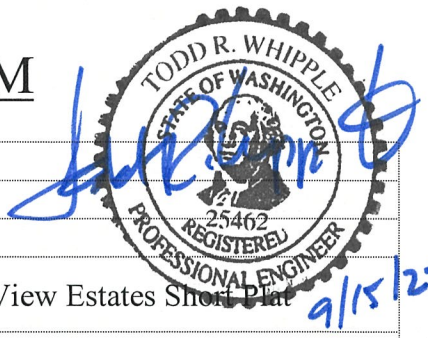
WCE

Whipple Consulting Engineers, Inc.

21 S. Pines Road
Spokane Valley, WA 99206
Ph 509-893-2617 Fax 509-926-0227

MEMORANDUM



9/15/22

TO:	Mike Nilsson, P.E.		
FROM:	Todd R. Whipple, P. E.		
DATE:	09-15-2022		
PROJECT NO:	22-TOM	**NAME:**	Crest View Estates Short Plat
REGARDING:	Strom Drainage Report		

This report has been prepared by Elliott Whipple under the direction of the undersigned professional engineer whose seal and signature appears hereon:

INTRODUCTION:

The purpose of this drainage report is to identify drainage impacts resulting from the proposed Crest View Estates Short Plat. This drainage report will describe the drainage infrastructure improvements that are necessary to control and treat the stormwater runoff from the project site. The results reported will demonstrate there is no negative impact to the adjacent properties with the proposed development. The proposed project lies within the City of Spokane and will be designed in accordance with the Spokane Regional Stormwater Manual (SRSM). Due to the poor-draining onsite soil beneath the proposed swales we are proposing a 2.5-foot deep gravel gallery beneath the entire proposed pond bottoms, and treatment methods will be based on equation 6-1d; V=1815A, as outlined in the SRSM, and updated soil, and swale amendments per the 2019 Eastern Washington Stormwater Management Manual (EWSMM).

The proposed storm report will act as an addendum to the May 24th, 1996 Taylor Storm report attached in the appendix.

Table 1 -Site Summary

Item No.	Description	Volume @ 1.0 ft of depth
A	Required treatment volume	3,571 cf **Generated by this Project**
B	Provided treatment volume	4,920 cf **Provided by this Project**
C	Extra area if Any (A – B)	1,349 sf/cf **Excess**

(.: The pond system will have an additional 1,349 cf of storage available)
Refer to Pre & Post basin Tables Appendix for Pre-Development and Post Development storm drainage information.

NARRATIVE:

Project Description:

- Parcel # 26241.0410 & 26241.0310
- Property address: 8903 N ASH ST & 8904 N ASH ST
- NE 1/4 of Section 24, T 26 N., R 42 E., W.M.
- Lot size: 24,393 sf or 0.56± ac
- Bio-retention swales proposed with 12" treatment depth, & 2.5-foot gravel gallery beneath pond
- See Geotech information below for surface soils
- Existing site is vegetated with, field grass, and weeds.

Geotechnical Information:

Per Liberty Geotech Report 04-05-2022

The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt.

Per Budinger & Associates Report 09-29-1995

Their recommendations are the following:

"We recommend that accumulated stormwater be discharged to / lowly percolating retention swales utilizing permeability rates of the sod1and topsoil or 0.5 in/hr,' whichever is slower. Excess stormwater in the southern portion of the site may be discharged to the permeable sand and gravel through an infiltration gallery at a permeability of ks30 ft/day {15 in/hr) ."

Pre-Development Basin information:

Refer to Pre & Post basin tables in Appendix for Pre-Development storm drainage information.

Post-Development Basin information:

Refer to Pre & Post basin tables in Appendix for Post-Development storm drainage information.

Critical Areas:

Based on the Critical Area Maps provided by Spokane County, (DNR Streams, Fish and Wildlife, Wetlands, and Critical Aquifer Resource Area), there appears to be erodible soils on site, No inventoried wetlands or federal flood zones are present within the project site.

Down-Gradient Analysis:

Tieton Avenue & Ash Street Avenue Analysis:

The stormwater generated from Ash Street and Tieton avenue will continue to flow to the existing curb inlets. The existing curb inlets are not proposed to be removed or changed.

Methodology:

As required by the SRSM, and the EWLID the storm drainage facilities proposed for this site have been sized to attenuate the 10- and 50-year storm events using the Rational Method as outlined in Section 5.5 of the SRSM. Due to the small size of the onsite basins within this analysis, the Rational Method has been used to calculate peak flows and volumes. The peak flows and volumes for these storm events are shown in the calculations that are included within the Appendix of this report.

Water Quality Treatment:

The proposed storm drainage pond has been designed to provide treatment volume based on SWMMEW (Stormwater Management Manual for Eastern Washington) chapter 5.4.3, SSC-6 Soil Physical and Chemical Suitability for Treatment, and Equation 6-1d (V=1815A) of the SRSM, and as outlined in Section 6.7.1. see the below description for bio-infiltration swale and L.I.D. swales

Bio-Retention Swale

For Bio-retention swale stormwater will be attenuated in the swale until it reaches a height of 12 inches. Once the stormwater exceeds a height of 12 inches, excess stormwater will spill into a proposed catch basin that is interconnected to a subsurface gravel gallery where it will discharge excess stormwater.

Results:

Refer to Table 1 and Pre & Post basin tables in Appendix for Post-Development storm drainage information.

Operation Characteristics:

Bio Retentions swale:

Pond A & B:

The proposed pond A & B will receive stormwater generated from the existing Ash Street and Tieton Avenue. This storm water sheet flows across the pavement to the curb and gutter where it will then be collected by a curb inlet and discharged into the proposed pond A. This stormwater will be treated in the proposed swale to a depth of 12 inches via 18 inches of treatment soil. Once the stormwater exceeds a height of 12 inches, it will spill into an catch basin that is interconnected to a gravel gallery that is 3.0' deep below the proposed Pond A & B treatment soil that will discharged into the ground as required per the Spokane Regional Stormwater Manual and the Eastern Washington Low Impact Development Guidance Manual

Perpetual Maintenance of Facilities:

There is an existing home owner association and the swales within the proposed tracts will be provided by the HOA. The City of Spokane will not be liable for any maintenance or operation of the facilities. A maintenance plan will be provided to the owner if requested.

Offsite Easements:

There are no offsite easements required for this property.

Regional Facilities:

There are no known regional facilities that lie within or are affected by the project site.

CONCLUSION:

As required by the City of Spokane and the Spokane Regional Stormwater Manual, the onsite storm drainage facilities for this project will adequately collect, treat and discharge stormwater runoff generated by the site during the 50-year storm event. Also, the storm drainage facilities will contain and discharge the 50-year storm under non frozen conditions. Therefore, this project will have no adverse impact to adjacent and/or downstream properties.

APPENDIX

PRE & POST BASIN TABLES

PRE-DEVELOPMENT BASIN INFORMATION:

As shown on the Pre-Developed Basin Map table 1 located in the Appendix, the site gradually slopes to the south at approximately 2% to 5%. The stormwater flows to the ponds adjacent to the intersection of Ash street and Tieton Avenue to an existing drywell in the low spot of the street. The undeveloped remainder of the site is pervious areas with grass and trees. From the existing ground contours, it appears that the excess stormwater is absorb into the soil generated in the pre-developed condition.

Per the original report they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates, and conveyed along the easter property line in a ditch to a ponds A and B per WCE proposed short plat located along Ash Street and Tieton. The below table reflect this reduction in runoff compared to the Taylor report.

Table 1A – Pre-Development Project Site Basin Summary

Pre-Basin	Ponds	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)	PGIS Area (sf)
A	N/A	312,811	79,800	233,011	79,800
Total	-	312,811	79,800	233,011	79,800

POST-DEVELOPMENT BASIN INFORMATION:

The Post-Development basins remains as one (1) basins please see Table 2,3 and 4 located in the appendix for addition storm drainage information.

The Post-Development basins are defined by designed finish grades and storm drain facilities. A copy of the basin map and calculations are included in the appendix with a summary provided in the following table.

Per the original report they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates, and conveyed along the easter property line in a ditch to a ponds A and B per WCE proposed short plat located along Ash Street and Tieton. The below table reflect this reduction in runoff compared to the Taylor report.

Table 2 – Post-Development Project Site Basin Summary V=1133A

Post Basin's	Onsite / Offsite	Pond	Total Basin Area (sf)	Impervious Area (sf)	Pervious Area (sf)	PGIS Area (sf)
1	onsite	A & B	312,811	85,700	227,111	85,700
Total	**N/A**	**A & B**	312,811	85,700	227,111	85,700

Table 3 – Post-Development Project Site Pond Summary

Basins	Onsite / Offsite	Ponds	(Method 1133A (ac)) Treatment Area/Volume (square feet/cubic feet)				
			Required		Provided		
			Treatment area	Treatment vol.	Pond area	Treatment vol.	Pond vol.
Basin 1	onsite	A & B	7,142	3,571	4,360	4,920	10,926
Total	-	A & B	**7,142**	**3,571**	**4,360**	**4,920**	**10,926**

Refer to basin calculations in Appendix for areas and peak flows for all basins.

Results:

As shown in Table 3 within this report we have provided the required treatment volume for the improvements proposed for the development. Table 4 below shows the onsite pond/swale storage summary for the 50-year storm events as well as the peak pond/swale depth.

Table 4 – Project Site Pond/Swale Storage Summary

Basin	Onsite / Offsite	50-YR Storm		
		Required	Provided	
		Vol. (cf)	Vol. (cf)	
1	onsite	13,592	14,021	*

NOTE: Pond Bottom Infiltration was not accounted for within the Bowstring Calculations

See pond bottoms volume worksheet, volumes are not conic.

* Per the Budinger & Associates Geotech report 1996 their recommend infiltration rates was 0.5 inch per hour. This was converted to cfs/sf to equal 1.16 x 10 ^-5 cfs/sf. The proposed pond will have a 3-foot gravel gallery beneath them with an infiltration rate of 0.025 cfs/sf for each pond totaling 0.05cfs/sf which was used in the bowstring to calculate storage volume.

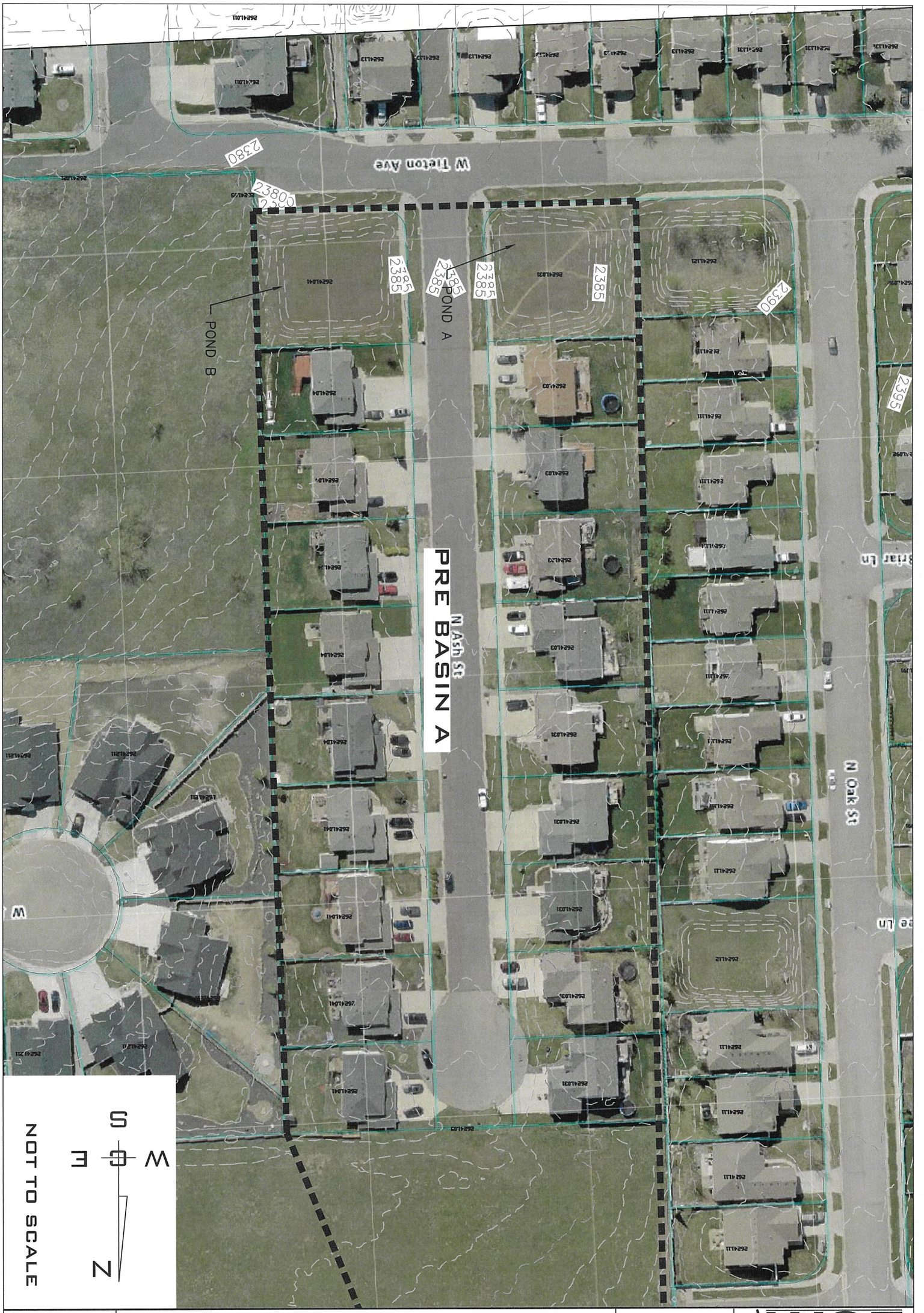
VICINITY MAP

VICINITY MAP

N
W E
S
NOT TO SCALE

PROJ #: 22-TOM DATE: 09/07/22 DRAWN: TEW APPROVED: TRW	DRAINAGE REPORT CREST VIEW ESTATS SHORT PLAT 8904 N. ASH STREET SPOKANE, WASHINGTON	WCE WHIPPLE CONSULTING ENGINEERS 21 SOUTH PINES ROAD SPOKANE VALLEY, WASHINGTON 99206 PH: 509-893-2617 FAX: 509-926-0227
FIGURE 1	VICINITY MAP	

BASIN MAPS



SHEET 1 OF 4

PRE-DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

WCE
WHIPPLE CONSULTING ENGINEERS
CIVIL , STRUCTURAL AND
TRANSPORTATION ENGINEERING
21 SOUTH PINES ROAD
SPOKANE VALLEY, WASHINGTON 99206
PH: 509-893-2617 FAX: 509-926-0227

SHEET 2 OF 4

PRE OVER ALL -DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

WCE
WHIPPLE CONSULTING ENGINEERS
CIVIL , STRUCTURAL AND
TRANSPORTATION ENGINEERING
21 SOUTH PINES ROAD
SPOKANE VALLEY, WASHINGTON 99206
PH: 509-893-2617 FAX: 509-926-0227

NOT TO SCALE

S
W
E
N

POST-DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

SHEET 3 OF 4

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

WCE
WHIPPLE CONSULTING ENGINEERS
CIVIL , STRUCTURAL AND
TRANSPORTATION ENGINEERING
21 SOUTH PINES ROAD
SPOKANE VALLEY, WASHINGTON 99206
PH: 509-893-2617 FAX: 509-926-0227

NOT TO SCALE

S
W E
N

POST OVER ALL-DEVELOPMENT BASIN MAP
CREST VIEW ESTATS SHORT PLAT
8904 N. ASH STREET
SPOKANE, WASHINGTON

SHEET 4 OF 4

PROJ #: 22-TOM
DATE: 09/07/22
DRAWN: TEW
APPROVED: TRW

WCE
WHIPPLE CONSULTING ENGINEERS
CIVIL , STRUCTURAL AND
TRANSPORTATION ENGINEERING
21 SOUTH PINES ROAD
SPOKANE VALLEY, WASHINGTON 99206
PH: 509-893-2617 FAX: 509-926-0227

BASIN SUMMARY SHEET

Whipple Consulting Engineers

Basin Calculation Worksheet

			Imp	0.9	Intensities from SRSM eqn. 5-13, per Table 5-7, Assumes Tc = 5 min				
			Per	0.15	I (2 yr) =	1.418 inches	I (10 yr)=	2.619 inches	NOTE:
	WCE No.	Project Name			I (25 yr) =	3.319 inches	I (50 yr)=	3.843 inches	
9/15/2022	-	Crest View Short Plat			I (100 yr) =	4.381 inches			
TEW					driveway area	1200 sf			
					1/2 House Area	1,750 sf			

SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD

Basin	Total	Access/Parking	Sidewalk	Lot #	DV	Buildings	Total	Total	Wtd	PGIS	1815 A Pond	Pond	Q=CIA (cfs)				
	sf	/Street (sf)	sf	#	sf	sf	Impervious	Pervious	"C"	sf	Area (sf)	Vol (cf)	2 yr	10 yr	25 yr	50 yr	100 yr
Pre Onsite Flow																	
Pre A	312,811	26,700	0	18	21,600	31,500	79,800	233,011	0	79,800	6,650	3,325	3.48	6.42	8.14	9.42	10.74
Total	**312,811**	**26,700**	**0**	**0**	**21,600**	**31,500**	**79,800**	**233,011**	**0**	**79,800**	**6,650**	**3,325**	**3.48**	**6.42**	**8.14**	**9.42**	**10.74**
Post Onsite Flow																	
POST A	312,811	26,700	0	20	24,000	35,000	85,700	227,111	0.36	85,700	7,142	3,571	3.62	6.69	8.47	9.81	11.18
Total	**312,811**	**26,700**	**0**	**20**	**24,000**	**35,000**	**85,700**	**227,111**	**0.36**	**85,700**	**7,142**	**3,571**	**3.62**	**6.69**	**8.47**	**9.81**	**11.18**

POND VOLUME WORKSHEET

WHIPPLE CONSULTING ENGINEERS **Date: 9/15/2022**

POND VOLUME CALC SHEET

Project: 22-TOM CREST VIEW ESTATS SHORT PLAT

Designer: TEW

								Treatment					*Storage*
Basins	Ponds/ Swales	Bottom Area sf	Treatment Area (w/ Side Slopes)	Squared Side lf	Pond Bottom Elevation at Drywell	Pond Drywell Elevation	Pond Inlet Elevation (avg)	Conic Volume to Rim cf	Side * Slope Volume cf	Total Volume to to Rim cf	Conic Volume to Inlet cf	Side Slope Volume cf	Total Volume to Inlet cf
A	**A**	2,180	4,920	46.69	1000.00	1001.00	1002.00	2,180	280	**2,460**	4,360	1,121	5,481
A	**B**	2,180	4,920	46.69	1000.00	1001.00	1002.00	2,180	280	**2,460**	4,360	1,121	5,481
Totals		**4,360**	**9,841**	**-**	**-**	**-**	**-**	**-**	**-**	**4,920**	**-**	**-**	**10,961**

* LID ponds do not calculate side slopes.

WHIPPLE CONSULTING ENGINEERS

Gravel Gallery under Ponds A & B

9/15/2022

22-Tom Crest View Estates Short Plat
ENGINEER TEW

Foundation Depth (Min)	Gallery Depth (Min)	Porosity of Gravel (Typ)			Infiltration Rate
ft	ft	cf/cf			cfs/sf
0	3	0.3			1.16E-05

Note: infiltration rates per are asumded rates onsite testing of the gravel galleries during construction can be completed if required.

Basins	Pond / Swale	Number of Galleries	Length	Width	Ground Water EL.	Gravel Gallery Bott. EL	Volume	Storage Volume	Perimeter	Sidewall Area	Bottom Area	Outflow
			ft	ft	ft	ft	cf	cf	ft	sf	sf	cfs
A	A	1	41.23	41.23	-		5,100	**1,530**	164.92	494.76	1700	**0.025**
A	B	1	41.23	41.23	-		5,100	**1,530**	164.92	494.76	1700	**0.025**
Totals		2	82	41			10199	**3060**	329.84	989.52	3399.83	**0.05**

Storage Volume = Volume* Porosity
Sidewall Area= Perimeter*Depth
OutFlow = Sidewall Area+ Bottom Area * Infiltration Rate

Note: Outflow Assumes a Full Gallery

50 – YEAR STORM EVENT BOWSTRING CALCULATIONS

PEAK FLOW CALCULATION PROJECT:

50-Year Design Storm **CREST VIEW EST. S.PLAT**

BASIN: A

Tot. Area	312,811 SF	7.18 Acres	
Imp. Area	85,700 SF	C=	0.9
Perv. Area	227,111 SF	C=	0.15
Wt. C =	0.36	PGIS Area =	85,700

WCE Applicable Travel Time Ground Cover Coefficients			
Per Table 5-6 SRSM			
Type of Cover		K (ft/min)	
Short Pasture		420	
Nearly Bare Ground		600	
Small Roadside Ditch/ Grass		900	
Paved Area (use for parking lots)		1200	
Gutter - 4 inches deep		1500	
Gutter - 6 inches deep		2400	
Pipe - 12-inch PVC/DI		3000	
Pipe - 15/18-inch PVC/DI		3900	
Pipe - 24-inch PVC/DI		4700	

Reaches		
Reach 1	Offsite	also applicable for Pre-Developed Tc
Length	800.00	
K	420.00	
Slope (ft/ft)	0.0400	be sure this is decimal equivalent slope 0.0000
Travel Time	9.52	Minutes
Reach 2	Finished Lot from House to Street	
Length	700.00	
K	1500.00	
Slope (ft/ft)	0.0300	be sure this is decimal equivalent slope 0.0000
Travel Time	2.69	Minutes
Reach 3	Gutter Flow to Inlet/Catch Basin	
Length	0.00	
K	2400.00	
Slope (ft/ft)	0.0200	be sure this is decimal equivalent slope 0.0000
Travel Time	0.00	Minutes
Reach 4	Pipe Flow	Pipe Reach One (only need one if no Dia change)
Length	0.00	
K	3000.00	12-inch Pipe minimum
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	0.00	Minutes
Reach 5	Pipe Flow	Add additional pipe reacheds for other Dia
Length	0.00	
K	3900.00	15/18-inch Pipe
Slope (ft/ft)	0.0050	Average Slope for total pipe run
Travel Time	0.00	Minutes
Sum of Tc	12.22	Minutes
Tc for Analysis	12.22	Minutes

Whipple Consulting Engineers

BOWSTRING METHOD PROJECT: 0

DETENTION BASIN DESIGN BASIN: A

DESIGNER: TEW

DATE: 15-Sep-22

Time Increment (min)	10
Time of Conc. (min)	12.22
Outflow (cfs)	0.0500
Design Year Flow	50
Area (acres)	7.18
Impervious Area (sq ft)	85700
'C' Factor	0.36
Area * C	2.553
PGIS Area	85,700

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)
12.22	733	2.18	5.56	5465	37	5428
15	900	1.91	4.88	5613	45	5568
25	1500	1.38	3.53	6176	75	6101
35	2100	1.12	2.85	6699	105	6594
45	2700	0.95	2.43	7170	135	7035
55	3300	0.84	2.14	7596	165	7431
65	3900	0.75	1.92	7986	195	7791
75	4500	0.69	1.76	8347	225	8122
85	5100	0.64	1.62	8683	255	8428
95	5700	0.59	1.51	8999	285	8714
105	6300	0.56	1.42	9296	315	8981
115	6900	0.52	1.34	9578	345	9233
125	7500	0.50	1.27	9847	375	9472
135	8100	0.47	1.21	10103	405	9698
145	8700	0.45	1.16	10349	435	9914
155	9300	0.43	1.11	10585	465	10120
165	9900	0.42	1.07	10812	495	10317
175	10500	0.40	1.03	11031	525	10506
185	11100	0.39	0.99	11243	555	10688
195	11700	0.38	0.96	11448	585	10863
205	12300	0.36	0.93	11647	615	11032
215	12900	0.35	0.90	11841	645	11196
225	13500	0.34	0.87	12029	675	11354
235	14100	0.33	0.85	12212	705	11507
245	14700	0.32	0.83	12390	735	11655
255	15300	0.32	0.81	12564	765	11799
265	15900	0.31	0.79	12734	795	11939
275	16500	0.30	0.77	12900	825	12075
285	17100	0.29	0.75	13063	855	12208
295	17700	0.29	0.74	13222	885	12337
305	18300	0.28	0.72	13377	915	12462
315	18900	0.28	0.71	13530	945	12585
325	19500	0.27	0.69	13680	975	12705
335	20100	0.27	0.68	13827	1005	12822
345	20700	0.26	0.67	13971	1035	12936
355	21300	0.26	0.65	14092	1065	13027
365	21900	0.25	0.64	14206	1095	13111
375	22500	0.25	0.63	14296	1125	13171
385	23100	0.25	0.63	14673	1155	13518

Rainfall Intensity Coefficients for ***Spokane***

taken from Table 5-7 SRSM

M_{50} = 10.68

N_{50} = 0.635

Flow (weighted c)

Qwc= 9.81 cfs

Flow (time of concentration)

Qtc= 5.56 cfs

Time (min)	Time Inc. (sec)	Intens. (in/hr)	Q Devel (cfs)	Vol.In (cu ft)	Vol.Out (cu ft)	Storage (cu ft)	
385							
395	23700	0.24	0.60	14439	1185	13254	
405	24300	0.24	0.60	14801	1215	13586	
415	24900	0.23	0.58	14520	1245	13275	
425	25500	0.23	0.58	14867	1275	13592	<==
435	26100	0.22	0.55	14540	1305	13235	
445	26700	0.22	0.55	14872	1335	13537	
455	27300	0.21	0.53	14499	1365	13134	
465	27900	0.21	0.53	14815	1395	13420	
475	28500	0.20	0.50	14397	1425	12972	
485	29100	0.20	0.50	14698	1455	13243	
495	29700	0.19	0.48	14234	1485	12749	
505	30300	0.19	0.48	14519	1515	13004	
515	30900	0.18	0.45	14009	1545	12464	
525	31500	0.18	0.45	14278	1575	12703	
535	32100	0.17	0.42	13723	1605	12118	
545	32700	0.17	0.42	13977	1635	12342	
555	33300	0.16	0.40	13375	1665	11710	
565	33900	0.16	0.40	13614	1695	11919	
575	34500	0.15	0.37	12967	1725	11242	
585	35100	0.15	0.37	13190	1755	11435	
595	35700	0.14	0.35	12497	1785	10712	
605	36300	0.14	0.35	12705	1815	10890	
615	36900	0.13	0.32	11965	1845	10120	
625	37500	0.13	0.32	12159	1875	10284	
635	38100	0.12	0.30	11373	1905	9468	
645	38700	0.12	0.30	11551	1935	9616	
655	39300	0.11	0.27	10719	1965	8754	
665	39900	0.11	0.27	10882	1995	8887	
675	40500	0.10	0.25	10004	2025	7979	
685	41100	0.10	0.25	10152	2055	8097	
695	41700	0.09	0.22	9228	2085	7143	
705	42300	0.09	0.22	9360	2115	7245	
715	42900	0.08	0.19	8391	2145	6246	
725	43500	0.08	0.19	8507	2175	6332	
735	44100	0.07	0.17	7492	2205	5287	
745	44700	0.07	0.17	7593	2235	5358	

"1815A" TREATMENT REQUIREMENTS		
Minimum "1815A" Volume Required	3,571	cu ft
Provided Treatment Volume - Min.	3,895	cu ft
STORAGE REQ. - 50 YEAR DESIGN STORM		
Maximum Storage Required by Bowstring	13,592	cu ft
Provided Pond Storage Volume to Inlet - Min.	10,961	cu ft
Provided Drywell/Gallery Storage Volume	3,060	cu ft
Total Provided Volume	**14,021**	**cu ft**

GEOTECHNICAL REPORT

Geotechnical Engineering Report
Crestview Estates 1st Addition
Ash Street and Tieton Avenue
Spokane County, Washington

Prepared For:
Austin J Fuller
Whipple Consulting Engineers, Inc.
21 South Pines Road
Spokane Valley, Washington 99206

Prepared By:

Liberty Geotechnical Engineering, Inc.
3012 N Sullivan Rd
Spokane Valley, Washington 99216
(509) 213-0400

BENJAMIN D VANCE
STATE OF WASHINGTON
54048
REGISTERED
PROFESSIONAL ENGINEER

Report Date: April 5, 2022
Job Number: 21425

Table of Contents

Appendices

1.0 EXECUTIVE SUMMARY

The following geotechnical engineering report has been prepared for Crestview Estates 1st Addition in Ash Street, Spokane County, Washington. The following items have been identified at the project site and proposed construction that should be carefully considered during design and construction:

- Standing water was observed within the existing drywells located at the site. This may be due to fluctuations of groundwater and perching between the topsoil or undocumented fill, and bedrock at the site.
- Swales consisting of single or double-depth drywells were not feasible across the site due to the limiting layer of shallow bedrock. Drainage retention swales are recommended to treat and retain the stormwater.
- The area appears to be a stormwater disposal facility. Drain rock, filter fabric and drywells were observed in the area.
- Undocumented fill was observed in both test pits to a depth of 1 ½- to 2-feet below the ground surface. Undocumented fill may be reused as *Embankment Fill* provided it meets the requirements of *Table 4.1.2.A* of this report.

Liberty Geotech should be involved in the design development and earthwork construction to help ensure that the report recommendations are incorporated into the design and construction. Liberty Geotech is available to discuss these items further in-person or via a conference call.

2.0 PROPOSED CONSTRUCTION

The proposed construction consists of a stormwater drainage facility. Stormwater disposal will consist of swales and typical single or double-depth drywells position within the swale areas. The recommendations included in this report are based on a plat map prepared by Taylor Engineering, Inc. dated October 10, 2003.

3.0 GEOTECHNICAL EXPLORATION

Subsurface exploration was performed by excavating two test pits with a SANY SY26U mini-excavator. Subsurface exploration was performed at the project site on December 2, 2021. The test pits were excavated through the topsoil, undocumented fill, and bedrock and terminated on the rock surface. The contractor or client is recommended to notify Liberty Geotech if the soil conditions are different from those described in the following sections.

Throughout this report, test pits are abbreviated TP and are hyphenated with a numbering system that corresponds to Appendix A: *Exploration Site Plan* and Appendix B: *Subsurface Exploration Results*. The test pits depicted in Appendix A were located using the accuracy of a cell phone location system. The locations were not surveyed and the accuracy is expected to be

within 10-feet of the depicted location. Also, the elevation of each test pit was estimated using Google Earth™ mapping service with the GWS84 EGM96 geoid.

3.1 Geology, Topography, and Current Site Use

The *Geologic map of the Spokane Northwest 7.5-minute quadrangle, Spokane County, Washington* (Derkey, 2004) was reviewed to determine the geologic deposit at the site. The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt.

The two lots have existing drainage swales and both with a single-depth drywell. According to the historical aerial images, the earthwork construction for the residential development within the site's vicinity was between 2003 to 2006. The existing swales and drywells appeared to be placed within the site during that time. In addition, based on the topography obtained from Google Earth™, the site is relatively level with approximately five to seven feet of relief across the site.

3.2 Summary of Soil and Rock Encountered During Exploration

The soil encountered during the exploration is generally consistent with the geologic research. However, both test pits observed undocumented fill to depths of 2 ½- to 3-feet below the ground surface. The test pits encountered one foot of topsoil overlying a separation fabric overlying drain rock with a separation fabric overlying bedrock.

3.3 Estimated Groundwater and Bedrock Elevations

Groundwater was not observed in both test pits. However, there was standing water at the drywells during the exploration. This may be due to fluctuations of groundwater and perching between the topsoil and bedrock at the site.

According to the well logs in the vicinity of the site (Ecology), the static water level is approximately 37-feet below the ground surface. Seasonal and annual fluctuations in groundwater levels should be anticipated.

Both test pits met refusal due to basalt bedrock to depths ranging from three to four feet below the ground surface. In TP-2, residual bedrock was observed 2 ½-feet below the ground surface.

4.0 GEOTECHNICAL RECOMMENDATIONS

4.1 Earthwork

The following recommendations should be considered by the general contractors and earthwork subcontractors prior to providing a cost estimate for the earthwork on the project.

4.1.1 Subgrade Preparation

Clear and grub all vegetation, strip all topsoil. Topsoil and undocumented fill removal are estimated to be one to three feet across the site.

Liberty Geotech should be contacted once the subgrade areas have been exposed to review the subgrade conditions.

4.1.2 Earthwork Soil Products, Compaction, and Testing Frequency

Different soil products should be used for different applications. The following table presents recommendations for anticipated earthwork construction:

Table 4.1.2.A - Soil product selection.

Soil Product	Project Use	Soil Description
Embankment Fill	• Utility trench backfill	Soil classified as: • GP-GM or GW-GM • GM • SP-SM or SW-SM • SM • ML Soil should have less than 6% organic deleterious material, and all material larger than 3-inches in diameter.

The following table provides compaction recommendations specific to ASTM D1557 *Laboratory Compaction Characteristics of Soil Using Modified Effort.* All fill products should be compacted in lifts of soil not exceeding 12 inches measured prior to compaction.

Table 4.1.2.B - Compaction recommendation.

Project Use	Recommended Compaction
• Exterior wall backfill. • Utility trench backfills.	92 percent of the maximum dry density of Modified Proctor.
• Non-structural fill areas.	80 to 85 percent of the maximum

• Vegetated areas.	dry density of Modified Proctor.

If more than 30 percent of native or imported *Structural Fill* material is retained on the ¾" sieve, ASTM D1557 *Laboratory Compaction Characteristics of Soil Using Modified Effort* is not recommended to be used. In this case, a soil-specific method specification can be developed. A nuclear density gauge can be used during earthwork operations to establish a moisture and compaction method that provides an acceptable maximum dry density. Method specification earthwork operations are recommended to have full-time soil testing to ensure adequate compaction.

The soil products are recommended to have passing compaction testing results at the following frequency to ensure the soil is uniformly meeting compaction requirements. Failing test results should be retested after additional compactive effort and, if necessary, water is added. At least 90% of the compaction testing results must achieve the required maximum dry density.

