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Tatum Wash Sedimentation Study
Final Report
Technical Appendix

January 22, 1997

Prepared for: **Flood Control District of Maricopa County**
Planning Division
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HYDROLOGIC MODELING - HEC-1

Tatum Wash Discretized Hydrographs

100-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	70	215	0.149	21
2	2000	50	0.035	138
3	200	100	0.069	28
4	20	170	0.118	5
		Total Volume (AF) =		191
		HEC-1 Volume (AF) =		189
		Percent Difference =		-0.9

50-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	70	215	0.149	21
2	1500	50	0.035	103
3	150	100	0.069	21
4	40	190	0.132	10
		Total Volume (AF) =		155
		HEC-1 Volume (AF) =		156
		Percent Difference =		0.5

10-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	40	220	0.153	12
2	750	50	0.035	52
3	150	100	0.069	21
4	20	170	0.118	5
		Total Volume (AF) =		89
		HEC-1 Volume (AF) =		89
		Percent Difference =		-0.1

2-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	30	211	0.147	9
2	300	50	0.035	21
3	40	250	0.174	14
		Total Volume (AF) =		43
		HEC-1 Volume (AF) =		42
		Percent Difference =		-2.7

Phase 2 Phoenix Mountain Preserve Basin Outflow

Q100

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	10	200	0.139	3
2	500	150	0.104	103
3	170	250	0.174	59
4	5	700	0.486	5
		Total Volume (AF) =		169
		HEC-1 Volume (AF) =		168
		Percent Difference =		-0.8

50-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	15	200	0.139	4
2	400	150	0.104	83
3	130	250	0.174	45
4	10	630	0.438	9
		Total Volume (AF) =		140
		HEC-1 Volume (AF) =		139
		Percent Difference =		-0.9

10-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	10	200	0.139	3
2	215	150	0.104	44
3	85	250	0.174	29
4	5	600	0.417	4
		Total Volume (AF) =		81
		HEC-1 Volume (AF) =		80
		Percent Difference =		-0.7

2-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	8	200	0.139	2
2	100	150	0.104	21
3	40	250	0.174	14
4	4	500	0.347	3
		Total Volume (AF) =		39
		HEC-1 Volume (AF) =		39
		Percent Difference =		-1.0

HYDRAULIC MODELING - HEC-2

Figure 1. Tatum Wash - Longitudinal Profile

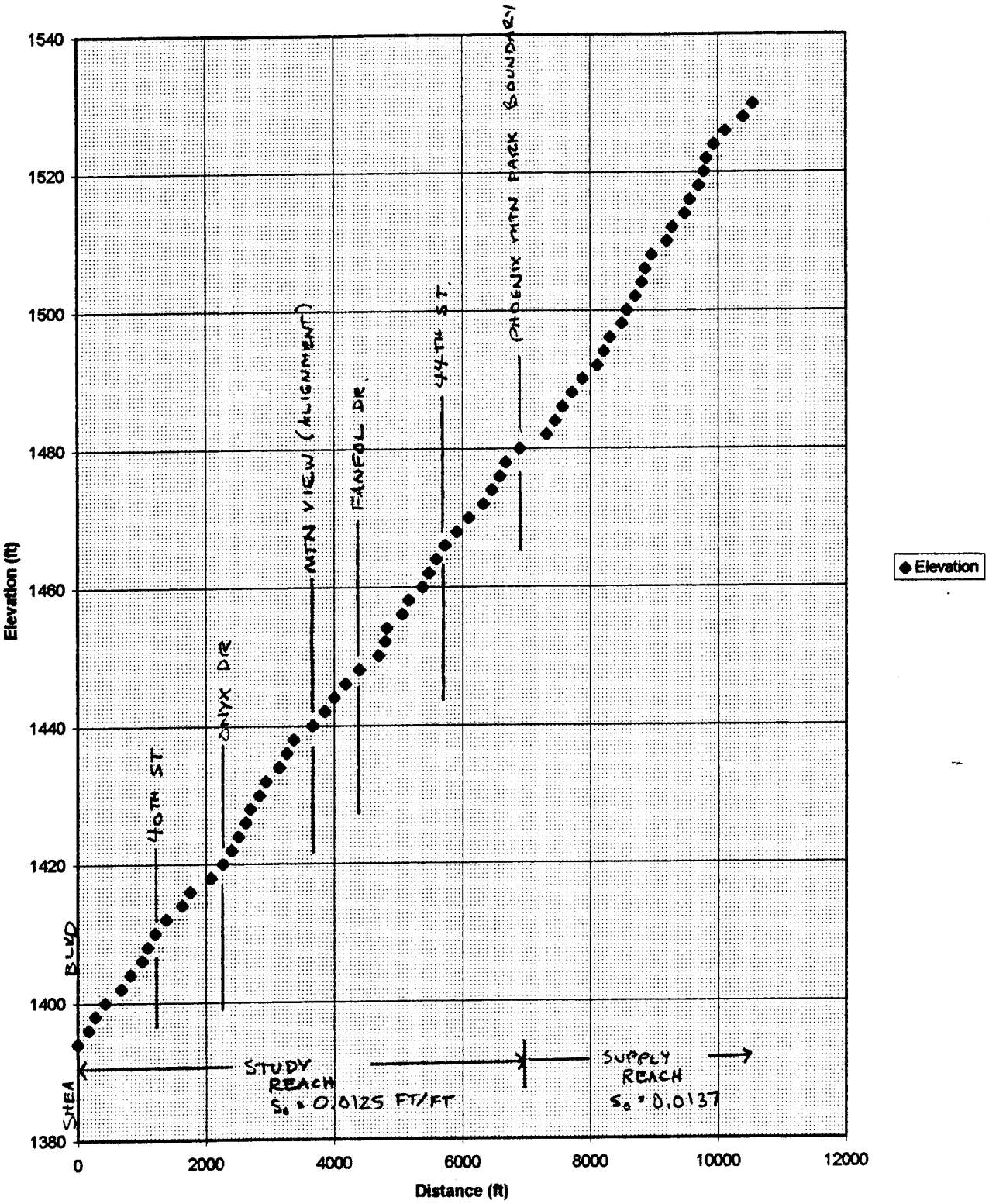


Figure 2. **Tatum Wash**
Shea Blvd. - Xn 7693.8

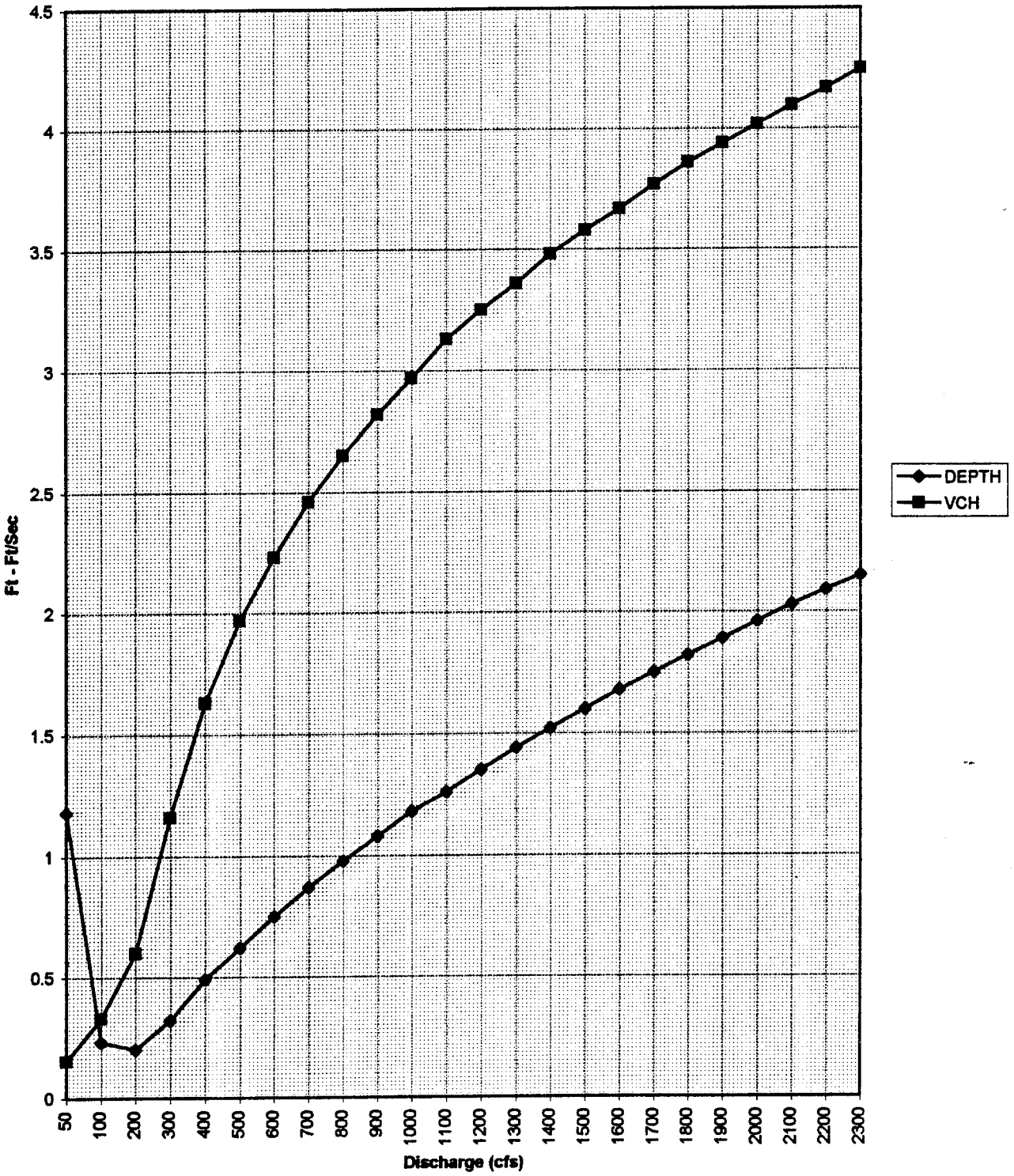


Figure 3. Tatum Wash 44th Street (Downstream) Xn 6573.8

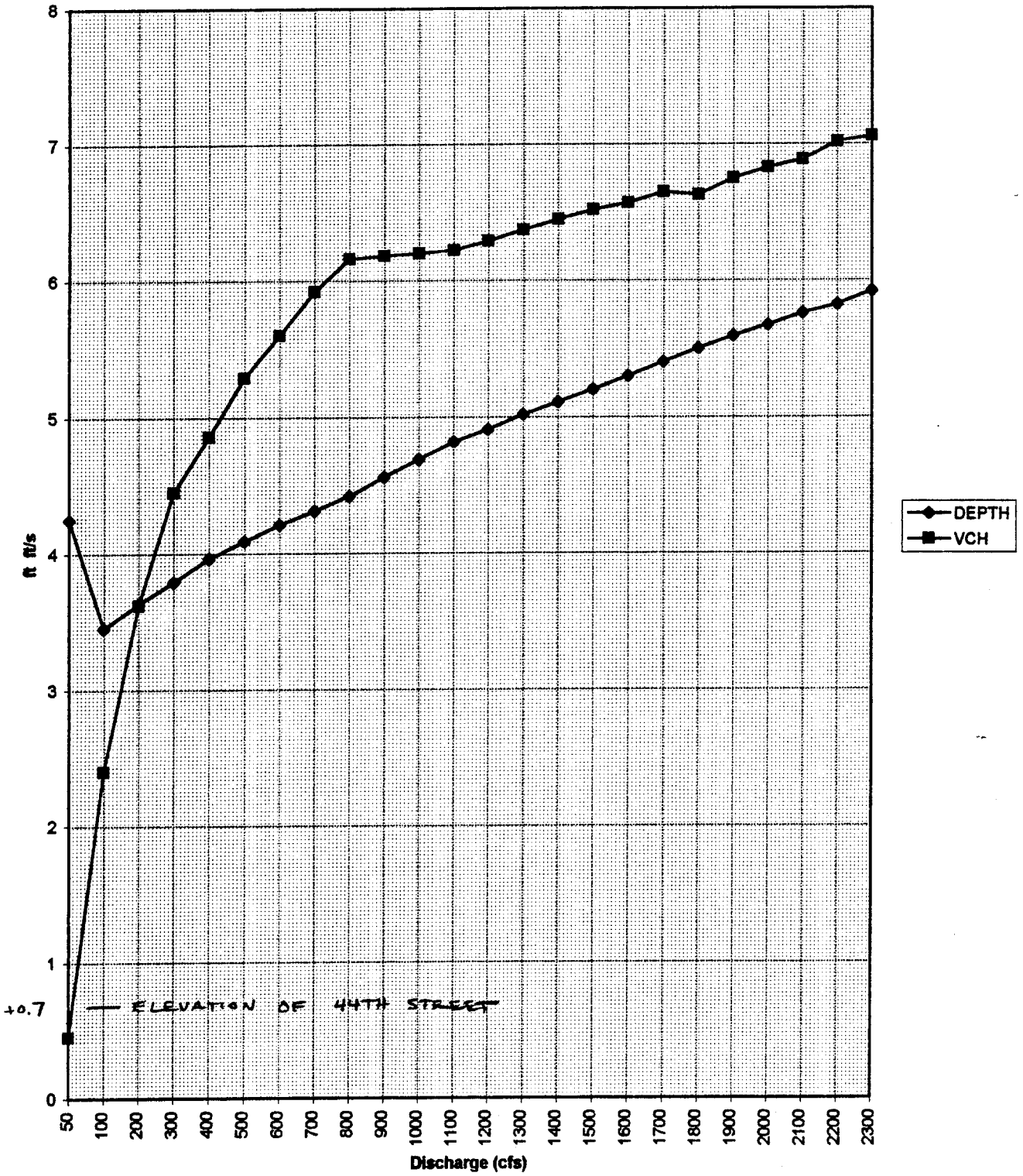


Figure 4. **Tatum Wash 44th St. (Upstream) Xn 6520.8**

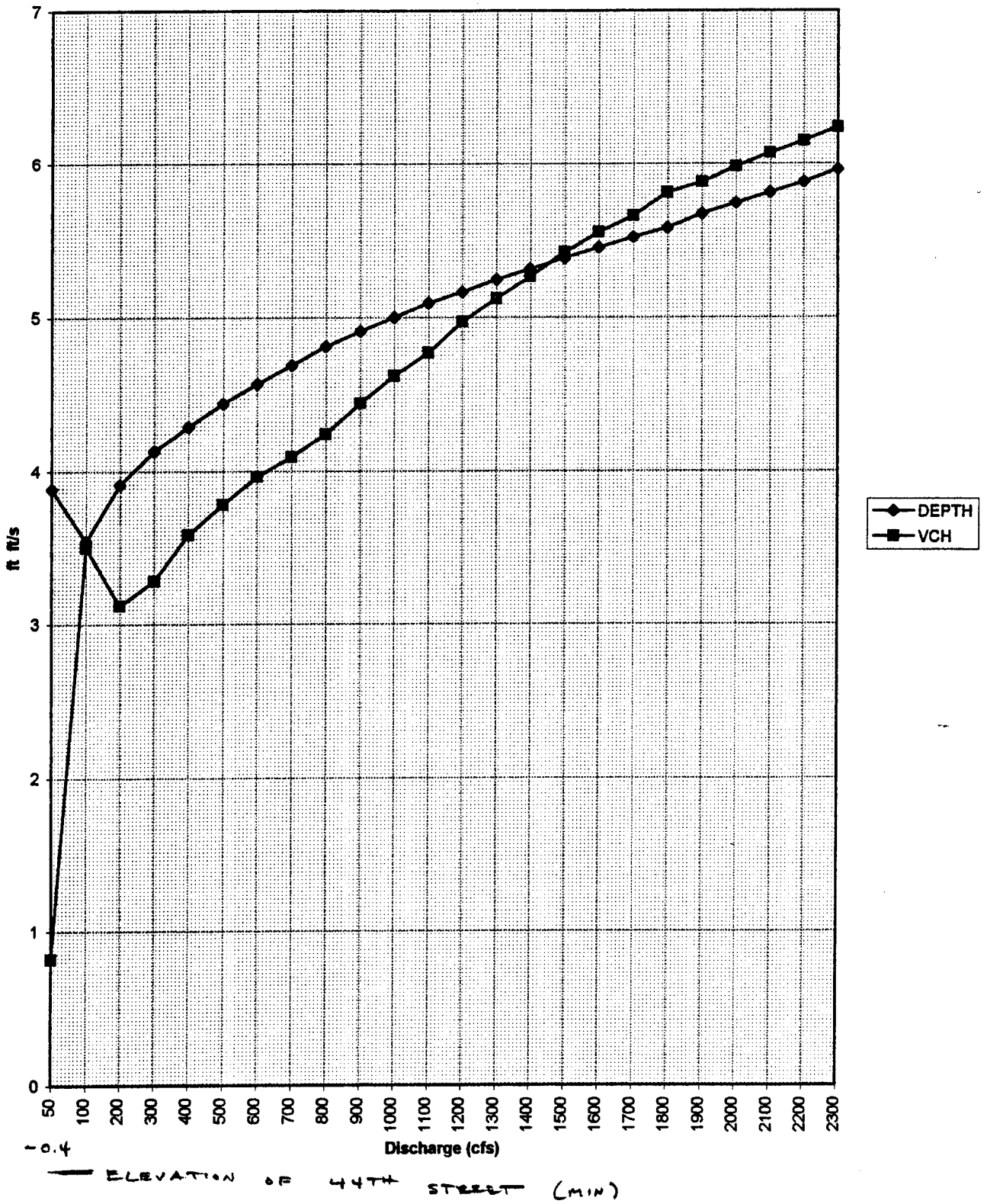


Figure 5. **Tatum Wash Onyx Dr. (Downstream) Xn 5500.8**

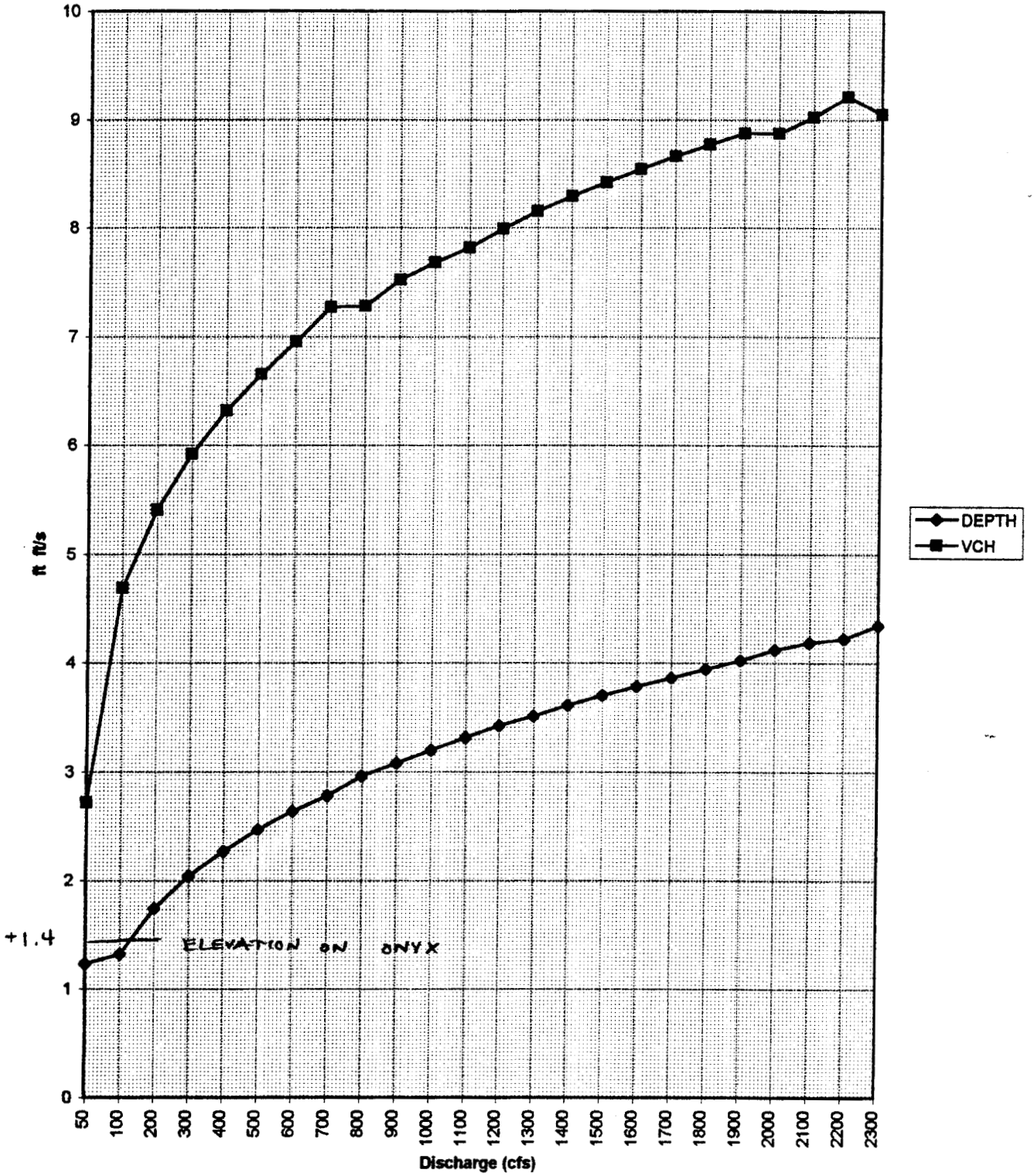


Figure 6. Tatum Wash Onyx Dr. (Upstream) Xn 5460.8

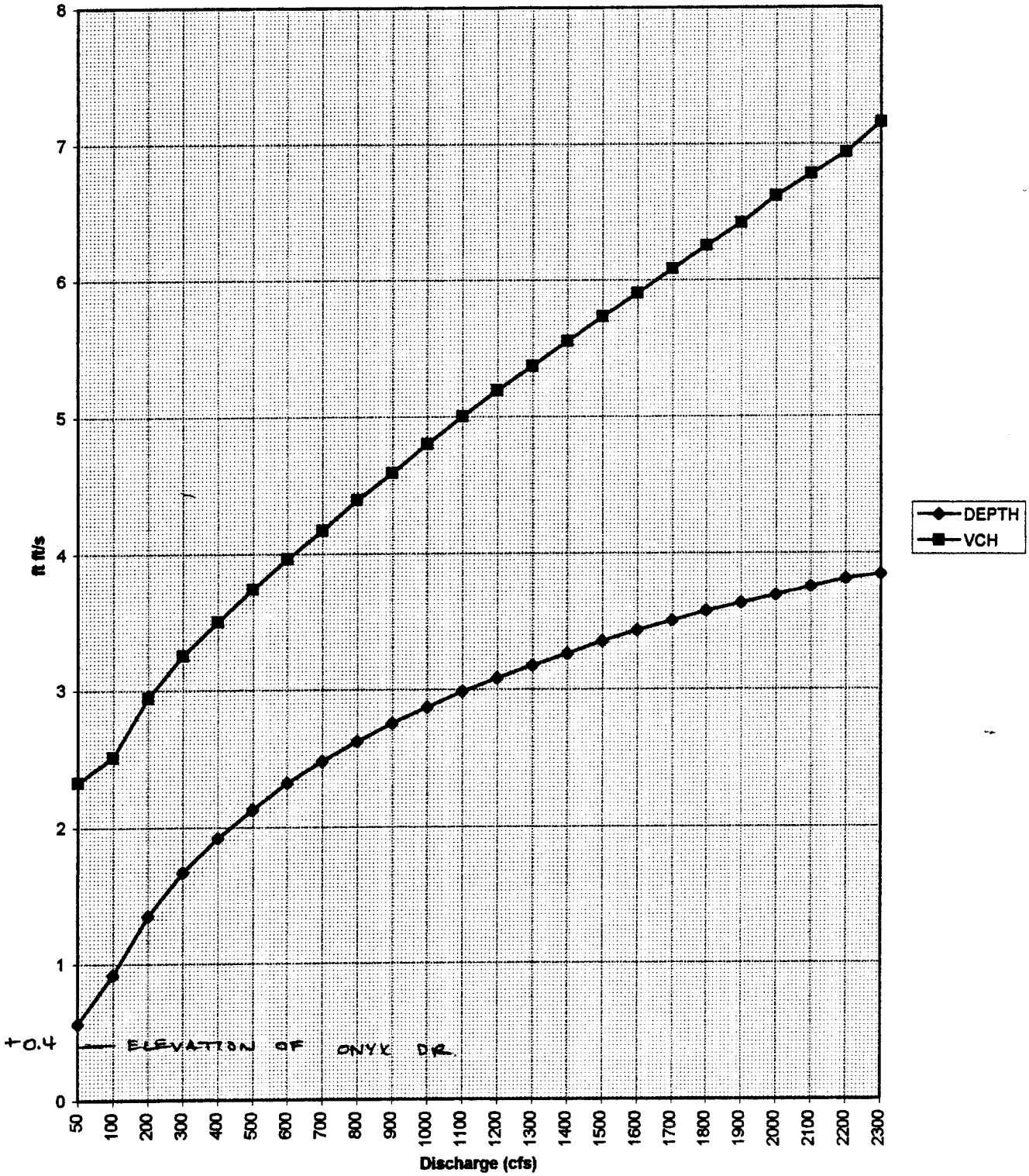


Figure 7. Tatum Wash Fanfol Dr. Xn 3535.8

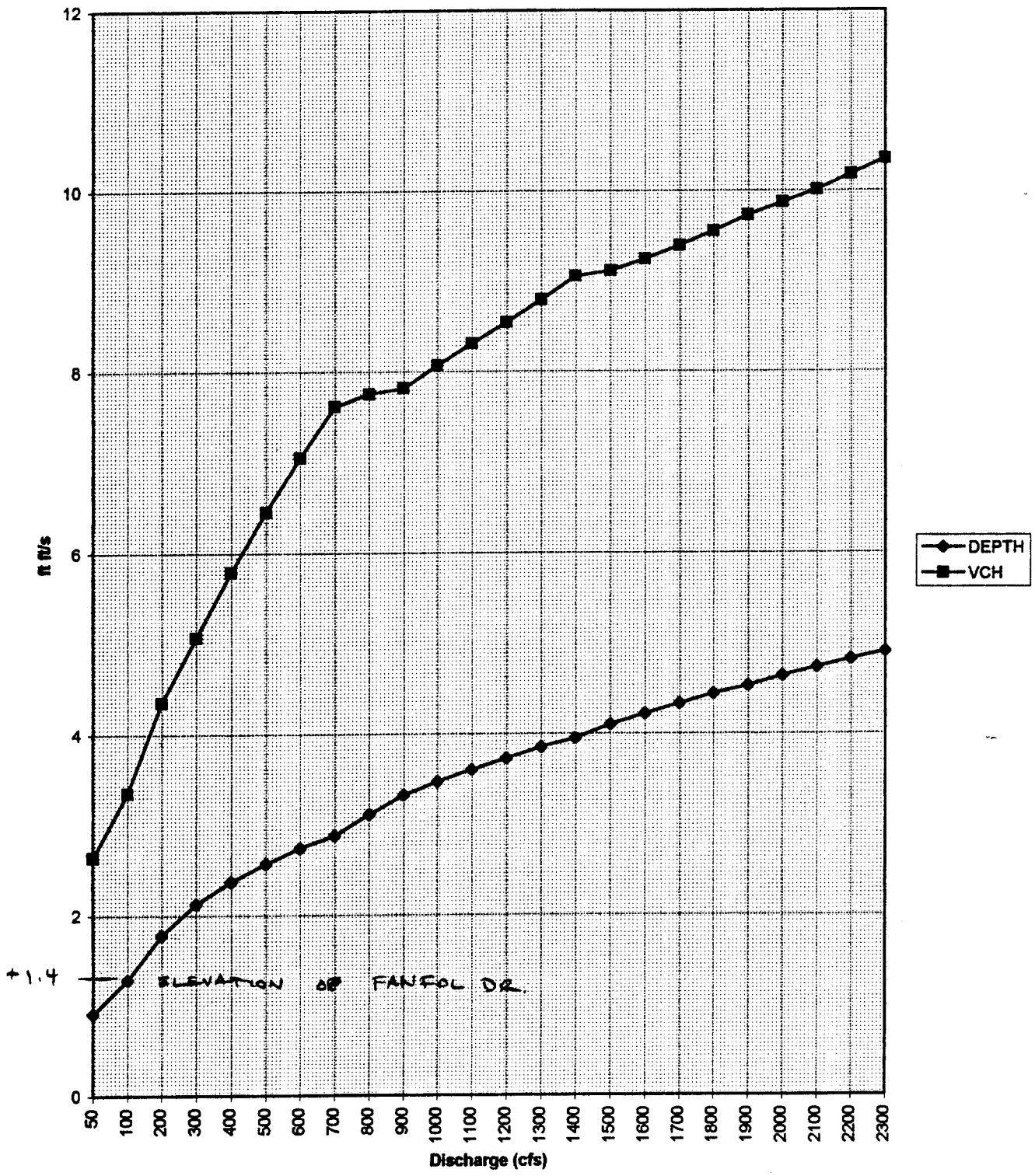
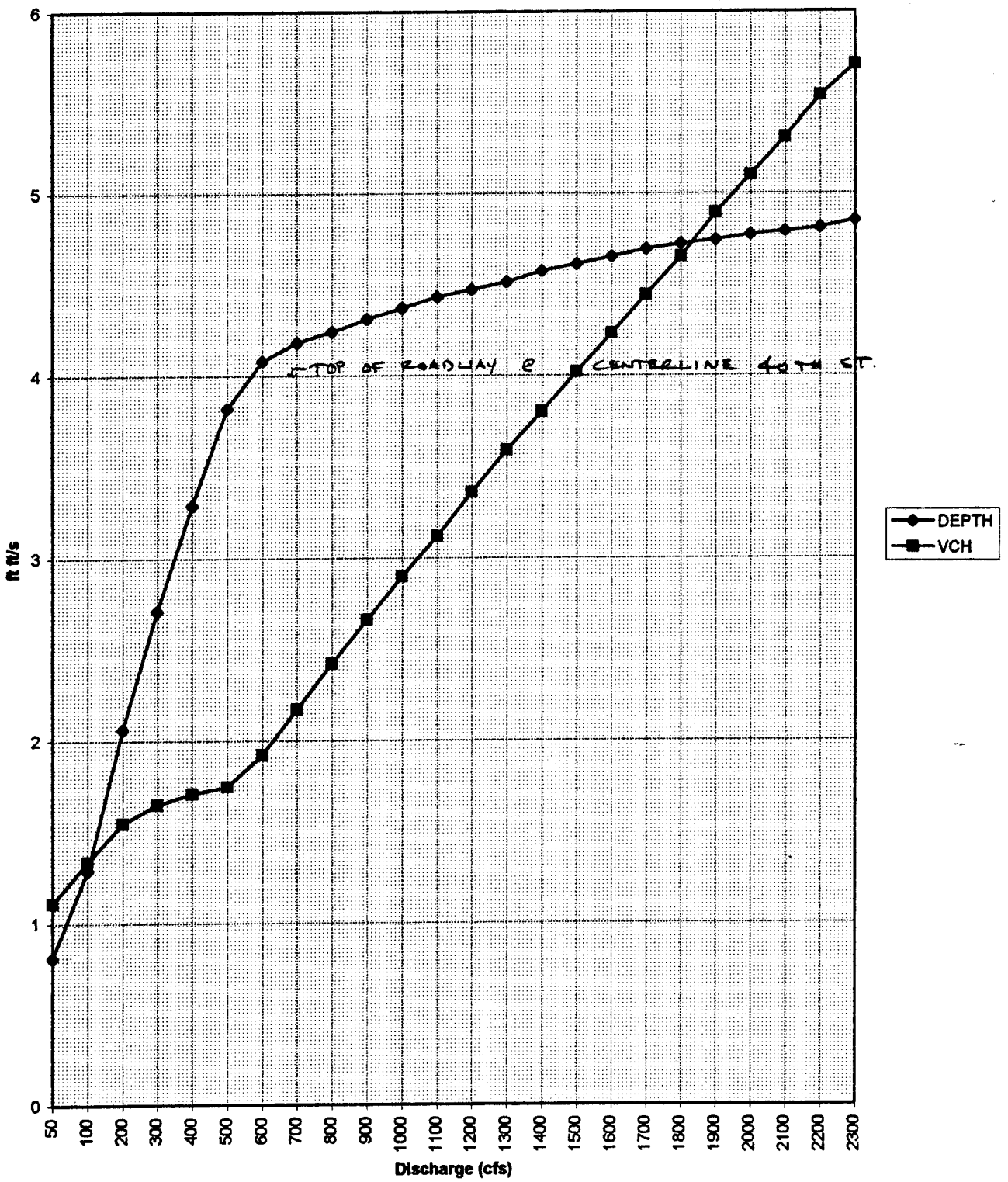


Figure 8. Tatum Wash 40th St. Xn 2215.8



Tatum Wash Sedimentation Study
Additional Cross Section Data from FCDMC Topo/DTM

Section #	Pt.#	X	Y	Xn Dist	CL=1000	Elev	Dist. d/s	Notes
1	1	5757.33	176.83	0	875.4	1478	136.96	
	2	5794.28	155.31	58.47	933.8			L_EFB
	3	5809.9	146.08	83.32	958.7	1476		
	4	5815.83	142.24	93.09	968.5	1474		
	5	5821.99	138.39	103.1	978.5	1472		
	6	5828.92	134.55	113.87	989.2	1470		LB
	7	5835.08	129.94	124.64	1000.0	1468.2		CL
	8	5866.64	110.71	175.43	1050.8	1470		RB
	9	5892.04	94.57	216.97	1092.3	1472		
	10	5907.43	84.57	242.36	1117.7	1472		
	11	5922.06	76.12	265.44	1140.8	1476		
2	1	622.47	5010.85	0	778.9	1480.9	215.17	
	2	706.88	4958.55	136.71	915.6	1480		
	3	712.22	4954.28	146.32	925.2	1478		
	4	718.63	4950.02	156.99	935.9	1476		
	5	722.91	4947.88	163.41	942.3	1474		
	6	729.32	4943.61	174.09	953.0	1472		LB
	7	732.52	4941.48	179.42	958.3	1471		
	8	744.28	4934.01	198.65	977.6	1471		
	9	758.17	4925.47	221.08	1000.0	1470.8		CL
	10	767.78	4919.07	237.09	1016.0	1472		RB
	11	780.61	4911.6	257.39	1036.3	1472		
	12	789.15	4906.26	271.27	1050.2	1476		
	13	796.63	4900.92	284.09	1063.0	1478		
	14	873.5	4852.73	409.15	1188.1	1480.5		
3	1	566	753.59	0	890.0	1484	242.34	
	2	593.18	739.36	41.41	931.4			L_EFB
	3	597.07	738.07	46.59	936.6	1482		
	4	607.43	732.9	62.12	952.1	1480		
	5	625.55	723.85	89.29	979.3	1476		LB
	6	639.79	717.38	110	1000.0	1474		CL
	7	674.75	700.57	161.77	1051.8	1474		
	8	681.22	696.7	172.11	1062.1	1476		RB
	9	704.52	686.35	205.76	1095.8	1484		
	10	752.42	663.08	276.93	1166.9	1485.2		R_EFB
4	1	388.61	559.98	0	794.8	1489	249.51	L_EFB
	2	436.63	538.4	69.6	864.4	1488		
	3	471.44	521.61	121.2	916.0	1486		
	4	495.45	510.82	156	950.8	1480		LB
	5	511.06	502.43	180	974.8	1478		
	6	527.86	494.04	205.19	1000.0	1477.5		CL
	7	537.47	490.44	218.4	1013.2	1478		
	8	549.47	485.64	235.2	1030.0	1480		RB
	9	580.69	468.86	283.2	1078.0	1486		
	10	601.09	459.27	313.19	1108.0	1488		
	11	668.42	427	412.79	1207.6	1489		
5	1	201.57	342.11	0	828.4	1493.5	244.78	
	2	285.6	326.53	99.61	928.0	1492		
	3	319.22	322.93	136.83	965.2	1490		

	4	339.62	319.33	160.83	989.2	1482		LB
	5	348.03	316.93	171.64	1000.0	1480		CL
	6	393.65	309.74	224.45	1052.8	1482		RB
	7	426.06	303.75	262.85	1091.2	1484		
	8	436.86	302.55	274.85	1103.2	1486		
	9	487.28	292.95	334.87	1163.2	1490		
	10	552.11	282.16	410.49	1238.9	1490.8		
6	1	402.15	169.98	0	782.2	1494	137.3	topo bust between CAD sheets (ELEV)
	2	457.34	177.23	62.44	844.6	1490		
	3	499.46	184.49	111.82	894.0	1482		
	4	518.34	184.49	130.7	912.9	1482		
	5	554.65	190.29	172.81	955.0	1482		LB
	6	576.44	193.19	197.5	979.7	1480		
	7	593.87	196.09	217.83	1000.0	1478.5		CL
	8	604.04	196.09	228	1010.2	1480		
	9	617.11	198.99	243.97	1026.1	1482		RB
	10	637.44	201.9	267.21	1049.4	1484		
	11	660.68	204.8	293.35	1075.5	1490		
	12	689.73	207.7	325.3	1107.5	1490.5		
7	1	415.22	32.17	0	684.9	1494	162.0	
	2	461.7	37.97	52.28	737.2	1492		
	3	505.27	43.78	101.66	786.5	1486		
	4	573.53	51.03	177.17	862.0	1484		
	5	589.51	55.38	197.5	882.4	1486		
	6	617.11	59.73	229.45	914.3	1486.2		
	7	640.35	61.18	254.14	939.0	1486		
	8	685.37	66.99	304.97	989.8	1482		LB
	9	694.08	68.44	315.13	1000.0	1480		CL
	10	708.61	71.34	332.56	1017.4	1480		RB
	11	711.51	71.34	335.46	1020.3	1490		
	12	723.13	72.78	348.52	1033.4	1492		
	13	743.47	75.69	371.77	1056.6	1493.5		
8	1	441.37	937.88	0	737.2	1494	257.54	
	2	498.01	904.51	90.01	827.3	1490		
	3	524.15	890.01	130.65	867.9	1488		
	4	548.84	875.5	169.85	907.1	1488.5		
	5	567.72	865.35	198.88	936.1	1488		
	6	585.15	853.74	227.92	965.2	1486		
	7	596.77	849.39	243.89	981.1	1484		LB
	8	608.39	842.14	262.76	1000.0	1483.2		CL
	9	617.11	837.78	275.84	1013.1	1484		RB
	10	618.11	836.78	277.84	1015.1	1490		
	11	628.73	830.53	294.71	1032.0	1492		
	12	638.89	824.73	310.67	1047.9	1494		
9	1	376.73	873.44	0	883.3	1497	201.39	
	2	395.1	835.44	56.37	939.7	1496		
	3	402.97	818.41	81.27	964.6	1490		LB
	4	406.91	806.62	97	980.3	1488		
	5	413.47	793.52	116.66	1000.0	1486		CL
	6	422.65	775.17	144.19	1027.5	1488		RB
	7	433.14	754.21	175.64	1059.0	1489.5		
	8	453.28	711.67	238.32	1121.7	1490		
	9	463.32	691.32	268.71	1152.1	1496		

	10	484.31	646.77	334.25	1217.6	1498		
	11	515.79	578.63	433.87	1317.2	1502		
10	1	202.26	760.76	0	891.2	1500	183.24	
	2	236.37	724.07	70.8	962.0	1492		LB
	3	244.24	714.9	87.84	979.0	1490		
	4	254.73	704.42	108.81	1000.0	1488.6		CL
	5	267.85	690.01	136.34	1027.5	1490		RB
	6	282.28	672.97	167.81	1059.0	1496		
	7	347.87	600.91	305.46	1196.7	1496		
	8	359.68	586.5	331.68	1222.9	1500		
11	1	27.78	624.49	0	791.5	1503	206.12	
	2	75.01	586.5	85.22	876.8	1502		
	3	107.8	557.67	146.84	938.4	1500		
	4	124.86	545.88	175.69	967.2	1492		LB
	5	143.22	531.46	208.47	1000.0	1490.7		CL
	6	153.93	523.6	227.04	1018.6	1492		RB
	7	173.4	505.26	264.85	1056.4	1494		
	8	186.52	496.09	287.14	1078.7	1500		
	9	261.29	433.19	424.81	1216.3	1504		
12	1	4983.18	446.3	0	918.7	1504	164.15	
	2	5008.1	426.64	44.58	963.3	1502		
	3	5021.22	414.85	69.49	988.2	1494		LB
	4	5029.09	410.92	81.29	1000.0	1492.3		CL
	5	5044.84	399.13	108.83	1027.5	1494		RB
	6	5054.02	388.65	128.49	1047.2	1496		
	7	5106.49	346.72	222.89	1141.6	1498		
	8	5122.23	333.62	251.73	1170.4	1506		
13	1	4813.95	310.03	0	723.1	1508	207.23	
	2	4884.79	266.93	113.94	837.0	1506		
	3	4911.03	252.38	154.73	877.8	1500		LB
	4	4964.81	218.31	242.58	965.7	1499		
	5	4979.24	211.76	263.56	986.7	1498		
	6	4986.59	205.77	276.9	1000.0	1496.6		CL
	7	4997.61	198.66	295.03	1018.1	1498		
	8	5006.79	198.42	304.45	1027.6	1500		RB
	9	5017.29	188.18	325.19	1048.3	1510		
	10	5069.76	155.42	410.42	1133.5	1512		
14	1	736.55	164.59	0	725.9	1510.8	158.5	
	2	769.35	146.25	51.14	777.1	1510		
	3	798.21	129.21	97.04	823.0	1508		
	4	813.95	121.35	120.64	846.6	1502		LB
	5	853.31	97.77	183.58	909.5	1502		
	6	901.84	68.94	260.94	986.9	1500		
	7	909.72	63.7	274.06	1000.0	1498.5		CL
	8	917.59	59.77	285.86	1011.8	1500		
	9	929.39	53.22	304.21	1030.2	1502		RB
	10	941.2	46.67	322.57	1048.5	1510		
	11	953.01	40.12	340.93	1066.9	1512		
15	1	660.46	3027.01	0	716.8	1514	150.05	
	2	709	3002.12	73.43	790.2	1512		
	3	718.19	2998.19	86.55	803.3	1510		

	4	752.29	2978.54	140.3	857.1	1504		LB
	5	824.45	2940.54	250.46	967.2	1504		
	6	836.25	2935.3	267.5	984.3	1502		
	7	846.75	2930.06	283.24	1000.0	1501.5		CL
	8	850.68	2926.12	291.11	1007.9	1502		RB
	9	879.54	2911.71	334.38	1051.1	1510		
	10	928.08	2888.13	406.5	1123.3	1516		
16	1	615.86	926.12	0	726.0	1516	144.77	
	2	640.79	903.85	47.2	773.2	1514		
	3	673.58	878.96	104.88	830.9	1510		
	4	690.64	865.85	135.05	861.0	1506		LB
	5	765.41	801.65	274.02	1000.0	1504		CL
	6	779.84	795.1	295	1021.0	1506		RB
	7	796.9	780.69	326.47	1052.5	1510		
	8	844.12	741.38	413	1139.0	1510		
	9	888.73	709.93	489.06	1215.0	1520		

