0 Lea Terrace Drive
Preliminary Drainage Study

Storm Water - Hydrology and Hydraulics

State of California, County of San Diego, City of Santee

Project Name: Jutras Residence
Project ID: DR2021-3

Preparation Date: October, 2022

Prepared By:

Projection Engineering

Projection Engineering, Inc.
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Paul Fisher RCE No. 71549

Prepared For:

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Drainage Study Main Report

Appendices

References

San Diego County Hydrology Manual, June 2003
http://www.sandiegocounty.gov/dpw/floodcontrol/floodcontrolpdf/hydro-hydrologymanual.pdf

Section 1 – Discussion (Drainage Concept, Methodology, and Vicinity Map)

Project Information
Name of Project: Jutras Residence
Project Location: Latitude: 32.840295° Longitude: -116.952997°
Client Name/Applicant: Louis Jutras
Contact Address: 11510 Rocoso Road, Lakeside, CA 92040
Contact Phone: 619-495-2785
Legal Description: Parcel 1, portion of Lot 2, Block 7 of the subdivision of lots 'H' and 'O' of Rancho el Cajon, in the City of Santee, County of San Diego, State of California, according to map thereof no. 817 filed in the office of the county recorder of San Diego County April 2, 1896 and a portion of the south half of Lakeside Avenue, now vacated and closed to public use as described in deed doc.#2000-0121825 recorded march 10, 2000, O.R.

Project Overview

The subject project is a residentially zoned site that is undeveloped. This study is aimed to analyze the proposed project's storm water drainage needs for collection, conveyance, and discharge of stormwater within the subject parcel. This study has been prepared in conjunction with a Preliminary Grading Plan for the construction of a mixed use development project. This study will also analyze offsite drainage collection and conveyance, if there are any offsite watersheds that require drainage conveyance through the project site.

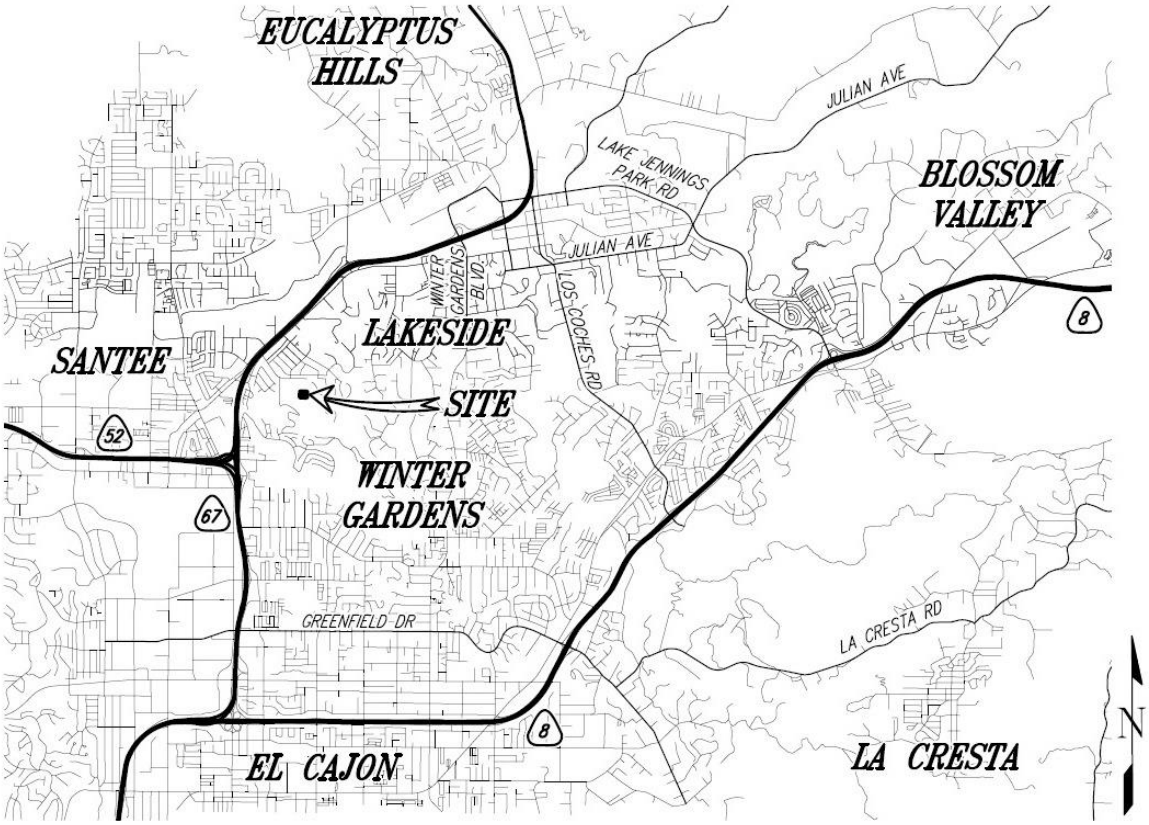
Storm Water Drainage Concept

Currently, storm water is conveyed across the existing parcel via sheet flow to a brow ditch on the north side of the project. Storm water then flows northerly in a flow line in the center of the existing acess driveway. The subject improvements will convey water collected from the proposed single family dwelling development, driveway, flatwork, and landscaping to the northwest where it will be conveyed to the existing drainage course and will be released in a controlled fashion to the same existing point of storm water discharge.