Table 4.1.2.C - Testing Frequency.

Project Use	Testing Frequency
• Utility trenches for every two vertical feet of trench backfill.	100 lineal feet and a minimum of 2 tests.

The jurisdictional requirements should be conformed to if there is a conflict with the requirements of Table 5.1.2.C. Excavations deeper than four feet must have adequate trenching protection or be sloped back in accordance with state and federal requirements in order to be compaction tested.

4.2 Drainage and Stormwater Infiltration Recommendations

Drainage retention swales may be utilized to treat and retain stormwater. The following recommendations should be used by the civil engineer to retention swales:

- The depth to a restrictive layer is at least three feet below the ground surface based on the shallow bedrock encountered at the site during the exploration.
- Swales should be located 10-feet from the edge of buildings and concrete hardscapes to minimize the effects of retention.

5.0 DESIGN REVIEW AND CONSTRUCTION OBSERVATIONS

5.1 Geotechnical Consultant versus Geotechnical Inspector

In order to retain Liberty Geotech as the geotechnical engineer of record, the client must contact Liberty Geotech or require their contractor to contact Liberty Geotech to perform the observations and notifications that are recommended within this report. Liberty Geotech is not the engineer of record and has no liability for the construction or design based on this report if

observations and material testing are not performed and meet the recommendations contained within this report. In addition, Liberty Geotech's liability is limited to the authorized proposal dated November 24, 2021.

5.2 Revisions and Transfer of Geotechnical Recommendations

Liberty Geotech should be notified to update recommendations if the proposed development changes or subsurface soil or groundwater conditions vary from those described in this report. This report cannot be relied upon by property owners adjacent to this property without confirmation of their specific site soil conditions. Also, the report recommendations cannot be transferred to other business entities or subsequent property owners without written authorization. No warranty or certification of construction is provided with this report. Liberty Geotech should review the final construction drawings to confirm the incorporation of the recommendations of this report.

7.0 REFERENCES

ACI Committee 302. "Guide for Concrete Floor and Slab Construction." ACI 302.1R-15. American Concrete Institute, P.O. Box 19150 Redford Station, Detroit, Michigan 48219.

Derkey, Robert E., Hamilton, Michael M., Stradling, Dale F., 2004. Geologic Map of the Spokane Northwest 7.5-Minute Quadrangle, Spokane County, Washington. Washington Division of Geology and Earth Resources.

Spokane County, City of Spokane, and City of Spokane Valley. "Spokane Regional Stormwater Manual." April 2008.

United States Department of Agriculture, Natural Resources Conservation Service. "Web Soil Survey." Accessed December 23, 2021. http://websoilsurvey.nrcs.usda.gov/

Washington State Department of Ecology. "Washington State Well Report Viewer." Accessed December 23, 2021. fortress.wa.gov/ecy/wellconstruction/map/WCLSWebMap/

APPENDIX A

Exploration Site Plan

BASE SOURCE: PORTION OF THE CRESTVIEW ESTATES 1ST ADDITION, PLAT MAP, PROVIDED BY TAYLOR ENGINEERING, INC. DATED OCTOBER 10, 2003.

APPENDIX B

Subsurface Exploration Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS GROUP SYMBOL	SOIL DECRIPTION
COURSE GRAINED SOIL	GRAVEL	CLEAN GRAVEL		GW	WELL-GRADED GRAVEL
				GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES		GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
				GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
	SAND	CLEAN SAND		SW	WELL-GRADED SAND
				SP	POORLY-GRADED SAND
		SAND WITH FINES		SM	SILTY SAND
				SC	CLAYEY SAND
FINE GRAINED SOIL	SILT AND CLAY LIQUID LIMIT LESS THAN 50%			ML	INELASTIC SILT
				CL	LEAN CLAY
				OL	ORGANIC SILT
	SILT AND CLAY LIQUID LIMIT GREATER THAN 50%			MH	ELASTIC SILT
				CH	FAT CLAY
				OH	ORGANIC CLAY
				PT	PEAT

ABBREVATIONS
BGS - BELOW EXISTING GROUND SURFACE
N.E. - NOT ENCOUNTERED

USCS DESCRIPTION	ELEVATION (FT)	DEPTH (FT)	LITHOLOGY	SAMPLE INTERVAL	POCKET PEN. (TSF)	% PASSING NO. 200 SIEVE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	VOID RATIO (%)	ADDITIONAL NOTES
TOPSOIL - Well-Graded Sand with Silt (SW-SM) Medium Dense, Brown, Moist	2385									1-foot treatment soil overlying geo fabric overlying drain rock overlying bedrock.
UNDOCUMENTED FILL - Well-Graded Gravel (GW) Medium Dense, Black, Moist		3								

Test pit terminated at 3-feet bgs due to bedrock.

Client: Whipple Consulting Engineers, Inc.	Test Pit Number: 1		
Project: Crestview Estates 1st Addition	Project Number: 21425		
Equipment: SANY SY26U	Date Excavated: 12/2/2021		
Depth to Groundwater: NE	Logged By: TMC		Sheet: 1 of 2

USCS DESCRIPTION	ELEVATION (FT)	DEPTH (FT)	LITHOLOGY	SAMPLE INTERVAL	POCKET PEN. (TSF)	% PASSING NO. 200 SIEVE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	VOID RATIO (%)	ADDITIONAL NOTES
TOPSOIL - Well-Graded Sand with Silt (SW-SM) Medium Dense, Brown, Moist	2385									1-foot treatment soil overlying geo fabric overlying drain rock overlying geo fabric overlying bedrock. Drain rock.
UNDOCUMENTED FILL - Poorly-Graded Gravel (GP) Medium Dense, Black, Moist										
BEDROCK - Well-Graded Gravel (GW) Very Dense, Black, Dry		4								

Test pit terminated at 4-feet bgs due to bedrock.

Client: Whipple Consulting Engineers, Inc.	Test Pit Number: 2		
Project: Crestview Estates 1st Addition	Project Number: 21425		
Equipment: SANY SY26U	Date Excavated: 12/2/2021		
Depth to Groundwater: NE	Logged By: TMC		Sheet: 2 of 2

APPENDIX C

Photo Log

Appendix C: Photo Log

PHOTO 1: TP-1 LOCATION

PHOTO 2: GEOFABRIC WITHIN TP-1

PHOTO 3: TP-1 EXCAVATED SOILS

PHOTO 4: BOULDERS WITHIN TP-1

Appendix C: Photo Log

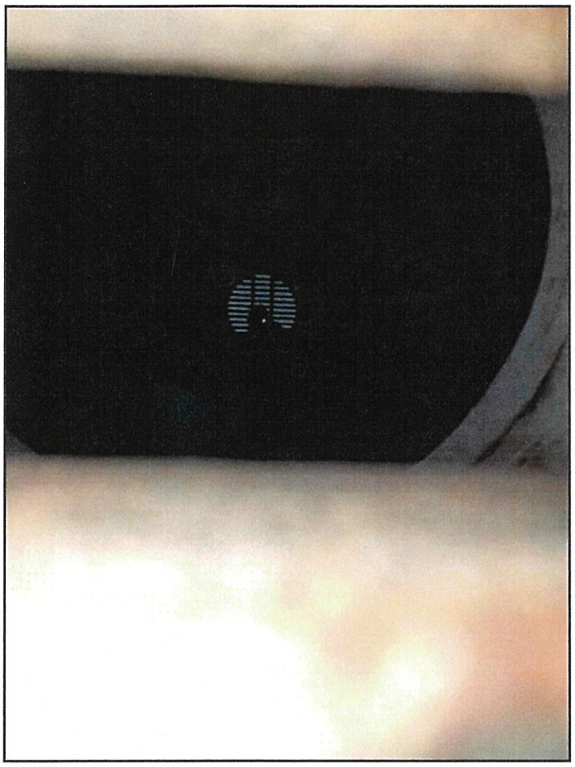


PHOTO 5: TP-1 STANDING WATER WITHIN DRYWELL

PHOTO 6: TP-2 LOCATION

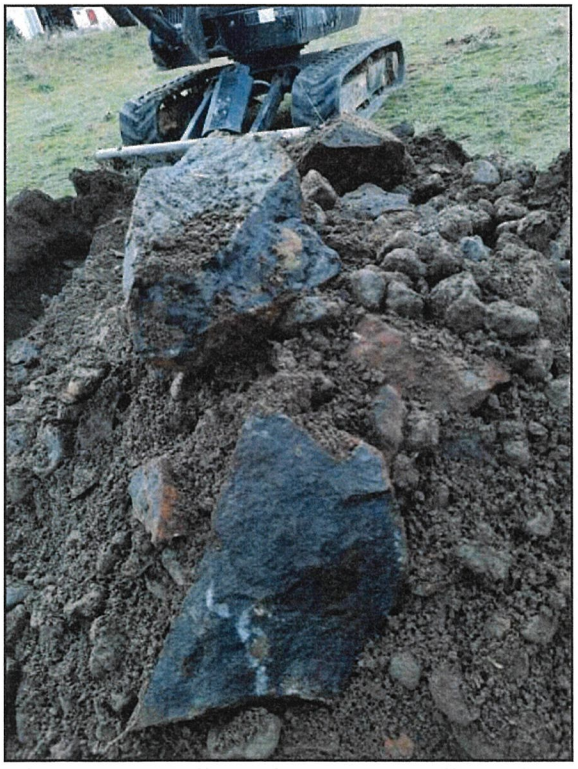
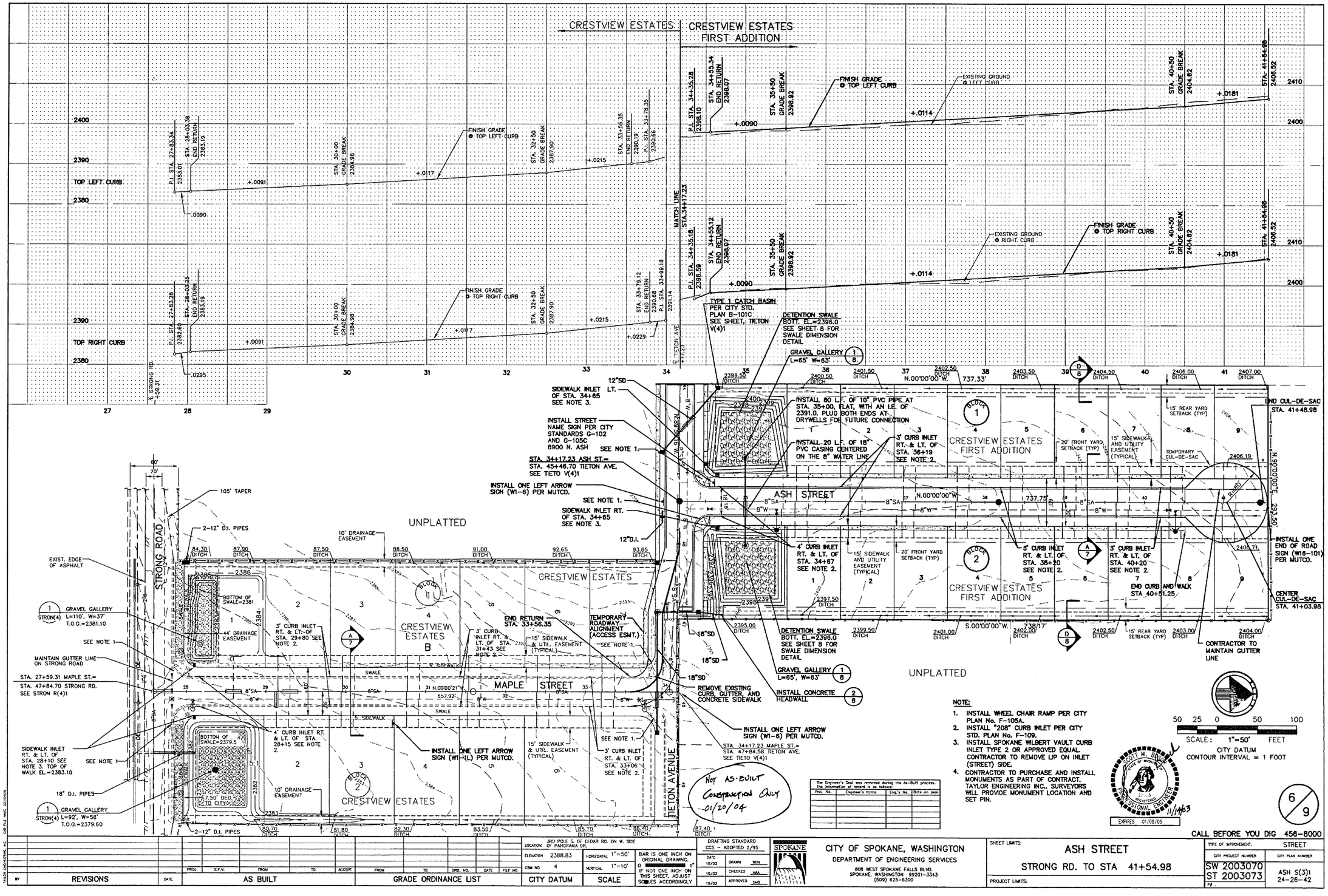


PHOTO 7: TP-2 EXCAVATED SOILS AND BOULDERS

PHOTO 8: GEOFABRIC WITHIN TP-2



BY	REVISIONS	DATE	PROJ.	E.F.N.	FROM	TO	ACCEPT	FROM	TO	ORD. NO.	DATE	FILE NO.
					AS BUILT			GRADE ORDINANCE LIST				

LOCATION OF BENCHMARK	3RD POLE S. OF CEDAR RD. ON W. SIDE
ELEVATION	2388.83
CBM NO.	4
CITY DATUM	
HORIZONTAL SCALE	1"=50'
VERTICAL SCALE	1"=10'

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

DRAFTING STANDARD: CCS – ADOPTED 2/95

DATE 10/02	DRAWN	RCH
10/02	CHECKED	MAA
10/02	APPROVED	SMD

The Engineer's Seal was removed during the As-Built process. The information of record is as follows:

Proj. No.	Engineer's Name	Eng's No.	Date on plan

SPOKANE

CITY OF SPOKANE, WASHINGTON
DEPARTMENT OF ENGINEERING SERVICES
808 WEST SPOKANE FALLS BLVD.
SPOKANE, WASHINGTON 99201-3343
(509) 625-6300

SHEET LIMITS: ASH STREET
STRONG RD. TO STA 41+54.98
PROJECT LIMITS:

TYPE OF IMPROVEMENT	STREET
CITY PROJECT NUMBER	CITY PLAN NUMBER
SW 2003070 ST 2003073	ASH S(3)1 24-26-42

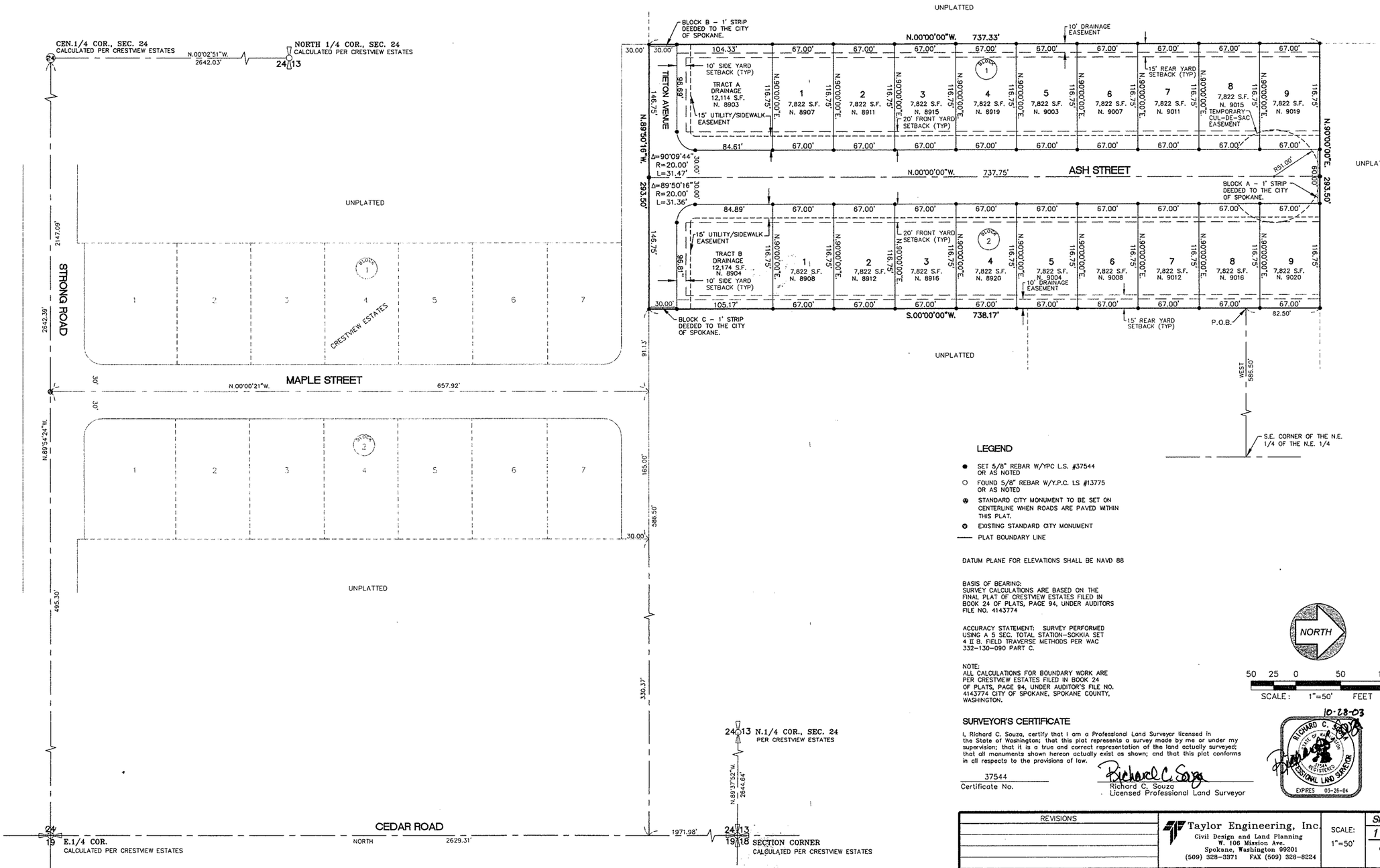
6/9

5142404 30/42

FINAL PLAT
CRESTVIEW ESTATES 1ST ADDITION

BEING AN UNPLATTED PORTION OF THE EAST 1/2 , N.E. 1/4 OF SEC. 24, T.26N., R.42E., W.M.
CITY OF SPOKANE, SPOKANE COUNTY, WASHINGTON

AUDITOR'S CERTIFICATE
FILED FOR RECORD THIS 3RD DAY OF NOVEMBER 2004
AT 1:24 PM. IN BOOK 36 OF Plats, Pages 42-43.
By TEH Corp Inc, GAGER CONSTRUCTION INC, MOUNTAIN CREST INC.
COUNTY AUDITOR
DEPUTY



LEGEND

- ● SET 5/8" REBAR W/YPC L.S. #37544 OR AS NOTED
- ○ FOUND 5/8" REBAR W/Y.P.C. LS #13775 OR AS NOTED
- ⊗ STANDARD CITY MONUMENT TO BE SET ON CENTERLINE WHEN ROADS ARE PAVED WITHIN THIS PLAT.
- ⊗ EXISTING STANDARD CITY MONUMENT
- —— PLAT BOUNDARY LINE

DATUM PLANE FOR ELEVATIONS SHALL BE NAVD 88

BASIS OF BEARING:
SURVEY CALCULATIONS ARE BASED ON THE FINAL PLAT OF CRESTVIEW ESTATES FILED IN BOOK 24 OF PLATS, PAGE 94, UNDER AUDITORS FILE NO. 4143774

ACCURACY STATEMENT: SURVEY PERFORMED USING A 5 SEC. TOTAL STATION-SOKKIA SET 4 II B. FIELD TRAVERSE METHODS PER WAC 332-130-090 PART C.

NOTE:
ALL CALCULATIONS FOR BOUNDARY WORK ARE PER CRESTVIEW ESTATES FILED IN BOOK 24 OF PLATS, PAGE 94, UNDER AUDITOR'S FILE NO. 4143774 CITY OF SPOKANE, SPOKANE COUNTY, WASHINGTON.

NORTH

50 25 0 50 100
SCALE: 1"=50' FEET

SURVEYOR'S CERTIFICATE

I, Richard C. Souza, certify that I am a Professional Land Surveyor licensed in the State of Washington; that this plat represents a survey made by me or under my supervision; that it is a true and correct representation of the land actually surveyed; that all monuments shown hereon actually exist as shown; and that this plat conforms in all respects to the provisions of law.

37544
Certificate No.

Richard C. Souza
Richard C. Souza
Licensed Professional Land Surveyor

10-28-03

RICHARD C. SOUZA — STATE OF WASHINGTON — 37544 — REGISTERED PROFESSIONAL LAND SURVEYOR — EXPIRES 03-26-04

REVISIONS	Taylor Engineering, Inc.	SCALE:	SHEET
	Civil Design and Land Planning W. 108 Mission Ave. Spokane, Washington 99201 (509) 328-3371 FAX (509) 328-8224	1"=50'	1 OF 2
DWN: JDH DATE: 10-10-03 CK'D: RCS DATE: 10-10-03	FINAL PLAT OF CRESTVIEW ESTATES 1ST ADDITION		CADD FILE 02117P1A

30/42

5142404

30/43

FINAL PLAT
CRESTVIEW ESTATES 1ST ADDITION

BEING AN UNPLATTED PORTION OF THE EAST 1/2 , N.E. 1/4 OF SEC. 24, T.26N., R.42E., W.M.
CITY OF SPOKANE, SPOKANE COUNTY, WASHINGTON

AUDITOR'S CERTIFICATE

FILED FOR RECORD THIS 3RD DAY OF NOVEMBER 2004
AT 12:24 PM. IN BOOK 30 OF PLATS, PAGES 42-43
By TFH Corporation, Greer Construction Inc, Mountain Crest, Inc.
William L. Lindstrom COUNTY AUDITOR
DEPUTY

#3694

DEDICATION:

KNOW ALL MEN BY THESE PRESENTS, THAT TFH CORPORATION INC., A WASHINGTON CORPORATION, GREER CONSTRUCTION, INC., A WASHINGTON CORPORATION, AND MOUNTAIN CREST INC., A WASHINGTON CORPORATION; HAVE CAUSED TO BE PLATTED INTO LOTS, BLOCKS AND STREETS THE UNPLATTED LAND SHOWN HEREIN TO BE KNOWN AS CRESTVIEW ESTATES FIRST ADDITION IN SPOKANE COUNTY, THE STATE OF WASHINGTON; SAID LAND BEING IN THE CITY OF SPOKANE, N.E. 1/4 OF SECTION 24, T.26N., R.42E., W.M., BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

THAT PORTION OF THE EAST HALF OF THE NORTHEAST QUARTER OF SAID SECTION 24, T.26N., R.42E., W.M. SPOKANE COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

BEGINNING AT A POINT 586.50 FEET WEST OF THE SOUTHEAST CORNER OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SAID SECTION 24; THENCE SOUTH AND PARALLEL WITH THE EAST LINE OF SAID NORTHEAST QUARTER 660.00 FEET; THENCE WEST 293.50 FEET; THENCE NORTH AND PARALLEL WITH THE EAST LINE OF SAID NORTHEAST QUARTER, 742.50 FEET; THENCE EAST 293.50 FEET; THENCE SOUTH 82.50 FEET TO THE POINT OF BEGINNING;

SITUATE IN THE COUNTY OF SPOKANE, STATE OF WASHINGTON.

AREA = 4.97 ACRES

THE OWNER ADOPTS THE PLAN OF LOTS AND BLOCKS SHOWN HEREON.

THIS SUBDIVISION HAS BEEN MADE WITH THE FREE CONSENT AND IN ACCORDANCE WITH THE DESIRES OF THE OWNERS OF LAND SO DIVIDED. THE SIGNATORIES HEREOF HEREBY CERTIFY THAT THEY ARE THE OWNERS OF AND THE ONLY PARTIES HAVING ANY INTEREST IN THE LANDS SO DIVIDED; AND THAT THE PROPERTY SHOWN HEREON IS NOT ENCUMBERED BY ANY DELINQUENT TAXES OR ASSESSMENTS. THE OWNERS ADOPT THE PLAN OF LOTS, BLOCKS, AND STREETS SHOWN HEREON, AND HEREBY DEDICATE TO THE CITY OF SPOKANE FOR PUBLIC USE FOREVER THE STREETS, AS SHOWN HEREON. THE OWNERS WAIVE ALL CLAIMS AGAINST ANY GOVERNMENTAL AGENCY FOR DAMAGES WHICH MAY BE OCCASIONED TO THE ADJACENT LAND BY THE ESTABLISHED CONSTRUCTION, DRAINAGE, AND MAINTENANCE OF SAID STREETS.

THIS PLAT SHALL BE SERVED BY THE CITY SANITARY SEWER AND WATER SYSTEM ONLY. INDIVIDUAL ON-SITE SEWAGE SYSTEMS AND PRIVATE WELLS AND WATER SYSTEMS ARE PROHIBITED. THE CITY WATER SYSTEM APPROVED BY COUNTY AND STATE HEALTH OFFICIALS AND THE CITY WATER DEPARTMENT WILL BE INSTALLED WITHIN THIS PLAT. THE PLATTOR WILL PROVIDE FOR INDIVIDUAL DOMESTIC WATER SERVICE AS WELL AS FIRE HYDRANTS FOR FIRE PROTECTION TO EACH LOT PRIOR TO SALE. NO LOT MAY BE SOLD OR OTHERWISE TRANSFERRED UNLESS IT IS SERVED BY PUBLIC SEWER, PUBLIC WATER, PUBLIC STREET, FIRE HYDRANTS, AND A STORM DRAINAGE SYSTEM APPROVED BY THE CITY OF SPOKANE. STREET IMPROVEMENTS (INCLUDING CURBS, PAVING, AND SIDEWALKS ON ALL PUBLIC STREETS) AND SEWER IMPROVEMENTS SHALL BE COMPLETED IN EACH PUBLIC STREET FOR THE ENTIRE LENGTH OF A BLOCK OR SO MUCH OF A BLOCK LENGTH AS IS WITHIN THE SUBDIVISION, WITHIN THREE (3) YEARS AFTER THE DATE THAT BUILDING PERMITS ARE ISSUED FOR NOT LESS THAN 60% OF THE COMBINED FRONTAGE ON BOTH SIDES OF SAID BLOCK. IN THE EVENT THAT SAID IMPROVEMENTS HAVE NOT BEEN COMPLETED WITHIN SAID THREE (3) YEARS, THE SUBDIVIDERS AND PERSONS WITH ANY INTEREST IN THE PROPERTY IN SAID BLOCK WILL NOT PROTEST A "LOCAL IMPROVEMENT DISTRICT" FOR SAID IMPROVEMENTS AS MAY BE INITATED BY RESOLUTION OF THE CITY COUNCIL. STRONG ROAD IS TO BE IMPROVED PRIOR TO THE SALE OF ANY LOT. TRUNK AND LATERAL STORM SEWERS ARE REQUIRED IN CITY PLATTED PROPERTY AS THE SAME IS DEVELOPED. AS CONSIDERATION FOR THE ACCEPTANCE OF THIS PLAT BY THE CITY OF SPOKANE, THE OWNERS OF ALL NON-PUBLIC PROPERTY HEREIN PLATTED INTO LOTS AND BLOCKS AGREE NOT TO PROTEST UNDER 35.43.180 R.C.W., THE CONSTRUCTION OF OR LEGAL ASSESSMENT FOR, ANY SEWER ULTIMATELY SERVING THEIR NON-PUBLIC PROPERTY AT SUCH TIME AS IT IS DESIRED BY THE CITY OF SPOKANE TO CONSTRUCT SUCH SEWERS. THE AGREEMENTS HEREIN EXPRESSED SHALL BE CONSIDERED A COVENANT TO RUN WITH THE LAND AND SHALL BY REFERENCE BE CARRIED AS A PROVISION IN EACH AND EVERY DEED DRAWN TO TRANSFER OWNERSHIP OF ANY AND ALL PROPERTY DELINEATED WITHIN THIS PLAT. THE PROPERTIES IN THE PLAT SHALL BE SUBJECT TO PRIVATE COVENANTS AND RESTRICTIONS AS RECORDED IN SEPARATE DOCUMENTS.

ALL DWELLINGS SHALL BE SET BACK NOT LESS THAN THE MINIMUM FRONT AND REAR YARD OR FLANKING STREET SIDE YARD REQUIREMENTS AS SHOWN HEREIN. A TEN (10) FOOT WIDE UTILITY EASEMENT (INCLUDING CABLE TV, WASHINGTON WATER POWER, AND US WEST COMMUNICATIONS) IS HEREBY GRANTED TO THE CITY ALONG FRONT LOT LINES AND ALONG ALL LOT BOUNDARIES ADJACENT TO STREETS. OTHER EASEMENTS OF RECORD ARE SHOWN ON THE FACE OF THIS PLAT.

ALL STORM WATER AND SURFACE DRAINAGE GENERATED ON-SITE MUST BE DISPOSED OF ON-SITE IN ACCORDANCE WITH SMC 1.09A "STORM WATER FACILITIES" AND AS PER THE PROJECT ENGINEER'S RECOMMENDATIONS, BASED ON THE DRAINAGE PLANS ACCEPTED FOR THIS FINAL PLAT. NO BUILDING PERMIT SHALL BE ISSUED FOR ANY LOT IN THIS PLAT UNTIL EVIDENCE SATISFACTORY TO THE CITY ENGINEER HAS BEEN PROVIDED SHOWING THAT THE RECOMMENDATIONS OF SMC 11.09A "STORM WATER FACILITIES" AND THE PROJECT ENGINEER'S RECOMMENDATIONS, BASED ON THE DRAINAGE PLANS ACCEPTED FOR THIS FINAL PLAT, HAVE BEEN COMPLIED WITH. THIS PLAT IS NOT IN AN IRRIGATION DISTRICT. TRACTS A AND B, AS PLATTED AND SHOWN HEREON, WHICH ARE FOR THE PURPOSE OF INSTALLING, OPERATING, AND MAINTAINING DRAINAGE SWALES AND DRAINAGE FACILITIES TO DISPOSE OF RUNOFF, SHALL BE DESIGNATED AS UNBUILDABLE, AND ARE HEREBY GRANTED TO THE PUBLIC. THESE TRACTS, INCLUDING ALL DRAINAGE SWALES AND DRAINAGE FACILITIES, WILL BE OPERATED AND MAINTAINED BY THE CRESTVIEW ESTATES HOMEOWNER'S ASSOCIATION. THE CITY OF SPOKANE WILL OPERATE AND MAINTAIN ALL STORM WATER LINES AND STRUCTURES LOCATED IN PUBLIC RIGHT-OF-WAY, EXCEPT FOR ANY LINES CONNECTING FROM STORM WATER STRUCTURES IN PUBLIC STREETS TO DRAINAGE TRACTS. THESE LINES WILL BE MAINTAINED BY THE CRESTVIEW ESTATES HOMEOWNER'S ASSOCIATION. THE CITY OF SPOKANE IS HEREBY GRANTED THE RIGHT OF INGRESS AND EGRESS TO ALL DRAINAGE EASEMENTS ADJACENT TO THE PUBLIC RIGHT-OF-WAY. THE PROPERTY OWNER SHALL MAINTAIN THE DRAINAGE SWALE IN PUBLIC RIGHT-OF-WAY, ADJACENT TO THE PROPERTY OWNER'S PROPERTY, WITH A PERMANENT LIVE COVER OF LAWN TURF, WITH OPTIONAL SHRUBBERY AND/OR TREES, WHICH DO NOT OBSTRUCT THE FLOW AND PERCOLATION OF STORM DRAINAGE WATER IN THE DRAINAGE SWALE AS INDICATED BY THE APPROVED PLANS. THE PROPERTY OWNER OR HIS REPRESENTATIVE SHALL INFORM EACH SUCCEEDING PURCHASER OF ALL DRAINAGE EASEMENTS ON THE PROPERTY AND HIS RESPONSIBILITY FOR MAINTAINING DRAINAGE FACILITIES WITHIN SAID EASEMENTS. THE LAND IN THIS PLAT IS NOT IN A DESIGNATED DRAINAGE CHANNEL OR DESIGNATED FLOOD PLAN AND HAS NO PONDING AREAS EXCEPT '208' PONDS AND SWALES AND EXCEPT AS NOTED ABOVE.

THE FUTURE EXTENSION OF ASH STREET WILL REQUIRE THAT THE PLATTOR(S) OF THE DEVELOPMENT REQUIRING SAID EXTENSION MUST REMOVE THE TEMPORARY CUL-DE-SAC AND REPLACE IT WITH CITY STANDARD CURB/GUTTER, SIDEWALK, AND PLANTING STRIPS/SWALES AT SAID PLATTOR(S) EXPENSE.

A TEMPORARY CUL-DE-SAC EASEMENT OVER A PORTION OF LOTS 8 AND 9, BLOCK 1, AND LOTS 8 AND 9, BLOCK 2, AS SHOWN HEREON, IS HEREBY GRANTED TO THE CITY OF SPOKANE UNTIL SUCH TIME AS THE PUBLIC STREET RIGHT-OF-WAY IS EXTENDED. THE TEMPORARY CUL-DE-SAC EASEMENT IS FOR THE USE OF THE PUBLIC AND MAY BE USED BY THE PUBLIC IN THE SAME MANNER AS PUBLIC RIGHT-OF-WAYS AND THE SAME RESTRICTIONS AND LIABILITIES SHALL APPLY TO SAID EASEMENT AS IF IT IS A PUBLIC RIGHT-OF-WAY.