TATUM_A.XLS

Tatum Wash Sedimentation Study - HEC2 Output

PROF	SECNO	Q	CWSEL	DEPTH	TOPWID	VLOB	VCH	VROB	QLOB	QCH	QROB	10*KS	AREA
1	7693.8	50	1396.98	1.18	191.77	0	0.15	0.2	0	10.64	39.36	0.25	267.11
2	7693.8	100	1396.03	0.23	161.06	0	0.33	1.04	0	2.3	97.7	15.39	100.45
3	7693.8	200	1396	0.2	160.05	0	0.6	2.18	0	3.17	196.83	69.53	95.47
4	7693.8	300	1396.12	0.32	163.84	0	1.16	2.79	0	13.39	286.61	99.97	114.35
5	7693.8	400	1396.29	0.49	169.35	0	1.63	3.02	0	34.99	365.01	98.32	142.56
6	7693.8	500	1396.42	0.62	173.79	0	1.97	3.24	0	59.34	440.66	100.12	166.01
7	7693.8	600	1396.55	0.75	177.94	0	2.23	3.43	0	86.74	513.26	100.16	188.45
8	7693.8	700	1396.67	0.87	181.74	0	2.46	3.6	0	116.1	583.9	100.15	209.52
9	7693.8	800	1396.78	0.98	185.29	0	2.65	3.75	0	147.04	652.96	100.1	229.55
10	7693.8	900	1396.88	1.08	188.62	0	2.82	3.89	0	179.31	720.69	100.07	248.7
11	7693.8	1000	1396.98	1.18	191.77	0	2.97	4.03	0	212.74	787.26	100.03	267.13
12	7693.8	1100	1397.06	1.26	194.44	0	3.13	4.18	0	245.82	854.18	102.02	283.02
13	7693.8	1200	1397.15	1.35	197.37	0	3.25	4.29	0	281.47	918.53	101.49	300.69
14	7693.8	1300	1397.24	1.44	200.37	0	3.36	4.38	0	318.79	981.21	99.97	319.02
15	7693.8	1400	1397.32	1.52	202.91	0	3.48	4.49	0	355.33	1044.67	100.5	334.8
16	7693.8	1500	1397.4	1.6	205.57	0	3.58	4.58	0	393.56	1106.44	99.88	351.5
17	7693.8	1600	1397.48	1.68	208.04	0	3.67	4.68	0	431.98	1168.01	99.83	367.23
18	7693.8	1700	1397.55	1.75	210.44	0	3.77	4.77	0	471.03	1228.97	99.81	382.63
19	7693.8	1800	1397.62	1.82	212.76	0	3.86	4.86	0	510.66	1289.34	99.79	397.74
20	7693.8	1900	1397.69	1.89	215.01	0	3.94	4.95	0	550.86	1349.14	99.77	412.6
21	7693.8	2000	1397.76	1.96	217.21	0	4.02	5.03	0	591.59	1408.4	99.76	427.21
22	7693.8	2100	1397.83	2.03	219.35	0	4.1	5.11	0	632.83	1467.16	99.75	441.6
23	7693.8	2200	1397.89	2.09	221.44	0	4.17	5.19	0	674.56	1525.44	99.74	455.78
24	7693.8	2300	1397.95	2.15	223.48	0	4.25	5.26	0	716.73	1583.27	99.74	469.74
1	7533.8	50	1398.06	0.56	105.98	0	2.09	2.49	0	6.89	43.11	540.36	20.58
2	7533.8	100	1398.17	0.67	113.65	0	2.82	3.16	0	17.25	82.74	587.79	32.34
3	7533.8	200	1398.56	1.06	158.66	0	2.17	2.51	0	47.43	152.57	145.69	82.71
4	7533.8	300	1398.8	1.3	248.53	0	2.02	2.36	0	77.92	222.08	102.51	132.84
5	7533.8	400	1398.94	1.44	296.65	0	2.16	2.46	0	109.36	290.64	103.53	168.78
6	7533.8	500	1399.05	1.55	321.2	0	2.32	2.51	0	143.78	356.22	100.65	203.96
7	7533.8	600	1399.14	1.64	323.51	0	2.5	2.6	0	179.91	420.09	99	233.71
8	7533.8	700	1399.23	1.73	325.65	0	2.66	2.69	0	216.06	483.94	97.5	261.44
9	7533.8	800	1399.31	1.81	327.66	0	2.79	2.78	0	252.3	547.7	96.1	287.68
10	7533.8	900	1399.38	1.88	329.59	0	2.91	2.88	0	288.7	611.3	94.44	313.11
11	7533.8	1000	1399.46	1.96	331.44	0	3.02	2.94	0	325.22	674.78	92.97	337.52
12	7533.8	1100	1399.53	2.03	333.32	0	3.11	3	0	362.1	737.9	90.47	362.6
13	7533.8	1200	1399.6	2.1	335.02	0	3.2	3.07	0	398.82	801.18	89.47	385.24
14	7533.8	1300	1399.66	2.16	336.6	0	3.29	3.15	0	435.56	864.43	89.02	406.51
15	7533.8	1400	1399.73	2.23	338.25	0	3.37	3.21	0	472.69	927.31	87.59	428.79
16	7533.8	1500	1399.79	2.29	339.79	0	3.45	3.28	0	509.8	990.2	86.82	449.65
17	7533.8	1600	1399.85	2.35	341.32	0	3.52	3.34	0	547.12	1052.88	85.83	470.52
18	7533.8	1700	1399.91	2.41	342.82	0	3.58	3.4	0	584.58	1115.42	84.89	491.02
19	7533.8	1800	1399.97	2.47	344.29	0	3.64	3.46	0	622.18	1177.82	83.96	511.24
20	7533.8	1900	1400.03	2.53	346.97	0.02	3.71	3.51	0	661.4	1238.6	83.02	530.84
21	7533.8	2000	1400.09	2.59	350.55	0.29	3.79	3.57	0.06	701.77	1298.16	82.6	548.89
22	7533.8	2100	1400.14	2.64	354.32	0.4	3.87	3.61	0.25	742.55	1357.19	81.6	568.08
23	7533.8	2200	1400.19	2.69	358.01	0.5	3.94	3.66	0.61	783.31	1416.08	80.69	587.03
24	7533.8	2300	1400.24	2.74	361.63	0.59	4.01	3.7	1.17	824.04	1474.78	79.83	605.88
1	7338.8	50	1401.56	1.16	51.49	0	1.67	0	0	50	0	53.18	29.87
2	7338.8	100	1401.89	1.49	66.2	0	2.03	0	0	100	0	55.7	49.37
3	7338.8	200	1402.07	1.67	71.9	0.03	3.22	0	0	200	0	114.54	62.15
4	7338.8	300	1402.19	1.79	73.38	0.74	4.23	0	0.1	299.9	0	167.12	71.12
5	7338.8	400	1402.37	1.97	75.4	1.15	4.8	0	0.54	399.46	0	177.72	83.62
6	7338.8	500	1402.5	2.1	76.89	1.48	5.41	0	1.25	498.75	0	198.4	93.08
7	7338.8	600	1402.6	2.2	78.23	1.77	5.95	0	2.25	597.75	0	216.56	101.73
8	7338.8	700	1402.7	2.3	79.37	2.04	6.48	0	3.48	696.52	0	236.51	109.22
9	7338.8	800	1402.79	2.39	80.42	2.3	6.97	0	4.96	795.04	0	254.87	116.25
10	7338.8	900	1402.92	2.52	82.37	2.5	7.2	0.04	7.36	892.64	0	246.76	126.87
11	7338.8	1000	1403.05	2.65	91.61	2.68	7.36	0.71	10.41	989.18	0.41	234.14	138.86
12	7338.8	1100	1403.19	2.79	100.7	2.83	7.48	1.07	14	1083.67	2.32	221.84	151.91
13	7338.8	1200	1403.32	2.92	109.58	2.95	7.58	1.35	18.07	1175.58	6.35	210.3	165.85
14	7338.8	1300	1403.45	3.05	118.1	3.06	7.67	1.58	22.52	1264.82	12.66	200.24	180.32
15	7338.8	1400	1403.57	3.17	126.14	3.16	7.75	1.77	27.26	1351.57	21.17	191.97	194.97
16	7338.8	1500	1403.68	3.28	133.78	3.25	7.83	1.93	32.26	1435.96	31.78	184.95	209.79
17	7338.8	1600	1403.79	3.39	141.01	3.34	7.91	2.07	37.47	1518.23	44.3	179.07	224.63

18	7338.8	1700	1403.89	3.49	147.88	3.41	7.98	2.2	42.86	1598.57	58.56	174.12	239.44
19	7338.8	1800	1404.05	3.65	155.91	3.46	7.84	2.36	50.7	1665.64	83.66	157.58	262.62
20	7338.8	1900	1404.11	3.71	157.29	3.63	7.99	2.55	56.61	1742.19	101.2	159.74	273.44
21	7338.8	2000	1404.19	3.79	158.79	3.78	8.1	2.74	62.92	1815.93	121.15	160.08	285.25
22	7338.8	2100	1404.28	3.88	160.6	3.91	8.13	2.91	70.04	1884.44	145.52	156.63	299.72
23	7338.8	2200	1404.32	3.92	161.37	4.07	8.36	3.07	75.06	1964.45	160.49	163.52	305.93
24	7338.8	2300	1404.41	4.01	163.25	4.17	8.35	3.22	82.53	2029.6	187.88	158.59	321.14
1	6983.8	50	1404.73	0.93	33.86	0	2.92	0	0	50	0	195.39	17.1
2	6983.8	100	1405.05	1.25	44.19	0	3.39	0	0	100	0	180.84	29.51
3	6983.8	200	1405.69	1.89	64.85	0	3.12	0	0	200	0	90.61	64.16
4	6983.8	300	1406.08	2.28	76.21	0.02	3.25	0.02	0	300	0	73.7	92.32
5	6983.8	400	1406.33	2.53	79.74	0.68	3.61	0.68	0.27	399.47	0.25	71.58	111.31
6	6983.8	500	1406.56	2.76	83.15	0.95	3.88	0.95	1.12	497.83	1.05	67.92	130.43
7	6983.8	600	1406.77	2.97	86.2	1.16	4.13	1.16	2.59	595	2.41	65.86	148.26
8	6983.8	700	1406.97	3.17	89.15	1.33	4.34	1.32	4.74	690.84	4.42	63.44	166.11
9	6983.8	800	1407.16	3.36	91.88	1.47	4.53	1.47	7.48	785.55	6.97	61.83	183.12
10	6983.8	900	1407.32	3.52	94.03	1.61	4.77	1.61	10.4	879.9	9.7	63.03	196.91
11	6983.8	1000	1407.45	3.65	95.99	1.74	5	1.74	13.67	973.57	12.75	64.54	209.78
12	6983.8	1100	1407.57	3.77	97.79	1.86	5.23	1.86	17.26	1066.65	16.09	66.31	221.79
13	6983.8	1200	1407.69	3.89	99.44	1.98	5.46	1.98	21.11	1159.21	19.68	68.29	233.04
14	6983.8	1300	1407.79	3.99	101.01	2.09	5.67	2.09	25.26	1251.19	23.55	70.24	243.85
15	6983.8	1400	1407.89	4.09	102.52	2.2	5.88	2.2	29.72	1342.56	27.72	72.02	254.44
16	6983.8	1500	1407.99	4.19	103.93	2.31	6.08	2.3	34.43	1433.47	32.1	73.89	264.53
17	6983.8	1600	1408.09	4.29	104	2.46	6.28	2.46	40.07	1522.58	37.35	75.92	273.83
18	6983.8	1700	1408.17	4.37	104	2.61	6.47	2.61	46.03	1611.08	42.9	77.64	283.09
19	6983.8	1800	1408.21	4.41	104	2.76	6.74	2.76	50.62	1702.2	47.17	82.68	288
20	6983.8	1900	1408.31	4.51	104	2.9	6.88	2.9	57.47	1789	53.53	82.95	298.26
21	6983.8	2000	1408.4	4.6	104	3.04	7.04	3.03	64.17	1876.07	59.76	83.82	307.53
22	6983.8	2100	1408.48	4.68	104	3.17	7.22	3.16	70.39	1964.07	65.54	85.92	315.03
23	6983.8	2200	1408.59	4.79	104	3.28	7.31	3.27	78.33	2048.77	72.91	84.67	326.42
24	6983.8	2300	1408.65	4.85	104	3.41	7.5	3.4	84.47	2136.91	78.62	87.23	332.82
1	6573.8	50	1411.45	4.25	105.27	0	0.45	0	0	50	0	1.72	111.35
2	6573.8	100	1410.65	3.45	69.39	0	2.4	0	0	100	0	103.89	41.72
3	6573.8	200	1410.83	3.63	77.63	0	3.62	0	0	200	0	190.04	55.18
4	6573.8	300	1410.99	3.79	84.4	0	4.45	0	0	300	0	245.73	67.37
5	6573.8	400	1411.16	3.96	92	0	4.86	0	0	400	0	251.79	82.28
6	6573.8	500	1411.29	4.09	97.84	0	5.29	0	0	500	0	268.35	94.58
7	6573.8	600	1411.41	4.21	103.5	0	5.6	0	0	600	0	274.03	107.24
8	6573.8	700	1411.51	4.31	108.18	0	5.92	0	0	700	0	285.67	118.25
9	6573.8	800	1411.62	4.42	112.95	0	6.16	0	0	800	0	288.37	129.97
10	6573.8	900	1411.76	4.56	119	0	6.18	0	0	900	0	268.16	145.57
11	6573.8	1000	1411.89	4.69	124.78	0	6.2	0	0	1000	0	250.98	161.21
12	6573.8	1100	1412.02	4.82	135.85	0.04	6.22	0.04	0	1100	0	235.2	176.98
13	6573.8	1200	1412.11	4.91	140	0.92	6.29	0.81	0.52	1199.1	0.37	217.51	191.79
14	6573.8	1300	1412.22	5.02	140	1.34	6.37	1.26	1.43	1297.37	1.2	204.61	205.72
15	6573.8	1400	1412.31	5.11	140	1.65	6.45	1.59	2.56	1395.15	2.28	193.85	219.23
16	6573.8	1500	1412.4	5.2	140	1.91	6.52	1.85	3.9	1492.52	3.58	183.1	233.04
17	6573.8	1600	1412.5	5.3	140	2.12	6.57	2.07	5.37	1589.61	5.02	173.36	246.78
18	6573.8	1700	1412.6	5.4	140	2.29	6.65	2.25	6.86	1686.66	6.49	166.29	259.6
19	6573.8	1800	1412.7	5.5	140	2.44	6.63	2.41	8.72	1782.95	8.33	153.42	275.77
20	6573.8	1900	1412.79	5.59	140	2.57	6.75	2.54	10.16	1880.09	9.75	151.27	286.4
21	6573.8	2000	1412.87	5.67	140	2.69	6.83	2.66	11.72	1976.98	11.3	147.58	297.88
22	6573.8	2100	1412.96	5.76	140	2.79	6.89	2.76	13.42	2073.59	12.99	142.23	310.49
23	6573.8	2200	1413.02	5.82	140	2.89	7.02	2.87	14.84	2170.76	14.4	142.32	319.47
24	6573.8	2300	1413.12	5.92	140	2.98	7.06	2.95	16.62	2267.22	16.16	136.88	332.28
1	6520.8	50	1411.88	3.88	112.37	0	0.82	0	0	50	0	14.22	60.61
2	6520.8	100	1411.54	3.54	77.2	0	3.5	0	0	100	0	421.19	28.61
3	6520.8	200	1411.91	3.91	115.56	0	3.12	0	0	200	0	195.92	64.1
4	6520.8	300	1412.13	4.13	137.73	0	3.28	0.54	0	299.55	0.45	150.19	92.16
5	6520.8	400	1412.29	4.29	152.85	0	3.58	0.87	0	396.54	3.46	138.81	114.68
6	6520.8	500	1412.44	4.44	167.63	0	3.78	1.1	0	489.77	10.23	125.25	138.97
7	6520.8	600	1412.57	4.57	170	0	3.96	1.42	0	578.36	21.64	117.21	161.44
8	6520.8	700	1412.69	4.69	170	0	4.09	1.7	0	664.16	35.84	108.69	183.69
9	6520.8	800	1412.81	4.81	170	0	4.24	1.92	0	749.65	50.35	105.09	202.84
10	6520.8	900	1412.91	4.91	170	0	4.44	2.12	0	835.53	64.47	105.86	218.51
11	6520.8	1000	1413	5	170	0	4.62	2.31	0	920.69	79.31	106.22	233.66
12	6520.8	1100	1413.09	5.09	170	0	4.77	2.47	0	1004.94	95.06	105.41	249.01
13	6520.8	1200	1413.16	5.16	170	0	4.97	2.64	0	1090.13	109.87	108.24	261.03
14	6520.8	1300	1413.24	5.24	170	0	5.12	2.79	0	1173.91	126.08	108.19	274.7

15	6520.8	1400	1413.31	5.31	170	0	5.26	2.93	0	1257.6	142.4	108.66	287.53
16	6520.8	1500	1413.38	5.38	170	0	5.42	3.07	0	1341.42	158.58	110.01	299.17
17	6520.8	1600	1413.45	5.45	170	0	5.55	3.19	0	1424.35	175.65	109.82	311.77
18	6520.8	1700	1413.52	5.52	170	0	5.66	3.31	0	1506.89	193.11	109.25	324.43
19	6520.8	1800	1413.58	5.58	170	0	5.81	3.43	0	1590.14	209.85	110.62	334.97
20	6520.8	1900	1413.67	5.67	170	0	5.88	3.52	0	1671.37	228.63	108.11	349.02
21	6520.8	2000	1413.74	5.74	170	0	5.98	3.62	0	1753.14	246.86	107.13	361.43
22	6520.8	2100	1413.81	5.81	170	0	6.07	3.71	0	1834.8	265.19	106.26	373.57
23	6520.8	2200	1413.88	5.88	170	0	6.15	3.8	0	1916.06	283.94	104.92	386.1
24	6520.8	2300	1413.96	5.96	170	0	6.24	3.89	0	1997.39	302.61	103.97	398.07
1	6420.8	50	1412.26	0.56	53.3	0	3.16	0	0	50	0	463.42	15.81
2	6420.8	100	1412.83	1.13	70.28	0	1.96	0	0	100	0	53.72	51.12
3	6420.8	200	1413.12	1.42	78.79	0	2.76	0	0	200	0	78.26	72.46
4	6420.8	300	1413.32	1.62	84.79	0	3.37	0	0	300	0	97.97	88.97
5	6420.8	400	1413.5	1.8	90.06	0	3.83	0	0	400	0	110.5	104.48
6	6420.8	500	1413.63	1.93	93.95	0	4.29	0	0	500	0	127	116.52
7	6420.8	600	1413.74	2.04	97.35	0	4.71	0	0	600	0	142.19	127.46
8	6420.8	700	1413.83	2.13	99.88	0	5.15	0	0	700	0	161.93	135.85
9	6420.8	800	1413.93	2.23	102.63	0	5.51	0	0	800	0	175.55	145.23
10	6420.8	900	1414.03	2.33	110.26	0	5.78	0.04	0	900	0	182.51	155.7
11	6420.8	1000	1414.11	2.41	132.74	0	6.05	0.52	0	999.23	0.76	187.87	166.58
12	6420.8	1100	1414.18	2.48	134.69	0	6.32	0.97	0	1096.52	3.48	194.7	177.01
13	6420.8	1200	1414.26	2.56	136.82	0	6.53	1.34	0	1192.01	7.98	196.71	188.56
14	6420.8	1300	1414.33	2.63	138.36	0	6.8	1.61	0	1287.57	12.43	205.7	197.06
15	6420.8	1400	1414.4	2.7	140.04	0	7.03	1.87	0	1381.87	18.13	211.13	206.4
16	6420.8	1500	1414.47	2.77	141.76	0	7.22	2.11	0	1475.12	24.88	214.61	216.09
17	6420.8	1600	1414.53	2.83	143.32	0	7.42	2.32	0	1568.03	31.97	219.24	225
18	6420.8	1700	1414.61	2.91	145.26	0	7.54	2.54	0	1658.79	41.21	217.43	236.15
19	6420.8	1800	1414.69	2.99	147.18	0	7.65	2.73	0	1748.7	51.3	215.15	247.37
20	6420.8	1900	1414.76	3.06	149.02	0	7.76	2.91	0	1838.08	61.92	213.32	258.31
21	6420.8	2000	1414.83	3.13	150.81	0	7.86	3.07	0	1926.96	73.04	211.75	269.03
22	6420.8	2100	1414.9	3.2	152.57	0	7.95	3.22	0	2015.27	84.73	210.08	279.72
23	6420.8	2200	1414.97	3.27	154.33	0	8.04	3.36	0	2102.93	97.07	208.04	290.53
24	6420.8	2300	1415.04	3.34	156	0	8.13	3.49	0	2190.39	109.6	206.71	300.91
1	6150.8	50	1415.29	1.29	35.5	0	2.18	0	0	50	0	47.51	22.92
2	6150.8	100	1415.26	1.26	34.78	0	4.55	0	0	100	0	212.17	21.99
3	6150.8	200	1415.75	1.75	48	0	4.77	0	0	200	0	152.24	41.89
4	6150.8	300	1416.1	2.1	56.19	0	4.98	0	0	300	0	125.62	60.28
5	6150.8	400	1416.35	2.35	59.34	0	5.34	0	0	400	0	116.78	74.85
6	6150.8	500	1416.58	2.58	62.35	0	5.59	0	0	500	0	107.47	89.51
7	6150.8	600	1416.79	2.79	65.02	0	5.82	0	0	600	0	102.26	103.08
8	6150.8	700	1417	3	67.63	0	5.98	0	0	700	0	96.3	116.98
9	6150.8	800	1417.19	3.19	69.91	0	6.18	0	0	800	0	93.68	129.5
10	6150.8	900	1417.34	3.34	71.86	0	6.4	0	0	900	0	93.64	140.55
11	6150.8	1000	1417.48	3.48	73.63	0	6.63	0	0	1000	0	94.38	150.84
12	6150.8	1100	1417.62	3.62	75.35	0	6.83	0	0	1100	0	94.64	161.08
13	6150.8	1200	1417.75	3.75	76.86	0	7.05	0	0	1200	0	96.11	170.29
14	6150.8	1300	1417.88	3.88	78.55	0	7.19	0	0	1300	0	95.11	180.81
15	6150.8	1400	1418.01	4.01	80.01	0	7.37	0	0	1400	0	95.75	190.04
16	6150.8	1500	1418.1	4.1	81.55	0.03	7.58	0.03	0	1500	0	96.23	197.85
17	6150.8	1600	1418.19	4.19	83.09	0.56	7.79	0.03	0.11	1599.88	0	96.46	205.73
18	6150.8	1700	1418.27	4.27	84.33	0.7	8.03	0.7	0.28	1699.59	0.13	98.57	212.23
19	6150.8	1800	1418.34	4.34	85.49	0.84	8.27	0.83	0.54	1799.21	0.24	100.9	218.41
20	6150.8	1900	1418.41	4.41	86.67	0.96	8.5	0.95	0.92	1898.67	0.41	102.83	224.72
21	6150.8	2000	1418.49	4.49	87.68	1.07	8.75	1.06	1.35	1998.04	0.61	105.68	230.23
22	6150.8	2100	1418.55	4.55	88.75	1.18	8.97	1.17	1.94	2097.19	0.87	107.79	236.12
23	6150.8	2200	1418.61	4.61	89.72	1.28	9.2	1.27	2.6	2196.24	1.17	110.37	241.55
24	6150.8	2300	1418.67	4.67	90.68	1.38	9.43	1.36	3.37	2295.11	1.52	112.79	246.96
1	5880.8	50	1417.67	0.67	46.85	0	3.19	0	0	50	0	243.08	15.68
2	5880.8	100	1418.12	1.12	71.44	0	2.28	0	0	100	0	55.36	43.86
3	5880.8	200	1418.43	1.43	74.9	0	3.04	0	0	200	0	60.86	65.87
4	5880.8	300	1418.66	1.66	77.54	0	3.6	0	0	300	0	65.5	83.34
5	5880.8	400	1418.87	1.87	79.97	0	4	0	0	400	0	66.15	99.99
6	5880.8	500	1419.05	2.05	82.03	0	4.37	0	0	500	0	68.09	114.5
7	5880.8	600	1419.21	2.21	84.03	0	4.65	0	0	600	0	68.15	128.96
8	5880.8	700	1419.37	2.37	85.79	0	4.93	0	0	700	0	69.31	141.92
9	5880.8	800	1419.53	2.53	87.54	0	5.16	0	0	800	0	69.09	155.18
10	5880.8	900	1419.68	2.68	89.31	0	5.33	0	0	900	0	67.93	168.75
11	5880.8	1000	1419.82	2.82	91.02	0	5.49	0	0	1000	0	66.64	182.2

12	5880.8	1100	1419.97	2.97	92.64	0	5.64	0	0	1100	0	65.73	195.1
13	5880.8	1200	1420.1	3.1	93.75	0	5.77	0	0	1200	0	64.22	208.01
14	5880.8	1300	1420.23	3.23	94.58	0	5.93	0	0	1300	0	64.13	219.13
15	5880.8	1400	1420.35	3.35	95.47	0	6.05	0	0	1400	0	62.95	231.28
16	5880.8	1500	1420.47	3.47	96.28	0	6.19	0	0	1500	0	62.57	242.34
17	5880.8	1600	1420.58	3.58	97.07	0	6.32	0	0	1600	0	62.2	253.21
18	5880.8	1700	1420.7	3.7	97.9	0	6.42	0	0	1700	0	61.22	264.77
19	5880.8	1800	1420.81	3.81	98.75	0	6.5	0	0	1800	0	59.9	276.81
20	5880.8	1900	1420.92	3.92	99.52	0	6.61	0	0	1900	0	59.38	287.6
21	5880.8	2000	1421.05	4.05	100.38	0	6.67	0	0	2000	0	57.9	299.92
22	5880.8	2100	1421.16	4.16	101.13	0	6.76	0	0	2100	0	57.3	310.75
23	5880.8	2200	1421.27	4.27	101.91	0	6.83	0	0	2200	0	56.42	322.04
24	5880.8	2300	1421.38	4.38	102.67	0	6.9	0	0	2300	0	55.61	333.23
1	5500.8	50	1422.23	1.23	35.12	0	2.72	0.52	0	49.55	0.45	70.05	19.11
2	5500.8	100	1422.32	1.32	39.59	0	4.69	1.07	0	98.07	1.93	181.8	22.74
3	5500.8	200	1422.74	1.74	59.15	0	5.41	1.73	0	182.82	17.18	154.05	43.74
4	5500.8	300	1423.04	2.04	72.66	0	5.92	2.11	0	259.17	40.83	147.07	63.1
5	5500.8	400	1423.27	2.27	83.42	0	6.32	2.39	0	330.52	69.48	143.8	81.35
6	5500.8	500	1423.47	2.47	92.47	0	6.65	2.62	0	398.54	101.46	142.31	98.64
7	5500.8	600	1423.64	2.64	100.27	0	6.95	2.82	0	464.21	135.79	142.16	114.99
8	5500.8	700	1423.78	2.78	106.75	0	7.27	3.01	0	528.88	171.11	145.39	129.56
9	5500.8	800	1423.96	2.96	115.07	0	7.28	3.09	0	587.07	212.93	134.23	149.63
10	5500.8	900	1424.08	3.08	125.71	0.35	7.52	3.27	0.06	646.21	253.7	133.1	163.77
11	5500.8	1000	1424.2	3.2	139.47	0.65	7.68	3.42	0.98	701.67	297.35	127.92	179.78
12	5500.8	1100	1424.31	3.31	152.74	0.87	7.82	3.54	3.32	755.23	341.45	123.08	196.78
13	5500.8	1200	1424.42	3.42	164.34	1.04	7.99	3.66	6.96	808.37	384.67	120.83	212.92
14	5500.8	1300	1424.51	3.51	175.39	1.19	8.15	3.77	12.07	859.94	427.99	118.79	229.38
15	5500.8	1400	1424.61	3.61	186.07	1.32	8.29	3.85	18.72	909.8	471.47	116.7	246.3
16	5500.8	1500	1424.7	3.7	196.37	1.43	8.42	3.93	26.88	958.1	515.02	114.65	263.58
17	5500.8	1600	1424.78	3.78	206.09	1.53	8.54	4.01	36.33	1005.3	558.37	113.01	280.75
18	5500.8	1700	1424.86	3.86	215.51	1.63	8.66	4.07	47.15	1051.12	601.73	111.37	298.17
19	5500.8	1800	1424.94	3.94	224.53	1.72	8.77	4.13	59.17	1095.88	644.94	109.94	315.57
20	5500.8	1900	1425.02	4.02	233.38	1.8	8.87	4.18	72.55	1139.26	688.19	108.38	333.35
21	5500.8	2000	1425.12	4.12	244.21	1.86	8.87	4.19	89.97	1176.97	733.06	103.72	356.03
22	5500.8	2100	1425.18	4.18	251.13	1.94	9.02	4.26	103.91	1221.08	775.01	104.31	371.05
23	5500.8	2200	1425.22	4.22	256.62	2.01	9.21	4.35	116.87	1267.07	816.06	106.52	383.29
24	5500.8	2300	1425.34	4.34	270.22	2.05	9.05	4.28	143.44	1293.7	862.86	97.75	414.71
1	5460.8	50	1422.56	0.56	53.02	1.03	2.33	0	3.41	46.59	0	79.11	23.3
2	5460.8	100	1422.92	0.92	67.44	1.16	2.51	0	10.15	89.85	0	52.39	44.49
3	5460.8	200	1423.35	1.35	85.46	1.41	2.94	0	27.08	172.92	0	45.92	78.09
4	5460.8	300	1423.67	1.67	98.38	1.6	3.25	0	46.69	253.31	0	44.66	107.06
5	5460.8	400	1423.92	1.92	108.89	1.75	3.5	0	68.01	331.99	0	44.23	133.61
6	5460.8	500	1424.13	2.13	118.54	1.92	3.74	0.29	91.4	408.51	0.09	42.77	157.38
7	5460.8	600	1424.32	2.32	127.44	2.07	3.96	0.51	115.67	483.45	0.88	41.51	179.72
8	5460.8	700	1424.48	2.48	135.57	2.2	4.17	0.67	140.28	557.03	2.7	40.7	201.53
9	5460.8	800	1424.62	2.62	142.45	2.33	4.39	0.79	164.78	629.86	5.37	41.08	221.05
10	5460.8	900	1424.75	2.75	148.87	2.44	4.59	0.91	189.54	701.49	8.98	41.44	240.14
11	5460.8	1000	1424.87	2.87	154.58	2.56	4.8	1.01	214.31	772.38	13.31	42.24	257.83
12	5460.8	1100	1424.98	2.98	159.91	2.67	5	1.1	239.23	842.36	18.4	43.06	274.94
13	5460.8	1200	1425.08	3.08	164.98	2.77	5.19	1.19	264.32	911.41	24.27	43.81	291.73
14	5460.8	1300	1425.17	3.17	169.73	2.86	5.37	1.27	289.51	979.7	30.79	44.62	307.95
15	5460.8	1400	1425.26	3.26	174.12	2.96	5.55	1.35	314.73	1047.43	37.84	45.57	323.36
16	5460.8	1500	1425.35	3.35	178.22	3.05	5.73	1.42	339.99	1114.63	45.38	46.6	338.11
17	5460.8	1600	1425.43	3.43	182.08	3.14	5.9	1.49	365.31	1181.29	53.4	47.68	352.31
18	5460.8	1700	1425.5	3.5	185.7	3.23	6.08	1.56	390.65	1247.54	61.81	48.85	365.9
19	5460.8	1800	1425.57	3.57	189.09	3.32	6.25	1.63	416.01	1313.43	70.56	50.1	378.84
20	5460.8	1900	1425.63	3.63	192.27	3.41	6.42	1.7	441.38	1378.98	79.63	51.42	391.23
21	5460.8	2000	1425.69	3.69	194.91	3.5	6.62	1.76	466.52	1445.11	88.37	53.29	401.65
22	5460.8	2100	1425.75	3.75	197.86	3.59	6.78	1.83	492.01	1509.83	98.16	54.58	413.47
23	5460.8	2200	1425.81	3.81	200.85	3.67	6.94	1.89	517.66	1573.74	108.61	55.66	425.63
24	5460.8	2300	1425.84	3.84	202.49	3.78	7.16	1.96	542.42	1640.71	116.87	58.46	432.38
1	5150.8	50	1429.45	0.65	66.29	0	2.95	0	0	50	0	296.36	16.98
2	5150.8	100	1429.61	0.81	88.27	0	3.36	0	0	100	0	268.54	29.72
3	5150.8	200	1429.83	1.03	116.92	0	3.86	0	0	200	0	245.81	51.76
4	5150.8	300	1429.98	1.18	137.95	0	4.17	0	0	300	0	231	71.86
5	5150.8	400	1430.12	1.32	159.03	0	4.38	0	0	400	0	223.31	91.32
6	5150.8	500	1430.23	1.43	177.26	0	4.55	0	0	500	0	216.97	109.98
7	5150.8	600	1430.33	1.53	193.75	0	4.67	0	0	600	0	208.86	128.59
8	5150.8	700	1430.41	1.61	207.79	0	4.8	0	0	700	0	205.57	145.75

9	5150.8	800	1430.49	1.69	220.52	0	4.93	0	0	800	0	202.87	162.35
10	5150.8	900	1430.56	1.76	232.29	0	5.04	0	0	900	0	200.33	178.57
11	5150.8	1000	1430.63	1.83	243.63	0	5.13	0	0	1000	0	196.58	194.98
12	5150.8	1100	1430.69	1.89	253.03	0	5.26	0	0	1100	0	197.86	209.2
13	5150.8	1200	1430.74	1.94	256.94	0	5.4	0	0	1200	0	196.65	222.17
14	5150.8	1300	1430.79	1.99	259.5	0	5.52	0	0	1300	0	192.91	235.38
15	5150.8	1400	1430.84	2.04	261.96	0	5.64	0	0	1400	0	189.84	248.21
16	5150.8	1500	1430.89	2.09	264.34	0	5.75	0	0	1500	0	187.11	260.77
17	5150.8	1600	1430.93	2.13	266.64	0	5.86	0	0	1600	0	184.88	272.99
18	5150.8	1700	1430.98	2.18	268.91	0	5.96	0	0	1700	0	182.54	285.15
19	5150.8	1800	1431.02	2.22	271.17	0	6.05	0	0	1800	0	180.04	297.31
20	5150.8	1900	1431.07	2.27	273.36	0	6.14	0	0	1900	0	177.78	309.27
21	5150.8	2000	1431.11	2.31	275.52	0	6.23	0	0	2000	0	175.66	321.1
22	5150.8	2100	1431.15	2.35	277.64	0	6.31	0	0	2100	0	173.57	332.85
23	5150.8	2200	1431.19	2.39	279.73	0	6.39	0	0	2200	0	171.58	344.48
24	5150.8	2300	1431.24	2.44	281.82	0	6.46	0	0	2300	0	169.41	356.21
1	4630.8	50	1437.94	0.94	53.13	0	2.62	1.67	0	23.06	26.94	105.47	24.91
2	4630.8	100	1438.21	1.21	97.93	0.63	2.55	2.15	0.5	40.48	59.02	114.1	44.1
3	4630.8	200	1438.47	1.47	152.45	1.14	2.86	2.52	4.91	83.24	111.86	121.23	77.84
4	4630.8	300	1438.64	1.64	187.29	1.43	3.17	2.73	11.46	129.13	159.41	126.29	107.1
5	4630.8	400	1438.77	1.77	201.36	1.62	3.55	2.91	18.45	179.26	202.29	129.26	131.31
6	4630.8	500	1438.87	1.87	202.45	1.89	3.95	3.09	27.06	230.44	242.5	131.67	151.24
7	4630.8	600	1438.96	1.96	203.02	2.14	4.31	3.27	36.08	281.28	282.64	135.64	168.56
8	4630.8	700	1439.04	2.04	206.39	2.35	4.63	3.42	45.5	332.27	322.23	137.32	185.36
9	4630.8	800	1439.11	2.11	213.03	2.54	4.91	3.55	55.08	383.11	361.81	138.92	201.44
10	4630.8	900	1439.18	2.18	219.22	2.72	5.18	3.67	64.76	433.68	401.57	140.63	216.87
11	4630.8	1000	1439.25	2.25	224.87	2.89	5.44	3.78	74.41	483.9	441.68	143.13	231.35
12	4630.8	1100	1439.32	2.32	230.83	3.03	5.66	3.86	84.35	534	481.65	142.69	247.01
13	4630.8	1200	1439.38	2.38	236.19	3.17	5.88	3.94	94.16	583.66	522.18	143.76	261.46
14	4630.8	1300	1439.43	2.43	240.92	3.32	6.1	4.04	103.83	632.96	563.21	146.49	274.48
15	4630.8	1400	1439.48	2.48	245.55	3.45	6.32	4.12	113.53	682	604.47	148.63	287.48
16	4630.8	1500	1439.54	2.54	249.91	3.58	6.52	4.21	123.19	730.78	646.05	151.05	299.94
17	4630.8	1600	1439.59	2.59	254.19	3.7	6.72	4.29	132.87	779.24	687.89	153.04	312.37
18	4630.8	1700	1439.64	2.64	258.21	3.82	6.92	4.36	142.49	827.47	730.03	155.37	324.25
19	4630.8	1800	1439.68	2.68	262.15	3.93	7.1	4.44	152.11	875.44	772.44	157.36	336.1
20	4630.8	1900	1439.72	2.72	265.92	4.05	7.28	4.51	161.7	923.18	815.13	159.5	347.57
21	4630.8	2000	1439.76	2.76	269.65	4.15	7.45	4.57	171.28	970.65	858.08	161.24	359.11
22	4630.8	2100	1439.81	2.81	273.06	4.26	7.63	4.65	180.77	1017.96	901.27	163.78	369.78
23	4630.8	2200	1439.85	2.85	275.83	4.36	7.8	4.71	190.23	1064.86	944.91	165.86	380.54
24	4630.8	2300	1439.88	2.88	278.82	4.46	7.97	4.79	199.57	1111.19	989.24	168.15	390.76
1	4260.8	50	1441.19	1.19	28.31	0	2.75	0	0	50	0	76.36	18.16
2	4260.8	100	1441.56	1.56	35.02	0	3.35	0	0	100	0	77.41	29.86
3	4260.8	200	1442.02	2.02	43.19	0	4.17	0	0	200	0	84.53	47.94
4	4260.8	300	1442.32	2.32	45.74	0	4.89	0	0	300	0	90.69	61.29
5	4260.8	400	1442.56	2.56	47.82	0	5.5	0	0	400	0	96.74	72.75
6	4260.8	500	1442.78	2.78	49.56	0	6.04	0	0	500	0	103.43	82.72
7	4260.8	600	1442.97	2.97	51.17	0	6.5	0	0	600	0	108.13	92.26
8	4260.8	700	1443.13	3.13	52.56	0	6.95	0	0	700	0	113.89	100.73
9	4260.8	800	1443.28	3.28	53.84	0	7.36	0	0	800	0	119.08	108.74
10	4260.8	900	1443.42	3.42	55.03	0	7.74	0	0	900	0	123.93	116.34
11	4260.8	1000	1443.55	3.55	56.16	0	8.08	0	0	1000	0	128.03	123.75
12	4260.8	1100	1443.66	3.66	57.1	0	8.46	0	0	1100	0	134.32	130.04
13	4260.8	1200	1443.77	3.77	58.03	0	8.8	0	0	1200	0	139.7	136.3
14	4260.8	1300	1443.89	3.89	59	0	9.09	0	0	1300	0	142.9	143
15	4260.8	1400	1444.08	4.08	74.81	0	9.08	0.35	0	1399.81	0.19	131.89	155.12
16	4260.8	1500	1444.44	4.44	148.72	0	8.36	0.98	0	1481.59	18.4	97.81	195.96
17	4260.8	1600	1444.65	4.65	158.27	0	8.13	1.37	0	1547.6	52.4	85.83	228.66
18	4260.8	1700	1444.77	4.77	158.85	0	8.2	1.6	0	1621.06	78.94	83.97	247.08
19	4260.8	1800	1444.88	4.88	159.41	0	8.26	1.8	0	1692.13	107.86	82.25	264.6
20	4260.8	1900	1444.95	4.95	159.76	0	8.45	1.95	0	1769.55	130.45	84.1	276.25
21	4260.8	2000	1445.04	5.04	160.2	0	8.56	2.11	0	1841.84	158.16	84.19	290.04
22	4260.8	2100	1445.12	5.12	160.6	0	8.69	2.25	0	1913.8	186.2	84.57	302.93
23	4260.8	2200	1445.18	5.18	160.91	0	8.86	2.39	0	1988.72	211.28	86.39	313.01
24	4260.8	2300	1445.3	5.3	161.51	0	8.81	2.53	0	2047.35	252.65	82.49	332.45
1	3880.8	50	1445.26	1.06	26.36	0	3.6	0	0	50	0	169.5	13.89
2	3880.8	100	1445.58	1.38	34.43	0	4.22	0	0	100	0	163.09	23.71
3	3880.8	200	1446.02	1.82	45.47	0	4.77	0	0	200	0	141.42	41.92
4	3880.8	300	1446.35	2.15	50.26	0	5.25	0	0	300	0	129.19	57.19
5	3880.8	400	1446.63	2.43	54.47	0	5.56	0	0	400	0	119.34	71.89

6	3880.8	500	1446.89	2.69	58.33	0	5.79	0	0	500	0	110.73	86.41
7	3880.8	600	1447.12	2.92	61.78	0	5.99	0	0	600	0	104.99	100.24
8	3880.8	700	1447.34	3.14	65.06	0	6.13	0	0	700	0	99.42	114.11
9	3880.8	800	1447.54	3.34	68.11	0	6.27	0	0	800	0	95.09	127.62
10	3880.8	900	1447.73	3.53	70.98	0	6.38	0	0	900	0	91.31	140.96
11	3880.8	1000	1447.91	3.71	73.69	0	6.49	0	0	1000	0	88.24	154
12	3880.8	1100	1448.09	3.89	76.89	0.03	6.56	0	0	1100	0	84.13	167.67
13	3880.8	1200	1448.26	4.06	80.22	0.68	6.65	0	0.17	1199.82	0	81.09	180.75
14	3880.8	1300	1448.41	4.21	83.28	0.92	6.75	0	0.59	1299.41	0	79.05	193.28
15	3880.8	1400	1448.5	4.3	85.06	1.07	7	0	1.02	1398.98	0	82.6	200.77
16	3880.8	1500	1448.42	4.22	83.41	1.07	7.76	0	0.71	1499.29	0	104.45	193.82
17	3880.8	1600	1448.41	4.21	83.19	1.13	8.32	0	0.71	1599.29	0	120.39	192.9
18	3880.8	1700	1448.48	4.28	84.69	1.28	8.57	0	1.13	1698.87	0	124.49	199.18
19	3880.8	1800	1448.55	4.35	85.93	1.42	8.84	0	1.59	1798.41	0	129.88	204.49
20	3880.8	1900	1448.66	4.46	88.08	1.59	8.94	0	2.55	1897.45	0	128.16	213.83
21	3880.8	2000	1448.74	4.54	89.62	1.72	9.13	0	3.46	1996.54	0	130.43	220.67
22	3880.8	2100	1448.81	4.61	91.12	1.86	9.28	0	4.65	2095.35	0	130.69	228.39
23	3880.8	2200	1448.9	4.7	91.75	1.97	9.41	0	6.01	2193.99	0	129.28	236.11
24	3880.8	2300	1448.98	4.78	92.36	2.08	9.56	0	7.51	2292.49	0	128.37	243.49
1	3535.8	50	1448.71	0.91	27.18	0	2.64	0	0	50	0	63.1	18.95
2	3535.8	100	1449.09	1.29	30.93	0	3.35	0	0	100	0	66.19	29.84
3	3535.8	200	1449.58	1.78	35.77	0	4.35	0	0	200	0	76.26	45.98
4	3535.8	300	1449.93	2.13	39.29	0	5.07	0	0	300	0	84	59.17
5	3535.8	400	1450.17	2.37	48.8	0.56	5.79	0.56	0.35	399.56	0.09	91.31	69.82
6	3535.8	500	1450.37	2.57	58.61	0.96	6.46	0.96	2.66	496.67	0.66	98.55	80.35
7	3535.8	600	1450.54	2.74	67.05	1.28	7.06	1.27	7.46	590.67	1.86	105.28	90.96
8	3535.8	700	1450.68	2.88	74.38	1.54	7.62	1.54	14.59	681.78	3.64	111.9	101.32
9	3535.8	800	1450.91	3.11	85.47	1.78	7.76	1.77	29.4	763.27	7.33	102.34	119.05
10	3535.8	900	1451.12	3.32	91.23	2.09	7.82	1.94	51.94	835.81	12.25	93.01	138.12
11	3535.8	1000	1451.27	3.47	92.68	2.38	8.07	2.1	73.25	909.86	16.89	92.4	151.47
12	3535.8	1100	1451.4	3.6	94.05	2.65	8.31	2.24	95.8	982.06	22.14	91.9	164.25
13	3535.8	1200	1451.53	3.73	95.34	2.88	8.54	2.38	119.17	1052.89	27.94	91.62	176.46
14	3535.8	1300	1451.65	3.85	96.46	3.1	8.79	2.5	142.12	1123.95	33.94	92.64	187.26
15	3535.8	1400	1451.75	3.95	97.51	3.3	9.05	2.63	165.26	1194.45	40.28	93.99	197.4
16	3535.8	1500	1451.9	4.1	98.99	3.47	9.11	2.71	194.33	1256.74	48.93	89.85	211.98
17	3535.8	1600	1452.02	4.22	100.41	3.63	9.24	2.82	221.41	1320.75	57.84	88.19	224.36
18	3535.8	1700	1452.13	4.33	102.36	3.78	9.39	3	247.49	1384.04	68.47	87.45	235.63
19	3535.8	1800	1452.24	4.44	104.19	3.93	9.55	3.14	273.43	1447.16	79.41	87.08	246.45
20	3535.8	1900	1452.33	4.53	105.84	4.07	9.73	3.27	298.74	1510.91	90.34	87.46	256.34
21	3535.8	2000	1452.44	4.64	107.6	4.2	9.87	3.38	325.18	1572.36	102.46	86.96	267.11
22	3535.8	2100	1452.53	4.73	109.27	4.33	10.01	3.48	351.39	1633.72	114.9	86.76	277.45
23	3535.8	2200	1452.62	4.82	110.76	4.45	10.18	3.57	376.89	1695.88	127.23	87.26	286.82
24	3535.8	2300	1452.7	4.9	112.19	4.58	10.35	3.66	402.28	1757.86	139.87	87.92	295.87
1	3095.8	50	1453.87	0.87	30.36	0	3.8	0	0	50	0	244.29	13.17
2	3095.8	100	1454.13	1.13	35.96	0	4.53	0	0	100	0	219.71	22.06
3	3095.8	200	1454.5	1.5	38.78	0	5.54	0	0	200	0	188.76	36.1
4	3095.8	300	1454.82	1.82	41.17	0	6.15	0	0	300	0	168.56	48.82
5	3095.8	400	1455.12	2.12	43.37	0	6.53	0	0	400	0	151.11	61.26
6	3095.8	500	1455.39	2.39	45.41	0	6.82	0	0	500	0	138.3	73.29
7	3095.8	600	1455.64	2.64	47.29	0	7.06	0	0	600	0	128.8	84.93
8	3095.8	700	1455.87	2.87	49.04	0	7.28	0	0	700	0	121.85	96.14
9	3095.8	800	1455.99	2.99	49.9	0	7.86	0	0	800	0	134.64	101.81
10	3095.8	900	1456.09	3.09	50.68	0.04	8.41	0.04	0	900	0	144.67	107.06
11	3095.8	1000	1456.26	3.26	51.92	0.88	8.67	0.04	0.14	999.85	0	139.24	115.56
12	3095.8	1100	1456.41	3.41	53.09	1.19	8.93	1.15	0.51	1099.25	0.24	135.31	123.76
13	3095.8	1200	1456.58	3.58	54.37	1.46	9.1	1.41	1.24	1198.16	0.6	128.62	132.91
14	3095.8	1300	1456.73	3.73	55.46	1.68	9.33	1.62	2.23	1296.7	1.07	125.9	140.91
15	3095.8	1400	1456.87	3.87	56.52	1.87	9.55	1.8	3.54	1394.76	1.7	123.48	148.81
16	3095.8	1500	1457.01	4.01	57.58	2.05	9.75	1.97	5.23	1492.25	2.52	120.72	156.88
17	3095.8	1600	1457.15	4.15	58.61	2.2	9.94	2.13	7.26	1589.24	3.5	118.33	164.84
18	3095.8	1700	1457.26	4.26	59.45	2.35	10.19	2.27	9.32	1686.19	4.49	118.82	171.43
19	3095.8	1800	1457.4	4.4	60.5	2.49	10.33	2.4	12.18	1781.95	5.87	115.53	179.85
20	3095.8	1900	1457.54	4.54	61.54	2.61	10.46	2.52	15.47	1877.08	7.46	112.36	188.34
21	3095.8	2000	1457.66	4.66	62.44	2.73	10.63	2.63	18.79	1972.15	9.06	111.15	195.78
22	3095.8	2100	1457.79	4.79	63.4	2.84	10.77	2.74	22.66	2066.41	10.93	109.07	203.78
23	3095.8	2200	1457.94	4.94	64.53	2.94	10.83	2.83	27.58	2159.13	13.3	104.68	213.45
24	3095.8	2300	1458.05	5.05	70.3	3.05	10.99	2.97	32.38	2252.02	15.6	103.94	220.76
1	2575.8	50	1461.52	1.52	19	0	3.46	0	0	50	0	97.55	14.44
2	2575.8	100	1461.93	1.93	24.18	0	4.28	0	0	100	0	107.97	23.38