Methodology

Per Section 3.1 of the SDCHM the design storm frequency for this project is the 100-year event. The method to determine flows is based on the size of watershed, for an area that is up to 1 square mile, the Rational Method or Modified Rational Method shall be used. No onsite junctions of independent drainage systems are present within this design, so the Rational Method will be the selected method for determining the peak storm water runoff rate. The Rational Method estimates the peak rate of runoff at any location in the watershed as a function of Area, Runoff Coefficient, and Rainfall Intensity for a duration equal to the time of concentration. See the SDCHM, Section 3 for a full explanation of the Rational Method and its implementation.

Section 1 (Cont.) – Vicinity Map



VICINITY MAP

Section 2 – Declaration of Responsible Charge

DECLARATION OF RESPONSIBLE CHARGE

I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSION CODE, AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR THE PROJECT DESIGN.

PROJECTION ENGINEERING, INC.
1230 CEDAR STREET
RAMONA, CA 92065
760-443-6504

October, 2022

PAUL FISHER, PRESIDENT — DATE
RCE: 71549, EXP.: 12-31-23

Section 3 –Pre-Project Rational Method Calculations

The hydrologic design for this project is based on the design criteria outlined in the San Diego County Hydrology Manual, June 2003 (SDCHM), Section 3 - Rational Method.

Pre-Project Watershed Description
The pre-project watershed land use is described as county element Permanent Open Space (Natural). Existing grades within the watershed are moderate, running between 5% - 15%. There are no existing impervious surfaces onsite which will be taken into account using the counties land use to runoff coefficient table and assigning a C value based on land use.

Runoff Coefficient for Urban Runoff
Per Appendix 'A' – SDCHM – Hydrologic Soil Groups Map

- Soil Group B

Per Appendix 'C' – SDCHM – Runoff Coefficients for Urban Areas

- Land Use: County Element – Permanent Open Space (Natural)
- Soil Type: B
- **C = 0.25**

Design Frequency Storm Determination
Per Section 2.3 of the SDCHM the flood frequency for determining the stormwater discharge for drainage that is upstream of any major roadway is the 100-year, 6-hour event.

Design Frequency Storm Data
Per Appendix 'B' – SDCHM – Rainfall Isopluvial Maps

- Event: 100-year, 24-hour (P=5.3 Inches)
- Event: 100-year, 6-hour (P=2.6 Inches)

Application of Weighted Average Rainfall Amount
Per Appendix 'D' – SDCHM – Intensity-Duration Design Chart

- P_6/P_{24} = 49%, no adjustment needed for weighted average

Time of Concentration

- $T_c = T_i + T_t$
- Per Table 3-2 – SDCHM, T_i Max = 6.9 min. for Natural at 10.0% slope
- Checking this against Figure 3-3 – SDCHM yields using the Maximum T_i = 6.9 minutes
- Per Figure 3-4 – SDCHM with a $\triangle$E= 84' and L=300' T_t = 0 minutes
- $T_c = T_i + T_t$ = 6.9 + 0 = 6.9 minutes

Intensity-Duration Design Chart
Per Appendix 'D' – SDCHM – Intensity-Duration Design Chart, P_6 = 3.6", T_x= Per Appendix 'D'
T_x= 6.9 Min. **I = 5.2 in/hr**

Basin Areas
A = 1.01 Acres

Peak Discharge Flow Rate
Q_{100} = CIA = (0.25)(5.2)(1.01) = **Q_{100} = 1.3 ft^3/s**

Section 4 –Post-Project Rational Method Calculations

The hydrologic design for this project is based on the design criteria outlined in the San Diego County Hydrology Manual, June 2003 (SDCHM), Section 3 - Rational Method.

Post-Project Watershed Description
The post-project watershed land use is described as county element Residential 1.0 DU/Ac. Existing grades within the watershed are moderate, running between 5% - 15%. The project proposes various impervious surfaces which will be taken into account using the counties land use to runoff coefficient table and assigning a C value based on land use.

Runoff Coefficient for Urban Runoff
Per Appendix 'A' – SDCHM – Hydrologic Soil Groups Map
- Soil Group B

Per Appendix 'C' – SDCHM – Runoff Coefficients for Urban Areas
- Land Use: County Element – Residential 1.0 DU/Ac
- Soil Type: B
- **C = 0.32**

Design Frequency Storm Determination
Per Section 2.3 of the SDCHM the flood frequency for determining the stormwater discharge for drainage that is upstream of any major roadway is the 100-year, 6-hour event.

