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Subdivision Maps
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Cadastral Surveys
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Environmental Analysis
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Tentative Maps
Major Use Permits
Specific Plans
Rezoning
Variances
Administrative Permits
Annexations
Boundary Adjustments

February 29, 2012

Monica Bilodeau
County of San Diego
Department of Planning and Land Use
5201 Ruffin Road, Suite B, 92123

Subject: Former TM 5254 and current TPM 21193 and BA12-0009

The project proposes a Minor Subdivision (4 parcels and a remainder) and a Boundary Adjustment (4 parcels) to be filed concurrently on the subject property to the north of the Minor Subdivision and under the same ownership. The attached study reviews both proposals. Originally the proposed project was submitted as TM 5254. This TM was withdrawn and a new application for TPM 21193 and BA 12-0009 was submitted for review and processing by the County of San Diego.

Boundary Adjustment (BA 12-0009) reconfigures four existing parcels created per TPM14192 into 42.83, 46.75, 30.90 acres and the southern parcel is 110.03 acres. TPM 21193 proposes 4 parcels and a remainder on the southern parcel. APN 102-102-07 was included in the boundary of TM 5254 but it has been removed from the current proposal.

The pad locations and environmental impact review analyzed in this report for TM 5254 has not significantly changed with this new application.

Sincerely,

Ivan R. Fox PE

SDC DPLU RCVD 03-01-12

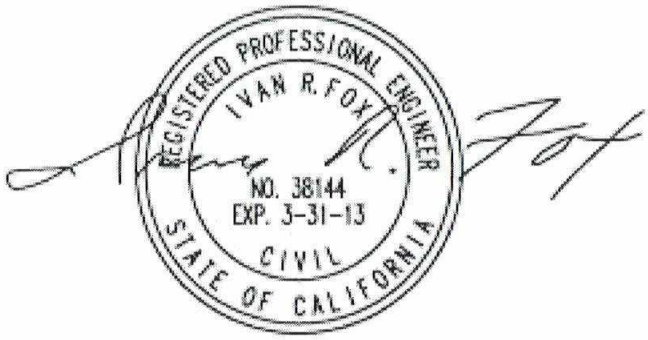
TPM21193

www.sdeinc.com
(760) 753-5525 • FAX (760) 943-8236
4407 Manchester Avenue • Suite 105 • Encinitas, California 92024

Preliminary Drainage Study
For
The Chandler Property
TPM21193/LOG NO.01-01-004A

Prepared By:
Ivan R. Fox, RCE 38144
San Dieguito Engineering, Inc.
4407 Manchester Ave., Suite 105
Encinitas, CA 92024

Date: 06/10/2011
SDE Job No. 5108



SDC DPLU RCVD 05-09-12

TPM21193

PROJECT DESCRIPTION

This study addresses both existing and proposed hydrologic conditions for a 262+/- acre subdivision and boundary adjustment located on Harris Trail in Fallbrook, California. The project proposes detention

The proposed project site has varying steep topography and is bisected by an non-ephemeral stream. Approximately 2/3 of the site drains to this existing natural channel that slopes down to the south into a series of 3 reservoirs. Runoff from the reservoir is conveyed via a natural channel that runs in the easterly direction. The remainder of the site drains in the south/southeasterly direction.

The existing use of the site is agricultural and the proposed development will keep this use largely in tact. Existing residential developments consists of Conquistador Road, which is partially paved, and two mobile homes and two farm labor buildings which are to remain. Vegetation consists of dense native trees and brush, as well as non-native orchards.

The proposed development consists of a 154 acre, 7 lot-subdivision, a 109 acre 2 lot boundary adjustment, and will include a 24' private access road. Each residential lot is proposed to be a minimum of 20 acres in size. The proposed pads vary in size between 10,000 and 35,000 sf, and driveways shall be 16' improved per North County Fire Department Standards.

EXISTING HYDROLOGY:

The site is affected by runoff from 4 distinct basins. Basin A is the largest and runoff accumulates at a series of three existing reservoirs. The three reservoirs are lined up in series and are connected by concrete spillways. Runoff exiting the reservoirs is conveyed offsite by a natural channel. Please refer to the "Existing Conditions Drainage Map" located in Appendix A for a map of the existing conditions.

The Runoff Coefficient for each basin was calculated based on an undisturbed, natural terrain C-value of 0.30 for soil type D and 0.25 for soil type B. A weighed average was used to calculate each basin's C-value.

Please refer to the "RESULTS" section below for the Existing Conditions peak flow rates as the runoff leaves the site.

PROPOSED HYDROLOGY:

The proposed hydrology for this project is to remain similar to the existing hydrology. The minor decrease in overall "Q" in the proposed condition is a result of detaining the runoff in ponds. Please refer to the "Proposed Conditions Drainage Map" included in Appendix A.

Proposed Basins B, C, & D have pads sited at the top of the basins which increase the Initial Time of Concentration and ultimately decrease the peak flowrate at each exit point. Culverts and/or brow ditches are proposed in all three basins for routing purposes.

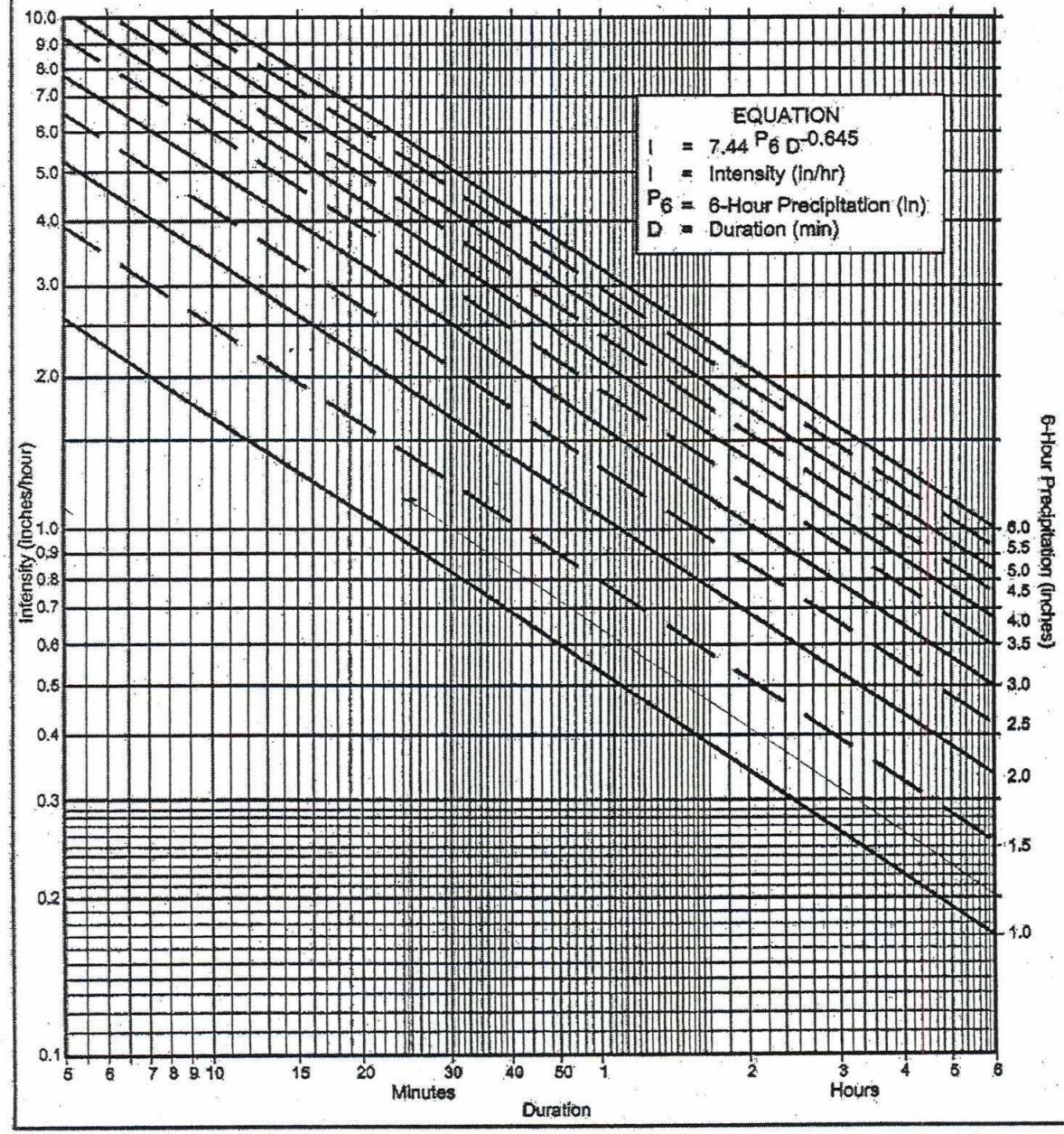
Runoff coefficients for the proposed conditions were calculated based on percent imperviousness and soil types B & D. Pads were assigned a percent imperviousness based on their size, decreasing in percent impervious as the pad size increases. The driveways were calculated to be exactly 80% impervious (16'paved) and the proposed private road was taken to be 86% impervious (24'paved/28'graded).

RESULTS:

Pre- and post-construction peak flow rates as the runoff leaves the site are as follows:

BASIN	Q_{100} – PRE (cfs)	Q_{100} – POST (cfs)
A	353.3	346.1
B	21.3	15.1
C	39.1	22.8
D	7.0	6.3

HYDROLOGY MANUAL
FIGURES AND CHARTS



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 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 = 2.5 in., P_{24} = 5.0, $\frac{P_6}{P_{24}}$ = 50 %(2)

(c) Adjusted P_6(2) = 2.5 in.

(d) t_x = _____ min.

(e) I = 6.59 in./hr.

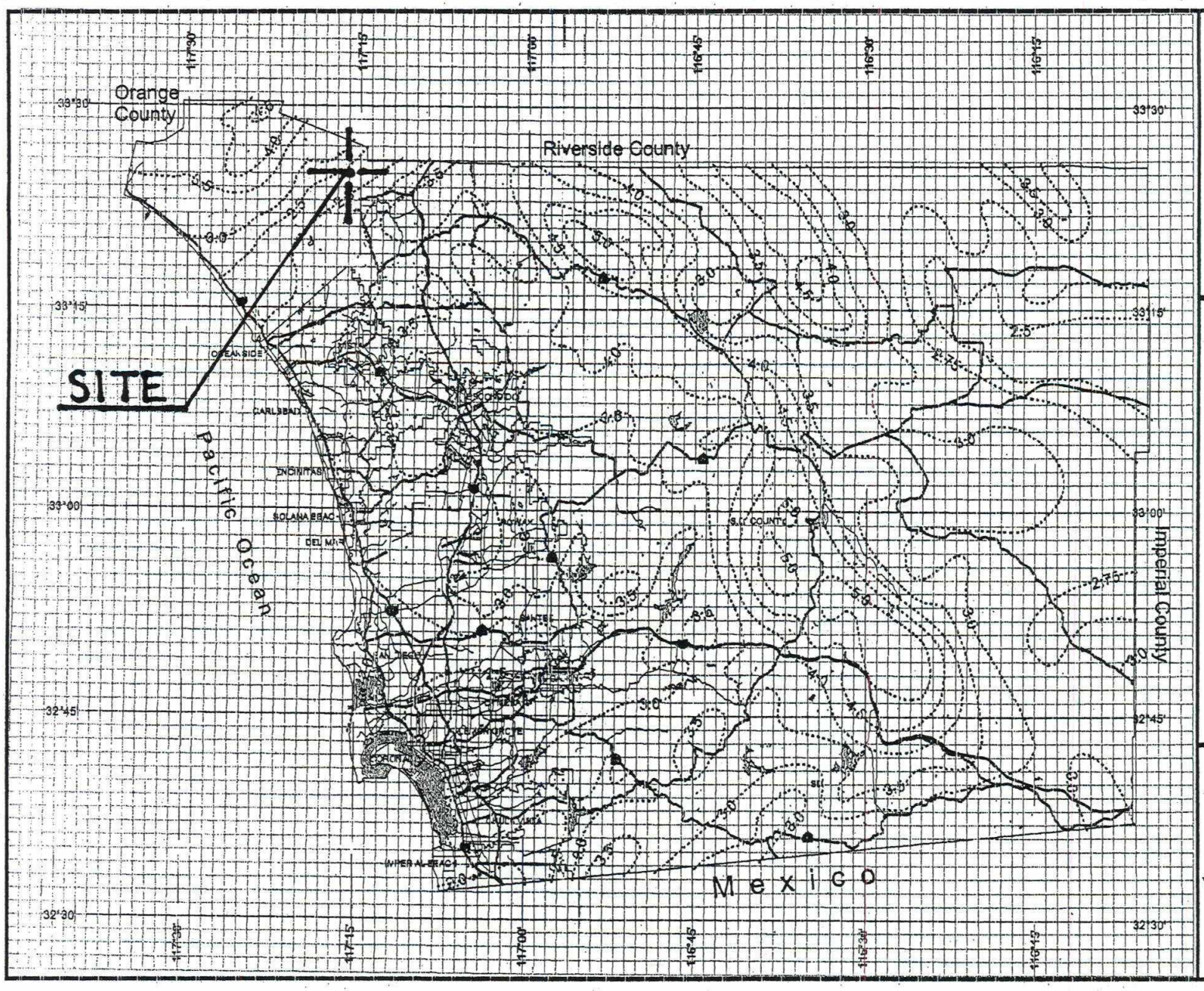
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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

FIGURE

3-1

Intensity-Duration Design Chart - Template



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvia (inches)

$P_6 = 2.5''/hr$

DPW GIS

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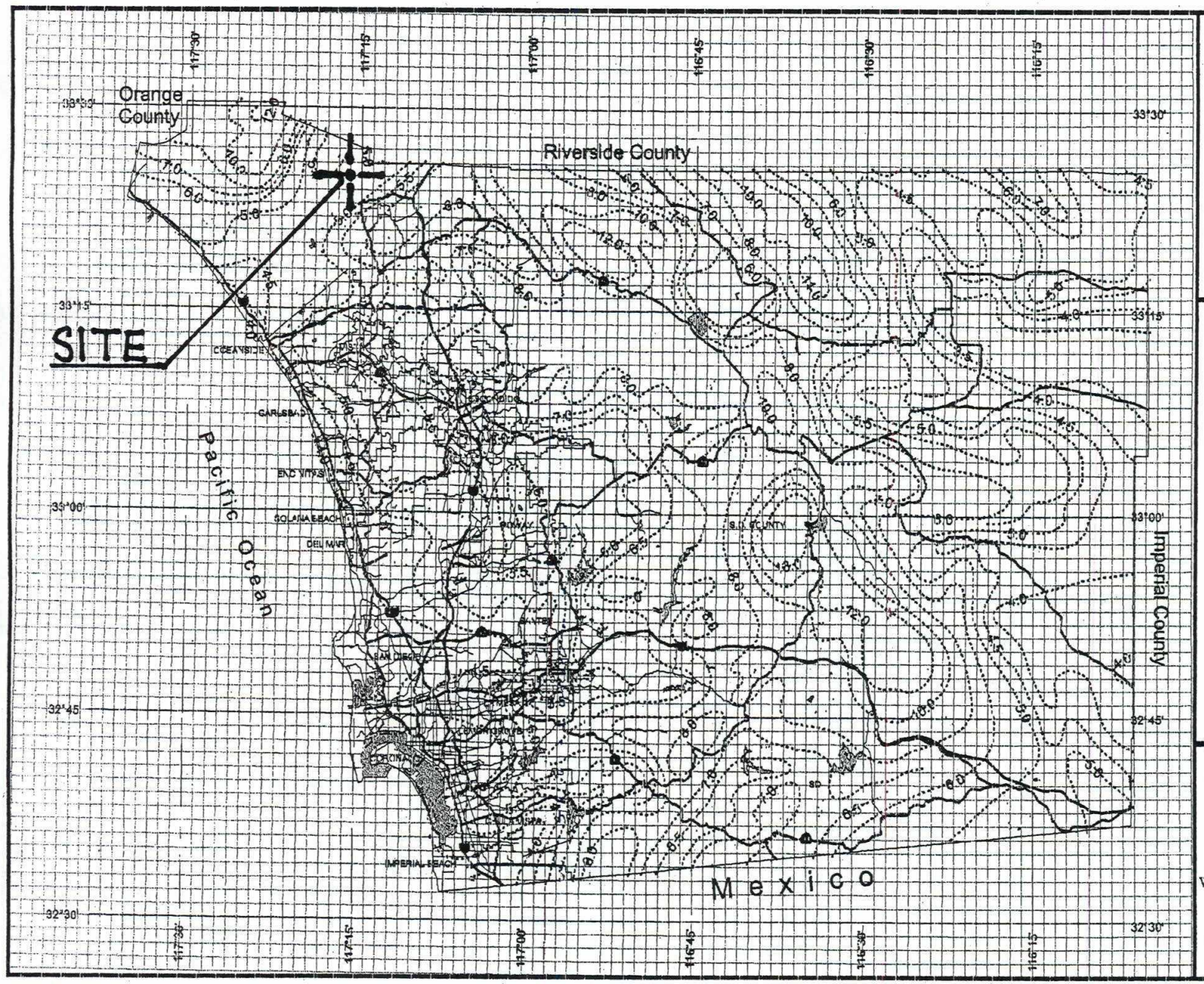
We Have San Diego Covered!

N
W E
S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvia (inches)

$P_{24} = 5''/hr$

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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
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
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/	.5%		1%		2%		3%		5%		10%	
	Acre	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
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
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

PRE-CONSTRUCTION HYDROLOGY
EXISTING CONDITIONS

HYDROLOGY STUDY

100 YEAR STORM

PRE-CONSTRUCTION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 05.01.2011
COMMENT:

P6 (in): 2.50 P6/P24: 0.50
P24 (in): 5.00 ADJUSTED P6: 2.50
Soil types B &D, see NOTE below

Discharge Point	WATERSHED DESIGNATION	EVENT (year)	AREA (SF)	AREA (Ac)	SOIL GROUP	*1* C	Tc (min)	I (iph)	Q (cfs)
POI-1	*A1*	*100*	*29,032,973*	*666.51*	*B/D*	*0.30*	*37.4*	**1.80**	**357.11**
N/A	*A2*	*100*	*592,039*	*13.59*	*B*	*0.26*	*1.0*	*N/A*	*N/A*
N/A	*A3*	*100*	*558,608*	*12.82*	*B*	*0.26*	*2.1*	*N/A*	*N/A*
N/A	*A4*	*100*	*800,509*	*18.38*	*B*	*0.25*	*2.1*	*N/A*	*N/A*
N/A	*A5*	*100*	*2,255,924*	*51.79*	*B/D*	*0.28*	*4.8*	*N/A*	*N/A*
POI-2	**A**	**100**	**33,240,053**	**763.09**	**B/D**	**0.30**	**47.4**	**1.54**	**353.32**
POI-3	**B**	**100**	**837,820**	**19.23**	**B**	**0.25**	**9.3**	**4.42**	**21.26**
POI-5	**C**	**100**	**1,378,841**	**31.65**	**B**	**0.26**	**8.3**	**4.75**	**39.05**
POI-4	**D**	**100**	**316,387**	**7.26**	**B**	**0.25**	**11.5**	**3.86**	**7.01**

1 Coefficient based upon percent impervious and class "B" & "D" soils, see below.

NOTES:

All calculations are based on the San Diego County Hydrology Manual, dated June 2003.

Soil types vary for Basins A1 & A2. Per **Section 3.1.2** of the SDC Hydrology Manual, a weighted average of the runoff coefficients was used as the "C" value in the table above.