A DEED RESTRICTION SHALL BE PLACED ON LOTS 8 AND 9, BLOCK 1, AND LOTS 8 AND 9, BLOCK 2, AFFECTED BY ELIMINATION OF TEMPORARY CUL-DE-SAC. IT SHOULD STATE THAT AFFECTED PROPERTY OWNER(S) WILL BE RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH RECONSTRUCTION OF PRIVATE IMPROVEMENTS IMPACTED BY REMOVAL OF THE TEMPORARY CUL-DE-SAC AND CONSTRUCTION OF THE REQUIRED STREET IMPROVEMENTS.

A TRANSPORTATION MITIGATION FEE OF $1,430.00 SHALL BE CHARGED FOR EACH DWELLING UNIT. THE FEE SHALL BE COLLECTED AT THE TIME OF APPLICATION FOR A BUILDING PERMIT.

BLOCKS A, B AND C AS SHOWN HEREON, ARE HEREBY DEDICATED IN FEE TO THE CITY OF SPOKANE.

ALL PARKING AREAS AND DRIVES, INCLUDING PRIVATE PARKING AREAS AND DRIVES, SHALL BE HARD SURFACED.

STORM DRAINAGE REQUIREMENTS. ALL STORM WATER AND SURFACE DRAINAGE MUST BE DISPOSED OF ON SITE IN ACCORDANCE WITH THE CITY OF SPOKANE'S "208"

SLOPE EASEMENTS, AS NECESSARY, ARE HEREBY GRANTED ALONG ALL PUBLIC RIGHT OF WAYS.

ALL IMPROVEMENTS, INCLUDING REQUIRED STREET AND TRAFFIC CONTROL SIGNS WITHIN THE PLAT, SHALL BE PAID FOR BY THE PLATTOR.

THE PLATTOR AGREES TO INSTALL FIRE HYDRANTS WHICH COMPLY WITH THE CITY FIRE DEPARTMENT STANDARDS AND SPECIFICATIONS.

ALL IMPROVEMENTS, INCLUDING STREET IMPROVEMENTS, SHALL BE INSTALLED TO SERVE EACH RESIDENCE FOR WHICH THE CERTIFICATE OF OCCUPANCY IS SOUGHT IN ACCORDANCE WITH THE PLANS APPROVED BY THE CITY OF SPOKANE.

THE TEN (10) FOOT DRAINAGE EASEMENT AT THE REAR OF EACH LOT FOR OFF-SITE DRAINAGE SHALL BE MAINTAINED BY THE PROPERTY OWNER AND MUST RETAIN ITS SHAPE TO ALLOW THE COLLECTION AND TRANSPORT OF STORMWATER AROUND THE PLAT. FENCES OR ANY STRUCTURE WHICH WOULD INTERFERE WITH THE FLOW OF STORMWATER WILL NOT BE ALLOWED ACROSS THIS EASEMENT. THE GRASS SURFACE OF ALL DRAINAGE EASEMENT AREAS SHALL BE MAINTAINED BY THE PROPERTY OWNER.

A RUNOFF EVALUATION MUST BE PERFORMED ON EACH LOT TO DETERMINE THE SUITABILITY OF ANY ABOVE OR BELOW GRADE LEVEL STRUCTURES PROPOSED FOR EACH LOT. THIS EVALUATION MUST BE PERFORMED BY A CIVIL AND/OR GEOTECHNICAL ENGINEER, LICENSED IN THE STATE OF WASHINGTON. IT MUST INCLUDE AN INDIVIDUAL LOT DRAINAGE PLAN AND AN ANALYSIS AS TO HOW DRAINAGE WILL BE HANDLED AND DISPOSED OF DURING AND AFTER CONSTRUCTION OF EACH LOT. THIS EVALUATION MUST BE SUBMITTED TO THE CITY BUILDING AND ENGINEERING SERVICES DEPARTMENTS AT THE TIME OF APPLICATION FOR A BUILDING PERMIT AND REVIEW AND CONCURRENCE MUST BE GIVEN PRIOR TO THE ISSUANCE OF A BUILDING PERMIT.

ALL IMPROVEMENTS REQUIRED TO BE CONSTRUCTED OR COMPLETED AS A CONDITION OF THE APPROVAL OF THE PRELIMINARY PLAT SHALL BE COMPLETED BY THE DEVELOPER PRIOR TO THE OCCUPANCY OF ANY STRUCTURES SERVED BY SAID IMPROVEMENTS.

THE USE OF INDIVIDUAL ON-SITE SANITARY WASTE DISPOSAL SYSTEMS AND PRIVATE WELLS IS PROHIBITED.

IN WITNESS WHEREOF, THE FOLLOWING OWNER HAS HEREUNTO SET HIS HAND
THIS 14TH DAY OF November 2003

TFH CORPORATION INC.
BY _____
ROBERT J. FRISCH

ACKNOWLEDGMENT

STATE OF WASHINGTON } SS.
COUNTY OF SPOKANE }

ON THIS 11th DAY OF November 2003 BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED ROBERT J. FRISCH TO ME KNOWN TO BE THE PRESIDENT OF TFH CORPORATION INC, THE CORPORATION THAT EXECUTED THE FOREGOING INSTRUMENT, AND ACKNOWLEDGED THE SAID INSTRUMENT TO BE THE FREE AND VOLUNTARY ACT AND DEED OF SAID CORPORATION, FOR THE USES AND PURPOSES THEREIN MENTIONED, AND TO OATH STATED THAT THEY ARE AUTHORIZED TO EXECUTE THE SAID INSTRUMENT.

WITNESS MY HAND AND OFFICIAL SEAL HERETO AFFIXED THE DAY AND YEAR FIRST ABOVE WRITTEN.

_____
NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, RESIDING AT SPOKANE

MY COMMISSION EXPIRES 8/25/06.

LINDA M. ALVERSON NOTARY PUBLIC STATE OF WASHINGTON MY COMMISSION EXPIRES AUG. 25, 2006

IN WITNESS WHEREOF, THE FOLLOWING OWNER HAS HEREUNTO SET HIS HAND
THIS 11TH DAY OF November 2003

MOUNTAIN CREST INC.
BY _____
DONALD V. MATTSON

ACKNOWLEDGMENT

STATE OF WASHINGTON } SS.
COUNTY OF SPOKANE }

ON THIS 11th DAY OF November 2003 BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED DONALD V. MATTSON TO ME KNOWN TO BE THE VICE PRESIDENT OF MOUNTAIN CREST INC, THE CORPORATION THAT EXECUTED THE FOREGOING INSTRUMENT, AND ACKNOWLEDGED THE SAID INSTRUMENT TO BE THE FREE AND VOLUNTARY ACT AND DEED OF SAID CORPORATION, FOR THE USES AND PURPOSES THEREIN MENTIONED, AND TO OATH STATED THAT THEY ARE AUTHORIZED TO EXECUTE THE SAID INSTRUMENT.

WITNESS MY HAND AND OFFICIAL SEAL HERETO AFFIXED THE DAY AND YEAR FIRST ABOVE WRITTEN.

_____
NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, RESIDING AT SPOKANE

MY COMMISSION EXPIRES 8/25/06

LINDA M. ALVERSON NOTARY PUBLIC STATE OF WASHINGTON MY COMMISSION EXPIRES AUG. 25, 2006

IN WITNESS WHEREOF, THE FOLLOWING OWNER HAS HEREUNTO SET HIS HAND
THIS 11TH DAY OF November 2003

GREER CONSTRUCTION INC.
BY _____
DEAN GREER

ACKNOWLEDGMENT

STATE OF WASHINGTON } SS.
COUNTY OF SPOKANE }

ON THIS 11th DAY OF November 2003 BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, DULY COMMISSIONED AND SWORN, PERSONALLY APPEARED DEAN GREER TO ME KNOWN TO BE THE PRESIDENT OF GREER CONSTRUCTION INC, THE CORPORATION THAT EXECUTED THE FOREGOING INSTRUMENT, AND ACKNOWLEDGED THE SAID INSTRUMENT TO BE THE FREE AND VOLUNTARY ACT AND DEED OF SAID CORPORATION, FOR THE USES AND PURPOSES THEREIN MENTIONED, AND TO OATH STATED THAT THEY ARE AUTHORIZED TO EXECUTE THE SAID INSTRUMENT.

WITNESS MY HAND AND OFFICIAL SEAL HERETO AFFIXED THE DAY AND YEAR FIRST ABOVE WRITTEN.

_____
NOTARY PUBLIC IN AND FOR THE STATE OF WASHINGTON, RESIDING AT SPOKANE

MY COMMISSION EXPIRES 8/25/06

LINDA M. ALVERSON NOTARY PUBLIC STATE OF WASHINGTON MY COMMISSION EXPIRES AUG. 25, 2006

APPROVALS:

CITY SUBDIVISION ADMINISTRATOR

APPROVED AS CONFORMING TO THE REQUIREMENTS OF SUBDIVISION REGULATIONS AND APPROVED PRELIMINARY PLAT THIS 26TH DAY OF OCTOBER, 2004.

Donald D. Carlson
CITY OF SPOKANE SUBDIVISION ADMINISTRATOR

CITY ENGINEER

EXAMINED AND APPROVED
THIS 26TH DAY OF October, 2004.

Thomas J. Arnold
CITY OF SPOKANE ENGINEER

CITY ATTORNEY

EXAMINED AND APPROVED AS TO FORM THIS 2 DAY OF November, 2004.

Michael E. Connelly
CITY OF SPOKANE ATTORNEY

CITY HEARING EXAMINER

APPROVED BY THE CITY OF SPOKANE HEARING EXAMINER THIS 2ND DAY OF November, 2004.

Brian A. Smith
CITY OF SPOKANE HEARING EXAMINER

CITY TREASURER

I HEREBY CERTIFY THAT ALL ASSESSMENTS FOR WHICH THE PROPERTY INCLUDED WITHIN THIS SUBDIVISION MAY BE LIABLE, HAVE BEEN DULY PAID, SATISFIED, OR DISCHARGED AS OF THIS 17 DAY OF FEBRUARY, 2004.

CITY OF SPOKANE TREASURER

COUNTY TREASURER

I HEREBY CERTIFY THAT ALL ASSESSMENTS FOR WHICH THE PROPERTY INCLUDED WITHIN THIS SUBDIVISION MAY BE LIABLE, HAVE BEEN DULY PAID, SATISFIED, OR DISCHARGED AS OF THIS 3RD DAY OF Nov, 2004.

Linda M Wolverton a Jack
SPOKANE COUNTY TREASURER BY DEPUTY

COUNTY ASSESSOR

APPROVED THIS 3RD DAY OF November, 2004.

D Sommers by Robert d Folsom
SPOKANE COUNTY ASSESSOR

Surveyor's Certificate

I, Richard C. Souza, certify that I am a Professional Land Surveyor licensed in the State of Washington; that this plat represents a survey made by me or under my supervision; that it is a true and correct representation of the land actually surveyed; that all monuments shown hereon actually exist as shown; and that this plat conforms in all respects to the provisions of law.

37544
Certificate No.

Richard C. Souza
Richard C. Souza
Licensed Professional Land Surveyor

10-28-03

RICHARD C. SOUZA STATE OF WASHINGTON 37544 REGISTERED PROFESSIONAL LAND SURVEYOR EXPIRES 03-26-04

REVISIONS			
DWN: JDH	DATE: 10-10-03		
CK'D: RCS	DATE: 10-10-03		

Taylor Engineering, Inc.
Civil Design and Land Planning
W. 105 Mission Ave.
Spokane, Washington 99201
(509) 328-3371 FAX (509) 328-8224

SCALE: 1"=50'

SHEET 2 OF 2

FINAL PLAT
CRESTVIEW ESTATES 1ST ADDITION

CADD FILE 02117P1A

TAYLOR 1996 STORM REPORT

DRAINAGE REPORT

FOR

CRESTVIEW ESTATES

Taylor Engineering, Inc.

Civil Design and Land Planning

TABLE OF CONTENTS

DRAINAGE REPORT
for
CRESTVIEW ESTATES

Project Description:

The proposed project involves the development of approximately 4.76 acres of property into 14 residential lots. The interior road will be asphalt with curb and gutter, 36' in width measured from the face of the curbs.

The project is located on the north side of Strong Road, between Cedar and Five Mile Roads in the Northeast quarter of Section 24, Township 26, Range 42 East, W.M. Spokane County, Washington. The site was previously unoccupied. (See Vicinity Map, Attachment "A".)

Methodology:

The procedures as outlined in the *Guidelines for Stormwater Management* (GSM) as published by Spokane County Engineers were followed. The Rational Method was used with a 10 year return frequency for on-site drainage along Strong Road. Off-site drainage and the majority of the on-site drainage was analyzed using a 50 year return frequency and the Haestad Methods computer program QTR-55.

Soils: (See Soils Map, Attachment "B")

Soils are classified as UmC - Uhlig Silt Loam in accordance with the *Soil Survey, Spokane County Washington, 1968.*

> UmC- 5 to 30 percent slopes. Deep, medium-textured, well-drained soils formed from glacial till mixed with loess and volcanic ash in the upper parts. Depth to bedrock ranges from 30 to 40 inches.

This soil group is not acceptable for drywells per the GSM. An alternative system will be utilized and is outlined in the Methods of Disposal section of this report.

Topographic Data:

The majority of the site slopes from the northwest to the southeast with grades varying from 1% to 8%.

Demographic Data:

Located within the Five Mile Prairie, the Crestview Estates site is currently unoccupied. Neighboring land uses include other residential developments and various farming operations.

Rainfall Data:

Data used is in accordance with Figure 2, page 6-3 of the *Guidelines for Stormwater Management,* by Spokane County Engineers. A 10 year return frequency event was used for a small portion of on-site drainage and a 50 year return frequency event was used for the majority of the on-site and all of the off-site drainage. The chart is included with the calculations of this report.

Methods of Runoff Control:

Runoff will be controlled by various drainage basins. Off-site drainage flows overland and is intercepted by ditches on either side of the plat. The ditches direct the flow around the plat and to the existing outlet point (a culvert) under Strong Road. On-site drainage flows overland or along the new roadways to grass percolation areas (208 swales) along the front of the lots. Excess flow continues out of the grass percolation areas and flows to infiltration galleries downstream. Galleries are sized to dispose of the on-site drainage on the site.

Methods of Disposal:

Since we are diverting the off-site flow around the plat, only the on-site drainage needs to be disposed of on-site. Attachment "C" consists of a *Limited Subsurface Evaluation for Stormwater Management* prepared by Budinger and Associates. This report recommends that stormwater be discharged to slowly percolating retention swales utilizing permeability rates of the sod and topsoil and that excess stormwater in the southern portion of the site be discharged to the permeable sand and gravel through an infiltration gallery.

Therefore, the 208 swales along the lot frontages are for treatment of the contaminants off the impervious road areas. The infiltration galleries are for disposal of the excess drainage that is not infiltrated or evaporated in the 208 swales. Infiltration galleries have a gallery drywell located in them for conveyance of the stormwater into the gravel envelope of the gallery. Where the galleries are not being utilized as 208 swales, the drywell inlet is set 0.10' off of the grassed bottom. Where galleries are being used as 208 swales, the inlet is set 0.50' off the grassed bottom for the standard depth of ponding.

Peak Flow, Volume and Disposal Calculations:

a. Hydrology Computations:

The site has been divided into two (2) off-site drainage basins for sizing the ditches along the plat boundary and six (6) on-site basins, labeled numerically.

* **Off-site Basin 1:** (west side ditch) includes approximately 23.07 acres of cultivated land and generates a calculated runoff rate of 12 cfs for a 50 year storm.

* **Off-site Basin 2:** (east side ditch) includes approximately 18.58 acres of cultivated land and generates a calculated runoff rate of 10 cfs for a 50 year storm.

* **On-site Basin 3 (future):** includes the west half of Maple Street north of Tieton Avenue and the abutting residential lots. A 50 year storm was used for analyzing this basin since an alternative disposal system is being used and since the City of Spokane required it. Basin 3 generates 2.3 cfs and is able to dispose of it at a rate of 0.025 cfs. This requires 5100 cubic feet of storage volume to maintain the 50 year storm. Since Basin 3 is located in Crestview Estates First Addition, it will not be built at this time. We have, however, completed the runoff rate and storage volume portion of the calculations and have shown the facilities on the plans. The infiltration gallery will be sized at a later date.

* **On-site Basin 4 (future):** includes the east half of Maple Street north of Tieton Avenue and the abutting residential lots. Again, a 50 year storm was used for analyzing this basin. Basin 4 generates 2.3 cfs and is able to dispose of it at a rate of 0.025 cfs. This requires 5100 cubic feet of storage volume to maintain the 50 year storm. Basin 4 is also located in Crestview Estates First Addition and will not be built at this time. Additional infiltration gallery calculations will be completed at a later date.

* **On-site Basin 5:** includes the west half of Maple Street south of Tieton Avenue and north of Strong Road and the abutting residential lots. Basin 5 generates 2.8 cfs for a 50 year storm and is able to dispose of it at a rate of 0.70 cfs. At this rate, a storage volume of 1800 cubic feet is required. With a bottom of pond elevation of 2380, 1800 cubic feet is stored to a depth of 2381.35 in the pond. An infiltration gallery has been sized using the *Stormwater Management Manual for the Puget Sound Basin* (page III-3-16, February 1992). Per the geotechnical recommendations, the gallery must have a surface area of 4032 square feet for this basin.

* **On-site Basin 6:** includes the east half of Maple Street south of Tieton Avenue and north of Strong Road and the abutting residential lots. Basin 6 generates 2.4 cfs for a 50 year storm and is able to dispose of it at a rate of 0.70 cfs. At this rate, a storage volume of 1400 cubic feet is required. With a bottom of pond elevation of 2379.50, 1400 cubic feet is stored to a depth of 2380.75 in the pond. The infiltration gallery necessary for Basin 6 also has a surface area of 4032 square feet.

* **On-site Basin 7:** includes the added north portion of Strong Road from approximately STA. 45+14 to STA. 47+40. The Rational Method was used with a 10 year storm to analyze the runoff off of the new pavement area. Basin 7 generates 0.17 cfs which is routed through a combination 208 swale and infiltration gallery. The gallery requires 1152 square feet of surface area for disposal.

* **On-site Basin 8:** includes the added north portion of Strong Road from approximately STA. 47+40 to STA. 50+19. The Rational Method was used with a 10 year storm to analyze the runoff from the new pavement area. Basin 8 generates 0.20 cfs which is routed through a combination 208 swale and infiltration gallery. The gallery requires 1152 square feet of surface area for disposal.

We also completed an analysis of the anticipated drainage flow to the culvert for the 50 year event. An existing and phase one developed condition analysis were completed. The existing condition analyzed the contributing cultivated area up to the east boundary of phase one, since the contributing area east of there would be the same in both cases, and the existing asphalt road along the plat frontage. The maximum runoff rate for this condition was calculated to be 21.8 CFS for the design storm.

The developed condition was then analyzed which included the same area as the existing condition excepting out basins 5 and 6 which will be disposed of in the ponds near Strong Road. This basin also included the developed width of Strong Road along the plat frontage and north and southeast portion of Tieton Avenue. The resulting runoff rate calculated for the design storm is 19.5 CFS which is less than the existing condition therefore the development should not cause any additional adverse conditions. Another point which assists in providing a conservative system is that the disposal of the drainage facilities in the roadside swales along Strong Road was not included.

b. Inlet Capacities

Curb inlets were installed along Maple Street to intercept the on-site drainage and convey it to the 208 swales along the lot frontages. Sidewalk inlets were placed at the downstream end of the 208 swales to allow excess drainage to flow under the sidewalks, into the pond areas and eventually into the gravel galleries.

Curb inlets were also placed along Tieton Avenue to intercept the on-site drainage and convey it to the 208 swales.

Drainage along Strong Road enters the combination 208 swales and infiltration galleries through curb inlets along the road. This installation includes an inlet placed at the low spot in Strong Road, just east of the intersection with Maple Street.

Off-site drainage that is routed to ditches along the plat boundary will flow through sidewalk inlets on Strong Road enroute to the existing culvert under the road. Where the drainage currently exits the property.

A ductile iron pipe will be extended to the roadside swale on Strong Road, east of Maple Street. This pipe will be connected to the existing 18" RCP culvert under Strong and allow drainage to pass through the site as it currently does.

c. Ditch Capacities:

The off-site drainage is routed through ditches along the east and west plat boundaries for Crestview Estates. Off-site Basin 1 flows to the west ditch and generates 12 cfs. Off-site Basin 2 flows to the east ditch and generates 10 cfs, both for a 50 year storm. Ditch calculations were performed for each basin separately and a conservative ditch section was utilized for both basins. The ditch section used is a triangular ditch with 3:1 side slopes, grass surfacing and a minimum longitudinal slope of 1%. The ditch was sized for freeboard (1.3 x the flow depth), which made an 18" total depth.

Remarks:

The above described system of stormwater control will provide the necessary structures and systems as outlined in the Spokane County *Guidelines for Stormwater Management* to control runoff for the Crestview Estates residential development on Maple Street.

HYDROLOGY COMPUTATIONS

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 08:49:58 05-08-1996

Crestview Estates
Existing Condition
Basin West - CV-WD5

OFF-SITE BASIN 1

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	23.07	75	
COMPOSITE AREA --->	23.07	75.0	(75)

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 08:54:22 05-08-1996 a:CV-WD5.TCT

Crestview Estates
Existing Condition
Basin West Ditch - CV-WD5

Tc COMPUTATIONS FOR: Subarea #1

SHEET FLOW (Applicable to Tc only)

Segment ID		A	
Surface description		cultivated	
Manning's roughness coeff., n		0.0600	
Flow length, L (total < or = 300)	ft	100.0	
Two-yr 24-hr rainfall, P2	in	1.400	
Land slope, s	ft/ft	0.0200	
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.12	= 0.12

SHALLOW CONCENTRATED FLOW

Segment ID		B	
Surface (paved or unpaved)?		Unpaved	
Flow length, L	ft	1800.0	
Watercourse slope, s	ft/ft	0.0194	
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2473	
where: Unpaved Csf = 16.1345			
Paved Csf = 20.3282			
T = L / (3600*V)	hrs	0.22	= 0.22

CHANNEL FLOW

Segment ID			
Cross Sectional Flow Area, a	sq.ft	0.00	
Wetted perimeter, Pw	ft	0.00	
Hydraulic radius, r = a/Pw	ft	0.000	
Channel slope, s	ft/ft	0.0000	
Manning's roughness coeff., n		0.0000	
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000	
Flow length, L	ft	0	
T = L / (3600*V)	hrs	0.00	= 0.00

::

TOTAL TIME (hrs) 0.34

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 08:56:47
Watershed file: --> A:CV-WD5 .MOP
Hydrograph file: --> A:CV-WD55.HYD

Crestview Estates
Existing Condition
Basin West Ditch - CV-WD5

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Subarea #1	23.07	75.0	0.30	0.00	2.40	0.59	I.28	.28

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 23.07 acres or 0.03605 sq.mi
Peak discharge = 12 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.34	0.00	0.30	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 08:56:47
Watershed file: --> A:CV-WD5 .MOP
Hydrograph file: --> A:CV-WD55.HYD

Crestview Estates
Existing Condition
Basin West Ditch - CV-WD5

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	12	12.3
Composite Watershed	12	12.3

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 08:56:47
Watershed file: --> A:CV-WD5 .MOP
Hydrograph file: --> A:CV-WD55.HYD

Crestview Estates
Existing Condition
Basin West Ditch - CV-WD5

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	0	2	6	11	12	10
Total (cfs)	0	0	0	0	2	6	11	12	10

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	6	5	4	3	2	2	2	1	1
Total (cfs)	6	5	4	3	2	2	2	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	1	0	0	0	0
Total (cfs)	1	0	0	0	0

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 08:59:52 05-08-1996

Crestview Estates
Existing Condition
Basin East Ditch - CV-ED5

OFF-SITE BASIN 2

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	18.58	75	
COMPOSITE AREA --->	18.58	75.0	(75)

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 09:05:08 05-08-1996 a:CV-ED5.TCT

Crestview Estates
Existing Condition
Basin East Ditch - CV-ED5

Tc COMPUTATIONS FOR: Subarea #1

SHEET FLOW (Applicable to Tc only)

Segment ID		A		
Surface description		cultivated		
Manning's roughness coeff., n		0.0600		
Flow length, L (total < or = 300)	ft	100.0		
Two-yr 24-hr rainfall, P2	in	1.400		
Land slope, s	ft/ft	0.0133		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.14	=	0.14

SHALLOW CONCENTRATED FLOW

Segment ID		B		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	1580.0		
Watercourse slope, s	ft/ft	0.0203		
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.2988		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.19	=	0.19

CHANNEL FLOW

Segment ID				
Cross Sectional Flow Area, a	sq.ft	0.00		
Wetted perimeter, Pw	ft	0.00		
Hydraulic radius, r = a/Pw	ft	0.000		
Channel slope, s	ft/ft	0.0000		
Manning's roughness coeff., n		0.0000		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000		
Flow length, L	ft	0		
T = L / (3600*V)	hrs	0.00	=	0.00

::

TOTAL TIME (hrs) 0.33

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 09:07:03
Watershed file: --> A:CV-ED5 .MOP
Hydrograph file: --> A:CV-ED55.HYD

Crestview Estates
Existing Condition
Basin East Ditch - CV-ED5

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Subarea #1	18.58	75.0	0.30	0.00	2.40	0.59	I.28	.28

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 18.58 acres or 0.02903 sq.mi
Peak discharge = 10 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	* Tt (hr)	Rounded Values Tc (hr)	* Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.33	0.00	0.30	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 09:07:03
Watershed file: --> A:CV-ED5 .MOP
Hydrograph file: --> A:CV-ED55.HYD

Crestview Estates
Existing Condition
Basin East Ditch - CV-ED5

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	10	12.3
Composite Watershed	10	12.3

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-08-1996 09:07:03
Watershed file: --> A:CV-ED5 .MOP
Hydrograph file: --> A:CV-ED55.HYD

Crestview Estates
Existing Condition
Basin East Ditch - CV-ED5

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	0	1	5	9	10	8
Total (cfs)	0	0	0	0	1	5	9	10	8

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	5	4	3	2	2	1	1	1	1
Total (cfs)	5	4	3	2	2	1	1	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	0
Total (cfs)	1	1	1	1	1	1	1	1	0

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	0	0	0	0	0
Total (cfs)	0	0	0	0	0

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 07:32:42 02-28-1996

Crestview Estates
Developed Condition
Basin 3 - cv35
Area Times Ten (A x 10)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Residential, 1/4 ac.	24.28	75	
Type B, Asphalt	0.57	98	
COMPOSITE AREA --->	24.85	75.5	(76)

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:42:35
Watershed file: --> A:CV35 .MOP
Hydrograph file: --> A:CV355.HYD

Crestview Estates
Developed Condition
Basin 3 - CV35
Area Times Ten (A x 10)

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input	Ia/p used
Subarea #1	24.85	76.0	0.10	0.00	2.40	0.63	I.26	.26

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.85 acres or 0.03883 sq.mi
Peak discharge = 23 cfs ← 2.3 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.10	0.00	**	**	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:42:35
Watershed file: --> A:CV35 .MOP
Hydrograph file: --> A:CV355.HYD

Crestview Estates
Developed Condition
Basin 3 - CV35
Area Times Ten (A x 10)

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	23	12.1
Composite Watershed	23	12.1

2.3 cfs

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:42:35
Watershed file: --> A:CV35 .MOP
Hydrograph file: --> A:CV355.HYD

Crestview Estates
Developed Condition
Basin 3 - CV35
Area Times Ten (A x 10)

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	5	14	23	13	5	4
Total (cfs)	0	0	0	5	14	23	13	5	4

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	4	3	3	2	2	2	2	1	1
Total (cfs)	4	3	3	2	2	2	2	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	1	1	0	0	0
Total (cfs)	1	1	0	0	0

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:CV355.HYD
Output Hydrograph: B:CV3551 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
11.00	0.00	x	0.100	=	0.00
11.10	0.00	x	0.100	=	0.00
11.20	0.00	x	0.100	=	0.00
11.30	0.00	x	0.100	=	0.00
11.40	0.00	x	0.100	=	0.00
11.50	0.00	x	0.100	=	0.00
11.60	0.00	x	0.100	=	0.00
11.70	2.00	x	0.100	=	0.20
11.80	3.00	x	0.100	=	0.30
11.90	5.00	x	0.100	=	0.50
12.00	14.00	x	0.100	=	1.40
12.10	23.00	x	0.100	=	2.30
12.20	13.00	x	0.100	=	1.30
12.30	5.00	x	0.100	=	0.50
12.40	4.00	x	0.100	=	0.40
12.50	4.00	x	0.100	=	0.40
12.60	3.00	x	0.100	=	0.30
12.70	3.00	x	0.100	=	0.30
12.80	2.00	x	0.100	=	0.20
12.90	2.00	x	0.100	=	0.20
13.00	2.00	x	0.100	=	0.20
13.10	2.00	x	0.100	=	0.20
13.20	2.00	x	0.100	=	0.20
13.30	2.00	x	0.100	=	0.20
13.40	2.00	x	0.100	=	0.20
13.50	2.00	x	0.100	=	0.20
13.60	1.00	x	0.100	=	0.10
13.70	1.00	x	0.100	=	0.10
13.80	1.00	x	0.100	=	0.10
13.90	1.00	x	0.100	=	0.10
14.00	1.00	x	0.100	=	0.10
14.10	1.00	x	0.100	=	0.10
14.20	1.00	x	0.100	=	0.10
14.30	1.00	x	0.100	=	0.10
14.40	1.00	x	0.100	=	0.10
14.50	1.00	x	0.100	=	0.10
14.60	1.00	x	0.100	=	0.10
14.70	1.00	x	0.100	=	0.10
14.80	1.00	x	0.100	=	0.10
14.90	1.00	x	0.100	=	0.10
15.00	1.00	x	0.100	=	0.10
15.10	1.00	x	0.100	=	0.10

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:CV355.HYD
Output Hydrograph: B:CV3551 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
15.20	1.00	x	0.100	=	0.10
15.30	1.00	x	0.100	=	0.10
15.40	1.00	x	0.100	=	0.10
15.50	1.00	x	0.100	=	0.10
15.60	1.00	x	0.100	=	0.10
15.70	1.00	x	0.100	=	0.10
15.80	1.00	x	0.100	=	0.10
15.90	1.00	x	0.100	=	0.10
16.00	1.00	x	0.100	=	0.10
16.10	1.00	x	0.100	=	0.10
16.20	1.00	x	0.100	=	0.10
16.30	1.00	x	0.100	=	0.10
16.40	1.00	x	0.100	=	0.10
16.50	1.00	x	0.100	=	0.10
16.60	1.00	x	0.100	=	0.10
16.70	1.00	x	0.100	=	0.10
16.80	1.00	x	0.100	=	0.10
16.90	1.00	x	0.100	=	0.10
17.00	1.00	x	0.100	=	0.10
17.10	1.00	x	0.100	=	0.10
17.20	1.00	x	0.100	=	0.10
17.30	1.00	x	0.100	=	0.10
17.40	1.00	x	0.100	=	0.10
17.50	1.00	x	0.100	=	0.10
17.60	1.00	x	0.100	=	0.10
17.70	1.00	x	0.100	=	0.10
17.80	1.00	x	0.100	=	0.10
17.90	1.00	x	0.100	=	0.10
18.00	1.00	x	0.100	=	0.10
18.10	1.00	x	0.100	=	0.10
18.20	1.00	x	0.100	=	0.10
18.30	1.00	x	0.100	=	0.10
18.40	1.00	x	0.100	=	0.10
18.50	1.00	x	0.100	=	0.10
18.60	1.00	x	0.100	=	0.10
18.70	1.00	x	0.100	=	0.10
18.80	1.00	x	0.100	=	0.10
18.90	1.00	x	0.100	=	0.10
19.00	1.00	x	0.100	=	0.10
19.10	1.00	x	0.100	=	0.10
19.20	1.00	x	0.100	=	0.10

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:CV355.HYD
Output Hydrograph: B:CV3551 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
19.30	1.00	x	0.100	=	0.10
19.40	1.00	x	0.100	=	0.10
19.50	0.00	x	0.100	=	0.00
19.60	0.00	x	0.100	=	0.00
19.70	0.00	x	0.100	=	0.00
19.80	0.00	x	0.100	=	0.00
19.90	0.00	x	0.100	=	0.00
20.00	0.00	x	0.100	=	0.00
20.10	0.00	x	0.100	=	0.00
20.20	0.00	x	0.100	=	0.00
20.30	0.00	x	0.100	=	0.00
20.40	0.00	x	0.100	=	0.00
20.50	0.00	x	0.100	=	0.00
20.60	0.00	x	0.100	=	0.00
20.70	0.00	x	0.100	=	0.00
20.80	0.00	x	0.100	=	0.00
20.90	0.00	x	0.100	=	0.00
21.00	0.00	x	0.100	=	0.00
21.10	0.00	x	0.100	=	0.00
21.20	0.00	x	0.100	=	0.00
21.30	0.00	x	0.100	=	0.00
21.40	0.00	x	0.100	=	0.00
21.50	0.00	x	0.100	=	0.00
21.60	0.00	x	0.100	=	0.00
21.70	0.00	x	0.100	=	0.00
21.80	0.00	x	0.100	=	0.00
21.90	0.00	x	0.100	=	0.00
22.00	0.00	x	0.100	=	0.00
22.10	0.00	x	0.100	=	0.00
22.20	0.00	x	0.100	=	0.00
22.30	0.00	x	0.100	=	0.00
22.40	0.00	x	0.100	=	0.00
22.50	0.00	x	0.100	=	0.00
22.60	0.00	x	0.100	=	0.00
22.70	0.00	x	0.100	=	0.00
22.80	0.00	x	0.100	=	0.00
22.90	0.00	x	0.100	=	0.00
23.00	0.00	x	0.100	=	0.00
23.10	0.00	x	0.100	=	0.00
23.20	0.00	x	0.100	=	0.00
23.30	0.00	x	0.100	=	0.00