Design Frequency Storm Data
Per Appendix 'B' – SDCHM – Rainfall Isopluvial Maps
- Event: 100-year, 24-hour (P=5.3 Inches)
- Event: 100-year, 6-hour (P=2.6 Inches)

Application of Weighted Average Rainfall Amount
Per Appendix 'D' – SDCHM – Intensity-Duration Design Chart
- P_6/P_{24} = 49%, no adjustment needed for weighted average

Time of Concentration
- $T_c = T_i + T_t$
- Per Table 3-2 – SDCHM, T_i Max = 11.5 min. for Residential (1.0 DU/A or less) at 1.0% slope
- Checking this against Figure 3-3 – SDCHM yields using the Maximum T_i = 11.5 minutes
- **Hydraulic Calculation (Manning's) – Brow Ditch**
- Poured Concrete, n=0.015, Q = 1.3 ft^3/s, Longitudinal Slope = 0.24 (Average)
- Solution Velocity at Solution Depth = 10.3 ft/s for 100' = T = 0.2 minutes
- $T_c = T_i + T_t$ = 11.5 + 0.2 = 11.7 minutes

Intensity-Duration Design Chart
Per Appendix 'D' – SDCHM – Intensity-Duration Design Chart, P_6 = 2.6"
T_x= 11.7 Min. **I = 4.0 in/hr**

Basin Areas
A = 1.01 Acres

Peak Discharge Flow Rate
Q_{100} = CIA = (0.32)(4.0)(1.01) = **Q_{100} = 1.3 ft^3/s**

Section 5 – Summary Table and Conclusion Narrative

*Drainage Summary Table		
	Pre-Development Data	**Post Development Data**
Basin #1: Q_{100} Peak Runoff Rate	1.3 ft^3/s	1.3 ft^3/s
Basin #1: V_{100} Peak Runoff Velocity	4.5 ft/s	4.5 ft/s