Basin A1:
14,043,980 SF (soil type D)
14,988,315 SF (soil type B)
"C" = (0.25*14,988,315)+(0.35*14,043,980)/(29,032,295) = 0.298

Basin A5:
702,703 SF (soil type D)
1,553,221 SF (soil type B)
"C" = (0.25*1,553,221)+(0.35*702,703)/(2,255,924) = 0.281

** Though a paved road exists in the pre-existing condidtion, its surface area comprises only 2/10th of a percent of the total area for Basin A, too small to make a difference in the "C" value.

6- and 24-hr storm rainfall amount are based on San Diego County Isopluvial maps (attached).

Time of Concentration:

Calculations shown on following pages.

Intensity Calculations:

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

Q=CIA

HYDROLOGY STUDY

100 YEAR STORM

PRE-CONSTRUCTION - TIME OF CONCENTRATION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 05.01.2011
COMMENT:

L	TYPE	UPSTREAM ELEVATION	DOWNSTREAM ELEVATION	ΔH/ΔE*	SLOPE	T_t	Manual Referral
BASIN A1							
100	Overland	1438.0	1412.0	26.0	0.26	4.86	**Fig. 3-3**
4000	Natural **	1412.0	1075.0	448.3	0.11	10.77	**Fig. 3-4**
4000	Natural **	1075.0	904.0	136.8	0.03	17.01	**Fig. 3-4**
1656	Natural **	904.0	650.0	260.3	0.16	4.79	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**37.43**	
BASIN A2							
364	Pond	*See Detention Pond Calculations*				1.00	**N/A**
					$\Sigma T_t = T_c =$	**1.00**	
BASIN A3							
105	Spillway #1	648.3	620.0	28.3	0.27	0.10	**See below**
N/A	Pond	*See Detention Pond Calculations*				2.00	**N/A**
					$\Sigma T_t = T_c =$	**2.10**	
BASIN A4							
150	Spillway #2	619.2	603.0	16.2	0.11	0.10	**See below**
N/A	Pond	*See Detention Pond Calculations*				2.00	**N/A**
					$\Sigma T_t = T_c =$	**2.10**	
BASIN A5							
65	Spillway #3	602.7	590	12.7	0.20	0.04	**See below**
950	Natural	590.0	530.0	50.1	0.05	4.76	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**4.80**	
BASIN B							
100	Overland	1065.0	1035.0	30.0	0.30	4.63	**Fig. 3-3**
1903	Natural	1035.0	625.0	429.7	0.23	4.64	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**9.27**	
BASIN C							
100	Overland	1070.0	1031.0	39.0	0.39	4.25	**Fig. 3-3**
1588	Natural	1031.0	730.0	351.6	0.22	4.07	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**8.31**	
BASIN D							
100	Overland	1002.0	998.0	4.0	0.04	9.07	**Fig. 3-3**
962	Natural	998.0	658.0	312.4	0.32	2.39	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**11.46**	

* ΔE refers to the change in elevation along the **effective slope** line. See attached graphs.

** Per the SDC Hydrology Manual, Section 3.1.4.2, a maximum length of 4000' shall be used

Overland-CALCULATED USING EQUATION FROM ATTACHED COUNTY "RATIONAL FORMULA - OVERLAND TIME OF FLOW NOMOGRAPH", FIGURE 3-3
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO.

Natural (or Tt)-CALCULATED USING THE EFFECTIVE SLOPE METHOD (SEE ATTACHED GRAPHS) AND FIGURE 3-4 OF THE COUNTY MANUAL.
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO

SPILLWAY CALCULATIONS:

Basin A3 (Spillway #1)
Qout (from pond calcs) = 331.08 cfs
From flowmaster ouput: V=16.3 fps (see attached)
Longitudinal length of spillway = 100'
Tt = 100ft/16.3fps = 6.1 sec = **0.10 min**

Basin A4 (Spillway #2)
Qout (from pond calcs) = 331.35 cfs
From flowmaster ouput: V=24.6 fps (see attached)
Longitudinal length of spillway = 150'
Tt = 150ft/24.6fps = 6.1 sec = **0.10 min**

Basin A5 (Spillway #3)
Qout (from pond calcs) = 321.88 cfs
From flowmaster ouput: V=28.3 fps (see attached)
Longitudinal length of spillway = 65'
Tt = 65ft/28.3fps = 2.3 sec = **0.04 min**

6-Hr Hydrograph for Basins A1 & A2

Q= 334.59 cfs
Tc=43.2 min*
A= 680.06 AC

0	0.00
43	32.49
86	39.71
129	45.23
172	66.42
215	94.43
258	334.59
301	53.27
344	35.64
387	0.00

6-Hr Hydrograph for Basin A3

Q=5.10 cfs
Tc=45.3 min*
A=12.82 AC

0	0
45	0.5
90	0.61
135	0.69
180	1.01
225	1.44
270	5.1
315	0.81
360	0.54
405	0

6-Hr Hydrograph for Basin A4

Q=7.03 cfs
Tc=48 min*
A= 18.38 AC

0	0
48	0.68
96	0.83
144	0.95
192	1.39
240	1.97
288	7.03
336	1.12
384	0.75
432	0

* Time of concentration for these hydrographs was estimated based on effective slope method. Those calculations are NOT included in this report.

A2 = 5.8 min
A3 = 2.1 min
A4 = 2.7 min

Worksheet for Pre Conditions POI-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.19600	ft/ft
Discharge	353.32	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
10+17	540.00
10+31	535.00
10+44	530.00
10+89	530.00
11+11	540.00
11+34	554.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+17, 540.00)	(10+31, 535.00)	0.030
(10+31, 535.00)	(10+44, 530.00)	0.030
(10+44, 530.00)	(10+89, 530.00)	0.030
(10+89, 530.00)	(11+11, 540.00)	0.030
(11+11, 540.00)	(11+34, 554.51)	0.030

Results

Normal Depth	0.54	ft
Elevation Range	530.00 to 554.51 ft	
Flow Area	24.86	ft^2
Wetted Perimeter	47.68	ft
Top Width	47.47	ft
Normal Depth	0.54	ft
Critical Depth	1.22	ft
Critical Slope	0.01269	ft/ft

Worksheet for Pre Conditions POI-1

Results

Velocity		14.21	ft/s
Velocity Head		3.14	ft
Specific Energy		3.68	ft
Froude Number		3.46	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	1.22	ft
Channel Slope	0.19600	ft/ft
Critical Slope	0.01269	ft/ft

Cross Section for Pre Conditions POI-1

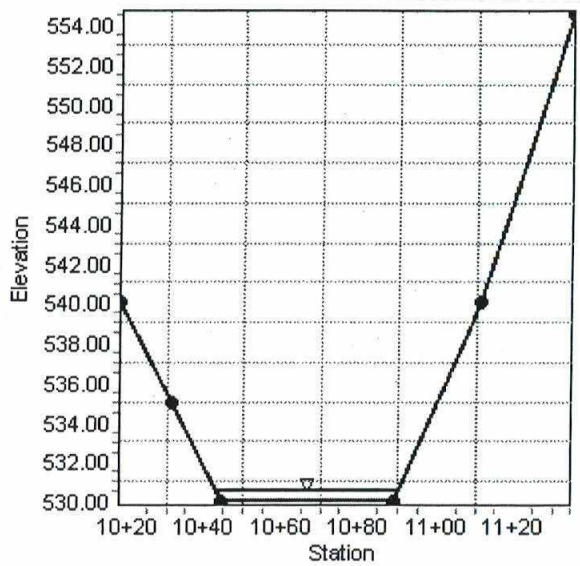
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.19600	ft/ft
Normal Depth	0.54	ft
Discharge	353.32	ft^3/s

Cross Section Image



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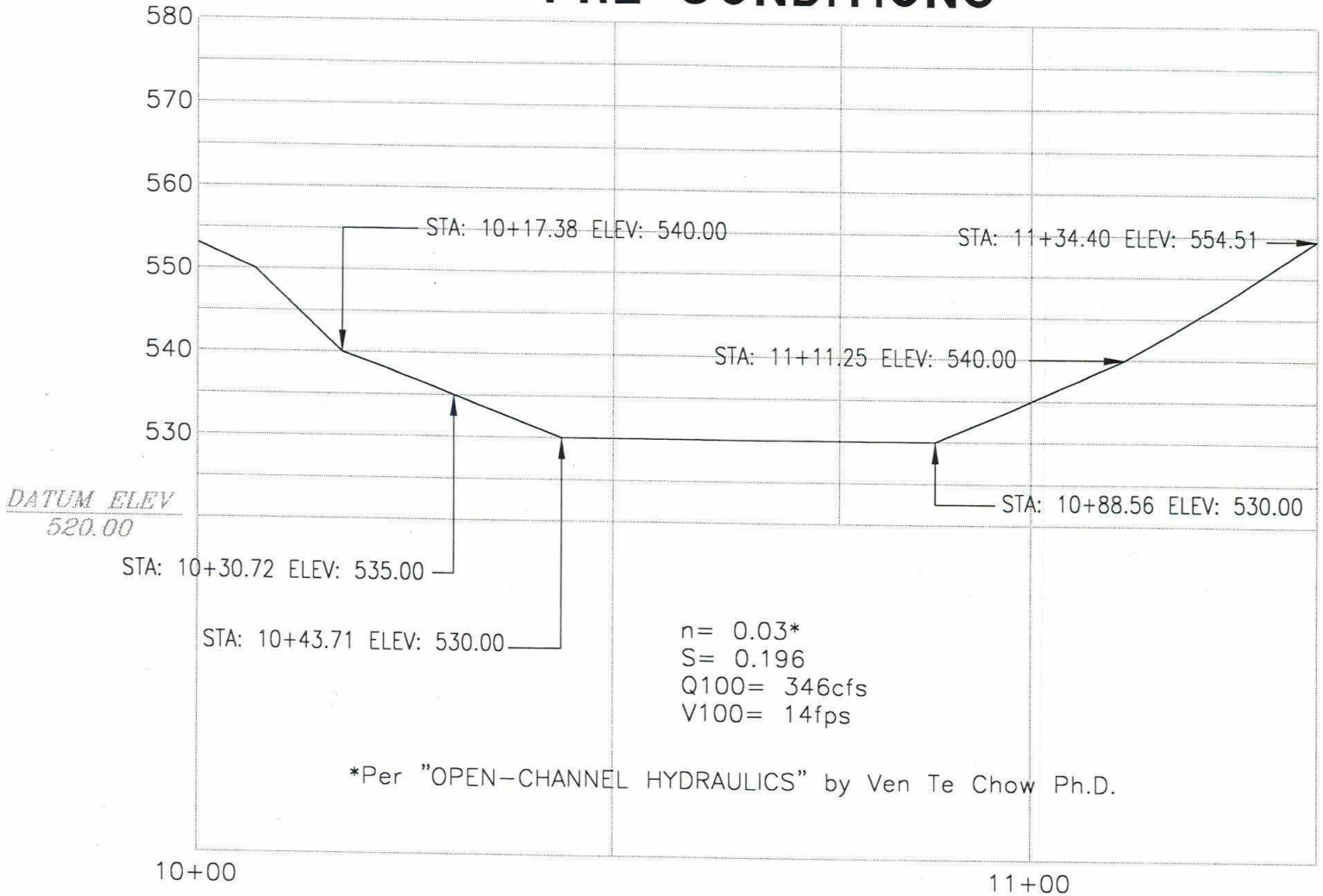


POI-1

Worksheet for Pre Conditions POI-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02100	ft/ft
Discharge	21.26	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
10+32	800.00
10+52	790.00
10+84	780.00
11+02	780.00
11+20	780.00
11+54	790.00
11+86	804.73

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+32, 800.00)	(10+52, 790.00)	0.033
(10+52, 790.00)	(10+84, 780.00)	0.033
(10+84, 780.00)	(11+02, 780.00)	0.033
(11+02, 780.00)	(11+20, 780.00)	0.033
(11+20, 780.00)	(11+54, 790.00)	0.033
(11+54, 790.00)	(11+86, 804.73)	0.033

Results

Normal Depth	0.23	ft
Elevation Range	780.00 to 804.73 ft	
Flow Area	8.73	ft^2
Wetted Perimeter	38.39	ft
Top Width	38.32	ft
Normal Depth	0.23	ft

Worksheet for Pre Conditions POI-2

Results

Critical Depth		0.22	ft
Critical Slope		0.02665	ft/ft
Velocity		2.43	ft/s
Velocity Head		0.09	ft
Specific Energy		0.32	ft
Froude Number		0.90	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.23	ft
Critical Depth	0.22	ft
Channel Slope	0.02100	ft/ft
Critical Slope	0.02665	ft/ft

Cross Section for Pre Conditions POI-2

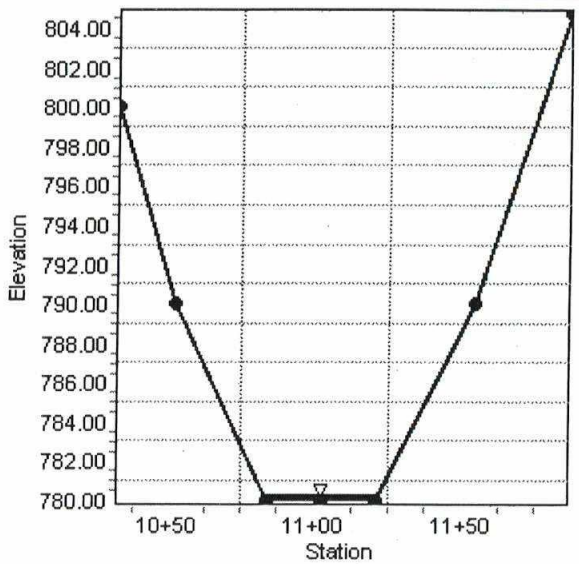
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

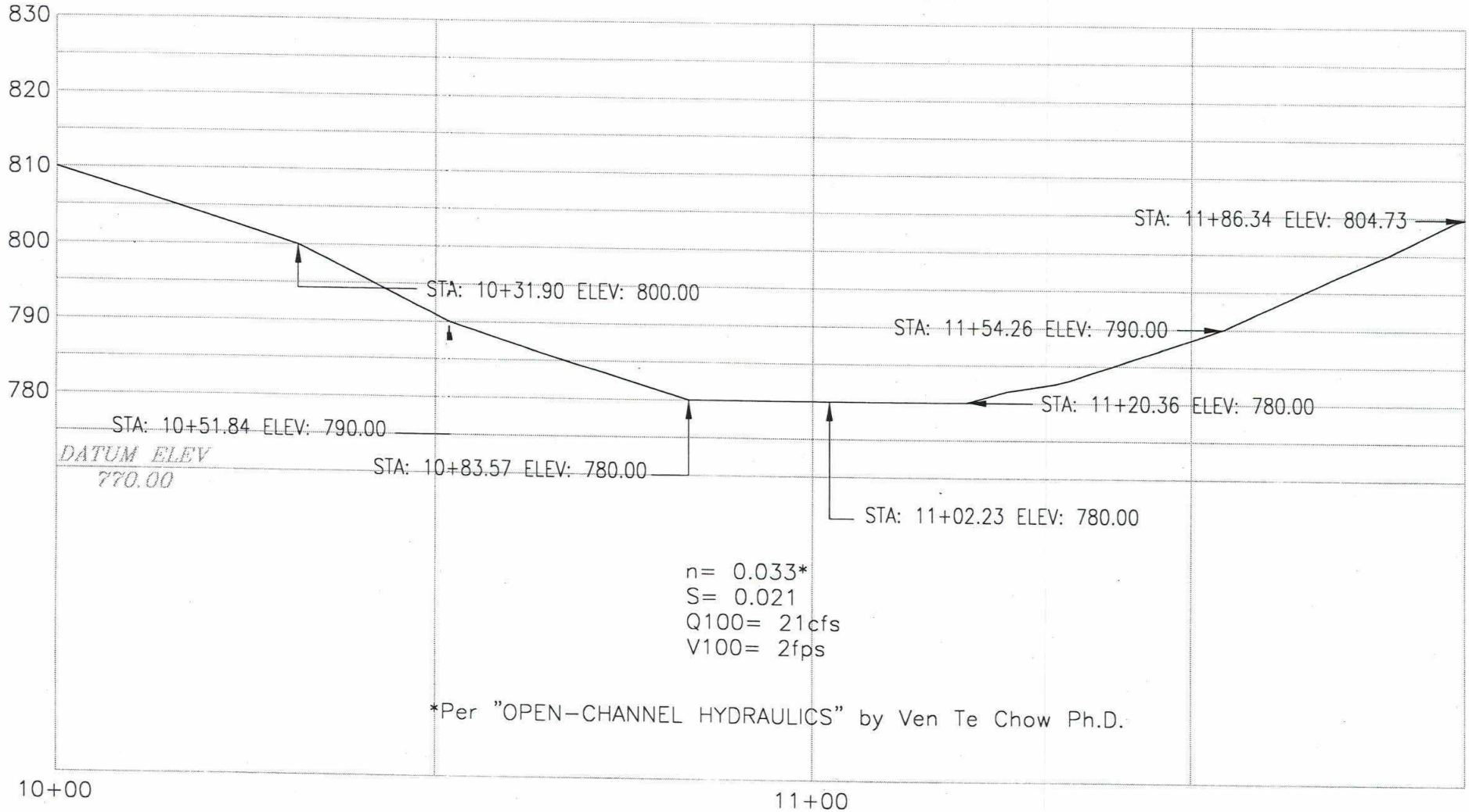
Input Data

Channel Slope	0.02100	ft/ft
Normal Depth	0.23	ft
Discharge	21.26	ft^3/s

Cross Section Image



PRE CONDITIONS



POI-2

Worksheet for Pre Conditions POI-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.58000	ft/ft
Discharge	7.01	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
10+39	670.00
10+54	665.00
10+69	658.56
10+77	657.65
10+82	660.00
10+93	667.45
11+17	677.65

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+39, 670.00)	(10+54, 665.00)	0.033
(10+54, 665.00)	(10+69, 658.56)	0.033
(10+69, 658.56)	(10+77, 657.65)	0.033
(10+77, 657.65)	(10+82, 660.00)	0.033
(10+82, 660.00)	(10+93, 667.45)	0.033
(10+93, 667.45)	(11+17, 677.65)	0.033

Results

Normal Depth	0.35	ft
Elevation Range	657.65 to 677.65 ft	
Flow Area	0.66	ft^2
Wetted Perimeter	3.87	ft
Top Width	3.78	ft
Normal Depth	0.35	ft

Worksheet for Pre Conditions POI-3

Results

Critical Depth		0.64	ft
Critical Slope		0.02401	ft/ft
Velocity		10.58	ft/s
Velocity Head		1.74	ft
Specific Energy		2.09	ft
Froude Number		4.45	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.64	ft
Channel Slope	0.58000	ft/ft
Critical Slope	0.02401	ft/ft

Cross Section for Pre Conditions POI-3

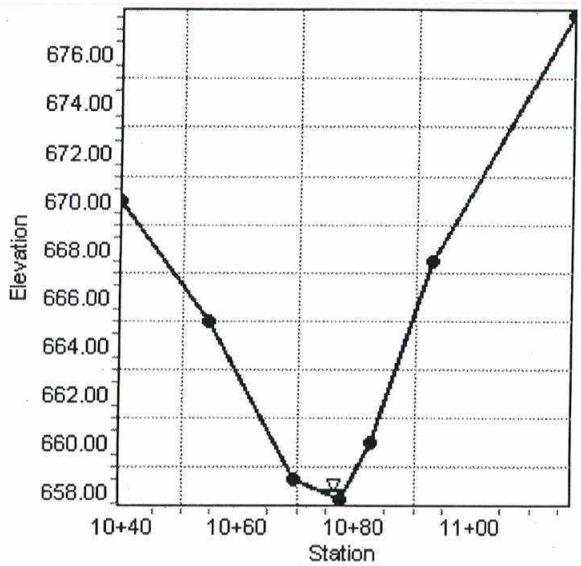
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