3	2575.8	200	1462.49	2.49	37.3	0	4.96	0	0	200	0	124.68	40.33
4	2575.8	300	1462.82	2.82	45.62	0	5.54	0	0	300	0	137.41	54.13
5	2575.8	400	1463.06	3.06	51.53	0	6.1	0	0	400	0	151.2	65.61
6	2575.8	500	1463.25	3.25	56.26	0	6.6	0	0	500	0	164.02	75.81
7	2575.8	600	1463.45	3.45	61.21	0	6.86	0	0	600	0	164.17	87.44
8	2575.8	700	1463.63	3.63	65.73	0	7.08	0	0	700	0	162.92	98.9
9	2575.8	800	1463.81	3.81	70.21	0	7.2	0	0	800	0	157.73	111.08
10	2575.8	900	1464	4	74.84	0	7.23	0	0	900	0	148.49	124.52
11	2575.8	1000	1464.09	4.09	75.92	0.04	7.58	0.04	0	1000	0	151.88	131.91
12	2575.8	1100	1464.18	4.18	76.86	0.04	7.92	0.04	0	1099.99	0	154.28	139.14
13	2575.8	1200	1464.3	4.3	77.97	1.01	8.15	1.01	0.22	1199.55	0.22	151.23	147.71
14	2575.8	1300	1464.41	4.41	79.11	1.24	8.34	1.24	0.52	1298.96	0.52	147.01	156.63
15	2575.8	1400	1464.52	4.52	80.2	1.43	8.52	1.43	0.97	1398.06	0.97	143.41	165.38
16	2575.8	1500	1464.63	4.63	81.29	1.6	8.69	1.6	1.59	1496.82	1.59	139.86	174.16
17	2575.8	1600	1464.74	4.74	82.36	1.76	8.85	1.76	2.38	1595.23	2.38	136.46	182.92
18	2575.8	1700	1464.87	4.87	83.73	1.91	8.89	1.91	3.63	1692.73	3.63	127.77	194.27
19	2575.8	1800	1464.97	4.97	84.66	2.03	9.07	2.03	4.74	1790.51	4.74	126.78	202.11
20	2575.8	1900	1465.06	5.06	85.57	2.15	9.24	2.15	6.01	1887.97	6.01	125.8	209.89
21	2575.8	2000	1465.15	5.15	86.5	2.26	9.4	2.26	7.47	1985.05	7.47	124.47	217.82
22	2575.8	2100	1465.24	5.24	87.39	2.37	9.55	2.37	9.09	2081.83	9.09	123.35	225.6
23	2575.8	2200	1465.33	5.33	88.26	2.47	9.71	2.47	10.85	2178.31	10.85	122.41	233.24
24	2575.8	2300	1465.41	5.41	89.15	2.56	9.84	2.56	12.82	2274.36	12.82	121.04	241.12
1	2265.8	50	1466.52	0.52	31.72	0	3.71	0	0	50	0	240.16	13.47
2	2265.8	100	1466.78	0.78	37.66	0	4.42	0	0	100	0	214.31	22.62
3	2265.8	200	1467.16	1.16	46.28	0	5.17	0	0	200	0	188.46	38.71
4	2265.8	300	1467.48	1.48	53.38	0	5.51	0	0	300	0	164.69	54.44
5	2265.8	400	1467.75	1.75	59.55	0	5.72	0	0	400	0	147.11	69.92
6	2265.8	500	1468	2	64.93	0	5.9	0	0	500	0	135.59	84.8
7	2265.8	600	1468.17	2.17	66.65	0	6.26	0	0	600	0	134.49	95.85
8	2265.8	700	1468.32	2.32	68.15	0	6.61	0	0	700	0	134.98	105.98
9	2265.8	800	1468.44	2.44	69.42	0	6.98	0	0	800	0	138.92	114.68
10	2265.8	900	1468.54	2.54	70.43	0	7.39	0	0	900	0	146.9	121.75
11	2265.8	1000	1468.68	2.68	71.77	0	7.62	0	0	1000	0	144.69	131.29
12	2265.8	1100	1468.8	2.8	73.05	0	7.83	0	0	1100	0	142.89	140.54
13	2265.8	1200	1468.9	2.9	74.1	0	8.09	0	0	1200	0	145.07	148.26
14	2265.8	1300	1469.03	3.03	75.27	0	8.28	0	0	1300	0	143.5	157.06
15	2265.8	1400	1469.14	3.14	76.44	0	8.44	0	0	1400	0	141.59	165.9
16	2265.8	1500	1469.26	3.26	77.55	0	8.6	0	0	1500	0	140.08	174.49
17	2265.8	1600	1469.37	3.37	78.65	0	8.74	0	0	1600	0	138.46	183.05
18	2265.8	1700	1469.47	3.47	79.73	0	8.87	0	0	1700	0	136.73	191.61
19	2265.8	1800	1469.58	3.58	80.76	0	9	0	0	1800	0	135.45	199.89
20	2265.8	1900	1469.68	3.68	81.76	0	9.14	0	0	1900	0	134.44	207.98
21	2265.8	2000	1469.77	3.77	82.74	0	9.26	0	0	2000	0	133.28	216.08
22	2265.8	2100	1469.87	3.87	83.7	0	9.37	0	0	2100	0	132.25	224.06
23	2265.8	2200	1469.97	3.97	84.73	0	9.45	0	0	2200	0	130.07	232.7
24	2265.8	2300	1470.06	4.06	86.01	0.03	9.57	0	0	2300	0	129.23	240.39
1	2215.8	50	1468.81	0.81	66.46	0	1.11	0.5	0	47.45	2.55	9.3	47.94
2	2215.8	100	1469.29	1.29	75.9	0	1.34	0.61	0	92.28	7.72	7.64	81.51
3	2215.8	200	1470.06	2.06	92.2	0.01	1.55	0.74	0	176.45	23.55	5.71	145.73
4	2215.8	300	1470.71	2.71	114.88	0.31	1.65	0.82	0.78	251.74	47.47	4.36	212.82
5	2215.8	400	1471.29	3.29	135.16	0.42	1.71	0.85	3.48	320.81	75.71	3.58	285.24
6	2215.8	500	1471.82	3.82	153.83	0.49	1.75	0.85	6.07	384.25	107.68	3.03	362.34
7	2215.8	600	1472.08	4.08	161.23	0.57	1.92	0.93	12.32	450.84	136.83	3.32	403.21
8	2215.8	700	1472.18	4.18	162.65	0.66	2.17	1.06	15.76	521.1	163.14	4.1	418.47
9	2215.8	800	1472.24	4.24	163.66	0.76	2.42	1.19	19.14	591.68	189.2	5	429.47
10	2215.8	900	1472.31	4.31	164.61	0.85	2.66	1.31	22.72	661.58	215.69	5.94	439.89
11	2215.8	1000	1472.37	4.37	165.57	0.93	2.9	1.43	26.59	730.65	242.76	6.88	450.51
12	2215.8	1100	1472.43	4.43	166.48	1.02	3.12	1.55	30.63	799.22	270.15	7.86	460.52
13	2215.8	1200	1472.47	4.47	167.05	1.11	3.36	1.67	34.37	868.83	296.8	9.01	466.89
14	2215.8	1300	1472.51	4.51	167.73	1.19	3.59	1.79	38.46	937.36	324.18	10.13	474.47
15	2215.8	1400	1472.57	4.57	168.6	1.27	3.8	1.9	43.11	1004.24	352.65	11.13	484.18
16	2215.8	1500	1472.61	4.61	169.17	1.35	4.02	2.01	47.39	1072.34	380.27	12.33	490.61
17	2215.8	1600	1472.65	4.65	169.81	1.43	4.23	2.12	51.98	1139.56	408.46	13.49	497.81
18	2215.8	1700	1472.69	4.69	170.38	1.51	4.44	2.23	56.6	1206.71	436.68	14.7	504.37
19	2215.8	1800	1472.72	4.72	170.91	1.59	4.65	2.35	61.27	1273.81	464.92	15.96	510.4
20	2215.8	1900	1472.74	4.74	171.17	1.67	4.89	2.47	65.37	1342.58	492.05	17.51	513.36
21	2215.8	2000	1472.77	4.77	171.59	1.75	5.1	2.58	69.97	1409.91	520.12	18.92	518.09
22	2215.8	2100	1472.79	4.79	171.98	1.83	5.31	2.69	74.65	1477.08	548.27	20.38	522.64
23	2215.8	2200	1472.81	4.81	172.26	1.91	5.54	2.8	79.06	1545.01	575.93	22	525.81
24	2215.8	2300	1472.85	4.85	172.91	1.98	5.71	2.9	84.77	1609.35	605.88	23.14	533.33

1	1	50	1469.08	0.88	29.97	0	3.81	0	0	50	0	243	13.13
2	1	100	1469.44	1.24	42.68	0	3.76	0	0	100	0	147.57	26.62
3	1	200	1470.16	1.96	65.75	0.02	3.06	0.38	0	199.9	0.1	48.47	65.55
4	1	300	1470.77	2.57	81.58	0.75	2.87	0.75	1.17	294.24	4.59	23.2	110.25
5	1	400	1471.33	3.13	96.43	0.86	2.76	0.86	4.07	379.96	15.97	14.53	160.88
6	1	500	1471.85	3.65	110.03	0.91	2.7	0.92	8.35	458.89	32.75	10.54	214.67
7	1	600	1472.11	3.91	140.45	1.03	2.9	1	12.36	538.49	49.15	10.74	247.01
8	1	700	1472.21	4.01	141.42	1.19	3.25	1.13	15.51	621.82	62.67	12.98	259.79
9	1	800	1472.28	4.08	142.22	1.34	3.6	1.27	18.69	704.66	76.65	15.4	270.3
10	1	900	1472.35	4.15	142.98	1.49	3.93	1.4	22.03	786.36	91.61	17.83	280.34
11	1	1000	1472.42	4.22	143.75	1.63	4.23	1.53	25.59	866.64	107.78	20.15	290.56
12	1	1100	1472.49	4.29	144.48	1.77	4.53	1.66	29.27	945.99	124.74	22.44	300.32
13	1	1200	1472.54	4.34	144.99	1.91	4.85	1.8	32.78	1026.46	140.75	25.22	307.21
14	1	1300	1472.59	4.39	145.58	2.04	5.14	1.93	36.54	1105.26	158.19	27.76	315.11
15	1	1400	1472.66	4.46	146.28	2.16	5.39	2.05	40.67	1181.68	177.65	29.82	324.67
16	1	1500	1472.7	4.5	146.8	2.29	5.67	2.17	44.6	1259.4	196	32.38	331.76
17	1	1600	1472.76	4.56	147.36	2.41	5.93	2.3	48.73	1335.83	215.44	34.74	339.39
18	1	1700	1472.81	4.61	147.89	2.52	6.18	2.42	52.92	1411.87	235.21	37.12	346.63
19	1	1800	1472.85	4.65	148.38	2.64	6.44	2.54	57.15	1487.69	255.17	39.56	353.41
20	1	1900	1472.88	4.68	148.73	2.76	6.71	2.66	61.13	1565.11	273.76	42.57	358.13
21	1	2000	1472.92	4.72	149.16	2.88	6.96	2.78	65.42	1640.54	294.03	45.14	364.16
22	1	2100	1472.96	4.76	149.59	2.99	7.21	2.89	69.79	1715.54	314.67	47.69	370.09
23	1	2200	1473	4.8	149.95	3.1	7.46	3.01	74.08	1791.07	334.85	50.51	375.12
24	1	2300	1473.05	4.85	150.53	3.2	7.65	3.12	79.03	1862.39	358.57	52.19	383.15
1	2	50	1471.48	0.68	53.17	0	1.96	0	0	50	0	56.63	25.54
2	2	100	1471.68	0.88	57.12	0	2.68	0	0	100	0	70.9	37.24
3	2	200	1471.8	1	59.4	0	4.51	0	0	200	0	166.74	44.37
4	2	300	1472	1.2	83.32	0	5.32	0.04	0	300	0	183.06	56.39
5	2	400	1472.22	1.42	85.22	0.83	5.64	1.31	0.1	394.01	5.88	154.07	74.5
6	2	500	1472.38	1.58	86.67	1.18	6.04	1.87	0.46	484.55	14.99	146.98	88.63
7	2	600	1472.53	1.73	88	1.45	6.39	2.28	1.1	573.09	25.81	141.6	101.79
8	2	700	1472.67	1.87	89.18	1.67	6.73	2.62	1.98	660.57	37.45	139.62	113.6
9	2	800	1472.8	2	90.36	1.86	7	2.91	3.18	746.37	50.45	135.17	125.7
10	2	900	1472.92	2.12	91.41	2.03	7.29	3.16	4.57	831.86	63.57	134.15	136.42
11	2	1000	1473.03	2.23	92.41	2.18	7.56	3.39	6.22	916.46	77.32	132.8	146.91
12	2	1100	1473.15	2.35	93.42	2.32	7.79	3.59	8.15	1000.05	91.8	130.5	157.51
13	2	1200	1473.26	2.46	94.43	2.44	7.98	3.77	10.38	1082.7	106.92	127.53	168.25
14	2	1300	1473.37	2.57	95.39	2.55	8.17	3.94	12.83	1164.88	122.3	125.22	178.59
15	2	1400	1473.46	2.66	96.17	2.68	8.43	4.11	15.22	1247.81	136.97	126.49	187.03
16	2	1500	1473.56	2.76	97.03	2.78	8.62	4.26	18.02	1329.32	152.65	125.26	196.51
17	2	1600	1473.65	2.85	97.89	2.88	8.8	4.4	21.05	1410.29	168.66	123.9	205.94
18	2	1700	1473.74	2.94	98.69	2.98	8.98	4.54	24.21	1491.12	184.67	123.27	214.84
19	2	1800	1473.83	3.03	99.46	3.07	9.16	4.67	27.53	1571.62	200.84	122.83	223.5
20	2	1900	1473.94	3.14	100.41	3.14	9.25	4.76	31.56	1649.91	218.53	118.94	234.27
21	2	2000	1474.03	3.23	101.14	3.25	9.4	4.87	35.75	1728.82	235.43	117.64	243.35
22	2	2100	1474.11	3.31	101.7	3.41	9.55	4.98	40.59	1807.3	252.11	117.09	251.77
23	2	2200	1474.2	3.4	102.26	3.55	9.69	5.08	45.66	1885.25	269.09	116.24	260.32
24	2	2300	1474.28	3.48	102.79	3.69	9.84	5.18	50.83	1963.12	286.05	115.8	268.47
1	3	50	1474.3	0.3	56.45	0	3.08	0	0	50	0	276.41	16.25
2	3	100	1474.47	0.47	59.16	0	3.8	0	0	100	0	235.82	26.33
3	3	200	1474.93	0.93	66.17	0	3.66	0	0	200	0	96.01	54.67
4	3	300	1475.2	1.2	70.35	0	4.1	0	0	300	0	89.09	73.09
5	3	400	1475.37	1.37	72.88	0	4.72	0	0	400	0	101.26	84.79
6	3	500	1475.53	1.53	75.47	0	5.15	0	0	500	0	105.25	97.18
7	3	600	1475.67	1.67	77.81	0	5.52	0	0	600	0	108.57	108.73
8	3	700	1475.82	1.82	80.02	0	5.83	0	0	700	0	110.45	120
9	3	800	1475.95	1.95	81.94	0	6.15	0	0	800	0	114	130.02
10	3	900	1476.08	2.08	83.52	0.03	6.43	0.03	0	900	0	114.21	140.07
11	3	1000	1476.17	2.17	84.67	0.03	6.73	0.03	0	999.99	0	115.51	148.84
12	3	1100	1476.26	2.26	85.72	0.83	7.02	0.82	0.2	1099.68	0.12	117.61	156.94
13	3	1200	1476.35	2.35	86.66	1.02	7.33	1	0.43	1199.31	0.26	120.68	164.33
14	3	1300	1476.44	2.44	87.61	1.19	7.61	1.17	0.77	1298.76	0.47	122.85	171.79
15	3	1400	1476.53	2.53	88.72	1.35	7.8	1.34	1.33	1397.85	0.81	121.35	180.69
16	3	1500	1476.61	2.61	89.64	1.5	8.05	1.48	1.97	1496.83	1.2	122.62	188.15
17	3	1600	1476.7	2.7	90.47	1.63	8.3	1.61	2.69	1595.66	1.65	124.91	194.9
18	3	1700	1476.77	2.77	91.34	1.76	8.52	1.74	3.6	1694.2	2.2	125.89	202.11
19	3	1800	1476.85	2.85	92.23	1.88	8.72	1.86	4.7	1792.42	2.88	126.1	209.58
20	3	1900	1476.92	2.92	92.96	2	8.96	1.98	5.78	1890.68	3.54	128.57	215.68
21	3	2000	1477.01	3.01	93.94	2.11	9.1	2.09	7.34	1988.16	4.5	126.78	224.01

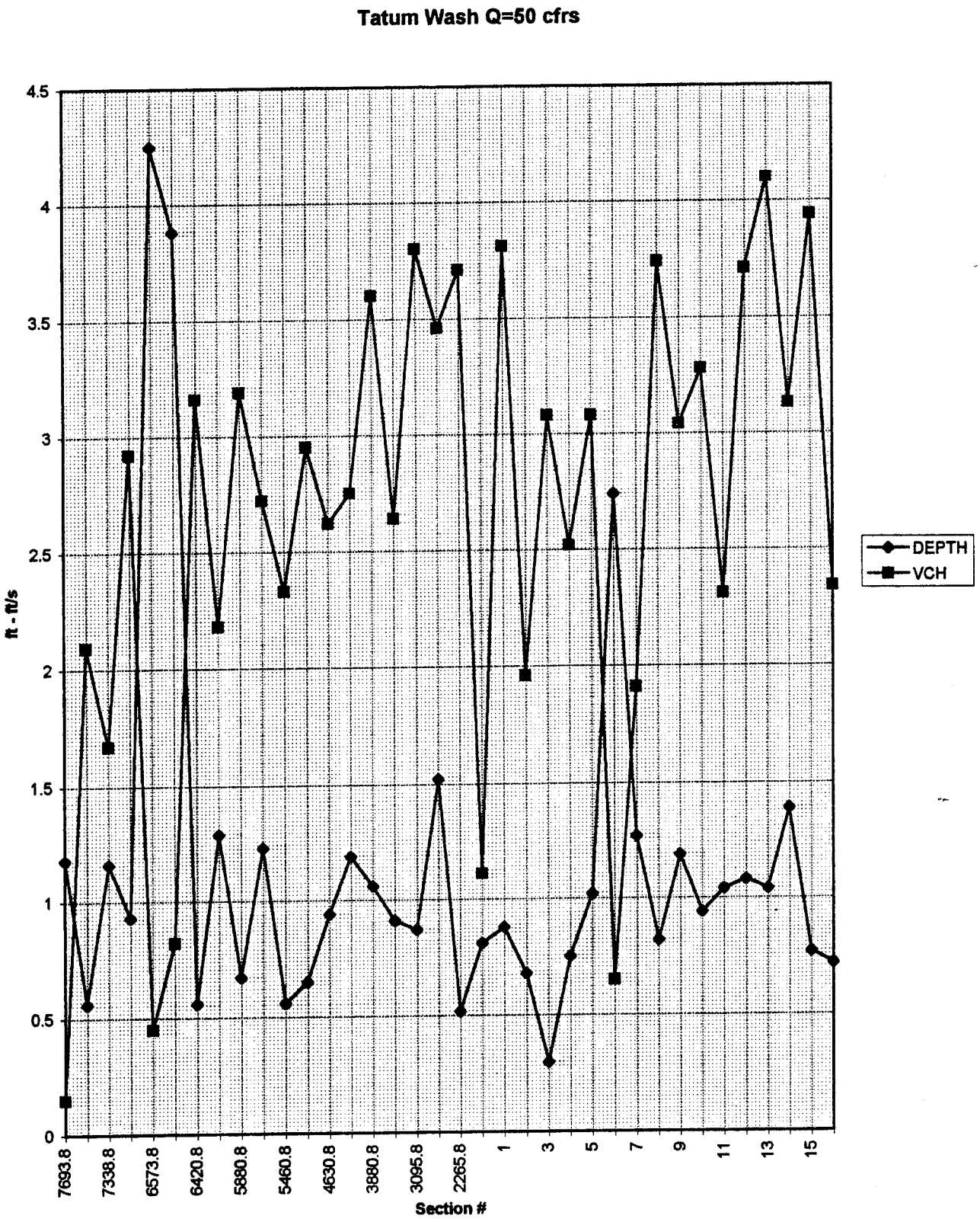
22	3	2100	1477.1	3.1	94.92	2.21	9.24	2.19	9.12	2085.29	5.59	124.88	232.4
23	3	2200	1477.19	3.19	95.88	2.31	9.37	2.29	11.1	2182.09	6.8	123.08	240.75
24	3	2300	1477.28	3.28	96.84	2.41	9.49	2.38	13.31	2278.54	8.15	121.22	249.15
1	4	50	1478.25	0.75	43.51	0	2.52	0	0	50	0	100.36	19.85
2	4	100	1478.48	0.98	48.12	0	3.31	0	0	100	0	113.26	30.21
3	4	200	1478.67	1.17	52.06	0	5.02	0	0	200	0	199.5	39.88
4	4	300	1478.93	1.43	57.32	0	5.56	0	0	300	0	186.12	53.98
5	4	400	1479.15	1.65	61.78	0	5.97	0	0	400	0	177.82	67.02
6	4	500	1479.34	1.84	65.76	0	6.29	0	0	500	0	171.26	79.45
7	4	600	1479.52	2.02	69.33	0	6.57	0	0	600	0	166.77	91.26
8	4	700	1479.68	2.18	72.65	0	6.81	0	0	700	0	162.41	102.81
9	4	800	1479.83	2.33	75.73	0	7.02	0	0	800	0	158.81	114.02
10	4	900	1479.97	2.47	78.55	0	7.22	0	0	900	0	156.68	124.68
11	4	1000	1480.09	2.59	80.39	0.04	7.46	0.04	0	1000	0	153.77	134.06
12	4	1100	1480.2	2.7	81.94	0.77	7.69	0.78	0.09	1099.79	0.12	150.03	143.2
13	4	1200	1480.31	2.81	83.5	1.03	7.9	1.03	0.29	1199.31	0.4	145.67	152.56
14	4	1300	1480.42	2.92	84.99	1.24	8.09	1.25	0.63	1298.49	0.88	142.31	161.64
15	4	1400	1480.53	3.03	86.45	1.42	8.28	1.43	1.14	1397.28	1.58	139.03	170.73
16	4	1500	1480.63	3.13	87.89	1.59	8.45	1.59	1.82	1495.65	2.53	135.93	179.78
17	4	1600	1480.73	3.23	89.3	1.74	8.61	1.74	2.69	1593.57	3.73	132.93	188.84
18	4	1700	1480.83	3.33	90.66	1.87	8.76	1.88	3.74	1691.07	5.19	130.36	197.75
19	4	1800	1480.93	3.43	92	1.99	8.91	2	4.98	1788.12	6.9	127.96	206.62
20	4	1900	1481.02	3.52	93.3	2.11	9.06	2.12	6.39	1884.76	8.85	125.91	215.32
21	4	2000	1481.12	3.62	94.61	2.22	9.19	2.23	8.02	1980.86	11.12	123.56	224.25
22	4	2100	1481.21	3.71	95.87	2.32	9.32	2.33	9.81	2076.59	13.6	121.67	232.93
23	4	2200	1481.3	3.8	97.1	2.42	9.45	2.43	11.78	2171.89	16.32	119.96	241.53
24	4	2300	1481.39	3.89	98.33	2.51	9.57	2.52	13.96	2266.71	19.34	118.15	250.22
1	5	50	1481.02	1.02	32.15	0	3.08	0	0	50	0	131.1	16.25
2	5	100	1481.32	1.32	42.33	0	3.55	0	0	100	0	120.87	28.17
3	5	200	1481.66	1.66	59	0	3.65	0	0	200	0	82.22	54.74
4	5	300	1482.12	2.12	66.26	0.03	4.21	0.42	0	299.94	0.06	84.99	71.38
5	5	400	1482.32	2.32	70.71	0.79	4.75	0.82	0.12	399.07	0.8	86.9	85.11
6	5	500	1482.5	2.5	74.61	1.07	5.22	1.1	0.39	497	2.61	88.91	97.87
7	5	600	1482.66	2.66	78.12	1.3	5.64	1.34	0.83	593.66	5.51	90.75	109.94
8	5	700	1482.8	2.8	81.34	1.5	6.02	1.55	1.43	689.08	9.49	92.4	121.5
9	5	800	1482.93	2.93	84.29	1.67	6.38	1.73	2.18	783.38	14.44	94.14	132.52
10	5	900	1483.05	3.05	87.14	1.83	6.69	1.9	3.09	876.43	20.48	95.06	143.54
11	5	1000	1483.17	3.17	89.69	1.98	7	2.05	4.11	968.7	27.19	96.96	153.67
12	5	1100	1483.28	3.28	92.04	2.12	7.31	2.2	5.23	1060.16	34.61	99.08	163.31
13	5	1200	1483.38	3.38	94.2	2.26	7.61	2.34	6.43	1150.97	42.6	101.63	172.36
14	5	1300	1483.47	3.47	96.37	2.38	7.88	2.46	7.78	1240.68	51.54	103.28	181.65
15	5	1400	1483.56	3.56	98.31	2.5	8.16	2.59	9.18	1330.01	60.8	105.69	190.18
16	5	1500	1483.65	3.65	100.08	2.62	8.44	2.71	10.63	1418.99	70.38	108.63	198.09
17	5	1600	1483.73	3.73	101.96	2.73	8.68	2.83	12.24	1506.67	81.09	110.23	206.66
18	5	1700	1483.81	3.81	103.82	2.84	8.91	2.94	13.97	1593.53	92.5	111.5	215.26
19	5	1800	1483.93	3.93	106.55	2.9	8.98	3	16.3	1675.78	107.92	106.91	228.21
20	5	1900	1484.06	4.06	108.51	2.96	9.03	3.12	18.77	1754.78	126.45	102.36	241.33
21	5	2000	1484.17	4.17	109.49	3.02	9.1	3.27	21.21	1832.14	146.65	99.31	253.19
22	5	2100	1484.24	4.24	110.16	3.1	9.28	3.42	23.31	1913.21	163.48	100.2	261.38
23	5	2200	1484.3	4.3	110.7	3.19	9.51	3.57	25.31	1995.65	179.04	102.55	268.01
24	5	2300	1484.4	4.4	111.57	3.24	9.59	3.69	27.95	2072.21	199.84	100.46	278.71
1	6	50	1481.24	2.74	55.69	0	0.65	0	0	50	0	1.57	76.36
2	6	100	1481.64	3.14	63.9	0	0.99	0	0	100	0	3.02	100.53
3	6	200	1482.21	3.71	136.01	0.23	1.41	0.14	3.08	196.88	0.04	4.47	153.9
4	6	300	1482.56	4.06	142.15	0.47	1.72	0.3	16.49	282.96	0.55	5.4	201.77
5	6	400	1482.85	4.35	147.28	0.64	1.96	0.41	34.94	363.32	1.74	6.02	243.43
6	6	500	1483.11	4.61	151.86	0.79	2.16	0.51	56.54	439.83	3.63	6.44	281.83
7	6	600	1483.34	4.84	156.08	0.92	2.33	0.59	80.4	513.37	6.23	6.73	318.32
8	6	700	1483.56	5.06	159.85	1.03	2.49	0.66	105.39	585.23	9.38	7.02	351.72
9	6	800	1483.76	5.26	163.42	1.13	2.63	0.73	131.66	655.18	13.15	7.23	384.08
10	6	900	1483.94	5.44	166.69	1.22	2.76	0.79	158.57	724.04	17.4	7.45	414.34
11	6	1000	1484.12	5.62	169.05	1.3	2.87	0.88	186.6	790.33	23.06	7.56	445.17
12	6	1100	1484.3	5.8	170.78	1.38	2.98	0.97	214.6	856.08	29.31	7.72	473.13
13	6	1200	1484.46	5.96	172.54	1.45	3.08	1.05	243.64	920.2	36.16	7.79	501.73
14	6	1300	1484.61	6.11	174.16	1.51	3.17	1.13	272.77	984.03	43.2	7.91	528.37
15	6	1400	1484.77	6.27	175.82	1.57	3.26	1.2	302.87	1046.32	50.81	7.94	556.04
16	6	1500	1484.93	6.43	177.5	1.63	3.33	1.26	333.74	1107.36	58.91	7.92	584.31
17	6	1600	1485.06	6.56	178.94	1.69	3.42	1.32	363.85	1169.4	66.75	8.02	608.57
18	6	1700	1485.2	6.7	180.41	1.74	3.49	1.38	394.73	1230.21	75.05	8.07	633.74

19	6	1800	1485.33	6.83	181.76	1.79	3.57	1.43	425.43	1291.22	83.35	8.16	656.96
20	6	1900	1485.45	6.95	183.08	1.84	3.65	1.49	456.42	1351.71	91.87	8.25	679.82
21	6	2000	1485.57	7.07	184.25	1.9	3.74	1.54	487.03	1412.73	100.24	8.4	700.27
22	6	2100	1485.69	7.19	185.5	1.94	3.81	1.59	518.44	1472.46	109.1	8.48	722.19
23	6	2200	1485.8	7.3	186.75	1.99	3.88	1.63	550.22	1531.55	118.23	8.53	744.25
24	6	2300	1485.91	7.41	187.89	2.03	3.95	1.68	581.77	1590.95	127.27	8.63	764.6
1	7	50	1481.27	1.27	24.22	0	1.91	0.4	0	49.91	0.09	18.09	26.34
2	7	100	1481.68	1.68	26.47	0	2.73	0.58	0	99.76	0.24	26.55	36.91
3	7	200	1482.23	2.23	31.19	0.43	3.88	0.83	0.15	199.26	0.6	36.74	52.46
4	7	300	1482.52	2.52	34.93	0.86	5.01	1.05	1.47	297.56	0.97	50.75	61.97
5	7	400	1482.72	2.72	37.63	1.22	6.06	1.26	4.11	394.53	1.36	65.59	69.51
6	7	500	1482.87	2.87	39.45	1.56	7.12	1.47	7.43	490.81	1.76	83.74	74.91
7	7	600	1482.96	2.96	40.64	1.87	8.21	1.7	10.94	586.91	2.15	106.18	78.58
8	7	700	1483.14	3.14	43.05	2.17	8.87	1.82	18.08	679.3	2.61	112.91	86.36
9	7	800	1483.4	3.4	46.41	2.42	9.15	1.87	30.29	766.57	3.14	106.82	97.93
10	7	900	1483.65	3.65	49.57	2.63	9.41	1.91	45.26	851.06	3.68	101.87	109.58
11	7	1000	1483.88	3.88	52.61	2.81	9.62	1.94	63.04	932.72	4.25	97.19	121.55
12	7	1100	1484.1	4.1	60.25	2.94	9.83	1.98	83.04	1012.14	4.82	93.53	133.63
13	7	1200	1484.37	4.37	76.66	2.86	9.81	1.97	111.91	1082.65	5.44	84.82	152.07
14	7	1300	1484.63	4.63	92.36	2.76	9.75	1.95	148.24	1145.72	6.04	77.15	173.84
15	7	1400	1484.85	4.85	106.11	2.74	9.73	1.94	189.28	1204.1	6.62	71.74	196.24
16	7	1500	1485.05	5.05	118.38	2.73	9.74	1.94	234.1	1258.74	7.17	67.72	218.83
17	7	1600	1485.23	5.23	129.4	2.74	9.76	1.94	281.69	1310.62	7.69	64.71	241.23
18	7	1700	1485.39	5.39	138.96	2.76	9.82	1.95	330.03	1361.76	8.2	62.84	262.3
19	7	1800	1485.54	5.54	147.97	2.79	9.88	1.96	380.89	1410.41	8.7	61.2	283.5
20	7	1900	1485.6	5.6	151.79	2.89	10.21	2.02	416.29	1474.53	9.19	64.25	292.89
21	7	2000	1485.97	5.97	174.4	2.73	9.46	1.86	527.97	1462.39	9.64	50.3	353.39
22	7	2100	1486.12	6.12	211.21	2.77	9.37	1.85	602.71	1487.26	10.02	47.71	381.47
23	7	2200	1486.18	6.18	229	2.85	9.58	1.89	653.28	1536.27	10.45	49.14	394.91
24	7	2300	1486.28	6.28	235	2.89	9.63	1.89	719.35	1569.82	10.82	48.59	417.34
1	8	50	1484.02	0.82	32.15	0.05	3.74	0	0	50	0	248.26	13.38
2	8	100	1484.27	1.07	34.24	1.11	4.65	0.04	0.32	99.67	0	204.58	21.75
3	8	200	1484.68	1.48	37.5	1.85	5.78	0.04	3.24	196.75	0	171.12	35.85
4	8	300	1484.99	1.79	40.18	2.29	6.56	1.07	8.88	290.94	0.17	154.38	48.42
5	8	400	1485.27	2.07	42.54	2.62	7.15	1.22	16.84	382.83	0.33	143.29	60.22
6	8	500	1485.53	2.33	44.68	2.88	7.65	1.34	26.81	472.67	0.52	135.18	71.51
7	8	600	1485.89	2.69	47.67	2.94	7.6	1.37	41.79	557.39	0.82	106.15	88.19
8	8	700	1486.17	2.97	51.03	3.18	7.79	1.42	59.55	639.33	1.11	95.93	101.62
9	8	800	1486.35	3.15	53.72	3.45	8.21	1.51	76.95	721.66	1.39	97.44	111.07
10	8	900	1486.51	3.31	56.22	3.68	8.61	1.6	95.63	802.68	1.68	98.9	120.31
11	8	1000	1486.67	3.47	58.48	3.88	9	1.68	115.23	882.78	1.99	100.99	129.01
12	8	1100	1486.81	3.61	60.55	4.06	9.38	1.76	135.71	961.98	2.31	103.43	137.3
13	8	1200	1486.95	3.75	62.75	4.2	9.68	1.82	158.36	1038.99	2.65	103.79	146.43
14	8	1300	1487.12	3.92	65.23	4.3	9.88	1.87	184.02	1112.95	3.03	101.34	157.07
15	8	1400	1487.29	4.09	67.72	4.37	10.04	1.91	211.54	1185.03	3.43	98.45	168.17
16	8	1500	1487.43	4.23	69.91	4.46	10.24	1.95	239.19	1256.97	3.83	97.18	178.33
17	8	1600	1487.57	4.37	71.88	4.55	10.47	2	267.03	1328.74	4.23	97	187.69
18	8	1700	1487.71	4.51	74.04	4.62	10.62	2.03	297.46	1397.85	4.67	95.23	198.28
19	8	1800	1487.89	4.69	76.68	4.63	10.65	2.04	332.64	1462.2	5.15	90.49	211.68
20	8	1900	1488.07	4.87	89.11	4.63	10.65	2.05	371.26	1523.08	5.65	85.65	226.01
21	8	2000	1488.36	5.16	135.44	4.19	10.23	1.98	434.15	1559.58	6.27	72.56	259.14
22	8	2100	1488.57	5.37	158.31	3.88	10.04	1.95	495.92	1597.31	6.77	66.04	280.24
23	8	2200	1488.67	5.47	160.29	3.88	10.18	1.97	541.69	1651.15	7.17	66.23	305.47
24	8	2300	1488.8	5.6	163.01	3.83	10.18	1.98	599.14	1693.28	7.59	63.92	326.82
1	9	50	1487.19	1.19	27.86	0	3.04	0	0	50	0	104.19	16.44
2	9	100	1487.49	1.49	35.18	0	3.81	0	0	100	0	119.91	26.23
3	9	200	1487.89	1.89	44.63	0	4.74	0	0	200	0	134.87	42.21
4	9	300	1488.15	2.15	51.91	0	5.45	0.66	0	299.81	0.18	140.01	55.28
5	9	400	1488.38	2.38	58.11	0	6.07	1.17	0	398.24	1.76	143.65	67.11
6	9	500	1488.57	2.57	63.7	0	6.55	1.55	0	494.67	5.33	144.58	78.92
7	9	600	1488.75	2.75	68.82	0	6.95	1.85	0	589.07	10.93	144.28	90.67
8	9	700	1488.93	2.93	73.98	0	7.21	2.1	0	680.98	19.02	139.58	103.43
9	9	800	1489.09	3.09	78.76	0	7.45	2.31	0	770.93	29.07	135.64	116.1
10	9	900	1489.28	3.28	84.17	0	7.51	2.47	0	857.36	42.64	125.53	131.38
11	9	1000	1489.42	3.42	88.27	0	7.72	2.63	0	943.93	56.06	123.85	143.63
12	9	1100	1489.6	3.6	103.41	0	7.72	2.8	0	1023.71	76.29	114.91	159.86
13	9	1200	1489.75	3.75	123.98	0	7.75	2.84	0	1099.23	100.77	108.53	177.42
14	9	1300	1489.91	3.91	145.34	0	7.7	2.79	0	1166.42	131.58	100.71	199
15	9	1400	1490.01	4.01	157.21	0	7.86	2.82	0	1241.57	158.43	100.89	214.17

16	9	1500	1490.14	4.14	158.39	0.03	7.85	2.86	0	1304.86	195.14	94.32	234.51
17	9	1600	1490.24	4.24	159.26	0.68	7.97	2.95	0.08	1371.64	228.26	92.52	249.77
18	9	1700	1490.29	4.29	159.76	0.79	8.24	3.08	0.14	1445.84	254.02	96.51	258.13
19	9	1800	1490.4	4.4	160.8	0.96	8.25	3.16	0.32	1505.28	294.4	91.7	276.15
20	9	1900	1490.46	4.46	161.24	1.05	8.5	3.29	0.44	1577.75	321.81	95.42	283.81
21	9	2000	1490.52	4.52	161.86	1.16	8.67	3.4	0.64	1644.54	354.82	96.15	294.7
22	9	2100	1490.59	4.59	162.52	1.26	8.8	3.5	0.91	1709.09	390	96.02	306.34
23	9	2200	1490.66	4.66	163.15	1.36	8.93	3.61	1.22	1773.42	425.36	96.13	317.43
24	9	2300	1490.72	4.72	163.76	1.45	9.06	3.71	1.57	1837.13	461.3	96.24	328.31
1	10	50	1489.54	0.94	32.52	0	3.28	0	0	50	0	163.57	15.26
2	10	100	1489.86	1.26	43.52	0	3.66	0	0	100	0	138.27	27.34
3	10	200	1490.25	1.65	51.92	0	4.32	0.79	0	199.87	0.13	116.79	46.45
4	10	300	1490.53	1.93	55.8	0	4.91	1.28	0	299.05	0.95	111.48	61.64
5	10	400	1490.78	2.18	59.2	0	5.35	1.62	0	397.43	2.57	107.12	75.84
6	10	500	1490.99	2.39	62.14	0	5.74	1.89	0	495.12	4.88	105.39	88.84
7	10	600	1491.18	2.58	64.74	0	6.1	2.12	0	592.24	7.76	105.3	100.8
8	10	700	1491.34	2.74	66.87	0	6.48	2.34	0	689.04	10.96	108.69	111.01
9	10	800	1491.48	2.88	68.8	0	6.84	2.54	0	785.46	14.54	112.22	120.54
10	10	900	1491.57	2.97	70.15	0	7.3	2.76	0	882.04	17.96	121.57	127.34
11	10	1000	1491.7	3.1	71.77	0	7.63	2.94	0	977.89	22.11	125.35	135.71
12	10	1100	1491.78	3.18	72.99	0	8.03	3.14	0	1073.89	26.11	133.2	142.12
13	10	1200	1491.89	3.29	74.46	0	8.31	3.3	0	1169.13	30.86	136.11	150.05
14	10	1300	1492	3.4	76.04	0	8.53	3.44	0	1263.83	36.17	136.59	158.65
15	10	1400	1492.12	3.52	77.66	0.03	8.73	3.53	0	1358.46	41.54	133.79	167.48
16	10	1500	1492.23	3.63	79.25	0.8	8.91	3.62	0.19	1452.6	47.21	131.06	176.33
17	10	1600	1492.34	3.74	80.81	1.03	9.08	3.7	0.53	1546.28	53.19	128.46	185.19
18	10	1700	1492.45	3.85	82.39	1.23	9.23	3.77	1.12	1639.34	59.54	125.46	194.33
19	10	1800	1492.56	3.96	83.88	1.4	9.39	3.84	1.94	1732.01	66.05	123.28	203.11
20	10	1900	1492.66	4.06	85.31	1.56	9.54	3.92	3.01	1824.24	72.75	121.52	211.72
21	10	2000	1492.76	4.16	86.74	1.7	9.68	3.98	4.37	1915.87	79.76	119.59	220.45
22	10	2100	1492.86	4.26	88.14	1.83	9.82	4.05	6.01	2007	86.98	117.83	229.13
23	10	2200	1492.96	4.36	89.55	1.95	9.94	4.11	7.99	2097.48	94.53	115.84	238.02
24	10	2300	1493.06	4.46	90.91	2.07	10.07	4.17	10.23	2187.55	102.21	114.24	246.69
1	11	50	1491.74	1.04	41.37	0	2.31	0	0	50	0	70.35	21.65
2	11	100	1492.03	1.33	52.03	0.03	2.87	0.03	0	100	0	76.79	34.86
3	11	200	1492.35	1.65	59.15	0.83	3.89	0.85	0.18	198.87	0.95	84.71	52.46
4	11	300	1492.6	1.9	64.96	1.21	4.58	1.24	0.79	294.95	4.26	86.36	68.47
5	11	400	1492.82	2.12	69.87	1.5	5.14	1.54	1.82	388.4	9.78	87.67	83.19
6	11	500	1493.01	2.31	74.24	1.73	5.6	1.78	3.22	479.49	17.29	88.42	97.16
7	11	600	1493.2	2.5	78.38	1.93	5.98	1.97	4.99	568.18	26.83	87.53	111.21
8	11	700	1493.38	2.68	82.46	2.09	6.27	2.14	7.16	654.35	38.49	84.98	125.8
9	11	800	1493.56	2.86	86.36	2.22	6.52	2.28	9.66	738.4	51.94	82.37	140.42
10	11	900	1493.74	3.04	90.53	2.32	6.67	2.38	12.65	819.31	68.04	77.46	156.82
11	11	1000	1493.91	3.21	94.23	2.42	6.85	2.48	15.82	899.14	85.04	74.72	172.02
12	11	1100	1494.07	3.37	96.91	2.5	6.97	2.62	19.29	974.8	105.91	71.21	187.91
13	11	1200	1494.22	3.52	97.94	2.59	7.13	2.81	22.74	1048.53	128.73	69.62	201.65
14	11	1300	1494.35	3.65	98.9	2.67	7.29	2.98	26.34	1121.72	151.94	68.55	214.64
15	11	1400	1494.46	3.77	99.77	2.75	7.48	3.15	29.99	1195.17	174.83	68.42	226.35
16	11	1500	1494.58	3.88	100.6	2.84	7.65	3.3	33.81	1267.99	198.2	68.32	237.74
17	11	1600	1494.69	3.99	101.4	2.91	7.82	3.44	37.78	1340.19	222.02	68.24	248.86
18	11	1700	1494.79	4.09	102.17	2.99	7.99	3.58	41.86	1412.15	245.99	68.39	259.45
19	11	1800	1494.89	4.19	102.93	3.06	8.15	3.71	46.14	1483.22	270.63	68.28	270.17
20	11	1900	1495	4.3	103.69	3.13	8.29	3.83	50.59	1553.66	295.75	68.08	280.83
21	11	2000	1495.09	4.39	104.41	3.2	8.44	3.94	55.15	1623.81	321.03	68	291.15
22	11	2100	1495.19	4.49	105.12	3.26	8.58	4.05	59.85	1693.52	346.63	67.91	301.33
23	11	2200	1495.29	4.59	105.8	3.33	8.72	4.16	64.64	1763.03	372.33	67.94	311.17
24	11	2300	1495.38	4.68	106.49	3.39	8.85	4.26	69.6	1831.96	398.44	67.86	321.04
1	12	50	1493.38	1.08	24.97	0	3.71	0	0	50	0	174.56	13.48
2	12	100	1493.71	1.41	32.62	0	4.34	0	0	100	0	167.68	23.02
3	12	200	1494.11	1.81	40.69	0.04	5.32	0.04	0	200	0	167.3	37.69
4	12	300	1494.37	2.07	44.11	1.2	6.23	1.24	0.26	298.9	0.84	165.99	48.87
5	12	400	1494.64	2.34	47.55	1.65	6.77	1.7	1.04	395.58	3.38	150.79	61.05
6	12	500	1494.88	2.58	50.7	1.97	7.21	2.02	2.37	489.93	7.71	139.72	72.97
7	12	600	1495.1	2.8	53.58	2.22	7.59	2.29	4.19	582.16	13.65	131.89	84.55
8	12	700	1495.31	3.01	56.23	2.43	7.94	2.5	6.46	672.5	21.04	126.21	95.79
9	12	800	1495.5	3.2	58.74	2.61	8.24	2.69	9.15	761.02	29.82	121.34	106.92
10	12	900	1495.68	3.38	61.07	2.78	8.53	2.86	12.2	848.06	39.74	117.88	117.67
11	12	1000	1495.84	3.54	63.1	2.94	8.85	3.03	15.42	934.32	50.25	117.09	127.4
12	12	1100	1496.07	3.77	68.9	3	8.82	3.15	20.08	1013.01	66.91	103.82	142.83