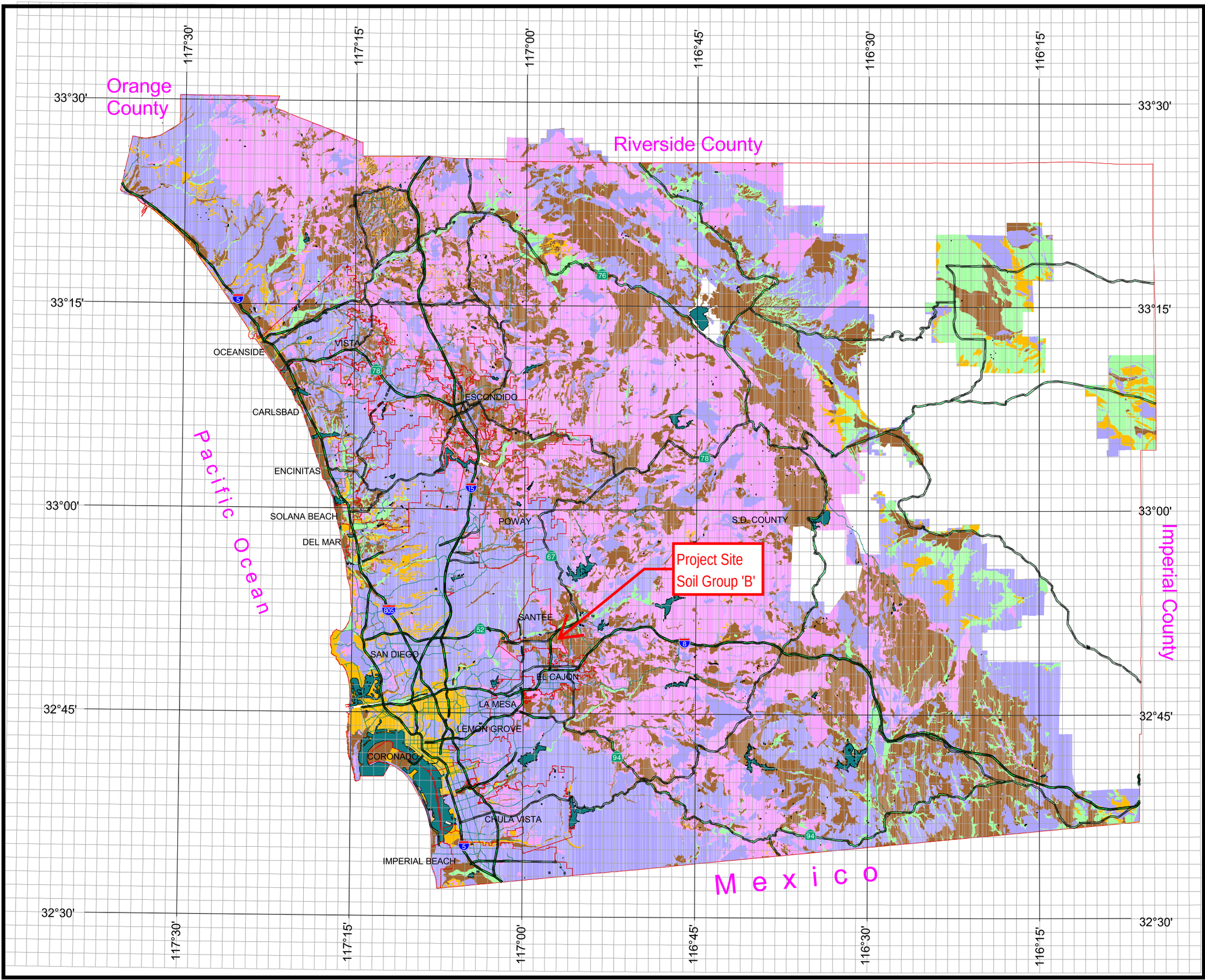
Conclusion

Proposed improvements will convey stormwater from the impervious and pervious areas within the development to the face of curb at the northwest end of the improvements. The runoff rate comparison from pre-development to post development shows no increase in flow in Basin #1 due to the installation of the impervious areas, and the slowing of the time of concentration due to grading activities. Stormwater will be released in a controlled manner with adequate erosion control protection to the downstream reach. This development including the designed mitigation measures will not adversely affect the current property and surrounding parcels. The proposed development will not substantially alter existing drainage patterns in a manner which would increase erosion or siltation onsite or offsite, all streams or rivers will not be altered. This development will not alter the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding onsite or offsite. This development will no contribute runoff water which would exceed the existing capacity of the downstream drainage facilities. This development or structures within this development are not placed within the FEMA flood hazard boundary or any other flood hazard map. This project will not expose people or structures to significant risk of loss, injury or death involving flooding as a result of failure of a levee or dam.

Appendix ‘A’

County of San Diego Hydrology Manual

Soil Hydrologic Groups



Legend

Soil Groups

- Group A
- Group B
- Group C
- Group D
- Undetermined
- Data Unavailable

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Appendix ‘B’

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

Project Site
P = 2.6"

Orange County
Riverside County
Imperial County
Pacific Ocean
Mexico

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

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County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

Project Site
P=5.3"

Orange County

Riverside County

Imperial County

Pacific Ocean

Mexico

OCEANSIDE
VISTA
CARLSBAD
ESCONDIDO
ENCINITAS
SOLANA BEACH
DEL MAR
POWAY
SANTEE
SAN DIEGO
EL CAJON
LA MESA
LEMON GROVE
CORONADO
CHULA VISTA
IMPERIAL BEACH
SD

117°30' 117°15' 117°00' 116°45' 116°30' 116°15'
33°30' 33°15' 33°00' 32°45' 32°30'

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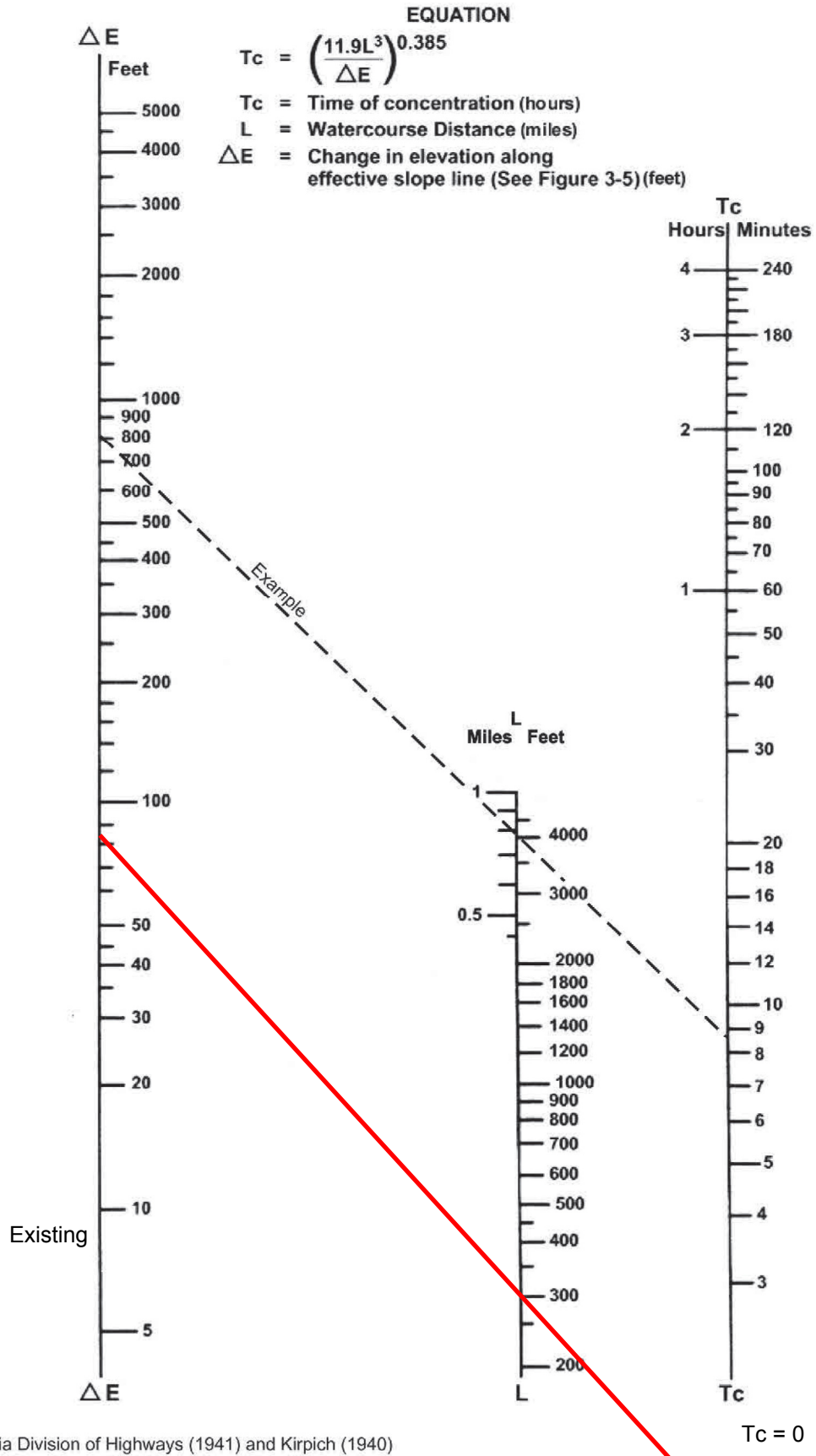
Appendix ‘C’