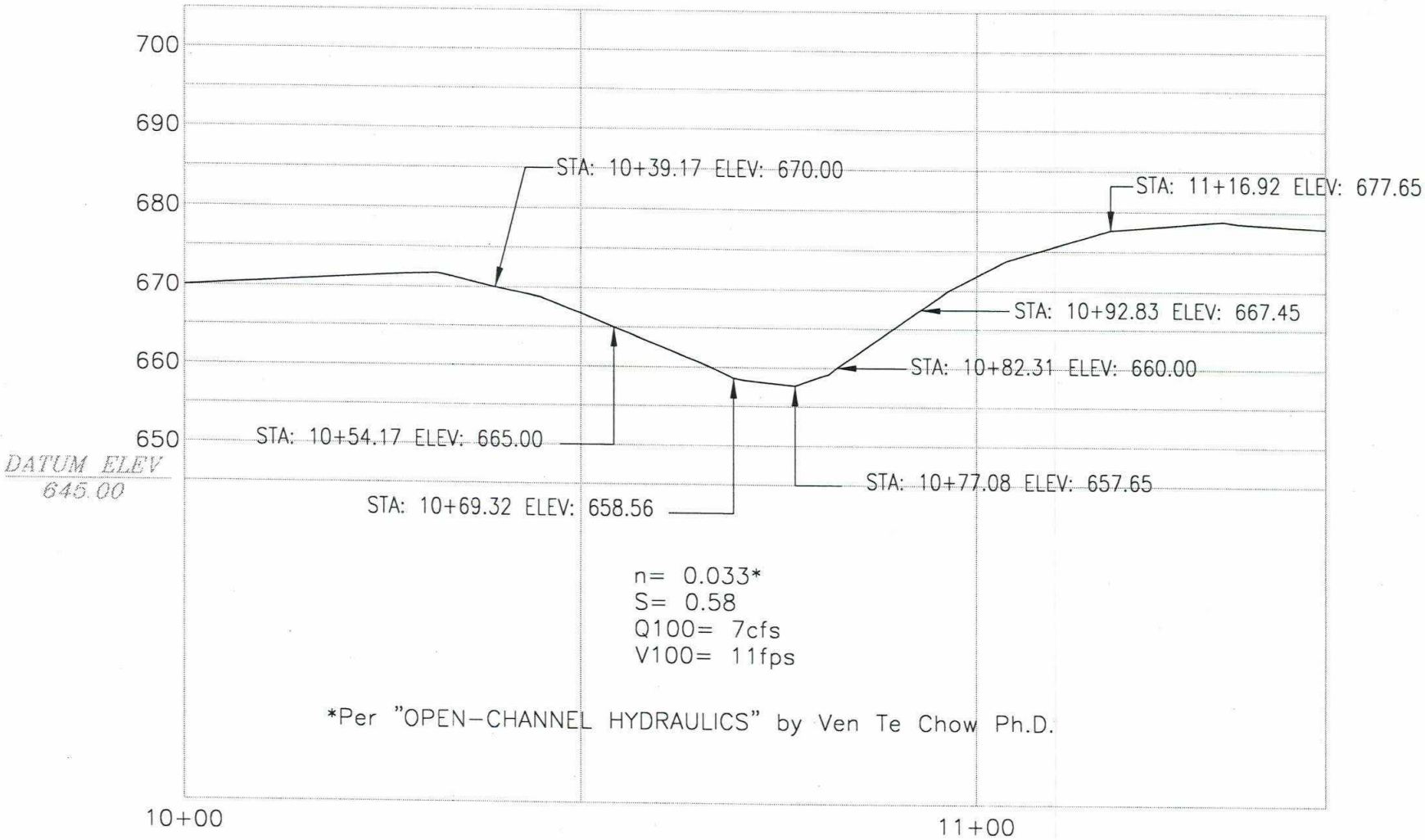
Input Data

Channel Slope	0.58000	ft/ft
Normal Depth	0.35	ft
Discharge	7.01	ft^3/s

Cross Section Image



PRE CONDITIONS



POI-3

Worksheet for Pre Conditions POI-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	39.05	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
10+00	740.00
10+13	735.00
10+26	730.00
10+88	730.00
11+21	740.00
11+47	749.97

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+00, 740.00)	(10+13, 735.00)	0.030
(10+13, 735.00)	(10+26, 730.00)	0.030
(10+26, 730.00)	(10+88, 730.00)	0.030
(10+88, 730.00)	(11+21, 740.00)	0.030
(11+21, 740.00)	(11+47, 749.97)	0.030

Results

Normal Depth	0.29	ft
Elevation Range	730.00 to 749.97 ft	
Flow Area	18.18	ft^2
Wetted Perimeter	63.58	ft
Top Width	63.49	ft
Normal Depth	0.29	ft
Critical Depth	0.23	ft
Critical Slope	0.02150	ft/ft

Worksheet for Pre Conditions POI-4

Results

Velocity		2.15	ft/s
Velocity Head		0.07	ft
Specific Energy		0.36	ft
Froude Number		0.71	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.29	ft
Critical Depth	0.23	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.02150	ft/ft

Cross Section for Pre Conditions POI-4

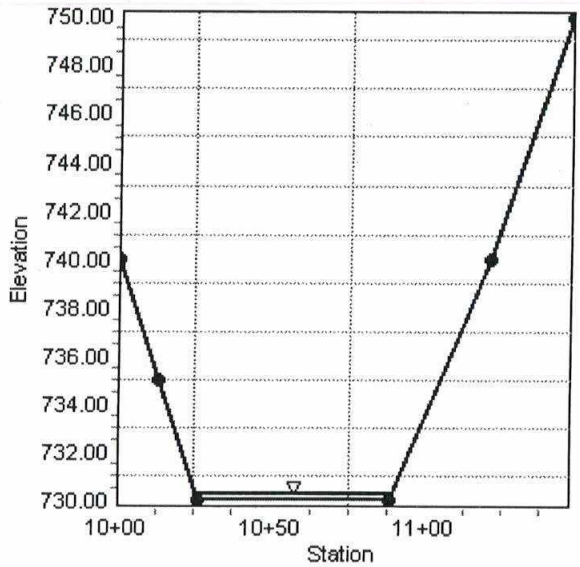
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.29	ft
Discharge	39.05	ft^3/s

Cross Section Image



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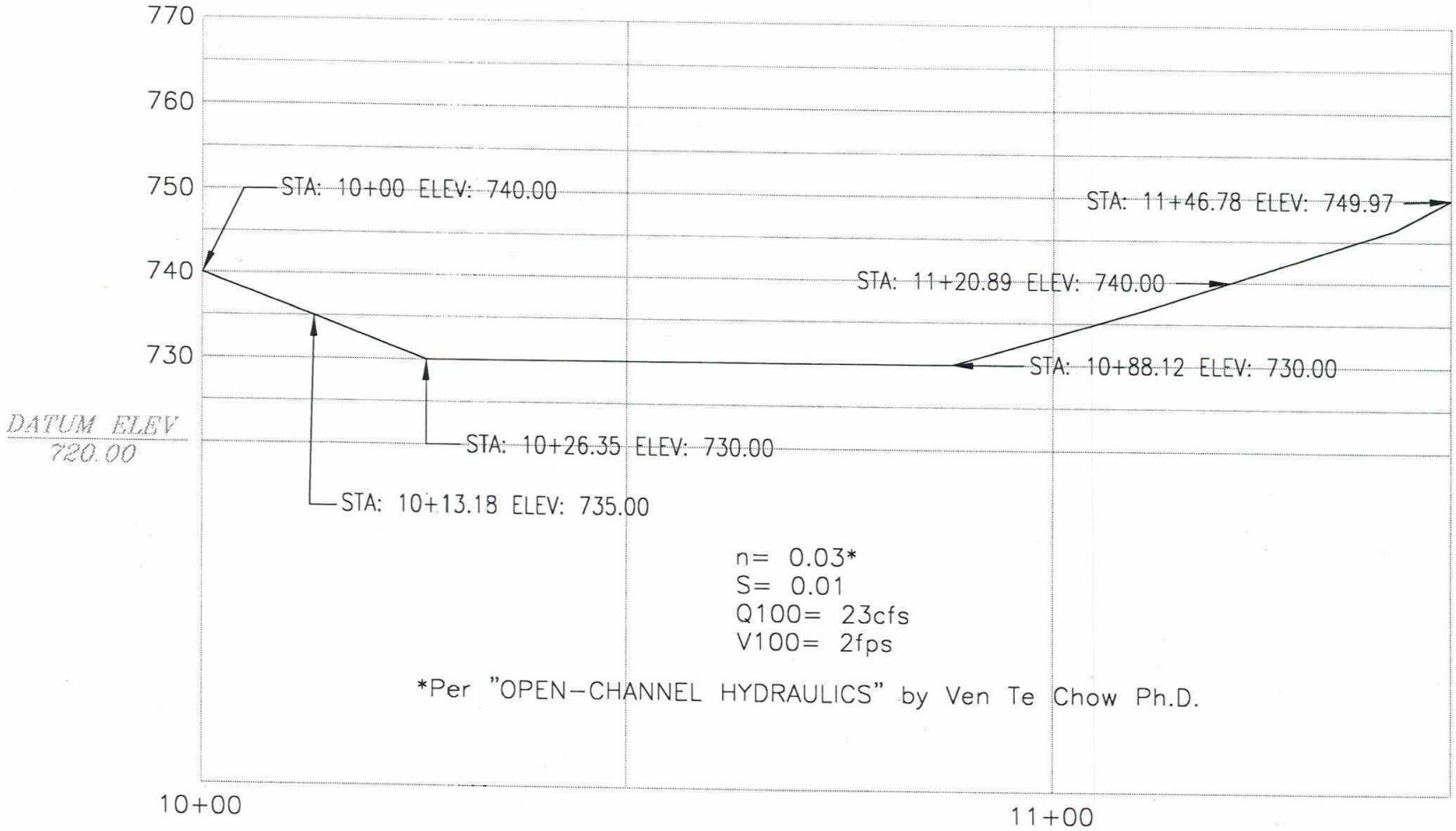
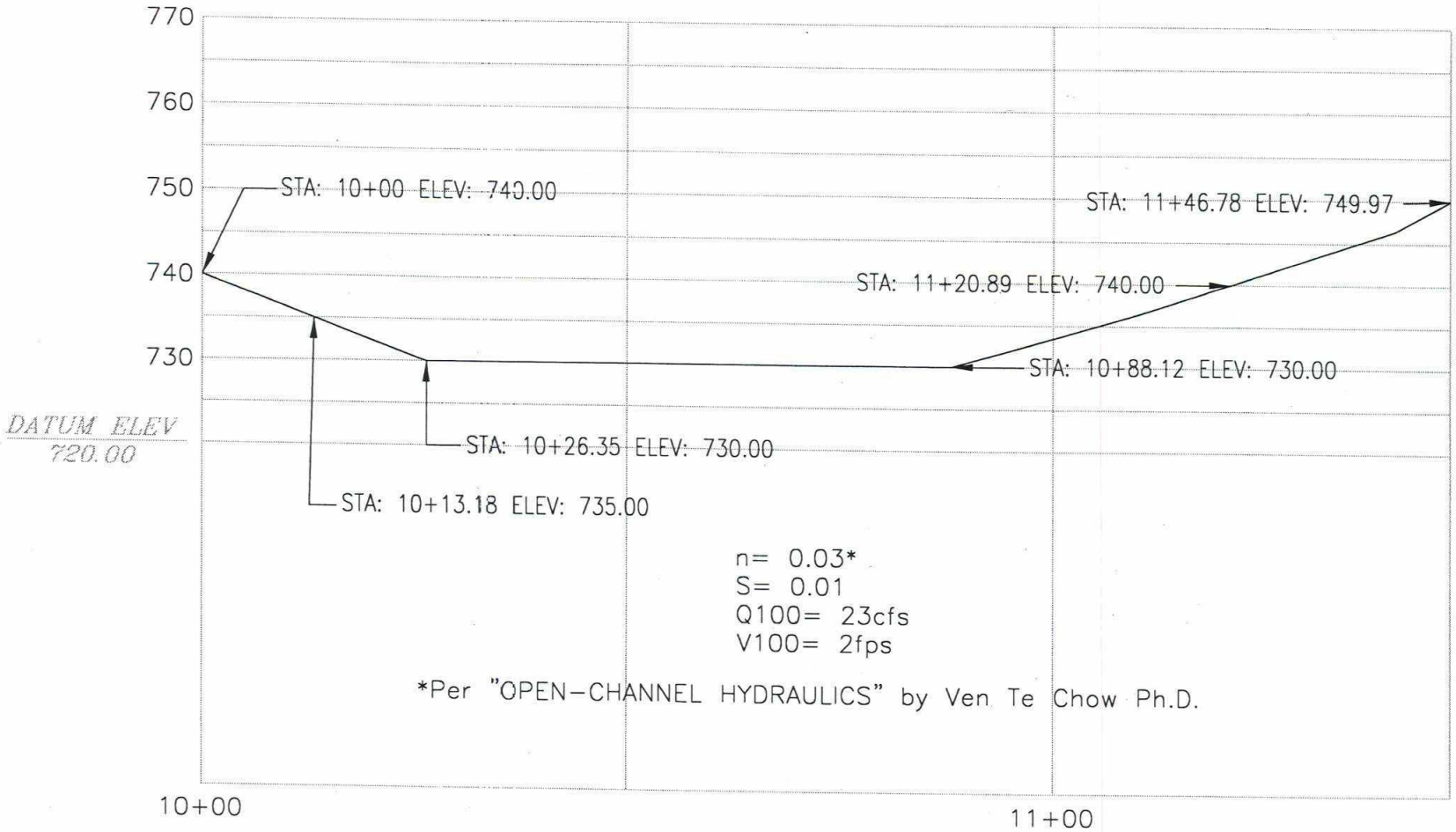


POI-4

PRE CONDITIONS



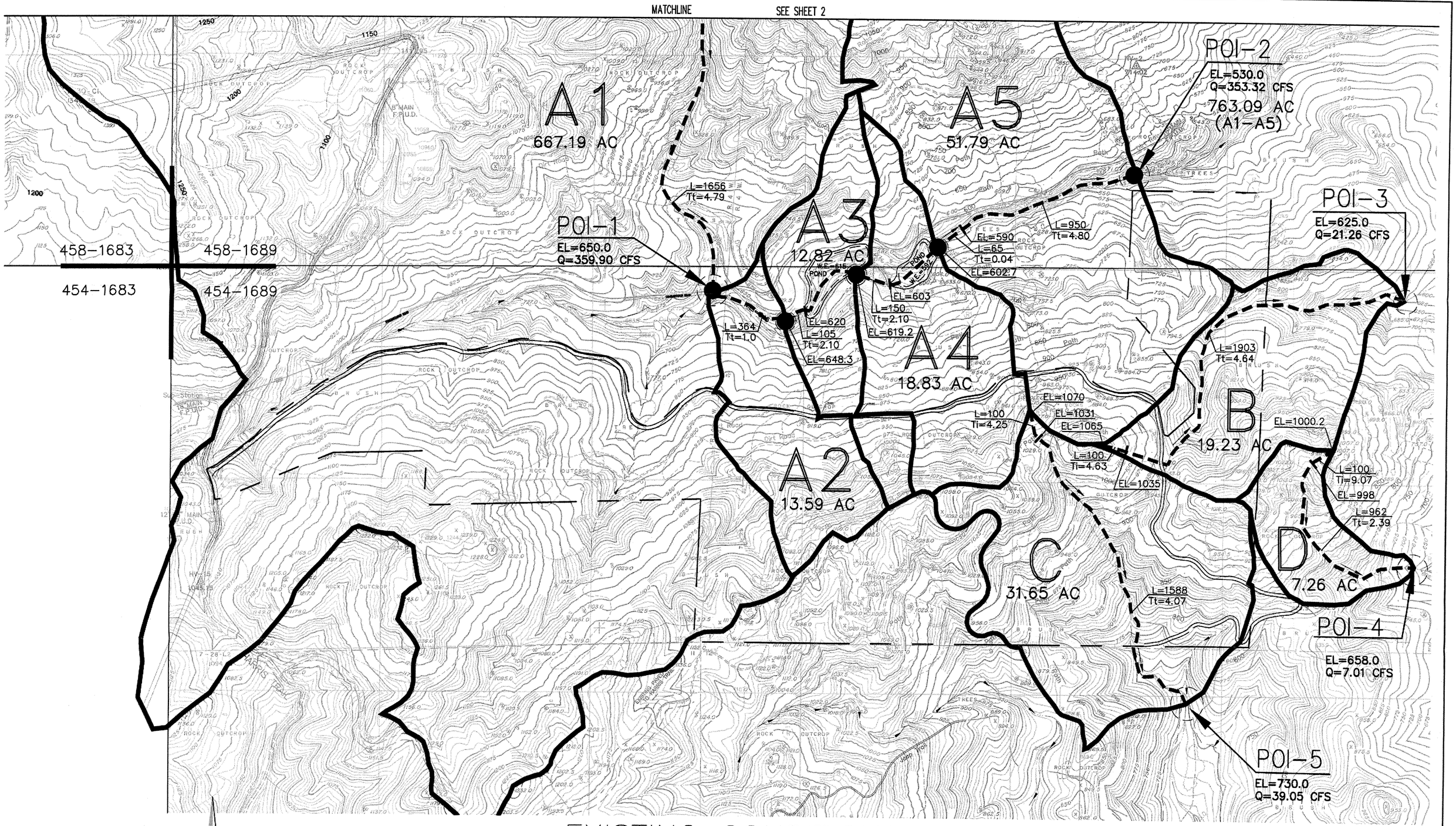
POI-4

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100



SCALE 1" = 200'

SAN DIEGUITO ENGINEERING, INC
4407 MANCHESTER, SUITE 105
ENCINITAS, CA 92024
PHONE: (760) 753-5525
CIVIL ENGINEERING • PLANNING
LAND SURVEYING