POND-2 Version: 5.16 S/N: 1295130196
Executed 02-28-1996 08:07:17

>>>>>>>> Summary of Hydrograph Volume <<<<<<<<

Hydrograph: B:CV3551 .HYD

Volume = 5,544 cu.ft.
  0.13 ac-ft

POND-2 Version: 5.16 S/N: 1295130196

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

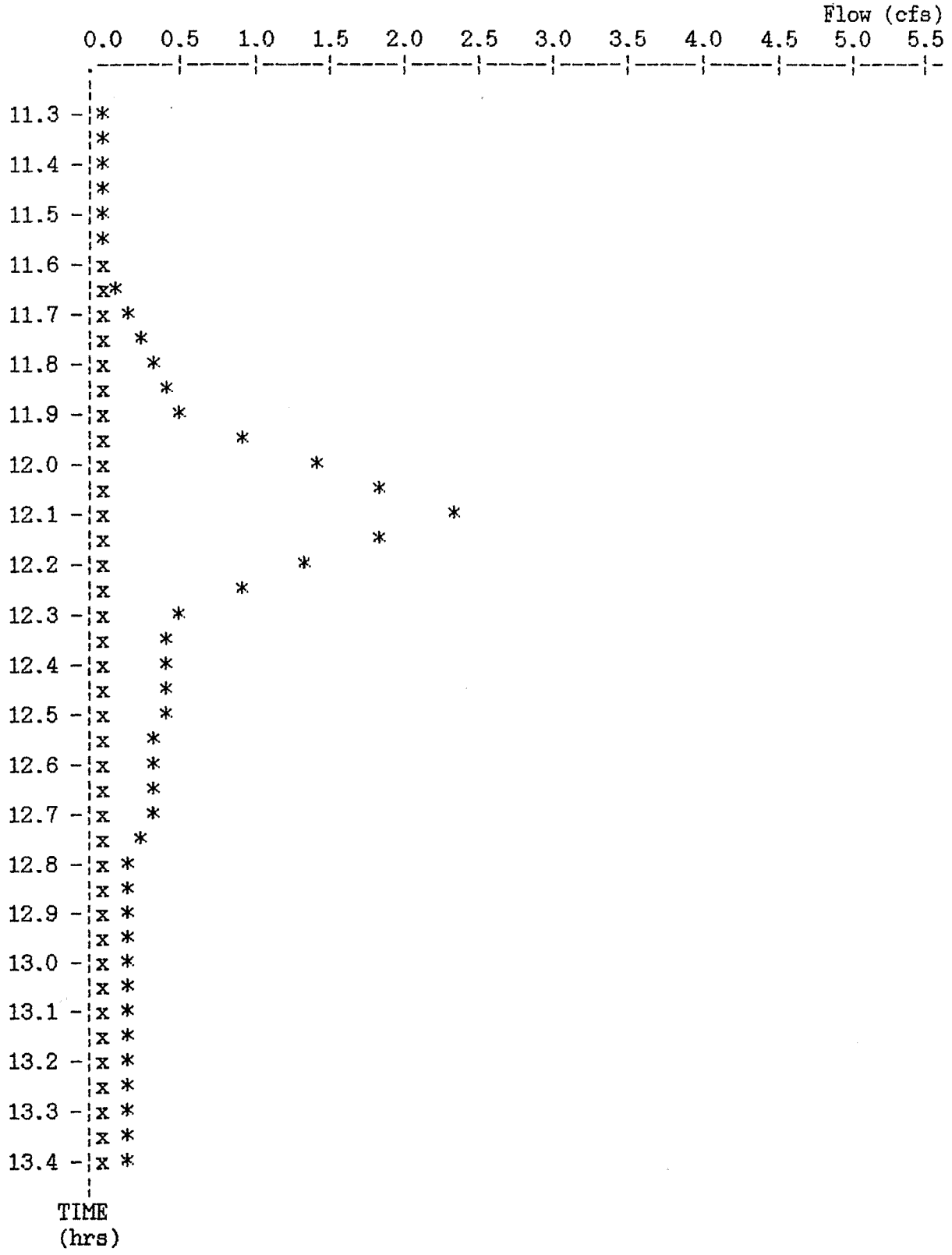
Inflow Hydrograph: B:CV3551 .HYD
Qpeak = 2.3 cfs

Estimated Outflow: B:ESTIMATE.EST
Qpeak = 0.0 cfs ← .025 cfs

Approximate Storage Volume
(computed from t= 11.60 to 19.47 hrs)

5,100 cubic-ft

POND-2 Version: 5.16 S/N: 1295130196
Plotted: 02-28-1996



* File: B:CV3551 .HYD Qmax = 2.3 cfs
x File: B:ESTIMATE.EST Qmax = 0.0 cfs

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 07:34:13 02-28-1996

Crestview Estates
Developed Condition
2asin 4 - cv45
Area Times Ten (A x 10)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Residential, 1/4 ac.	24.28	75	
Type B, Asphalt	0.57	98	
COMPOSITE AREA --->	24.85	75.5	(76)

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:44:59
Watershed file: --> A:CV45 .MOP
Hydrograph file: --> A:CV455.HYD

Crestview Estates
Developed Condition
Basin 4 - CV45
Area Times Ten (A x 10)

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Subarea #1	24.85	76.0	0.10	0.00	2.40	0.63	I.26 .26

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 24.85 acres or 0.03883 sq.mi
Peak discharge = 23 cfs ← 2.3 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.10	0.00	**	**	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

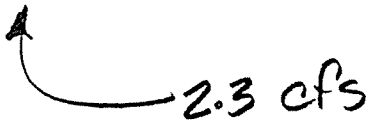
TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:44:59
Watershed file: --> A:CV45 .MOP
Hydrograph file: --> A:CV455.HYD

Crestview Estates
Developed Condition
Basin 4 - CV45
Area Times Ten (A x 10)

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	23	12.1
Composite Watershed	23	12.1



TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:44:59
Watershed file: --> A:CV45 .MOP
Hydrograph file: --> A:CV455.HYD

Crestview Estates
Developed Condition
Basin 4 - CV45
Area Times Ten (A x 10)

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	5	14	23	13	5	4
Total (cfs)	0	0	0	5	14	23	13	5	4

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	4	3	3	2	2	2	2	1	1
Total (cfs)	4	3	3	2	2	2	2	1	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	1	1	0	0	0
Total (cfs)	1	1	0	0	0

POND-2 Version: 5.16 S/N: 1295130196

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

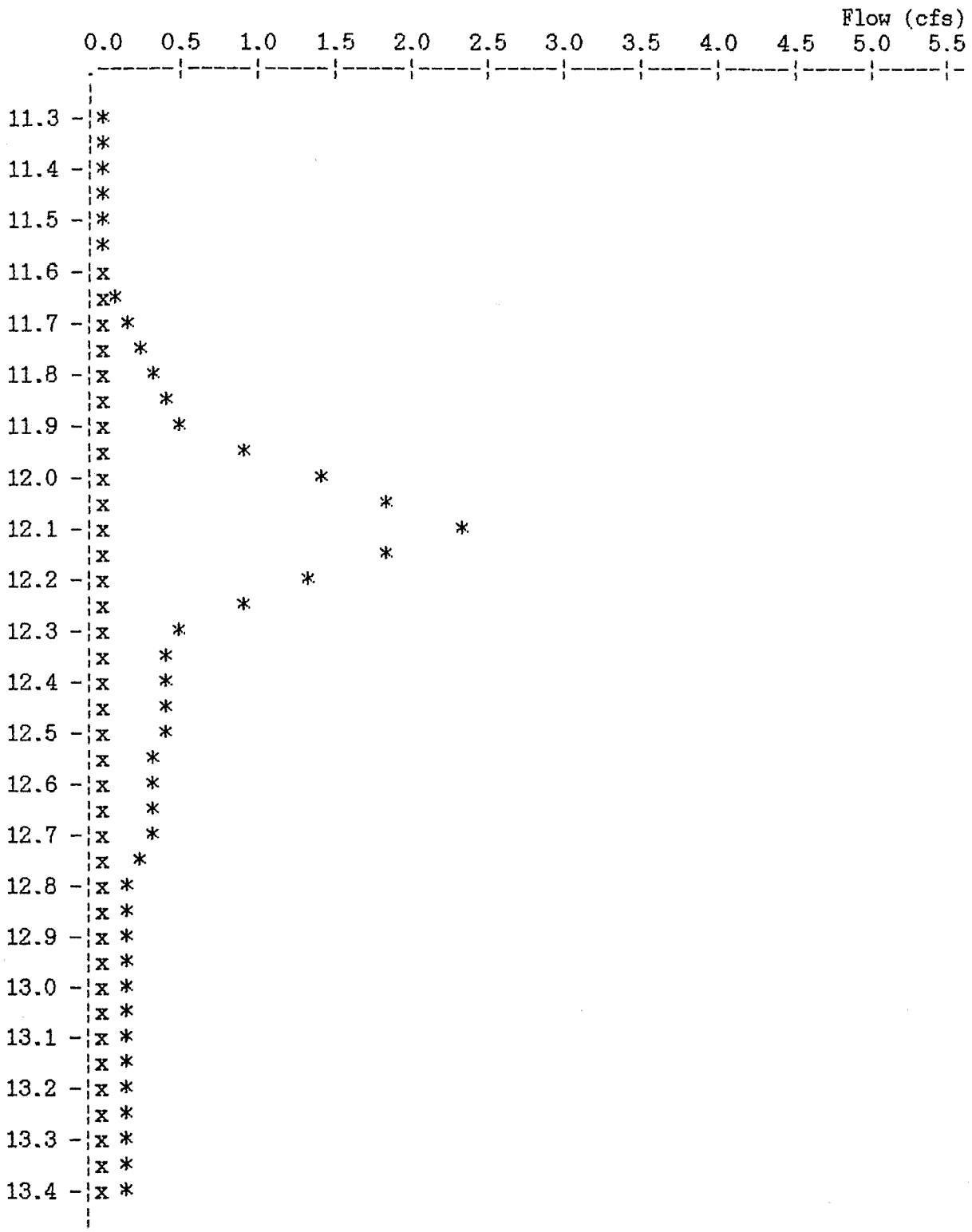
Inflow Hydrograph: B:CV4551 .HYD
Qpeak = 2.3 cfs

Estimated Outflow: B:ESTIMATE.EST
Qpeak = 0.0 cfs ← .025 cfs

Approximate Storage Volume
(computed from t= 11.60 to 19.47 hrs)

5,100 cubic-ft

POND-2 Version: 5.16 S/N: 1295130196
Plotted: 02-28-1996



* File: B:CV4551 .HYD Qmax = 2.3 cfs
x File: B:ESTIMATE.EST Qmax = 0.0 cfs

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 07:38:13 02-28-1996

Crestview Estates
Developed Condition
Basin 5 - cv55
Area Times Ten (A x 10)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Residential, 1/4 ac.	24.95	75	
Type B, Asphalt	2.21	98	
COMPOSITE AREA --->	27.16	76.9	(77)

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:47:23
Watershed file: --> A:CV55 .MOP
Hydrograph file: --> A:CV555.HYD

Crestview Estates
Developed Condition
Basin 5 - CV55
Area Times Ten (A x 10)

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Subarea #1	27.16	77.0	0.10	0.00	2.40	0.68	I.25	.25

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 27.16 acres or 0.04244 sq.mi
Peak discharge = 28 cfs ← 2.8 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.10	0.00	**	**	Yes	

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

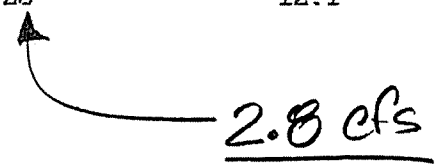
TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:47:23
Watershed file: --> A:CV55 .MOP
Hydrograph file: --> A:CV555.HYD

Crestview Estates
Developed Condition
Basin 5 - CV55
Area Times Ten (A x 10)

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	28	12.1
Composite Watershed	28	12.1



TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:47:23
Watershed file: --> A:CV55 .MOP
Hydrograph file: --> A:CV555.HYD

Crestview Estates
Developed Condition
Basin 5 - CV55
Area Times Ten (A x 10)

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	6	17	28	16	6	5
Total (cfs)	0	0	0	6	17	28	16	6	5

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	4	3	3	3	2	2	2	2	2
Total (cfs)	4	3	3	3	2	2	2	2	2

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	1	1	1	0	0
Total (cfs)	1	1	1	0	0

POND-2 Version: 5.16 S/N: 1295130196

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

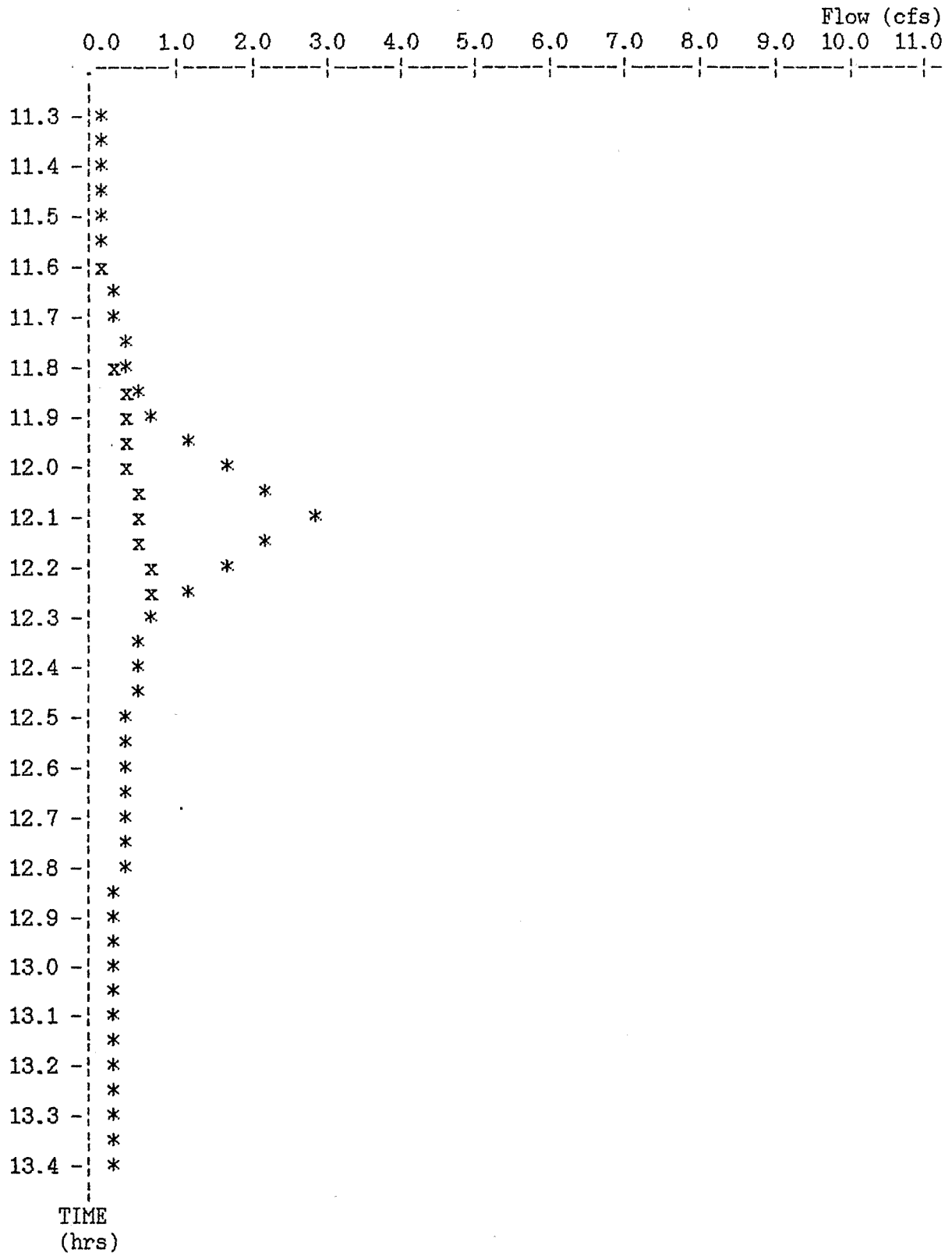
Inflow Hydrograph: B:CV5551 .HYD
Qpeak = 2.8 cfs

Estimated Outflow: B:ESTIMATE.EST
Qpeak = 0.7 cfs

Approximate Storage Volume
(computed from t= 11.60 to 12.29 hrs)

1,800 cubic-ft

POND-2 Version: 5.16 S/N: 1295130196
Plotted: 02-28-1996



* File: B:CV5551 .HYD Qmax = 2.8 cfs
x File: B:ESTIMATE.EST Qmax = 0.7 cfs

POND-2 Version: 5.16
S/N: 1295130196

Crestview Estates
Developed Condition
Basin 5 - CV55

CALCULATED 05-09-1996 08:11:27
DISK FILE: a:CV55 .VOL

Planimeter scale: 1 inch = 1 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	* Volume (cubic-ft)	Volume Sum (cubic-ft)
80.00	975.00	975	0	0	0
81.00	1,577.00	1,577	3,792	1,264	1,264
81.35	*I*	1,799	5,061	590	1,854
82.00	2,251.00	2,251	5,712	1,904	3,168
83.00	2,997.00	2,997	7,845	2,615	5,783

I ---> Interpolated area from closest two planimeter readings.

$$IA = (\text{sq.rt}(\text{Area1}) + ((Ei-E1)/(E2-E1))*(\text{sq.rt}(\text{Area2})-\text{sq.rt}(\text{Area1})))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* 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

Date: 5-8-96
Project: Crestview
Project #: 95-098
By: SAA

Taylor Engineering, Inc.
Civil Design and Land Planning

BASINS 5 & 6

○ Note to file
○ Telephone conv.
○ Meeting Notes
○ Field Report
⊙ Calcs. Chkd. _____

DETERMINE THE INFILTRATION GALLERY SIZE NECESSARY:

→ DESIGN IS PER THE "STORMWATER MANAGEMENT MANUAL FOR THE PUGET SOUND BASIN" (PAGE III-3-16, FEBRUARY 1992):

$Q = K i A_s$ WHERE $Q = 0.7$ cfs

$K = 30$ ft/day *

$i = 1$

A_s = SURFACE AREA

$$A_s = \frac{Q}{Ki}$$

$$= \frac{.7 \text{ ft}^3/\text{sec}}{(30 \text{ ft/day})(1 \text{ day}/24 \text{ hr})(1 \text{ hr}/60 \text{ min})(1 \text{ min}/60 \text{ sec}) \cdot 1}$$

$A_s = 2016 \text{ ft}^2$

→ USE A SAFETY FACTOR OF 2:

$A_{SF} = 2016 \text{ ft}^2 (2)$

$A_{SF} = 4032 \text{ ft}^2$

* PER GEOTECHNICAL REPORT BY BUDINGER & ASSOCIATES, (9-29-95)
SEE ATTACHED REPORT

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 07:39:44 02-28-1996

Crestview Estates
Developed Condition
Basin 6 - cv65
Area Times Ten (A x 10)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Residential, 1/4 ac.	24.95	75	
Type B, Asphalt	1.11	98	
COMPOSITE AREA --->	26.06	76.0	(76)

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:49:48
Watershed file: --> A:CV65 .MOP
Hydrograph file: --> A:CV655.HYD

Crestview Estates
Developed Condition
Basin 6 - CV65
Area Times Ten (A x 10)

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Subarea #1	26.06	76.0	0.10	0.00	2.40	0.63	I.26 .26

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 26.06 acres or 0.04072 sq.mi
Peak discharge = 24 cfs ← 2.4cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.10	0.00	**	**	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.
** Tc & Tt are available in the hydrograph tables.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:49:48
Watershed file: --> A:CV65 .MOP
Hydrograph file: --> A:CV655.HYD

Crestview Estates
Developed Condition
Basin 6 - CV65
Area Times Ten (A x 10)

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	24	12.1
Composite Watershed	24	12.1

2.4 cfs

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 02-28-1996 07:49:48
Watershed file: --> A:CV65 .MOP
Hydrograph file: --> A:CV655.HYD

Crestview Estates
Developed Condition
Basin 6 - CV65
Area Times Ten (A x 10)

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	5	15	24	14	6	4
Total (cfs)	0	0	0	5	15	24	14	6	4

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	4	3	3	2	2	2	2	2	1
Total (cfs)	4	3	3	2	2	2	2	2	1

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	1	1	1	1	1	1	1	1	1
Total (cfs)	1	1	1	1	1	1	1	1	1

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	1	1	0	0	0
Total (cfs)	1	1	0	0	0

POND-2 Version: 5.16 S/N: 1295130196

>>>>> OUTFLOW HYDROGRAPH ESTIMATOR <<<<<

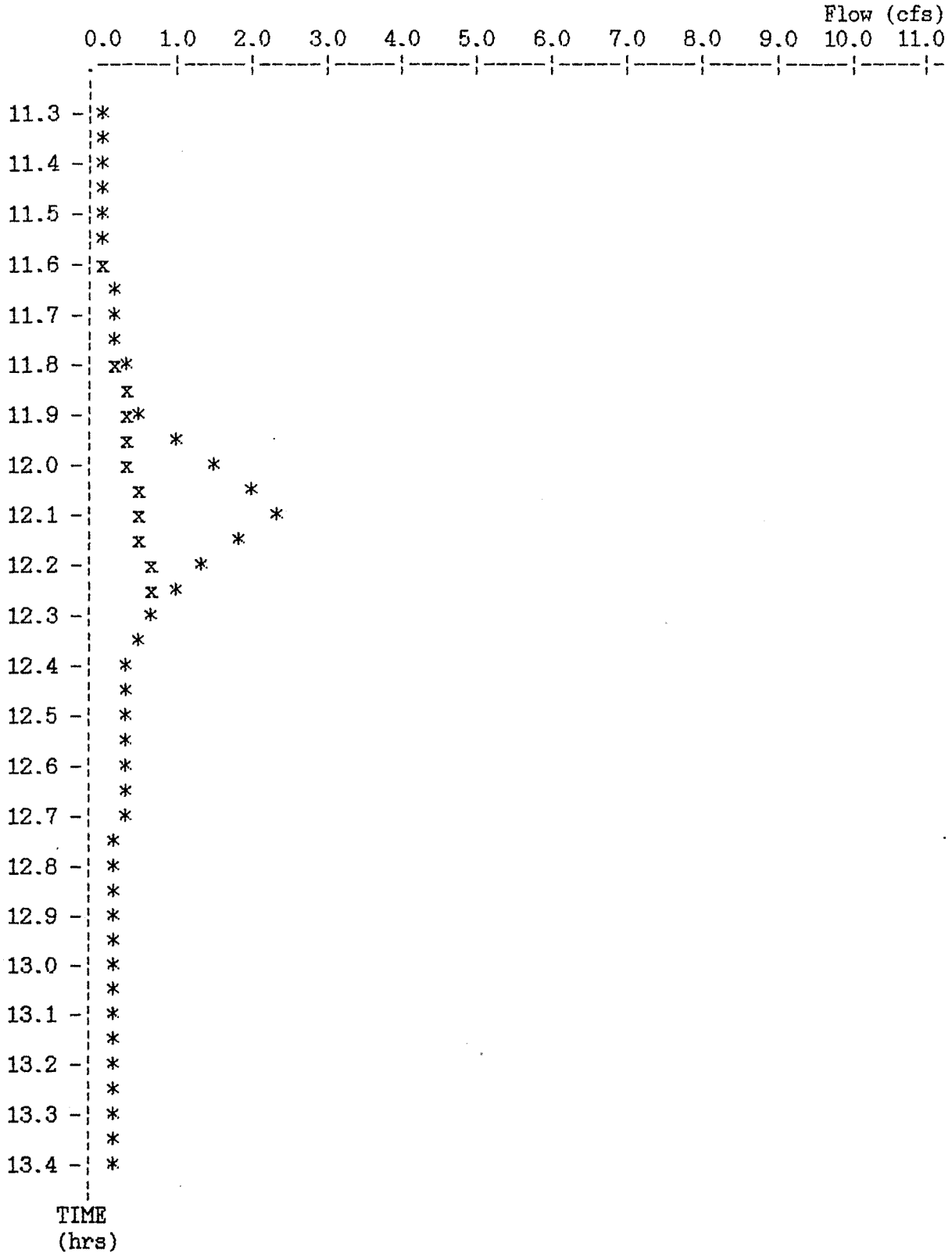
Inflow Hydrograph: B:CV6551 .HYD
Qpeak = 2.4 cfs

Estimated Outflow: B:ESTIMATE.EST
Qpeak = 0.7 cfs

Approximate Storage Volume
(computed from t= 11.60 to 12.29 hrs)

1,400 cubic-ft

POND-2 Version: 5.16 S/N: 1295130196
Plotted: 02-28-1996



* File: B:CV6551 .HYD Qmax = 2.4 cfs
x File: B:ESTIMATE.EST Qmax = 0.7 cfs

POND-2 Version: 5.16
S/N: 1295130196

Crestview Estates
Developed Condition
Basin 6 - CV65

CALCULATED 05-09-1996 08:13:40
DISK FILE: a:CV65 .VOL

Planimeter scale: 1 inch = 1 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	* Volume (cubic-ft)	Volume Sum (cubic-ft)
79.50	774.00	774	0	0	0
80.00	1,092.00	1,092	2,785	464	464
80.75	*I*	1,586	3,994	998	1,463
81.00	1,771.00	1,771	4,254	1,418	1;882

I ---> Interpolated area from closest two planimeter readings.

$$IA = (sq.rt(Area1) + ((Ei-E1)/(E2-E1))*(sq.rt(Area2)-sq.rt(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* 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

Taylor Engineering, Inc.
106 W. Mission Ave. Suite 206
Spokane, Washington 99201

Filename: cv-sr-w.wk1

RATIONAL METHOD
10 YEAR RETURN FREQUENCY
PROJECT: Crestview Estates
DATE: 09-May-96
TOTAL AREA (AC) 0.06

DESIGNED: S. Anthony

BASIN: Strong Road - West of Maple (BASIN 7)

TYPE OF SURFACE	(2) SQUARE FOOTAGE	(3) RUNOFF COEFF.	(4) (2 x 3)
ROADS & ASPHALT-208 REQD	2535	0.9	2281.5
ROOF & SIDEWALKS-208 NOT REQD		0.9	0
RESIDENTIAL			0
LANDSCAPE AREAS		0.25	0
			0
			0
			0
			0
TOTALS	2535		2281.5

DEVELOPED "C" = 0.90

TIME OF CONCENTRATION (MIN): LESS THAN 5 MIN.

RAINFALL INTENSITY (IN/HR):(i) 3.18

MAXIMUM RUNOFF RATE(CFS) Q = CiA
OVERALL: 0.17

Date: 5-9-96
Project: Crestview Estates
Project #: 95-098
By: SAA

Taylor Engineering, Inc.
Civil Design and Land Planning

BASINS 7 & 8

○ Note to file
○ Telephone conv.
○ Meeting Notes
○ Field Report
◉ Calcs. Chkd. _____

DETERMINE THE INFILTRATION GALLERY SIZE NECESSARY:

→ DESIGN IS PER THE "STORMWATER MANAGEMENT MANUAL FOR THE PUGET SOUND BASIN" (PAGE III - 3-16, FEBRUARY 1992):

$Q = K \cdot i \cdot A_s$ WHERE $Q = 0.20$ cfs

$K = 30$ ft/day *

$i = 1$

A_s = SURFACE AREA

$$A_s = \frac{Q}{K \cdot i}$$

$$= \frac{0.20 \text{ ft}^3/\text{sec}}{(30 \text{ ft/day})\left(\frac{1 \text{ day}}{24 \text{ hr}}\right)\left(\frac{1 \text{ hr}}{60 \text{ min}}\right)\left(\frac{1 \text{ min}}{60 \text{ sec}}\right) 1}$$

$A_s = 576 \text{ ft}^2$

→ USE A SAFETY FACTOR OF 2:

$A_{sf} = 576 \text{ ft}^2 (2)$

$A_{sf} = 1152 \text{ ft}^2$

USE AN INFILTRATION GALLERY: 120' LONG X 10' WIDE

= 1200 sf > 1152 sf

* PER GEOTECHNICAL REPORT BY BUDINGER & ASSOCIATES (9-29-95) SEE ATTACHED REPORT

Spokane, WA • 106 W. Mission Ave., 99201 • (509) 328-3371 • FAX 509) 328-8224
Goldendale, WA • 228 W. Columbus, Suite 104, 98620 • (509) 773-4945 • FAX (509) 773-5888

Taylor Engineering, Inc.
106 W. Mission Ave. Suite 206
Spokane, Washington 99201

Filename: cv-sr-e.wk1

RATIONAL METHOD
10 YEAR RETURN FREQUENCY
PROJECT: Crestview Estates
DATE: 10-May-96
TOTAL AREA (AC) 0.07

DESIGNED: S. Anthony

BASIN: Strong Road - East of Maple (BASIN B)

TYPE OF SURFACE	(2) SQUARE FOOTAGE	(3) RUNOFF COEFF.	(4) (2 x 3)
ROADS & ASPHALT-208 REQD	3019	0.9	2717.1
ROOF & SIDEWALKS-208 NOT REQD		0.9	0
RESIDENTIAL			0
LANDSCAPE AREAS		0.25	0
			0
			0
			0
			0
TOTALS	3019		2717.1

DEVELOPED "C" = 0.90

TIME OF CONCENTRATION (MIN): LESS THAN 5 MIN.