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35 Existing
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41 Proposed
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

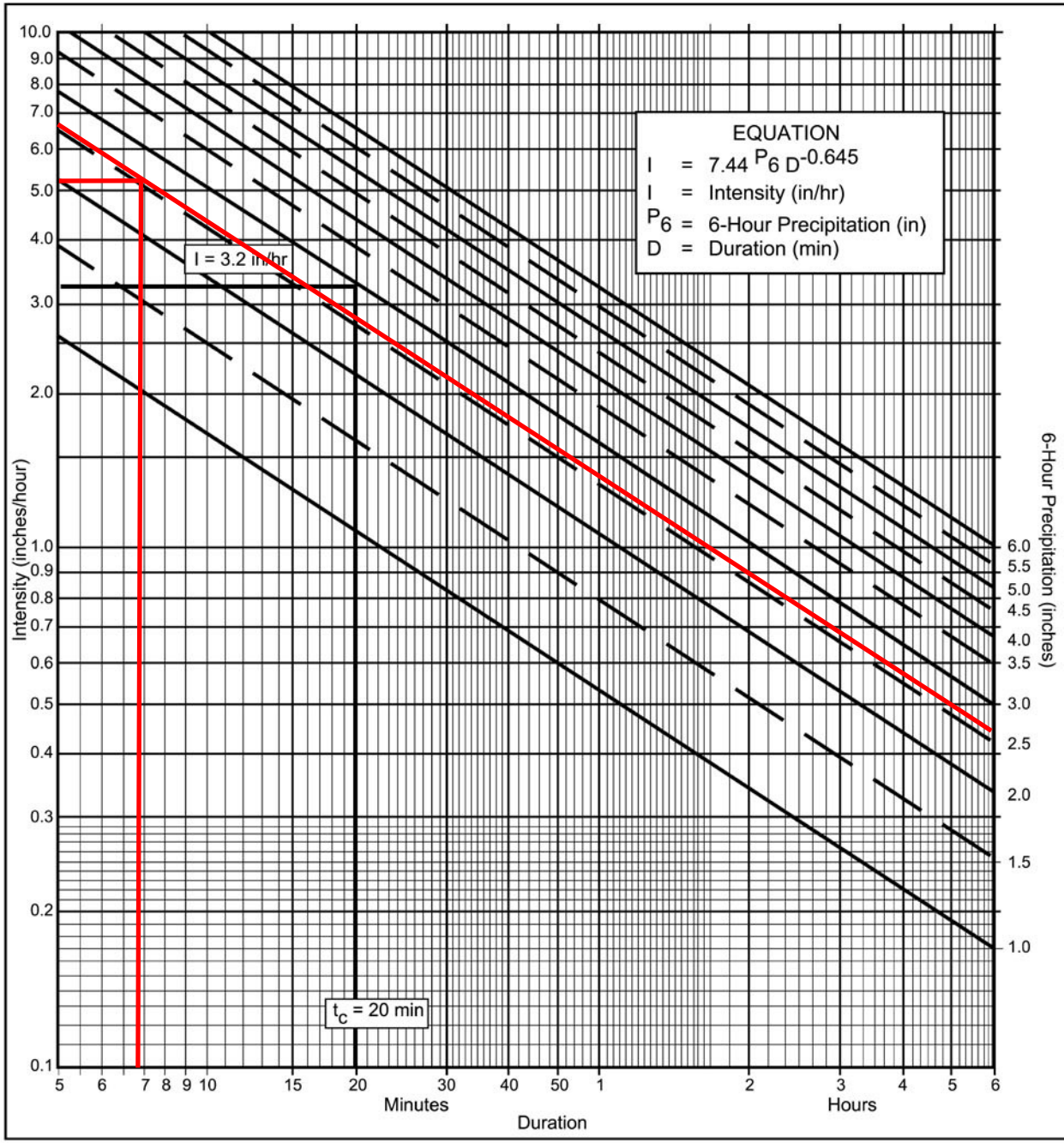
Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%		
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9	Existing
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4	Proposed
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8	
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6	
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3	
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8	
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5	
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3	
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5	
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7	
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7	
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4	
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2	
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2	
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9	

