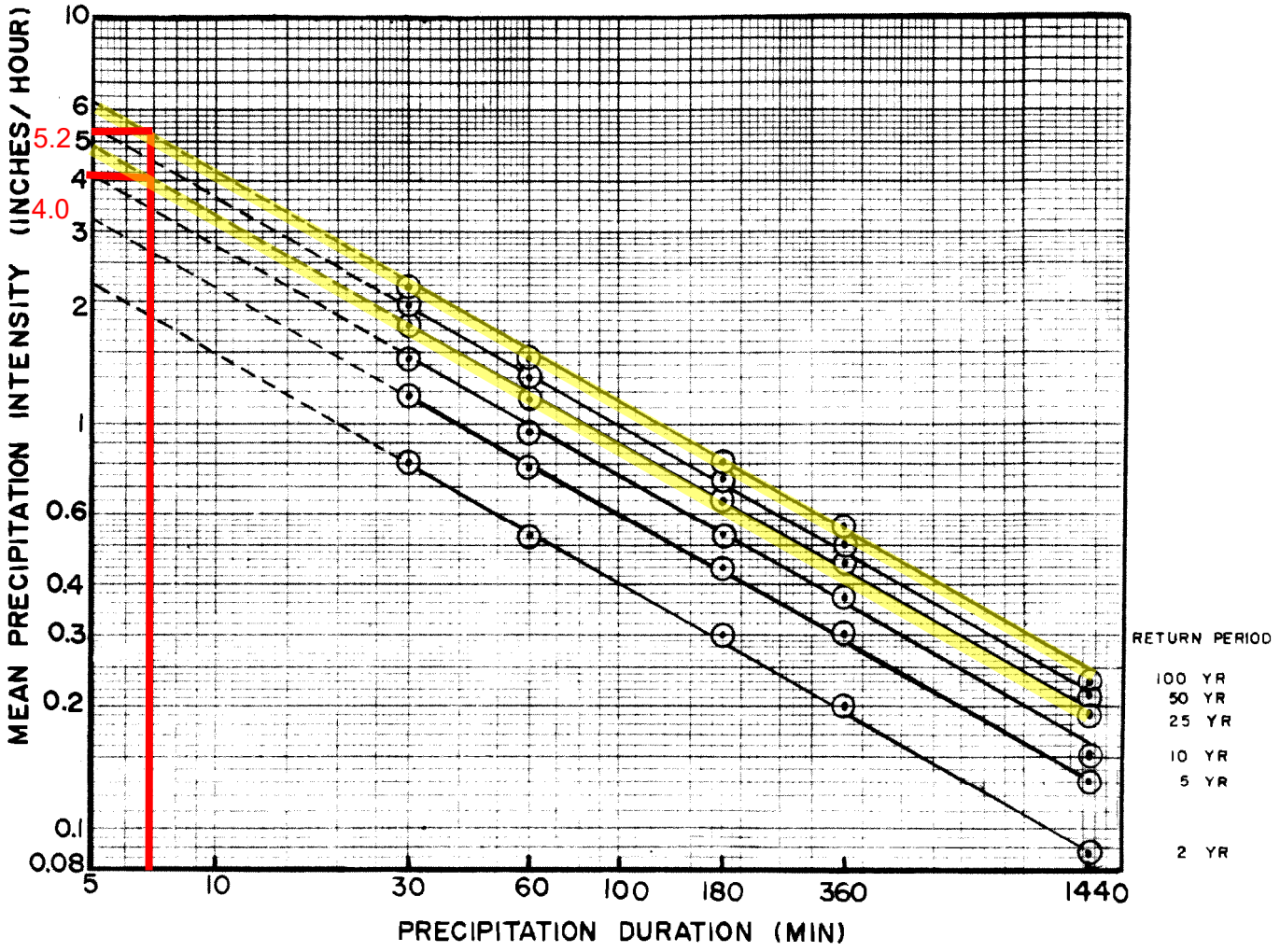
Figure B-3

AREA B1

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