RAINFALL INTENSITY (IN/HR):(i) 3.18

MAXIMUM RUNOFF RATE(CFS) Q = CiA
OVERALL: 0.20

OVERALL EXISTING

VS

DEVELOPED CONDITIONS

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 16:47:16 05-23-1996

Crestview Estates
Existing Condition
Area flowing to culvert CV-EX5
AREA TIMES 10

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	469.00	75	
Type B, Asphalt	0.80	98	
COMPOSITE AREA --->	469.80	75.0	(75)

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 16:51:01 05-23-1996 b:CV-EX5.TCT

Crestview Estates
Existing Condition
Flow to Low Point- CV-EX5

Tc COMPUTATIONS FOR: Subarea #1

SHEET FLOW (Applicable to Tc only)

Segment ID		A		
Surface description		cultivated		
Manning's roughness coeff., n		0.0600		
Flow length, L (total < or = 300)	ft	100.0		
Two-yr 24-hr rainfall, P2	in	1.400		
Land slope, s	ft/ft	0.0200		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.12	=	0.12

SHALLOW CONCENTRATED FLOW

Segment ID		B		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	2000.0		
Watercourse slope, s	ft/ft	0.0180		
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.1647		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.26	=	0.26

CHANNEL FLOW

Segment ID				
Cross Sectional Flow Area, a	sq.ft	0.00		
Wetted perimeter, Pw	ft	0.00		
Hydraulic radius, r = a/Pw	ft	0.000		
Channel slope, s	ft/ft	0.0000		
Manning's roughness coeff., n		0.0000		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000		
Flow length, L	ft	0		
T = L / (3600*V)	hrs	0.00	=	0.00

::

TOTAL TIME (hrs) 0.38

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 16:54:59
Watershed file: --> B:CV-EX5 .MOP
Hydrograph file: --> B:CV-EX55.HYD

Crestview Estates
Existing Condition
Flow to Low Point- CV-EX5
AREA TIMES 10

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Subarea #1	469.80	75.0	0.40	0.00	2.40	0.59	I.28 .28

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 469.80 acres or 0.7341 sq.mi
Peak discharge = 218 cfs

21.8 CFS

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
ubarea #1	0.38	0.00	0.40	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 16:54:59
Watershed file: --> B:CV-EX5 .MOP
Hydrograph file: --> B:CV-EX55.HYD

Crestview Estates
Existing Condition
Flow to Low Point- CV-EX5
AREA TIMES 10

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	218	12.4
Composite Watershed	218	12.4

21.8

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 16:54:59
Watershed file: --> B:CV-EX5 .MOP
Hydrograph file: --> B:CV-EX55.HYD

Crestview Estates
Existing Condition
Flow to Low Point- CV-EX5
AREA TIMES 10

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	1	1	2	5	16	56	136	213	218
Total (cfs)	1	1	2	5	16	56	136	213	218

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	180	132	101	80	54	42	35	31	28
Total (cfs)	180	132	101	80	54	42	35	31	28

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	26	23	21	19	17	16	14	13	12
Total (cfs)	26	23	21	19	17	16	14	13	12

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	12	10	9	8	0
Total (cfs)	12	10	9	8	0

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 17:07:57 05-23-1996

Crestview Estates
Developed Condition with First Phase
Area flowing to culvert CV-DV5
AREA TIMES 10

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	416.50	75	
Type B, Asphalt	4.50	98	
COMPOSITE AREA --->	421.00	75.2	(75)

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 17:03:18 05-23-1996 b:CV-DV5.TCT

Crestview Estates
Developed Condition
Flow to Low Point- CV-DV5

Tc COMPUTATIONS FOR: Subarea #1

SHEET FLOW (Applicable to Tc only)

Segment ID		A		
Surface description		cultivated		
Manning's roughness coeff., n		0.0600		
Flow length, L (total < or = 300)	ft	100.0		
Two-yr 24-hr rainfall, P2	in	1.400		
Land slope, s	ft/ft	0.0200		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.12	=	0.12

SHALLOW CONCENTRATED FLOW

Segment ID		B		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	2000.0		
Watercourse slope, s	ft/ft	0.0170		
$Avg.V = Csf * (s)^{0.5}$	ft/s	2.1037		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.26	=	0.26

CHANNEL FLOW

Segment ID				
Cross Sectional Flow Area, a	sq.ft	0.00		
Wetted perimeter, Pw	ft	0.00		
Hydraulic radius, r = a/Pw	ft	0.000		
Channel slope, s	ft/ft	0.0000		
Manning's roughness coeff., n		0.0000		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000		
Flow length, L	ft	0		
T = L / (3600*V)	hrs	0.00	=	0.00

::

TOTAL TIME (hrs) 0.38

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 17:09:12
Watershed file: --> B:CV-DV5 .MOP
Hydrograph file: --> B:CV-DV55.HYD

Crestview Estates
Developed Condition
Flow to Low Point- CV-DV5
AREA TIMES 10

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Subarea #1	421.00	75.0	0.40	0.00	2.40	0.59	I.28 .28

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 421.00 acres or 0.6578 sq.mi
Peak discharge = 195 cfs

19.5

>>>> Computer Modifications of Input Parameters <<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
ubarea #1	0.38	0.00	0.40	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 17:09:12
Watershed file: --> B:CV-DV5 .MOP
Hydrograph file: --> B:CV-DV55.HYD

Crestview Estates
Developed Condition
Flow to Low Point- CV-DV5
AREA TIMES 10

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	195	12.4
Composite Watershed	195	12.4

19.5

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 05-23-1996 17:09:12
Watershed file: --> B:CV-DV5 .MOP
Hydrograph file: --> B:CV-DV55.HYD

Crestview Estates
Developed Condition
Flow to Low Point- CV-DV5
AREA TIMES 10

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	1	1	1	4	15	50	122	191	195
Total (cfs)	1	1	1	4	15	50	122	191	195

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	161	118	90	71	48	38	32	28	25
Total (cfs)	161	118	90	71	48	38	32	28	25

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	23	20	18	17	15	14	12	12	11
Total (cfs)	23	20	18	17	15	14	12	12	11

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	10	9	8	7	0
Total (cfs)	10	9	8	7	0

DITCH CAPACITIES

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Crestview Estates

Comment: Determine ditch for west side

Solve For Depth

Given Input Data:

Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0100 ft/ft
Discharge.....	12.00 cfs

Computed Results:

Depth.....	1.11 ft
Velocity.....	3.23 fps
Flow Area.....	3.71 sf
Flow Top Width...	6.67 ft
Wetted Perimeter.	7.03 ft
Critical Depth...	1.00 ft
Critical Slope...	0.0177 ft/ft
Froude Number....	0.76 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Triangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Crestview Estates

Comment: Determine ditch for east side

Solve For Depth

Given Input Data:

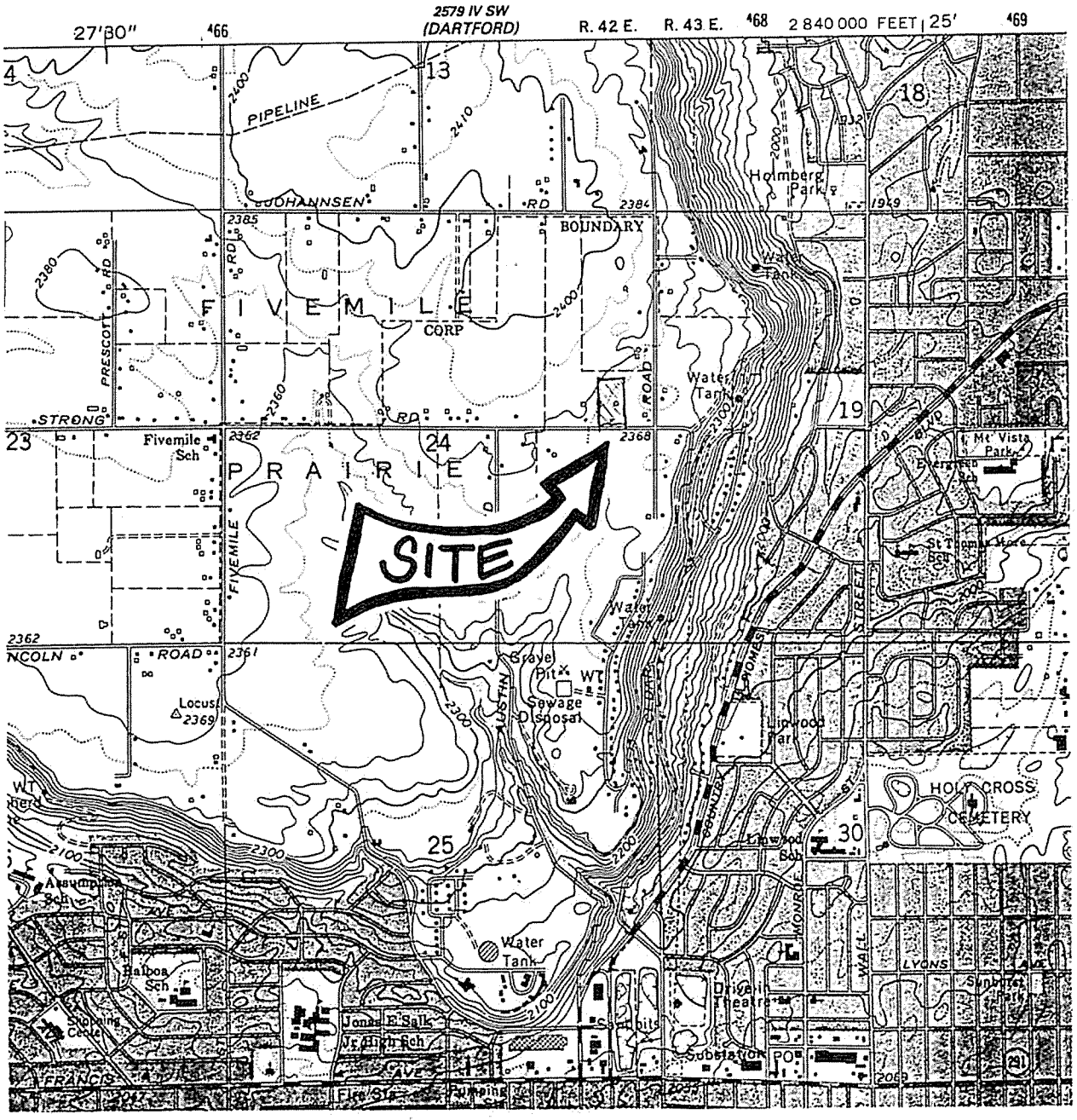
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0100 ft/ft
Discharge.....	10.00 cfs

Computed Results:

Depth.....	1.04 ft
Velocity.....	3.09 fps
Flow Area.....	3.24 sf
Flow Top Width...	6.23 ft
Wetted Perimeter.	6.57 ft
Critical Depth...	0.93 ft
Critical Slope...	0.0182 ft/ft
Froude Number....	0.76 (flow is Subcritical)

ATTACHMENT "A"

VICINITY MAP

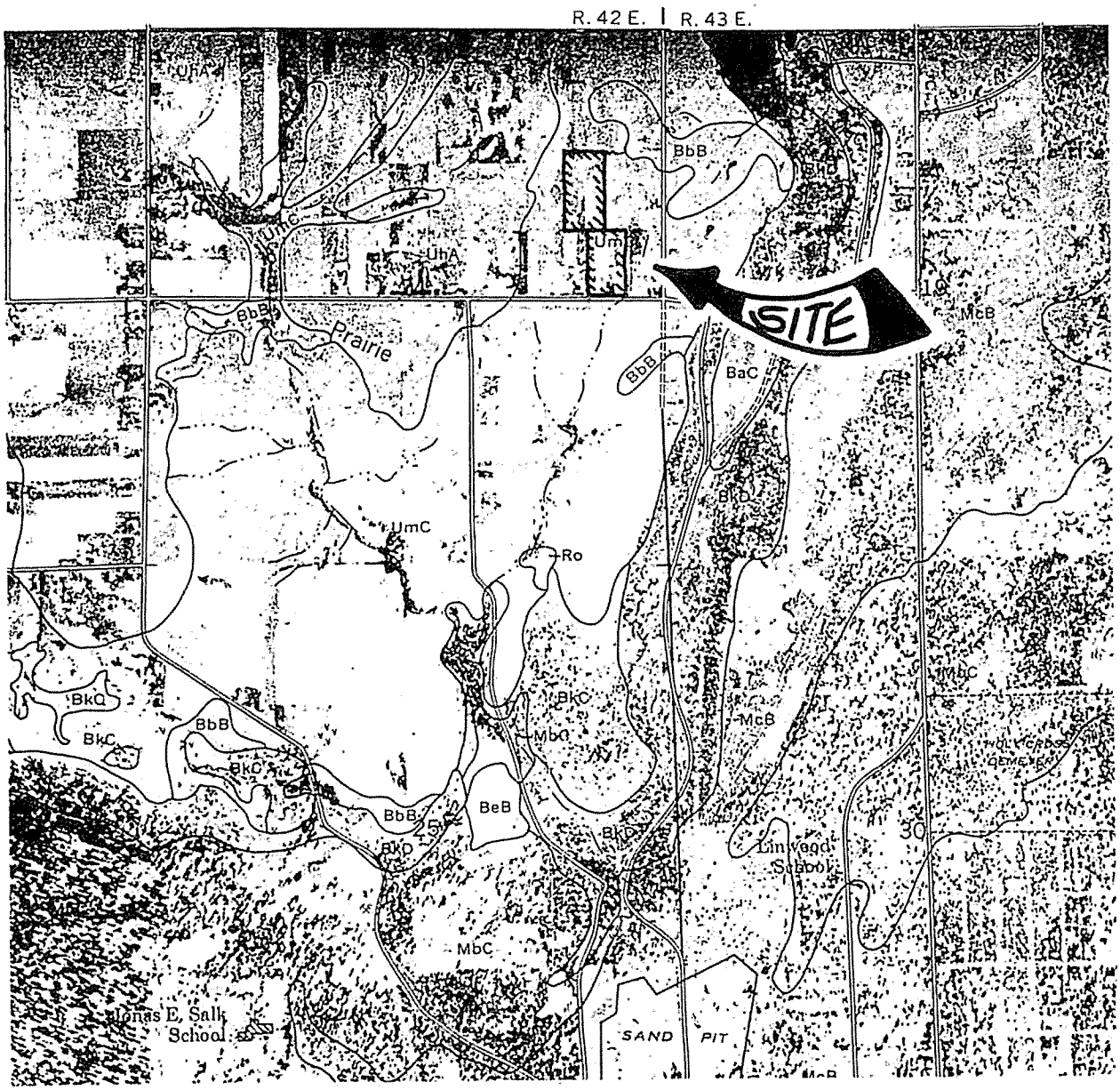


Taylor Engineering, Inc.
Civil Design and Land Planning

ATTACHMENT "B"

SOILS MAP

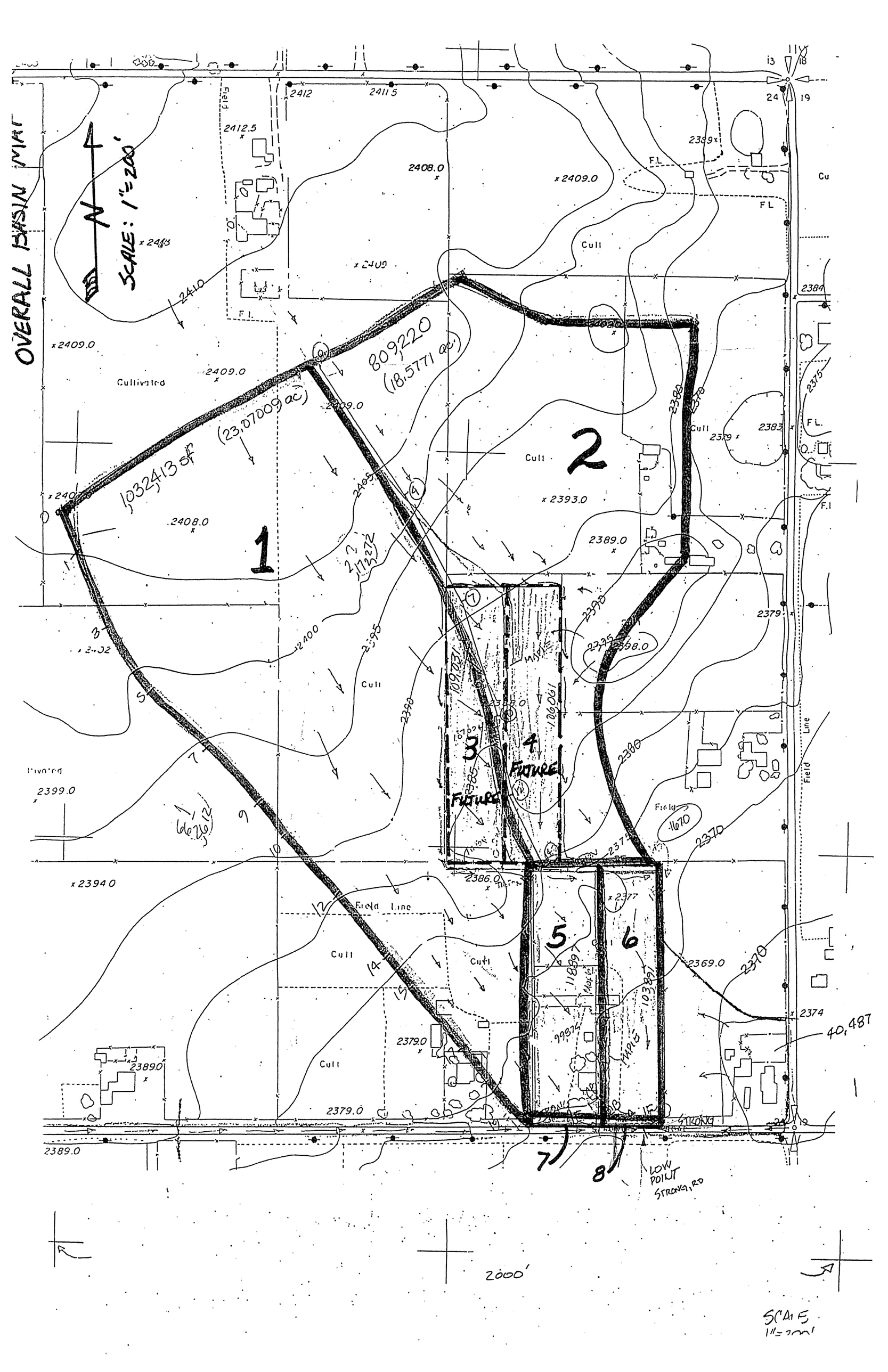
SPOKANE COUNTY, WASHINGTON — SHEET NUMBER 55



Taylor Engineering, Inc.
Civil Design and Land Planning

ATTACHMENT "C"

LIMITED SUBSURFACE EVALUATION FOR STORMWATER MANAGEMENT


OVERALL BASIN MAP
SCALE: 1"=200'
N
809220
(18.5771 ac)
1032413 sf
(23.07009 ac)
1
2
3
4
5
6
7
8
FUTURE
FUTURE
Cultivated
Cull
Field Line
LOW POINT STRONG RD
40,487
2000'
SCALE 1"=200'

OCT 3 1995

3820 E. Broadway Spokane, Washington 99202

budinger & associates
geotechnical & material engineers

Tomlinson North
8205 N. Division
Spokane, WA 99208

September 29, 1995

Project Number H95235

Attention: Bob Frisch

PROJECT: CRESTVIEW ESTATES
Stormwater Facilities
Spokane, WA

SUBJECT: Limited Subsurface Evaluation
For Stormwater Management

In accordance with your request, we have conducted subsurface exploration and testing at specific locations along the Maple Street alignment of the proposed Crestview Estates development to provide recommendations for stormwater handling. The site is located on Five Mile Prairie in the City of Spokane.

Our evaluation has consisted of site reconnaissance, geotechnical drilling, logging (borings and backhoe pits), geophysical testing, sampling, percolation testing, and laboratory testing. Four (4) borings were advanced near the intersections of proposed roads on August 3, 1995, and 2 backhoe pits were logged on September 8, 1995. Boring and test pit logs are provided as Figures 6.2. Infiltrometer test results are provided as Figure 6.2.5. Results of gradation analysis are presented as Figure 7.1.3, with the results summarized in Table 7.0. Two (2) shallow seismic refraction surveys were conducted to evaluate the soundness of rock. Results are presented as Figures 6.7.

(509) 535-8841

F.C. Budinger PE
Stephen D. Burchett PE

Seasonal groundwater flow is believed to follow the surface topography to the south at a gradient of approximately 0.02 (i=0.02). We did not encounter groundwater during our exploration of the site.

A single-ring infiltrometer test was conducted adjacent to Test Pit #5 in accordance with Spokane County specifications to evaluate the permeability of the clean gravel, sand, and cobble deposit. The 10" I.D. steel casing was driven approximately 3" below the excavated surface of the clean sand and gravel. The results were k=36 ft/day (18 in/hr). These results were somewhat lower than Hazen's Approximation of permeability from gradation analysis of a bulk sample of this material, indicating k=150 ft/day.

CONCLUSIONS

We conclude that the subsurface conditions are poorly suited for on-site disposal of stormwater by subsurface infiltration throughout most of the site. However, a limited zone of permeable soils appears to be present in the southern area of the site. The majority of the soils offer moderately slow permeability on the order of 1 ft/day (0.5 in/hr). The permeable sand and gravel encountered in the southern portion of the site offers more favorable permeability on the order of 40 ft/day (20 in/hr).

If cuts are required to achieve grade, excavation difficulty may be encountered due to shallow rock.

RECOMMENDATIONS

We recommend that accumulated stormwater be discharged to slowly percolating retention swales utilizing permeability rates of the sod and topsoil or 0.5 in/hr, whichever is slower. Excess stormwater in the southern portion of the site may be discharged to the permeable sand and gravel through an infiltration gallery at a permeability of k=30 ft/day (15 in/hr).

It has been a pleasure to be of service to you on this project. If we may be of further assistance, or if these results require further clarification, please do not hesitate to contact us.

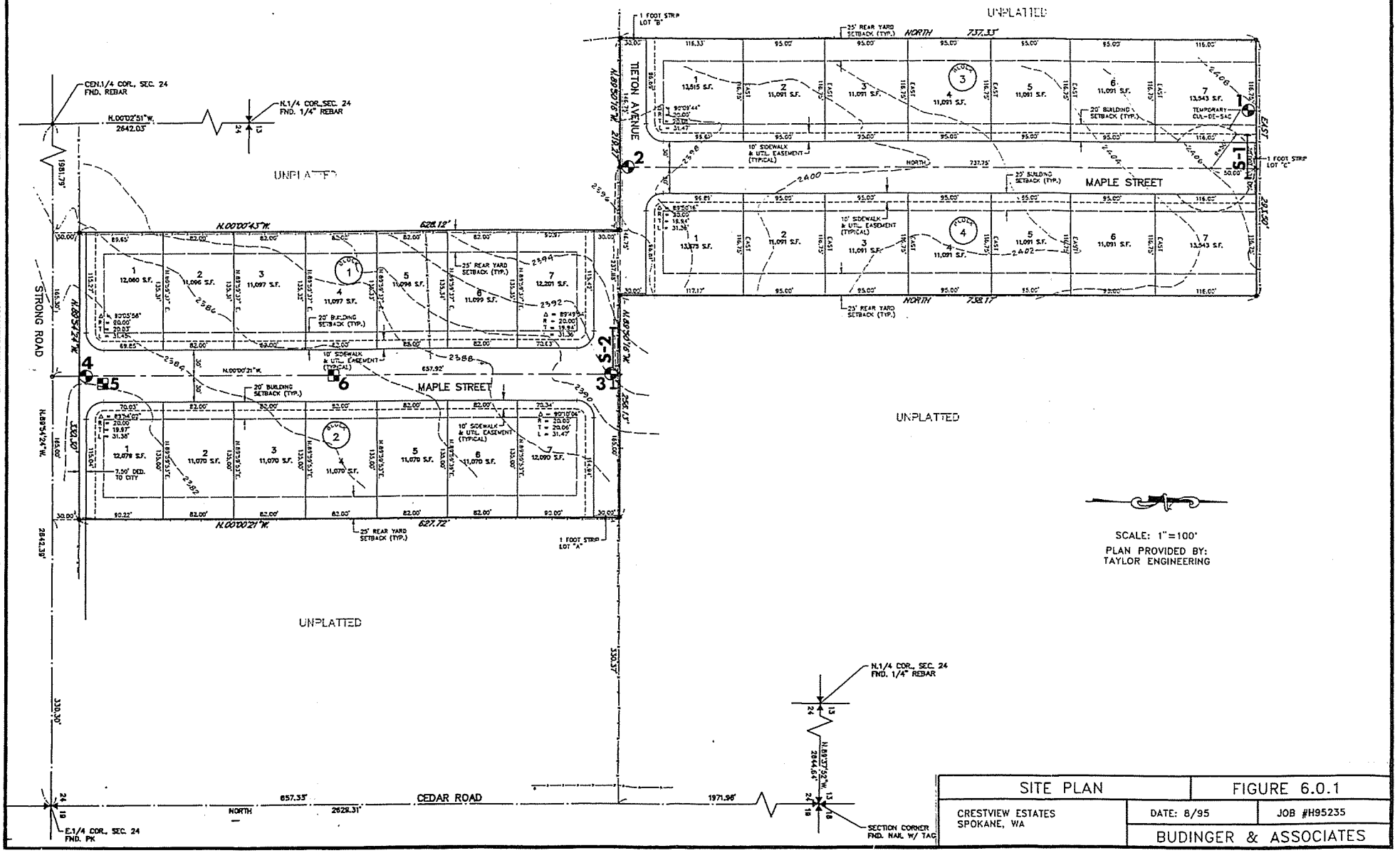
Respectfully Submitted:
BUDINGER & ASSOCIATES

By: John E. Finnegan, EIT
Geotechnical Engineer

JEF/sr
Addressee - 5
Scott Busch - 1
Attachments

Reviewed By: Stephen D. Burchett, PE
PE Expires 9/24/95

LOCATED IN THE N.E. 1/4 OF SECTION 24,
TOWNSHIP 26 NORTH, RANGE 42 EAST, W.M.
SPOKANE, SPOKANE COUNTY, WASHINGTON



SITE PLAN	FIGURE 6.0.1
CRESTVIEW ESTATES SPOKANE, WA	DATE: 8/95
	JOB #H95235
	BUDINGER & ASSOCIATES

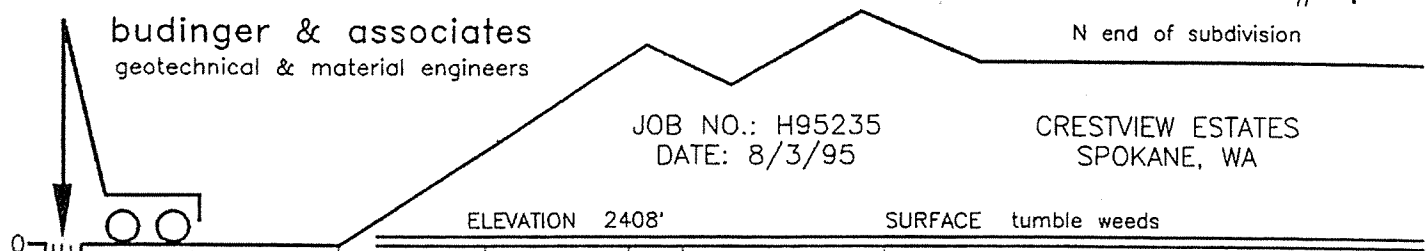
TEST BORING # 1

N end of subdivision

budinger & associates
geotechnical & material engineers

JOB NO.: H95235
DATE: 8/3/95

CRESTVIEW ESTATES
SPOKANE, WA



ELEVATION 2408' SURFACE tumble weeds

DEPTH	METHODS	MOISTURE	CONDITION	COLOR	STRATUM	DEPOSIT	VISUAL DESCRIPTION
0		Sl. Moist	Loose	Lt. Brown	2	Surficial	SILT & ORGANICS
1		Sl. Moist	Soft	Lt. Brown		Aeolian/ Alluvial	SILT trace fine SAND occ. GRAVEL non plastic
2			Sl. Firm				
3							
4	(R)NR	Sl. Moist	Very Dense	Grey, Dk. Grey (mottled)	2? 3?	Alluvial Extrusive	Weathered BASALT?: GRAVEL some SILT some SAND sm. amt. COBBLES angular
5	4½" SSFA						
6							
7		(No free groundwater observed)					SSFA REFUSED @ 7' BASALT? COBBLES? BOULDER?

KEY

■( )	Undisturbed spilt spoon sample
▨	Bulk sample
NR	No recovery
PR	Poor recovery
R	Refused
SSFA	Solid stem flight auger
HSFA	Hollow stem flight auger

Fig. 6.2( )

TEST BORING # 3

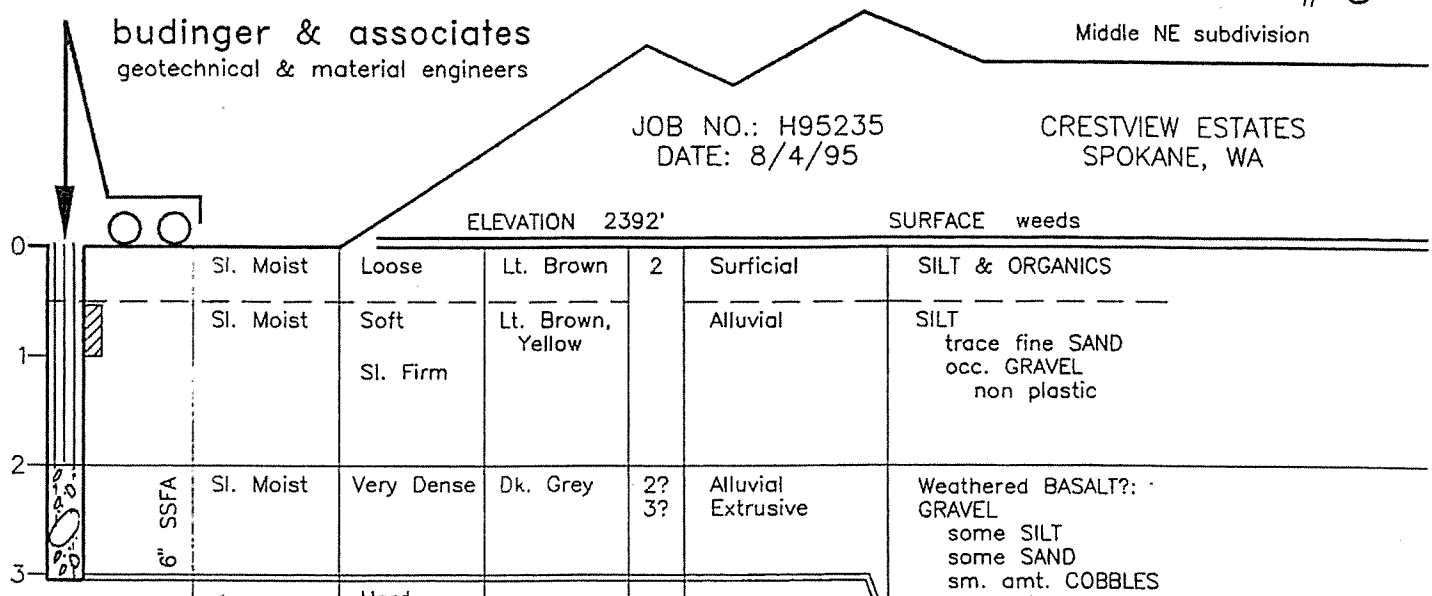
budinger & associates
geotechnical & material engineers

Middle NE subdivision

JOB NO.: H95235
DATE: 8/4/95

CRESTVIEW ESTATES
SPOKANE, WA

ELEVATION 2392' SURFACE weeds



DEPTH	METHODS	MOISTURE	CONDITION	COLOR	STRATUM	DEPOSIT	VISUAL DESCRIPTION
0		Sl. Moist	Loose	Lt. Brown	2	Surficial	SILT & ORGANICS
1		Sl. Moist	Soft Sl. Firm	Lt. Brown, Yellow		Alluvial	SILT trace fine SAND occ. GRAVEL non plastic
2	6" SSFA	Sl. Moist	Very Dense	Dk. Grey	2? 3?	Alluvial Extrusive	Weathered BASALT?: GRAVEL some SILT some SAND sm. amt. COBBLES angular
3		(No free groundwater observed)	Hard				SSFA REFUSED @ 3'

Fig. 8.2(3)

TEST PIT # 5

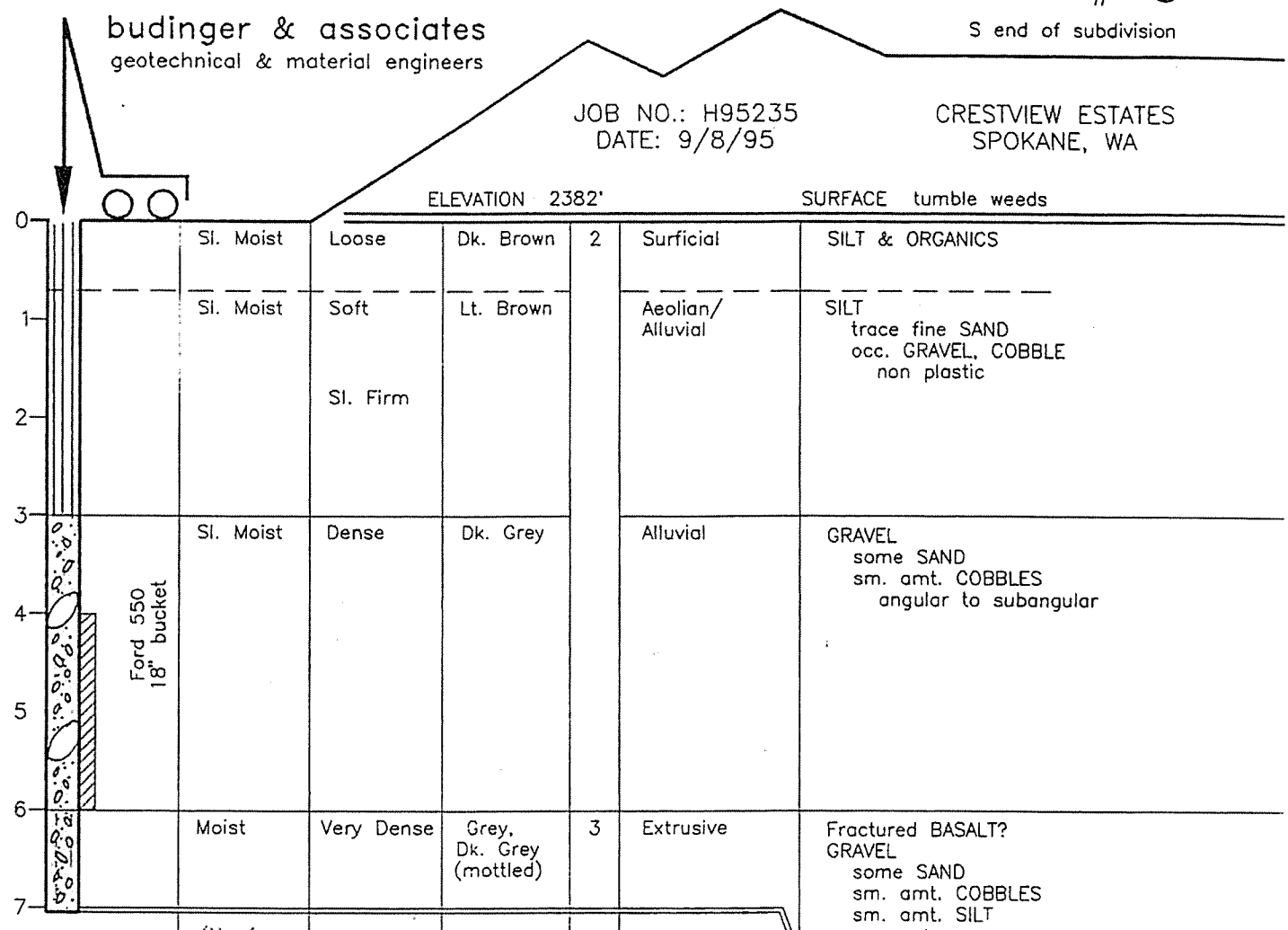
S end of subdivision

budinger & associates
geotechnical & material engineers

JOB NO.: H95235
DATE: 9/8/95

CRESTVIEW ESTATES
SPOKANE, WA

ELEVATION 2382' SURFACE tumble weeds



DEPTH	METHODS	MOISTURE	CONDITION	COLOR	STRATUM	DEPOSIT	VISUAL DESCRIPTION
0		Sl. Moist	Loose	Dk. Brown	2	Surficial	SILT & ORGANICS
1		Sl. Moist	Soft	Lt. Brown		Aeolian/ Alluvial	SILT trace fine SAND occ. GRAVEL, COBBLE non plastic
2			Sl. Firm				
3	Ford 550 18" bucket	Sl. Moist	Dense	Dk. Grey		Alluvial	GRAVEL some SAND sm. amt. COBBLES angular to subangular
6		Moist	Very Dense	Grey, Dk. Grey (mottled)	3	Extrusive	Fractured BASALT? GRAVEL some SAND sm. amt. COBBLES sm. amt. SILT angular
7		(No free groundwater observed)					EXCAVATION REFUSED @ 7' BASALT? COBBLES? BOULDER?