13	12	1200	1496.23	3.93	76.56	3.12	9.04	3.3	24.03	1092.47	83.5	101.94	153.9
14	12	1300	1496.4	4.1	85.39	3.19	9.13	3.33	28.65	1166.94	104.4	96.68	168.11
15	12	1400	1496.57	4.27	93.67	3.26	9.23	3.33	33.43	1238.9	127.66	92.43	182.84
16	12	1500	1496.72	4.42	101.41	3.33	9.33	3.32	38.33	1308.53	153.14	89.02	197.85
17	12	1600	1496.86	4.56	108.73	3.39	9.42	3.33	43.32	1375.86	180.81	86.16	213.13
18	12	1700	1497	4.7	115.74	3.45	9.51	3.33	48.43	1440.84	210.73	83.57	228.78
19	12	1800	1497.14	4.83	122.33	3.5	9.6	3.34	53.58	1504.09	242.32	81.46	244.37
20	12	1900	1497.26	4.96	128.59	3.56	9.69	3.36	58.78	1565.66	275.56	79.67	259.97
21	12	2000	1497.38	5.08	134.53	3.61	9.79	3.39	64.02	1625.73	310.24	78.16	275.52
22	12	2100	1497.49	5.19	140.23	3.65	9.87	3.41	69.3	1684.34	346.35	76.82	291.06
23	12	2200	1497.6	5.3	145.51	3.71	9.97	3.44	74.56	1742.34	383.1	75.9	306.08
24	12	2300	1497.69	5.39	150.31	3.76	10.09	3.48	79.74	1800.42	419.84	75.52	320.16
1	13	50	1497.64	1.04	23.39	0	4.1	0	0	50	0	223.24	12.2
2	13	100	1497.98	1.38	30.84	0	4.72	0	0	100	0	204.4	21.21
3	13	200	1498.42	1.82	42.09	0	5.37	0	0	200	0	189.53	37.24
4	13	300	1498.72	2.12	50	0	5.84	0	0	300	0	183.48	51.38
5	13	400	1498.99	2.39	56.81	0	6.11	0	0	400	0	172.16	65.5
6	13	500	1499.28	2.68	83.21	0	5.81	0	0	500	0	180.31	85.99
7	13	600	1499.46	2.86	100.22	0	5.83	0	0	600	0	183.24	102.83
8	13	700	1499.62	3.02	114.67	0	5.85	0	0	700	0	180.38	119.59
9	13	800	1499.73	3.13	124.65	0	6.04	0	0	800	0	187.19	132.48
10	13	900	1499.88	3.28	138.23	0	5.93	0	0	900	0	172.9	151.75
11	13	1000	1499.99	3.39	148.97	0	5.94	0	0	1000	0	166.67	168.4
12	13	1100	1500.07	3.47	150.45	0.04	6.09	0.04	0	1100	0	160.5	180.76
13	13	1200	1500.15	3.55	151.09	0.04	6.26	0.04	0	1200	0	157.34	191.66
14	13	1300	1500.21	3.61	151.64	0.82	6.47	0.04	0.12	1299.88	0	157.57	201.08
15	13	1400	1500.21	3.61	151.69	0.89	6.94	0.04	0.14	1399.86	0	180.32	201.9
16	13	1500	1500.28	3.68	152.28	1.06	7.09	0.04	0.28	1499.71	0	176.33	211.97
17	13	1600	1500.43	3.83	153.58	1.26	6.84	1.19	0.78	1598.99	0.22	144.19	234.41
18	13	1700	1500.51	3.91	154.35	1.39	6.89	1.3	1.24	1698.4	0.36	135.87	247.74
19	13	1800	1500.55	3.95	154.66	1.48	7.14	1.39	1.51	1798.06	0.43	142.13	253.05
20	13	1900	1500.62	4.02	155.28	1.58	7.24	1.49	2.05	1897.36	0.59	138.15	263.89
21	13	2000	1500.68	4.08	155.87	1.68	7.34	1.57	2.67	1996.57	0.76	135.09	274.24
22	13	2100	1500.75	4.15	156.43	1.76	7.44	1.66	3.35	2095.69	0.96	132.62	284.23
23	13	2200	1500.72	4.12	156.21	1.85	7.9	1.73	3.28	2195.78	0.94	152.2	280.34
24	13	2300	1500.78	4.18	156.71	1.93	8.01	1.81	3.99	2294.87	1.14	150.43	289.18
1	14	50	1499.89	1.39	23.03	0	3.13	0	0	50	0	89.36	15.97
2	14	100	1500.32	1.82	39.9	0	3.51	0.85	0	99.61	0.38	98.15	28.82
3	14	200	1500.77	2.27	61.9	0	3.96	1.57	0	195.69	4.31	100.08	52.19
4	14	300	1501.08	2.58	76.57	0	4.26	1.94	0	289.6	10.4	98.09	73.41
5	14	400	1501.31	2.81	87.65	0	4.53	2.21	0	382.52	17.48	98.35	92.39
6	14	500	1501.52	3.02	97.74	0	4.68	2.4	0	474.46	25.54	94.76	111.93
7	14	600	1501.69	3.19	105.87	0	4.88	2.58	0	566.14	33.86	94.77	129.21
8	14	700	1501.83	3.33	112.54	0	5.1	2.75	0	657.67	42.33	97.08	144.42
9	14	800	1501.97	3.47	119.38	0	5.23	2.87	0	748.56	51.43	96.02	160.96
10	14	900	1502.2	3.7	184.92	0.03	4.55	3.39	0	824.14	75.86	101.95	203.48
11	14	1000	1502.28	3.78	185.32	0.8	4.78	3.54	0.12	916.29	83.59	104.16	215.41
12	14	1100	1502.34	3.84	185.72	0.92	4.99	3.68	0.21	1008.42	91.37	105.42	227.32
13	14	1200	1502.4	3.9	186.12	1.03	5.17	3.8	0.33	1100.6	99.07	105.97	239.22
14	14	1300	1502.47	3.97	186.55	1.14	5.32	3.9	0.5	1192.8	106.69	104.71	252
15	14	1400	1502.58	4.08	187.23	1.24	5.3	3.86	0.83	1285.18	113.98	93.69	272.6
16	14	1500	1502.64	4.14	187.6	1.33	5.46	3.96	1.08	1377.25	121.67	94.25	283.74
17	14	1600	1502.64	4.14	187.57	1.42	5.84	4.24	1.14	1469.04	129.82	108.45	282.78
18	14	1700	1502.67	4.17	187.83	1.5	6.05	4.38	1.36	1561.03	137.61	112.09	290.46
19	14	1800	1502.75	4.25	188.3	1.58	6.11	4.41	1.77	1653.1	145.13	107.42	304.64
20	14	1900	1502.8	4.3	188.62	1.65	6.25	4.5	2.11	1745.06	152.83	107.89	314.42
21	14	2000	1502.85	4.35	188.91	1.72	6.4	4.6	2.47	1836.98	160.55	109.16	323.25
22	14	2100	1502.9	4.4	189.21	1.79	6.54	4.68	2.87	1928.87	168.26	109.7	332.5
23	14	2200	1503.02	4.52	189.93	1.83	6.43	4.58	3.74	2020.67	175.59	97.71	354.37
24	14	2300	1503.07	4.57	190.24	1.9	6.55	4.66	4.25	2112.44	183.31	97.93	363.88
1	15	50	1502.27	0.77	27.38	0	3.94	1.17	0	49.77	0.23	225.94	12.81
2	15	100	1502.56	1.06	31.43	0	4.81	1.77	0	98.49	1.51	198.6	21.34
3	15	200	1502.99	1.49	37.47	0	5.76	2.43	0	193.51	6.49	173.82	36.26
4	15	300	1503.33	1.83	42.14	0	6.39	2.86	0	286.36	13.64	163.17	49.6
5	15	400	1503.62	2.12	46.16	0	6.84	3.17	0	377.59	22.41	154.91	62.3
6	15	500	1504.16	2.66	163.92	0.83	4.67	4.64	0.1	441.3	58.6	225.16	107.33
7	15	600	1504.25	2.75	165.14	1.08	4.99	4.68	0.29	535.87	63.83	217.64	121.26
8	15	700	1504.3	2.8	165.97	1.28	5.42	4.91	0.53	629.04	70.43	231.62	130.76
9	15	800	1504.42	2.92	167.63	1.45	5.44	4.64	1.15	725.56	73.29	193.07	150.09

10	15	900	1504.5	3	168.75	1.6	5.64	4.65	1.78	819.93	78.29	185.91	163.25
11	15	1000	1504.57	3.07	169.82	1.73	5.84	4.67	2.53	914.08	83.39	180.42	175.81
12	15	1100	1504.64	3.14	170.81	1.84	6.04	4.71	3.4	1007.97	88.63	176.9	187.6
13	15	1200	1504.74	3.24	172.23	1.92	6.06	4.57	4.73	1102.55	92.72	159.14	204.56
14	15	1300	1504.81	3.31	173.17	2.02	6.24	4.61	5.89	1196.03	98.08	157.02	215.86
15	15	1400	1504.85	3.35	173.74	2.14	6.52	4.77	6.85	1288.9	104.25	164.59	222.74
16	15	1500	1504.94	3.44	175.12	2.19	6.52	4.65	8.7	1382.68	108.62	149.77	239.43
17	15	1600	1504.98	3.48	175.62	2.3	6.79	4.8	9.82	1475.36	114.82	157.22	245.51
18	15	1700	1505.03	3.53	176.35	2.39	6.97	4.87	11.28	1568.21	120.51	158.14	254.51
19	15	1800	1505.09	3.59	177.28	2.45	7.08	4.88	13.1	1661.06	125.84	154.18	265.87
20	15	1900	1505.16	3.66	178.24	2.51	7.16	4.87	15.11	1753.75	131.13	149.26	277.82
21	15	2000	1505.22	3.72	179.15	2.57	7.26	4.87	17.2	1846.23	136.57	145.71	289.08
22	15	2100	1505.21	3.71	178.98	2.71	7.67	5.17	17.8	1938.53	143.67	164.46	286.96
23	15	2200	1505.3	3.8	180.23	2.74	7.64	5.06	20.63	2030.82	148.55	152.41	302.61
24	15	2300	1505.32	3.82	180.54	2.83	7.89	5.21	22.1	2123.06	154.84	159.83	306.58
1	16	50	1504.72	0.72	58.5	0	2.34	0	0	50	0	116.1	21.39
2	16	100	1504.95	0.95	76.2	0	2.76	0	0	100	0	113.36	36.29
3	16	200	1505.26	1.26	100.94	0	3.14	0	0	200	0	101.24	63.68
4	16	300	1505.5	1.5	120.79	0	3.29	0	0	300	0	87.42	91.19
5	16	400	1505.72	1.72	137.75	0	3.37	0	0	400	0	77.11	118.6
6	16	500	1505.93	1.93	154.92	0	3.33	0	0	500	0	64.4	150
7	16	600	1506.04	2.04	160.78	0.02	3.57	0.02	0	600	0	66.26	168.09
8	16	700	1506.16	2.16	162.48	0.02	3.77	0.44	0	699.95	0.05	64.58	185.98
9	16	800	1506.22	2.22	163.41	0.58	4.09	0.58	0.11	799.78	0.11	71.18	195.85
10	16	900	1506.3	2.3	164.66	0.72	4.32	0.72	0.25	899.5	0.26	72.72	209.1
11	16	1000	1506.38	2.38	165.85	0.84	4.53	0.84	0.46	999.07	0.48	74.01	221.89
12	16	1100	1506.45	2.45	167.05	0.95	4.71	0.95	0.75	1098.46	0.79	74.48	234.88
13	16	1200	1506.5	2.5	167.84	1.05	4.96	1.05	1.03	1197.9	1.08	79	243.4
14	16	1300	1506.57	2.57	168.87	1.15	5.14	1.15	1.44	1297.06	1.51	80.15	254.66
15	16	1400	1506.66	2.66	170.11	1.25	5.27	1.25	2.02	1395.86	2.12	78.6	268.34
16	16	1500	1506.7	2.7	170.75	1.33	5.5	1.33	2.45	1494.99	2.56	82.96	275.47
17	16	1600	1506.79	2.79	171.98	1.42	5.6	1.42	3.22	1593.4	3.37	80.89	289.11
18	16	1700	1506.85	2.85	173	1.49	5.73	1.49	4	1691.8	4.19	80.74	300.52
19	16	1800	1506.91	2.91	173.85	1.57	5.89	1.57	4.78	1790.22	5	81.91	310.14
20	16	1900	1506.96	2.96	174.63	1.64	6.05	1.64	5.58	1888.57	5.85	83.46	319
21	16	2000	1507.01	3.01	175.43	1.71	6.2	1.72	6.48	1986.74	6.78	84.68	328.02
22	16	2100	1507.11	3.11	177.1	1.76	6.17	1.76	8.18	2083.25	8.57	78.08	347.15
23	16	2200	1507.14	3.14	177.48	1.84	6.39	1.84	8.91	2181.76	9.33	82.37	351.54
24	16	2300	1507.22	3.22	178.64	1.89	6.44	1.89	10.43	2278.65	10.92	80.01	365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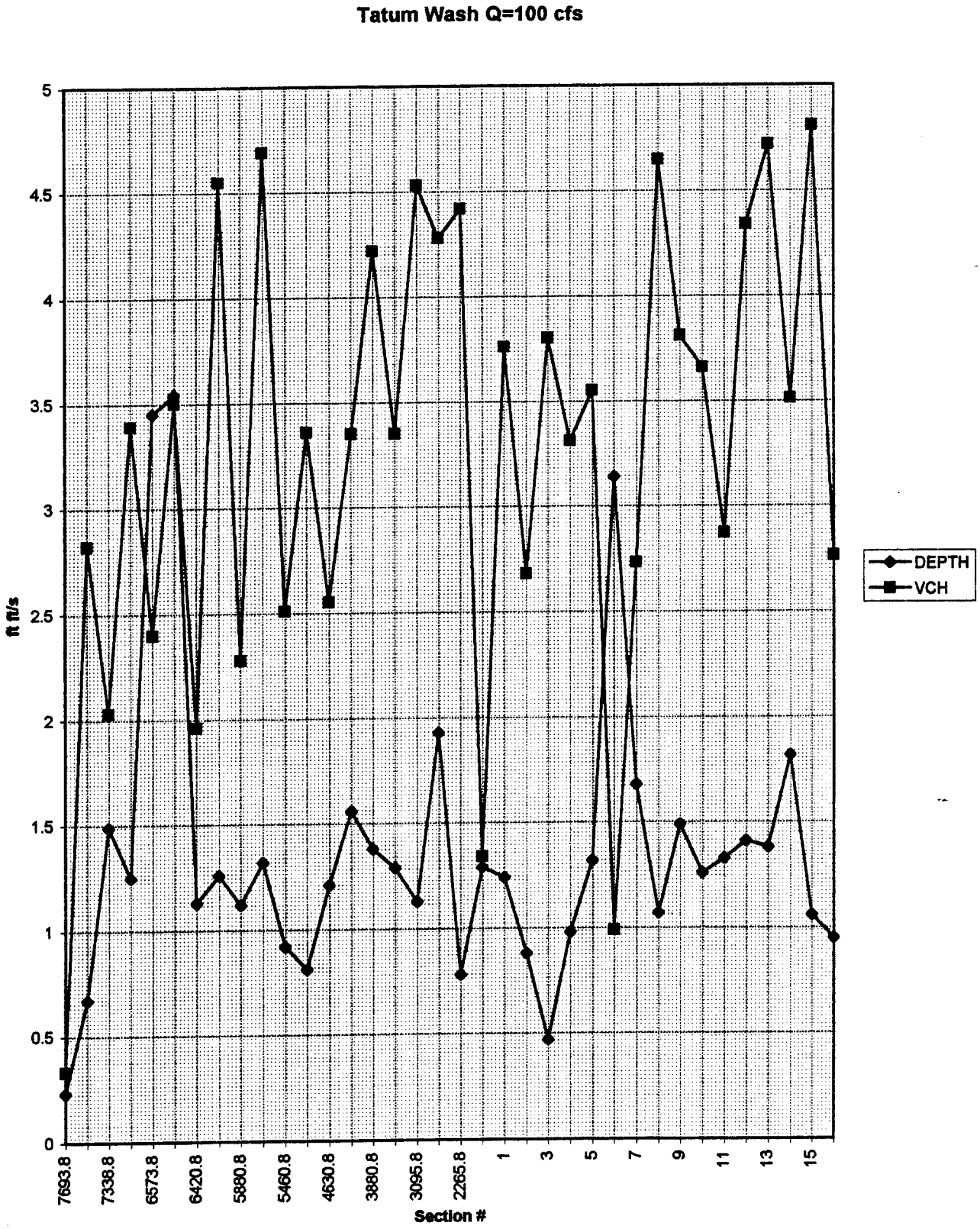
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
ft - ft/s
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
DEPTH
VCH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2.5
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1.5
1
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0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
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2265.8
1
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9
11
13
15
Section #
DEPTH
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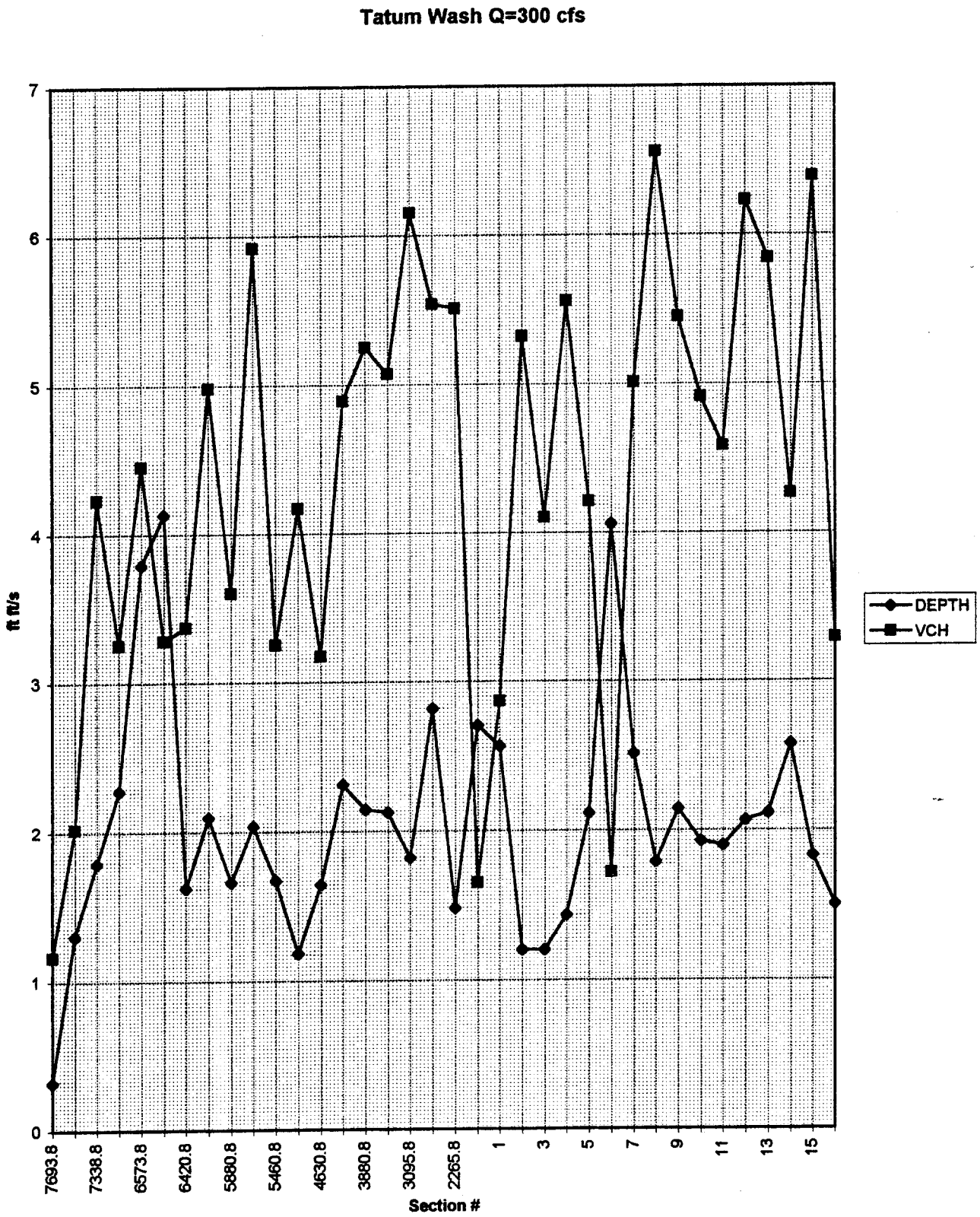
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4
5
6
7
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7338.8
6573.8
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5880.8
5460.8
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3095.8
2265.8
1
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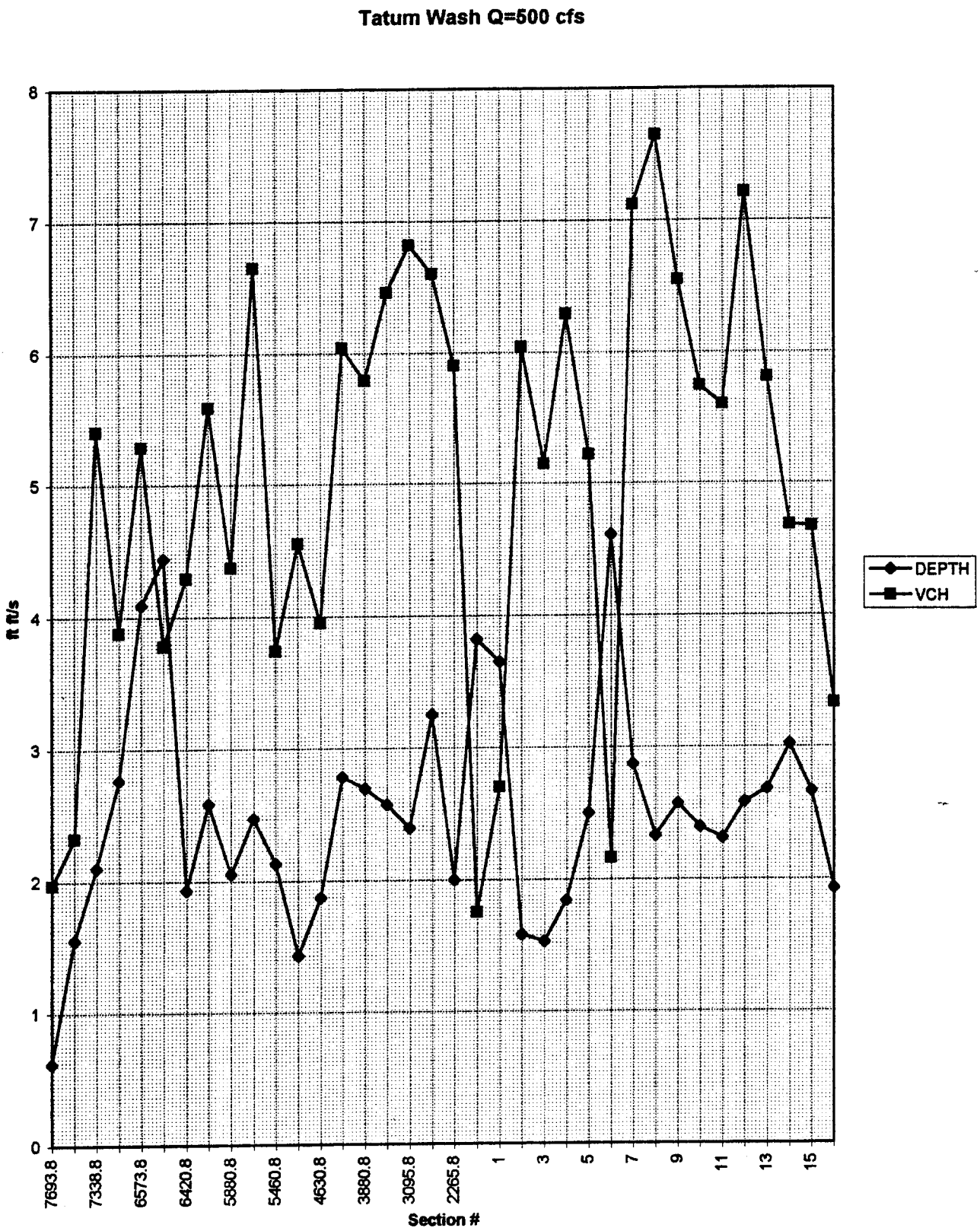
7
9
11
13
15
Section #
DEPTH
VCH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ft ft/s
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6
7
8
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7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
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3095.8
2265.8
1
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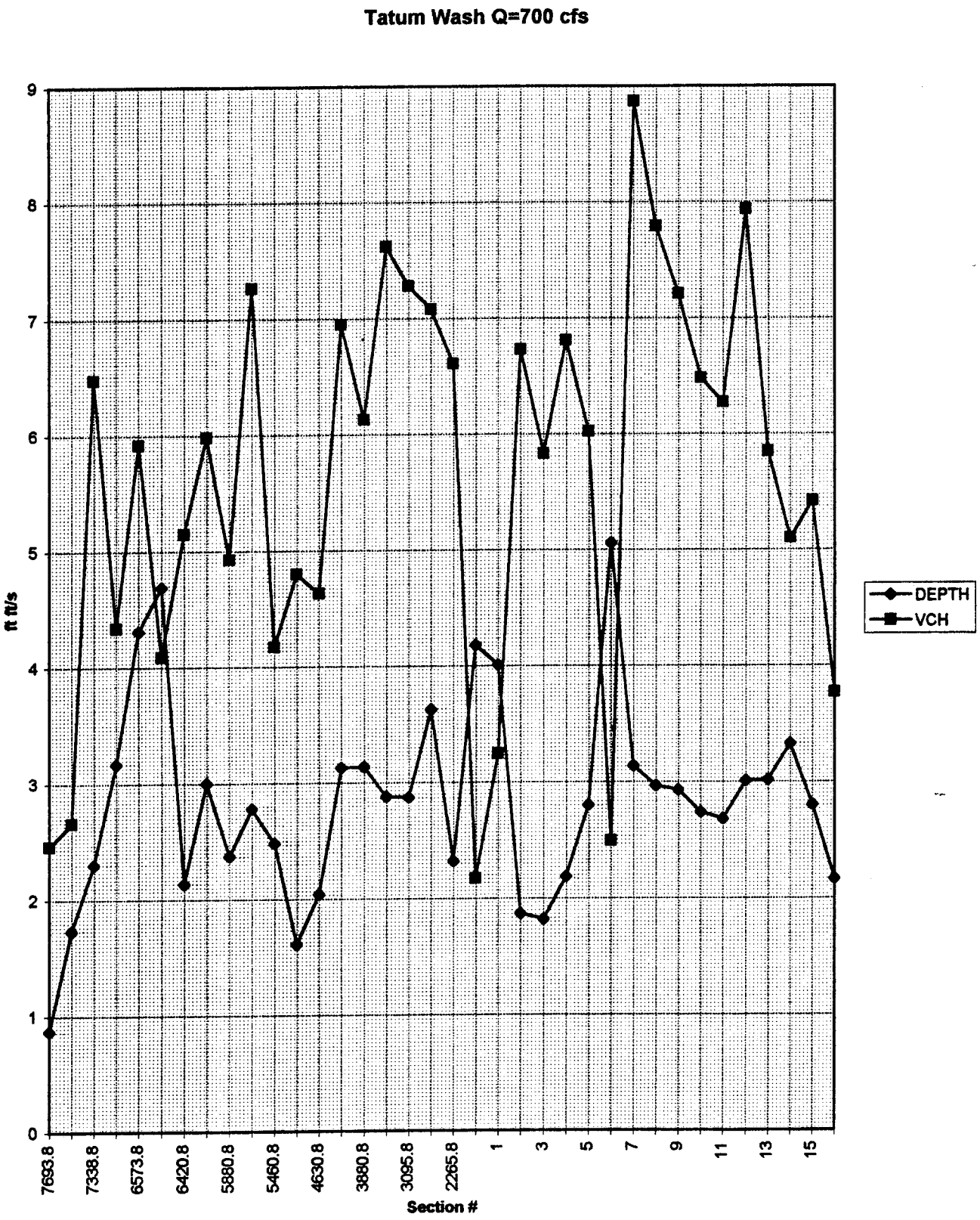
11
13
15
Section #
DEPTH
VCH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1
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3
4
5
6
7
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9
7693.8
7338.8
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6420.8
5880.8
5460.8
4630.8
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3095.8
2265.8
1
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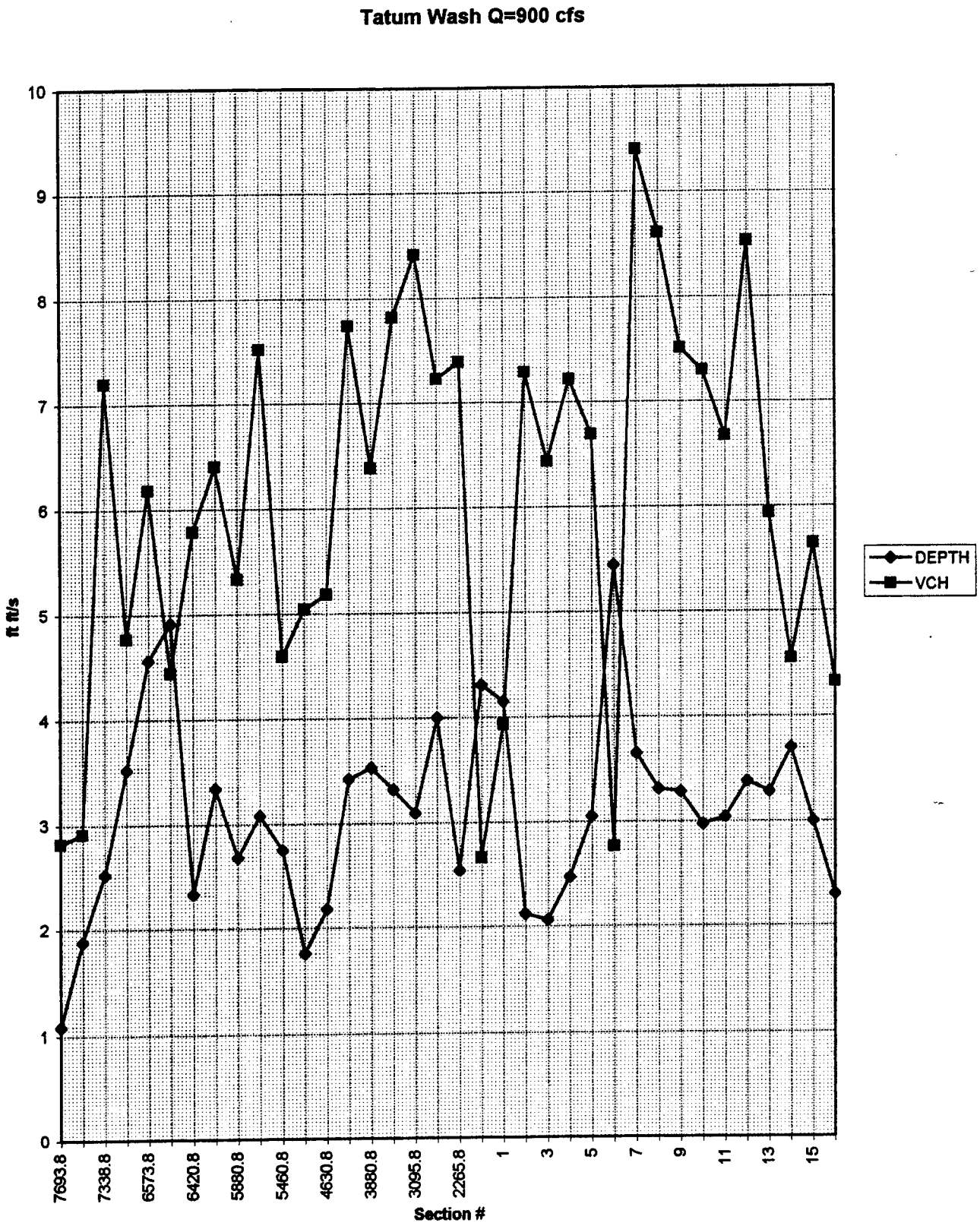
11
13
15
Section #
DEPTH
VCH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10
9
8
7
6
5
4
3
2
1
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
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3095.8
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1
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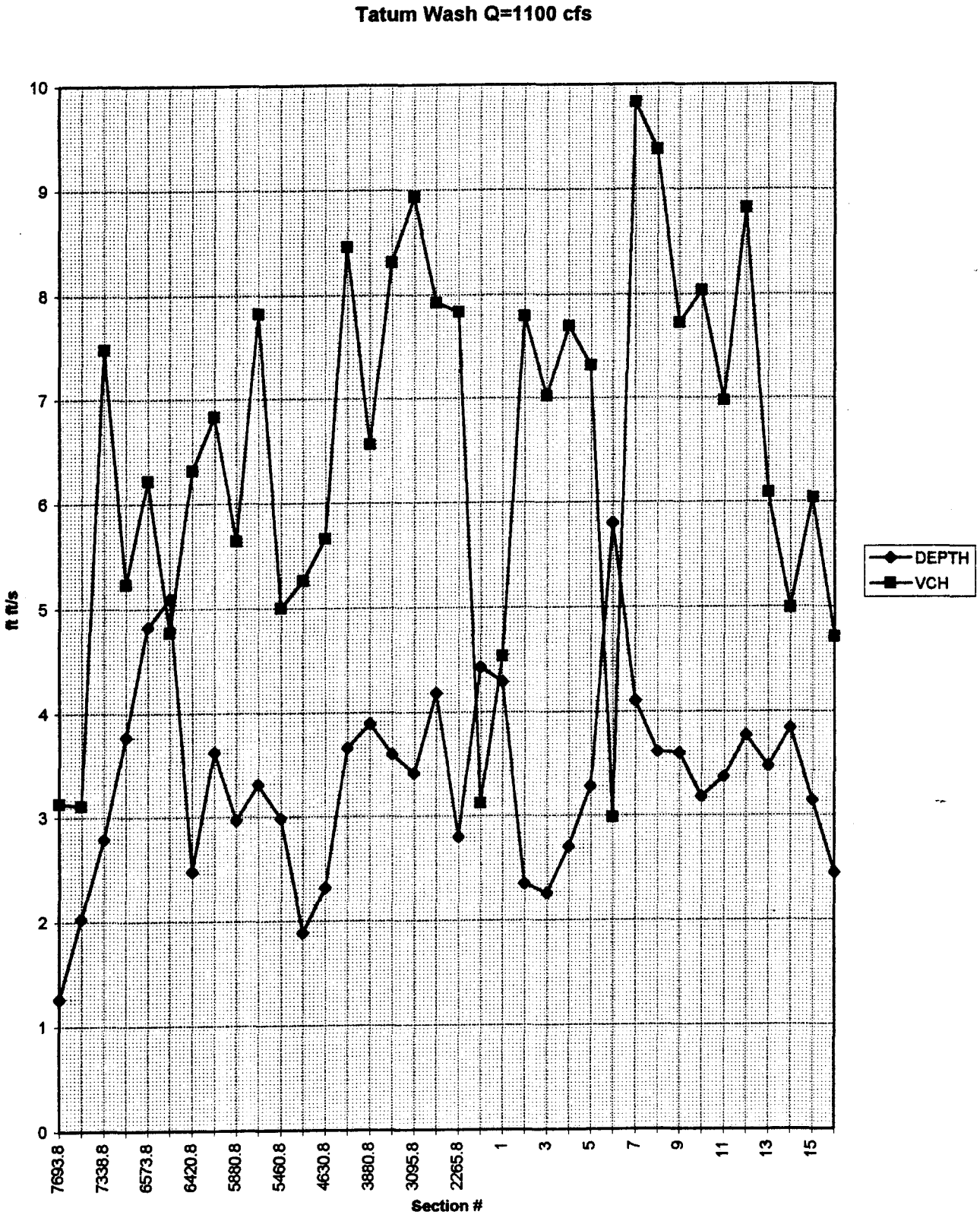
11
13
15
Section #
DEPTH
VCH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9
8
7
6
5
4
3
2
1
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
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3095.8
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1
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11
13
15
Section #
DEPTH
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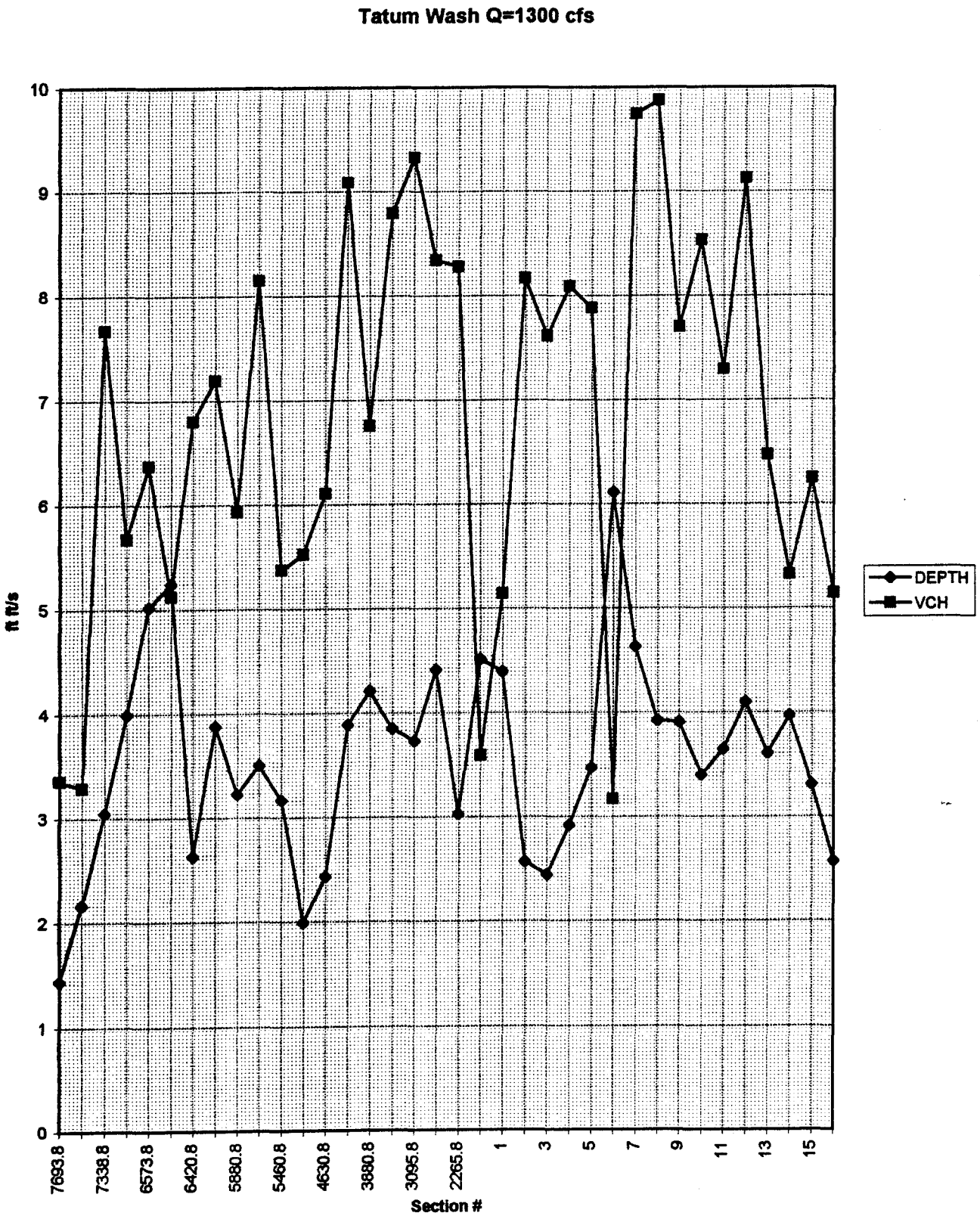
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9
8
7
6
5
4
3
2
1
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
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3095.8
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1
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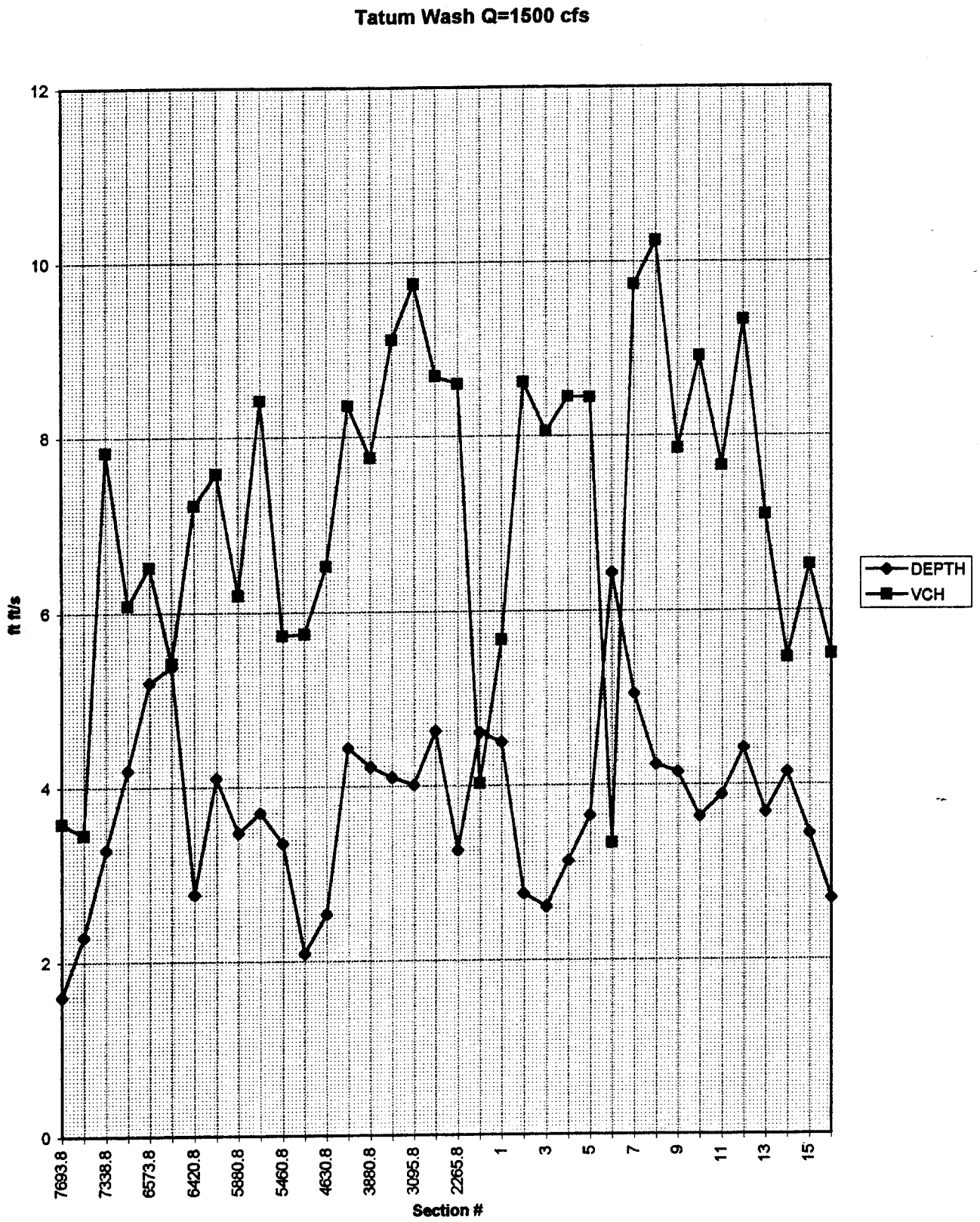
9
11
13
15
Section #
DEPTH
VCH