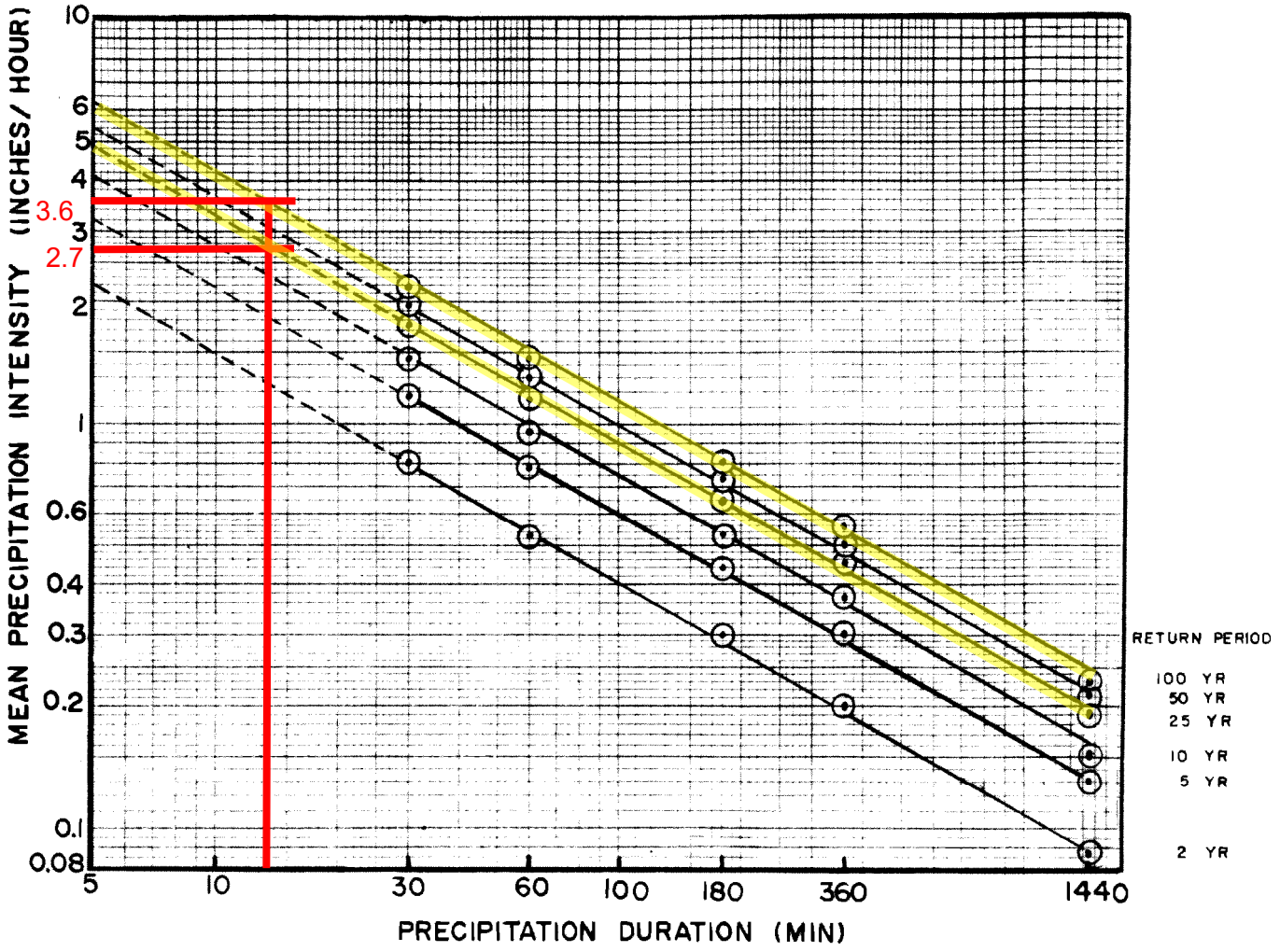
Figure B-3

AREA B2 AND
B-4

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