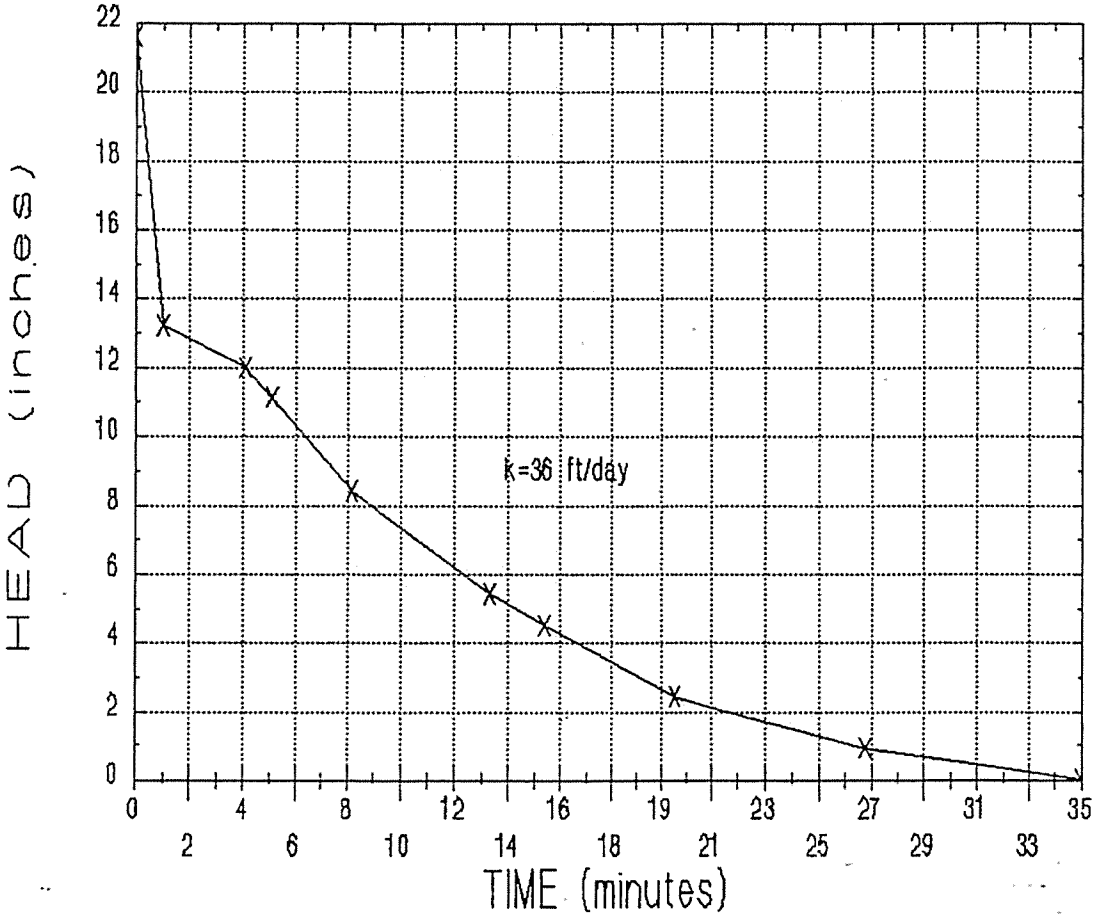
Fig. 6.2(1)

CRESTVIEW ESTATES
Spokane, WA

Project Number H95235
September 29, 1995

INFILTROMETER TEST RESULTS

TEST PIT #5

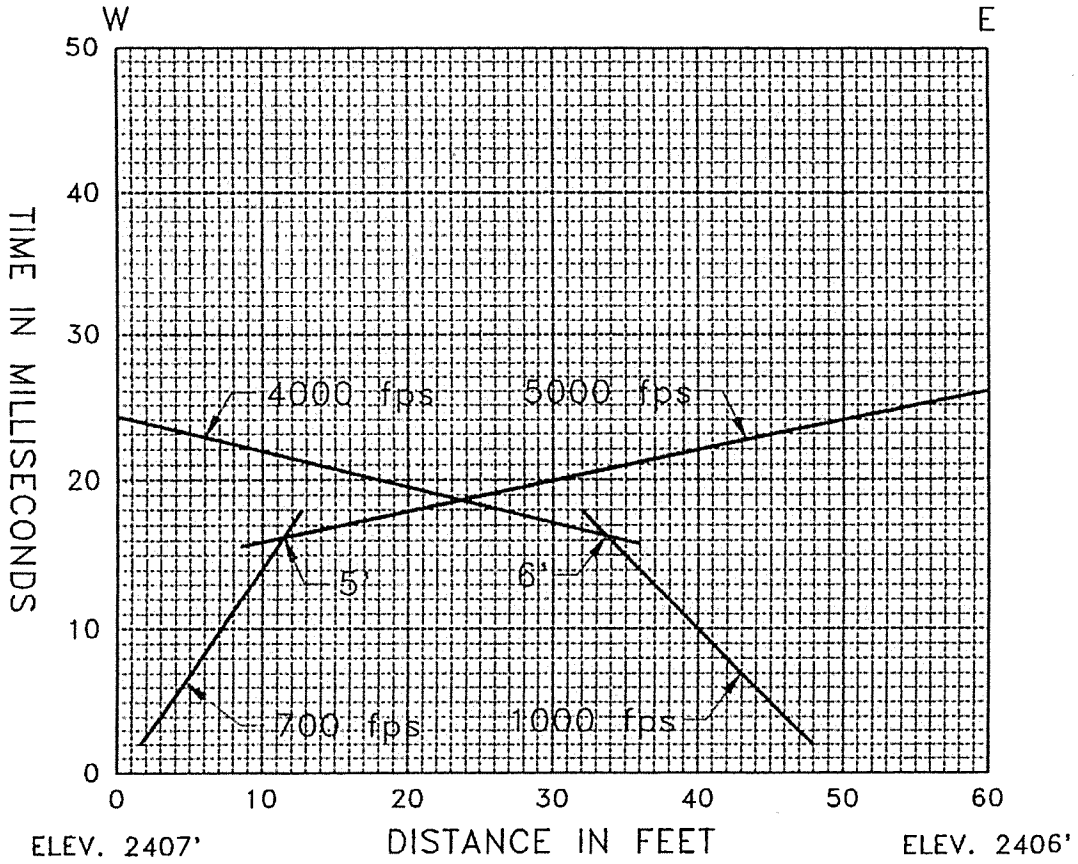


CRESTVIEW ESTATES
SPOKANE, WA

JOB #H95235
DATE: 8/4/95

SEISMIC LINE S-1

LOCATION: N END OF MAPLE ST.



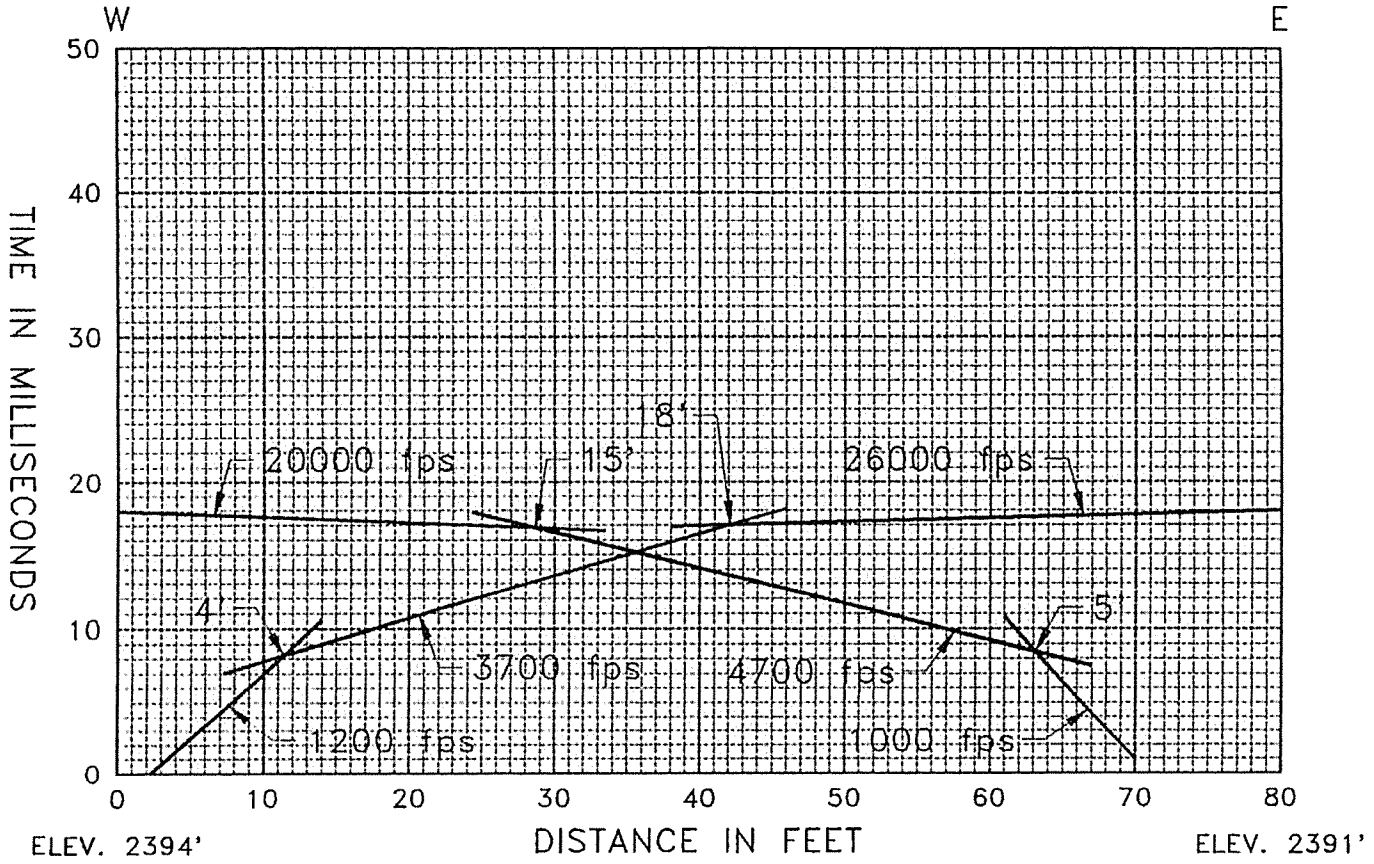
budinger & associates
geotechnical & material engineers

CRESTVIEW ESTATES
SPOKANE, WA

JOB #H95235
DATE: 8/4/95

SEISMIC LINE S-2

LOCATION: INTERSECTION OF TIETON AVE. & MAPLE ST.



budinger & associates
geotechnical & material engineers

TABLE 7.0			LABORATORY SUMMARY
		UNITS	
STRATUM			2
ELEVATION		ft	2378
BORING NUMBER			5
DEPTH TOP		ft	4
BOTTOM		ft	6
SAMPLE TYPE			BULK
UNIFIED CLASSIFICATION			GP
	3"		100%
S	1½"		87
I	1"		79
E	3/4"	GRAVEL	70
V	1/2"		62
E	3/8"		58
	# 4		49
S	# 10		37
I	# 16		24
Z	# 30	SAND	12
E	# 40		8
	# 100		4
	# 200		3
EFFECTIVE SIZE (D_{10})		mm	.51
HYDRAULIC CONDUCTIVITY * Hazen's Approximation		ft/day	150

PASSING

* Neglect Gravel Fraction

CRESTVIEW ESTATES
SPOKANE, WA

JOB #H95235

RESULTS OF GRADATION

COBBLE	GRAVEL (COARSE / FINE)	SAND (COARSE / MEDIUM / FINE)	SILT	CLAY

STRATUM 2
PIT #5
@ 4'–6'

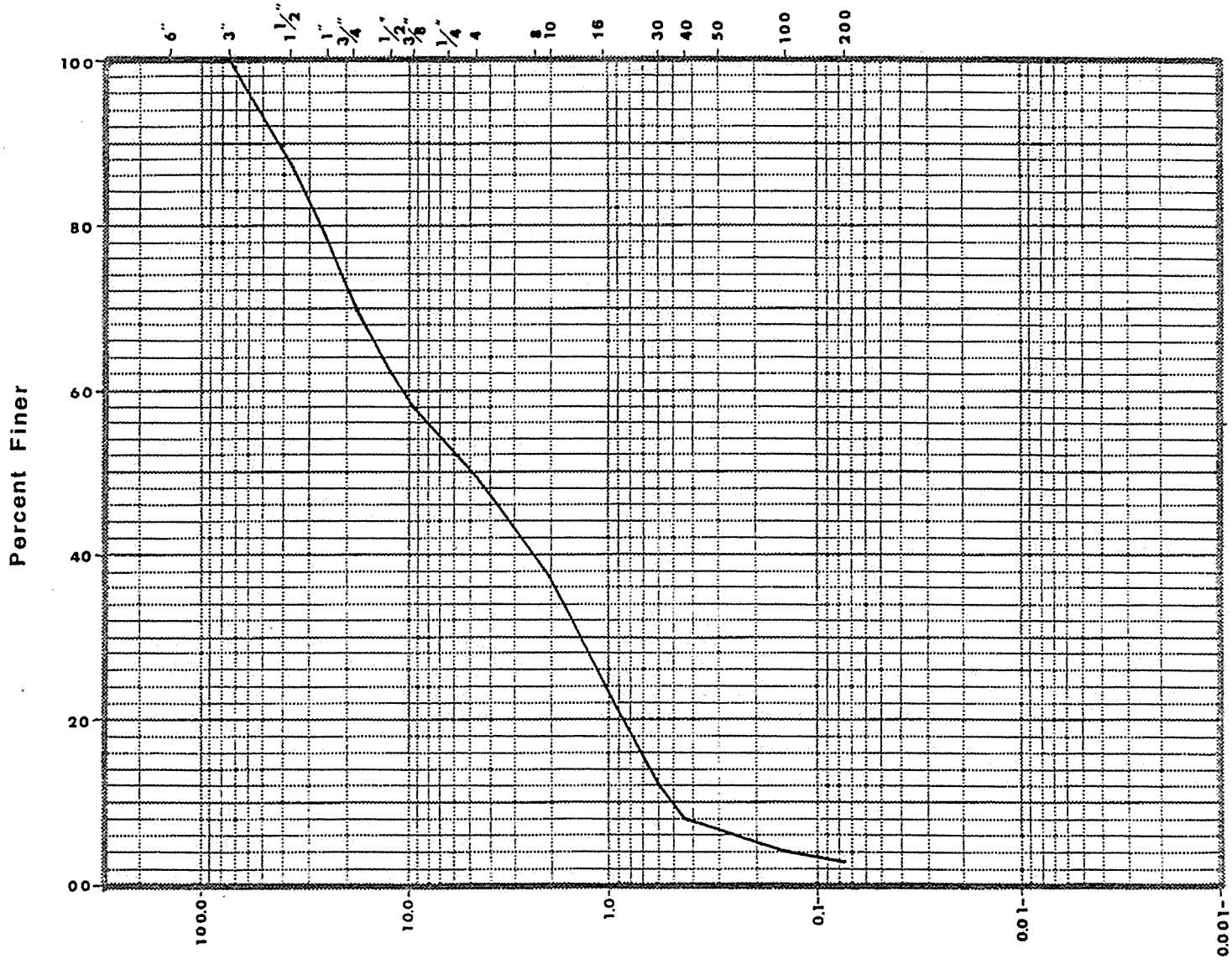


FIG. 7.1.4

STM020

Taylor Engineering, Inc.

Civil Design and Land Planning

Principals:
Perry M. Taylor, P.E.
Stanley R. Stirling
Mark A. Aronson, P.E.
David C. Larsen, P.E.

Associates:
Scott M. Busch, P.E.
Frank R. Ide, ASLA

Chief Financial Officer:
Edwin G. Wagnild

September 4, 1996

Eldon Brown, P.E.
City Construction Services
W 808 Spokane Falls Blvd. 3rd Floor
Spokane, WA 99201

RE: **Crestview Estates - Drainage Revision**

Dear Eldon,

This letter is in regard to the questions raised in our August 12, 1996 meeting and specifically to the overall drainage basin which flows to the existing 18" concrete culvert located at the south end of the referenced project. This culvert crosses Strong Road near the existing lowpoint of the road. This culvert is currently sedimented in but will be re-established with the project. As per our meeting at your office, we revised the basin boundary to include the area which flows to Strong Road and then east toward the existing culvert. The Cn numbers were also revised as per the meeting to 75 (cultivated) only for the areas which are currently farmed and the remaining area, except for roads, is 61 (meadow). These areas are shown on the attached basin map. The Tc path used for both the existing and developed condition is also shown on the map. This path did not change from the existing to the developed condition since the longest path for the Time of Concentration was not through the developed area. The resulting maximum runoff rates calculated for the 50 year event for the existing and developed conditions are as follows:

Existing condition:	16.3 CFS
Developed phasing	18.0 CFS*

* Excludes runoff to slow percolating retention pond for the area west of Maple. Includes improvements on north and southeast portion of Tieton, improvements on the north side of Strong Road, and the residential area on the east side of Maple.

Based on the above data, we completed a routing through the existing culvert to determine what the flow and ponding effects were for the existing condition. The flow through the existing culvert was calculated using HY 8 culvert analysis program. The tailwater for this analysis was assumed to be 75% of the pipe diameter. This information together with the

existing ponding volume available on the north side of Strong Road was then incorporated into a routing. The results of this routing show that the maximum outflow through the culvert is 10.8 cfs with a storage volume of 6,981 CF. The road elevation at centerline in the lowpoint is approximately elevation 82.2. The highest ponding elevation was calculated to be 81.95, which indicates that the calculated storm does not overflow the street.

The phase I only developed condition was reviewed to determine the impact generated by the 50 year design storm. Disposal through galleries with the developed condition totals 1.33 cfs which accounts for the two road side galleries along Strong and the gallery in the swale at the northeast corner of Maple and Strong. The total outflow per the calculations is 11.11 cfs which when reduced by the gallery outflow (1.33 cfs) results in 9.78cfs flowing out the culvert. This flow is less than the existing system, which should provide for an adequate system. A revised drawing is included providing this storage basin on Lot 1, Block 2.

Please review this information at your earliest convenience, and let us know if this is acceptable.

Sincerely,

TAYLOR ENGINEERING, INC.

Scott M .Busch, P.E.
Project Engineer

Enclosure

SMB/jsg/95-098/lt-brown.wrd

Taylor Engineering, Inc.
Civil Design and Land Planning
106 W. Mission Ave. • Spokane, WA 99201-2345 • (509) 328-3371
FAX (509) 328-8224

EXISTING CONDITION ANALYSIS

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 11:43:58 08-20-1996

Crestview Estates
Existing Condition (REVISED)
Area flowing to culvert CV-EX5R
AREA TIMES 10

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	418.20	75	
Type B, Asphalt	5.42	98	
Type B, Meadow	259.70	61	
COMPOSITE AREA --->	683.32	69.9	(70)

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 11:46:03 08-20-1996 c:\drain\CV-EX5R.TCT

Crestview Estates
Existing Condition (REVISED)
Flow to Low Point- CV-EX5R

Tc COMPUTATIONS FOR: Subarea #1

SHEET FLOW (Applicable to Tc only)

Segment ID		A		
Surface description		cultivated		
Manning's roughness coeff., n		0.0600		
Flow length, L (total < or = 300)	ft	100.0		
Two-yr 24-hr rainfall, P2	in	1.400		
Land slope, s	ft/ft	0.0200		
$T = \frac{.007 * (n*L)^{0.8}}{P2^{0.5} * s^{0.4}}$	hrs	0.12	=	0.12

SHALLOW CONCENTRATED FLOW

Segment ID		B		
Surface (paved or unpaved)?		Unpaved		
Flow length, L	ft	2880.0		
Watercourse slope, s	ft/ft	0.0130		
$Avg.V = Csf * (s)^{0.5}$	ft/s	1.8396		
where: Unpaved Csf = 16.1345				
Paved Csf = 20.3282				
T = L / (3600*V)	hrs	0.43	=	0.43

CHANNEL FLOW

Segment ID				
Cross Sectional Flow Area, a	sq.ft	0.00		
Wetted perimeter, Pw	ft	0.00		
Hydraulic radius, r = a/Pw	ft	0.000		
Channel slope, s	ft/ft	0.0000		
Manning's roughness coeff., n		0.0000		
$V = \frac{1.49 * r^{2/3} * s^{1/2}}{n}$	ft/s	0.0000		
Flow length, L	ft	0		
T = L / (3600*V)	hrs	0.00	=	0.00

::

TOTAL TIME (hrs) 0.55

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-20-1996 11:47:05
Watershed file: --> C:\DRAIN\CV-EX5R .MOP
Hydrograph file: --> C:\DRAIN\CV-EX5R.HYD

Crestview Estates
Existing Condition (REVISED)
Flow to Low Point- CV-EX5R
AREA TIMES 10

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used
Subarea #1	683.32	70.0	0.50	0.00	2.40	0.41	I.36 .36

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 683.32 acres or 1.0677 sq.mi
Peak discharge = 163 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.55	0.00	0.50	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-20-1996 11:47:05
Watershed file: --> C:\DRAIN\CV-EX5R .MOP
Hydrograph file: --> C:\DRAIN\CV-EX5R.HYD

Crestview Estates
Existing Condition (REVISED)
Flow to Low Point- CV-EX5R
AREA TIMES 10

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	163	12.5
Composite Watershed	163	12.5

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-20-1996 11:47:05
Watershed file: --> C:\DRAIN\CV-EX5R .MOP
Hydrograph file: --> C:\DRAIN\CV-EX5R.HYD

Crestview Estates
Existing Condition (REVISED)
Flow to Low Point- CV-EX5R
AREA TIMES 10

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	0	3	17	52	108	155
Total (cfs)	0	0	0	0	3	17	52	108	155

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	163	146	118	96	68	52	43	37	33
Total (cfs)	163	146	118	96	68	52	43	37	33

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	30	26	24	22	20	18	16	15	15
Total (cfs)	30	26	24	22	20	18	16	15	15

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	14	12	11	9	0
Total (cfs)	14	12	11	9	0

***** Multiply Hydrograph by Constant *****

Unit .HYD File: c:\drain\CV-EX5R.HYD
Output Hydrograph: c:\drain\CV-EX5R1.HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
11.00	0.00	x	0.100	=	0.00
11.10	0.00	x	0.100	=	0.00
11.20	0.00	x	0.100	=	0.00
11.30	0.00	x	0.100	=	0.00
11.40	0.00	x	0.100	=	0.00
11.50	0.00	x	0.100	=	0.00
11.60	0.00	x	0.100	=	0.00
11.70	0.00	x	0.100	=	0.00
11.80	0.00	x	0.100	=	0.00
11.90	0.00	x	0.100	=	0.00
12.00	3.00	x	0.100	=	0.30
12.10	17.00	x	0.100	=	1.70
12.20	52.00	x	0.100	=	5.20
12.30	108.00	x	0.100	=	10.80
12.40	155.00	x	0.100	=	15.50
12.50	163.00	x	0.100	=	16.30
12.60	146.00	x	0.100	=	14.60
12.70	118.00	x	0.100	=	11.80
12.80	96.00	x	0.100	=	9.60
12.90	82.00	x	0.100	=	8.20
13.00	68.00	x	0.100	=	6.80
13.10	60.00	x	0.100	=	6.00
13.20	52.00	x	0.100	=	5.20
13.30	48.00	x	0.100	=	4.80
13.40	43.00	x	0.100	=	4.30
13.50	40.00	x	0.100	=	4.00
13.60	37.00	x	0.100	=	3.70
13.70	35.00	x	0.100	=	3.50
13.80	33.00	x	0.100	=	3.30
13.90	32.00	x	0.100	=	3.20
14.00	30.00	x	0.100	=	3.00
14.10	29.00	x	0.100	=	2.90
14.20	27.00	x	0.100	=	2.70
14.30	26.00	x	0.100	=	2.60
14.40	25.00	x	0.100	=	2.50
14.50	25.00	x	0.100	=	2.50
14.60	24.00	x	0.100	=	2.40
14.70	24.00	x	0.100	=	2.40
14.80	23.00	x	0.100	=	2.30
14.90	22.00	x	0.100	=	2.20
15.00	22.00	x	0.100	=	2.20
15.10	22.00	x	0.100	=	2.20

***** Multiply Hydrograph by Constant *****

Unit .HYD File: c:\drain\CV-EX5R.HYD
Output Hydrograph: c:\drain\CV-EX5R1.HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
15.20	21.00	x	0.100	=	2.10
15.30	21.00	x	0.100	=	2.10
15.40	20.00	x	0.100	=	2.00
15.50	20.00	x	0.100	=	2.00
15.60	20.00	x	0.100	=	2.00
15.70	19.00	x	0.100	=	1.90
15.80	19.00	x	0.100	=	1.90
15.90	18.00	x	0.100	=	1.80
16.00	18.00	x	0.100	=	1.80
16.10	18.00	x	0.100	=	1.80
16.20	17.00	x	0.100	=	1.70
16.30	17.00	x	0.100	=	1.70
16.40	16.00	x	0.100	=	1.60
16.50	16.00	x	0.100	=	1.60
16.60	16.00	x	0.100	=	1.60
16.70	16.00	x	0.100	=	1.60
16.80	15.00	x	0.100	=	1.50
16.90	15.00	x	0.100	=	1.50
17.00	15.00	x	0.100	=	1.50
17.10	15.00	x	0.100	=	1.50
17.20	15.00	x	0.100	=	1.50
17.30	15.00	x	0.100	=	1.50
17.40	15.00	x	0.100	=	1.50
17.50	15.00	x	0.100	=	1.50
17.60	15.00	x	0.100	=	1.50
17.70	15.00	x	0.100	=	1.50
17.80	14.00	x	0.100	=	1.40
17.90	14.00	x	0.100	=	1.40
18.00	14.00	x	0.100	=	1.40
18.10	14.00	x	0.100	=	1.40
18.20	14.00	x	0.100	=	1.40
18.30	13.00	x	0.100	=	1.30
18.40	13.00	x	0.100	=	1.30
18.50	13.00	x	0.100	=	1.30
18.60	13.00	x	0.100	=	1.30
18.70	13.00	x	0.100	=	1.30
18.80	12.00	x	0.100	=	1.20
18.90	12.00	x	0.100	=	1.20
19.00	12.00	x	0.100	=	1.20
19.10	12.00	x	0.100	=	1.20
19.20	12.00	x	0.100	=	1.20

***** Multiply Hydrograph by Constant *****

Unit .HYD File: c:\drain\CV-EX5R.HYD
Output Hydrograph: c:\drain\CV-EX5R1.HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
19.30	12.00	x	0.100	=	1.20
19.40	12.00	x	0.100	=	1.20
19.50	12.00	x	0.100	=	1.20
19.60	11.00	x	0.100	=	1.10
19.70	11.00	x	0.100	=	1.10
19.80	11.00	x	0.100	=	1.10
19.90	11.00	x	0.100	=	1.10
20.00	11.00	x	0.100	=	1.10
20.10	11.00	x	0.100	=	1.10
20.20	11.00	x	0.100	=	1.10
20.30	11.00	x	0.100	=	1.10
20.40	11.00	x	0.100	=	1.10
20.50	10.00	x	0.100	=	1.00
20.60	10.00	x	0.100	=	1.00
20.70	10.00	x	0.100	=	1.00
20.80	10.00	x	0.100	=	1.00
20.90	10.00	x	0.100	=	1.00
21.00	10.00	x	0.100	=	1.00
21.10	10.00	x	0.100	=	1.00
21.20	10.00	x	0.100	=	1.00
21.30	10.00	x	0.100	=	1.00
21.40	10.00	x	0.100	=	1.00
21.50	10.00	x	0.100	=	1.00
21.60	9.00	x	0.100	=	0.90
21.70	9.00	x	0.100	=	0.90
21.80	9.00	x	0.100	=	0.90
21.90	9.00	x	0.100	=	0.90
22.00	9.00	x	0.100	=	0.90
22.10	9.00	x	0.100	=	0.90
22.20	9.00	x	0.100	=	0.90
22.30	8.00	x	0.100	=	0.80
22.40	8.00	x	0.100	=	0.80
22.50	8.00	x	0.100	=	0.80
22.60	8.00	x	0.100	=	0.80
22.70	7.00	x	0.100	=	0.70
22.80	7.00	x	0.100	=	0.70
22.90	7.00	x	0.100	=	0.70
23.00	7.00	x	0.100	=	0.70
23.10	7.00	x	0.100	=	0.70
23.20	6.00	x	0.100	=	0.60
23.30	6.00	x	0.100	=	0.60

***** Multiply Hydrograph by Constant *****

Unit .HYD File: c:\drain\CV-EX5R.HYD
Output Hydrograph: c:\drain\CV-EX5R1.HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
23.40	6.00	x	0.100	=	0.60
23.50	6.00	x	0.100	=	0.60
23.60	5.00	x	0.100	=	0.50
23.70	5.00	x	0.100	=	0.50
23.80	5.00	x	0.100	=	0.50
23.90	5.00	x	0.100	=	0.50
24.00	4.00	x	0.100	=	0.40
24.10	4.00	x	0.100	=	0.40
24.20	4.00	x	0.100	=	0.40
24.30	4.00	x	0.100	=	0.40
24.40	4.00	x	0.100	=	0.40
24.50	3.00	x	0.100	=	0.30
24.60	3.00	x	0.100	=	0.30
24.70	3.00	x	0.100	=	0.30
24.80	3.00	x	0.100	=	0.30
24.90	2.00	x	0.100	=	0.20
25.00	2.00	x	0.100	=	0.20
25.10	2.00	x	0.100	=	0.20
25.20	2.00	x	0.100	=	0.20
25.30	2.00	x	0.100	=	0.20
25.40	1.00	x	0.100	=	0.10
25.50	1.00	x	0.100	=	0.10
25.60	1.00	x	0.100	=	0.10
25.70	1.00	x	0.100	=	0.10
25.80	0.00	x	0.100	=	0.00
25.90	0.00	x	0.100	=	0.00

CURRENT DATE: 08-26-1996
CURRENT TIME: 10:37:38

FILE DATE: 08-26-1996
FILE NAME: CV

****
********** FHWA CULVERT ANALYSIS **********
********** HY-8, VERSION 4.0 **********

CULV #	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	79.69	78.58	34.02	1 RCP	1.50	1.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: CV DATE: 08-26-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
79.70	0	0	0	0	0	0	0	0	1
80.31	2	2	0	0	0	0	0	0	1
80.64	3	3	0	0	0	0	0	0	1
80.90	5	5	0	0	0	0	0	0	1
81.13	7	7	0	0	0	0	0	0	1
81.38	8	8	0	0	0	0	0	0	1
81.67	10	10	0	0	0	0	0	0	1
82.02	11	11	0	0	0	0	0	0	1
82.15	13	12	0	0	0	0	0	0	30
82.26	15	12	0	0	0	0	0	2	30
82.29	16	12	0	0	0	0	0	4	19
82.20	12	12	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: CV DATE: 08-26-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
79.70	0.00	0	0	0.00
80.31	0.00	2	0	0.00
80.64	0.00	3	0	0.00
80.90	0.00	5	0	0.00
81.13	0.00	7	0	0.00
81.38	0.00	8	0	0.00
81.67	0.00	10	0	0.00
82.02	0.00	11	0	0.00
82.15	-0.00	13	1	8.52
82.26	-0.00	15	0	2.13
82.29	-0.00	16	0	0.86

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 08-26-1996 FILE DATE: 08-26-1996
CURRENT TIME: 10:37:38 FILE NAME: CV

****

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (1.5 BY 1.5) RCP

****

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
0	79.70	0.00	0.01	0-NF	0.00	0.00	0.00	0.00	0.00	1.12
2	80.31	0.62	0.62	1-S2n	0.28	0.48	7.05	0.28	0.00	1.12
3	80.64	0.95	0.95	1-S2n	0.40	0.68	7.98	0.42	0.00	1.12
5	80.90	1.21	1.21	1-S2n	0.49	0.85	8.76	0.53	0.00	1.12
7	81.13	1.44	1.44	1-S2n	0.58	0.98	9.24	0.63	0.00	1.12
8	81.38	1.69	1.69	5-S2n	0.65	1.10	9.66	0.72	0.00	1.12
10	81.67	1.98	1.98	5-S2n	0.73	1.21	10.10	0.81	0.00	1.12
11	82.02	2.33	2.33	5-S2n	0.80	1.28	10.42	0.89	0.00	1.12
12	82.14	2.45	2.45	5-S2n	0.82	1.30	10.54	0.92	0.00	1.12
12	82.25	2.56	2.56	5-S2n	0.84	1.32	10.64	0.94	0.00	1.12
12	82.28	2.59	2.59	5-S2n	0.84	1.33	10.67	0.94	0.00	1.12

****

El. inlet face invert 79.69 ft El. outlet invert 78.58 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

****

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	79.69
OUTLET STATION (FT)	34.00
OUTLET ELEVATION (FT)	78.58
NUMBER OF BARRELS	1
SLOPE (V-FT/H-FT)	0.0326
CULVERT LENGTH ALONG SLOPE (FT)	34.02

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	CIRCULAR
BARREL DIAMETER	1.50 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	GROOVED END PROJECTION
INLET DEPRESSION	NONE

****

CURRENT DATE: 08-26-1996 FILE DATE: 08-26-1996
CURRENT TIME: 10:37:38 FILE NAME: CV

****
********** TAILWATER **********
****
****

CONSTANT WATER SURFACE ELEVATION
79.70

****
********** ROADWAY OVERTOPPING DATA **********
****

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH (FT) 20.00
***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X (FT)	Y (FT)
1	0.00	83.00
2	125.00	82.20
3	165.00	82.20
4	265.00	83.00

****

Outlet Structure File: CV-EX18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Existing Condition
Flow through 18" RCP Culvert
Overflow road @ Elevation 82.2
****

***** COMPOSITE OUTFLOW SUMMARY ****

Elevation (ft)	Q (cfs)	Contributing Structures
80.00	1.0	5
80.10	1.3	5
80.20	1.7	5
80.30	2.0	5
80.40	2.3	5
80.50	2.6	5
80.60	2.9	5
80.70	3.5	5
80.80	4.2	5
80.90	5.0	5
81.00	5.9	5
81.10	6.7	5
81.20	7.3	5
81.30	7.7	5
81.40	8.1	5
81.50	8.8	5
81.60	9.5	5
81.70	10.1	5
81.80	10.4	5
81.90	10.7	5
82.00	10.9	5
82.10	11.7	5
82.20	12.3	5

Outlet Structure File: CV-EX18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Existing Condition
Flow through 18" RCP Culvert
Overflow road @ Elevation 82.2
****

Outlet Structure File: c:\drain\CV-EX18 .STR
Planimeter Input File: c:\drain\CV5-EX .VOL
Rating Table Output File: c:\drain\CV5-EX .PND

Min. Elev.(ft) = 80 Max. Elev.(ft) = 82.2 Incr.(ft) = .1

Additional elevations (ft) to be included in table:
* *

****
SYSTEM CONNECTIVITY
****

Structure	No.	Q Table		Q Table
TABLE	5		->	5

Outflow rating table summary was stored in file:
c:\drain\CV5-EX .PND

Outlet Structure File: CV-EX18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Existing Condition
Flow through 18" RCP Culvert
Overflow road @ Elevation 82.2
****

Outflow Rating Table for Structure #5
TABLE Input your own rating table.