Tatum Wash Q=1500 cfs
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2
4
6
8
10
12
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
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3095.8
2265.8
1
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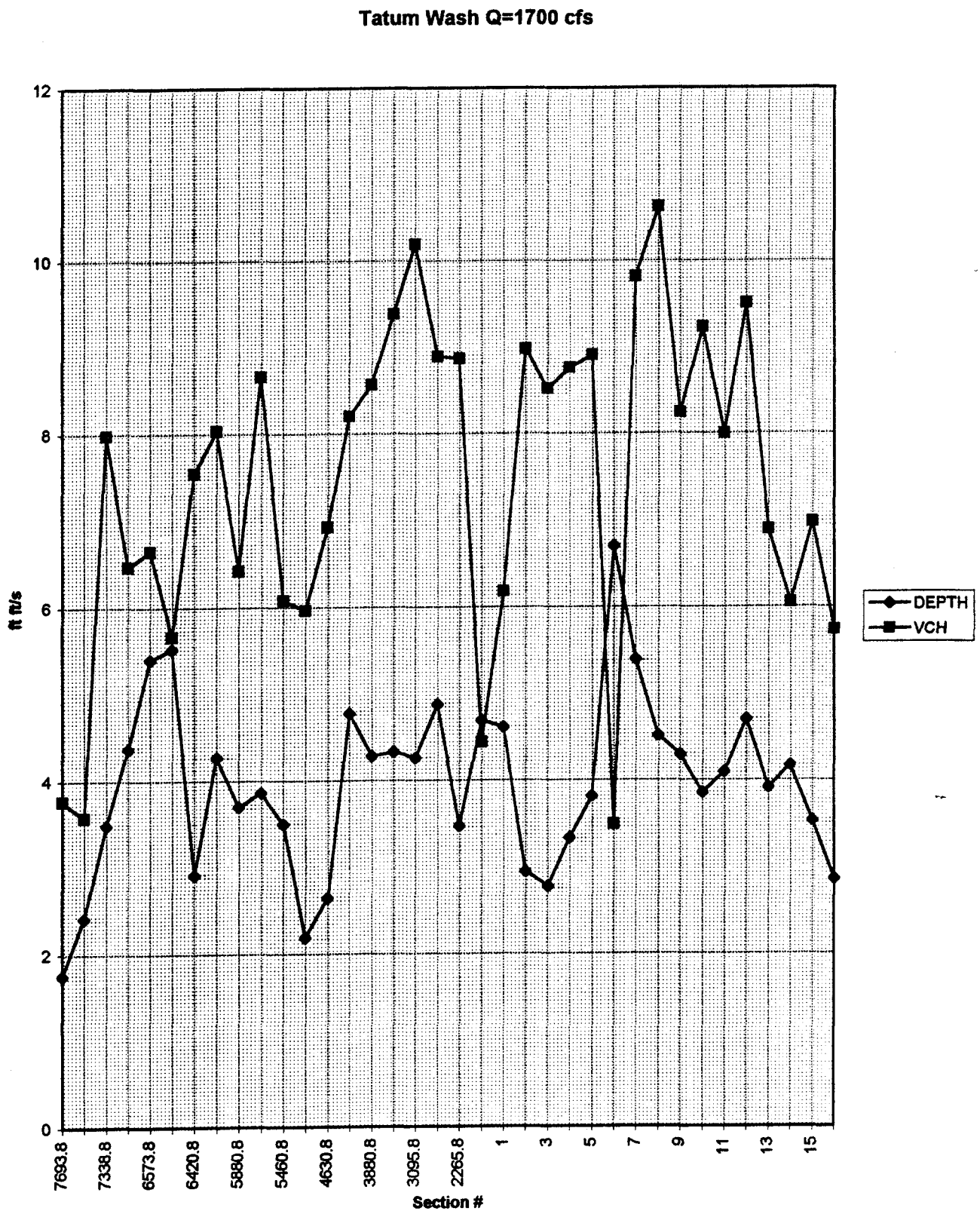
13
15
Section #
DEPTH
VCH


Tatum Wash Q=1700 cfs
ft ft/s
12
10
8
6
4
2
0
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7338.8
6573.8
6420.8
5880.8
5460.8
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3095.8
2265.8
1
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11
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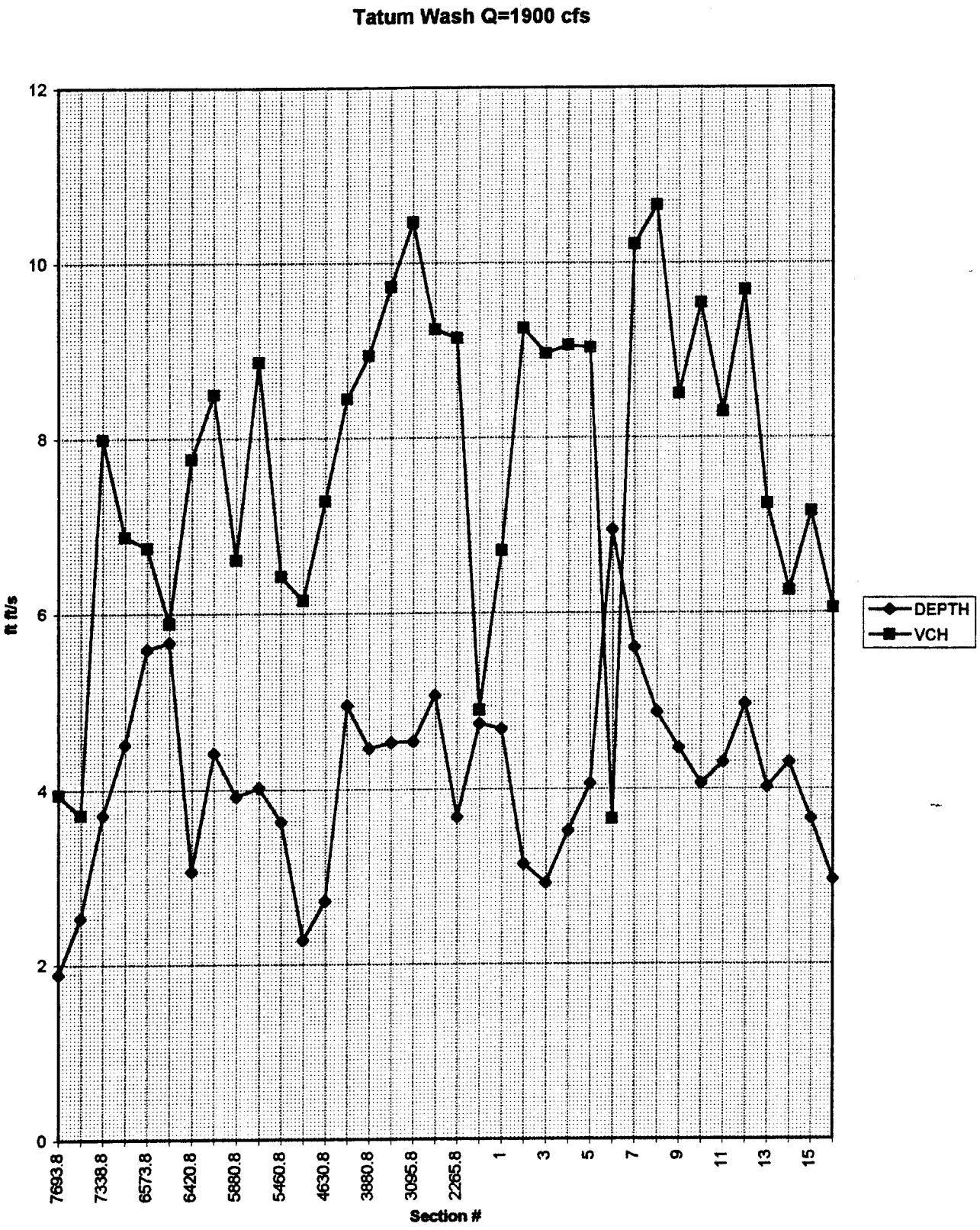
Section #
DEPTH
VCH


Tatum Wash Q=1900 cfs
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2
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6
8
10
12
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6420.8
5880.8
5460.8
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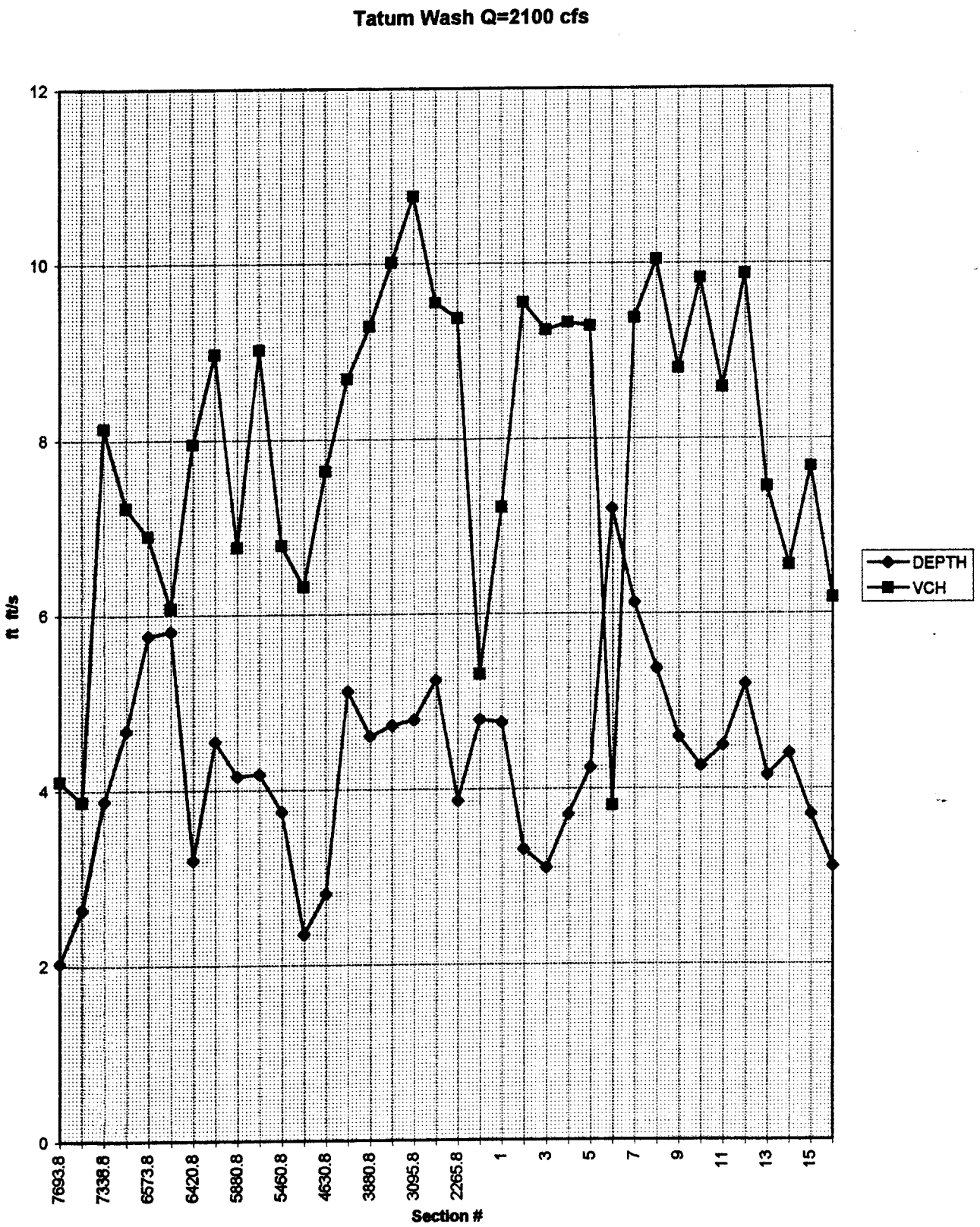
Section #
DEPTH
VCH


Tatum Wash Q=2100 cfs
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2
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6
8
10
12
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6573.8
6420.8
5880.8
5460.8
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3095.8
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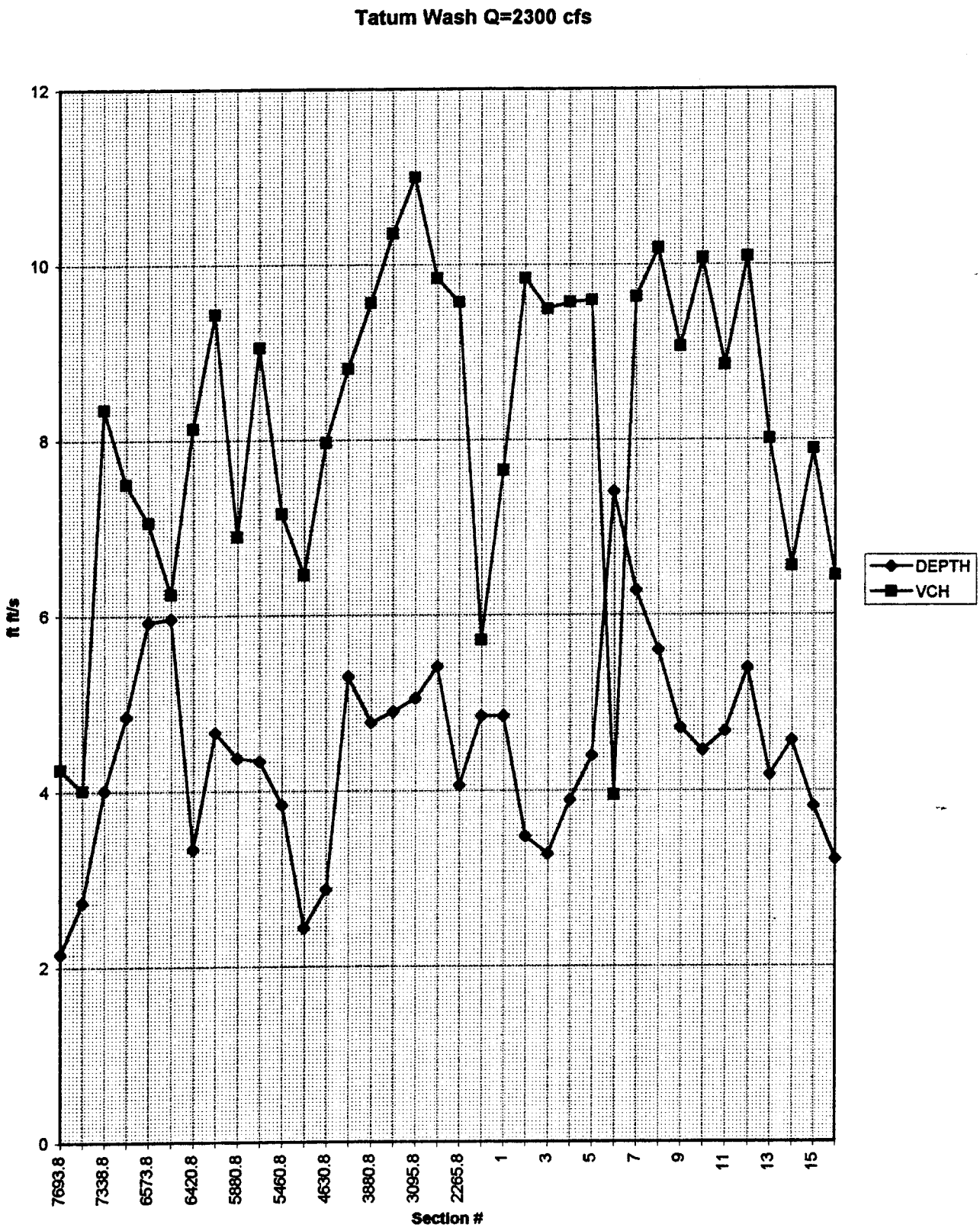
15
Section #
DEPTH
VCH


Tatum Wash Q=2300 cfs
ft ft/s
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2
4
6
8
10
12
7693.8
7338.8
6573.8
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5880.8
5460.8
4630.8
3880.8
3095.8
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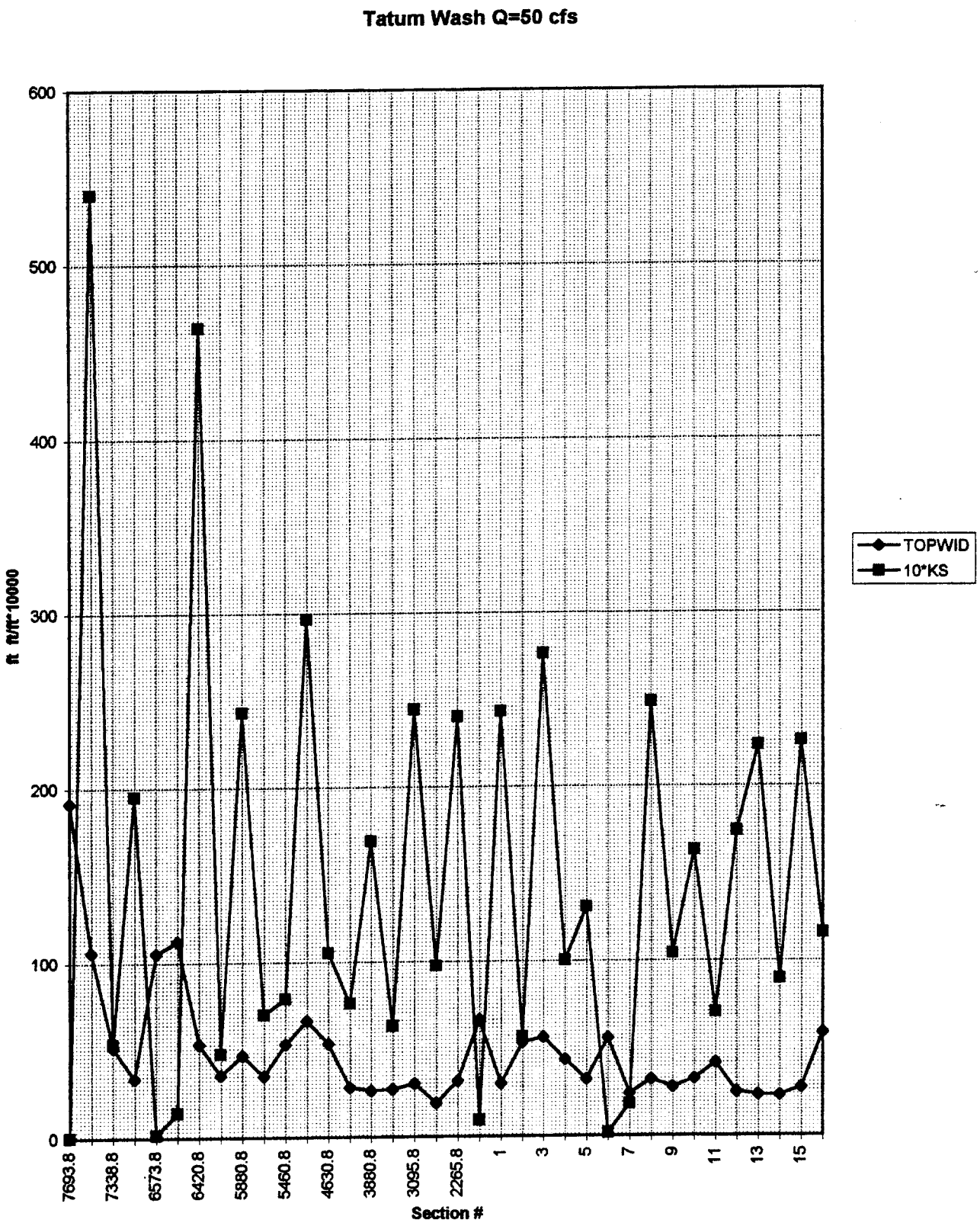
Section #
DEPTH
VCH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500
400
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100
0
ft ft/ft*10000
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6573.8
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5880.8
5460.8
4630.8
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3095.8
2265.8
1
3
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7
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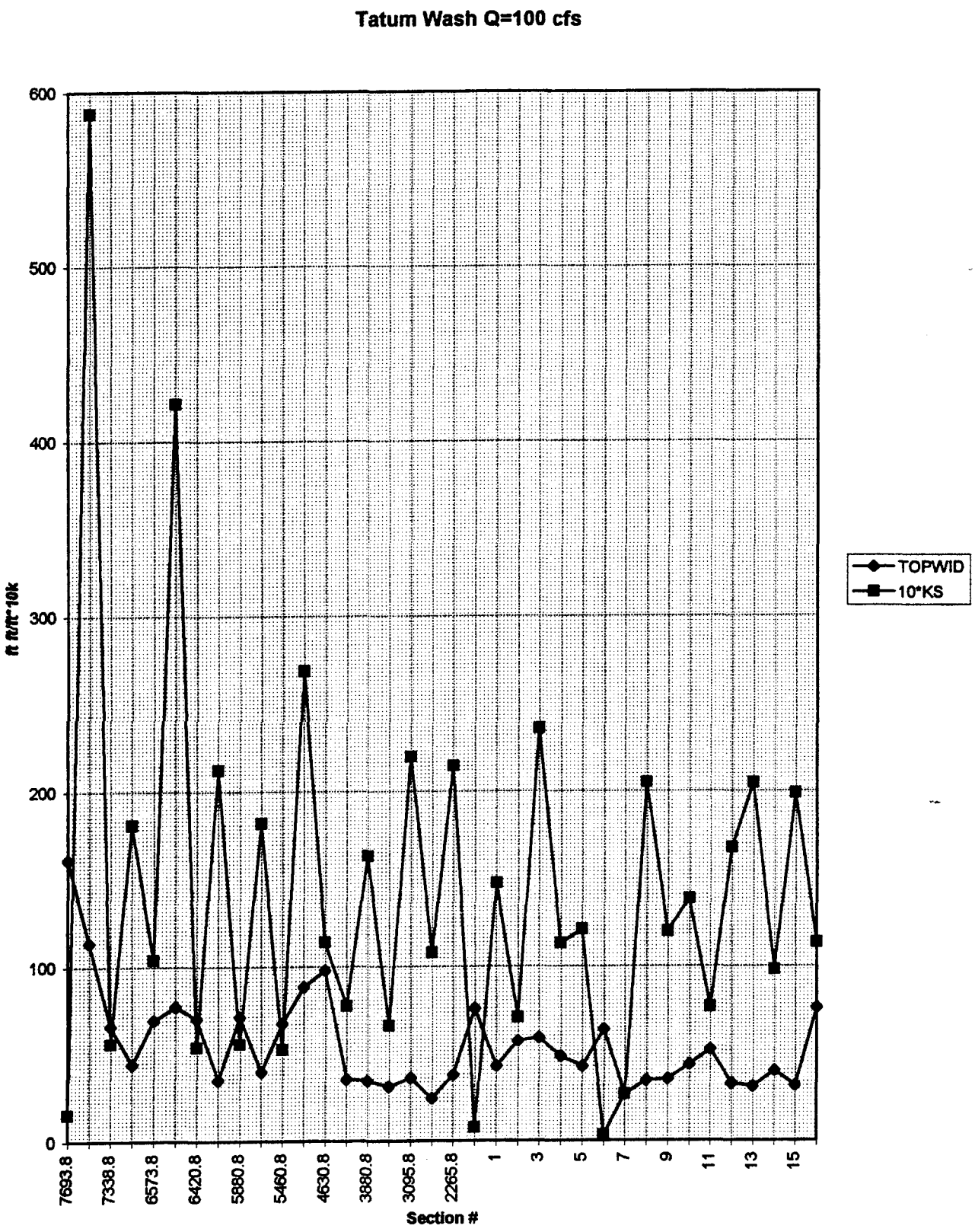
11
13
15
Section #
TOPWID
10*KS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500
400
300
200
100
0
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7338.8
6573.8
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5880.8
5460.8
4630.8
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3095.8
2265.8
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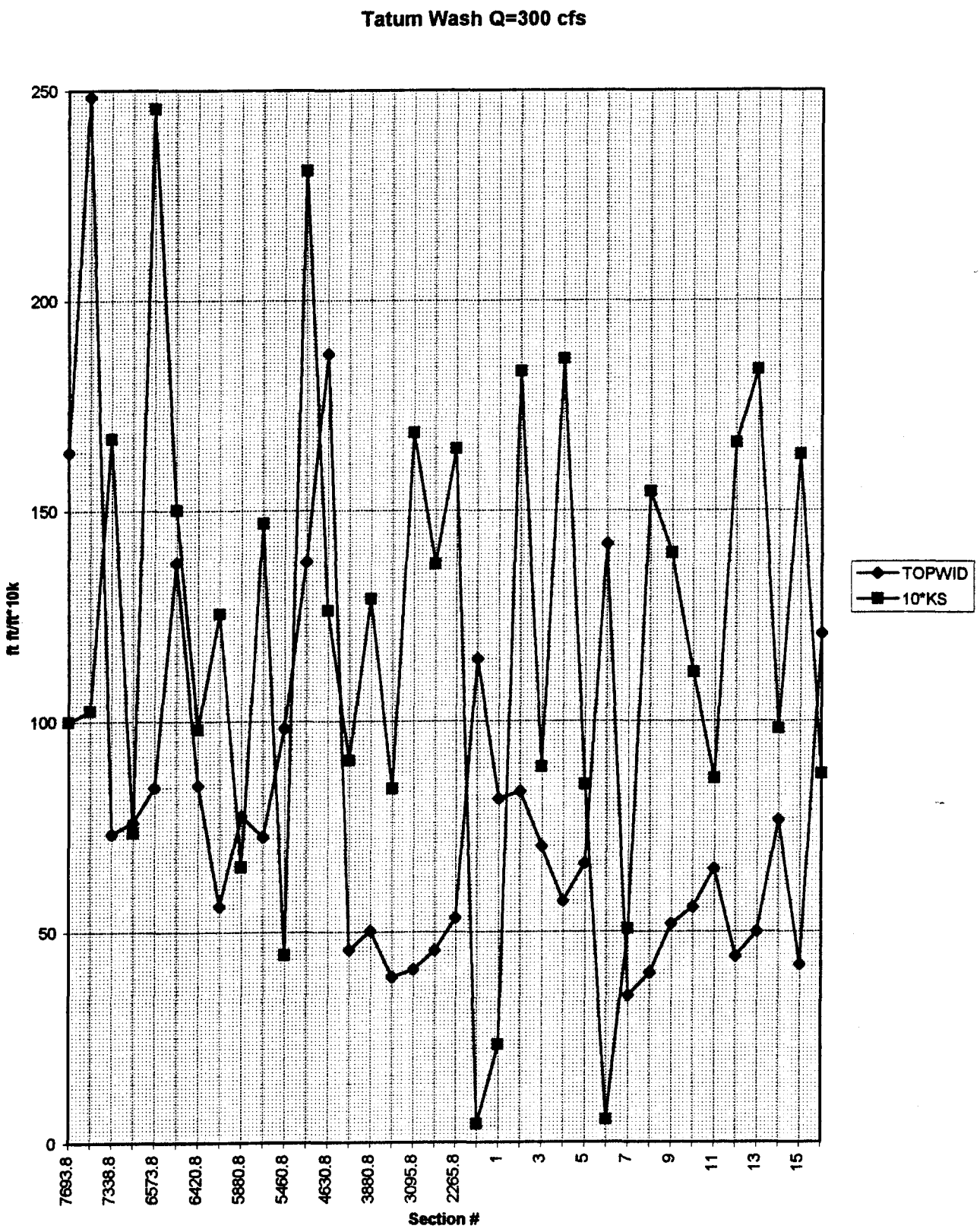
Section #
TOPWID
10*KS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200
150
100
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0
ft ft/ft*10k
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6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
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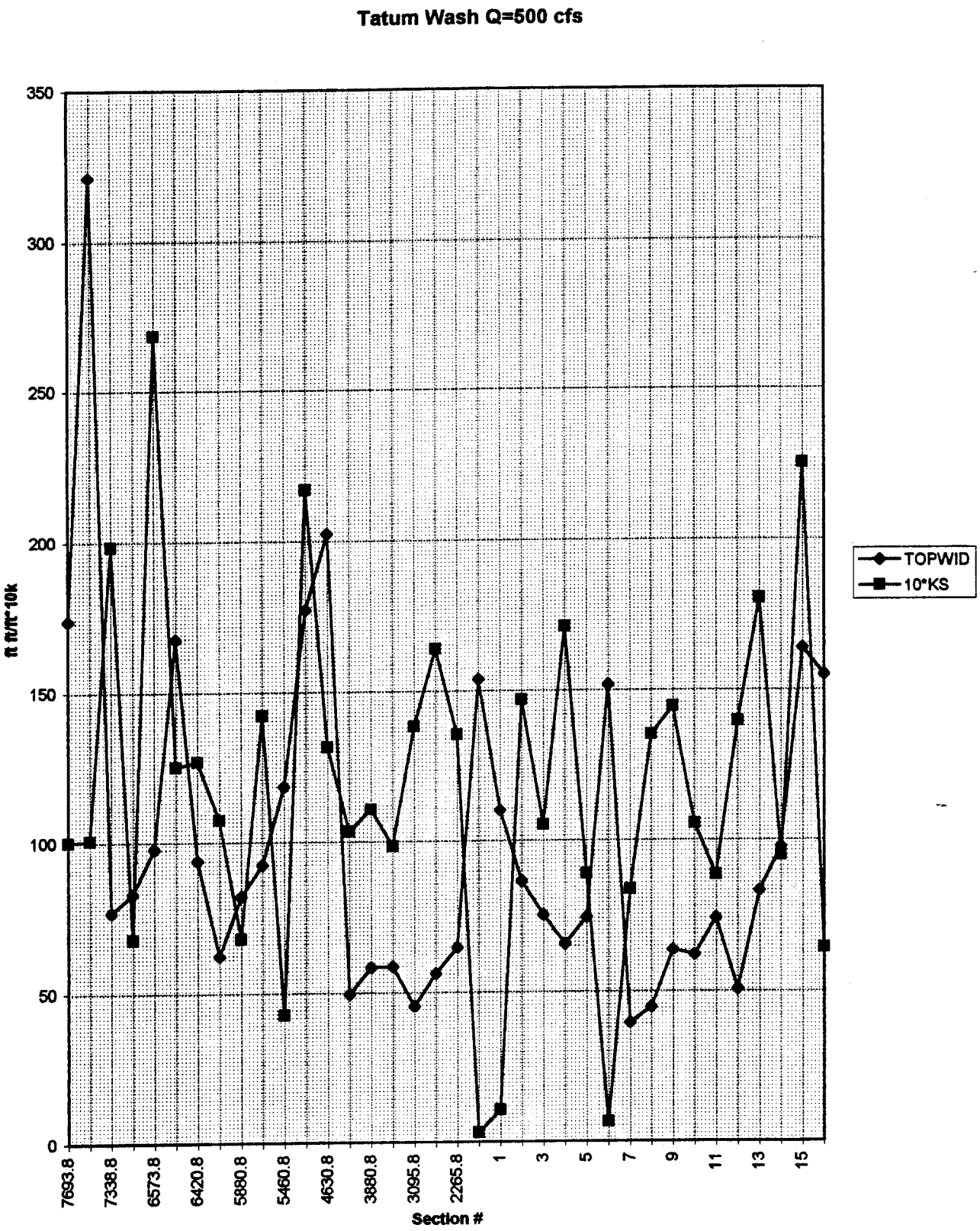
Section #
TOPWID
10*KS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300
250
200
150
100
50
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7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
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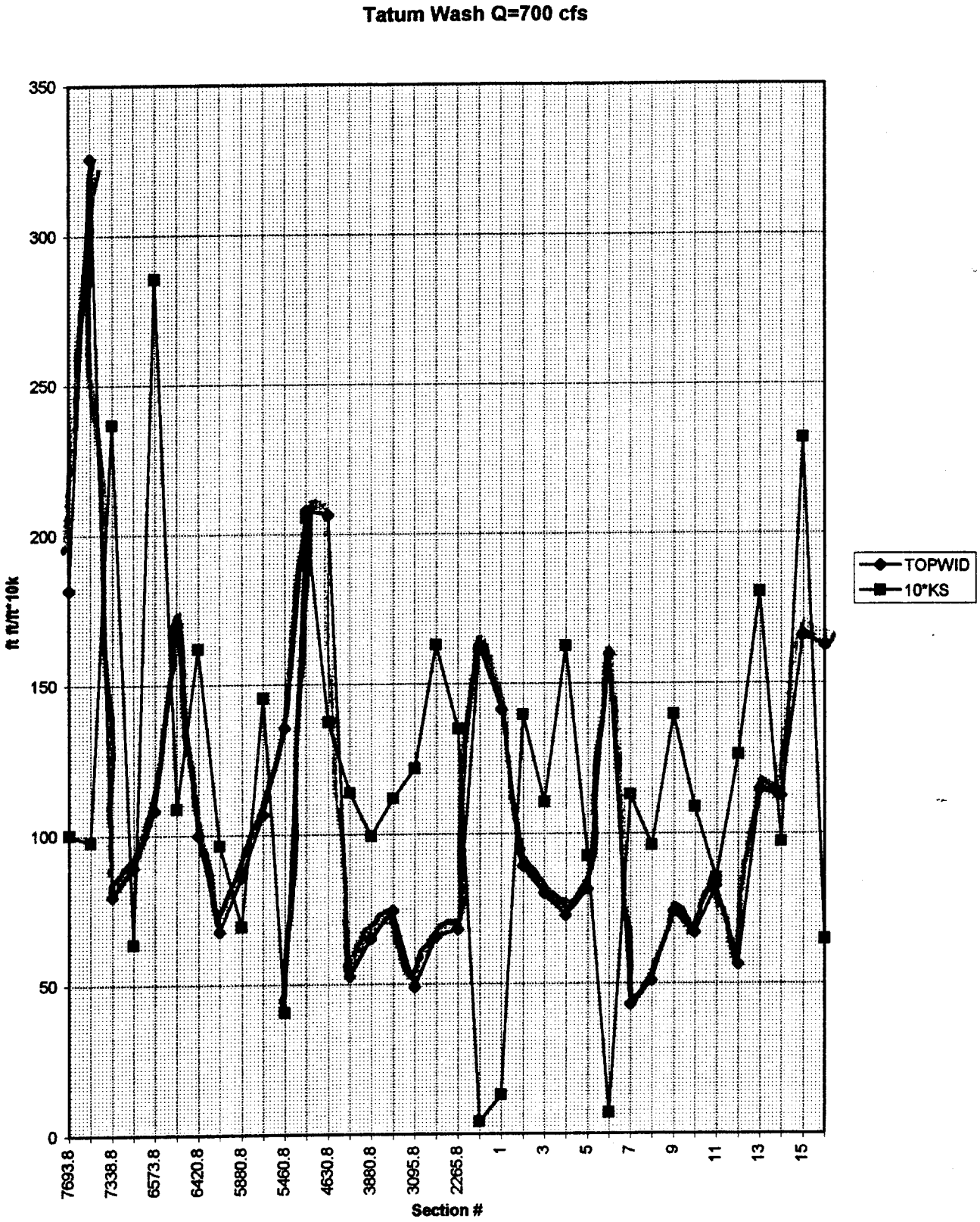
13
15
Section #
TOPWID
10*KS