*See Table 3-1 for more detailed description

Appendix ‘D’



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.6 in., P_{24} = 5.3, $\frac{P_6}{P_{24}}$ = 49 %(2)

(c) Adjusted P_6(2) = 2.6 in.

(d) t_x = 6.9 min.

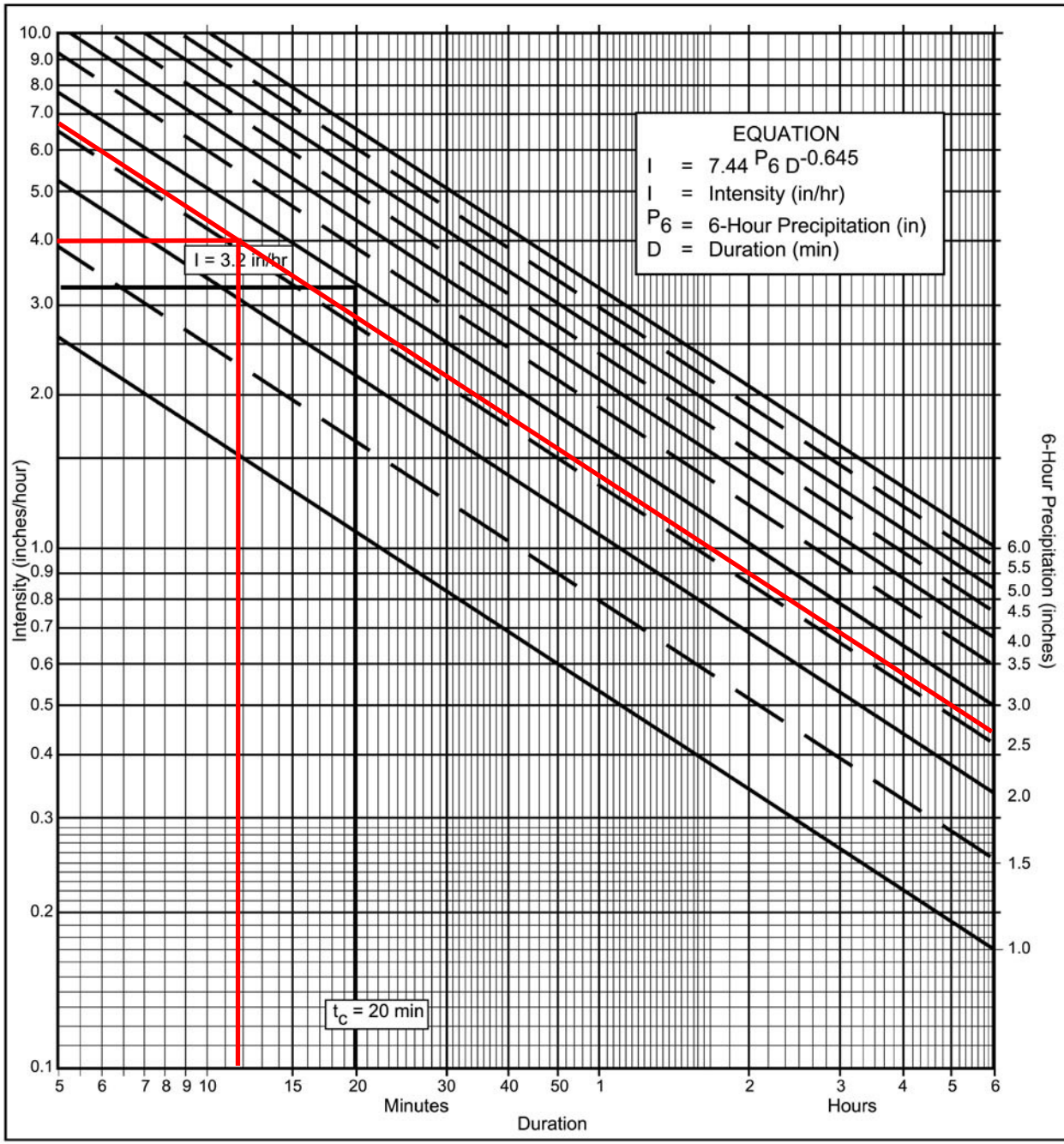
(e) I = 5.2 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Example

FIGURE 3-2



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(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.6 in., P_{24} = 5.3, $\frac{P_6}{P_{24}}$ = 49 %(2)

(c) Adjusted $P_6^{(2)}$ = 2.6 in.