Elevation (ft)	Q (cfs)	Computation Messages
80.00	1.0	Interpolated from input table
80.10	1.3	Interpolated from input table
80.20	1.7	Interpolated from input table
80.30	2.0	
80.40	2.3	Interpolated from input table
80.50	2.6	Interpolated from input table
80.60	2.9	Interpolated from input table
80.70	3.5	Interpolated from input table
80.80	4.2	Interpolated from input table
80.90	5.0	
81.00	5.9	Interpolated from input table
81.10	6.7	Interpolated from input table
81.20	7.3	Interpolated from input table
81.30	7.7	Interpolated from input table
81.40	8.1	Interpolated from input table
81.50	8.8	Interpolated from input table
81.60	9.5	Interpolated from input table
81.70	10.1	Interpolated from input table
81.80	10.4	Interpolated from input table
81.90	10.7	Interpolated from input table
82.00	10.9	Interpolated from input table
82.10	11.7	Interpolated from input table
82.20	12.3	Interpolated from input table

POND-2 Version: 5.16
S/N: 1295130196

Crestview Estates
Existing Condition
Overall Basin - CV5-EX

CALCULATED 08-26-1996 11:44:32
DISK FILE: c:\drain\CV5-EX .VOL

Planimeter scale: 1 inch = 1 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	* Volume (cubic-ft)	Volume Sum (cubic-ft)
80.00	10.00	10	0	0	0
81.00	200.00	200	255	85	85
82.00	21,245.00	21,245	23,506	7,835	7,920
82.50	*I*	35,392	84,058	14,010	21,930
83.00	53,130.00	53,130	107,972	35,991	43,911

I ---> Interpolated area from closest two planimeter readings.

$$IA = (\text{sq.rt}(Area1) + ((Ei-E1)/(E2-E1))*(\text{sq.rt}(Area2)-\text{sq.rt}(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* 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

****
*
* Crestview Estates *
* Existing Condition *
* Flow through 18" RCP Culvert *
* Overflow road @ Elevation 82.2 *
*
****

Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Rating Table file: c:\drain\CV5-EX .PND

----INITIAL CONDITIONS----
Elevation = 80.00 ft
Outflow = 1.00 cfs
Storage = 0 cu-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (cu-ft)	2S/t (cfs)	2S/t + O (cfs)
80.00	1.0	0	0.0	1.0
80.10	1.3	1	0.0	1.3
80.20	1.7	4	0.0	1.7
80.30	2.0	7	0.0	2.0
80.40	2.3	12	0.1	2.4
80.50	2.6	19	0.1	2.7
80.60	2.9	27	0.2	3.1
80.70	3.5	38	0.2	3.7
80.80	4.2	51	0.3	4.5
80.90	5.0	66	0.4	5.4
81.00	5.9	85	0.5	6.4
81.10	6.7	129	0.7	7.4
81.20	7.3	246	1.4	8.7
81.30	7.7	468	2.6	10.3
81.40	8.1	832	4.6	12.7
81.50	8.8	1,372	7.6	16.4
81.60	9.5	2,122	11.8	21.3
81.70	10.1	3,118	17.3	27.4
81.80	10.4	4,393	24.4	34.8
81.90	10.7	5,982	33.2	43.9
82.00	10.9	7,921	44.0	54.9
82.10	11.7	10,171	56.5	68.2
82.20	12.3	12,682	70.5	82.8

Time increment (t) = 0.100 hrs.

Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	0.00	-----	-1.0	1.0	1.00	80.00
11.100	0.00	0.0	-1.0	-1.0	0.00	80.00
11.200	0.00	0.0	-1.0	-1.0	0.00	80.00
11.300	0.00	0.0	-1.0	-1.0	0.00	80.00
11.400	0.00	0.0	-1.0	-1.0	0.00	80.00
11.500	0.00	0.0	-1.0	-1.0	0.00	80.00
11.600	0.00	0.0	-1.0	-1.0	0.00	80.00
11.700	0.00	0.0	-1.0	-1.0	0.00	80.00
11.800	0.00	0.0	-1.0	-1.0	0.00	80.00
11.900	0.00	0.0	-1.0	-1.0	0.00	80.00
12.000	0.30	0.3	-0.7	-0.7	0.00	80.00
12.100	1.70	2.0	-1.3	1.3	1.29	80.10
12.200	5.20	6.9	-4.8	5.6	5.22	80.92
12.300	10.80	16.0	-4.5	11.2	7.84	81.34
12.400	15.50	26.3	2.7	21.8	9.55	81.61
12.500	16.30	31.8	13.7	34.5	10.39	81.80
12.600	14.60	30.9	23.2	44.6	10.71	81.91
12.700	11.80	26.4	28.0	49.6	10.80	81.95
12.800	9.60	21.4	27.8	49.4	10.80	81.95
12.900	8.20	17.8	24.1	45.6	10.73	81.92
13.000	6.80	15.0	18.0	39.1	10.54	81.85
13.100	6.00	12.8	10.4	30.8	10.24	81.75
13.200	5.20	11.2	2.5	21.6	9.53	81.60
13.300	4.80	10.0	-3.6	12.5	8.06	81.39
13.400	4.30	9.1	-4.7	5.5	5.10	80.91
13.500	4.00	8.3	-3.2	3.6	3.38	80.68
13.600	3.70	7.7	-3.9	4.5	4.23	80.80
13.700	3.50	7.2	-2.9	3.3	3.09	80.63
13.800	3.30	6.8	-3.4	3.9	3.66	80.72
13.900	3.20	6.5	-2.8	3.1	2.92	80.60
14.000	3.00	6.2	-3.1	3.4	3.25	80.66
14.100	2.90	5.9	-2.6	2.8	2.72	80.54
14.200	2.70	5.6	-2.7	3.0	2.86	80.59
14.300	2.60	5.3	-2.4	2.6	2.49	80.46
14.400	2.50	5.1	-2.5	2.7	2.60	80.50
14.500	2.50	5.0	-2.3	2.5	2.42	80.44
14.600	2.40	4.9	-2.4	2.6	2.47	80.46
14.700	2.40	4.8	-2.3	2.4	2.35	80.42
14.800	2.30	4.7	-2.3	2.4	2.35	80.42
14.900	2.20	4.5	-2.1	2.2	2.16	80.35
15.000	2.20	4.4	-2.2	2.3	2.23	80.38
15.100	2.20	4.4	-2.1	2.2	2.18	80.36
15.200	2.10	4.3	-2.1	2.2	2.13	80.34
15.300	2.10	4.2	-2.0	2.1	2.08	80.33
15.400	2.00	4.1	-2.0	2.1	2.03	80.31

Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	2.00	4.0	-1.9	2.0	1.98	80.29
15.600	2.00	4.0	-2.0	2.1	2.02	80.31
15.700	1.90	3.9	-1.9	1.9	1.89	80.26
15.800	1.90	3.8	-1.9	1.9	1.91	80.27
15.900	1.80	3.7	-1.8	1.8	1.80	80.23
16.000	1.80	3.6	-1.8	1.8	1.80	80.23
16.100	1.80	3.6	-1.8	1.8	1.80	80.23
16.200	1.70	3.5	-1.7	1.7	1.71	80.20
16.300	1.70	3.4	-1.7	1.7	1.69	80.20
16.400	1.60	3.3	-1.6	1.6	1.61	80.18
16.500	1.60	3.2	-1.6	1.6	1.59	80.17
16.600	1.60	3.2	-1.6	1.6	1.61	80.18
16.700	1.60	3.2	-1.6	1.6	1.59	80.17
16.800	1.50	3.1	-1.5	1.5	1.51	80.15
16.900	1.50	3.0	-1.5	1.5	1.49	80.15
17.000	1.50	3.0	-1.5	1.5	1.51	80.15
17.100	1.50	3.0	-1.5	1.5	1.49	80.15
17.200	1.50	3.0	-1.5	1.5	1.51	80.15
17.300	1.50	3.0	-1.5	1.5	1.49	80.15
17.400	1.50	3.0	-1.5	1.5	1.51	80.15
17.500	1.50	3.0	-1.5	1.5	1.49	80.15
17.600	1.50	3.0	-1.5	1.5	1.51	80.15
17.700	1.50	3.0	-1.5	1.5	1.49	80.15
17.800	1.40	2.9	-1.4	1.4	1.41	80.13
17.900	1.40	2.8	-1.4	1.4	1.39	80.12
18.000	1.40	2.8	-1.4	1.4	1.41	80.13
18.100	1.40	2.8	-1.4	1.4	1.39	80.12
18.200	1.40	2.8	-1.4	1.4	1.41	80.13
18.300	1.30	2.7	-1.3	1.3	1.30	80.10
18.400	1.30	2.6	-1.3	1.3	1.30	80.10
18.500	1.30	2.6	-1.3	1.3	1.30	80.10
18.600	1.30	2.6	-1.3	1.3	1.30	80.10
18.700	1.30	2.6	-1.3	1.3	1.30	80.10
18.800	1.20	2.5	-1.2	1.2	1.20	80.07
18.900	1.20	2.4	-1.2	1.2	1.20	80.07
19.000	1.20	2.4	-1.2	1.2	1.20	80.07
19.100	1.20	2.4	-1.2	1.2	1.20	80.07
19.200	1.20	2.4	-1.2	1.2	1.20	80.07
19.300	1.20	2.4	-1.2	1.2	1.20	80.07
19.400	1.20	2.4	-1.2	1.2	1.20	80.07
19.500	1.20	2.4	-1.2	1.2	1.20	80.07
19.600	1.10	2.3	-1.1	1.1	1.11	80.04
19.700	1.10	2.2	-1.1	1.1	1.09	80.03
19.800	1.10	2.2	-1.1	1.1	1.10	80.03
19.900	1.10	2.2	-1.1	1.1	1.10	80.03
20.000	1.10	2.2	-1.1	1.1	1.10	80.03

Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	1.10	2.2	-1.1	1.1	1.10	80.03
20.200	1.10	2.2	-1.1	1.1	1.10	80.03
20.300	1.10	2.2	-1.1	1.1	1.10	80.03
20.400	1.10	2.2	-1.1	1.1	1.10	80.03
20.500	1.00	2.1	-1.0	1.0	1.00	80.00
20.600	1.00	2.0	-1.0	1.0	1.00	80.00
20.700	1.00	2.0	-1.0	1.0	1.00	80.00
20.800	1.00	2.0	-1.0	1.0	1.00	80.00
20.900	1.00	2.0	-1.0	1.0	1.00	80.00
21.000	1.00	2.0	-1.0	1.0	1.00	80.00
21.100	1.00	2.0	-1.0	1.0	1.00	80.00
21.200	1.00	2.0	-1.0	1.0	1.00	80.00
21.300	1.00	2.0	-1.0	1.0	1.00	80.00
21.400	1.00	2.0	-1.0	1.0	1.00	80.00
21.500	1.00	2.0	-1.0	1.0	1.00	80.00
21.600	0.90	1.9	-0.9	0.9	0.90	80.00
21.700	0.90	1.8	-0.9	0.9	0.90	80.00
21.800	0.90	1.8	-0.9	0.9	0.90	80.00
21.900	0.90	1.8	-0.9	0.9	0.90	80.00
22.000	0.90	1.8	-0.9	0.9	0.90	80.00
22.100	0.90	1.8	-0.9	0.9	0.90	80.00
22.200	0.90	1.8	-0.9	0.9	0.90	80.00
22.300	0.80	1.7	-0.8	0.8	0.80	80.00
22.400	0.80	1.6	-0.8	0.8	0.80	80.00
22.500	0.80	1.6	-0.8	0.8	0.80	80.00
22.600	0.80	1.6	-0.8	0.8	0.80	80.00
22.700	0.70	1.5	-0.7	0.7	0.70	80.00
22.800	0.70	1.4	-0.7	0.7	0.70	80.00
22.900	0.70	1.4	-0.7	0.7	0.70	80.00
23.000	0.70	1.4	-0.7	0.7	0.70	80.00
23.100	0.70	1.4	-0.7	0.7	0.70	80.00
23.200	0.60	1.3	-0.6	0.6	0.60	80.00
23.300	0.60	1.2	-0.6	0.6	0.60	80.00
23.400	0.60	1.2	-0.6	0.6	0.60	80.00
23.500	0.60	1.2	-0.6	0.6	0.60	80.00
23.600	0.50	1.1	-0.5	0.5	0.50	80.00
23.700	0.50	1.0	-0.5	0.5	0.50	80.00
23.800	0.50	1.0	-0.5	0.5	0.50	80.00
23.900	0.50	1.0	-0.5	0.5	0.50	80.00
24.000	0.40	0.9	-0.4	0.4	0.40	80.00
24.100	0.40	0.8	-0.4	0.4	0.40	80.00
24.200	0.40	0.8	-0.4	0.4	0.40	80.00
24.300	0.40	0.8	-0.4	0.4	0.40	80.00
24.400	0.40	0.8	-0.4	0.4	0.40	80.00
24.500	0.30	0.7	-0.3	0.3	0.30	80.00
24.600	0.30	0.6	-0.3	0.3	0.30	80.00

Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

INFLOW HYDROGRAPH

TIME (hrs)	INFLOW (cfs)
24.700	0.30
24.800	0.30
24.900	0.20
25.000	0.20
25.100	0.20
25.200	0.20
25.300	0.20
25.400	0.10
25.500	0.10
25.600	0.10
25.700	0.10
25.800	0.00
25.900	0.00

ROUTING COMPUTATIONS

I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.6	-0.3	0.3	0.30	80.00
0.6	-0.3	0.3	0.30	80.00
0.5	-0.2	0.2	0.20	80.00
0.4	-0.2	0.2	0.20	80.00
0.4	-0.2	0.2	0.20	80.00
0.4	-0.2	0.2	0.20	80.00
0.4	-0.2	0.2	0.20	80.00
0.3	-0.1	0.1	0.10	80.00
0.2	-0.1	0.1	0.10	80.00
0.2	-0.1	0.1	0.10	80.00
0.2	-0.1	0.1	0.10	80.00
0.1	-0.0	0.0	0.00	80.00
0.0	-0.0	-0.0	0.00	80.00

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

Starting Pond W.S. Elevation = 80.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	16.30 cfs
Peak Outflow	=	10.80 cfs
Peak Elevation	=	81.95 ft

***** Summary of Approximate Peak Storage *****

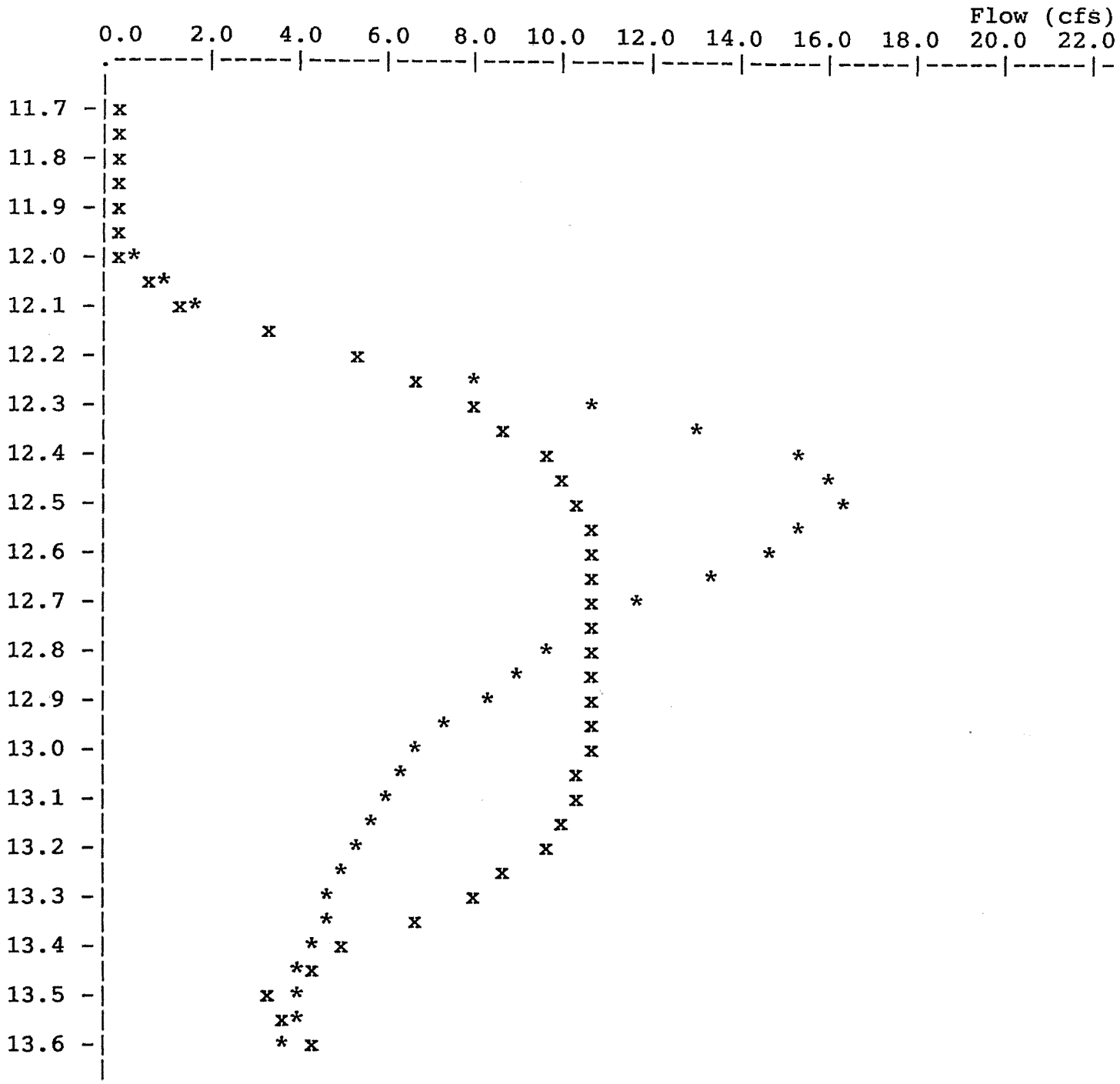
Initial Storage	=	0 cu-ft
Peak Storage From Storm	=	6,981 cu-ft
Total Storage in Pond	=	6,981 cu-ft

>>>>> Warning, initial pond outflow > 1st inflow ordinate. <<<<<

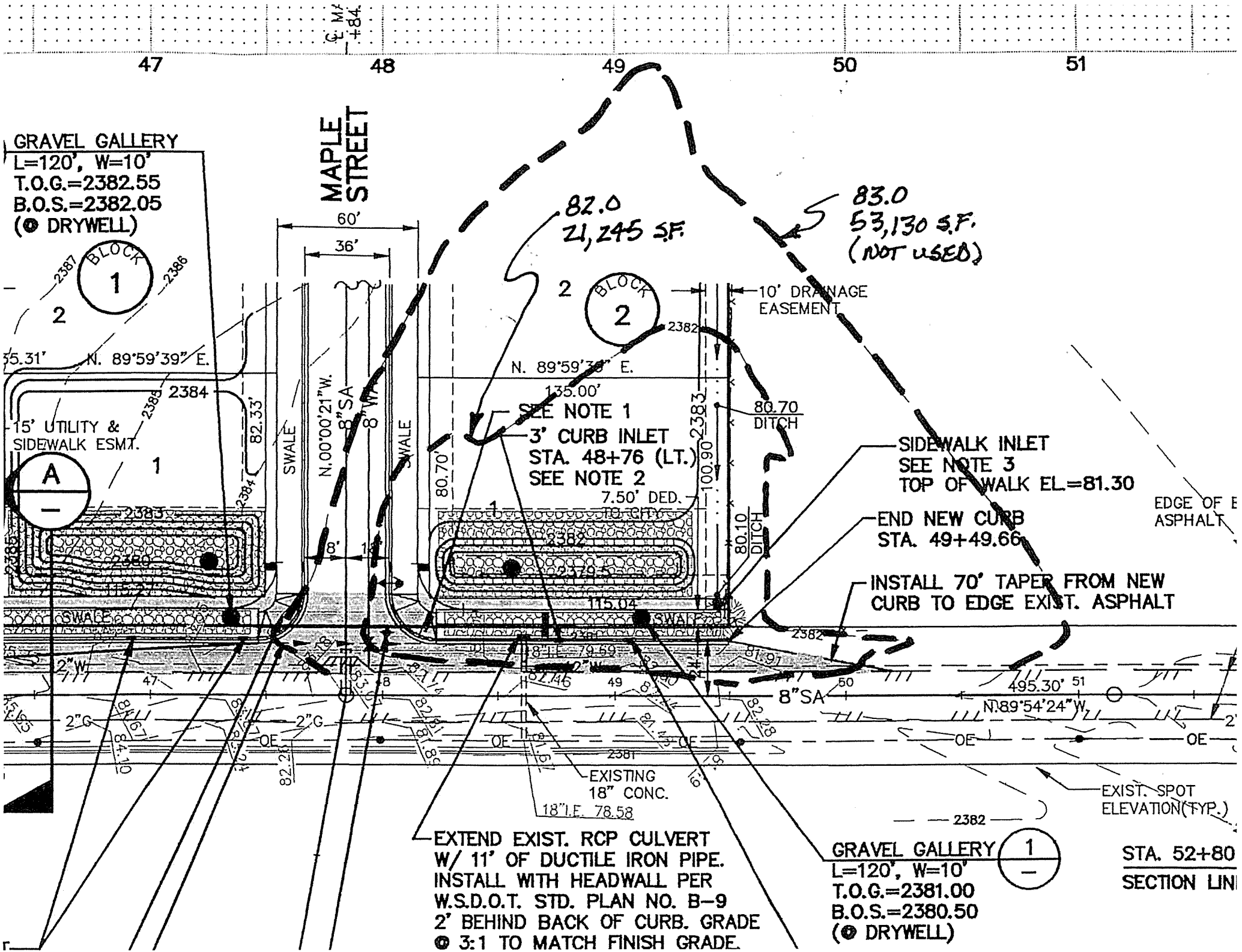
Pond File: c:\drain\CV5-EX .PND
Inflow Hydrograph: c:\drain\CV-EX5R1.HYD
Outflow Hydrograph: c:\drain\OUT .HYD

EXECUTED: 08-26-1996
11:49:25

Peak Inflow = 16.30 cfs
Peak Outflow = 10.80 cfs
Peak Elevation = 81.95 ft



* File: c:\drain\CV-EX5R1.HYD Qmax = 16.3 cfs
x File: c:\drain\OUT .HYD Qmax = 10.8 cfs


47
48
49
50
51
GRAVEL GALLERY
L=120', W=10'
T.O.G.=2382.55
B.O.S.=2382.05
(@ DRYWELL)
MAPLE STREET
60'
36'
82.0
21,245 S.F.
83.0
53,130 S.F.
(NOT USED)
BLOCK 1
BLOCK 2
10' DRAINAGE EASEMENT
N. 89°59'39" E.
135.00'
15' UTILITY & SIDEWALK ESMT.
SWALE
8"SA
8"W
SEE NOTE 1
3' CURB INLET
STA. 48+76 (LT.)
SEE NOTE 2
7.50' DED. TO CITY
80.70' DITCH
80.10' DITCH
SIDEWALK INLET
SEE NOTE 3
TOP OF WALK EL.=81.30
END NEW CURB
STA. 49+49.66
INSTALL 70' TAPER FROM NEW CURB TO EDGE EXIST. ASPHALT
EDGE OF E ASPHALT
115.04
8"I.E. 79.59
2"W
2"G
OE
8"SA
N.89°54'24"W
495.30'
EXISTING 18" CONC.
18"I.E. 78.58
EXTEND EXIST. RCP CULVERT W/ 11' OF DUCTILE IRON PIPE. INSTALL WITH HEADWALL PER W.S.D.O.T. STD. PLAN NO. B-9 2' BEHIND BACK OF CURB. GRADE @ 3:1 TO MATCH FINISH GRADE.
EXIST. SPOT ELEVATION (TYP.)
GRAVEL GALLERY
L=120', W=10'
T.O.G.=2381.00
B.O.S.=2380.50
(@ DRYWELL)
STA. 52+80
SECTION LIN

PHASE I ONLY

DEVELOPED CONDITION ANALYSIS

Quick TR-55 Ver.5.46 S/N:1315430222
Executed: 10:49:47 08-29-1996

Crestview Estates
Developed Condition w/E part Ph1 (REVISED)
Area flowing to culvert : CV DV5RE
AREA TIMES 10 (A x 10)

RUNOFF CURVE NUMBER DATA

Composite Area: Subarea #1

SURFACE DESCRIPTION	AREA (acres)	CN	
Type B, Cultivated land	416.50	75	
Type B, Asphalt	9.69	98	
Type B, Meadow	218.80	61	
Type B, Residential	18.37	75	
COMPOSITE AREA --->	663.36	70.7	(71)

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-29-1996 10:51:10
Watershed file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.MOP
Hydrograph file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.HYD

Crestview Estates
Developed Condition (REVISED)
Flow to Low Point- CV-DV5RE
AREA TIMES 10 (A x 10)

>>>> Input Parameters Used to Compute Hydrograph <<<<

Subarea Description	AREA (acres)	CN	Tc (hrs)	* Tt (hrs)	Precip. (in)	Runoff (in)	Ia/p input/used	
Subarea #1	663.36	71.0	0.50	0.00	2.40	0.44	I.34	.34

* Travel time from subarea outfall to composite watershed outfall point.
I -- Subarea where user specified interpolation between Ia/p tables.

Total area = 663.36 acres or 1.0365 sq.mi
Peak discharge = 180 cfs

>>>> Computer Modifications of Input Parameters <<<<<

Subarea Description	Input Values Tc (hr)	Input Values * Tt (hr)	Rounded Values Tc (hr)	Rounded Values * Tt (hr)	Ia/p Interpolated (Yes/No)	Ia/p Messages
Subarea #1	0.55	0.00	0.50	0.00	Yes	--

* Travel time from subarea outfall to composite watershed outfall point.

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-29-1996 10:51:10
Watershed file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.MOP
Hydrograph file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.HYD

Crestview Estates
Developed Condition (REVISED)
Flow to Low Point- CV-DV5RE
AREA TIMES 10 (A x 10)

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
Subarea #1	180	12.5
Composite Watershed	180	12.5

Return Frequency: 50 years

TR-55 TABULAR HYDROGRAPH METHOD
Type II. Distribution
(24 hr. Duration Storm)

Executed: 08-29-1996 10:51:10
Watershed file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.MOP
Hydrograph file: --> A:\CRESTVEW\SCOTT\CV-DV5RE.HYD

Crestview Estates
Developed Condition (REVISED)
Flow to Low Point- CV-DV5RE
AREA TIMES 10 (A x 10)

Composite Hydrograph Summary (cfs)

Subarea Description	11.0 hr	11.3 hr	11.6 hr	11.9 hr	12.0 hr	12.1 hr	12.2 hr	12.3 hr	12.4 hr
Subarea #1	0	0	0	0	3	20	60	123	173
Total (cfs)	0	0	0	0	3	20	60	123	173

Subarea Description	12.5 hr	12.6 hr	12.7 hr	12.8 hr	13.0 hr	13.2 hr	13.4 hr	13.6 hr	13.8 hr
Subarea #1	180	159	127	103	71	54	44	38	34
Total (cfs)	180	159	127	103	71	54	44	38	34

Subarea Description	14.0 hr	14.3 hr	14.6 hr	15.0 hr	15.5 hr	16.0 hr	16.5 hr	17.0 hr	17.5 hr
Subarea #1	31	27	24	22	20	19	17	15	15
Total (cfs)	31	27	24	22	20	19	17	15	15

Subarea Description	18.0 hr	19.0 hr	20.0 hr	22.0 hr	26.0 hr
Subarea #1	14	12	11	9	0
Total (cfs)	14	12	11	9	0

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:\crestvew\scott\CV-DV5RE.HYD
Output Hydrograph: a:\crestvew\scott\E-PH1 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
11.00	0.00	x	0.100	=	0.00
11.10	0.00	x	0.100	=	0.00
11.20	0.00	x	0.100	=	0.00
11.30	0.00	x	0.100	=	0.00
11.40	0.00	x	0.100	=	0.00
11.50	0.00	x	0.100	=	0.00
11.60	0.00	x	0.100	=	0.00
11.70	0.00	x	0.100	=	0.00
11.80	0.00	x	0.100	=	0.00
11.90	0.00	x	0.100	=	0.00
12.00	3.00	x	0.100	=	0.30
12.10	20.00	x	0.100	=	2.00
12.20	60.00	x	0.100	=	6.00
12.30	123.00	x	0.100	=	12.30
12.40	173.00	x	0.100	=	17.30
12.50	180.00	x	0.100	=	18.00
12.60	159.00	x	0.100	=	15.90
12.70	127.00	x	0.100	=	12.70
12.80	103.00	x	0.100	=	10.30
12.90	87.00	x	0.100	=	8.70
13.00	71.00	x	0.100	=	7.10
13.10	62.00	x	0.100	=	6.20
13.20	54.00	x	0.100	=	5.40
13.30	49.00	x	0.100	=	4.90
13.40	44.00	x	0.100	=	4.40
13.50	41.00	x	0.100	=	4.10
13.60	38.00	x	0.100	=	3.80
13.70	36.00	x	0.100	=	3.60
13.80	34.00	x	0.100	=	3.40
13.90	32.00	x	0.100	=	3.20
14.00	31.00	x	0.100	=	3.10
14.10	30.00	x	0.100	=	3.00
14.20	28.00	x	0.100	=	2.80
14.30	27.00	x	0.100	=	2.70
14.40	26.00	x	0.100	=	2.60
14.50	25.00	x	0.100	=	2.50
14.60	24.00	x	0.100	=	2.40
14.70	24.00	x	0.100	=	2.40
14.80	23.00	x	0.100	=	2.30
14.90	22.00	x	0.100	=	2.20
15.00	22.00	x	0.100	=	2.20
15.10	22.00	x	0.100	=	2.20

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:\crestvew\scott\CV-DV5RE.HYD
Output Hydrograph: a:\crestvew\scott\E-PH1 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
15.20	21.00	x	0.100	=	2.10
15.30	21.00	x	0.100	=	2.10
15.40	20.00	x	0.100	=	2.00
15.50	20.00	x	0.100	=	2.00
15.60	20.00	x	0.100	=	2.00
15.70	20.00	x	0.100	=	2.00
15.80	19.00	x	0.100	=	1.90
15.90	19.00	x	0.100	=	1.90
16.00	19.00	x	0.100	=	1.90
16.10	19.00	x	0.100	=	1.90
16.20	18.00	x	0.100	=	1.80
16.30	18.00	x	0.100	=	1.80
16.40	17.00	x	0.100	=	1.70
16.50	17.00	x	0.100	=	1.70
16.60	17.00	x	0.100	=	1.70
16.70	16.00	x	0.100	=	1.60
16.80	16.00	x	0.100	=	1.60
16.90	15.00	x	0.100	=	1.50
17.00	15.00	x	0.100	=	1.50
17.10	15.00	x	0.100	=	1.50
17.20	15.00	x	0.100	=	1.50
17.30	15.00	x	0.100	=	1.50
17.40	15.00	x	0.100	=	1.50
17.50	15.00	x	0.100	=	1.50
17.60	15.00	x	0.100	=	1.50
17.70	15.00	x	0.100	=	1.50
17.80	14.00	x	0.100	=	1.40
17.90	14.00	x	0.100	=	1.40
18.00	14.00	x	0.100	=	1.40
18.10	14.00	x	0.100	=	1.40
18.20	14.00	x	0.100	=	1.40
18.30	13.00	x	0.100	=	1.30
18.40	13.00	x	0.100	=	1.30
18.50	13.00	x	0.100	=	1.30
18.60	13.00	x	0.100	=	1.30
18.70	13.00	x	0.100	=	1.30
18.80	12.00	x	0.100	=	1.20
18.90	12.00	x	0.100	=	1.20
19.00	12.00	x	0.100	=	1.20
19.10	12.00	x	0.100	=	1.20
19.20	12.00	x	0.100	=	1.20

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:\crestvew\scott\CV-DV5RE.HYD
Output Hydrograph: a:\crestvew\scott\E-PH1 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
19.30	12.00	x	0.100	=	1.20
19.40	12.00	x	0.100	=	1.20
19.50	12.00	x	0.100	=	1.20
19.60	11.00	x	0.100	=	1.10
19.70	11.00	x	0.100	=	1.10
19.80	11.00	x	0.100	=	1.10
19.90	11.00	x	0.100	=	1.10
20.00	11.00	x	0.100	=	1.10
20.10	11.00	x	0.100	=	1.10
20.20	11.00	x	0.100	=	1.10
20.30	11.00	x	0.100	=	1.10
20.40	11.00	x	0.100	=	1.10
20.50	10.00	x	0.100	=	1.00
20.60	10.00	x	0.100	=	1.00
20.70	10.00	x	0.100	=	1.00
20.80	10.00	x	0.100	=	1.00
20.90	10.00	x	0.100	=	1.00
21.00	10.00	x	0.100	=	1.00
21.10	10.00	x	0.100	=	1.00
21.20	10.00	x	0.100	=	1.00
21.30	10.00	x	0.100	=	1.00
21.40	10.00	x	0.100	=	1.00
21.50	10.00	x	0.100	=	1.00
21.60	9.00	x	0.100	=	0.90
21.70	9.00	x	0.100	=	0.90
21.80	9.00	x	0.100	=	0.90
21.90	9.00	x	0.100	=	0.90
22.00	9.00	x	0.100	=	0.90
22.10	9.00	x	0.100	=	0.90
22.20	9.00	x	0.100	=	0.90
22.30	8.00	x	0.100	=	0.80
22.40	8.00	x	0.100	=	0.80
22.50	8.00	x	0.100	=	0.80
22.60	8.00	x	0.100	=	0.80
22.70	7.00	x	0.100	=	0.70
22.80	7.00	x	0.100	=	0.70
22.90	7.00	x	0.100	=	0.70
23.00	7.00	x	0.100	=	0.70
23.10	7.00	x	0.100	=	0.70
23.20	6.00	x	0.100	=	0.60
23.30	6.00	x	0.100	=	0.60

***** Multiply Hydrograph by Constant *****

Unit .HYD File: a:\crestvew\scott\CV-DV5RE.HYD
Output Hydrograph: a:\crestvew\scott\E-PH1 .HYD

Multiplier Constant: .1

TIME (hrs)	Unit Ordinates		Multiplier Constant		Output Hydrograph (cfs)
23.40	6.00	x	0.100	=	0.60
23.50	6.00	x	0.100	=	0.60
23.60	5.00	x	0.100	=	0.50
23.70	5.00	x	0.100	=	0.50
23.80	5.00	x	0.100	=	0.50
23.90	5.00	x	0.100	=	0.50
24.00	4.00	x	0.100	=	0.40
24.10	4.00	x	0.100	=	0.40
24.20	4.00	x	0.100	=	0.40
24.30	4.00	x	0.100	=	0.40
24.40	4.00	x	0.100	=	0.40
24.50	3.00	x	0.100	=	0.30
24.60	3.00	x	0.100	=	0.30
24.70	3.00	x	0.100	=	0.30
24.80	3.00	x	0.100	=	0.30
24.90	2.00	x	0.100	=	0.20
25.00	2.00	x	0.100	=	0.20
25.10	2.00	x	0.100	=	0.20
25.20	2.00	x	0.100	=	0.20
25.30	2.00	x	0.100	=	0.20
25.40	1.00	x	0.100	=	0.10
25.50	1.00	x	0.100	=	0.10
25.60	1.00	x	0.100	=	0.10
25.70	1.00	x	0.100	=	0.10
25.80	0.00	x	0.100	=	0.00
25.90	0.00	x	0.100	=	0.00

Date: 8-30-96
Project: CREST VIEW
Project #: 95-098
By: SAA

Taylor Engineering, Inc.
Civil Design and Land Planning

- ○ Note to file
- ○ Telephone conv.
- ○ Meeting Notes
- ○ Field Report
- ◉ Calcs. Chkd. _____

DETERMINE THE OUTFLOW FROM THE INFILTRATION GALLERY:

→ DESIGN IS PER THE "STORMWATER MANAGEMENT MANUAL FOR THE PUGET SOUND BASIN" (PAGE III-3-16, FEB. 1992)

$Q = KiA_s$ WHERE Q = OUTFLOW

$K = 30$ FT/DAY *

$i = 1$

$A_s = 5316$ SF.

$$Q = \left(30 \frac{FT}{DAY}\right)(1)\left(5316\ FT^2\right)\left(\frac{DAY}{24\ HR.}\right)\left(\frac{HR}{60\ MIN.}\right)\left(\frac{MIN}{60\ SEC.}\right)$$

$$Q = 1.85 \frac{FT^3}{SEC}$$

→ USE A SAFETY FACTOR OF 2:

$$Q_{SF} = \frac{1.85 \frac{ft^3}{SEC}}{2}$$

$$\boxed{Q_{SF} = 0.93 \frac{FT^3}{SEC}}$$

* PER GEOTECHNICAL REPORT BY BUDINGER & ASSOCIATES (9-29-95) SEE ATTACHED REPORT

Spokane, WA • 106 W. Mission Ave., 99201 • (509) 328-3371 • FAX 509) 328-8224
Goldendale, WA • 228 W. Columbus, Suite 104, 98620 • (509) 773-4945 • FAX (509) 773-5888

POND-2 Version: 5.16
S/N: 1295130196

Crestview Estates
Developed Condition
Overall Basin - CV5-DV

CALCULATED 08-30-1996 13:40:33
DISK FILE: a:\crestvew\scott\CV5-DV .VOL

Planimeter scale: 1 inch = 1 ft.