Tatum Wash Q=700 cfs
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200
150
100
50
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ft ft/ft*10k
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7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
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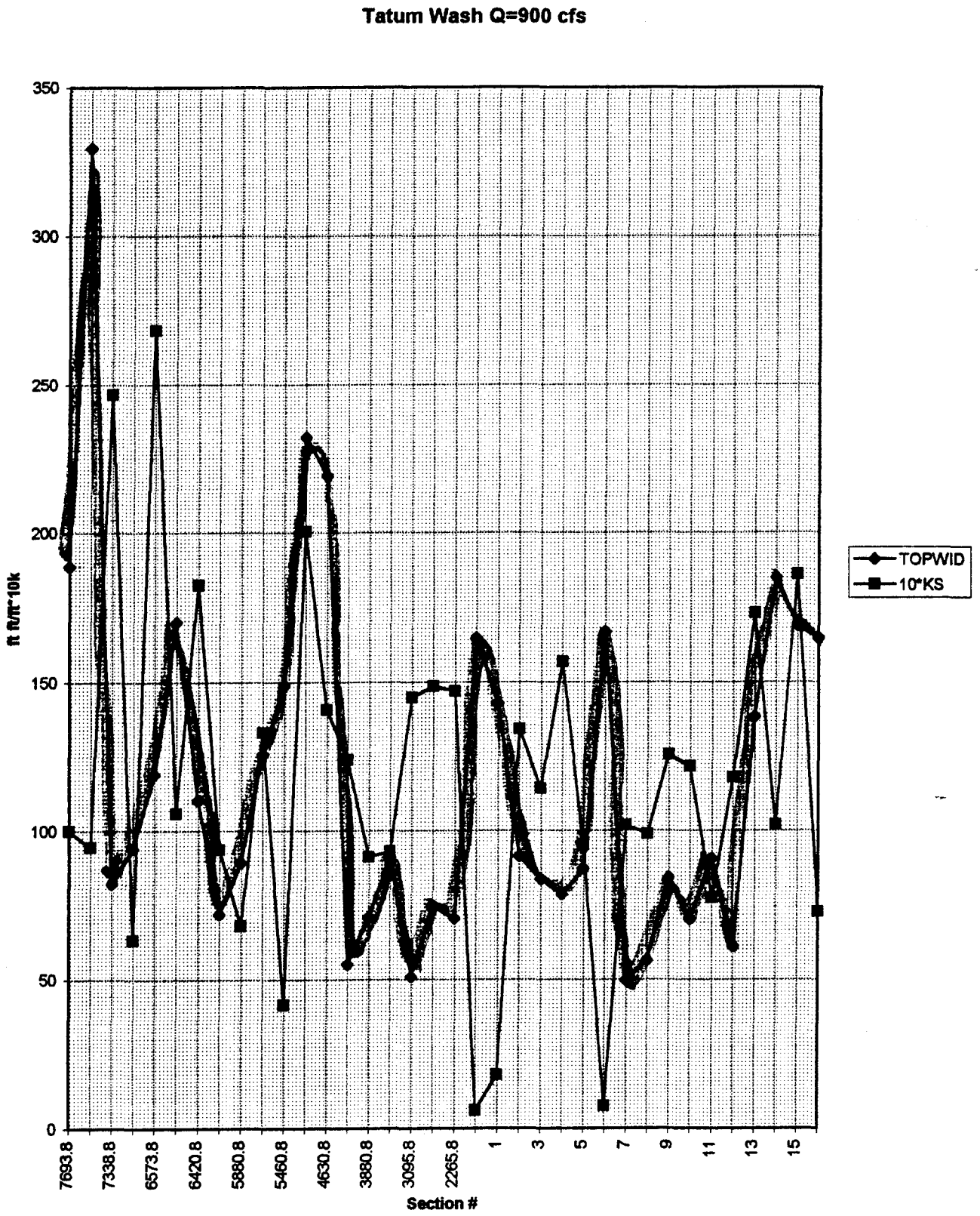
11
13
15
Section #
TOPWID
10*KS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300
250
200
150
100
50
0
ft ft/ft*10k
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7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
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13
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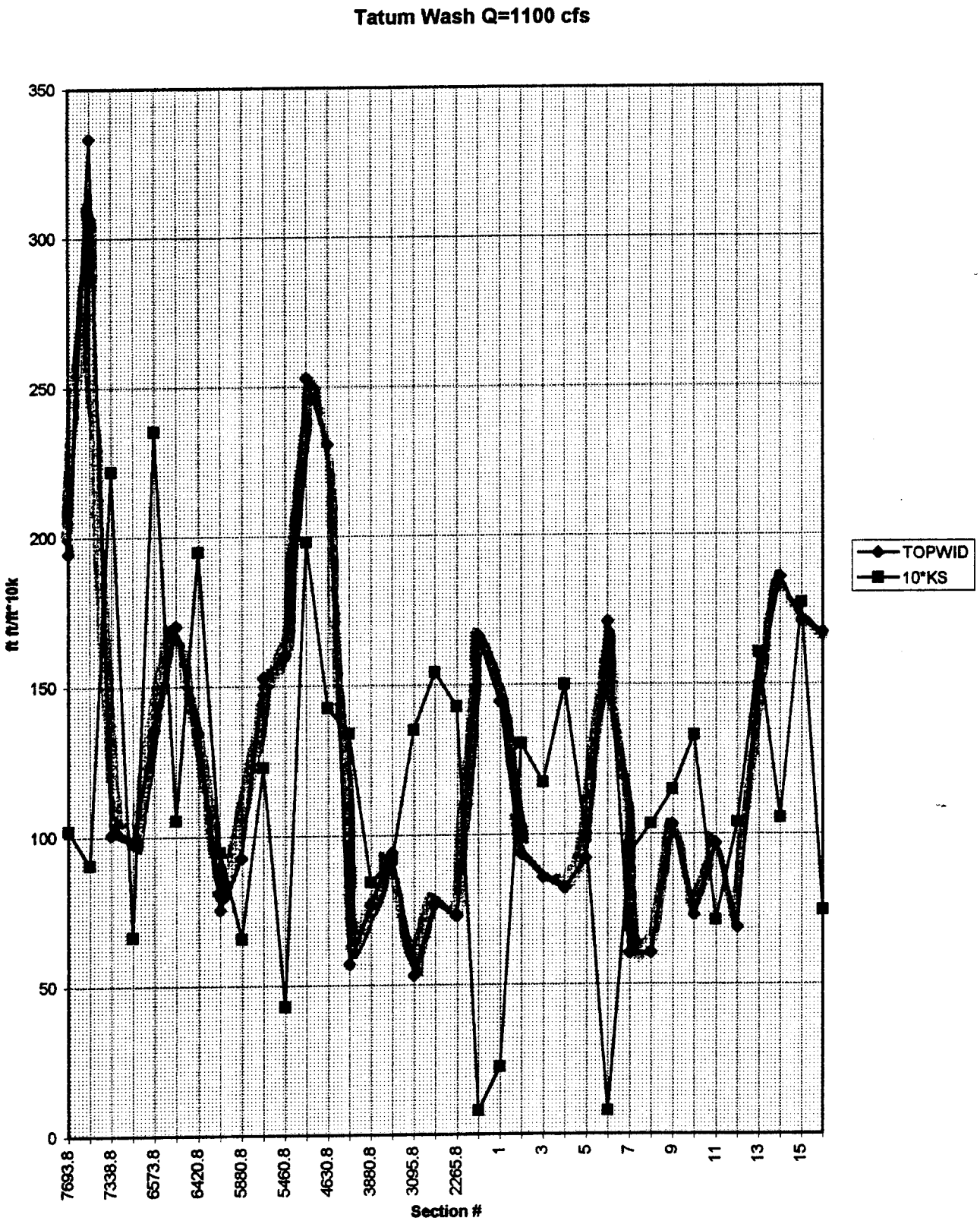
Section #
TOPWID
10*KS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300
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200
150
100
50
0
ft ft/ft*10k
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7338.8
6573.8
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5880.8
5460.8
4630.8
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3095.8
2265.8
1
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11
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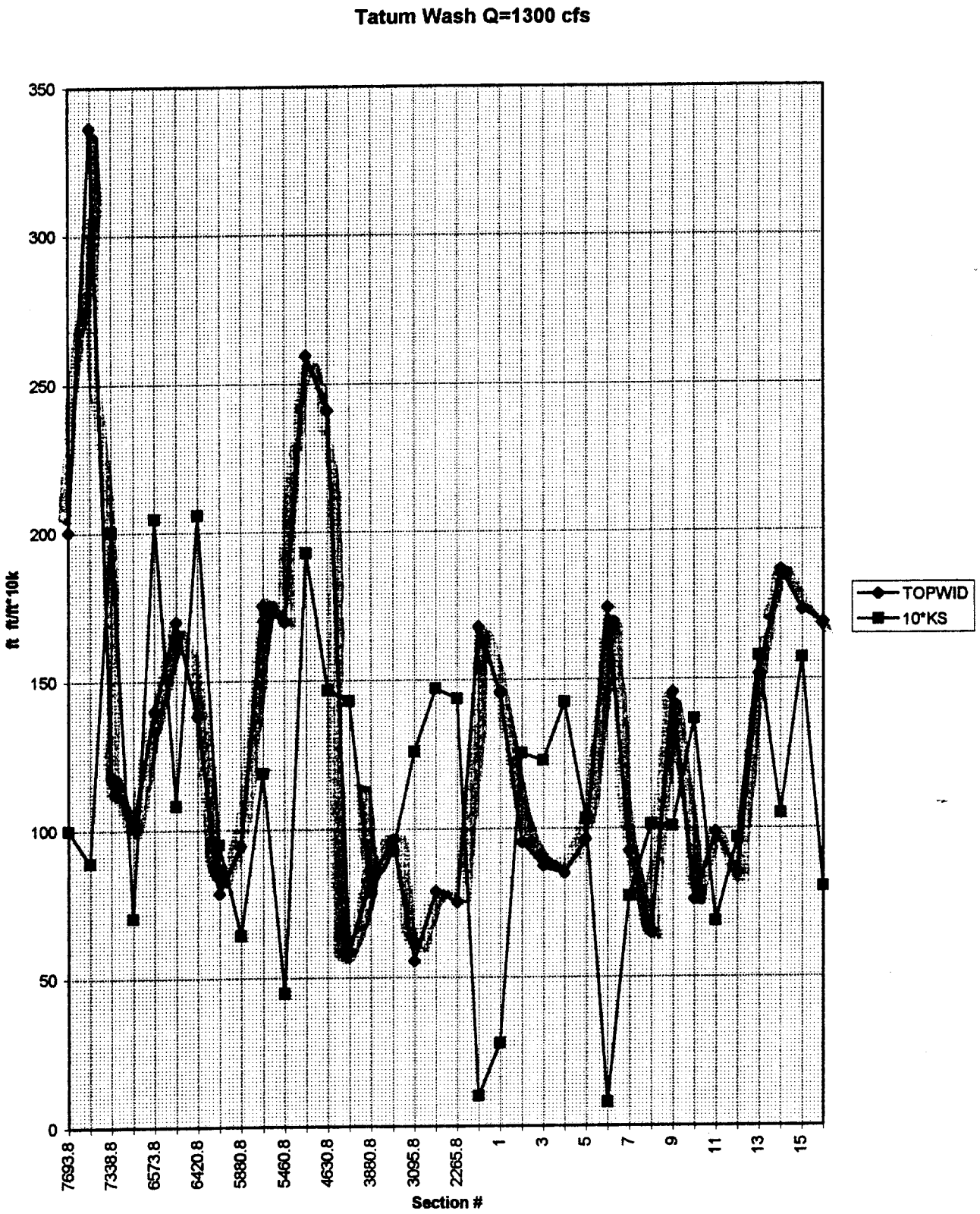
Section #
TOPWID
10*KS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200
150
100
50
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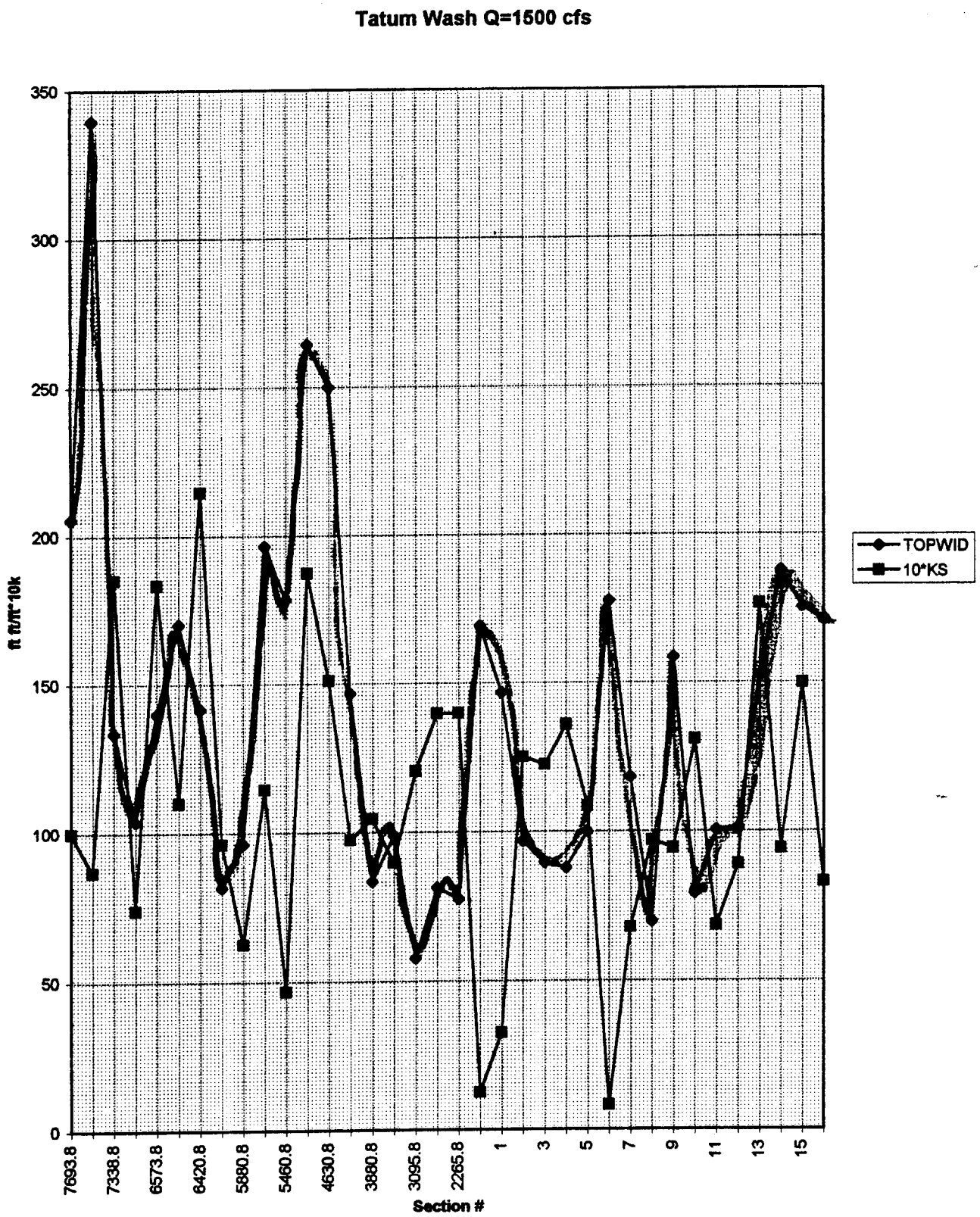
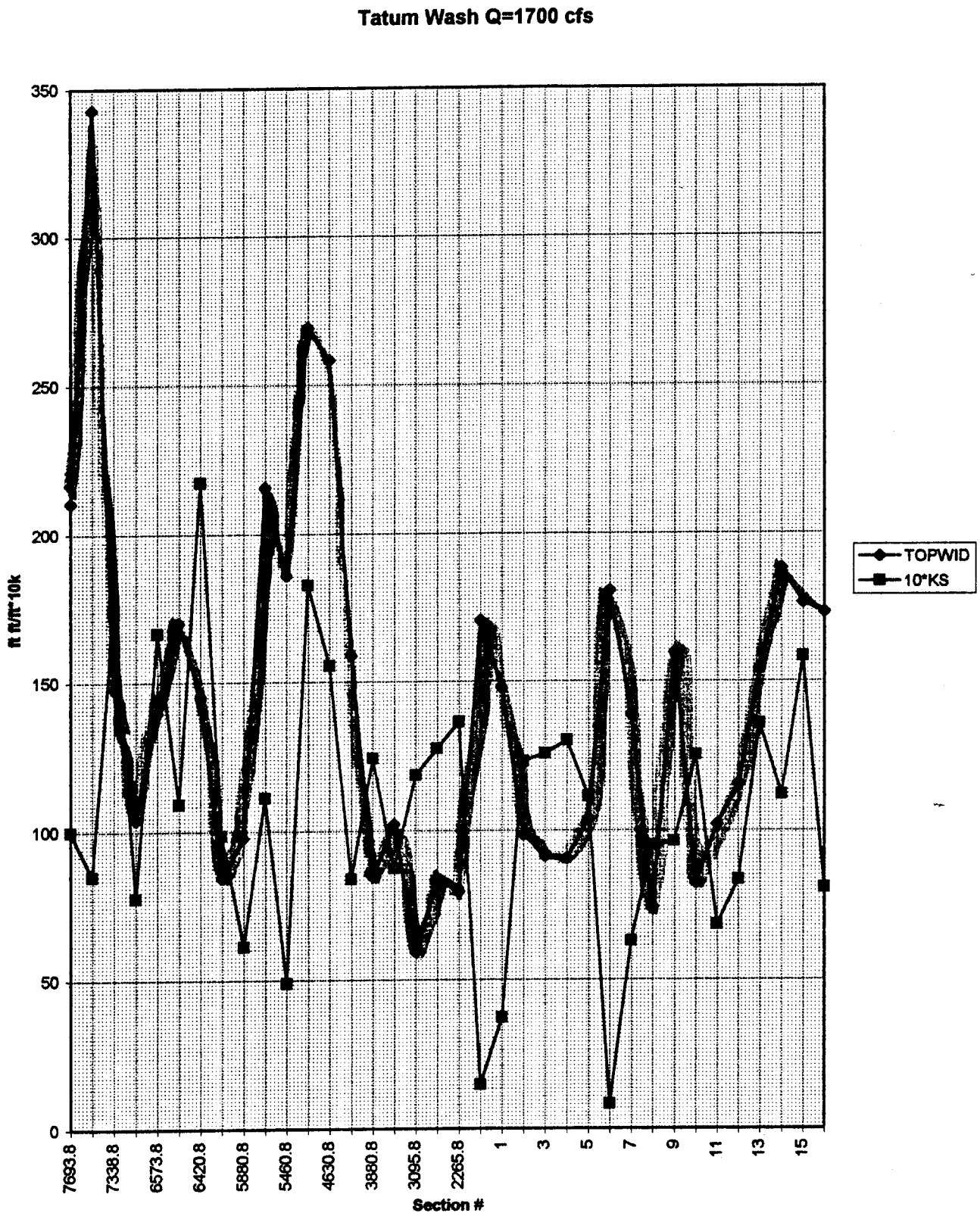
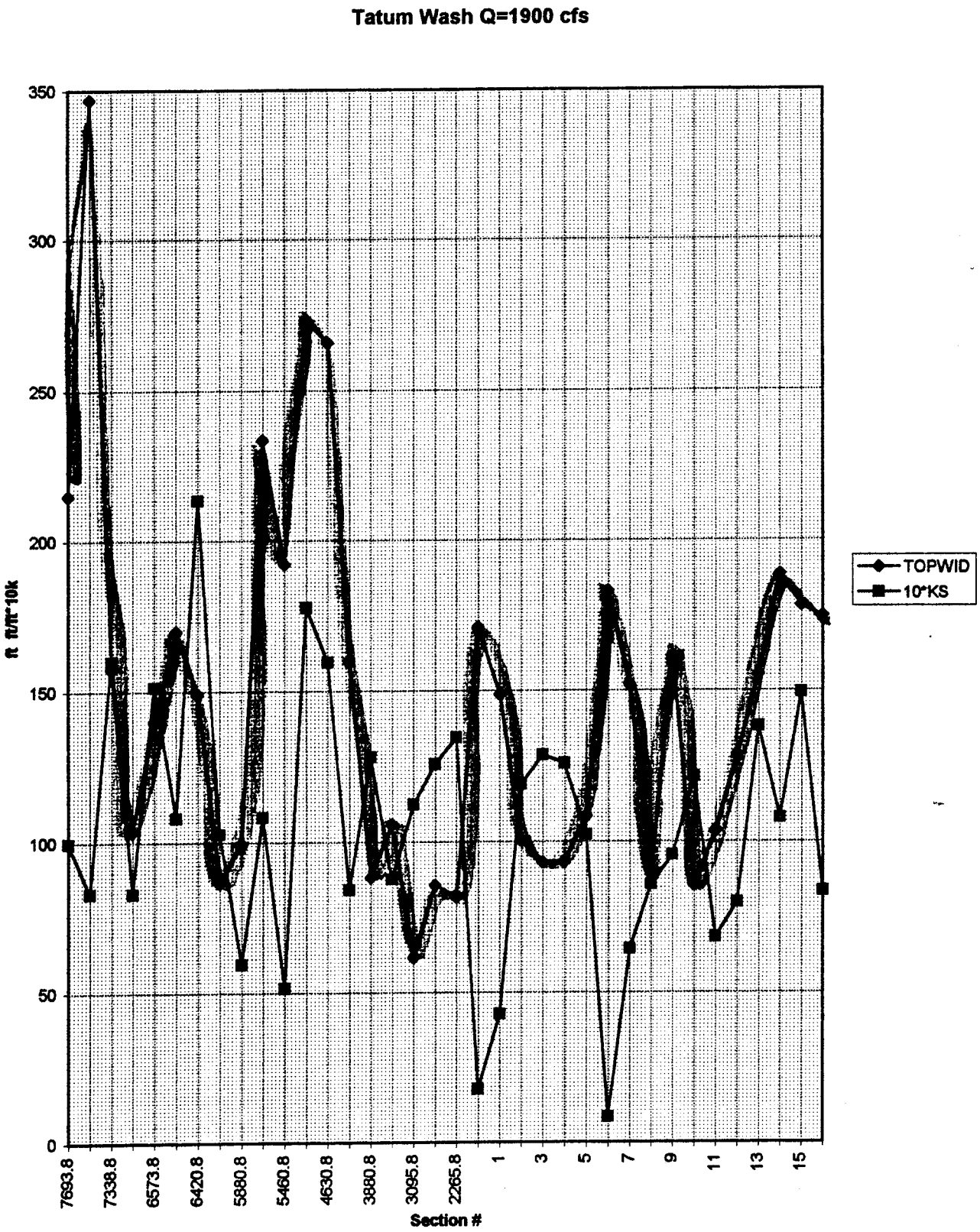
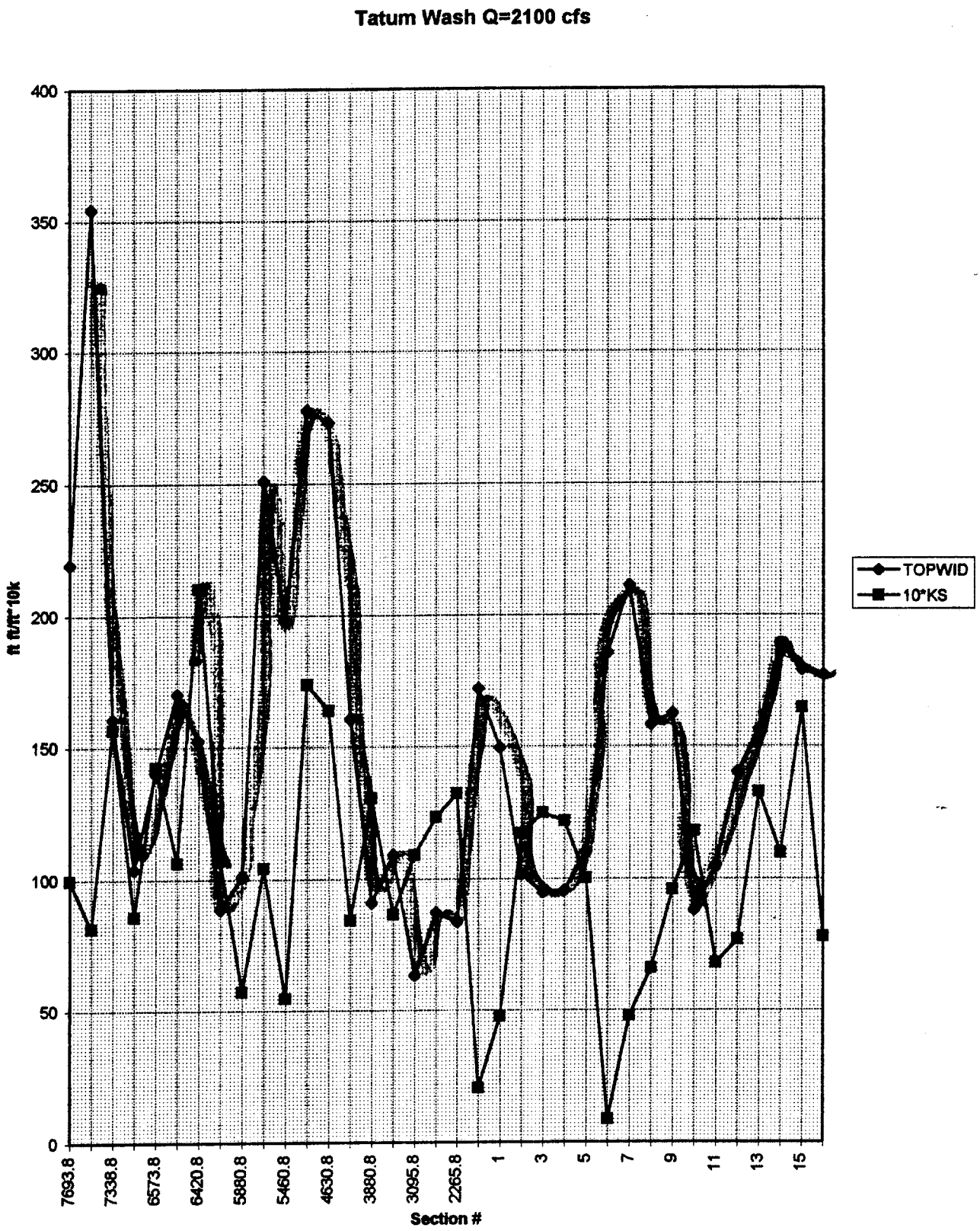
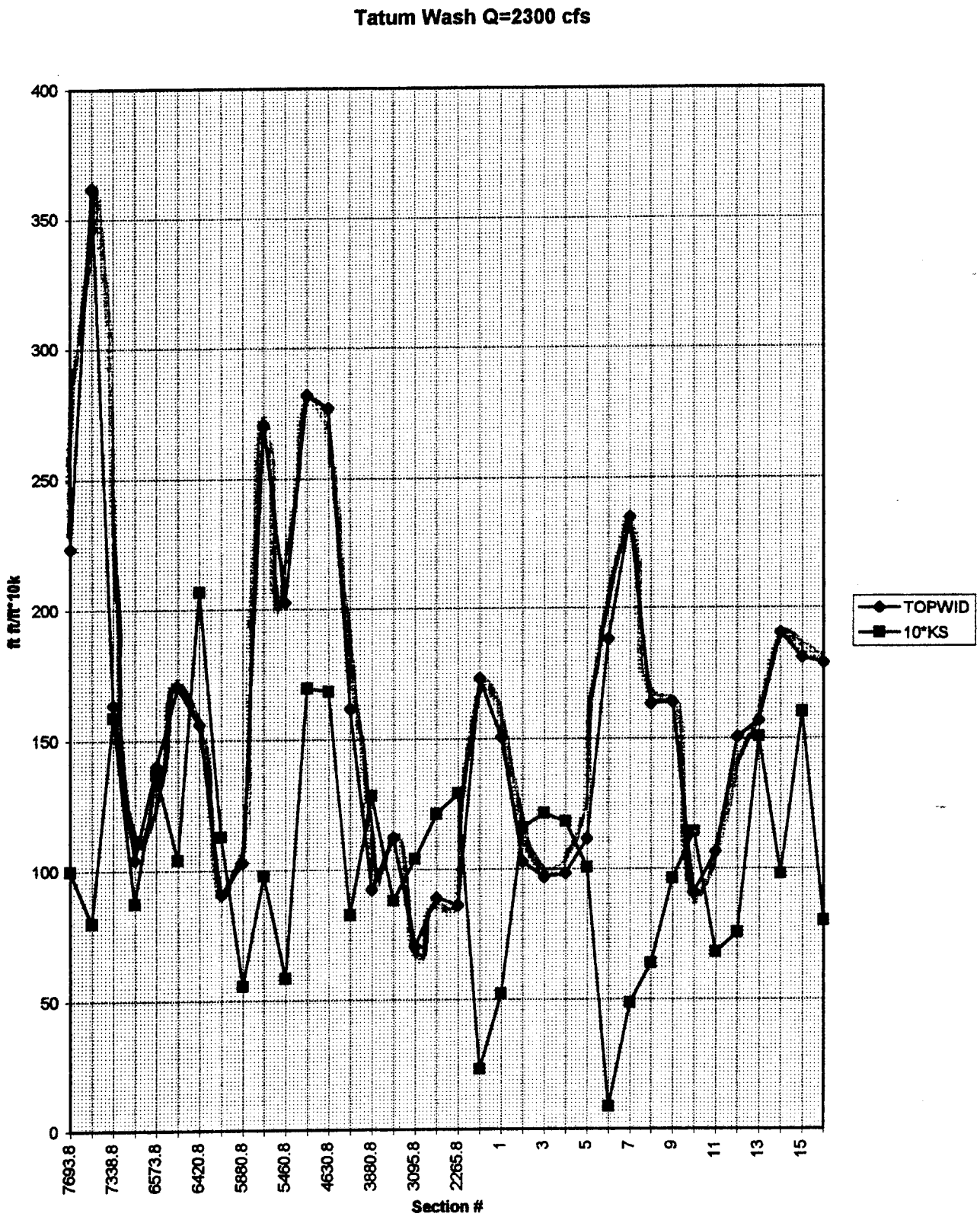
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS


Tatum Wash Q=1500 cfs
350
300
250
200
150
100
50
0
ft ft/ft*10k
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS

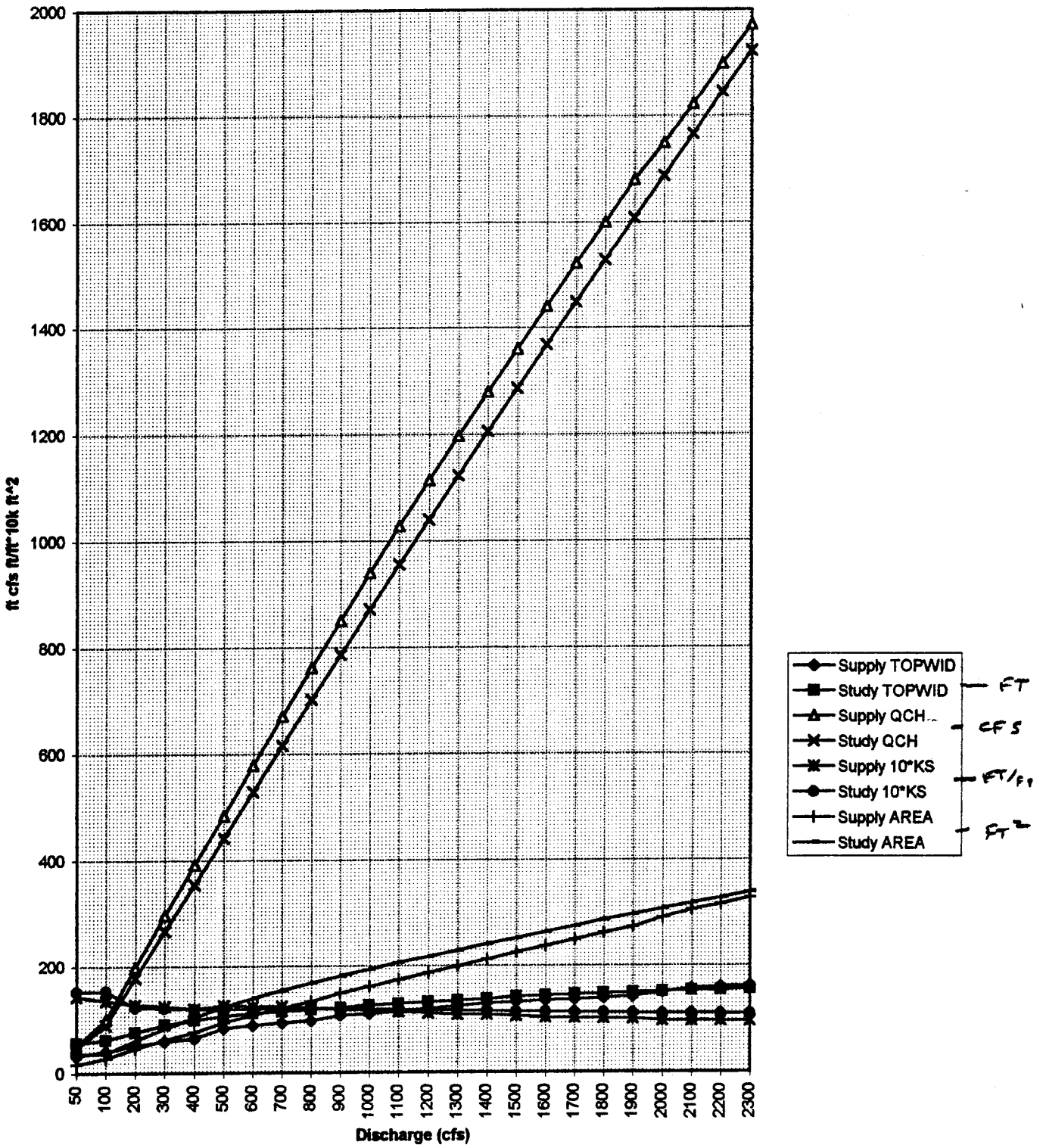

Tatum Wash Q=1700 cfs
ft ft/ft*10k
350
300
250
200
150
100
50
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS


Tatum Wash Q=1900 cfs
350
300
250
200
150
100
50
0
ft ft/ft*10k
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS

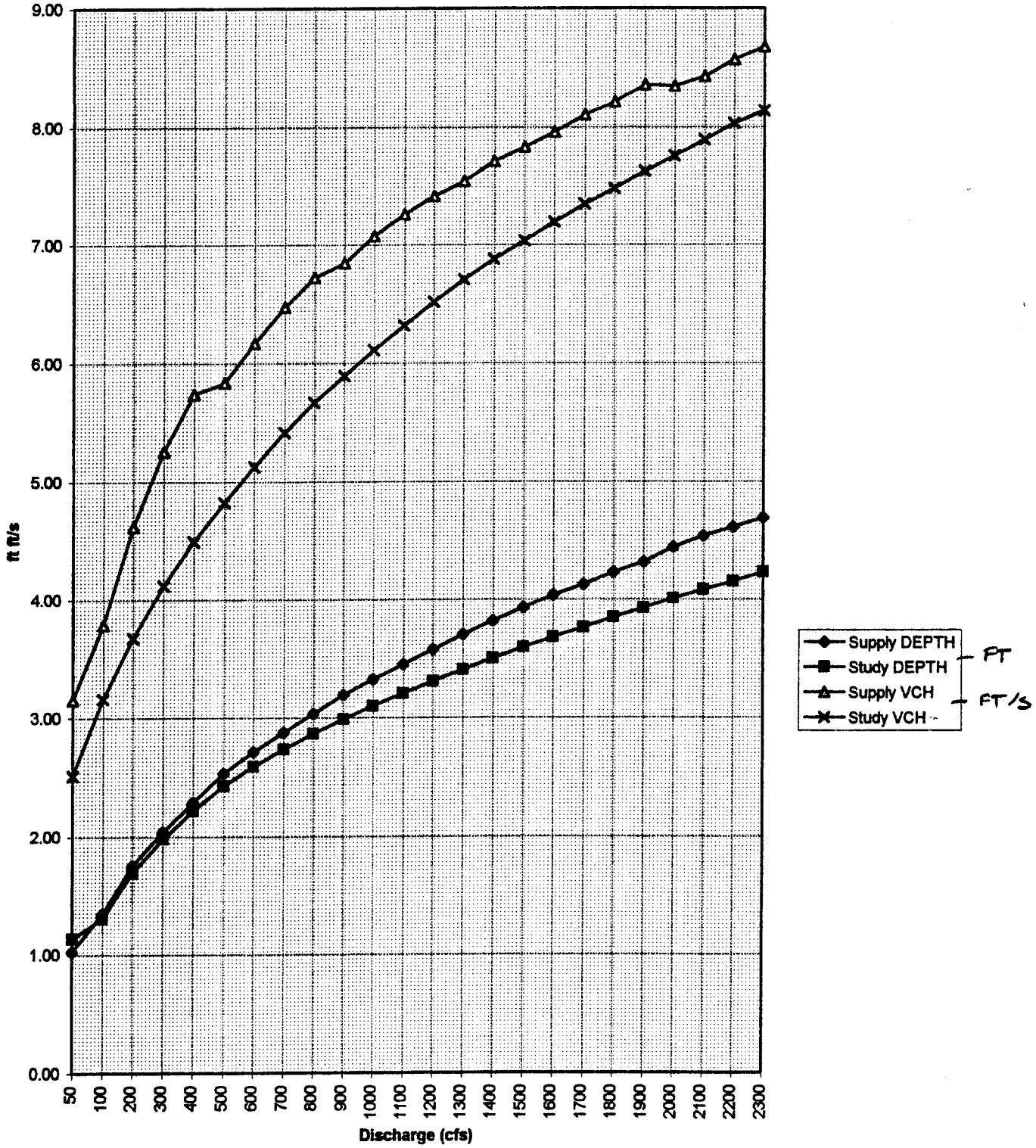

Tatum Wash Q=2100 cfs
ft ft/ft*10k
400
350
300
250
200
150
100
50
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS


Tatum Wash Q=2300 cfs
ft ft/ft*10k
400
350
300
250
200
150
100
50
0
7693.8
7338.8
6573.8
6420.8
5880.8
5460.8
4630.8
3880.8
3095.8
2265.8
1
3
5
7
9
11
13
15
Section #
TOPWID
10*KS

Tatum Wash - Reach Averaged Hydraulic Characteristics



Tatum Wash - Reach Averaged Hydraulic Characteristics



REACH AVERAGES

TATUM_A

Reach Averages - Study Reach

PROF	SECNO	Q	CWSEL	DEPTH	TOPWID	VLOB	VCH	VROB	QLOB	QCH	QROB	10*KS	AREA
1		50	1.13	56	0.04	2.51	0.22	0	45	4	153	35
2		100	1.31	61	0.07	3.16	0.32	0	90	10	154	37
3		200	1.69	76	0.10	3.68	0.40	1	179	20	123	60
4		300	1.98	90	0.20	4.12	0.50	2	267	30	121	83
5		400	2.22	99	0.35	4.49	0.67	4	355	41	119	104
6		500	2.42	106	0.43	4.82	0.78	6	442	52	119	124
7		600	2.59	111	0.51	5.12	0.88	8	529	64	119	140
8		700	2.73	115	0.58	5.41	0.97	10	615	75	121	154
9		800	2.86	118	0.64	5.67	1.05	12	701	87	121	168
10		900	2.99	122	0.72	5.89	1.13	15	786	99	120	181
11		1000	3.10	126	0.82	6.11	1.24	18	871	111	119	194
12		1100	3.21	129	0.96	6.32	1.44	21	955	124	118	206
13		1200	3.31	132	1.15	6.52	1.63	24	1039	136	117	218
14		1300	3.41	134	1.26	6.70	1.75	28	1123	149	116	229
15		1400	3.50	137	1.35	6.88	1.88	32	1206	163	115	241
16		1500	3.60	142	1.44	7.03	2.01	35	1287	177	114	253
17		1600	3.68	144	1.54	7.19	2.12	40	1368	192	113	264
18		1700	3.77	146	1.62	7.34	2.25	44	1449	208	112	275
19		1800	3.85	148	1.70	7.48	2.35	48	1528	224	111	287
20		1900	3.93	149	1.78	7.62	2.45	53	1608	239	111	297
21		2000	4.01	151	1.86	7.76	2.54	57	1687	256	110	308
22		2100	4.08	152	1.94	7.89	2.63	62	1766	272	110	318
23		2200	4.15	154	2.01	8.03	2.72	67	1846	287	110	328
24		2300	4.23	156	2.09	8.14	2.79	72	1923	305	109	339

Reach Average - Supply Reach

PROF	SECNO	Q	CWSEL	DEPTH	TOPWID	VLOB	VCH	VROB	QLOB	QCH	QROB	10*KS	AREA
1		50	1.03	32	0.01	3.15	0.16	0	50	0	143	17
2		100	1.35	40	0.11	3.79	0.33	0	100	0	135	28
3		200	1.75	51	0.32	4.62	0.66	0	198	1	128	46
4		300	2.04	58	0.56	5.25	1.13	1	296	3	124	61
5		400	2.29	64	0.70	5.74	1.39	2	392	6	120	76
6		500	2.53	83	0.90	5.84	1.71	4	484	12	126	94
7		600	2.71	89	1.01	6.17	1.86	6	578	16	124	108
8		700	2.88	93	1.12	6.47	2.04	9	670	21	124	120
9		800	3.03	97	1.27	6.72	2.13	13	762	25	120	133
10		900	3.19	107	1.38	6.85	2.27	17	850	33	118	149
11		1000	3.32	110	1.54	7.08	2.38	21	940	39	116	161
12		1100	3.45	114	1.63	7.26	2.48	26	1027	46	114	173
13		1200	3.58	119	1.68	7.42	2.55	32	1113	54	111	186
14		1300	3.71	124	1.81	7.55	2.61	40	1197	64	108	199
15		1400	3.82	128	1.87	7.71	2.66	47	1279	73	108	212
16		1500	3.93	131	2.01	7.83	2.70	56	1360	84	105	225
17		1600	4.04	134	2.17	7.96	2.90	65	1441	94	103	238
18		1700	4.13	136	2.26	8.11	2.98	74	1522	105	102	249
19		1800	4.23	139	2.34	8.21	3.03	84	1600	116	100	262
20		1900	4.32	142	2.42	8.36	3.10	93	1680	127	99	273
21		2000	4.44	150	2.43	8.35	3.13	112	1750	139	96	291
22		2100	4.54	157	2.47	8.43	3.21	127	1822	151	96	305
23		2200	4.61	160	2.53	8.57	3.24	138	1899	163	96	316
24		2300	4.69	162	2.59	8.68	3.31	152	1973	175	95	329

TATUM
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11-96

TATUM WASH - SUPERCRITICAL HEC-2 RUNS

TATUM.HC2

RI.	Q (CFS)
100	2315
50	1800
10	850
2	330

REMOVE SC RECORDS - ENTER WSEL FOR SUPERCRIT RUN

(ASSUME INLET CONTROL) - USE XS RECORDS

WSEL XN 2215.8

100	1472.83
50	1472.70
10	1472.26
2	1470.88

TATUM
JBR
11-96

CRITICAL DEPTH MESSAGES

XN	PROFILE			
16	1	2	3	4
15	(1)	2	3	4
14		2	3	
13	(1)	2	3	4
12	0			
11			3	4
10	(1)	2		
9			3	4
8	1	2		4
7			3	4
6			3	4
5	1	2	3	4
4		2		4
3				4
2	1	2	3	4
1	1	2	3	4
2575	(1)	2	3	4
3095	0		3	4
3535				4
3880	(1)	2	3	4
4260	(1)	2	3	4
4630			3	4
5150	(1)	2	3	4
5500	1	2	3	4
5880	1	2	3	4
6150	1	2	3	4

XN	PROFILE			
6420	(1)	2	3	4
6520	1	2	3	4
6577	1	2	3	4 ← SLOPE > 10%
6983	1	2	3	4
7338	(1)	2	3	4
7533	1	2	3	4
7693	1	2	3	4

5460
4630
3535
3095
2265
2215

XNS SUPERCRITICAL

5460 — ONYX DR

2265 } 40TH ST

(2215) — GOX

Q100 ONLY

4630 — U/S OF ONYX

3535 — FANFOL

3095 — U/S FANFOL

IF N × 1.5 (Q100)
↳ NO SUPERCRITICAL

IF N × 1.4 — NO CRITICAL
N = 0.05 (.035)

IF N × 1.15 3535 & 2265

IF N × 1.2 2265 ONLY

IF N × 1.1 NO Δ, EXCEPT 3095

TATUM
JEF

JARRETT'S N VALUE (JARRETT, 1984 ASCE JOUR HYDRAUL p 1519 – 1539)

$$N = 0.39\, S^{0.38}\, R^{-0.16}$$

USE REACH-AVERAGE $R = \frac{A}{P} = \frac{348}{\ } = \frac{A}{TW + 2D} = 2.08$

$S = .0102$

$N = 0.061$

WHERE NOT CONFINED ?

SUPERCRITICAL	SUBCRITICAL
SAME →	@ SHEA (7963 – 7338) TO R
SAME →	@ 44TH (6573) TO L
@ FANFOL TO ONYX	ONYX–FANFOL @ DISTRIB (4630) TO L 3880 TO R

CONFINED

U/S OF 3880 (FANFOL) U/S OF 3095 (FANFOL)

Table 1. Tatum Wash Sedimentation Study
Unit Discharge and Hydraulic Parameters - 100-year HEC-2 Results

Section #	Discharge (cfs)	Unit Q (cfs/ft)	Topwidth (ft)	Velocity (ft/s)	Energy Slope	Area (ft^2)	Water Surface	Depth (ft)
7693.8	2315	10	224	4.3	0.010	470	1397.96	2.2
7533.8	2315	6	362	4.0	0.008	609	1400.25	2.8
7338.8	2315	14	163	8.5	0.017	317	1404.39	4.0
6983.8	2315	22	104	7.5	0.009	337	1408.69	4.9
6573.8	2315	17	140	7.1	0.014	332	1413.11	5.9
6520.8	2315	14	170	6.3	0.010	400	1413.97	6.0
6420.8	2315	15	156	8.1	0.021	303	1415.05	3.4
6150.8	2315	25	91	9.5	0.011	248	1418.68	4.7
5880.8	2301	22	103	6.9	0.006	335	1421.39	4.4
5500.8	2301	8	271	9.0	0.010	417	1425.35	4.4
5460.8	2301	11	202	7.2	0.006	432	1425.84	3.8
5150.8	2301	8	282	6.5	0.017	356	1431.24	2.4
4630.8	2268	8	277	7.9	0.017	388	1439.87	2.9
4260.8	2268	14	161	8.8	0.008	327	1445.27	5.3
3880.8	2261	25	92	9.5	0.013	240	1448.95	4.8
3535.8	2261	20	112	10.3	0.009	292	1452.67	4.9
3095.8	2244	35	65	10.9	0.011	216	1457.98	5.0
2575.8	2244	25	89	9.8	0.012	237	1465.36	5.4
2265.8	2244	26	85	9.5	0.013	236	1470.01	4.0
2215.8	2244	13	173	5.6	0.022	531	1472.84	4.8
1	2219	15	150	7.4	0.005	381	1473.04	4.8
2	2219	22	102	9.7	0.012	262	1474.21	3.4
3	2219	23	96	9.4	0.012	242	1477.20	3.2
4	2219	23	97	9.5	0.012	243	1481.31	3.8
5	2219	20	111	9.5	0.010	270	1484.31	4.3
6	2212	12	187	3.9	0.001	748	1485.83	7.3
7	2212	9	234	9.6	0.005	398	1486.20	6.2
8	2212	14	160	10.2	0.007	307	1488.68	5.5
9	2212	14	163	8.9	0.010	319	1490.67	4.7
10	2212	25	90	10.0	0.012	239	1492.97	4.4
11	2212	21	106	8.7	0.007	312	1495.30	4.6
12	2212	15	146	10.0	0.008	308	1497.61	5.3
13	2212	14	157	7.6	0.013	295	1500.82	4.2
14	2212	12	190	6.7	0.011	342	1502.95	4.5
15	2212	12	180	7.8	0.016	298	1505.27	3.8
16	2212	12	178	6.3	0.008	358	1507.17	3.2
Average	-	17	157	8.1	0.010	343	-	4.4

Note: Subcritical profile model results shown.

Stnd Devin 6.5 67 1.8 .004 110 - 1.1
(10.5-23.5) (90-224) (6.3-9.9) (3.3-5.5)
above average
— below average

CONTINUED

GEOMORPHIC ANALYSIS

Tatum Wash Sedimentation Study
Armoring Analysis

BUREC, 1984 - Meyer Peter Muller

n = 0.035
d90 = 42 mm
K = 0.19

RI (yrs)	Topwidth (ft)	Area (ft2)	Avg Depth (ft)	Sf (ft/ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	93	90	0.967742	0.012	24	30	0.2	0.5
10	120	175	1.458333	0.0121	36	15	0.4	2.0
50	148	287	1.939189	0.0111	44	8	0.4	no armor
100	156	339	2.173077	0.0109	48	6	0.5	no armor

BUREC, 1984 - Competent Bottom Velocity

RI (yrs)	Chl Vel. (ft/s)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	4.24	34	17	0.3	1.6
10	5.78	63	0	0.5	no armor
50	7.48	105	0	0.5	no armor
100	8.14	125	0	0.5	no armor

BUREC, 1984 - Lane's Tractive Force

Tw = 62.4 lb/ft2

RI (yrs)	Sf (ft/ft)	Avg Depth (ft)	Tc (lb/ft2)	Tc (g/m2)	Dc (mm) Fig. 4	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	0.012	0.967742	0.72	3536	46	8	0.5	no armor
10	0.0121	1.458333	1.10	5373	70	0	0.5	no armor
50	0.0111	1.939189	1.34	6554	85	0	0.5	no armor
100	0.0109	2.173077	1.48	7213	92	0	0.5	no armor

BUREC, 1984 - Shield's Diagram

Tw = 62.4 lb/ft2 T* = 0.06
Ts = 165 lb/ft2

RI (yrs)	Sf (ft/ft)	Avg Depth (ft)	Dc (ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	0.012	0.967742	0.117714	36	15	0.4	2.0
10	0.0121	1.458333	0.178866	55	1	0.5	no armor
50	0.0111	1.939189	0.218187	67	0	0.5	no armor
100	0.0109	2.173077	0.240097	73	0	0.5	no armor

BUREC, 1984 - Yang's Incipient Motion

RI (yrs)	Chl Vel. (ft/s)	Dc (ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	4.24	0.118472	36	15	0.4	2.0
10	5.78	0.220161	67	0	0.5	no armor
50	7.48	0.368713	112	0	0.5	no armor
100	8.14	0.436651	133	0	0.5	no armor

Tatum Wash Sedimentation Study
Equilibrium Slope Calculations

Zeller-Fullerton Equation (AMAFCA)

n = 0.035
G = 5.24
d50 = 6.3

a = 1.16E-05
b = 4.32
c = -0.3

RI (yrs)	Q (cfs)	Width (ft)	q-s (cfs/ft)	q (cfs/ft)	Seq (ft/ft)
2	330	60	0.00917	5.5	0.0101
10	850	92	0.02281	9.2	0.0109
50	1800	92	0.05285	19.6	0.0087
100	2300	92	0.07274	25.0	0.0083

AMAFCA Eq'n 3.59

RI (yrs)	Q (cfs)	C	Width (ft)	Depth (ft)	F (W/D)	Fr	Seq (ft/ft)
2	330	0.037169	93	2.06	45.14563	1	0.017188
10	850	0.036707	120	2.92	41.09589	1	0.014967
50	1800	0.036382	148	3.85	38.44156	1	0.013426
100	2300	0.036182	156	4.23	36.87943	1	0.012924

BUREC, 1984 - Schoklitsch

d50 = 6.3 mm
K = 0.00174

RI (yrs)	Chl Width (ft)	Q (cfs)	Seq	Topwidth (ft)	Seq
2	60	330	0.001927	93	0.002676
10	92	850	0.001306	120	0.001594
50	92	1800	0.000744	148	0.001062
100	92	2300	0.000619	156	0.00092

BUREC, 1984 - Meyer Peter Muller

d50 = 6.3 mm K = 0.19
d90 = 42 mm n = 0.035

RI (yrs)	Q (cfs)	Qchl (cfs)	Topwidth (ft)	Area (ft2)	Avg Depth (ft)	Seq
2	330	296	93	90	0.967742	0.003546
10	850	744	120	175	1.458333	0.002412
50	1800	1528	148	287	1.939189	0.00187
100	2300	1923	156	339	2.173077	0.001694

BUREC, 1984 - Shield's Diagram

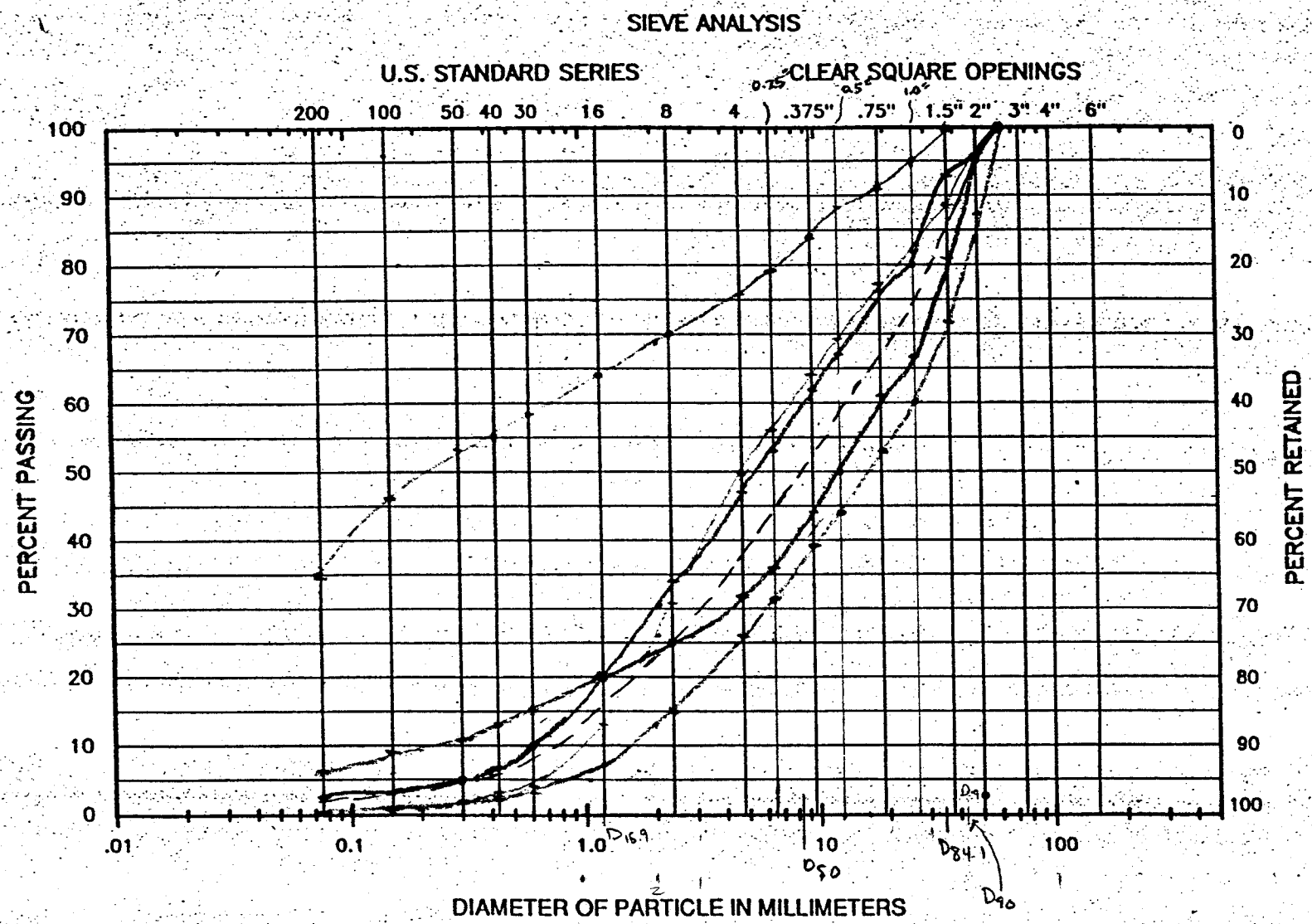
d50 = 0.020669 ft v = 1.22E-05 ft2/s
g = 32.2 ft/s2 Tw = 62.4 lb/ft3
Ts = 165.4 lb/ft3

RI (yrs)	Sf (ft/ft)	R (ft)	U* (ft/s)	R*	T* Fig. 5	Avg Depth (ft)	Seq (ft/ft)	Redo R*	T* Fig. 5	Seq (ft/ft)
2	0.012	0.967742	0.611503	1039	0.055	0.967742	0.001939	417.5	0.055	0.001939
10	0.0121	1.458333	0.753788	1280	0.055	1.458333	0.001287	417.5	0.055	0.001287
50	0.0111	1.939189	0.832529	1414	0.055	1.939189	0.000968	417.5	0.055	0.000968
100	0.0109	2.173077	0.873331	1483	0.055	2.173077	0.000864	417.5	0.055	0.000864

BUREC, 1984 - Lane's Tractive Force

Tc = 0.123 lb/ft2 (Figure 4)
Tw = 62.4 lb/ft3

RI (yrs)	Avg Depth (ft)	Seq (ft/ft)
2	0.967742	0.002037
10	1.458333	0.001352
50	1.939189	0.001016
100	2.173077	0.000907



— 4A — 2B — 1A

— 3A — 2A - - - Average (eye fit) of 3A, 2A, 2B, 1A

TATUM
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11-96

LANE'S RELATION

$$QS = Q_s D_{50}$$

EXISTING CONDITIONS - NO CHANGE

FOR PROPOSED BASINS

PHASE 1 SED. TRAP - NO CHANGE, @ DOWNSTREAM END

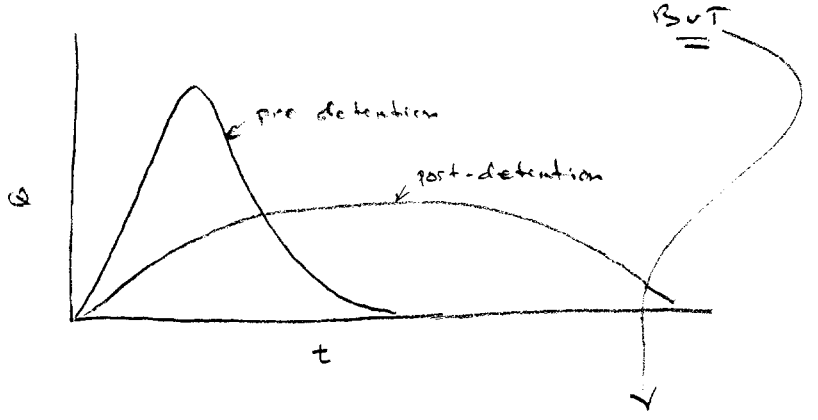
PHASE 2 DETENTION - REDUCES PEAK DISCHARGE

- NO CHANGE IN FLOW VOLUME
- NO CHANGE IN S, Q_s, D_{50}

$\therefore$ $Q^- S^0$ $\Rightarrow$ REQUIRES DECREASE IN Q_s OR D_{50}

D_{50} WON'T CHANGE (FINER MATERIAL MAY REMAIN OR BE DEPOSITED, THO.)