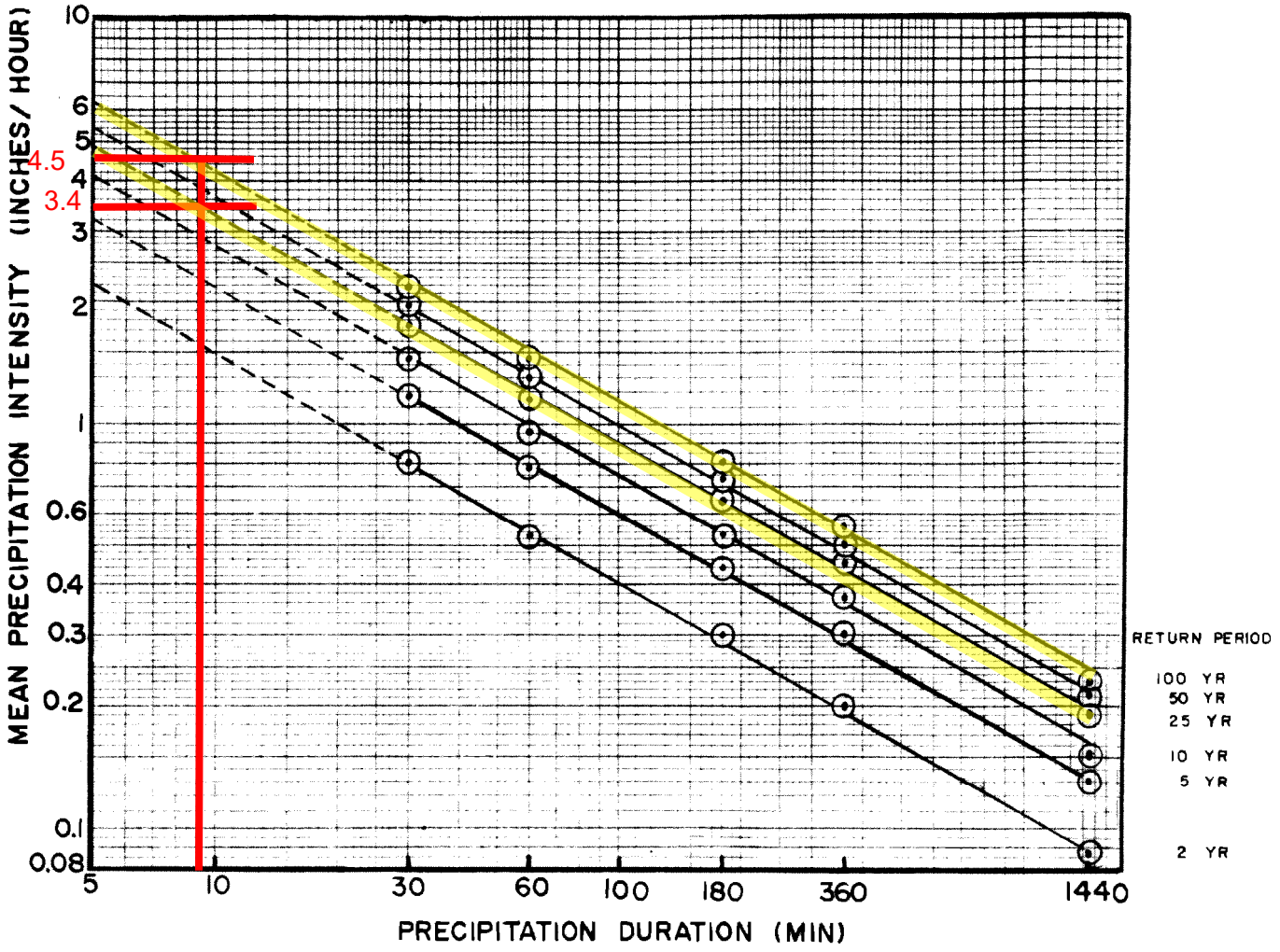
Figure B-3

AREA B3

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

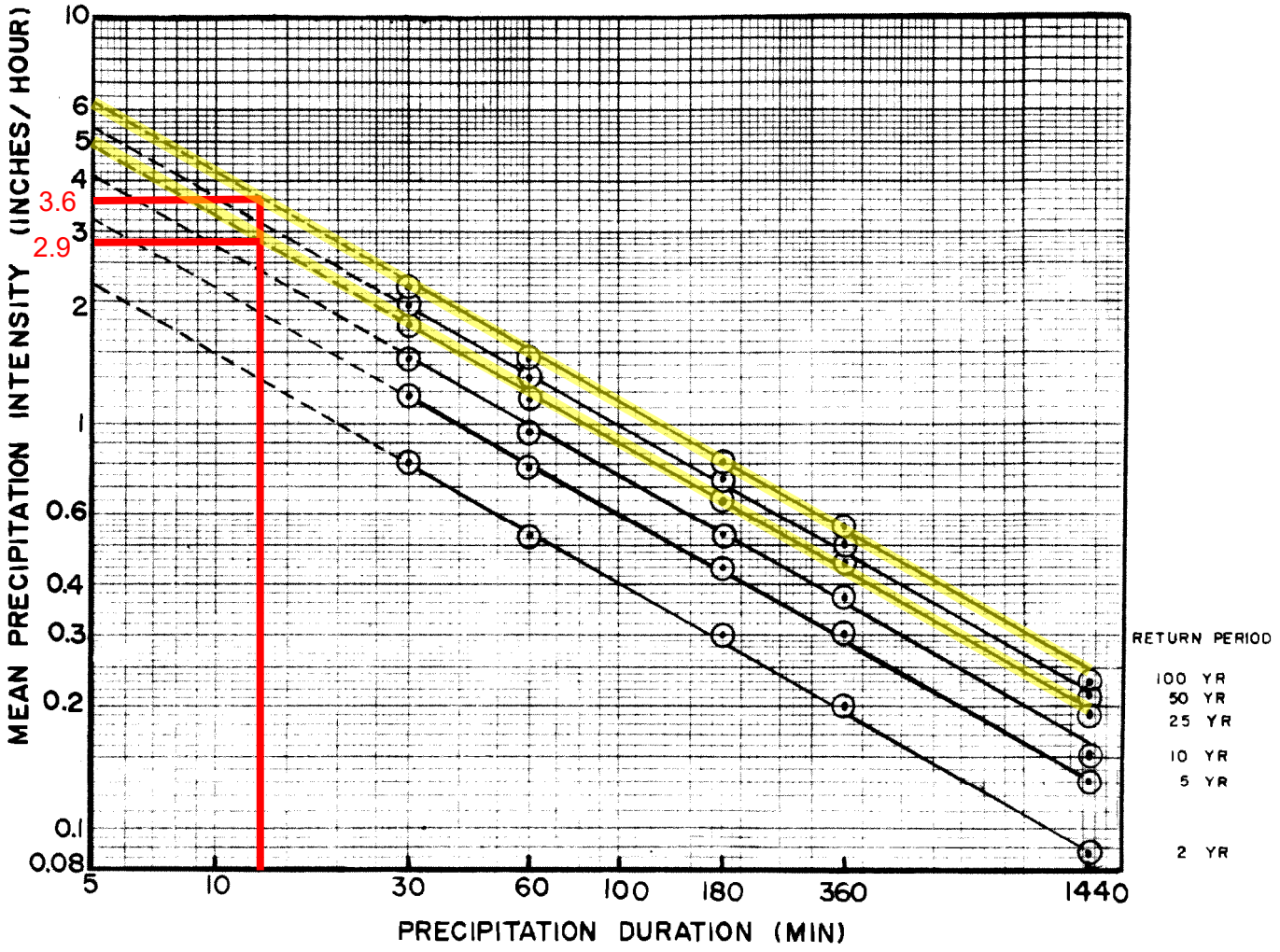
Figure B-3

EX-1

Regression Equations: $I(t) = at^b$

(I= Intensity in inches/hour, t= duration in minutes)