Elevation (ft)	Planimeter (sq.in.)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	* Volume (cubic-ft)	Volume Sum (cubic-ft)
79.50	5,316.00	5,316	0	0	0
80.00	6,091.00	6,091	17,097	2,850	2,850
80.50	*I*	6,914	19,495	3,249	6,099
81.00	7,790.00	7,790	20,769	6,923	9,773
81.50	*I*	10,352	27,122	4,520	14,293
82.00	13,278.00	13,278	31,238	10,413	20,185

I ---> Interpolated area from closest two planimeter readings.

$$IA = (sq.rt(Area1) + ((Ei-E1)/(E2-E1))*(sq.rt(Area2)-sq.rt(Area1)))^2$$

where: E1, E2 = Closest two elevations with planimeter data
Ei = Elevation at which to interpolate area
Area1,Area2 = Areas computed for E1, E2, respectively
IA = Interpolated area for Ei

* 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

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

***** COMPOSITE OUTFLOW SUMMARY ****

Elevation (ft)	Q (cfs)	Contributing Structures
79.70	1.3	1
79.80	1.3	1
79.90	1.3	1
80.00	1.3	1 +5
80.10	2.0	1 +5
80.20	2.7	1 +5
80.30	3.3	1 +5
80.40	3.6	1 +5
80.50	3.9	1 +5
80.60	4.2	1 +5
80.70	4.8	1 +5
80.80	5.6	1 +5
80.90	6.3	1 +5
81.00	7.2	1 +5
81.10	8.1	1 +5
81.20	8.6	1 +5
81.30	9.0	1 +5
81.40	9.5	1 +5
81.50	10.2	1 +5
81.60	10.8	1 +5
81.70	11.4	1 +5
81.80	11.7	1 +5
81.90	12.0	1 +5
82.00	12.3	1 +5

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

Outlet Structure File: a:\crestvew\scott\CV-DV18 .STR
Planimeter Input File: a:\crestvew\scott\CV5-DV .VOL
Rating Table Output File: a:\crestvew\scott\CV5-DV .PND

Min. Elev.(ft) = 79.7 Max. Elev.(ft) = 82 Incr.(ft) = .1

Additional elevations (ft) to be included in table:
* *

****
SYSTEM CONNECTIVITY
****

Structure	No.	Q Table		Q Table
TABLE	1		->	1
TABLE	5		->	5

Outflow rating table summary was stored in file:
a:\crestvew\scott\CV5-DV .PND

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

>>>>>> Structure No. 1 <<<<<<
(Input Data)

TABLE
Input your own rating table.
E1 (ft) =79.6 E2 (ft) = 82.001

Constant (ft) added to each elevation was:

Elev. (ft)	Q (cfs)
79.7	1.33
82	1.33

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

>>>>>> Structure No. 5 <<<<<<
(Input Data)

TABLE
Input your own rating table.
E1 (ft) =80.0 E2 (ft) = 82.001

Constant (ft) added to each elevation was:

Elev. (ft)	Q (cfs)
80	0
80.3	2
80.64	3
80.90000000000001	5
81.13	7
81.38	8
81.67	10
82.02	11
82.14	12
82.25	12.5

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

Outflow Rating Table for Structure #1
TABLE Input your own rating table.

Elevation (ft)	Q (cfs)	Computation Messages
79.70	1.3	
79.80	1.3	Interpolated from input table
79.90	1.3	Interpolated from input table
80.00	1.3	Interpolated from input table
80.10	1.3	Interpolated from input table
80.20	1.3	Interpolated from input table
80.30	1.3	Interpolated from input table
80.40	1.3	Interpolated from input table
80.50	1.3	Interpolated from input table
80.60	1.3	Interpolated from input table
80.70	1.3	Interpolated from input table
80.80	1.3	Interpolated from input table
80.90	1.3	Interpolated from input table
81.00	1.3	Interpolated from input table
81.10	1.3	Interpolated from input table
81.20	1.3	Interpolated from input table
81.30	1.3	Interpolated from input table
81.40	1.3	Interpolated from input table
81.50	1.3	Interpolated from input table
81.60	1.3	Interpolated from input table
81.70	1.3	Interpolated from input table
81.80	1.3	Interpolated from input table
81.90	1.3	Interpolated from input table
82.00	1.3	

Outlet Structure File: CV-DV18 .STR

POND-2 Version: 5.16 S/N: 1295130196
Date Executed: Time Executed:

****
Crestview Estates
Developed Condition
Flow through 18" RCP Culvert and Gravel Galleries
Overflow road @ Elevation 82.2
****

Outflow Rating Table for Structure #5
TABLE Input your own rating table.

Elevation (ft)	Q (cfs)	Computation Messages
79.70	0.0	E < E1=80.0
79.80	0.0	E < E1=80.0
79.90	0.0	E < E1=80.0
80.00	0.0	
80.10	0.7	Interpolated from input table
80.20	1.3	Interpolated from input table
80.30	2.0	
80.40	2.3	Interpolated from input table
80.50	2.6	Interpolated from input table
80.60	2.9	Interpolated from input table
80.70	3.5	Interpolated from input table
80.80	4.2	Interpolated from input table
80.90	5.0	
81.00	5.9	Interpolated from input table
81.10	6.7	Interpolated from input table
81.20	7.3	Interpolated from input table
81.30	7.7	Interpolated from input table
81.40	8.1	Interpolated from input table
81.50	8.8	Interpolated from input table
81.60	9.5	Interpolated from input table
81.70	10.1	Interpolated from input table
81.80	10.4	Interpolated from input table
81.90	10.7	Interpolated from input table
82.00	10.9	Interpolated from input table

****
*
* Crestview Estates *
* Developed Condition *
* Flow through 18" RCP Culvert and Gravel Galleries *
* Overflow road @ Elevation 82.2 *
*
****

Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Rating Table file: a:\crestvew\scott\CV5-DV .PND

----INITIAL CONDITIONS----
Elevation = 79.70 ft
Outflow = 1.30 cfs
Storage = 1,093 cu-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (cu-ft)	2S/t (cfs)	2S/t + O (cfs)
79.70	1.3	1,093	6.1	7.4
79.80	1.3	1,663	9.2	10.5
79.90	1.3	2,249	12.5	13.8
80.00	1.3	2,850	15.8	17.1
80.10	2.0	3,467	19.3	21.3
80.20	2.7	4,100	22.8	25.5
80.30	3.3	4,749	26.4	29.7
80.40	3.6	5,416	30.1	33.7
80.50	3.9	6,099	33.9	37.8
80.60	4.2	6,799	37.8	42.0
80.70	4.8	7,516	41.8	46.6
80.80	5.6	8,250	45.8	51.4
80.90	6.3	9,003	50.0	56.3
81.00	7.2	9,773	54.3	61.5
81.10	8.1	10,575	58.8	66.9
81.20	8.6	11,428	63.5	72.1
81.30	9.0	12,331	68.5	77.5
81.40	9.5	13,285	73.8	83.3
81.50	10.2	14,293	79.4	89.6
81.60	10.8	15,356	85.3	96.1
81.70	11.4	16,475	91.5	102.9
81.80	11.7	17,652	98.1	109.8
81.90	12.0	18,888	104.9	116.9
82.00	12.3	20,185	112.1	124.4

Time increment (t) = 0.100 hrs.

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
11.000	0.00	-----	4.8	7.4	1.30	79.70
11.100	0.00	0.0	3.1	4.8	0.84	79.70
11.200	0.00	0.0	2.0	3.1	0.54	79.70
11.300	0.00	0.0	1.3	2.0	0.35	79.70
11.400	0.00	0.0	0.8	1.3	0.23	79.70
11.500	0.00	0.0	0.5	0.8	0.15	79.70
11.600	0.00	0.0	0.4	0.5	0.10	79.70
11.700	0.00	0.0	0.2	0.4	0.06	79.70
11.800	0.00	0.0	0.1	0.2	0.04	79.70
11.900	0.00	0.0	0.1	0.1	0.03	79.70
12.000	0.30	0.3	0.3	0.4	0.07	79.70
12.100	2.00	2.3	1.7	2.6	0.45	79.70
12.200	6.00	8.0	7.1	9.7	1.30	79.77
12.300	12.30	18.3	20.0	25.4	2.68	80.20
12.400	17.30	29.6	39.0	49.6	5.30	80.76
12.500	18.00	35.3	56.8	74.3	8.76	81.24
12.600	15.90	33.9	70.1	90.7	10.30	81.52
12.700	12.70	28.6	76.6	98.7	11.03	81.64
12.800	10.30	23.0	77.4	99.6	11.11	81.65
12.900	8.70	19.0	74.8	96.4	10.83	81.60
13.000	7.10	15.8	70.0	90.6	10.29	81.51
13.100	6.20	13.3	64.3	83.3	9.50	81.40
13.200	5.40	11.6	58.1	75.9	8.88	81.27
13.300	4.90	10.3	51.9	68.4	8.25	81.13
13.400	4.40	9.3	46.9	61.2	7.15	80.99
13.500	4.10	8.5	43.1	55.4	6.17	80.88
13.600	3.80	7.9	39.9	51.0	5.52	80.79
13.700	3.60	7.4	37.5	47.3	4.93	80.72
13.800	3.40	7.0	35.4	44.5	4.53	80.65
13.900	3.20	6.6	33.6	42.0	4.21	80.60
14.000	3.10	6.3	31.8	39.9	4.05	80.55
14.100	3.00	6.1	30.1	37.9	3.91	80.50
14.200	2.80	5.8	28.4	35.9	3.76	80.45
14.300	2.70	5.5	26.6	33.9	3.61	80.40
14.400	2.60	5.3	25.0	31.9	3.47	80.36
14.500	2.50	5.1	23.4	30.1	3.33	80.31
14.600	2.40	4.9	22.1	28.3	3.11	80.27
14.700	2.40	4.8	21.1	26.9	2.91	80.23
14.800	2.30	4.7	20.3	25.8	2.75	80.21
14.900	2.20	4.5	19.6	24.8	2.59	80.18
15.000	2.20	4.4	19.1	24.0	2.46	80.17
15.100	2.20	4.4	18.8	23.5	2.37	80.15
15.200	2.10	4.3	18.5	23.1	2.30	80.14
15.300	2.10	4.2	18.2	22.7	2.23	80.13
15.400	2.00	4.1	18.0	22.3	2.17	80.12

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
15.500	2.00	4.0	17.7	22.0	2.12	80.12
15.600	2.00	4.0	17.6	21.7	2.08	80.11
15.700	2.00	4.0	17.5	21.6	2.05	80.11
15.800	1.90	3.9	17.3	21.4	2.02	80.10
15.900	1.90	3.8	17.2	21.1	1.98	80.10
16.000	1.90	3.8	17.1	21.0	1.95	80.09
16.100	1.90	3.8	17.0	20.9	1.93	80.09
16.200	1.80	3.7	16.9	20.7	1.91	80.09
16.300	1.80	3.6	16.8	20.5	1.87	80.08
16.400	1.70	3.5	16.6	20.3	1.83	80.08
16.500	1.70	3.4	16.4	20.0	1.79	80.07
16.600	1.70	3.4	16.3	19.8	1.76	80.07
16.700	1.60	3.3	16.2	19.6	1.72	80.06
16.800	1.60	3.2	16.0	19.4	1.68	80.05
16.900	1.50	3.1	15.8	19.1	1.64	80.05
17.000	1.50	3.0	15.7	18.8	1.59	80.04
17.100	1.50	3.0	15.5	18.7	1.56	80.04
17.200	1.50	3.0	15.5	18.5	1.54	80.03
17.300	1.50	3.0	15.4	18.5	1.53	80.03
17.400	1.50	3.0	15.4	18.4	1.52	80.03
17.500	1.50	3.0	15.4	18.4	1.51	80.03
17.600	1.50	3.0	15.3	18.4	1.51	80.03
17.700	1.50	3.0	15.3	18.3	1.50	80.03
17.800	1.40	2.9	15.3	18.2	1.49	80.03
17.900	1.40	2.8	15.1	18.1	1.46	80.02
18.000	1.40	2.8	15.1	17.9	1.44	80.02
18.100	1.40	2.8	15.0	17.9	1.42	80.02
18.200	1.40	2.8	15.0	17.8	1.42	80.02
18.300	1.30	2.7	14.9	17.7	1.39	80.01
18.400	1.30	2.6	14.8	17.5	1.36	80.01
18.500	1.30	2.6	14.7	17.4	1.34	80.01
18.600	1.30	2.6	14.6	17.3	1.33	80.00
18.700	1.30	2.6	14.6	17.2	1.32	80.00
18.800	1.20	2.5	14.5	17.1	1.30	80.00
18.900	1.20	2.4	14.3	16.9	1.30	79.99
19.000	1.20	2.4	14.1	16.7	1.30	79.99
19.100	1.20	2.4	13.9	16.5	1.30	79.98
19.200	1.20	2.4	13.7	16.3	1.30	79.98
19.300	1.20	2.4	13.5	16.1	1.30	79.97
19.400	1.20	2.4	13.3	15.9	1.30	79.96
19.500	1.20	2.4	13.1	15.7	1.30	79.96
19.600	1.10	2.3	12.8	15.4	1.30	79.95
19.700	1.10	2.2	12.4	15.0	1.30	79.94
19.800	1.10	2.2	12.0	14.6	1.30	79.92
19.900	1.10	2.2	11.6	14.2	1.30	79.91
20.000	1.10	2.2	11.2	13.8	1.30	79.90

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
20.100	1.10	2.2	10.8	13.4	1.30	79.89
20.200	1.10	2.2	10.4	13.0	1.30	79.88
20.300	1.10	2.2	10.0	12.6	1.30	79.86
20.400	1.10	2.2	9.6	12.2	1.30	79.85
20.500	1.00	2.1	9.1	11.7	1.30	79.84
20.600	1.00	2.0	8.5	11.1	1.30	79.82
20.700	1.00	2.0	7.9	10.5	1.30	79.80
20.800	1.00	2.0	7.3	9.9	1.30	79.78
20.900	1.00	2.0	6.7	9.3	1.30	79.76
21.000	1.00	2.0	6.1	8.7	1.30	79.74
21.100	1.00	2.0	5.5	8.1	1.30	79.72
21.200	1.00	2.0	4.9	7.5	1.30	79.70
21.300	1.00	2.0	4.5	6.9	1.22	79.70
21.400	1.00	2.0	4.2	6.5	1.14	79.70
21.500	1.00	2.0	4.0	6.2	1.09	79.70
21.600	0.90	1.9	3.8	5.9	1.04	79.70
21.700	0.90	1.8	3.6	5.6	0.99	79.70
21.800	0.90	1.8	3.5	5.4	0.96	79.70
21.900	0.90	1.8	3.4	5.3	0.94	79.70
22.000	0.90	1.8	3.4	5.2	0.92	79.70
22.100	0.90	1.8	3.4	5.2	0.92	79.70
22.200	0.90	1.8	3.3	5.2	0.91	79.70
22.300	0.80	1.7	3.3	5.0	0.89	79.70
22.400	0.80	1.6	3.1	4.9	0.86	79.70
22.500	0.80	1.6	3.1	4.7	0.84	79.70
22.600	0.80	1.6	3.0	4.7	0.82	79.70
22.700	0.70	1.5	2.9	4.5	0.80	79.70
22.800	0.70	1.4	2.8	4.3	0.76	79.70
22.900	0.70	1.4	2.7	4.2	0.74	79.70
23.000	0.70	1.4	2.7	4.1	0.73	79.70
23.100	0.70	1.4	2.6	4.1	0.72	79.70
23.200	0.60	1.3	2.5	3.9	0.69	79.70
23.300	0.60	1.2	2.4	3.7	0.66	79.70
23.400	0.60	1.2	2.3	3.6	0.64	79.70
23.500	0.60	1.2	2.3	3.5	0.63	79.70
23.600	0.50	1.1	2.2	3.4	0.60	79.70
23.700	0.50	1.0	2.1	3.2	0.56	79.70
23.800	0.50	1.0	2.0	3.1	0.54	79.70
23.900	0.50	1.0	1.9	3.0	0.53	79.70
24.000	0.40	0.9	1.8	2.8	0.50	79.70
24.100	0.40	0.8	1.7	2.6	0.46	79.70
24.200	0.40	0.8	1.6	2.5	0.44	79.70
24.300	0.40	0.8	1.6	2.4	0.43	79.70
24.400	0.40	0.8	1.5	2.4	0.42	79.70
24.500	0.30	0.7	1.4	2.2	0.39	79.70
24.600	0.30	0.6	1.3	2.0	0.36	79.70

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (hrs)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
24.700	0.30	0.6	1.2	1.9	0.34	79.70
24.800	0.30	0.6	1.2	1.8	0.33	79.70
24.900	0.20	0.5	1.1	1.7	0.30	79.70
25.000	0.20	0.4	1.0	1.5	0.26	79.70
25.100	0.20	0.4	0.9	1.4	0.24	79.70
25.200	0.20	0.4	0.8	1.3	0.23	79.70
25.300	0.20	0.4	0.8	1.2	0.22	79.70
25.400	0.10	0.3	0.7	1.1	0.19	79.70
25.500	0.10	0.2	0.6	0.9	0.16	79.70
25.600	0.10	0.2	0.5	0.8	0.14	79.70
25.700	0.10	0.2	0.5	0.7	0.13	79.70
25.800	0.00	0.1	0.4	0.6	0.10	79.70
25.900	0.00	0.0	0.2	0.4	0.06	79.70

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD

Starting Pond W.S. Elevation = 79.70 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	18.00 cfs
Peak Outflow	=	11.11 cfs
Peak Elevation	=	81.65 ft

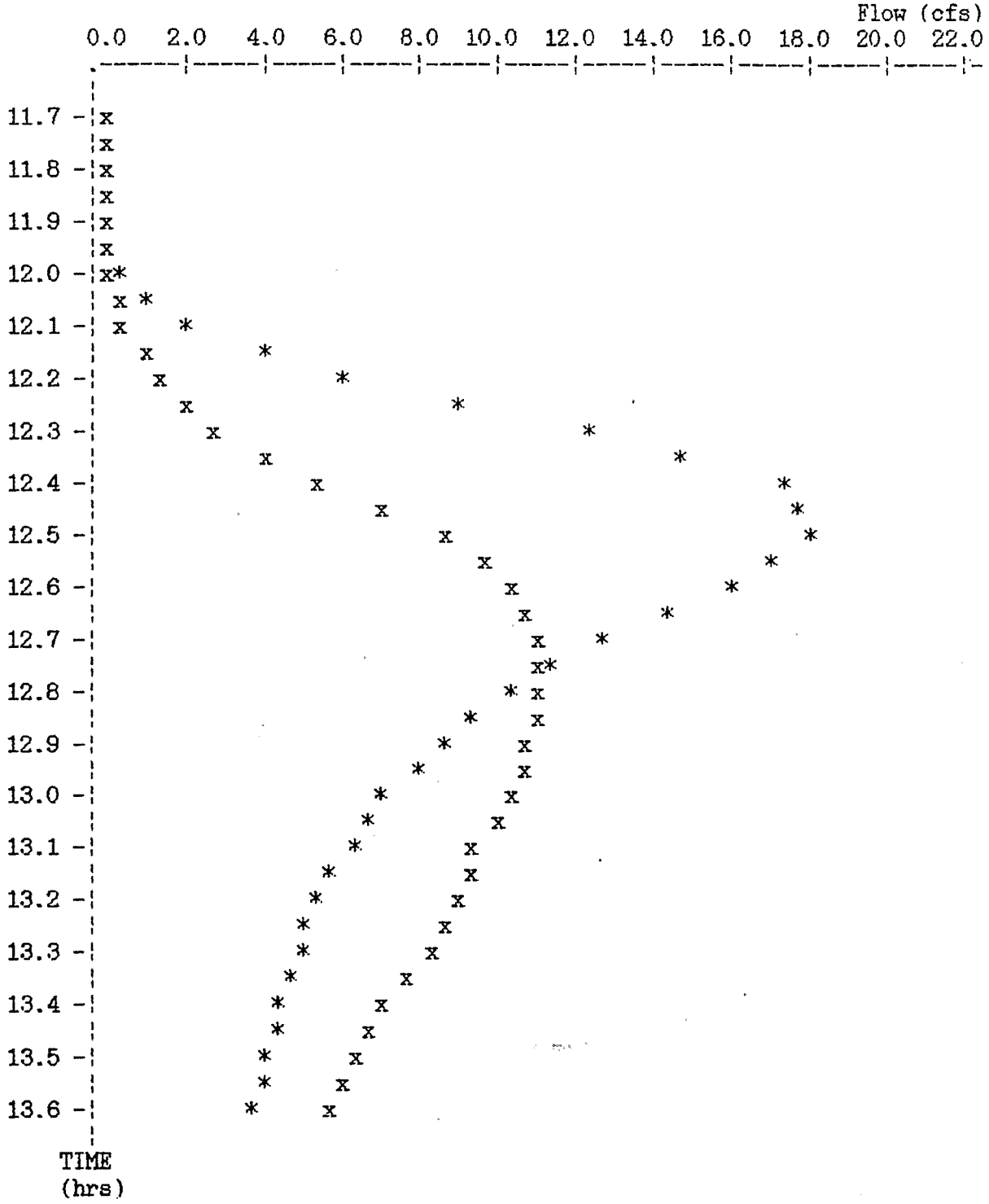
***** Summary of Approximate Peak Storage *****

Initial Storage	=	1,093 cu-ft
Peak Storage From Storm	=	14,839 cu-ft
Total Storage in Pond	=	15,933 cu-ft

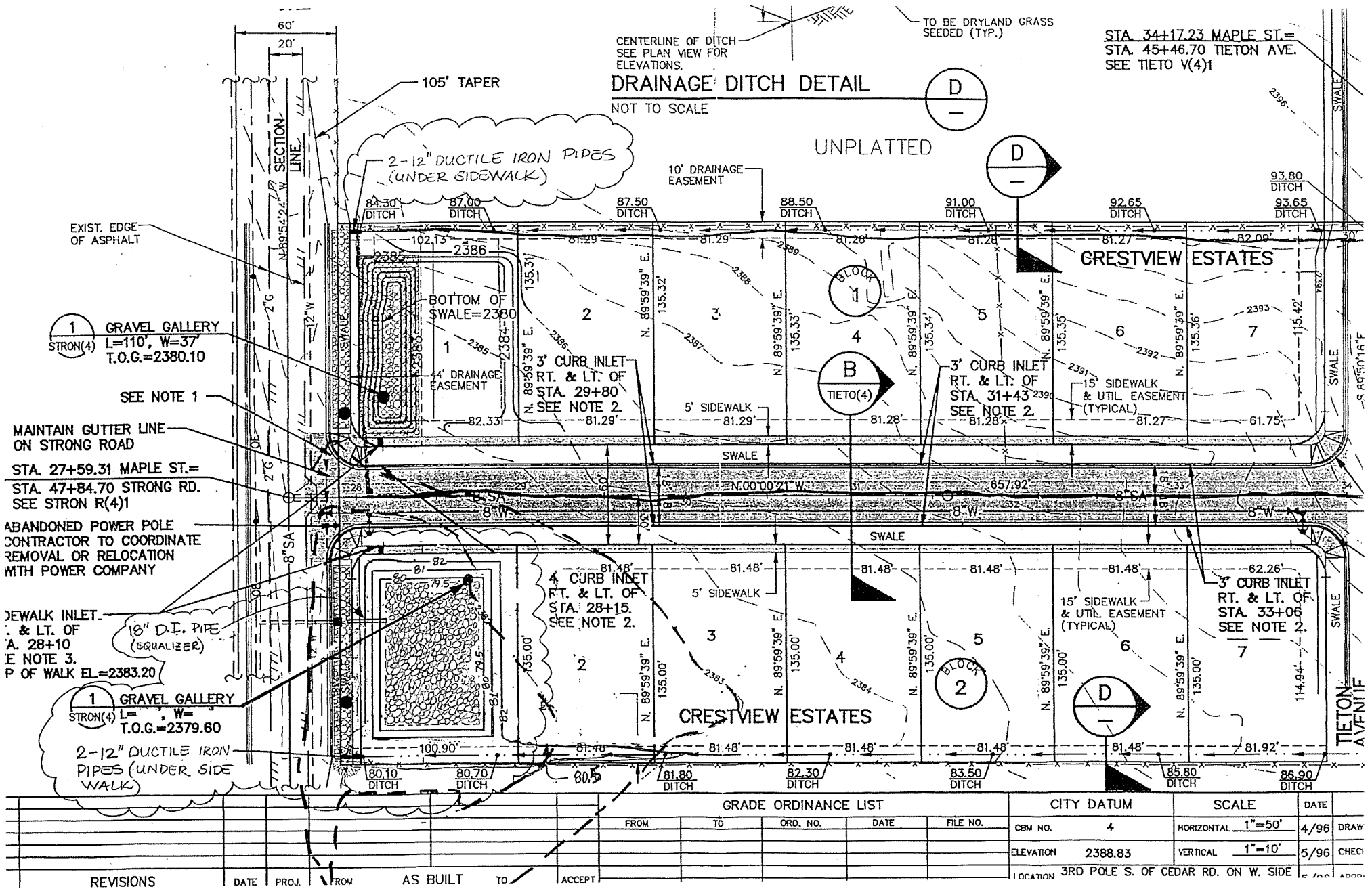
>>>>> Warning, initial pond outflow > 1st inflow ordinate. <<<<<

Pond File: a:\crestvew\scott\CV5-DV .PND
Inflow Hydrograph: a:\crestvew\scott\E-PH1 .HYD
Outflow Hydrograph: a:\crestvew\scott\OUT .HYD
EXECUTED: 08-30-1996
13:47:50

Peak Inflow = 18.00 cfs
Peak Outflow = 11.11 cfs
Peak Elevation = 81.65 ft



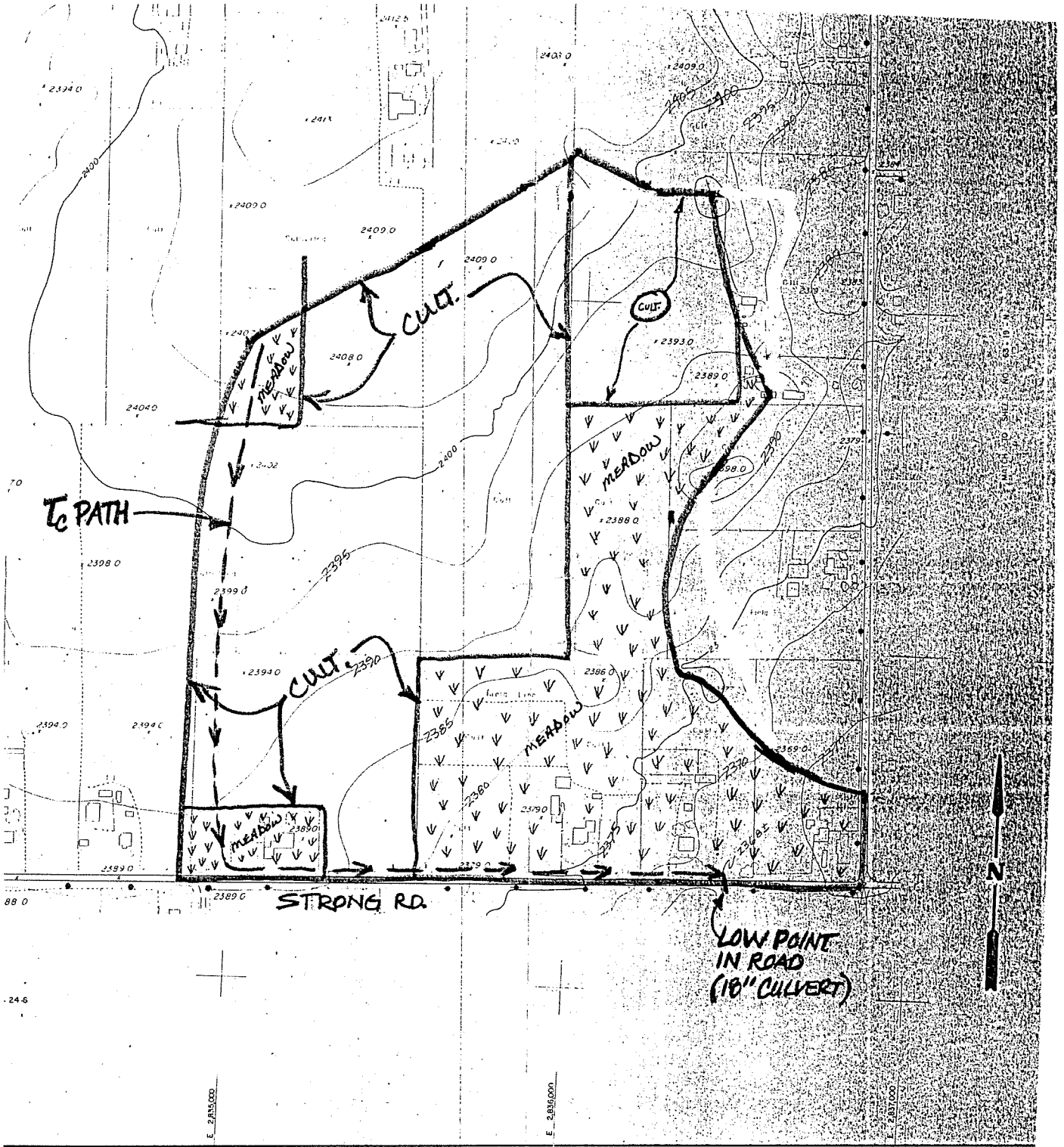
* File: a:\crestvew\scott\E-PH1 .HYD Qmax = 18.0 cfs
x File: a:\crestvew\scott\OUT .HYD Qmax = 11.1 cfs



GRADE ORDINANCE LIST				
FROM	TO	ORD. NO.	DATE	FILE NO.

CITY DATUM		SCALE		DATE	
CBM NO.	4	HORIZONTAL	1"=50'	4/96	DRAW
ELEVATION	2388.83	VERTICAL	1"=10'	5/96	CHEC
LOCATION	3RD POLE S. OF CEDAR RD. ON W. SIDE				APPR

REVISIONS	DATE	PROJ.	FROM	AS BUILT	TO	ACCEPT



JOHN W. ARRASMITH
COUNTY ROAD ENGINEER

DATUM: USC & GS

DATE OF PHOTOGRAPHY: 9-16-67

SCALE: 1" = 200'