$\therefore$ Q_s WILL DECREASE SOMEWHAT



Q_s FOR HIGHER Q'S WILL DECREASE (LOWER PEAK) DUE TO DETENTION

Q_s FOR LOWER Q'S WILL INCREASE (LONGER DURATION) DUE TO DETENTION

SINCE HIGHER Q'S CARRY COARSER MATERIAL

NET EFFECT IS MORE FINES REMOVED & COARSENING OF BED.

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SLOPE PROFILE - FROM

DIST	ELEV	NOTE
0	1394	SHEA ℄
170	96	
100	98	
160	1400	
260	2	
140	4	
180	6	
90	8	
120	10	(40th)
170	12	
250	14	
120	16	
320	18	
190	20	ONYX
130	22	
110	24	
120	26	
70	28	
140	30	
100	32	
210	34	
170	36	
110	38	
290	40	
190	42	
150	44	
180	46	
210	48	FANFOL
300	50	
100	52	
30	54	
240	56	
100	58	
210	60	
100	62	
120	64	
130	(44th)	

	1464
132.5	
	1466 44th
192.2	
	1468
186.1	
	1470
221.2	
	1472
133.1	
	1474
126.5	
	76
93.9	
	78
216.3	
	80
272	
	fence line & Park
250.9	
	80
147.9	
	82
131.4	TRIB
	84
122.2	
	86
146.2	
	88
165.1	
	90
234.1	
	92
97.9	
	94
94.4	
	96
184.8	98
79.4	
	1500
136.1	
	02
102.0	
	4
56.4	
	6
100.5	
	8
240.4	
	10
83.9	
	12
92.2	
	14
79.4	
	1516
145.6	
	18 TRIB
78.2	
	20
36.7	
	22
117.8	
	24
179.0	
	26
278.3	
	28
147.0	
	30

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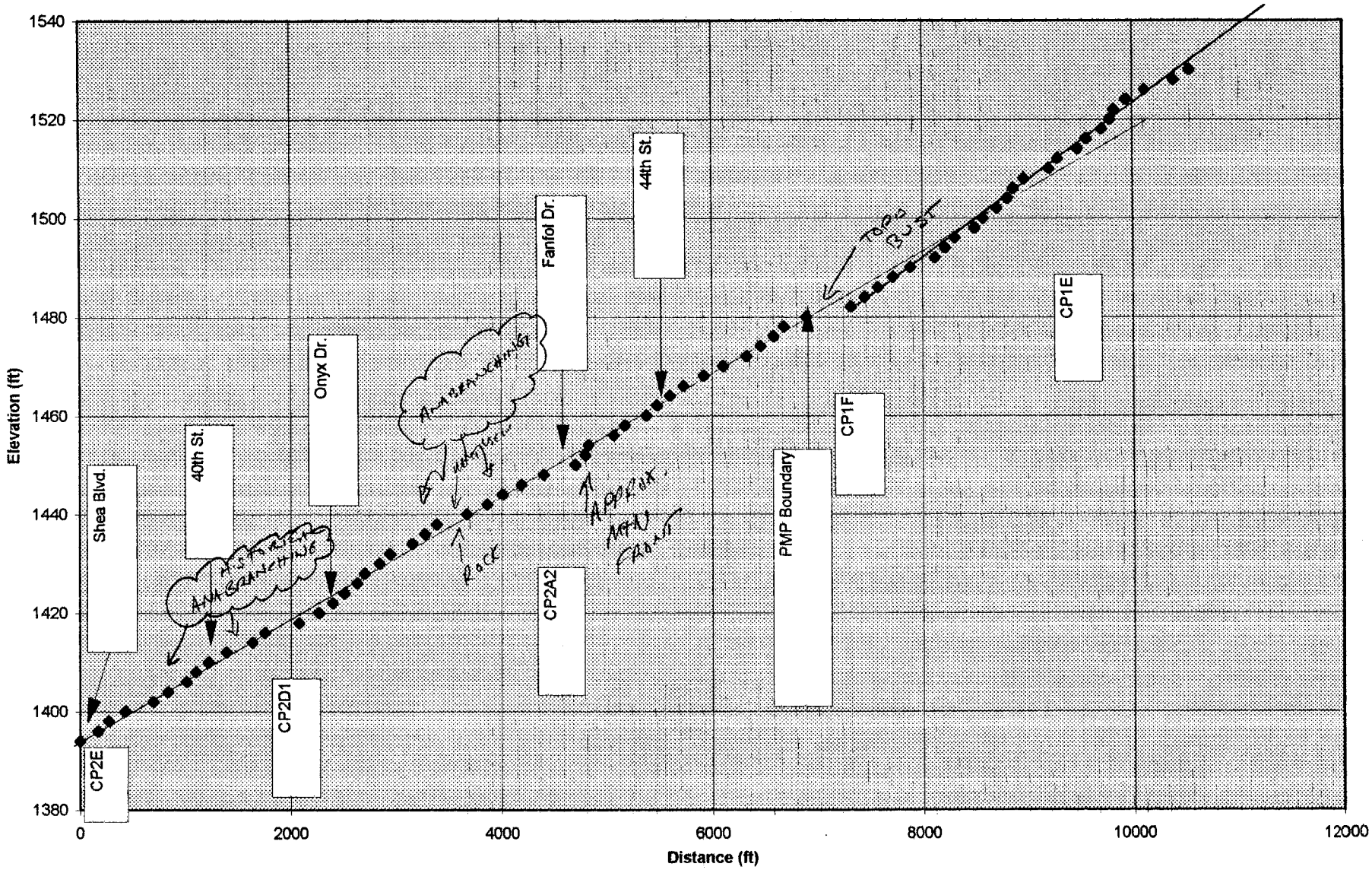
PROFILE FROM QUAD SHEET

	DIST	ELEV	
IBW	0	1366	
	500	1370	
	2000	1380	
	3100	1390	
	3300		Shea
	4100	1400	
	4700		4444
	4900	1410	
	5500	1420	
	5800	Olympic	
	6100	1430	
	6400	1440	
	7600	1450	
	8000	Fonfon 1	
	8700	1460	
	9300	Fo 4 L	
	10200	1480	
	12000	1500	
	12400	Edge Ridge	
	13600	1520	
	14500	1540	
	15500	60	
	16400	80	
	17500	1600	
	18300	1620	
	18700	40	
	19300	60	
	19600	80	
	19800	1700	

Figure 3. Tatum Wash Longitudinal Profile



Tatum Wash Sedimentation Study
Equilibrium Slope Calculations

Zeller-Fullerton Equation (AMAFCA)

n = 0.035
G = 5.24
d50 = 6.3

a = 1.16E-05
b = 4.32
c = -0.3

RI (yrs)	Q (cfs)	Width (ft)	q-s (cfs/ft)	q (cfs/ft)	Seq (ft/ft)
2	330	60	0.00917	5.5	0.0101
10	850	92	0.02281	9.2	0.0109
50	1800	92	0.05285	19.6	0.0087
100	2300	92	0.07274	25.0	0.0083

AMAFCA Eq'n 3.59

RI (yrs)	Q (cfs)	C	Width (ft)	Depth (ft)	F (W/D)	Fr	Seq (ft/ft)
2	330	0.037169	93	2.06	45.14563	1	0.017188
10	850	0.036707	120	2.92	41.09589	1	0.014967
50	1800	0.036382	148	3.85	38.44156	1	0.013426
100	2300	0.036182	156	4.23	36.87943	1	0.012924

BUREC, 1984 - Schoklitsch

d50 = 6.3 mm
K = 0.00174

RI (yrs)	Chl Width (ft)	Q (cfs)	Seq	Topwidth (ft)	Seq
2	60	330	0.001927	93	0.002676
10	92	850	0.001306	120	0.001594
50	92	1800	0.000744	148	0.001062
100	92	2300	0.000619	156	0.00092

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BUREC, 1984 - Meyer Peter Muller

d50 = 6.3 mm K = 0.19
d90 = 42 mm n = 0.035

RI (yrs)	Q (cfs)	Qchl (cfs)	Topwidth (ft)	Area (ft2)	Avg Depth (ft)	Seq
2	330	296	93	90	0.967742	0.003546
10	850	744	120	175	1.458333	0.002412
50	1800	1528	148	287	1.939189	0.00187
100	2300	1923	156	339	2.173077	0.001694

BUREC, 1984 - Shield's Diagram

d50 = 0.020669 ft v = 1.22E-05 ft2/s
g = 32.2 ft/s2 Tw = 62.4 lb/ft3
Ts = 165.4 lb/ft3

RI (yrs)	Sf (ft/ft)	R (ft)	U* (ft/s)	R*	T* Fig. 5	Avg Depth (ft)	Seq (ft/ft)	Redo R*	T* Fig. 5	Seq (ft/ft)
2	0.012	0.967742	0.611503	1039	0.055	0.967742	0.001939	417.5	0.055	0.001939
10	0.0121	1.458333	0.753788	1280	0.055	1.458333	0.001287	417.5	0.055	0.001287
50	0.0111	1.939189	0.832529	1414	0.055	1.939189	0.000968	417.5	0.055	0.000968
100	0.0109	2.173077	0.873331	1483	0.055	2.173077	0.000864	417.5	0.055	0.000864

BUREC, 1984 - Lane's Tractive Force

Tc = 0.123 lb/ft2 (Figure 4)
Tw = 62.4 lb/ft3

RI (yrs)	Avg Depth (ft)	Seq (ft/ft)
2	0.967742	0.002037
10	1.458333	0.001352
50	1.939189	0.001016
100	2.173077	0.000907

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GEOMORPHIC ANALYSIS

(1) EQUILIBRIUM SLOPE EQUATIONS

A.) PIMA CO FCD (DRAINAGE DESIGN MANUAL 1984) Eq'n 8-V

$$S_u = \left[\frac{N_u}{N_n}\right]^2 \left[\frac{Q_{wu}}{Q_{wn}}\right]^{-1.4} \left[\frac{T_u}{T_n}\right]^{0.5} (1-R)^{0.9} S_N$$

S_u = EQUILIB. SLOPE FT/FT AFTER CHANGE

S_n = NATURAL SLOPE

N = ROUGHNESS N_N - NATURAL, N_u - URBAN / CHANGE

Q_w = 2-YR Q PEAK (CFS)

T = TOPWIDTH

R = REDUCTION FACTOR FOR SEDIMENT SUPPLY

SCENARIO #1 — NO BASIN	SCENARIO #2 - PMP BASIN (U/S)
$T_u = T_N$	$T_u = T_N$
$Q_{wu} = Q_{wn}$	$Q_{wu} \approx Q_{wN}$
$N_u = N_N$	$N_u = N_N$
$R = 0$	$R = 93\%$
$S_N = .0125$ = ($\bar{S}_{.7}$ MTN PKES. TO SHEA)	$S_N = 0.0125$
$S_u = S_N$	$S_u = 0.0011$

POTENTIAL ADJUSTMENTS	DIST. (FT)	(0.0125 − 0.0011)	= Δ ELEV.
SHEA TO 44TH :	1220	× 0.0114	= 13.9 FT.
44TH TO ONYX	1050	"	= 12.0 FT
ONYX TO FANFOL :	2130	"	= 24.3 FT.
FANFOL TO 40TH	1330	"	= 15.2 FT
40TH TO PRESERVE :	1169	"	= 13.3 FT

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EQUIL. SLOPE

B) CITY OF TUCSON DESIGN MANUAL (1989)

$$S_{EQ} = \left(\frac{1.45\,N}{q^{0.11}}\right)^2 \qquad \text{Eq. 6.25}$$

N = ROUGNESS

q = CHANNEL UNIT DISCHARGE (Q10) (CFS/FT)

S_{EQ} = EQUIL. SLOPE (FT/FT)

Q_{10} = 850 CFS
CHL WIDTH = 92 FT } q = 9.2

S_{EQ} = 0.0016 FT/FT

FOR CHANNEL DOWNSTREAM OF ZERO SEDIMENT SUPPLY, IE. DETENTION BASIN

C) AMAFCA SEDIMENT & EROSION DESIGN GUIDE (1994)

(1) WIDE, RECTANGULAR CHANNELS

$$S_{EQ} = \left(\frac{a}{q_s}\right)^{\frac{10}{3(c-b)}} q^{\frac{2(2b+3c)}{3(c-b)}} \left(\frac{n}{1.49}\right)^2 \qquad \text{Eqn 3.56}$$

S_{EQ} = Equilibrium Slope

q_s = bed material supply / unit width

q = water discharge / unit width

a, b, c = coefficients given by:

$q_s = a Y^b V^c$ & FIG 3-10

D_{50} = 6.3 mm

FOR ZELLER-FULLERTON

$a = .0064 (n^{1.77})(G^{0.45})(D_{50})^{-.61}$

$b = -0.3$

$c = 4.32$

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EQUIL SLOPE (AMAFCA)

Zeller-Fullerton

$$S_{EQ} = \left(\frac{1.16\times10^{-5}}{q_s}\right)^{0.72} q^{1.78} \quad (0.00055)$$

FOR	Q (CFS)	WIDTH* Ft	q_s CFS/FT	q CFS/FT	S_{EQ}
Q_2	330	60	0.00917	5.5	0.010
Q_{10}	850	92	0.02281	9.2	0.011
Q_{50}	1800	92	0.05285	19.6	0.009
Q_{100}	2300	92	0.07274	25.0	0.008

* WIDTH TRANSPORTING SEDIMENT

$$q_s = a V^b d^c \qquad a = 0.0064\,(0.035)^{1.77}\,(5.24)^{0.45}\,(6.31)^{-0.61}$$

$a = 1.16\times10^{-5}$

$b = 4.32$

$c = -0.3$

$S_{EQ} = 0.011$

FOR WITH UPSTREAM BASIN CONDITION

$$S_{EQ} = S_{Ex}\left(\frac{Q_{s\text{-supply}}}{Q_{s\text{-existing}}}\right)^{\left(\frac{2}{6-x}\right)} \qquad x = \frac{3}{5}\left(\frac{2b}{3} + c\right)$$

$x = 1.55$

$(.93)\,Q_{s,exist} = Q_{s\,future}$

$= .011\,(.07)^{0.72}$

$= .0016$ FT/FT

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ESTIMATE FINE SEDIMENT CONCENTRATION

USE MUSLE RESULTS

RI.	WATER VOL (AF)	SEDIMENT VOL (AF)	CONCENTRATION ppm	
Q100	189.4	13.3	70222	(7%
Q50	156.7	10.4	66369	(7%
Q10	89.5	5.0	55866	(6%
Q2	42.1	2.0	47506	(5%

AMAFCA

ALTERNATIVE APPROACH

$$S_s = C\,Q^{-0.133}$$

$$C = 18.28\, n^2\, F^{0.133}\, F_r^{2.133}$$

F_r = MAX FROUDE #

F = width / depth ratio

Q = dominant discharge

FOR

$F_r = 0.85$	$S_{EQ} = 0.012$	(Q2)
	$= 0.011$	(Q10)
$F = 1$	$S_{EQ} = 0.017$	(Q2)
	$S_{EQ} = 0.015$	(Q10)

$S_{EQ} \propto F_r$ WIDTH / DEPTH ≅ 40 (OKAY)

BUREC METHODS (BUREC, 1984)

(a) Schoklitsch $S_L = K \left(\frac{DB}{Q}\right)^{3/4}$

$K = 0.00174$

$D = D_{50} = 6.3$ mm

B = channel width (ft)

Q = dominant discharge (cfs)

	CHL WIDTH	TOP WIDTH
Q_2	.002	.003
Q_{10}	.001	.002

EQUIL SLOPE

BURMC K84

(b) MEYER-PETER MUELLER

$$S_L = \frac{k\left(\frac{Q}{Q_B}\right)\left(\frac{n_s}{D_{90}^{1/6}}\right)^{3/2} D}{d}$$

$k = 0.19$

$\frac{Q}{Q_B}$ = RATIO OF TOTAL FLOW TO FLOW OVER BED

D_{90} = 42mm % PASSING

N = CHANNEL MANNING'S N

$D = D_{50} = 6.3$ mm

d = MEAN DEPTH

S_L = STABLE SLOPE (FT/FT)

$Q_2 = 0.003$

$Q_{10} = 0.005$

(c) SHIELD'S DIAGRAM METHOD

$$R_* = \frac{u_* D}{\nu}$$

R_* = boundary Reynold's No.

u_* = shear velocity $\sqrt{S_L R g}$ (ft/s

S_L = slope (ft/ft)

R = mean depth (ft)

g = grav. constant $32.2 \frac{ft}{s^2}$

D = particle diameter (ft)

ν = kinematic viscosity of H_2O $\frac{ft^2}{s}$

EQUIL SLOPE

BURGC. Shields

$$T_* = \frac{T_c}{(\gamma_s - \gamma_w) D}$$

T_* = dimensionless shear stress

T_c = critical shear stress $\frac{lb}{ft^2}$ $\rightarrow = \gamma_w d S_L$

γ_s = specific wt sediment $165.4 \frac{lb}{ft^3}$

γ_w = spec. wt. water $62.4 \frac{lbs}{ft^3}$

d = mean depth ft

S = slope (ft/ft)

D = sed. diameter (ft)

REARRANGING FOR S_L

$$T_* = \frac{\gamma_w d S_L}{(\gamma_s - \gamma_w) D}$$

$$S_L = \frac{(\gamma_s - \gamma_w) D T_*}{\gamma_w d}$$

		S_L	
FOR TATUM WASH	Q_2 =	0.002	FT./FT.
	Q_{10}	0.003	FT./FT.

(c) LANE'S TRACTIVE FORCE

$$T_c = \gamma_w d S_L \Rightarrow S_L = \frac{\tau_c}{\gamma_w d}$$

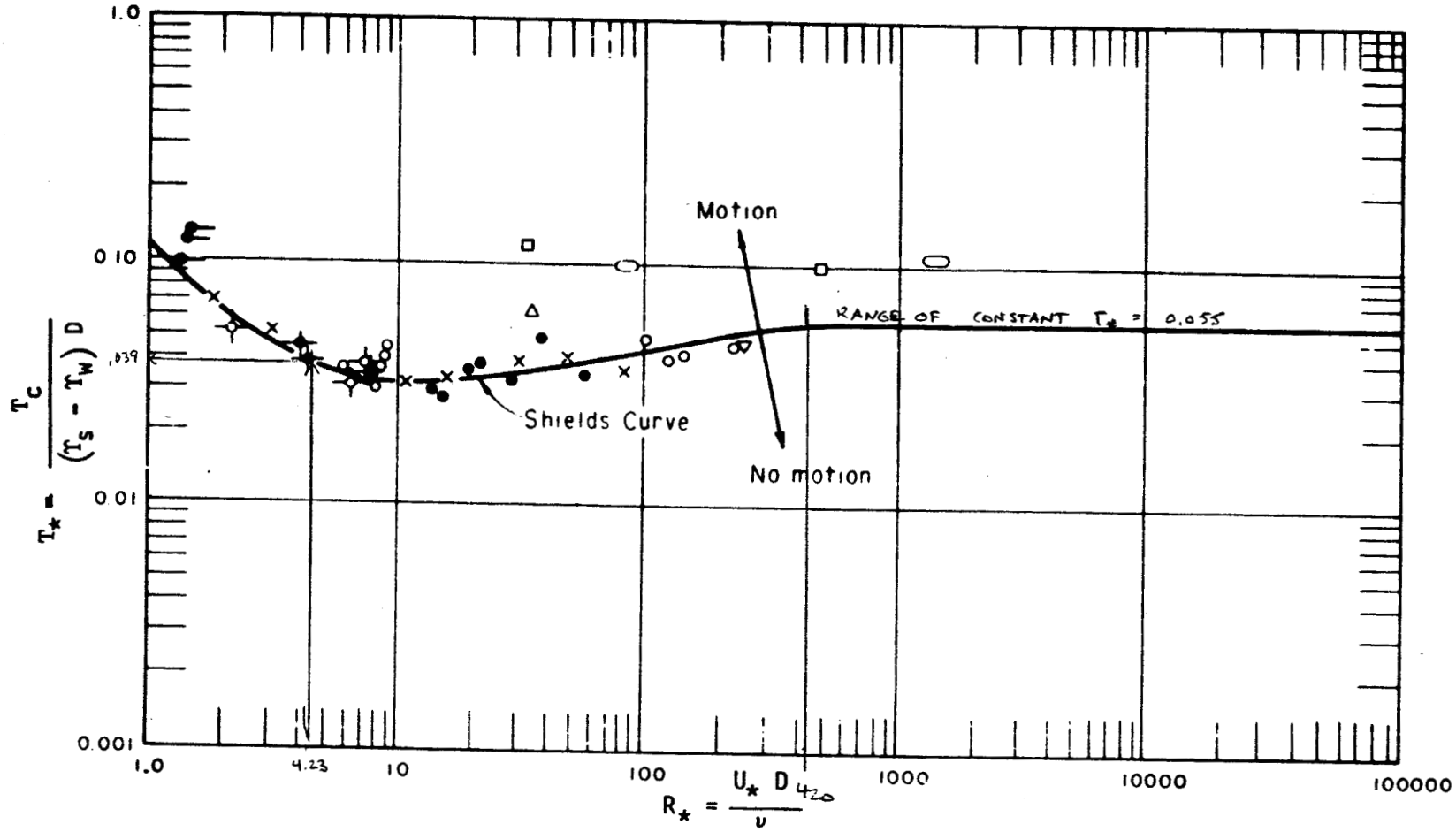
T_c = CRITICAL TRACTIVE FORCE $\left(\frac{LB}{FT}\right)$ FIG. 4

γ_w = SPECIFIC WEIGHT H_2O $\left(\frac{LBS}{FT^3}\right)$

d = MEAN DEPTH (FT)

$$T_c = 600 \frac{g}{m^2} \left(\frac{1 m^2}{10.76 ft^2}\right) \left(\frac{2.205 \times 10^{-3} lbs}{gr}\right) = 0.12$$

	S_{L_2}
Q_2 =	0.002
Q_{10} =	0.003



Sym	Description	γ_s, g/cm³
○	Amber	1.06
●	Lignite (Shields)	1.27
●	Granite	2.7
●	Barite	4.25
×	Sand (Casey)	2.65
✦	Sand (Kramer)	2.65
✦	Sand (U.S.W.E.S.)	2.65
▽	Sand (Gilbert)	2.65

Fully developed turbulent velocity profile

Turbulent boundary layer

●—	Sand (Vanoni)	2.65
—●	Glass beads (Vanoni)	2.49
□	Sand (White)	2.61
⬭	Sand in air (White)	2.10
△	Steel shot (White)	7.9

Figure 5. - Shields diagram for initiation of bed material movement

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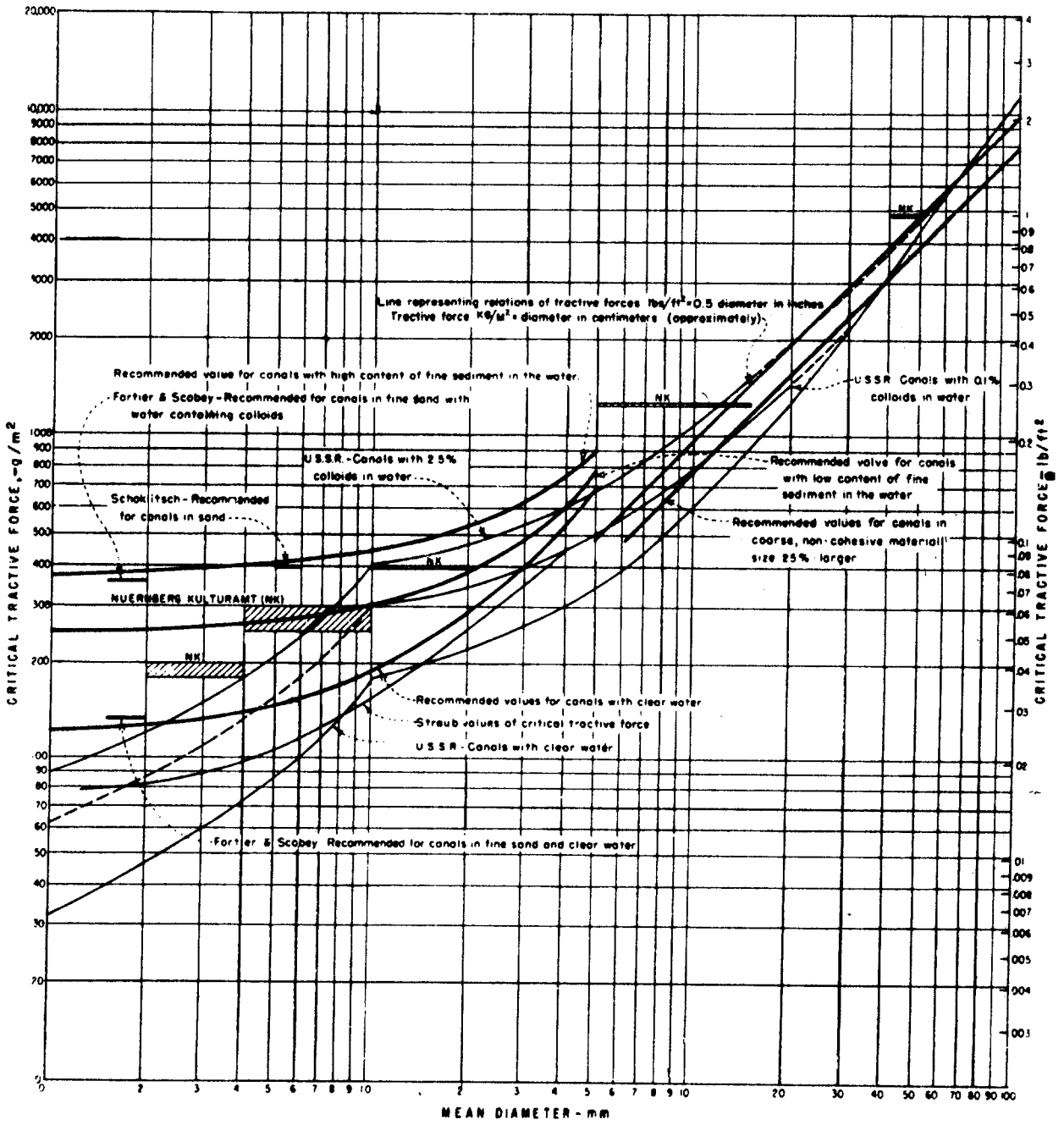

Figure 4. - Tractive force versus transportable sediment size (after Lane, 1952).

CONVERT $\frac{\text{GRAMS}}{m^2} \rightarrow \frac{lbs}{Ft^2}$

$\times \left(\frac{1\ m^2}{10.76\ Ft^2}\right)\left(\frac{2.205 \times 10^{-3}\ lbs}{gram}\right)$

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Tatum Wash Sedimentation Study
Armoring Analysis

BUREC, 1984 - Meyer Peter Muller

n = 0.035
d90 = 42 mm
K = 0.19

RI (yrs)	Topwidth (ft)	Area (ft2)	Avg Depth (ft)	Sf (ft/ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	93	90	0.967742	0.012	24	30	0.2	0.5
10	120	175	1.458333	0.0121	36	15	0.4	2.0
50	148	287	1.939189	0.0111	44	8	0.4	no armor
100	156	339	2.173077	0.0109	48	6	0.5	no armor

BUREC, 1984 - Competent Bottom Velocity

RI (yrs)	Chl Vel. (ft/s)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	4.24	34	17	0.3	1.6
10	5.78	63	0	0.5	no armor
50	7.48	105	0	0.5	no armor
100	8.14	125	0	0.5	no armor

BUREC, 1984 - Lane's Tractive Force

Tw = 62.4 lb/ft2

RI (yrs)	Sf (ft/ft)	Avg Depth (ft)	Tc (lb/ft2)	Tc (g/m2)	Dc (mm) Fig. 4	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	0.012	0.967742	0.72	3536	46	8	0.5	no armor
10	0.0121	1.458333	1.10	5373	70	0	0.5	no armor
50	0.0111	1.939189	1.34	6554	85	0	0.5	no armor
100	0.0109	2.173077	1.48	7213	92	0	0.5	no armor

BUREC, 1984 - Shield's Diagram

Tw = 62.4 lb/ft2 T* = 0.06
Ts = 165 lb/ft2

RI (yrs)	Sf (ft/ft)	Avg Depth (ft)	Dc (ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	0.012	0.967742	0.117714	36	15	0.4	2.0
10	0.0121	1.458333	0.178866	55	1	0.5	no armor
50	0.0111	1.939189	0.218187	67	0	0.5	no armor
100	0.0109	2.173077	0.240097	73	0	0.5	no armor

BUREC, 1984 - Yang's Incipient Motion

RI (yrs)	Chl Vel. (ft/s)	Dc (ft)	Dc (mm)	% Finer than Dc	Ya (ft)	Armor Depth (ft)
2	4.24	0.118472	36	15	0.4	2.0
10	5.78	0.220161	67	0	0.5	no armor
50	7.48	0.368713	112	0	0.5	no armor
100	8.14	0.436651	133	0	0.5	no armor

TATUM WASH – GEOMORPHIC ANALYSIS

ARMORING POTENTIAL

① AMAFCA 1993 / BUREC 1984

$$y_s = y_a \left(\frac{1}{P_c} - 1 \right)$$

y_a = THICKNESS OF ARMOR LAYER

P_c = DECIMAL FRACTION OF MATERIAL COARSER THAN ARMORING SIZE

$$D_c = \frac{\tau_o}{F_* (\gamma_s - \gamma)}$$

D_c = DIAMETER OF SED. PARTICLE @ INCIPIENT MOTION

τ_o = BED SHEAR STRESS = $\gamma R S$

γ_s = SPEC WT. SEDIMENT

γ = SPEC WT. H_2O

F_* = SHIELD'S PARAMETER

BUREC 1984

(a) MEYER-PETER MULLER

$$D_c = \frac{d\,S}{k \left(\frac{n_s}{D_{90}^{1/6}} \right)^{3/2}}$$

D_c = PARTICLE SIZE, mm

d = mean depth (ft)

S = ENERGY SLOPE (FT/FT)

n_s = CHANNEL MANNING'S N

k = 0.19

D_{90} = 90% PASSING SIZE (mm)

ARMORING

(b) COMPETENT BOTTOM VELOCITY

$$D_c = 1.88\, V_m^2$$

D_c = ARMOR SIZE mm

V_m = MEAN CHL VELOCITY

(c) LANE'S TRACTIVE FORCE

$$T_c = \gamma_w d S$$

T_c = CRITICAL TRACTIVE FORCE

γ_w = SPECIFIC WT H_2O $62.4 \frac{LB}{FT^2}$

d = MEAN DEPTH (FT)

S = SLOPE (FT/FT)

USE FIG 4.

(d) SHIELD'S DIAGRAM

$$T_* = \frac{T_c}{(\gamma_s - \gamma_w) D_c} = .06 \quad (\text{FOR } R_* > 500)$$

↳ SEE STABLE SLOPE CALCS

T_* = DIMENSIONLESS SHEAR STRESS

T_c = CRITICAL SHEAR STRESS $\frac{LB}{FT^2}$

$= \gamma_w R S$ $\quad$ R = AVERAGE DEPTH (FT)

S = SLOPE (FT/FT)

γ_s = 164.5 LB/FT³ SPECIFIC WT. SED

γ_w = 62.4 LB/FT³ SPECIFIC WT. H_2O

D_c = PARTICLE DIAMETER

$$D_c = \frac{\gamma_w R S}{(\gamma_s - \gamma_w)\, T_*}$$

ARMORING

(c) YANG INCIPIENT MOTION ($R_* > 70$)

$$\frac{V_{cr}}{w} = 2.05$$

V_{cr} = CRITICAL VELOCITY @ INCIPIENT MOTION (FT/S)

w = TERMINAL FALL VELOCITY (FT/S)

$= 6.01\, D_c^{1/2}$

$$\therefore\ D_c = 0.00659\, V_{cr}^2 \qquad (D_c \text{ IN FT.})$$

ARMORING DEPTH

ARMOR SIZE MUST BE $\leq D_{90}$

ASSUME ARMOR LAYER THICKNESS = $3 \times D_c$ OR 0.5 FT (WHICHEVER SMALLER)

ASSUME HYDRAULIC CONDITIONS NOT CHANGED BY SCOUR

SLOPE NOT CHANGED BY SCOUR

$$y_d = y_a \left(\frac{1}{\Delta_p} - 1 \right)$$

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ALLOWABLE VELOCITY

① CORPS OF ENGINEERS - SEE ATTACHED

EM 1110-2-1601 (1970)

F. GRAVEL - 6 FT/S

IGNEOUS / METAMORPHIC ROCK - 20 FT/S

D_{50} = 6.3 mm = .021 FT 1.5 FT/S
D_{90} = 42 mm = .138 FT 3.2 FT/S
} PLATE 29

↑ VELOCITY AGAINST STONE

② HYDRAULIC DATA

	AVG DEPTH FT	AVG VEL. FT/S
Q2	0.97	4.24
Q10	1.46	5.78
Q50	1.94	7.48
Q100	2.17	8.14

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Table 2.3.1 Example of allowable velocity criteria (from EM 1110-2-1601, 1970)

Channel Material	Mean Channel Velocity, fps
Fine sand	2.0
Coarse sand	4.0
Fine gravel††	6.0
Earth	
Sandy silt	2.0
Silt clay	3.5
Clay	6.0
Grass-lined earth (slopes less than 5%)‡	
Bermuda grass - sandy silt	6.0
- silt clay	8.0
Kentucky Blue Grass - sandy silt	5.0
- silt clay	7.0
Poor rock (usually sedimentary)	10.0
Soft sandstone	8.0
Soft shale	3.5
Good rock (usually igneous or hard metamorphic)	20.0

† Based on TM 5-886-4 and CE Hydraulic Design Conferences of 1958-1960.

* †† For particles larger than fine gravel (about 20 mm = 3/4 in.), see plate 29. - attached

‡ Keep velocities less than 5.0 fps unless good cover and proper maintenance can be obtained.

The following comments discuss applicability of the criterion.

(1) Theoretical objections can be raised to using velocity alone as a criterion. Velocities are however comparatively easy to measure, compute, or visualize. It is often useful to convert more sophisticated criteria so that velocity appears as a primary variable. For instance, the shear stress criterion can be converted to terms of velocities for specified depths of flow: see Section 2.3.3.

(2) Velocity criteria can be modified to allow for sediment transport and other factors. A Soil Conservation Service manual for open channel design (USDA 1977) provides basic allowable velocities for "sediment free" and "sediment laden" flow (Figure 2.3.1). Adjustment factors are suggested for depth of flow, channel curvature and bank slope angle. The difficulty arises, however, of interpreting terms like "sediment laden": in the USDA manual, it refers to a certain level of suspended sediment concentration.

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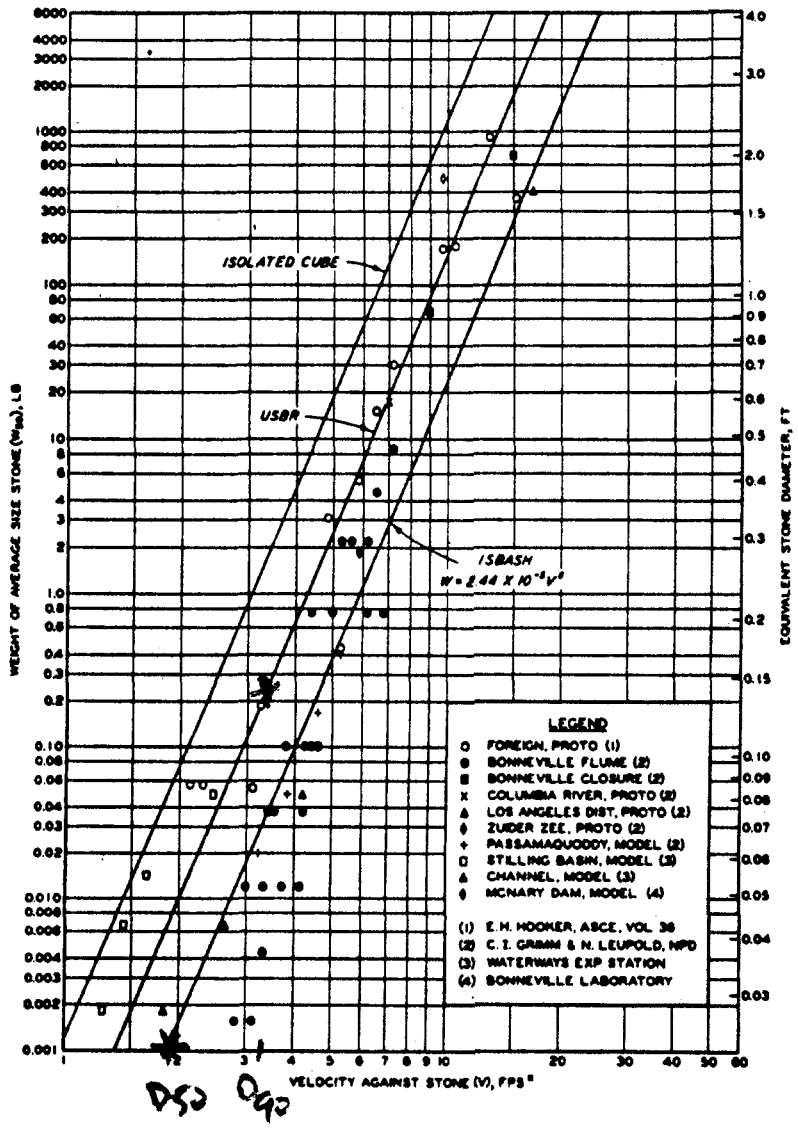
(23)



D50 D95

NOTE: SPECIFIC WEIGHT OF ROCK = 165 LB/CU FT.
*FOR STONE PROTECTION BELOW ENERGY DISSIPATORS USE AS AVERAGE VELOCITY ACROSS END SILL.

VELOCITY VS STONE WEIGHT

SEE TEXT PAGE 36

Plate 29

(3) ECS (1977)

	VELOCITY (FT/S) SEDIMENT LADEN	CLEAR WATER
D_{50} = 6.3 mm	4.7	2.8
D_{90} = 42 mm	7.8	5.5

MORE EROSIVE AFTER BASIN (PHASE 2) CONSTRUCTED

(4) COHESIVE MATERIAL (COE, 1991)

FOR D = 5 FT, VEL = 3.5' - AVERAGE COHESIVE ERODED

D = 5 FT, VEL. = 5.5' - VERY STIFF ERODED

(5) GRANULAR BED MATERIAL (COE, 1991)

D_{50} ≅ 5 mm - D = 5 FT, VEL = 3.5'

D_{90} ≅ 50 mm D = 5 FT, VEL = 7.5'

D_{50} ERODED IN > Q2

D_{90} ERODED IN > Q50

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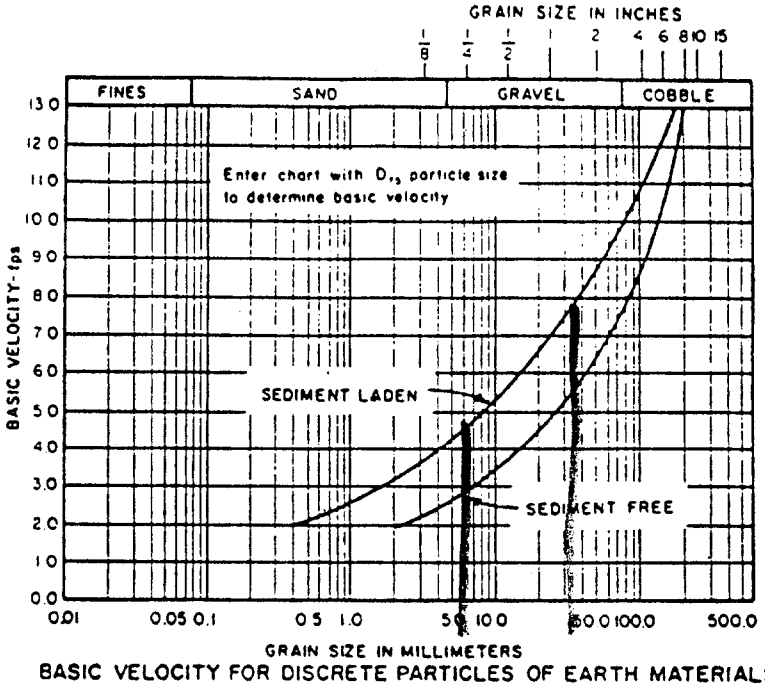

BASIC VELOCITY FOR DISCRETE PARTICLES OF EARTH MATERIALS

(Notes: 1. Applies to 3 ft depth of flow. D_{50} D_{90}
2. Provided as example only of modified velocity criterion.)

Figure 2.3.1. Allowable velocity criteria with provision for sediment transport (USDA 1977).

(3) For channels with substantial bed-sediment inflows, an allowable minimum velocity to avoid sedimentation may be as important as an allowable maximum to avoid erosion.

(4) In applying velocity criteria it is important to consider the full range of discharges. One approach that has been used in designing modified channels is to match so far as possible the velocity-discharge curve of the natural channel. Experience with local constrictions and widenings of alluvial channels generally supports this approach: artificially constricted sections will often scour their beds to restore more or less the natural velocity, and widened sections will often infill similarly.