Return Frequency (years)	a	b
2	5.702	-0.574
5	7.870	-0.562
10	10.209	-0.573
25	11.995	-0.566
50	13.521	-0.566
100	15.560	-0.573



ORANGE COUNTY
HYDROLOGY MANUAL

MEAN PRECIPITATION INTENSITIES FOR NONMOUNTAINOUS AREAS

Figure B-3

Hydraulic Analysis Report

Project Data

Project Title: **RESIDENTIAL STREET CAPACITY**
Designer: **100-YEAR STORM FOR AREA B-2**
(LARGEST RESIDENTIAL SUB-AREA)

Project Date: Friday, December 15, 2017

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis

Notes:

Input Parameters

Channel Type: Custom Cross Section

Cross Section Data

Elevation (ft)	Elevation (ft)	Manning's n
0.00	100.00	0.0130
0.50	99.50	0.0130
2.00	99.63	0.0130
36.50	100.32	0.0130
37.00	100.82	-----

Longitudinal Slope: 0.0050 ft/ft

Flow: 8.1700 cfs

Result Parameters

Depth: 0.4479 ft

Area of Flow: 3.2008 ft^2

Wetted Perimeter: 18.0361 ft

Hydraulic Radius: 0.1775 ft

Average Velocity: 2.5525 ft/s

Top Width: 17.8417 ft

Froude Number: 1.0620

Critical Depth: 0.4567 ft