(d) t_x = 11.7 min.

(e) I = 4.0 in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

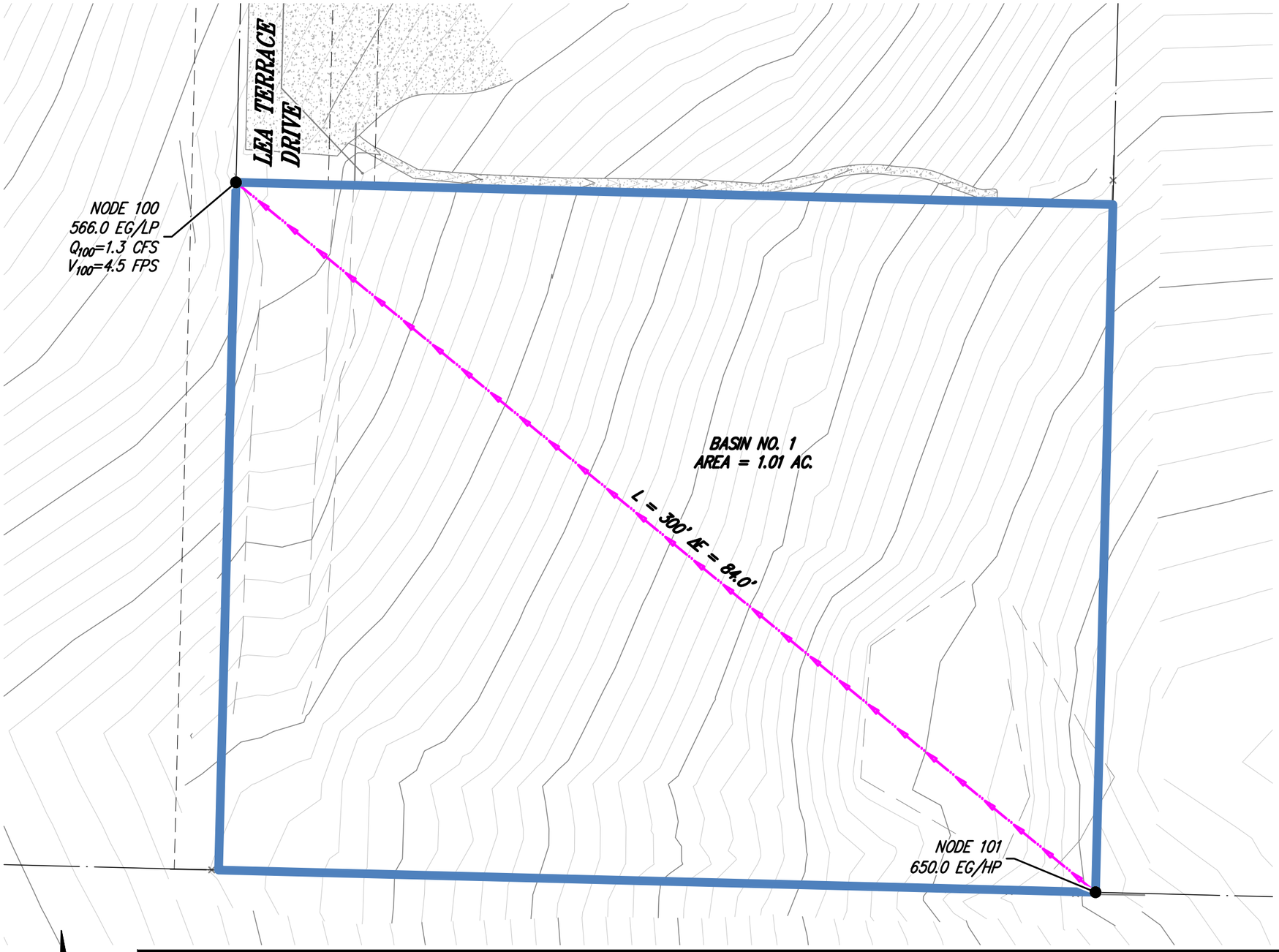
P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Example

FIGURE 3-2

Appendix ‘E’

PAPER SIZE: Arch TABLOID (11" x 17")
PLOTTED: 11/1/2022 9:43 AM



LEGEND

BASIN BOUNDARY

DIRECTION OF SURFACE FLOW

N

0' 15' 30'

SCALE: 1" = 30'

F:\Personal\Projection Engineering, Inc\Marketing\2019 Rebranding\Projection Engineering Logo jpg - Copy.jpg