EXISTING CONDITIONS HYDROLOGY MAP CHANDLER

NOTE:
ACTUAL POND AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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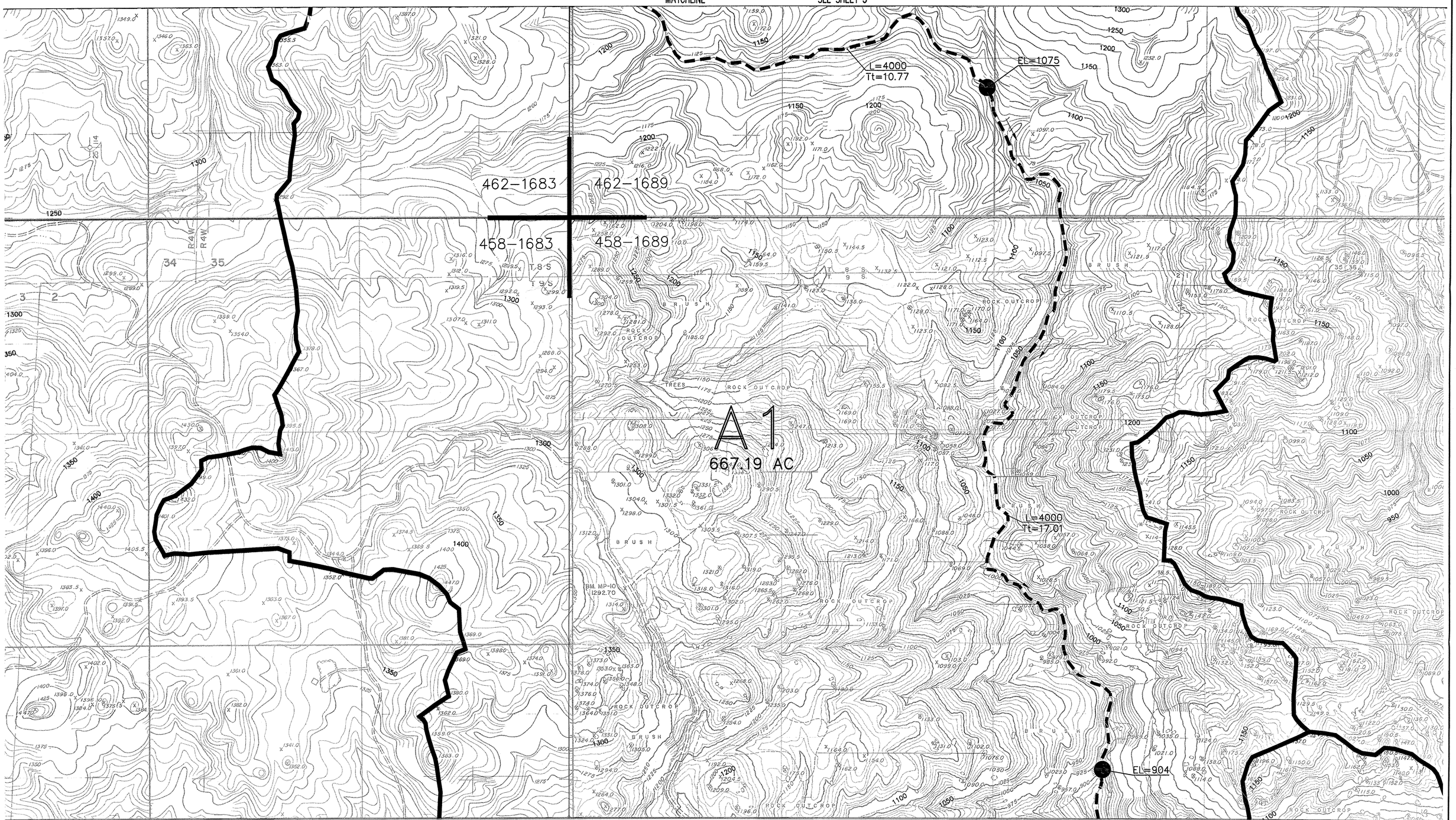

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EXISTING CONDITIONS
HYDROLOGY MAP
CHANDLER

NOTE:
ACTUAL POND AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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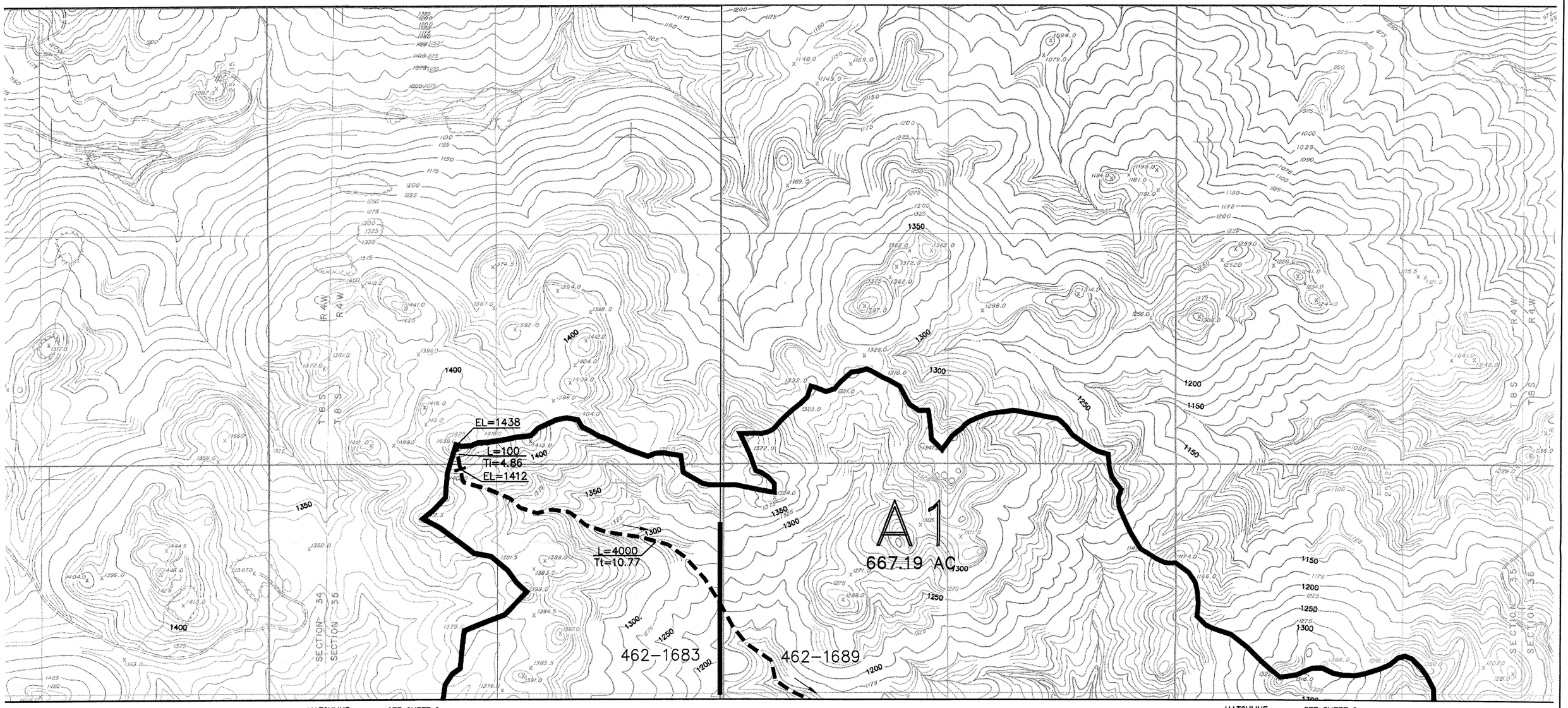

SCALE 1" = 200'

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EXISTING CONDITIONS HYDROLOGY MAP CHANDLER

NOTE:
ACTUAL POND AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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POST-CONSTRUCTION HYDROLOGY
PROPOSED CONDITIONS

HYDROLOGY STUDY

100 YEAR STORM

POST-CONSTRUCTION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 5/1/2011
COMMENT:

P6 (in): 2.50 P6/P24: 0.50
P24 (in): 5.00 ADJUSTED P6: 2.50
Soil types B &D, see NOTE below

Discharge Point	WATERSHED DESIGNATION	EVENT (year)	AREA (SF)	AREA (Ac)	SOIL GROUP	*1* C	Tc (min)	I (iph)	Q (cfs)	Post Development Comparison Q pre	(-)
POI-1	A1	100	29,062,672	667.19	B/D	0.30	37.4	1.80	359.90		
N/A	A2	100	192,971	4.43	B	0.25	1.0	N/A	N/A		
N/A	A3	100	850,174	19.52	B	0.31	3.1	N/A	N/A		
N/A	A4	100	854,690	19.62	B	0.26	2.1	N/A	N/A		
N/A	A5	100	2,232,974	51.26	B/D	0.29	4.8	N/A	N/A		
POI-2	**A**	**100**	**33,193,481**	**762.02**	**B/D**	**0.30**	**48.4**	**1.52**	**346.10**	353.32	7.22
POI-3	**B**	**100**	**871,911**	**20.02**	**B**	**0.28**	**20.1**	**2.69**	**15.07**	21.26	6.19
POI-5	**C**	**100**	**1,370,612**	**31.46**	**B**	**0.26**	**19.0**	**2.79**	**22.80**	39.05	16.25
POI-4	**D**	**100**	**337,537**	**7.75**	**B**	**0.27**	**16.8**	**3.01**	**6.31**	7.01	0.70

1 Coefficient based upon percent impervious and class "B" & "D" soils, see "RUNOFF COEFFICIENTS".

NOTES:

All calculations are based on the San Diego County Hydrology Manual, dated June 2003.
See attached calculations for runoff coefficients.
6- and 24-hr storm rainfall amount are based on San Diego County Isopluvial maps (attached).

Time of Concentration:

Calculations shown on following pages.

Intensity Calculations:

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

Q=CIA

HYDROLOGY STUDY

100 YEAR STORM

POST-CONSTRUCTION -TIME OF CONCENTRATION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 05.01.11
COMMENT:

L	TYPE	UPSTREAM ELEVATION	DOWNSTREAM ELEVATION	ΔH/ΔE*	SLOPE	T_t	Manual Referral
BASIN A1							
100	Overland	1438	1412	26	0.26	4.86	**Fig. 3-3**
4000	Natural **	1412	1075	448.3	0.11	10.77	**Fig. 3-4**
4000	Natural **	1075	904	136.8	0.03	17.01	**Fig. 3-4**
1656	Natural **	904	650	260.3	0.16	4.79	**Fig. 3-4**
					$\sum T_t = T_c =$	**37.43**	
BASIN A2							
364	Pond	*See Detention Pond Calculations*				1	**N/A**
					$\sum T_t = T_c =$	**1**	
BASIN A3							
100	Spillway #1	648.3	620	28.3	0.27	0.1	**See below**
N/A	Pond	*See Detention Pond Calculations*				3	**N/A**
					$\sum T_t = T_c =$	**3.1**	
BASIN A4							
150	Spillway #2	619.2	603	16.2	0.11	0.1	**See below**
N/A	Pond	*See Detention Pond Calculations*				2	**N/A**
					$\sum T_t = T_c =$	**2.1**	
BASIN A5							
65	Spillway #3	602.7	590	12.7	0.2	0.04	**See below**
950	Natural	590	530	50.1	0.05	4.76	**Fig. 3-4**
					$\sum T_t = T_c =$	**4.8**	
BASIN B							
70	Pad	1050.0	1049.3	0.7	0.01	12.05	**Fig. 3-3**
180	Pad	1049.3	1047.5	1.8	0.01	2.51	**Fig. 3-4**
191	Natural [1]	1047.5	955.0	92.5	0.48	0.59	**Fig. 3-4**
90	12" RCP	955.0	933.0	22.0	0.24	0.11	**See Below**
69	Natural [1]	933.0	917.0	16.0	0.23	0.36	**Fig. 3-4**
393	Brow ditch	917.0	890.0	27.0	0.07	0.83	**See Below**
1279	Natural [2]	890.0	625.0	250.0	0.20	3.61	**Fig. 3-4**
					$\sum T_t = T_c =$	**20.05**	

BASIN C							
70	Pad	1030.0	1029.3	0.7	0.01	12.05	**Fig. 3-3**
238	Pad	1029.3	1026.9	2.4	0.01	3.10	**Fig. 3-4**
1514	Natural [2]	1026.9	730.0	358.4	0.24	3.82	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**18.97**	
BASIN D							
70	Pad	1007.0	1006.3	0.7	0.01	12.05	**Fig. 3-3**
199	Pad	1006.3	1004.3	2.0	0.01	2.71	**Fig. 3-4**
870	Natural [2]	1004.3	658.0	346.8	0.40	2.04	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**16.80**	

* ΔE refers to the change in elevation along the **effective slope** line. See attached graphs.
** Per the SDC Hydrology Manual, Section 3.1.4.2, a maximum length of 4000' shall be used
[1] Refers to a natural slope that is very even. In this case $\Delta E = \Delta H$, no effective slope calc req'd.
[2] Refers to a natural slope that is uneven. Effective slope method required. See attached.

Overland-CALCULATED USING EQUATION FROM ATTACHED COUNTY "RATIONAL FORMULA - OVERLAND TIME OF FLOW NOMOGRAPH", FIGURE 3-3
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO.

Natural-CALCULATED USING THE EFFECTIVE SLOPE METHOD (SEE ATTACHED)

Tt-CALCULATED USING EQUATION FROM ATTACHED COUNTY NOMOGRAPH, FIGURE 3-4.
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO

BASIN A3
Spillway #1
Qout (from pond calcs) = 326.97 cfs
From flowmaster ouput: V=16.3 fps (see attached)
Longitudinal length of spillway = 100'
Tt = 100ft/16.3fps = 6.1 sec = **0.10 min**

BASIN A4
Spillway #2
Qout (from pond calcs) = 326.78 cfs
From flowmaster ouput: V= 24.7fps (see attached)
Longitudinal length of spillway = 150'
Tt = 150ft/24.7fps = 6.07 sec = **0.10 min**

BASIN 54
Spillway #3
Qout (from pond calcs) = 328.0 cfs
From flowmaster ouput: V=28.5 fps (see attached)
Longitudinal length of spillway = 65'
Tt = 65ft/28.5fps = 2.3 sec = **0.04min**

BASIN B

Assume that the pad has a earth swale sloped at 1% (max. L = 70')

Culvert Design:

Tributary area = 40,476 sf = 0.93 AC

Culvert T_t calculated using Flowmaster

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

$I = 7.44\ (2.5)\ 15.15^{(-0.645)} = 3.22$

$C_{comp} = 0.44$

Q = CIA = 0.44(3.22)0.93 = **1.31 cfs**

Per "Worksheet for Basin B - 12" RCP" attached, **T= 0.11 min**

Brow Ditch:

Tributary area = 187,024 sf = 4.29 AC

Brow dith T_t calculated using Flowmaster

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

$I = 7.44\ (2.5)\ 15.62^{(-0.645)} = 3.16$

$C_{comp} = 0.32$

Q = CIA = 0.32(3.16)4.29 = **4.34 cfs**

Per "Worksheet for Basin B - Brow Ditch" attached, **T= 0.83 min**

6-Hr Hydrograph for Basins A1&A2

Q=330.43 cfs
T= 43.2 min
A= 671.61 AC

0	0
43	32.09
86	39.22
129	44.67
172	65.59
215	93.24
258	330.43
301	52.61
344	35.2
387	0

6-Hr Hydrograph for Basins A3

Q=18.0 cfs
T= 45.3 min
A= 19.52 AC

0	0
45	1.75
90	2.14
135	2.44
180	3.58
225	5.12
270	18
315	2.87
360	1.92
405	0

6-Hr Hydrograph for Basins A4

Q=8.1 cfs
T= 48 min
A= 19.62 AC

0	0
48	0.79
96	0.96
144	1.09
192	1.61
240	2.28
288	8.1
336	1.29
384	0.86
432	0

DETENTION POND CALCULATIONS

Worksheet for Spillway #1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.27000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	140.00	ft
Discharge	331.08	ft^3/s

Results

Normal Depth	0.14	ft
Flow Area	20.27	ft^2
Wetted Perimeter	140.65	ft
Top Width	140.58	ft
Critical Depth	0.56	ft
Critical Slope	0.00301	ft/ft
Velocity	16.33	ft/s
Velocity Head	4.14	ft
Specific Energy	4.29	ft
Froude Number	7.58	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.56	ft
Channel Slope	0.27000	ft/ft
Critical Slope	0.00301	ft/ft

Worksheet for Spillway #2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.11000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	22.00	ft
Discharge	321.35	ft^3/s

Results

Normal Depth	0.56	ft
Flow Area	13.08	ft^2
Wetted Perimeter	25.10	ft
Top Width	24.80	ft
Critical Depth	1.75	ft
Critical Slope	0.00224	ft/ft
Velocity	24.57	ft/s
Velocity Head	9.38	ft
Specific Energy	9.94	ft
Froude Number	5.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.56	ft
Critical Depth	1.75	ft
Channel Slope	0.11000	ft/ft
Critical Slope	0.00224	ft/ft

Worksheet for Spillway #3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.20000	ft/ft
Left Side Slope	7.00	ft/ft (H:V)
Right Side Slope	7.00	ft/ft (H:V)
Bottom Width	21.00	ft
Discharge	321.88	ft^3/s

Results

Normal Depth	0.47	ft
Flow Area	11.38	ft^2
Wetted Perimeter	27.63	ft
Top Width	27.56	ft
Critical Depth	1.61	ft
Critical Slope	0.00234	ft/ft
Velocity	28.29	ft/s
Velocity Head	12.44	ft
Specific Energy	12.91	ft
Froude Number	7.76	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	1.61	ft
Channel Slope	0.20000	ft/ft
Critical Slope	0.00234	ft/ft

JOB TITLE

Project Date: 4/24/2007
Project Engineer: Sophie Tuong
Project Title: Chandler
Project Comments:
The existing 3-pond system was modeled using weirs as outlet structures linking the ponds topgether. Each pond was modeled as having the outlet spillway elevation for its "bottom" elevation. In order to form a volume, additional elevation-area relationships were added and higher contours were artificially tied at the spilway.
The outlet structures (spillways) were modeled to match existing shape. A weir coefficient of 3.0 was used for calculations.
A lag time of 1 minute was calculated for the pond in A2.
Calculations for pond in A3 & A4 returned a lag time of 2 minutes.
Peak flow rates coming out of the pond were used to route the runoff through the spillways, therefore determining actual travel time.