Critical Velocity: 2.4320 ft/s

Critical Slope: 0.0044 ft/ft

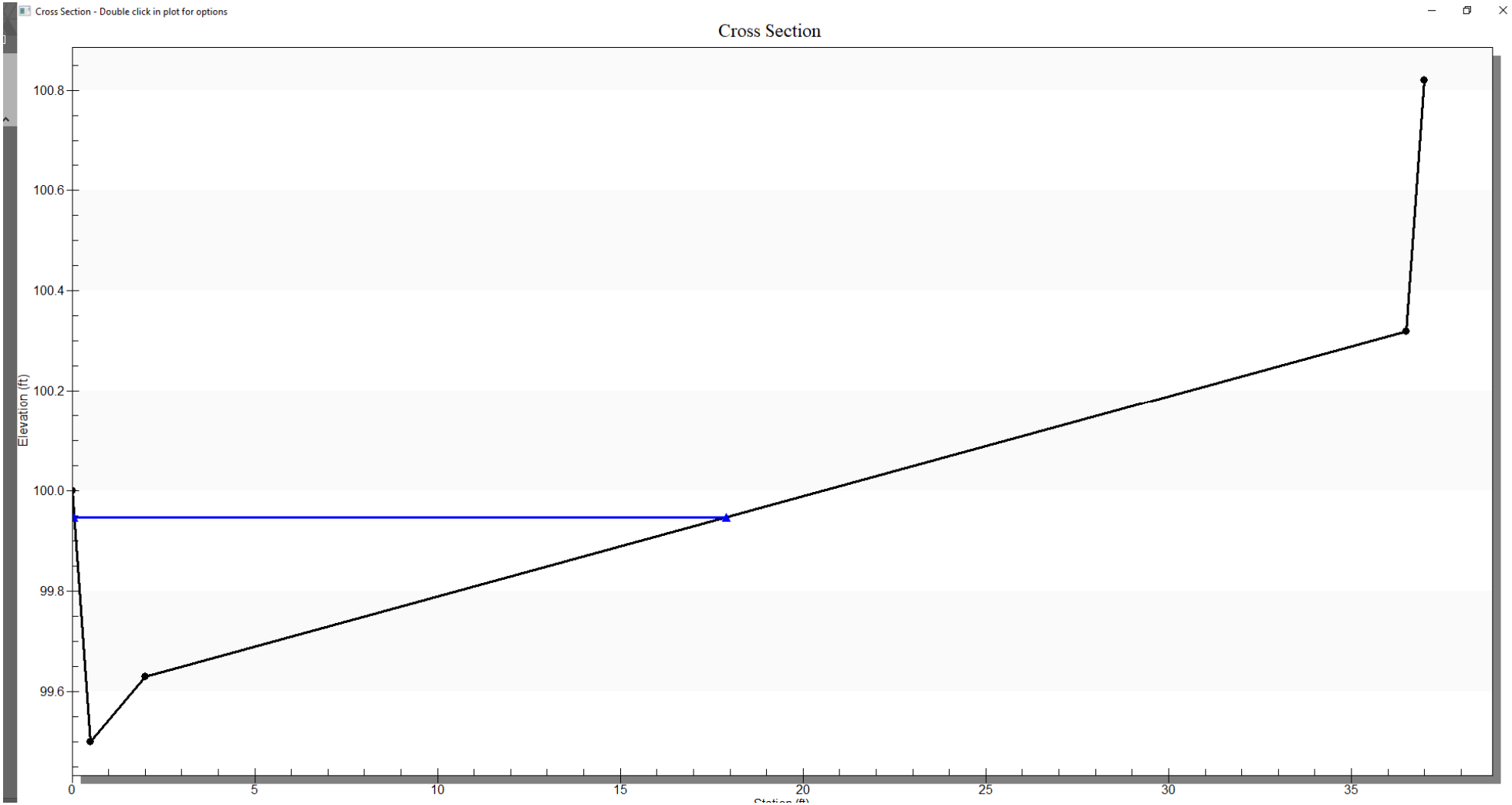
Critical Top Width: 18.29 ft

Calculated Max Shear Stress: 0.1397 lb/ft^2

Calculated Avg Shear Stress: 0.0554 lb/ft^2

Composite Manning's n Equation: Lotter method

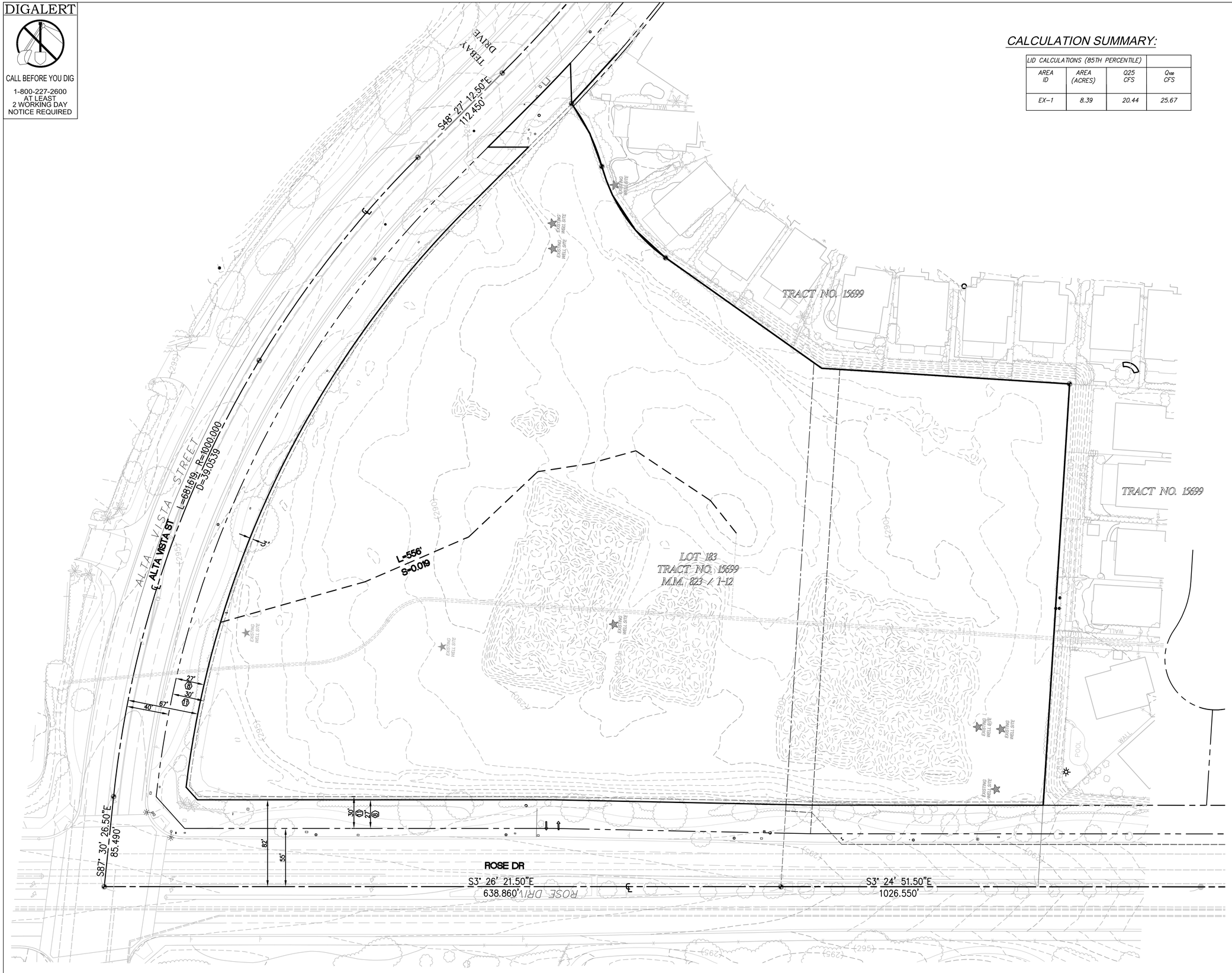
Manning's n: 0.0130


Cross Section - Double click in plot for options
Cross Section
Elevation (ft)
100.8
100.6
100.4
100.2
100.0
99.8
99.6
0
5
10
15
20
25
30
35

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED



CALCULATION SUMMARY:

LID CALCULATIONS (85TH PERCENTILE)			
AREA ID	AREA (ACRES)	Q25 CFS	Q_{100} CFS
EX-1	8.39	20.44	25.67

BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

DRAWING ISSUE RECORD

DATE	DESCRIPTION
–	–

REVISION RECORD

NO.	DATE	DESCRIPTION
1	–	–

PROJECT NAME

MIXED USE PROJECT

SEC ALTA VISTA STREET & ROSE DRIVE
PLACENTIA, CA

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
THOMAS W. HAWKSWORTH
No.68771