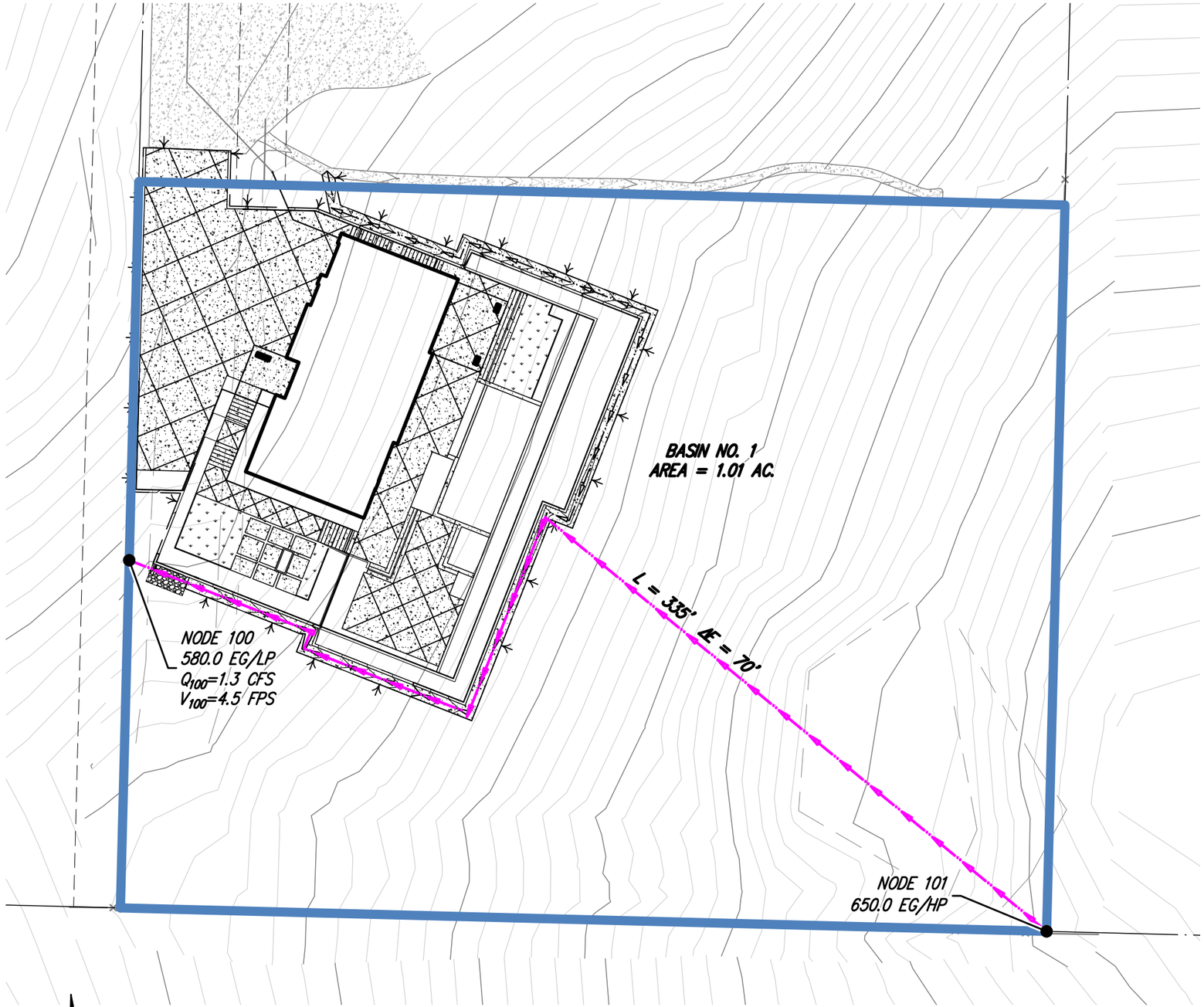
PROJECT NO.	201202-01
DRAWN:	11/1/2022
DRAWN BY:	PEF
CHECKED BY:	PEF

0 LEA TERRACE DRIVE
STORM WATER DRAINAGE EXHIBIT
PRE-DEVELOPMENT CONDITION

CITY OF SANTEE, COUNTY OF SAN DIEGO, CA

SHEET 1 OF 2

PAPER SIZE: Arch TABLOID (11" x 17")
PLOTTED: 11/1/2022 9:50 AM



LEGEND

BASIN BOUNDARY

DIRECTION OF SURFACE FLOW

N

0' 15' 30'

SCALE: 1" = 30'

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PROJECT NO.	201202-01
DRAWN:	11/1/2022
DRAWN BY:	PEF
CHECKED BY:	PEF

0 LEA TERRACE DRIVE
STORM WATER DRAINAGE EXHIBIT
POST DEVELOPMENT CONDITION

CITY OF SANTEE, COUNTY OF SAN DIEGO, CA

SHEET 2 OF 2