MASTER DESIGN STORM SUMMARY

Hydrograph Queue Only Network

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 3 node(s)

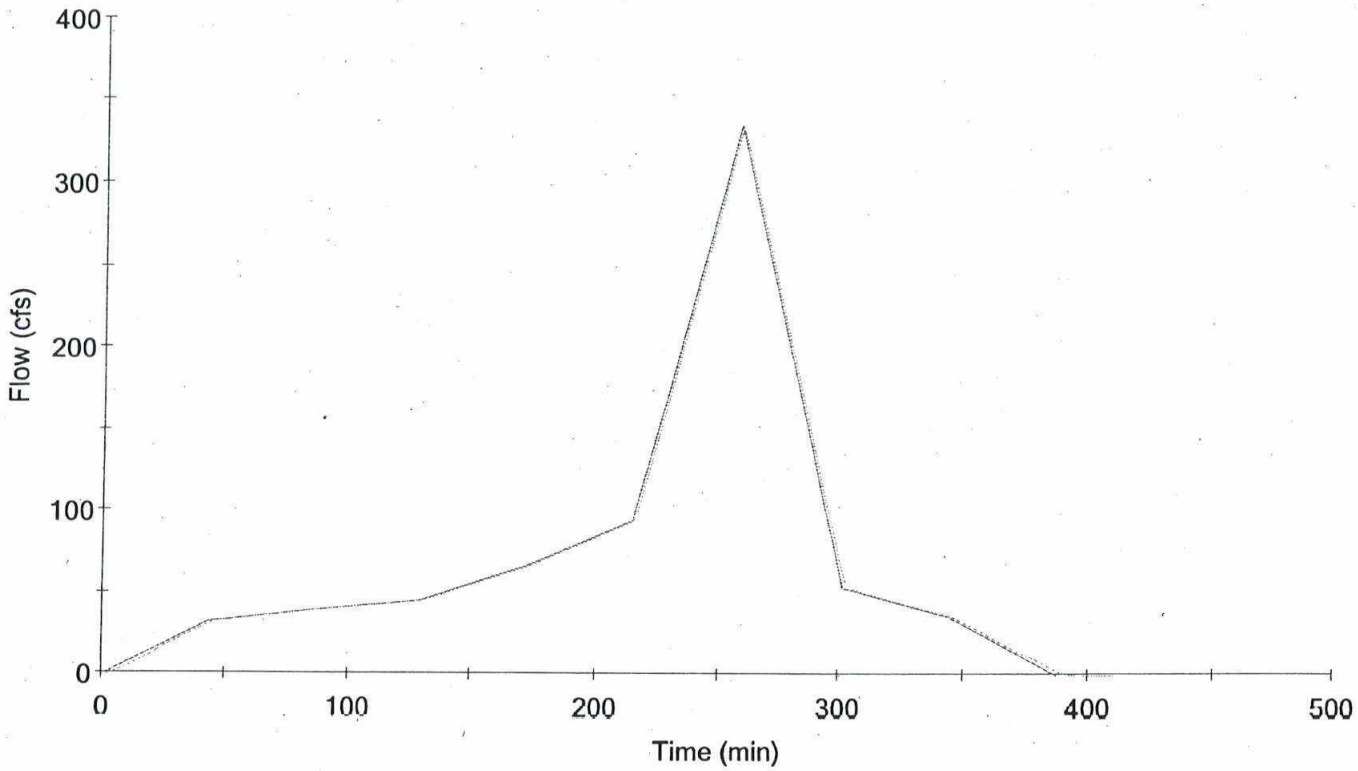
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol cu.ft	Trun	Qpeak min	Qpeak cfs	Max WSEL ft	Max Pond Storage cu.ft
100 YEAR - A3	HYG	100yr	28890		270.00	5.10		
100 YEAR - A4	HYG	100yr	42394		288.00	7.03		
100 YEAR A1-A2	HYG	100yr	1810592		258.00	334.59		
*OUT 10	JCT	100yr	1881875		264.00	321.88		
POND IN A2 IN	POND	100yr	1810592		258.00	334.59		
POND IN A2 OUT	POND	100yr	1810591		259.00	331.08	649.15	22297
POND IN A3 IN	POND	100yr	1839481		259.00	335.29		
POND IN A3 OUT	POND	100yr	1839481		261.00	321.35	620.10	53463
POND IN A4 IN	POND	100yr	1881875		262.00	325.59		
POND IN A4 OUT	POND	100yr	1881875		264.00	321.88	603.46	22114

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\PRE\
Inflow  HYG file = NONE STORED - POND IN A2   IN  100yr
Outflow HYG file = NONE STORED - POND IN A2   OUT 100yr

Pond Node   Data = POND IN A2
Pond Volume Data = POND IN A2
Pond Outlet Data = Spillway 1

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   648.30 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    334.59 cfs    at    258.00 min
Peak Outflow      =    331.08 cfs    at    259.00 min
-----------------------------------------------------
Peak Elevation    =    649.15 ft
Peak Storage =          22297 cu.ft
=====================================================


MASS BALANCE (cu.ft)
--------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =    1810592
- Infiltration =          0
- HYG Vol OUT  =    1810591
- Retained Vol =          0
                 ----------
Unrouted Vol =          -1 cu.ft  (.000% of Inflow Volume)
```

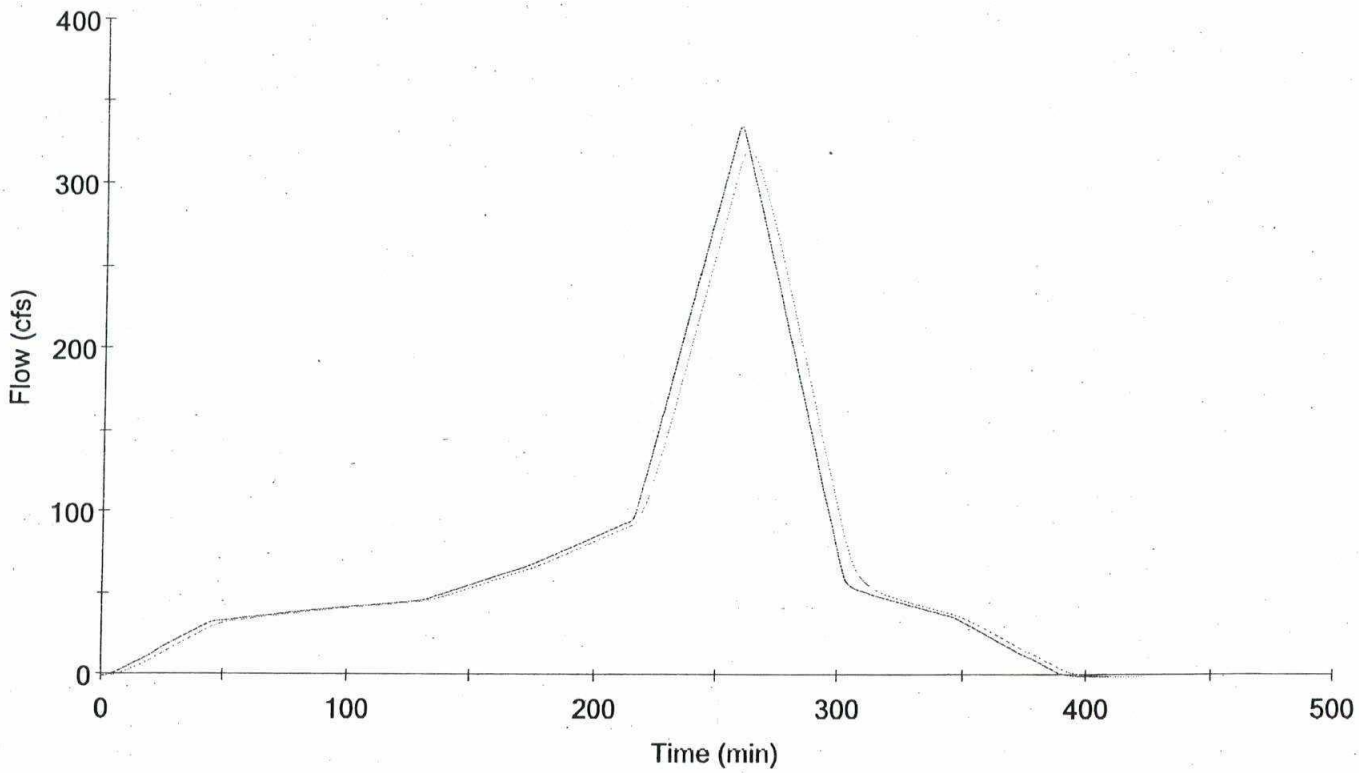
Hydrograph
POND IN A2 OUT 100yr



LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\PRE\
Inflow  HYG file = NONE STORED - POND IN A3   IN  100yr
Outflow HYG file = NONE STORED - POND IN A3   OUT 100yr

Pond Node   Data = POND IN A3
Pond Volume Data = POND IN A3
Pond Outlet Data = Spillway 2

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   619.20 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    335.29 cfs    at    259.00 min
Peak Outflow      =    321.35 cfs    at    261.00 min
-----------------------------------------------------
Peak Elevation    =    620.10 ft
Peak Storage =          53463 cu.ft
=====================================================


MASS BALANCE (cu.ft)
--------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =    1839481
- Infiltration =          0
- HYG Vol OUT  =    1839481
- Retained Vol =          0
                 ----------
Unrouted Vol = -            cu.ft  (.000% of Inflow Volume)
```

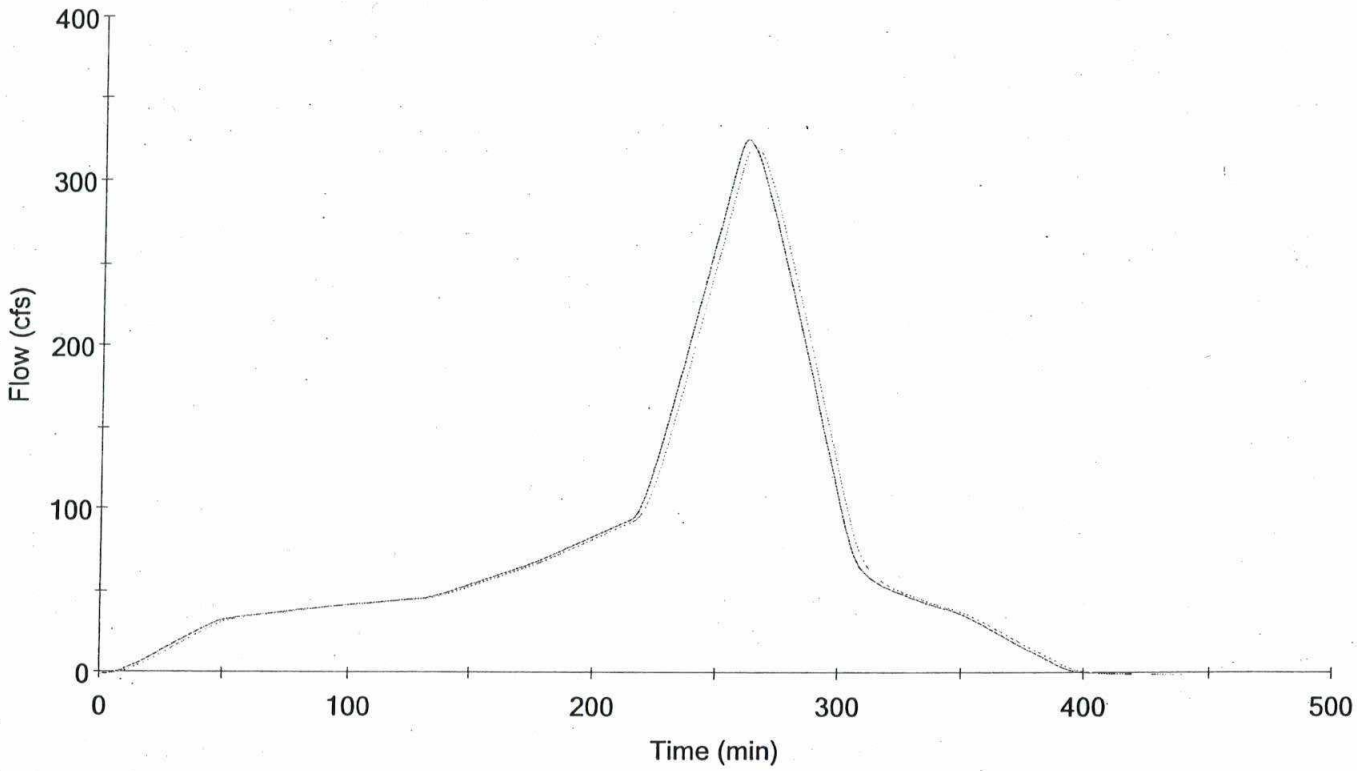
Hydrograph
POND IN A3 OUT 100yr



LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\PRE\
Inflow  HYG file = NONE STORED - POND IN A4   IN  100yr
Outflow HYG file = NONE STORED - POND IN A4   OUT 100yr

Pond Node   Data = POND IN A4
Pond Volume Data = POND IN A4
Pond Outlet Data = Spillway 3

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   602.70 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    325.59 cfs    at    262.00 min
Peak Outflow      =    321.88 cfs    at    264.00 min
-----------------------------------------------------
Peak Elevation    =    603.46 ft
Peak Storage =          22114 cu.ft
=====================================================