Exp.09/30/2019
CIVIL
STATE OF CALIFORNIA

SHEET TITLE

PRE HYDROLOGY EXHIBIT

SHEET NUMBER

DATE: 8/22/2017

DIGALERT

CALL BEFORE YOU DIG

1-800-227-2600
AT LEAST
2 WORKING DAY
NOTICE REQUIRED

LEGEND

CALCULATION SUMMARY:

LID CALCULATIONS (85TH PERCENTILE)			
AREA ID	AREA (ACRES)	Q25 CFS	Q_{100} CFS
A	2.00	5.87	7.4
B-1	0.29	1.044	1.36
B-2	2.58	5.99	8.17
B-3	1.56	4.68	6.18
B-4	1.96	4.60	6.21
TOTAL	8.39	22.18	29.32

LEGEND

LANDSCAPE

DRAINAGE AREA

AREA / ACRE — DRAINAGE CALLOUT

40 20 0 40 80

SCALE: 1"=40'

BLUE PEAK ENGINEERING, INC.
18543 YORBA LINDA BL., #235
YORBA LINDA, CA 92886
714.749.3077
714.281.1640 FAX

DRAWING ISSUE RECORD

DATE	DESCRIPTION
-	-

REVISION RECORD

NO.	DATE	DESCRIPTION
1	-	-

PROJECT NAME

MIXED USE PROJECT

SEC ALTA VISTA STREET & ROSE DRIVE
PLACENTIA, CA

PROFESSIONAL SEAL

REGISTERED PROFESSIONAL ENGINEER
THOMAS W. HAWKSWORTH
No.68771
Exp.09/30/2019
CIVIL
STATE OF CALIFORNIA

SHEET TITLE

POST HYDROLOGY EXHIBIT

SHEET NUMBER

DATE: 12/18/2017