MASS BALANCE (cu.ft)
--------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =    1881875
- Infiltration =          0
- HYG Vol OUT  =    1881875
- Retained Vol =          0
               ----------
Unrouted Vol =          -1 cu.ft  (.000% of Inflow Volume)
```

Hydrograph
POND IN A4 OUT 100yr



Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
648.30	-----	26055	0	0	0
649.00	-----	26055	78165	18239	18239
650.00	-----	33599	89242	29747	47986

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
619.20	-----	59223	0	0	0
620.00	-----	59223	177669	47378	47378
630.00	-----	78405	205770	685901	733279
640.00	-----	102103	269981	899936	1633215
650.00	-----	128014	344444	1148146	2781361

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
602.70	-----	28333	0	0	0
610.00	-----	48020	113239	275547	275547
620.00	-----	69411	175164	583881	859427
630.00	-----	69411	208233	694110	1553537
640.00	-----	69411	208233	694110	2247648
650.00	-----	69411	208233	694110	2941758

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

HYDROLOGY STUDY

100 YEAR STORM

POST-CONSTRUCTION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 2/6/2008
COMMENT:

P6 (in): 2.50 P6/P24: 0.50
P24 (in): 5.00 ADJUSTED P6: 2.50
Soil types B &D, see NOTE below

Discharge Point	WATERSHED DESIGNATION	EVENT (year)	AREA (SF)	AREA (Ac)	SOIL GROUP	*1* C	Tc (min)	I (iph)	Q (cfs)	Q pre	(-)
POI-1	A1	100	29,062,672	667.19	B/D	0.30	37.4	1.80	359.90		
N/A	A2	100	192,971	4.43	B	0.25	1.0	N/A	N/A		
N/A	A3	100	850,174	19.52	B	0.31	3.1	N/A	N/A		
N/A	A4	100	854,690	19.62	B	0.26	2.1	N/A	N/A		
N/A	A5	100	2,232,974	51.26	B/D	0.29	4.8	N/A	N/A		
POI-2	**A**	**100**	**33,193,481**	**762.02**	**B/D**	**0.30**	**48.4**	**1.52**	**346.10**	353.32	7.22
POI-3	**B**	**100**	**871,911**	**20.02**	**B**	**0.28**	**20.1**	**2.69**	**15.07**	21.26	6.19
POI-5	**C**	**100**	**1,370,612**	**31.46**	**B**	**0.26**	**19.0**	**2.79**	**22.80**	39.05	16.25
POI-4	**D**	**100**	**337,537**	**7.75**	**B**	**0.27**	**16.8**	**3.01**	**6.31**	7.01	0.70

1 Coefficient based upon percent impervious and class "B" & "D" soils, see "RUNOFF COEFFICIENTS".

NOTES:

All calculations are based on the San Diego County Hydrology Manual, dated June 2003.
See attached calculations for runoff coefficients.
6- and 24-hr storm rainfall amount are based on San Diego County Isopluvial maps (attached).

Time of Concentration:

Calculations shown on following pages.

Intensity Calculations:

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

Q=CIA

Run-off Coeficient Worksheet
PRE-CONSTRUCTION CONDITIONS

BASIN	TOT. AREA(sf)	TOTAL IMP. PRIV. ROAD AREA	IMP. AREA [2]	% IMP. [3]	TOTAL [1] SOIL B AREA(sf)	TOTAL [1] SOIL D AREA(sf)				
A1	29,032,973	189,796	189,796	1%	14,771,058	14,071,889				
A2	592,039	12,844	12,844	2%	579,068	0				
A3	558,608	10,345	10,345	2%	547,543	0				
A4	800,509	9,520	9,520	1%	790,663	0				
A5	2,255,924	10,068	10,068	0%	1,543,152	702,704	% SOIL B	% SOIL D	Cp [4]	C [5]
A	33,240,053		232,572	1%	18,231,484	14,774,593	55%	44%	0.29	**0.30**

BASIN	TOT. AREA(sf)	TOTAL IMP. PRIV. ROAD AREA	IMP. AREA	% IMP.	TOTAL SOIL B AREA(sf)	TOTAL SOIL D AREA(sf)	% SOIL B	% SOIL D	Cp	C
B	837,820	4,965	4,965	1%	832,855	0	99%	0%	0.25	**0.25**

BASIN	TOT. AREA(sf)	TOTAL IMP. PRIV. ROAD AREA	IMP. AREA	% IMP.	TOTAL SOIL B AREA(sf)	TOTAL SOIL D AREA(sf)	% SOIL B	% SOIL D	C_p	C
C	1,378,841	21,502	21,502	2%	1,357,339	0	98%	0%	0.25	**0.26**

BASIN	TOT. AREA(sf)	TOTAL IMP. PRIV. ROAD AREA	IMP. AREA	% IMP.	TOTAL SOIL B AREA(sf)	TOTAL SOIL D AREA(sf)	% SOIL B	% SOIL D	C_p	C
D	316,387	539	539	0%	315,849	0	100%	0%	0.25	**0.25**

NOTES:

1) This is the total Undisturbed Natural Terrain/Open Space area for the noted soil type in a given basin or sub-basin.
2) The sum of the impervious areas created by private roads. Derived as follows:
Private Roads - the ratio of paved width to graded width (14'/17') = **82%**
3) The percent impervious is calculated as the impervious area divided by the total area.
4) C_p is calculated as the weighted C value for the selected Basin. C was taken as the run-off coefficient for Undisturbed Natural Terrain/Open Space for soil types B and D.
from Table 3-5 of the County Hydrology Manual. **The formula used was (% Soil B) x (0.25) + (%Soil D) x (0.35).**
5) C is calculated from **C = 0.90 x (% Impervious) + C_p x (1 - % Impervious)**. This formula is from page 3-5 of the County Hydrology Manual.

HYDROLOGY STUDY

100 YEAR STORM

POST-CONSTRUCTION -TIME OF CONCENTRATION

PROJECT NAME: Chandler
PROJECT NUMBER: 5108
DATE: 4/24/2007
COMMENT:

L	TYPE	UPSTREAM ELEVATION	DOWNSTREAM ELEVATION	ΔH/ΔE*	SLOPE	T_t	Manual Referral
BASIN A1							
100	Overland	1438	1412	26	0.26	4.86	**Fig. 3-3**
4000	Natural **	1412	1075	448.3	0.11	10.77	**Fig. 3-4**
4000	Natural **	1075	904	136.8	0.03	17.01	**Fig. 3-4**
1656	Natural **	904	650	260.3	0.16	4.79	**Fig. 3-4**
					$\sum T_t = T_c =$	**37.43**	
BASIN A2							
364	Pond	*See Detention Pond Calculations*				1	**N/A**
					$\sum T_t = T_c =$	**1**	
BASIN A3							
100	Spillway #1	648.3	620	28.3	0.27	0.1	**See below**
N/A	Pond	*See Detention Pond Calculations*				3	**N/A**
					$\sum T_t = T_c =$	**3.1**	
BASIN A4							
150	Spillway #2	619.2	603	16.2	0.11	0.1	**See below**
N/A	Pond	*See Detention Pond Calculations*				2	**N/A**
					$\sum T_t = T_c =$	**2.1**	
BASIN A5							
65	Spillway #3	602.7	590	12.7	0.2	0.04	**See below**
950	Natural	590	530	50.1	0.05	4.76	**Fig. 3-4**
					$\sum T_t = T_c =$	**4.8**	
BASIN B							
70	Pad	1050.0	1049.3	0.7	0.01	12.05	**Fig. 3-3**
180	Pad	1049.3	1047.5	1.8	0.01	2.51	**Fig. 3-4**
191	Natural [1]	1047.5	955.0	92.5	0.48	0.59	**Fig. 3-4**
90	12" RCP	955.0	933.0	22.0	0.24	0.11	**See Below**
69	Natural [1]	933.0	917.0	16.0	0.23	0.36	**Fig. 3-4**
393	Brow ditch	917.0	890.0	27.0	0.07	0.83	**See Below**
1279	Natural [2]	890.0	625.0	250.0	0.20	3.61	**Fig. 3-4**
					$\sum T_t = T_c =$	**20.05**	

BASIN C							
70	Pad	1030.0	1029.3	0.7	0.01	12.05	**Fig. 3-3**
238	Pad	1029.3	1026.9	2.4	0.01	3.10	**Fig. 3-4**
1514	Natural [2]	1026.9	730.0	358.4	0.24	3.82	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**18.97**	
BASIN D							
70	Pad	1007.0	1006.3	0.7	0.01	12.05	**Fig. 3-3**
199	Pad	1006.3	1004.3	2.0	0.01	2.71	**Fig. 3-4**
870	Natural [2]	1004.3	658.0	346.8	0.40	2.04	**Fig. 3-4**
					$\Sigma T_t = T_c =$	**16.80**	

* ΔE refers to the change in elevation along the **effective slope** line. See attached graphs.
** Per the SDC Hydrology Manual, Section 3.1.4.2, a maximum length of 4000' shall be used
[1] Refers to a natural slope that is very even. In this case ΔE=ΔH, no effective slope calc req'd.
[2] Refers to a natural slope that is uneven. Effective slope method required. See attached.

Overland-CALCULATED USING EQUATION FROM ATTACHED COUNTY "RATIONAL FORMULA - OVERLAND TIME OF FLOW NOMOGRAPH", FIGURE 3-3
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO.

Natural-CALCULATED USING THE EFFECTIVE SLOPE METHOD (SEE ATTACHED)

Tt-CALCULATED USING EQUATION FROM ATTACHED COUNTY NOMOGRAPH, FIGURE 3-4.
INFORMATION OBTAINED FROM COUNTY 200 SCALE TOPO

BASIN A3
Spillway #1
Qout (from pond calcs) = 326.97 cfs
From flowmaster ouput: V=16.3 fps (see attached)
Longitudinal length of spillway = 100'
Tt = 100ft/16.3fps = 6.1 sec = **0.10 min**

BASIN A4
Spillway #2
Qout (from pond calcs) = 326.78 cfs
From flowmaster ouput: V= 24.7fps (see attached)
Longitudinal length of spillway = 150'
Tt = 150ft/24.7fps = 6.07 sec = **0.10 min**

BASIN 54
Spillway #3
Qout (from pond calcs) = 328.0 cfs
From flowmaster ouput: V=28.5 fps (see attached)
Longitudinal length of spillway = 65'
Tt = 65ft/28.5fps = 2.3 sec = **0.04min**

BASIN B

Assume that the pad has a earth swale sloped at 1% (max. L = 70')

Culvert Design:

Tributary area = 40,476 sf = 0.93 AC

Culvert T_t calculated using Flowmaster.

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

$I = 7.44\ (2.5)\ 15.15^{(-0.645)} = 3.22$

$C_{comp} = 0.44$

Q = CIA = 0.44(3.22)0.93 = **1.31 cfs**

Per "Worksheet for Basin B - 12" RCP" attached, **T= 0.11 min**

Brow Ditch:

Tributary area = 187,024 sf = 4.29 AC

Brow dith T_t calculated using Flowmaster

$I = 7.44\ (adj\text{-}P_6)\ Tc^{(-0.645)}$

$I = 7.44\ (2.5)\ 15.62^{(-0.645)} = 3.16$

C values for sub-basins (for Culvert/Brow Ditch design)

Basin B:

1st culvert
total A = 40,476 sf
soil type B (natural) = 20,225 sf => C=0.25
Pad = 20,221 sf (60% IMP) => C=0.64
COMP C = 0.44

Brow ditch
total A = 187,024 sf
soil type B (natural) = 156,803 sf => C=0.25
Pad = 20,221 sf (60% IMP) => C=0.64
Dwy = 500'x12'=10,000 sf (80% IMP) => C=0.77
COMP C = 0.32

6-Hr Hydrograph for Basins A1&A2

Q=330.43 cfs
T= 43.2 min
A= 671.61 AC

0	0
43	32.09
86	39.22
129	44.67
172	65.59
215	93.24
258	330.43
301	52.61
344	35.2
387	0

6-Hr Hydrograph for Basins A3

Q=18.0 cfs
T= 45.3 min
A= 19.52 AC

0	0
45	1.75
90	2.14
135	2.44
180	3.58
225	5.12
270	18
315	2.87
360	1.92
405	0

6-Hr Hydrograph for Basins A4

Q=8.1 cfs
T= 48 min
A= 19.62 AC

0	0
48	0.79
96	0.96
144	1.09
192	1.61
240	2.28
288	8.1
336	1.29
384	0.86
432	0

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	12.0000 in
Flowrate	1.3300 cfs
Slope	0.2400 ft/ft
Manning's n	0.0130

Computed Results:

Depth	2.2411 in
Area	0.7854 ft2
Wetted Area	0.1014 ft2
Wetted Perimeter	10.7252 in
Perimeter	37.6991 in
Velocity	13.1208 fps
Hydraulic Radius	1.3610 in
Percent Full	18.6759 %
Full flow Flowrate	17.4541 cfs
Full flow velocity	22.2233 fps

Critical Information

Critical depth	5.8501 in
Critical slope	0.0061 ft/ft
Critical velocity	3.4981 fps
Critical area	0.3802 ft2
Critical perimeter	18.5497 in
Critical hydraulic radius	2.9515 in
Critical top width	11.9963 in
Specific energy	2.8621 ft
Minimum energy	0.7313 ft
Froude number	6.4143
Flow condition	Supercritical

Manning Pipe Calculator

Given Input Data:

Shape	Circular
Solving for	Depth of Flow
Diameter	12.0000 in
Flowrate	1.3300 cfs
Slope	0.2400 ft/ft
Manning's n	0.0130

Computed Results:

Depth	2.2411 in
Area	0.7854 ft2
Wetted Area	0.1014 ft2
Wetted Perimeter	10.7252 in
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Critical Information

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Specific energy	2.8621 ft
Minimum energy	0.7313 ft
Froude number	6.4143
Flow condition	Supercritical

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	**0.022**	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. Minor streams (top width at flood stage <100 ft)			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	**0.030**	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

Worksheet for Post Conditions POI-1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.19600	ft/ft
Discharge	354.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
10+17	540.00
10+31	535.00
10+44	530.00
10+89	530.00
11+11	540.00
11+34	554.51

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+17, 540.00)	(10+31, 535.00)	0.030
(10+31, 535.00)	(10+44, 530.00)	0.030
(10+44, 530.00)	(10+89, 530.00)	0.030
(10+89, 530.00)	(11+11, 540.00)	0.030
(11+11, 540.00)	(11+34, 554.51)	0.030

Results

Normal Depth	0.54	ft
Elevation Range	530.00 to 554.51 ft	
Flow Area	24.89	ft²
Wetted Perimeter	47.69	ft
Top Width	47.47	ft
Normal Depth	0.54	ft
Critical Depth	1.22	ft
Critical Slope	0.01269	ft/ft

Worksheet for Post Conditions POI-1

Results

Velocity		14.22	ft/s
Velocity Head		3.14	ft
Specific Energy		3.68	ft
Froude Number		3.46	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	1.22	ft
Channel Slope	0.19600	ft/ft
Critical Slope	0.01269	ft/ft

Cross Section for Post Conditions POI-1

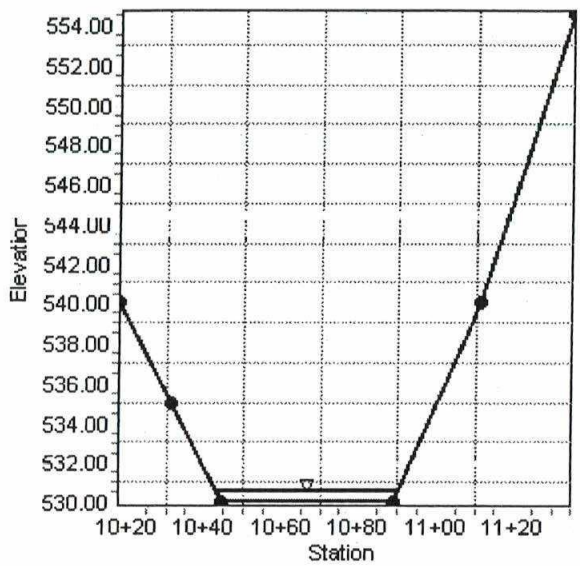
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

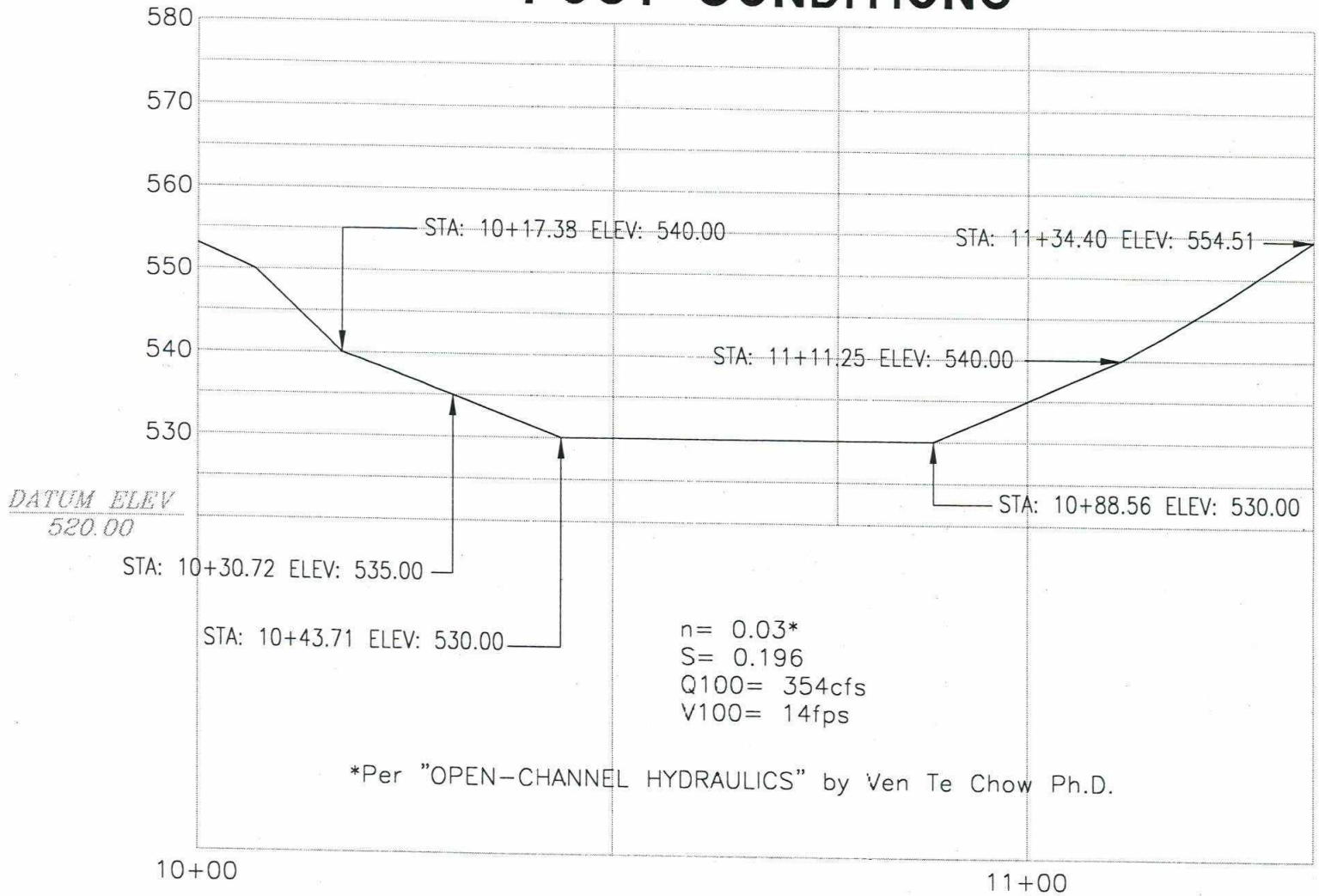
Input Data

Channel Slope	0.19600	ft/ft
Normal Depth	0.54	ft
Discharge	354.00	ft^3/s

Cross Section Image



POST CONDITIONS



POI-1

Worksheet for Post Conditions POI-2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02100	ft/ft
Discharge	15.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
10+32	800.00
10+52	790.00
10+84	780.00
11+02	780.00
11+20	780.00
11+54	790.00
11+86	804.73

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+32, 800.00)	(10+52, 790.00)	0.033
(10+52, 790.00)	(10+84, 780.00)	0.033
(10+84, 780.00)	(11+02, 780.00)	0.033
(11+02, 780.00)	(11+20, 780.00)	0.033
(11+20, 780.00)	(11+54, 790.00)	0.033
(11+54, 790.00)	(11+86, 804.73)	0.033

Results

Normal Depth	0.19	ft
Elevation Range	780.00 to 804.73 ft	
Flow Area	7.07	ft²
Wetted Perimeter	38.09	ft
Top Width	38.03	ft
Normal Depth	0.19	ft

Worksheet for Post Conditions POI-2

Results

Critical Depth		0.17	ft
Critical Slope		0.02872	ft/ft
Velocity		2.12	ft/s
Velocity Head		0.07	ft
Specific Energy		0.26	ft
Froude Number		0.87	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.19	ft
Critical Depth	0.17	ft
Channel Slope	0.02100	ft/ft
Critical Slope	0.02872	ft/ft

Cross Section for Post Conditions POI-2

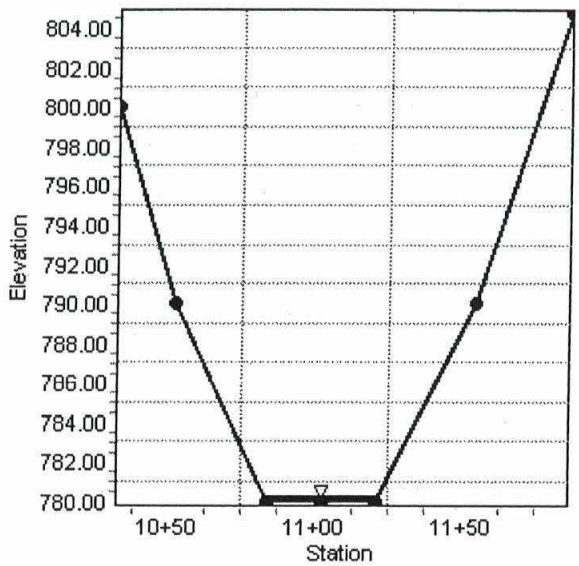
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02100	ft/ft
Normal Depth	0.19	ft
Discharge	15.00	ft^3/s

Cross Section Image



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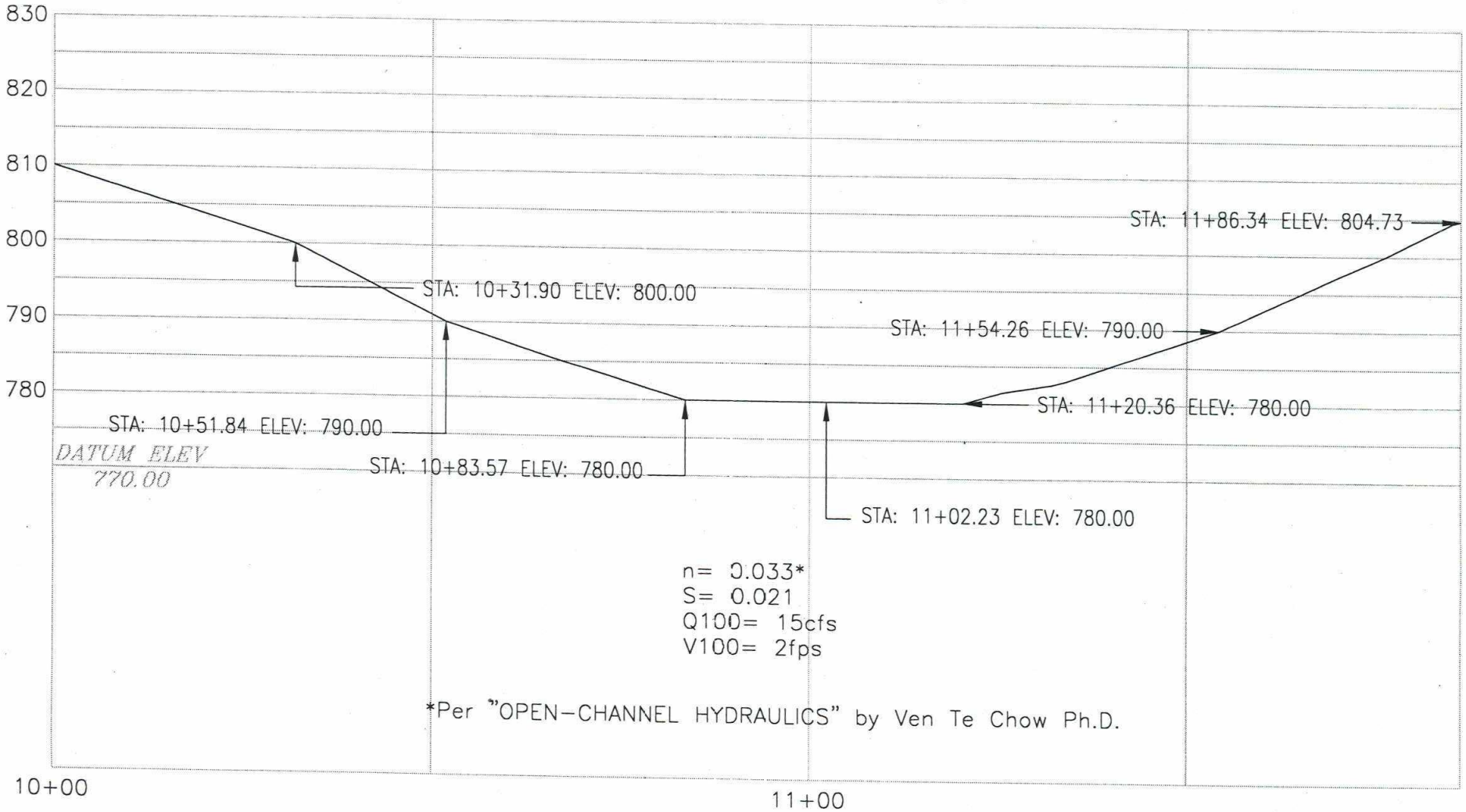


POI-2

Worksheet for Post Conditions POI-3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.58000	ft/ft
Discharge	6.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
10+39	670.00
10+54	665.00
10+69	658.56
10+77	657.65
10+82	660.00
10+93	667.45
11+17	677.65

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+39, 670.00)	(10+54, 665.00)	0.033
(10+54, 665.00)	(10+69, 658.56)	0.033
(10+69, 658.56)	(10+77, 657.65)	0.033
(10+77, 657.65)	(10+82, 660.00)	0.033
(10+82, 660.00)	(10+93, 667.45)	0.033
(10+93, 667.45)	(11+17, 677.65)	0.033

Results

Normal Depth	0.33	ft
Elevation Range	657.65 to 677.65 ft	
Flow Area	0.59	ft^2
Wetted Perimeter	3.65	ft
Top Width	3.56	ft
Normal Depth	0.33	ft

Worksheet for Post Conditions POI-3

Results

Critical Depth		0.60	ft
Critical Slope		0.02452	ft/ft
Velocity		10.17	ft/s
Velocity Head		1.61	ft
Specific Energy		1.94	ft
Froude Number		4.41	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.60	ft
Channel Slope	0.58000	ft/ft
Critical Slope	0.02452	ft/ft

Cross Section for Post Conditions POI-3

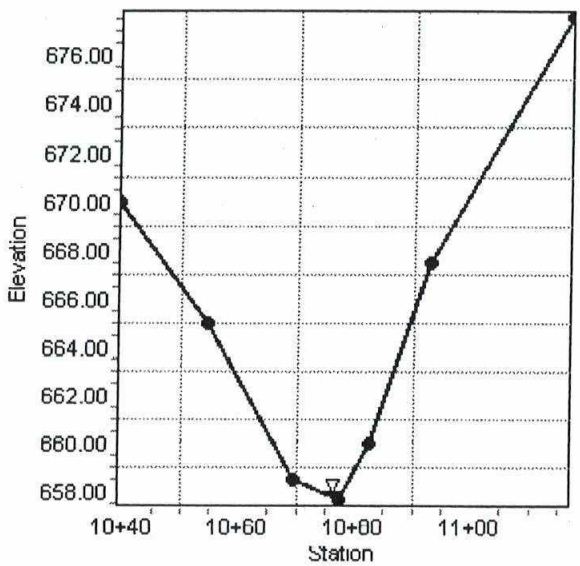
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.58000	ft/ft
Normal Depth	0.33	ft
Discharge	6.00	ft^3/s

Cross Section Image



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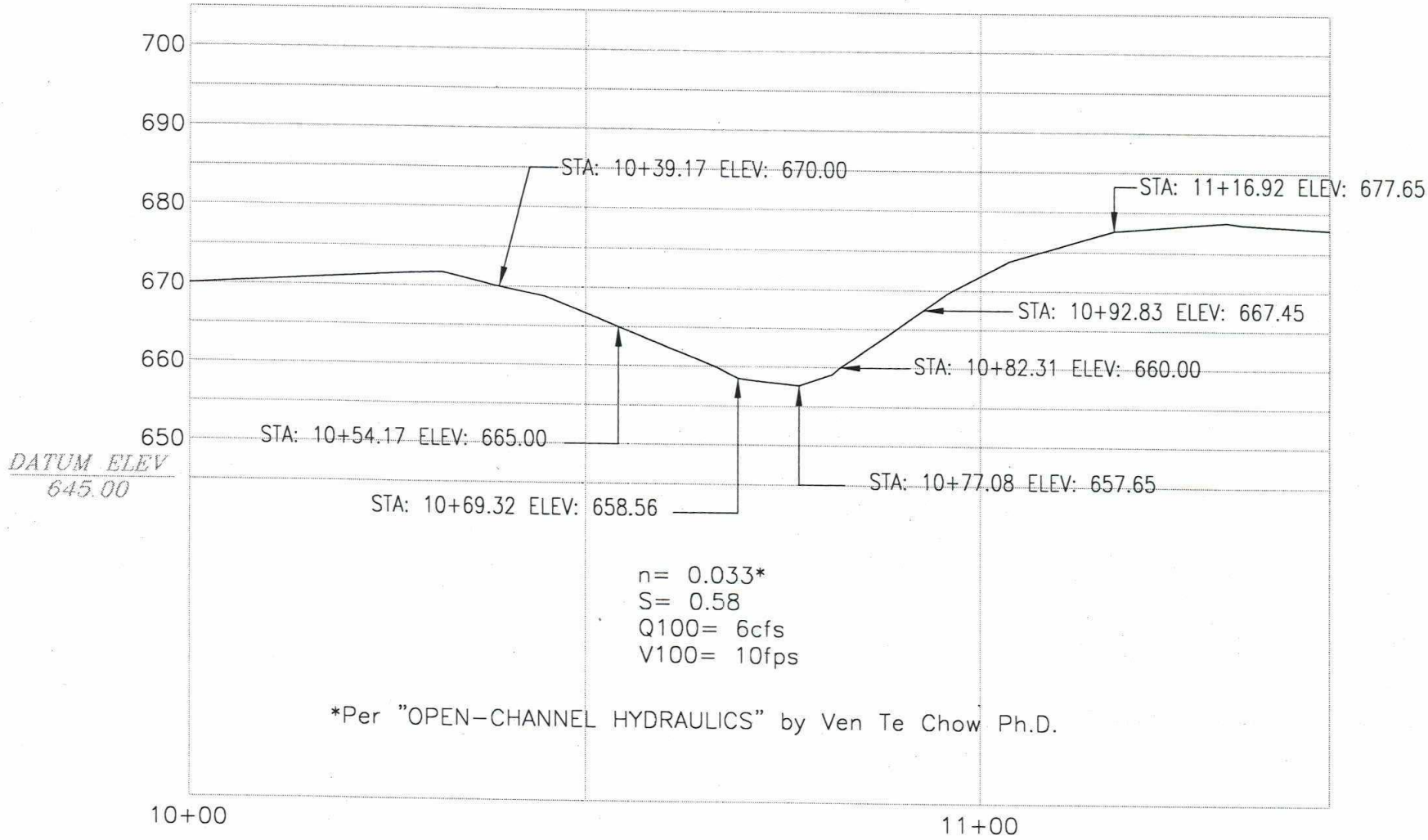


POI-3

Worksheet for Post Conditions POI-4

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	23.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
10+00	740.00
10+13	735.00
10+26	730.00
10+88	730.00
11+21	740.00
11+47	749.97

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(10+00, 740.00)	(10+13, 735.00)	0.030
(10+13, 735.00)	(10+26, 730.00)	0.030
(10+26, 730.00)	(10+88, 730.00)	0.030
(10+88, 730.00)	(11+21, 740.00)	0.030
(11+21, 740.00)	(11+47, 749.97)	0.030

Results

Normal Depth	0.21	ft
Elevation Range	730.00 to 749.97 ft	
Flow Area	13.19	ft²
Wetted Perimeter	63.09	ft
Top Width	63.02	ft
Normal Depth	0.21	ft
Critical Depth	0.16	ft
Critical Slope	0.02412	ft/ft

Worksheet for Post Conditions POI-4

Results

Velocity		1.74	ft/s
Velocity Head		0.05	ft
Specific Energy		0.26	ft
Froude Number		0.67	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.21	ft
Critical Depth	0.16	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.02412	ft/ft

Cross Section for Post Conditions POI-4

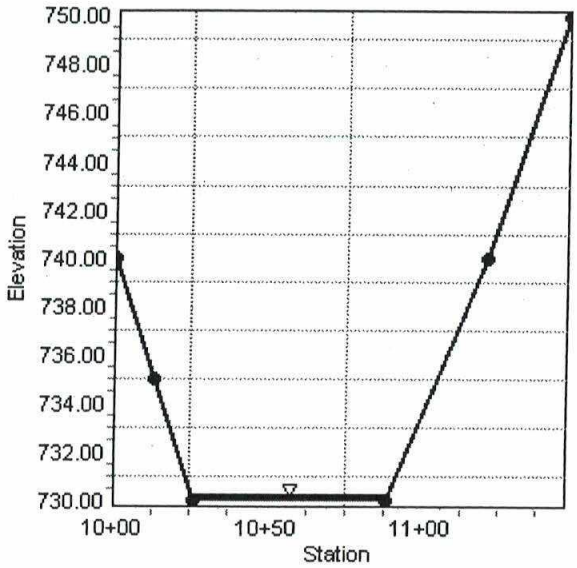
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

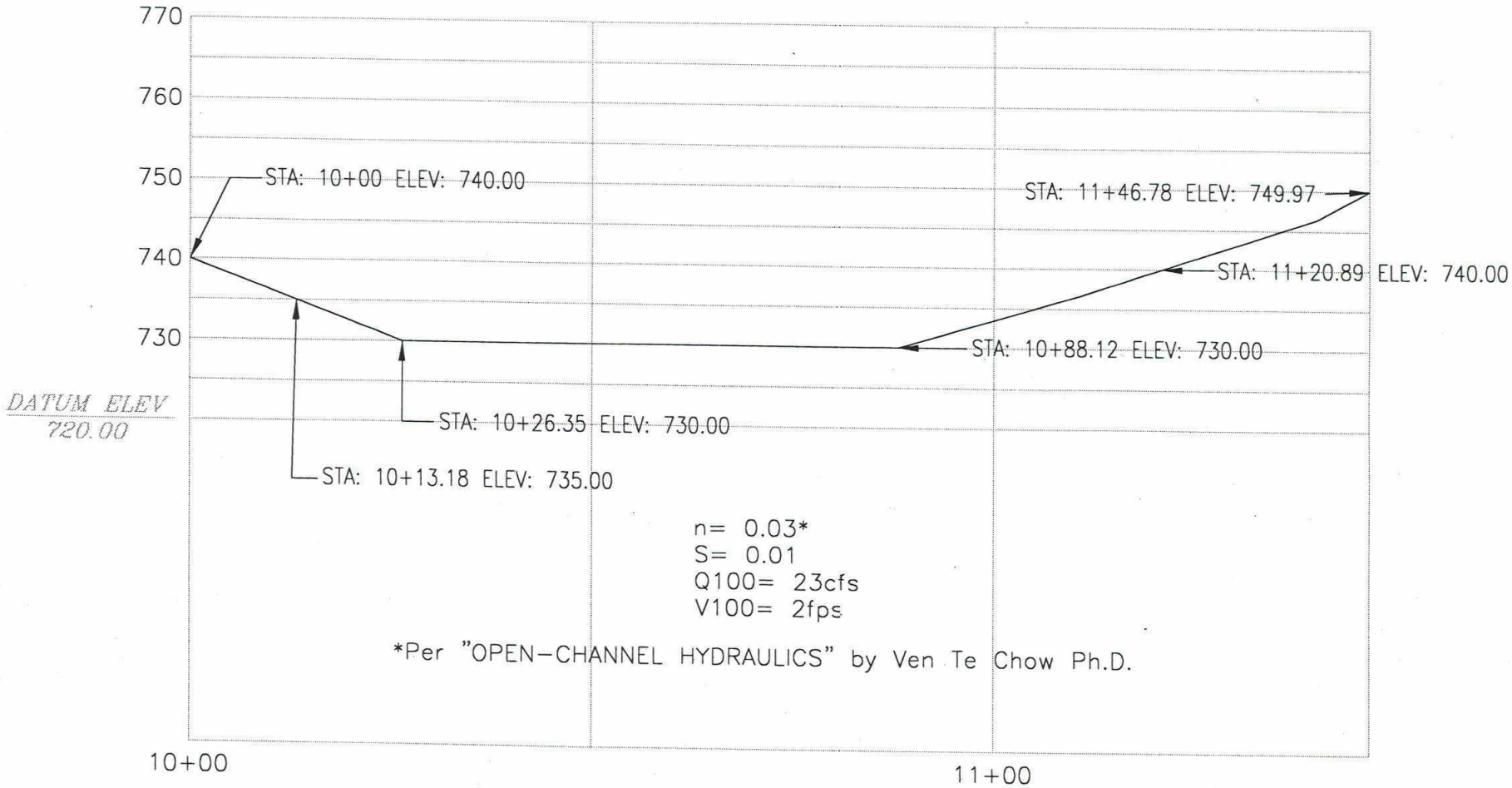
Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.21	ft
Discharge	23.00	ft^3/s

Cross Section Image



POST CONDITIONS



POI-4

Worksheet for Spillway #1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.27000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	140.00	ft
Discharge	326.97	ft^3/s

Results

Normal Depth	0.14	ft
Flow Area	20.12	ft^2
Wetted Perimeter	140.64	ft
Top Width	140.57	ft
Critical Depth	0.55	ft
Critical Slope	0.00302	ft/ft
Velocity	16.25	ft/s
Velocity Head	4.10	ft
Specific Energy	4.25	ft
Froude Number	7.57	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.14	ft
Critical Depth	0.55	ft
Channel Slope	0.27000	ft/ft
Critical Slope	0.00302	ft/ft

Worksheet for Spillway #2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.11000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	22.00	ft
Discharge	326.78	ft^3/s

Results

Normal Depth	0.57	ft
Flow Area	13.23	ft^2
Wetted Perimeter	25.13	ft
Top Width	24.83	ft
Critical Depth	1.77	ft
Critical Slope	0.00223	ft/ft
Velocity	24.70	ft/s
Velocity Head	9.48	ft
Specific Energy	10.05	ft
Froude Number	5.97	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	1.77	ft
Channel Slope	0.11000	ft/ft
Critical Slope	0.00223	ft/ft

Worksheet for Spillway #3

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.20000	ft/ft
Left Side Slope	7.00	ft/ft (H:V)
Right Side Slope	7.00	ft/ft (H:V)
Bottom Width	21.00	ft
Discharge	327.99	ft^3/s

Results

Normal Depth	0.47	ft
Flow Area	11.52	ft^2
Wetted Perimeter	27.70	ft
Top Width	27.63	ft
Critical Depth	1.63	ft
Critical Slope	0.00233	ft/ft
Velocity	28.48	ft/s
Velocity Head	12.60	ft
Specific Energy	13.08	ft
Froude Number	7.78	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.47	ft
Critical Depth	1.63	ft
Channel Slope	0.20000	ft/ft
Critical Slope	0.00233	ft/ft

JOB TITLE

Project Date: 4/24/2007
Project Engineer: Sophie Tuong
Project Title: Chandler
Project Comments:
The same method was used for post-construction conditions as for pre-construction conditions.
There is to be NO regarding of the original basin and the spillways are to remain in place.
Lag times of 1, 3 & 2 minutes were calculated for ponds in A2, A3 and A4, respectively.
Peak flow rates coming out of the ponds were used to route the runoff through the spillways, therefore determining actual travel time.

MASTER DESIGN STORM SUMMARY

Hydrograph Queue Only Network

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method
Hydrograph File Import Option Used For 3 node(s)

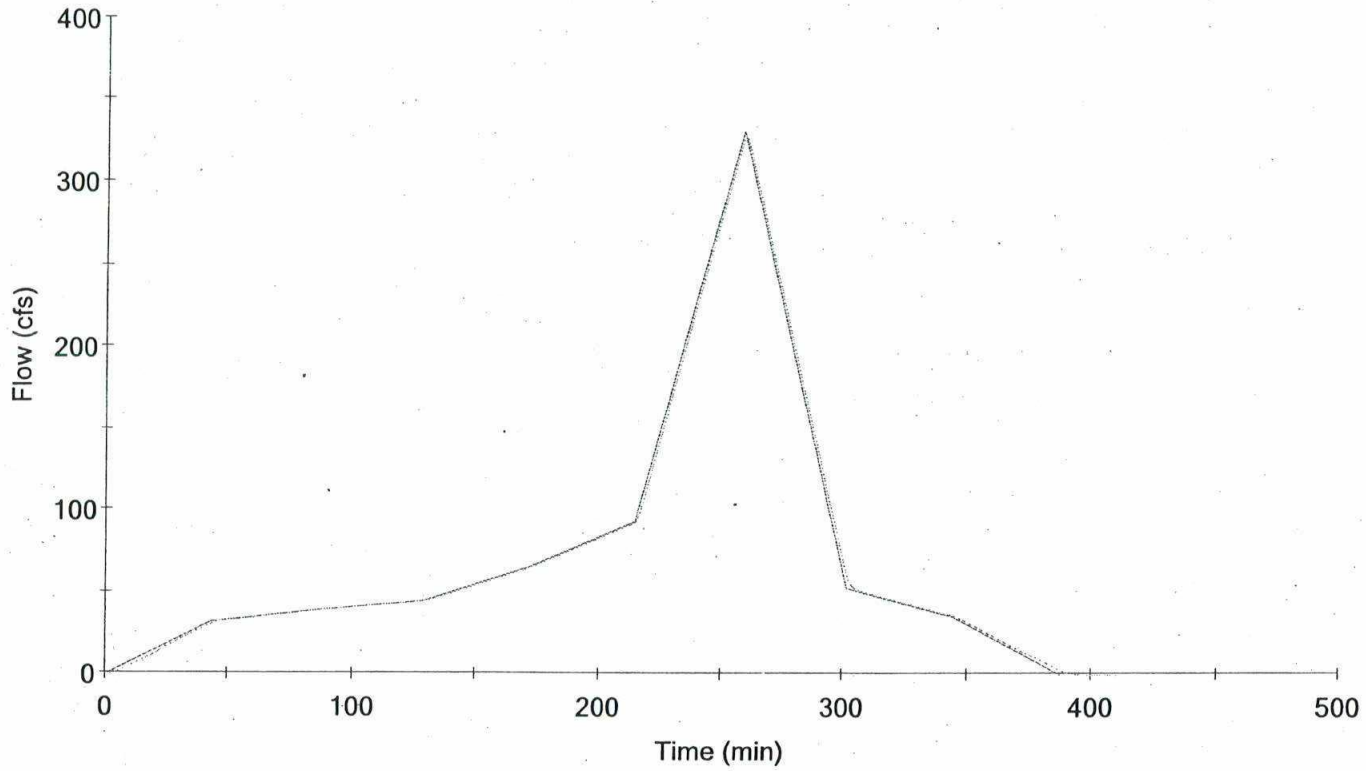
(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol cu.ft	Trun	Qpeak min	Qpeak cfs	Max WSEL ft	Max Pond Storage cu.ft
100 YEAR - A3	HYG	100yr	102114		270.00	18.00		
100 YEAR - A4	HYG	100yr	48902		288.00	8.10		
100 YEAR A1-A2	HYG	100yr	1788069		258.00	330.43		
*OUT 10	JCT	100yr	1939084		264.00	327.99		
POND IN A2 IN	POND	100yr	1788069		258.00	330.43		
POND IN A2 OUT	POND	100yr	1788069		259.00	326.97	649.15	22105
POND IN A3 IN	POND	100yr	1890183		259.00	341.82		
POND IN A3 OUT	POND	100yr	1890182		262.00	326.78	620.12	64210
POND IN A4 IN	POND	100yr	1939084		262.00	331.73		
POND IN A4 OUT	POND	100yr	1939084		264.00	327.99	603.47	22548

LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\POST\
Inflow  HYG file = NONE STORED - POND IN A2   IN  100yr
Outflow HYG file = NONE STORED - POND IN A2   OUT 100yr

Pond Node   Data = POND IN A2
Pond Volume Data = POND IN A2
Pond Outlet Data = Spillway 1

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   648.30 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    330.43 cfs    at    258.00 min
Peak Outflow      =    326.97 cfs    at    259.00 min
-----------------------------------------------------
Peak Elevation    =    649.15 ft
Peak Storage =          22105 cu.ft
=====================================================


MASS BALANCE (cu.ft)
--------------------------
+ Initial Vol  =           0
+ HYG Vol IN   =     1788069
- Infiltration =           0
- HYG Vol OUT  =     1788069
- Retained Vol =           0
                 ----------
Unrouted Vol = -            cu.ft  (.000% of Inflow Volume)
```

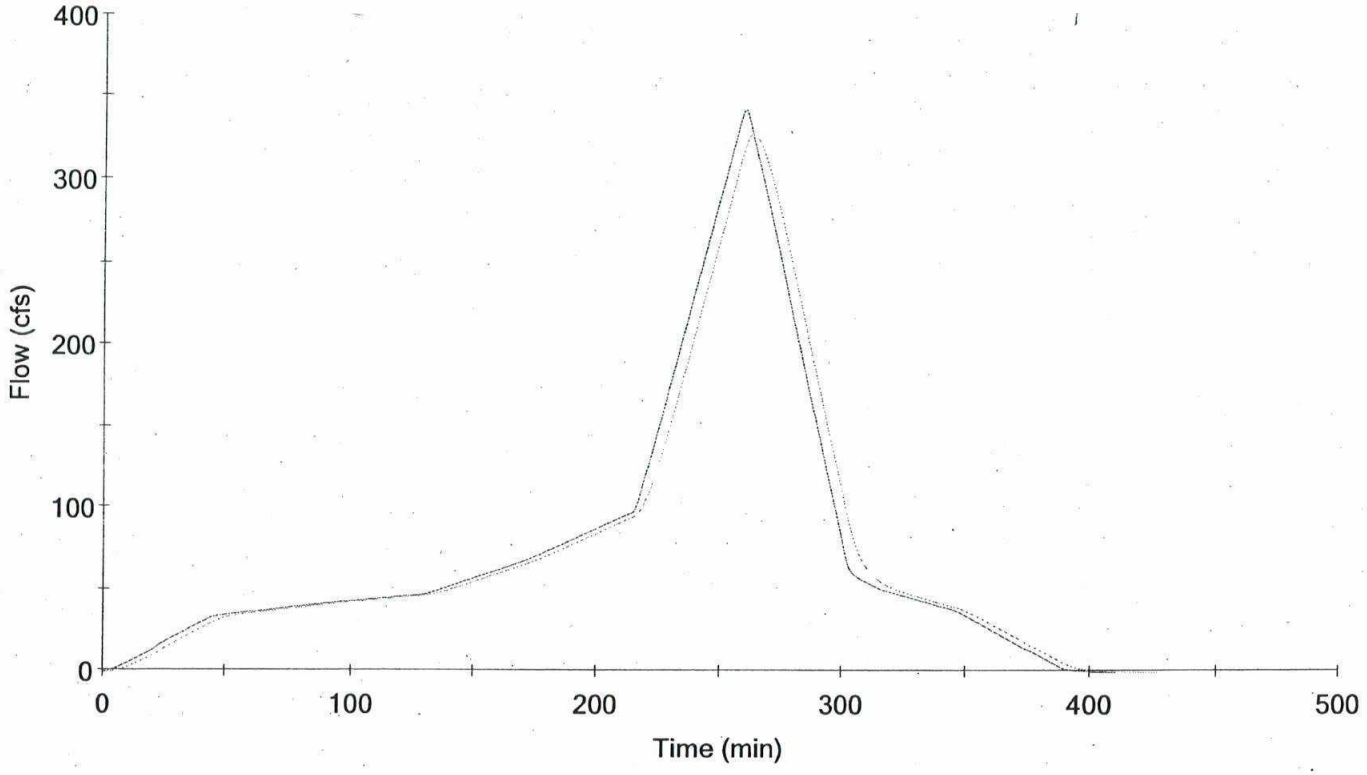
Hydrograph
POND IN A2 OUT 100yr



LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\POST\
Inflow  HYG file = NONE STORED - POND IN A3   IN  100yr
Outflow HYG file = NONE STORED - POND IN A3   OUT 100yr

Pond Node   Data = POND IN A3
Pond Volume Data = POND IN A3
Pond Outlet Data = Spillway 2

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   619.20 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    341.82 cfs    at    259.00 min
Peak Outflow      =    326.78 cfs    at    262.00 min
-----------------------------------------------------
Peak Elevation    =    620.12 ft
Peak Storage =          64210 cu.ft
=====================================================


MASS BALANCE (cu.ft)
--------------------------
+ Initial Vol  =          0
+ HYG Vol IN   =    1890183
- Infiltration =          0
- HYG Vol OUT  =    1890182
- Retained Vol =          0
                 ----------
Unrouted Vol =          -1 cu.ft  (.000% of Inflow Volume)
```

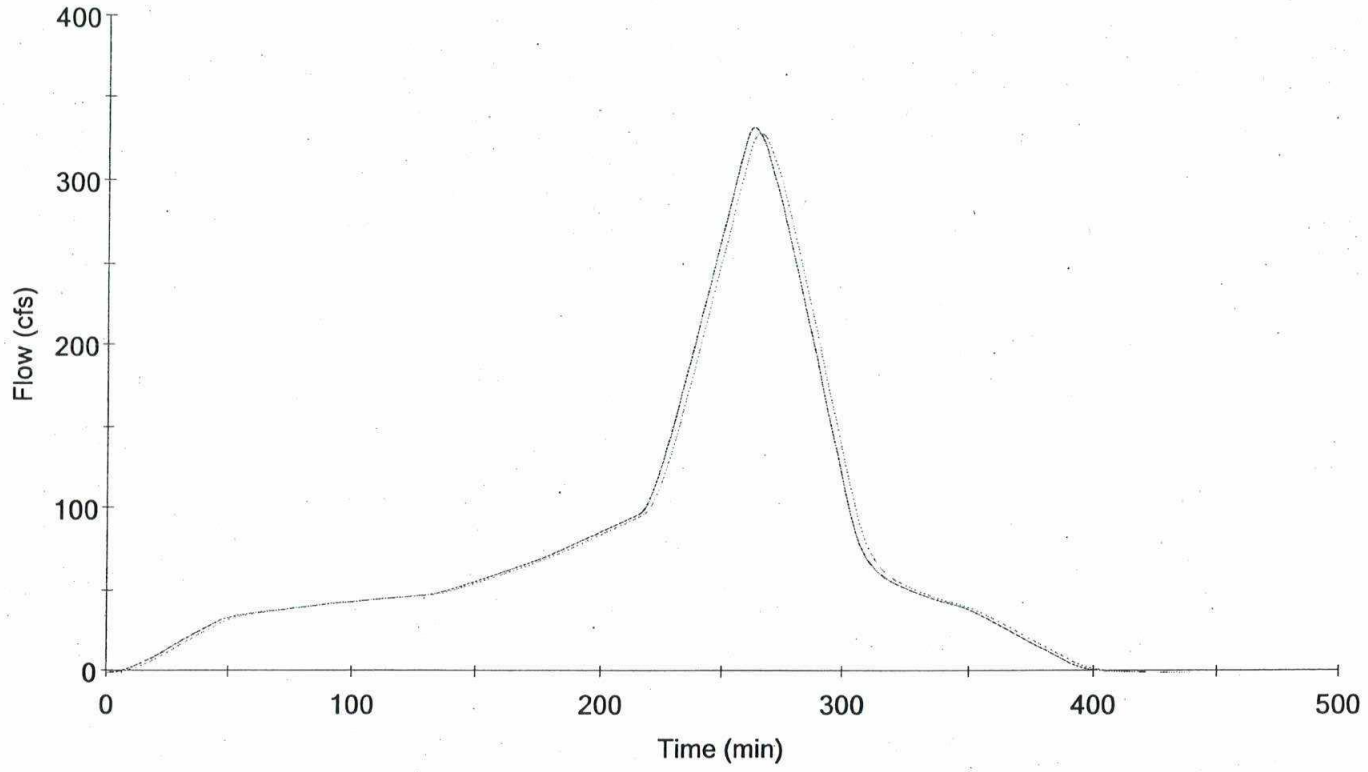
Hydrograph
POND IN A3 OUT 100yr



LEVEL POOL ROUTING SUMMARY

```
HYG Dir          = U:\ldata\engineering\5108\hydrology-PREandPOST\Pondpack\POST\
Inflow  HYG file = NONE STORED - POND IN A4   IN  100yr
Outflow HYG file = NONE STORED - POND IN A4   OUT 100yr

Pond Node   Data = POND IN A4
Pond Volume Data = POND IN A4
Pond Outlet Data = Spillway 3

No Infiltration

INITIAL CONDITIONS
----------------------------------
Starting WS Elev   =   602.70 ft
Starting Volume    =        0 cu.ft
Starting Outflow   =      .00 cfs
Starting Infiltr.  =      .00 cfs
Starting Total Qout=      .00 cfs
Time Increment     =     1.00 min


INFLOW/OUTFLOW HYDROGRAPH SUMMARY
=====================================================
Peak Inflow       =    331.73 cfs    at    262.00 min
Peak Outflow      =    327.99 cfs    at    264.00 min
-----------------------------------------------------
Peak Elevation    =    603.47 ft
Peak Storage =          22548 cu.ft
=====================================================


MASS BALANCE (cu.ft)
---------------------------
+ Initial Vol  =           0
+ HYG Vol IN   =     1939084
- Infiltration =           0
- HYG Vol OUT  =     1939084
- Retained Vol =           0
                 ----------
Unrouted Vol = -            cu.ft  (.000% of Inflow Volume)
```

Hydrograph
POND IN A4 OUT 100yr



Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
648.30	-----	26055	0	0	0
649.00	-----	26055	78165	18239	18239
650.00	-----	33599	89242	29747	47986
660.00	-----	86399	173877	579589	627575

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

Type.... Vol: Elev-Area
Name.... POND IN A3
File.... U:\1data\engineering\5108\hydrology-PREandPOST\Pondpack\POST\5108_Basin A routing

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
619.20	-----	58449	0	0	0
620.00	-----	79253	205763	54869	54869
630.00	-----	79253	237759	792530	847399
640.00	-----	105264	275854	919514	1766913
650.00	-----	132878	356410	1188033	2954946
660.00	-----	132878	398634	1328780	4283726

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

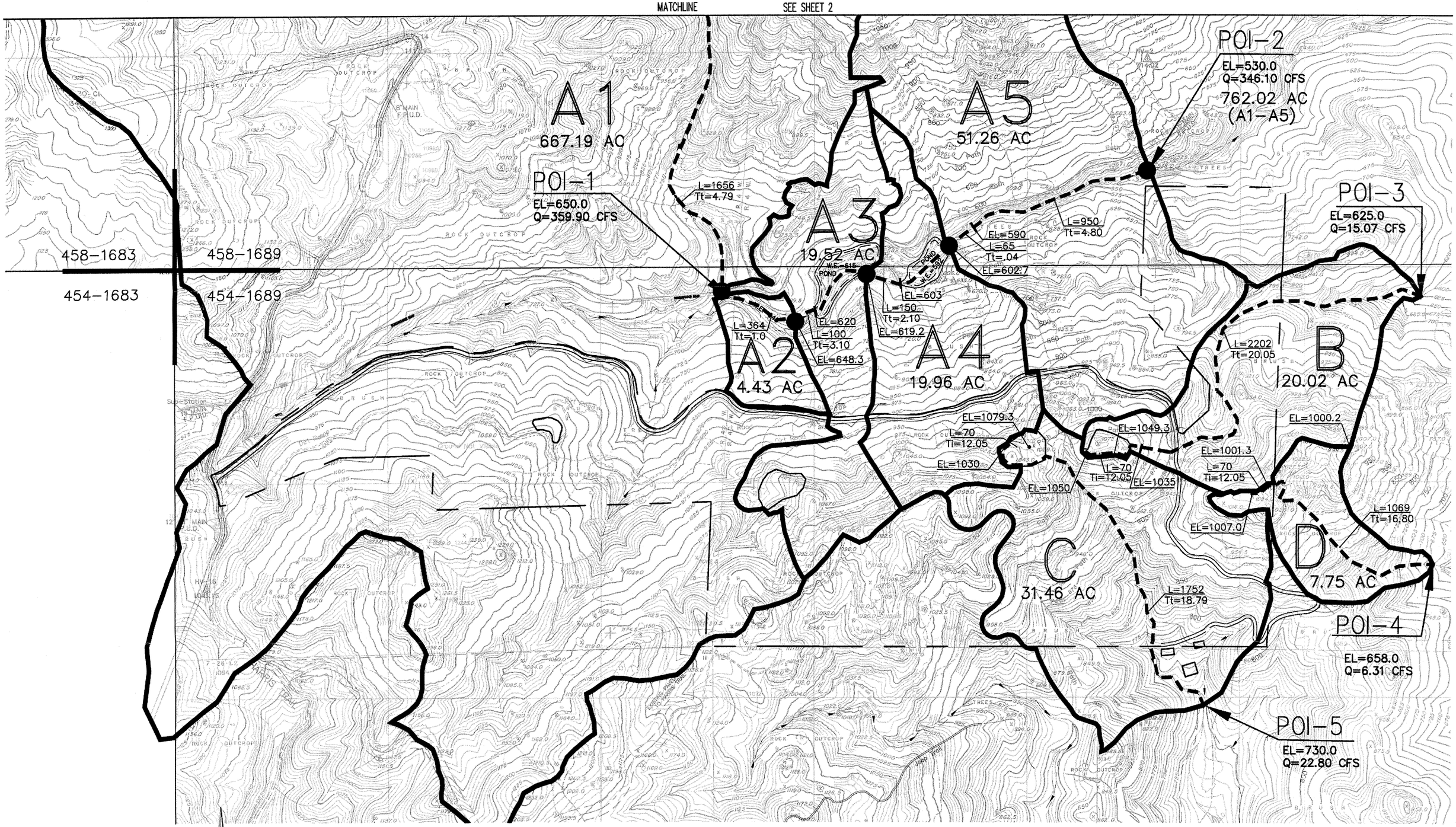
Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (cu.ft)	Volume Sum (cu.ft)
602.70	-----	28333	0	0	0
610.00	-----	48020	113239	275547	275547
620.00	-----	69411	175164	583881	859427
630.00	-----	69411	208233	694110	1553537
640.00	-----	69411	208233	694110	2247648
650.00	-----	69411	208233	694110	2941758
660.00	-----	69411	208233	694110	3635868

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2



SCALE 1" = 200'

POST CONDITIONS HYDROLOGY MAP CHANDLER

NOTE:
ACTUAL POND AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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SHEET 1 OF 3

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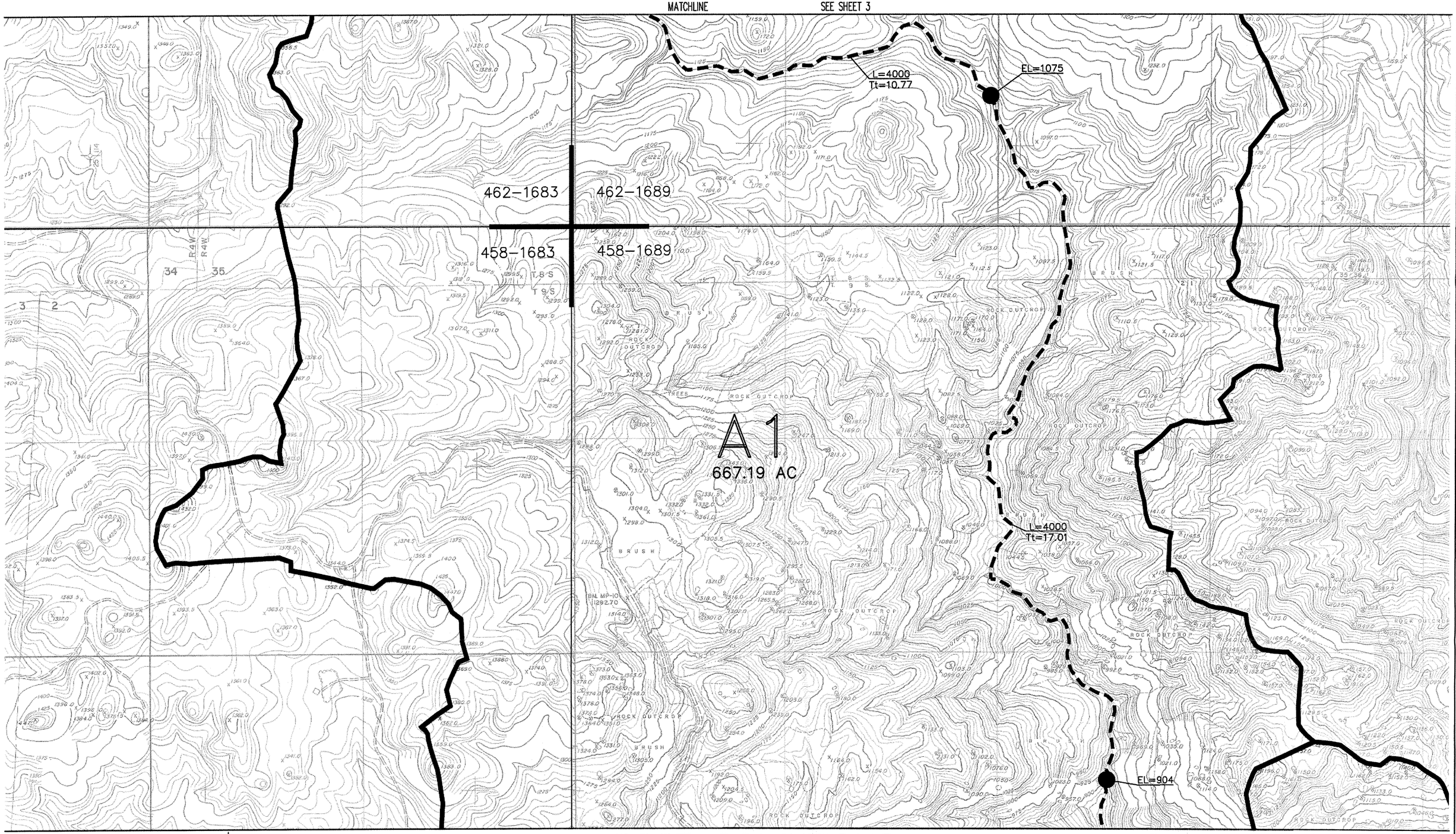
FILE NO.5108



SCALE 1" = 200'

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NOTE:
ACTUAL POND AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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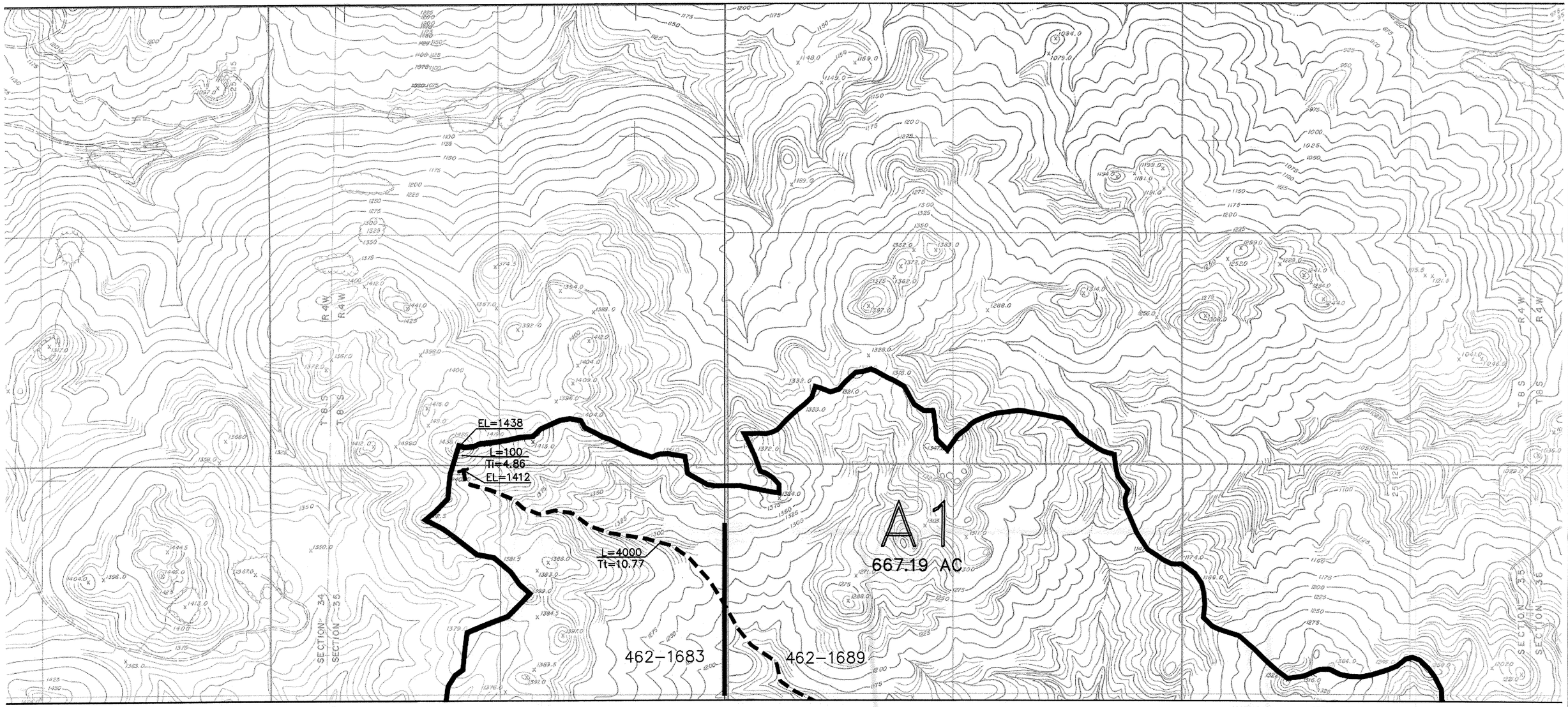

SCALE 1" = 200'

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NOTE:
ACTUAL PONO AND SPILLWAY ELEVATIONS TAKEN FROM PROJECT AERIAL TOPOGRAPHY MAP AND FIELD SURVEY.

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