(5) An allowable velocity will not in itself provide a complete channel design, because a specified value can be satisfied by a wide range of width, depth and slope combinations. Any specified upper limit can be satisfied theoretically by providing a wide shallow cross-section (Figure 2.3.2). In fact, however, the stream may erode a narrower sub-channel within the wide cross-section and then degrade to a flatter slope, or it may silt in from the sides. A velocity criterion therefore has to be used in conjunction with other criteria or guidelines for slope, width, or cross-sectional shape.

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Table 5.3.2 **Approximate mean channel velocities for erosion of cohesive materials**

Description of material	Depth of flow ft	Approximate velocity ft/sec
Very soft	5	2
	10	2.5
	20	3
Soft	5	2.5
	10	3
	20	3.5
Average	5	3.5
	10	4
	20	4.5
Stiff	5	4.5
	10	5
	20	5.5
Very stiff	5	5.5
	10	6
	20	7

BANKS V/S FANFOL

BANKS → V/S OF FANFOL

Note: Erosion of cohesive and semi-cohesive materials is affected by a wide variety of physical and chemical factors. Where possible, values should be determined by previous experience or laboratory testing.

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Table 5.3.1 Approximate mean channel velocities for "beginning of bed movement" of granular materials

(BED)

Grain size mm	Grain size ft	Depth of flow ft	Approximate velocity ft/sec
0.1	-	5	2
		10	3
		20	4
0.2		5	2
		10	3
		20	4.5
0.5		5	2.5
		10	3.5
		20	5
1	0.003	5	2.5
		10	4
		20	5
2	0.0066	5	3
		10	4
		20	5.5
5	0.016	5	3.5
D50		10	4.5
		20	6
10	0.033	5	4.5
		10	5.5
		20	6.5
20	0.066	5	5.5
		10	6.5
		20	7.5
D90 50	0.164	5	7.5
		10	8.5
		20	9.5
100	0.328	5	9.5
		10	10.5
		20	12
200	0.656	5	11.5
		10	13.5
		20	15
500	1.64	5	16
		10	18
		20	21

Note: Values are given for approximate guidance only. Threshold velocities will vary with grainsize distribution, bed forms, flow curvature and other factors.

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Tatum Wash Sedimentation Study — Q2 = 330 cfs — Slope = 0.011
Hydraulic Geometry Relationships — Q10 = 850 cfs

Hydraulic Geometry Equations	2-Year Surface Width	Depth	Velocity	10-Year Surface Width	Depth	Velocity	Data Source
Lacey	49	4.3	2.11	78	5.9	2.47	Canals in India
Pettis	45	4.1	0.90	71	5.4	0.92	Miami River
Bray	51	1.8	0.52				Gravel bed rivers
Ackers & Charlton	41			61			Flume data
Smith	40			40			
Leopold & Maddock							

Regime Equations	2-Year Hydraulic Radius	Depth	Velocity	10-Year Hydraulic Radius	Depth	Velocity	
Lacey	0.97	1.01	4.60	1.46	1.39	6.25	Canals in India
Silt factor =	3.2						
D50 =	0.25	inch					

	2-Year Channel Width	Channel Depth	Velocity	10-Year Channel Width	Channel Depth	Velocity	
Blench	72	1.62	2.78	116	2.22	3.25	Gravel bed rivers
Bed factor, Fb =	4.8						
Erodibilty factor, Fs =	0.3	cohesive material					
D50 =	6.3	mm					

	2-Year Hydraulic Radius	Width	Velocity	10-Year Hydraulic Radius	Width	Velocity	
Simons & Albertson	3.49	44	8.29	4.91	72	10.39	B type channel
C1 =	2.51						
C2 =	0.43						
C3 =	1.08						
C4 =	16.1						
C5 =	4.3						

Schuum	Channel Width	Channel Depth
Q mean annual:	8	0.29
Q mean flood:	51	1.31
m =	2	
Mean Annual Discharge=	0.038 cfs =	0.24 inch (Per Renard Eq'n)
Mean Annual Flood=	330 cfs	

Parker Gravel Bed	RI	Depth	Velocity	Discharge	Dim'less Discharge	Regime Width	Regime Depth	Regime Slope
	2	0.97	4.24	330	186	15	0.56	0.026
	10	1.46	5.78	850	382	22	0.75	0.019
	50	1.94	7.48	1800	657	28	0.94	0.016
	100	2.17	8.14	2300	800	31	1.02	0.014

sediment density =	164.5	lb/ft3
water density =	62.4	lb/ft3
gravitational constant =	32.2	ft/s2
d50 =	0.021 ft	0.252 in

Chang Gravel Bed	Q2 Slope	Width	Depth	Q10 Slope	Width	Depth
	0.00032	32	2.35	0.000216	50	3.50
d50 =	6.3	mm				
bankful discharge =	330	cfs (Q2)				
bankful discharge =	850	cfs (Q10)				

Kellerhals	Q2 Width	Depth	Q10 Width	Depth
	33	2.70	52	3.94
Grain Roughness, Ks =	0.02			

GEOMORPHIC ANALYSIS

A. PLAN FORM

(1) DOWNSTREAM OF FANFOL DR.

STRAIGHT

SINUOSITY $\frac{5.05}{4.85} = 1.04$ (< 1.5)

BRAIDED

DOWNSTREAM OF FANFOL - STEEP SLOPE

W/ WIDE, SHALLOW CHANNEL

(2) UPSTREAM OF FANFOL DR

STRAIGHT $\frac{1'4.53''}{1'4.08''} = 1.04$

ENTRENCHED / CONFINED MTN STREAM

B SLOPE - DISCHARGE RELATION = BRAIDED

(1) $S_o = 0.01$ FT/FT - IN THE BRAIDED REGION

REGARDLESS OF Q (FIGURE 5 ABOVE, P.35

(2) LANE : $S > 0.010\ Q_m^{-0.25}$

Q_m = AVG. ANNUAL DISCHARGE = 350 CFS

$S > 0.002$ (BRAIDED)

(3) ACKERS & CHARLETON

meander $S > .001$ $S < 0.0015\ Q^{0.12}$ NOT APPLIC

straight $S < .003$ $S < 0.003$

(4) LEOPOLD & WOLMAN $S > 0.06\ Q_{AV}^{-0.44}$

> 0.005

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GEOMORPHIC RELATIONSHIPS

(5) HENDERSON

$S > 0.64\, d_{50}^{1.14}\, Q_{AV}^{-0.44}$ $d_{50} = .021$ FT

$> .0006$ FT/FT BRAIDED

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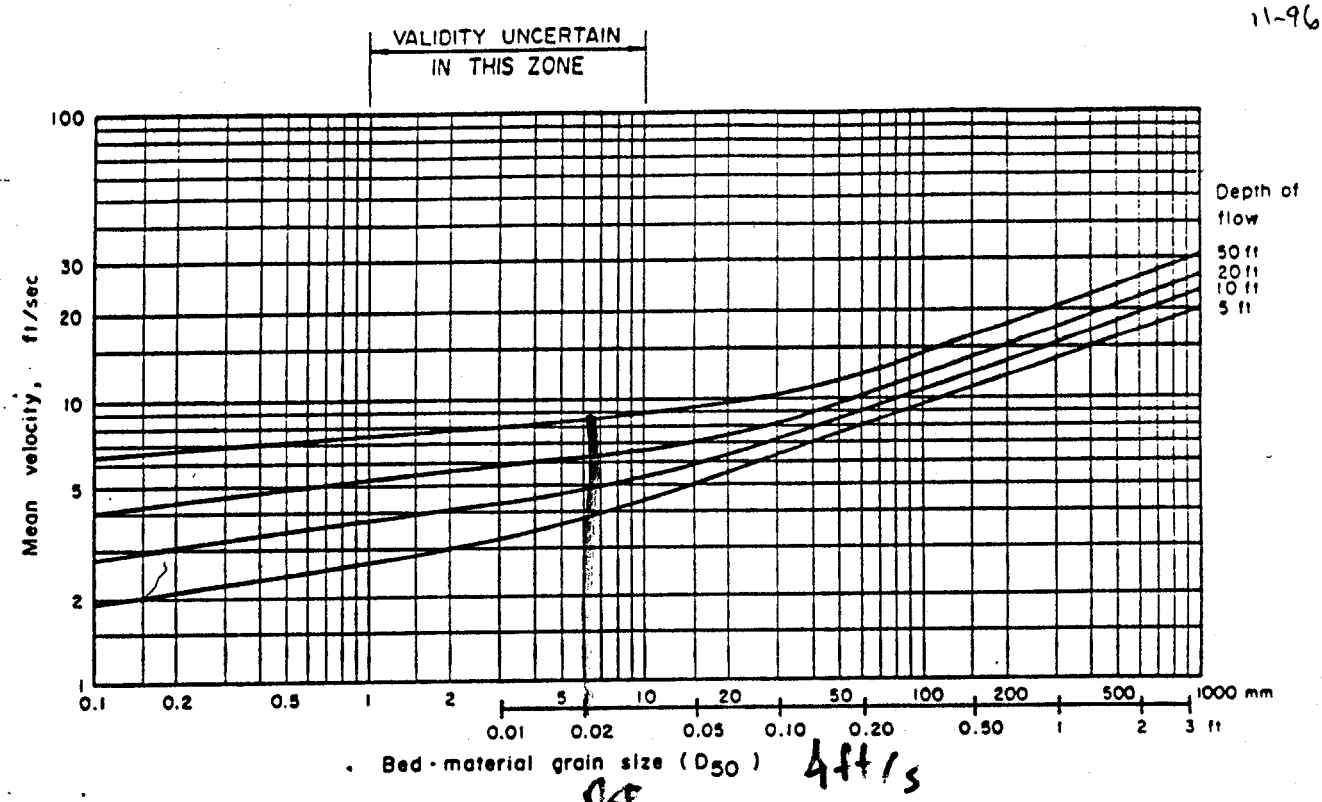
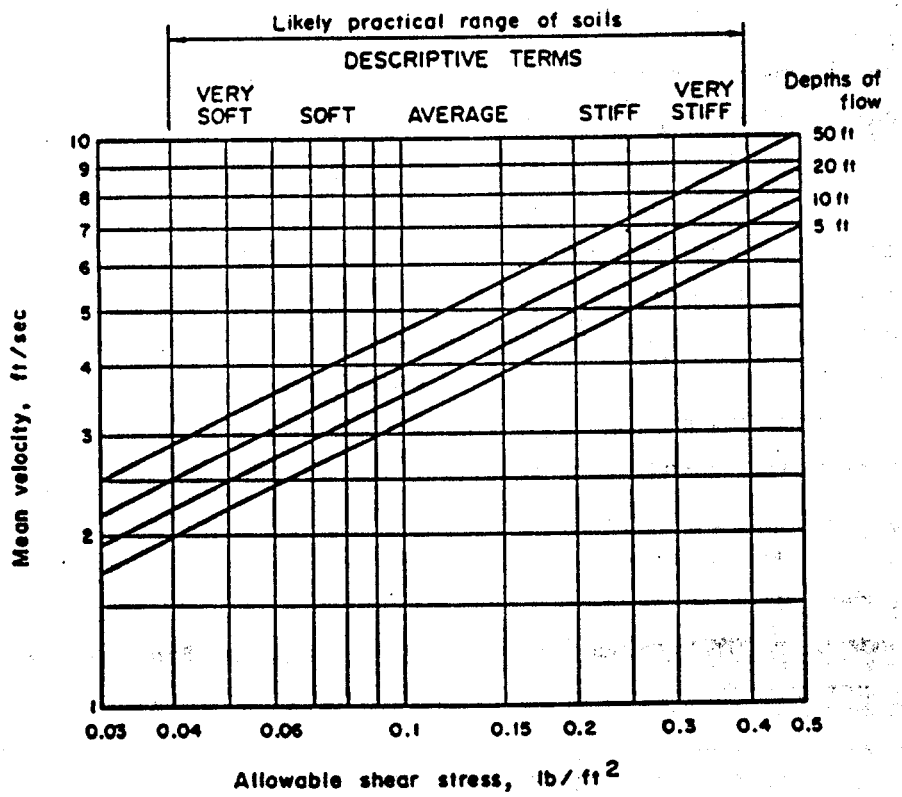


4ft/s

Figure 5.3.3 Approximate threshold velocities for bed movement of granular materials.



NOTE: Where possible, allowable shear stresses should be determined from previous experience or laboratory testing.

Figure 5.3.4 Approximate threshold shear stresses and velocities for erosion of cohesive materials.

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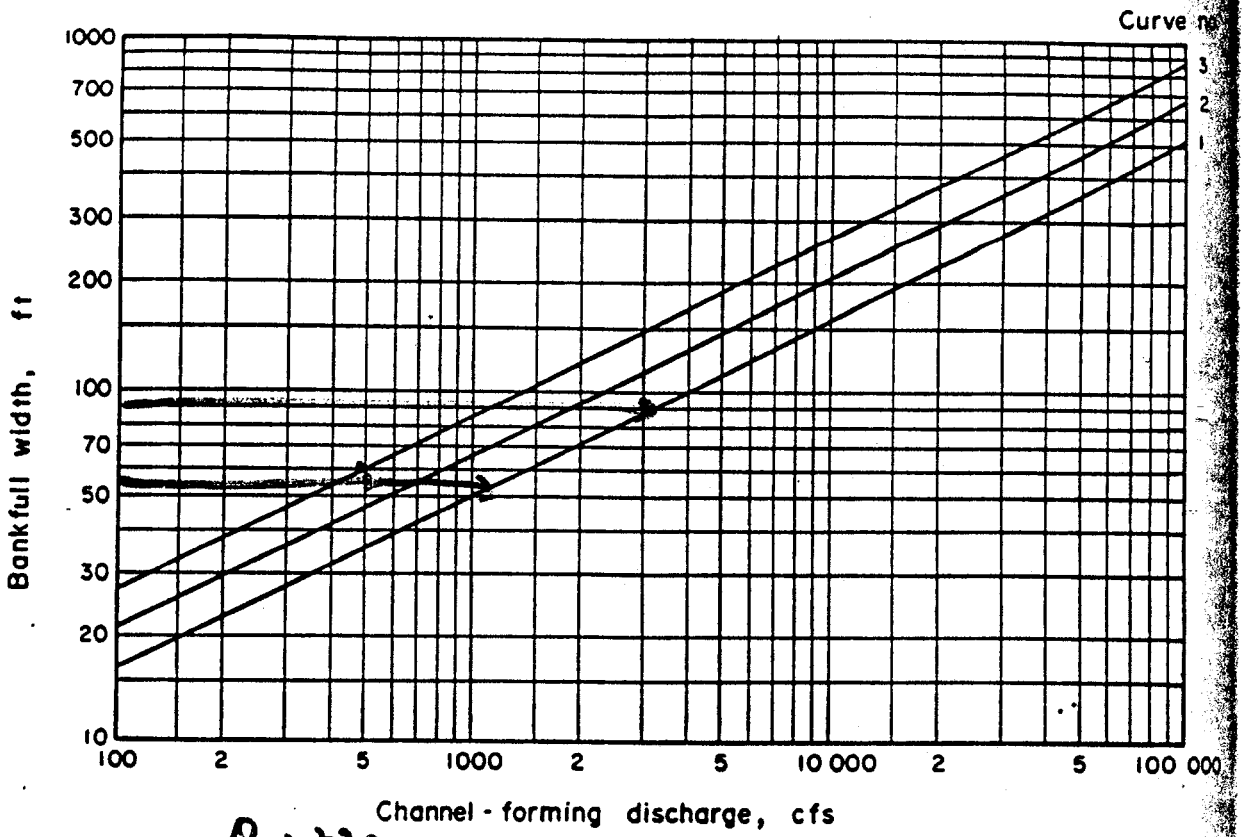

$Q_2 = 330$

$Q_{10} = 850$ → ALSO ADJUSTED TO Q_{10} TN: 90 (DRAFT)

Tentative guidance: Curve 1 : stiff cohesive or very coarse granular banks.
Curve 2: average cohesive or coarse granular banks.
Curve 3: sandy alluvial banks.

See section 5.3.3 of text for limitations.

Formula: $W = CQ^{0.5}$ with $C = 1.6, 2.1, 2.7$

ENTER WIDTH, COMPARE Q TO Q_2 OR $Q_{BANKFULL}$

Figure 5.3.5 Hydraulic geometry: bankfull width versus channel-forming discharge.

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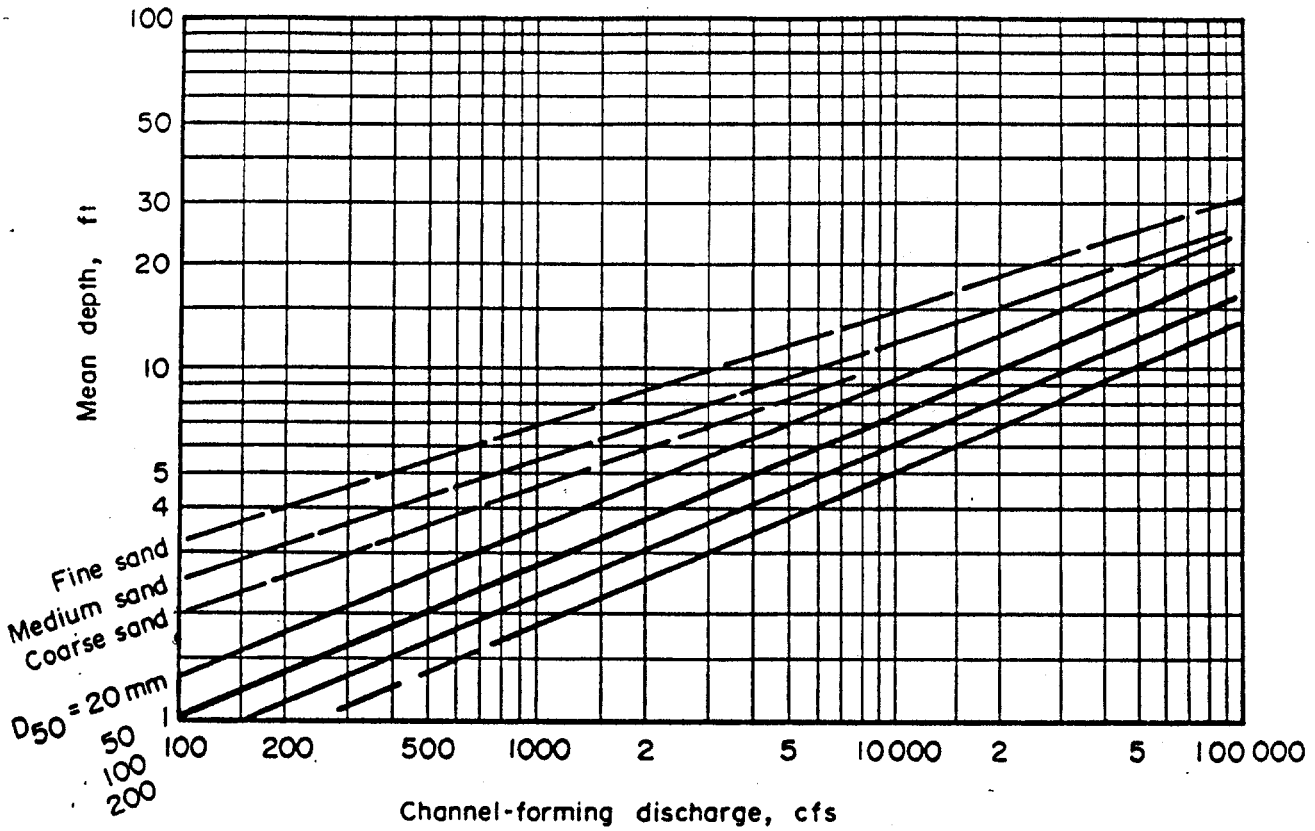

$D_{50} = 6.3$

$Q_2 = 330$ $\bar{D} = \frac{A}{T_W} = 0.97$

$Q_{10} = 850$ $\bar{D} = \quad = 1.46$

Note : for very approximate guidance only; depths should be checked by uniform - flow calculation using selected width and slope (Figures 5.3.4 and 5.3.5) and estimated roughness (see Section 4.5.5).

Applies basically to channels with low bed - sediment transport.

SUMMARY: ① BEDLOAD DOMINATED
② HIGHER THAN AVERAGE D_{50} FOR DEPTH & Q

Figure 5.3.6 Hydraulic geometry: mean depth versus channel-forming discharge.

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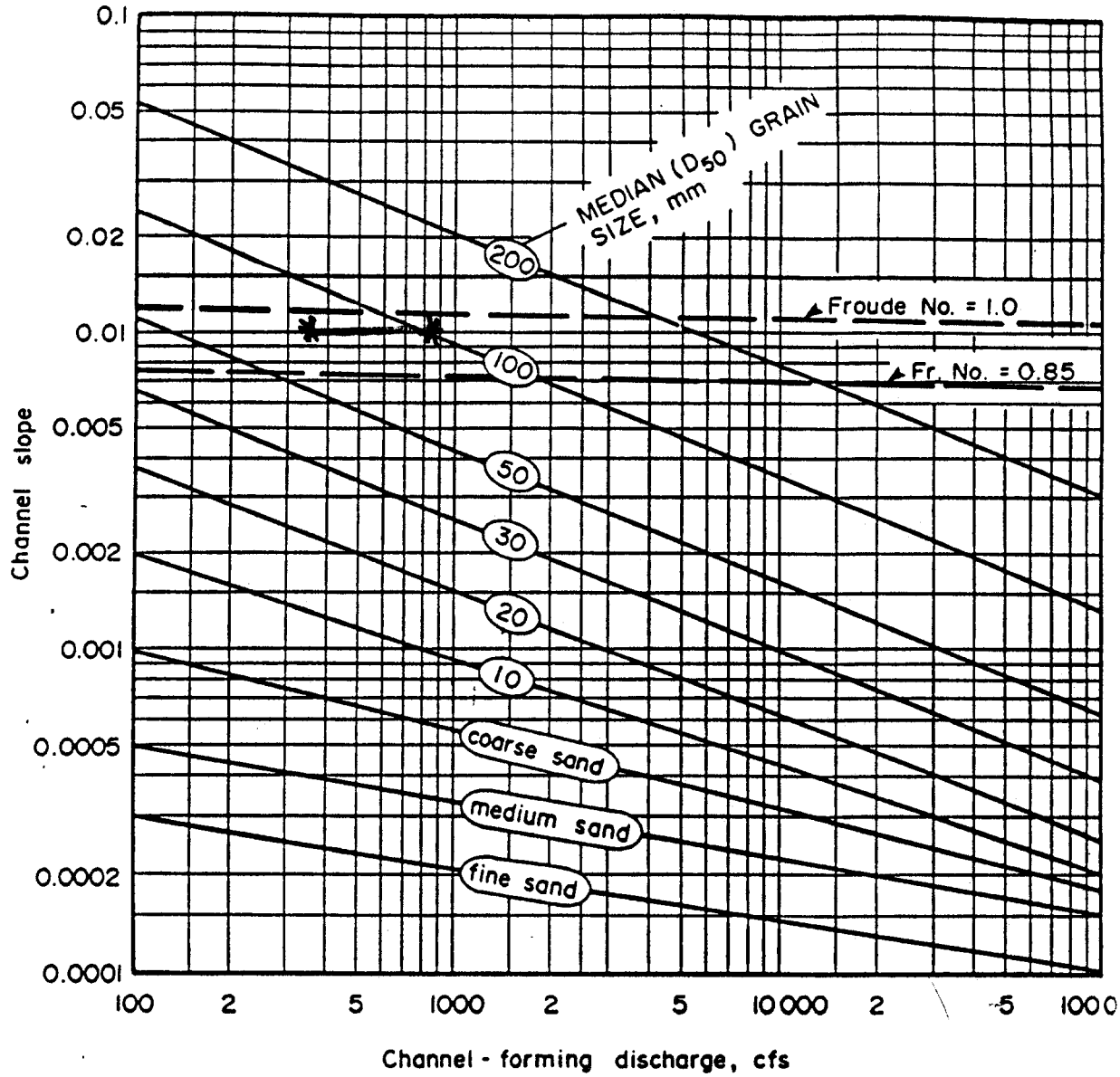

Note: for limitations see Section 5.3.3 of text. Curves are basically for single channels with fully alluvial bed but low bed-sediment transport. Slopes may be much higher with high sediment transport, especially with sand beds.

D_{50} REFERS TO BED MATERIAL

Figure 5.3.7 Hydraulic geometry: slope versus channel-forming discharge.

SUMMARY: ① BED LOAD DOMINATED

SEDIMENT YIELD

Tatum Wash Reservoir Trapping Efficiency

Churchill Method (Small Reservoirs, settling basins)

Basin	Phx Mtn	Shea
Capacity (AF)	135	35
Avg. Inflow (cfs)	94	105
Period of Retention (min)	1300	1300
Length (ft)	832	533
Avg. Cross Section Area (ft)	7068	2860
Mean Velocity (ft/sec)	0.013	0.037
S.I.	5.9E+06	2.1E+06
Trapping Efficiency (%)	41	25

Brune Method (Large Reservoirs, Normal Ponded Reservoirs)

Avg. Annual Inflow	46.6	46.6	
Capacity (AF)	135	35	
Ratio Capacity/Inflow	2.9	0.8	
Trapping Efficiency	98	98	Use Figure A-9, BUREC)

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Tatum Wash Sed. Yield Estimates:

I. Renard.

$$Y = 0.001846\, A_a^{-0.1187}$$

where Y = avg. annual sediment yield in ac-ft/ac/yr

A_a = drainage area in acres.

Concentration Point	Area (acres)	Y ac-ft/ac/yr	Y ac-ft/mi²/yr	Y AF/YR
CP1F	1228.8 (1.92mi²)	.000793	0.51	0.98
CP2E	1388.8 (2.17mi²)	.000782	0.50	1.09

II. Pacific Southwest Inter-Agency Committee (PSIAC)

Concentration Point	Surface Geology a	Soils b	Climate c	runoff d	Topography e	Ground cover f	Land use g	Upland erosion h	overall erosion & sed. tran. i
CP1F	5	4	5	5	15	-6	-7	10	10
CP2F	5	4	5	5	15	-6	-7	10	10

CP1F = 0.75
CP2E = 0.85

Both totals = 41 = X

class = 4

Interpolated Yield = 0.39 af/mi²/yr.

(NOTE From Renard, 1981 - $Y = 0.0816e^{0.0353X}$
$= 0.35$ af/mi²/yr)

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III. Dendy Bolton.

$$S = 1280\, Q^{0.46} (1.43 - 0.26 \log A)$$

where: S = sed. yield ($t/mi^2/yr$)
Q = annual runoff (in)
A = Watershed Area (mi^2)

& $Q = 0.4501\, A^{-0.1449}$ @ Walnut Gulch

Concentration Point	Annual * Avg. Q (in)	S Tons/mi²/yr	S af/mi²/yr **	DA mi²	YIELD AF/YR
CP1F	0.24"	900.5	0.44	1.92	0.84
CP2E	0.24"	891.3	0.43	2.17	0.93

$0.24\,IN \left(\frac{FT}{12\,IN}\right)\left(2.17\,mi^2\right)\frac{640\,AC}{mi^2} = 27.8\,\frac{AF}{YR} = \left(\frac{43560\,FT^2}{AC}\right)\left(\frac{YR}{365\,24\,3600\,S}\right) = 0.0$

---

* These numbers represent 2.9% of average annual precip as derived from $Q = .4501\, A^{-.1449}$ derived from walnut gulch, which receives 14" annually.
So 1) For 14" Annl – Eqn yields .41"; $\frac{.41}{14.00} = 2.9\%$
2) For 8.3" Annl 2.9% × 8.3 = .24"

** Assume sediment density = 95 lb/ft³

Avg Annl Precip @ Paradise Valley = 8.3"

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IV. U.S. Bureau (see Design of Small Dams)

$$Q_s = 1.84 A^{-0.24}$$

where Q_s = Sediment Yield (AF/mi²/year)

A = Drainage Area in square miles

Concentration Point	Area mi²	Qs (AF/mi²/year)	YIELD AF/YR
CP1E	1.92	1.57	3.02
CP2E	2.17	1.53	3.32

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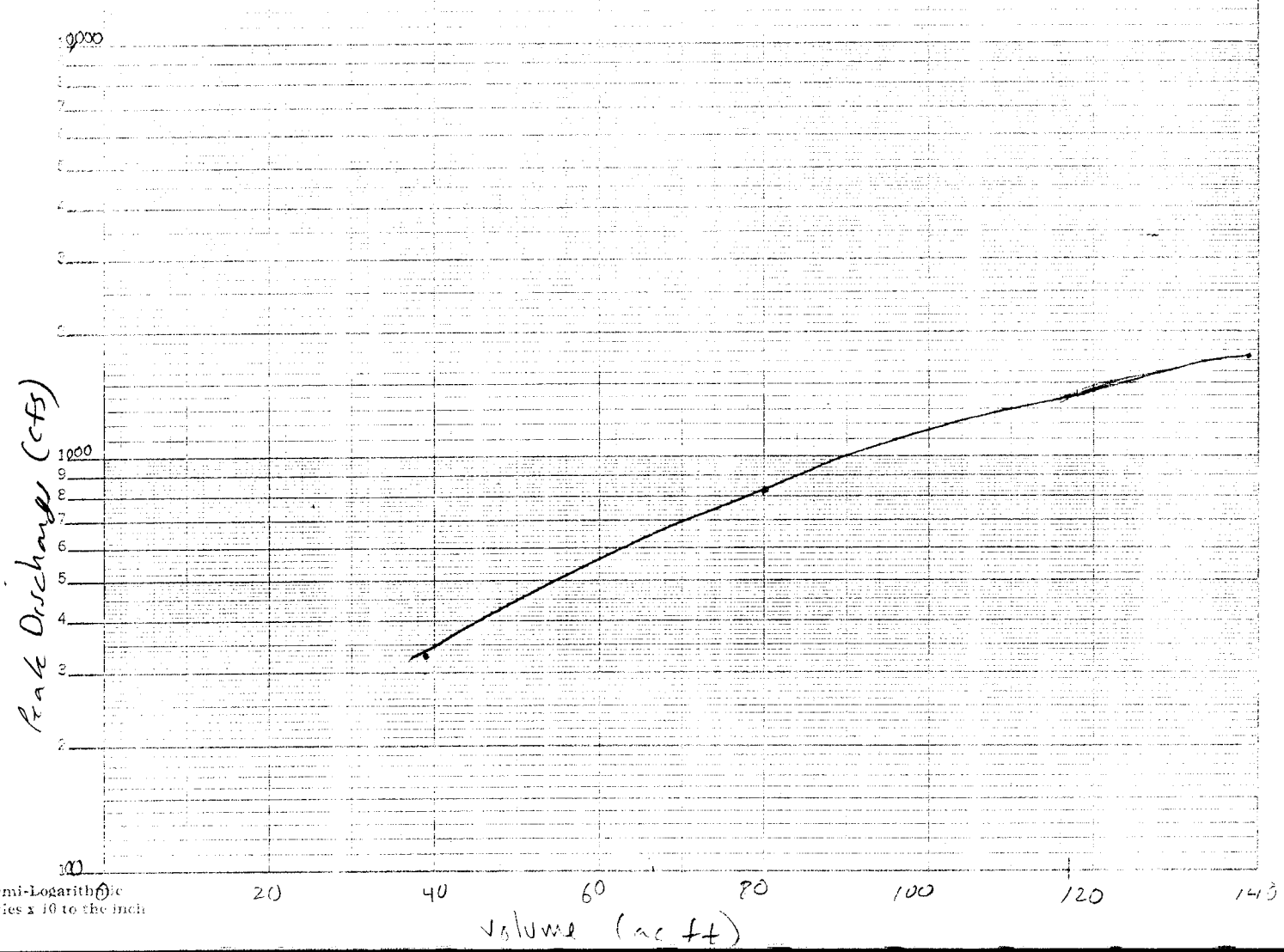
This graph was used to determine the total flow volume of the 5- & 25-year flows. These two discharges were interpolated using sheet 1, Chart 3 from "Report on Hydrology of Tatum Wash" by the FCDMC, 2/27/95



Semi-Logarithmic
4 Cycles x 10 to the inch

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Musle Data

Hydrology

Return Period	CP1F Qpeak (cfs)	CP1F Vol (acre-feet)	CP2E Qpeak (cfs)	CP2E Vol (acre-feet)
2	328	38.6	334	42.1
10	820	80.0	848	89.5
50	1719	139.3	1798	156.7
100	2212	168.3	2315	189.4

K-factor for CP1F only.

Soil class	Description	Area (acres)	% of Area	K
PvC	Pinamt very gravelly loam (3 to 5% slopes), contains small areas of Antho, Cavelt, Rillito & Tremant soils few fine roots, more than 10% is gravel. (Note: contiguous with 98-Pinamt/Tremant complex which has 56% Pinamt, 44% Tremant, & a weighted K of 0.17.) Permeability is moderately slow, subangular blocky structure. Assume 30% < 2 mm, 12% < .1 mm & 18% between .1-2 mm or 18% sand. Assume 1% Organic Matter.	248.3	21%	0.10

(Data from "Soil Survey, Eastern Maricopa & Northern Pinal Counties Area, Arizona", U.S. Department of Agriculture, SCS, Nov. 1974.)

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K-factor continued

Soils Class	Description	Area (acres)	% of Area	K
TrB	Tremant gravelly loam, 1-3 percent slopes. includes Pinant, Antho, Carelt, & Rillito soils. 45% of upper horizon is Gravel, permeability is moderately slow massive - slightly hard w/45% gravel (i.e, >2mm) that leaves 55% < 2mm, then approximately 30% < 1mm & 25% between 1 & 2 mm. assume organic matter = 1% (Data from same reference as PvC.)	26.9	2%	.21
"Rv"	Rough-Broken Land, gravelly soils & Antho, Carelt, Pinant, Rillito & Tremant Permeability is rapid to moderate. no estimates are given for structure, or gradation. A K value is estimated to fall between Pinant & RO (Rock outcrop). Pinant K = 0.10, Ro K = 0. (Ro K is contiguous to 109, -(see Ro below) (Data from same reference as PvC & from "Soil Survey of Aguila-Carefree Area, Parts of Maricopa & Pinal Counties Arizona, USDA-SCS 1981.)	93.5	8%	.07
Ro	109 Schenco-Rock Outcrop Complex. 55% Schenco extremely channery loam, & 35% Rock Outcrop. (normalized to 61% - 39%. Schenco K = .05, RO K = 0. Weighted = 0.03. Data from same 2 references already cited).	790	68%	0.03

1" = 2000'

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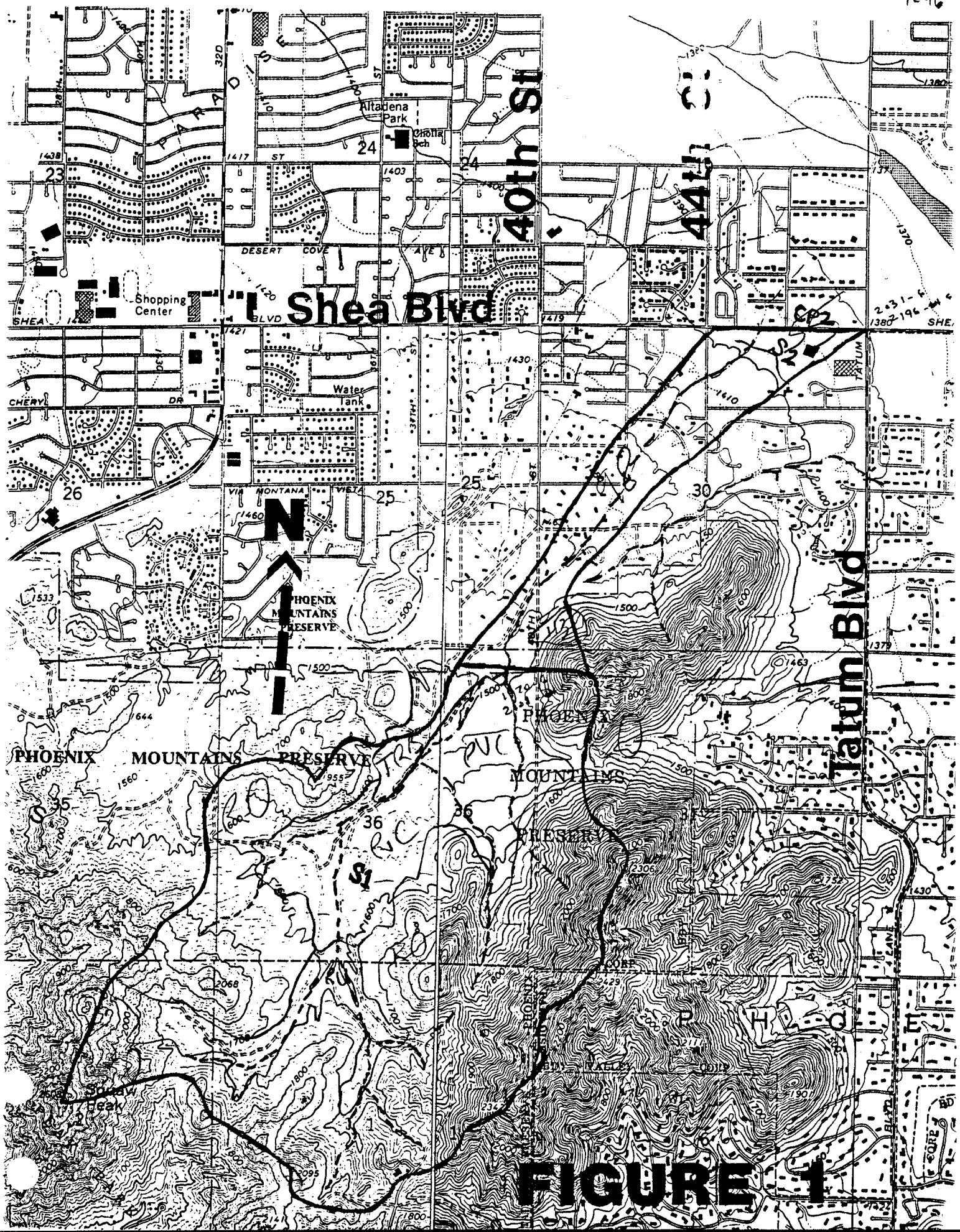
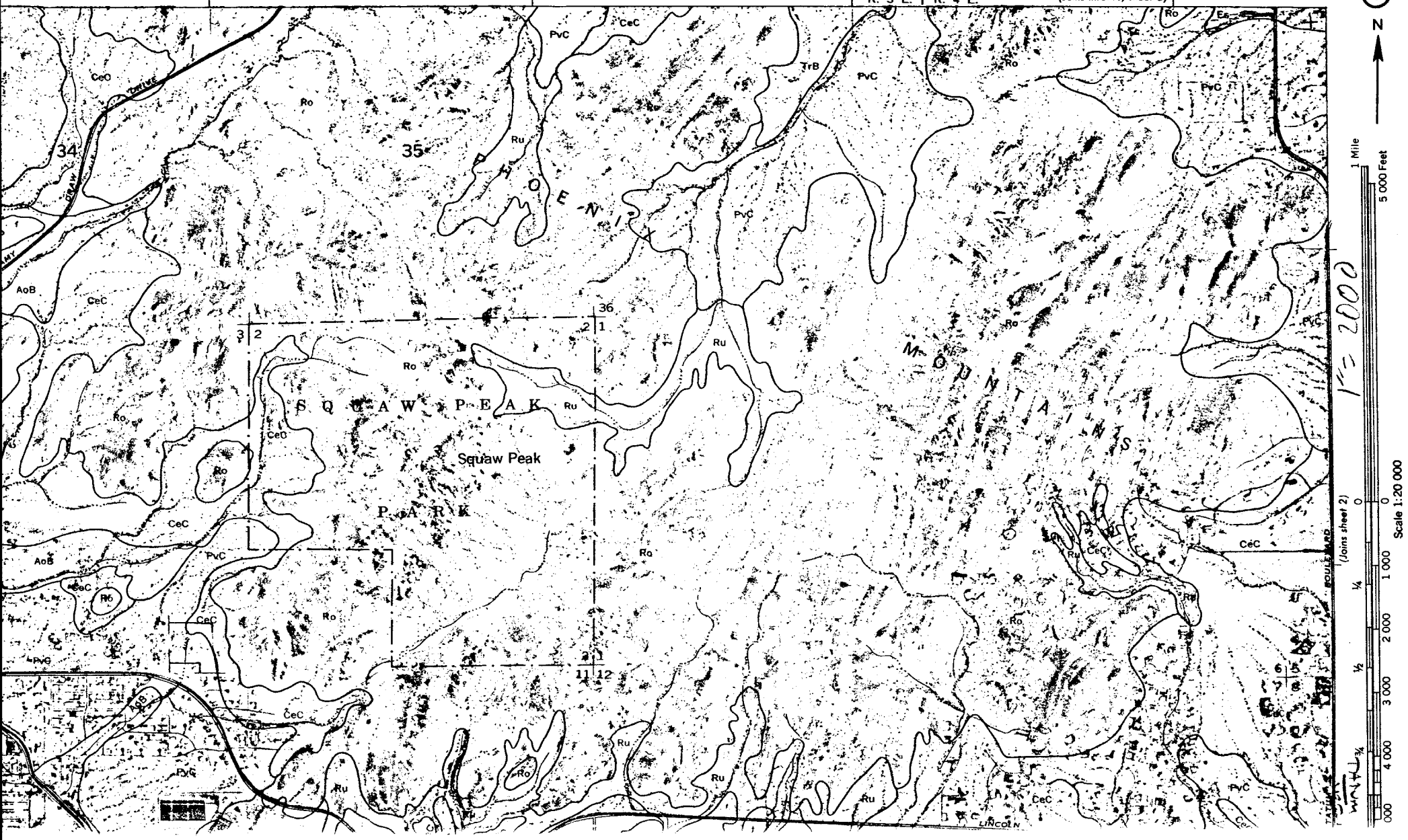
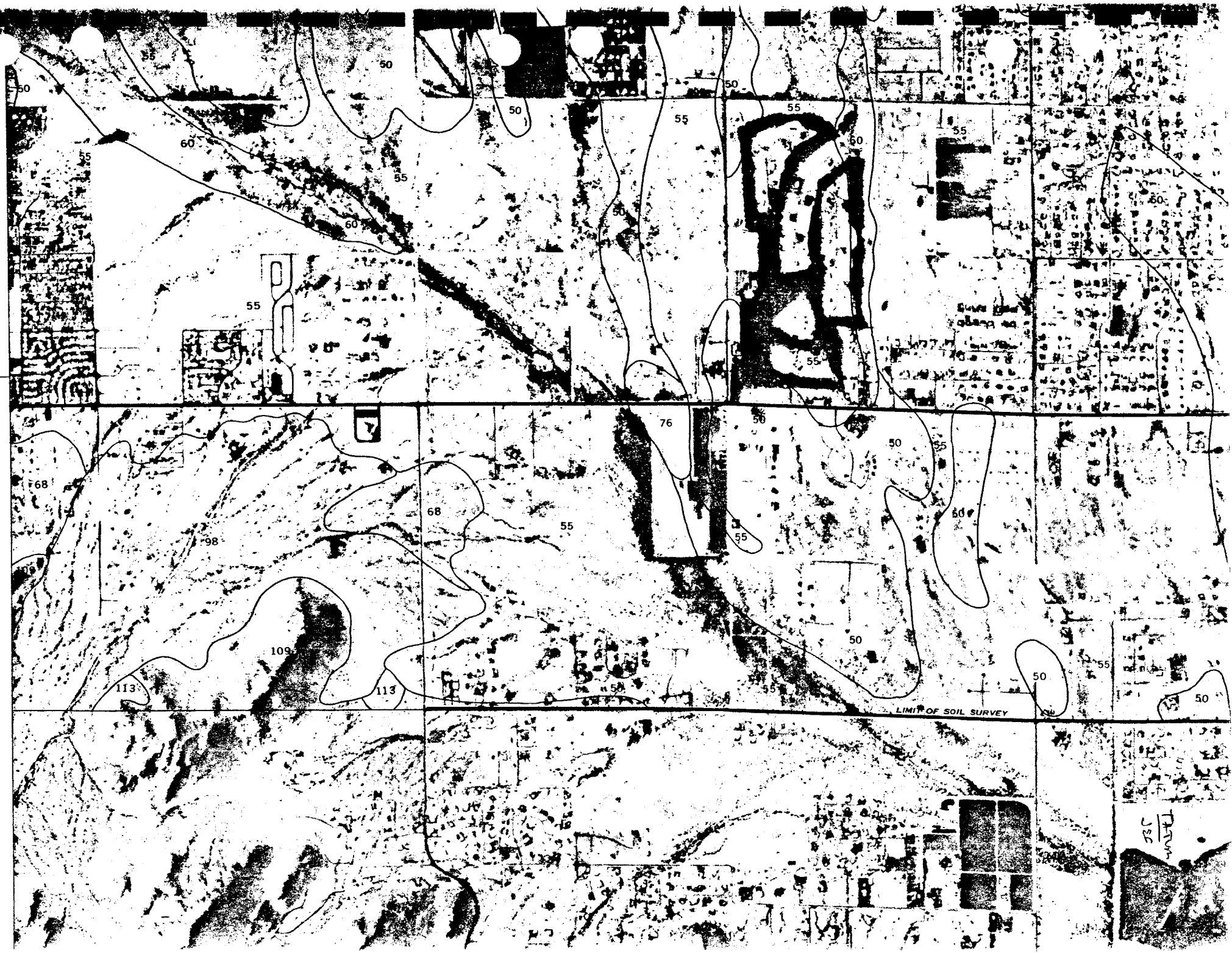
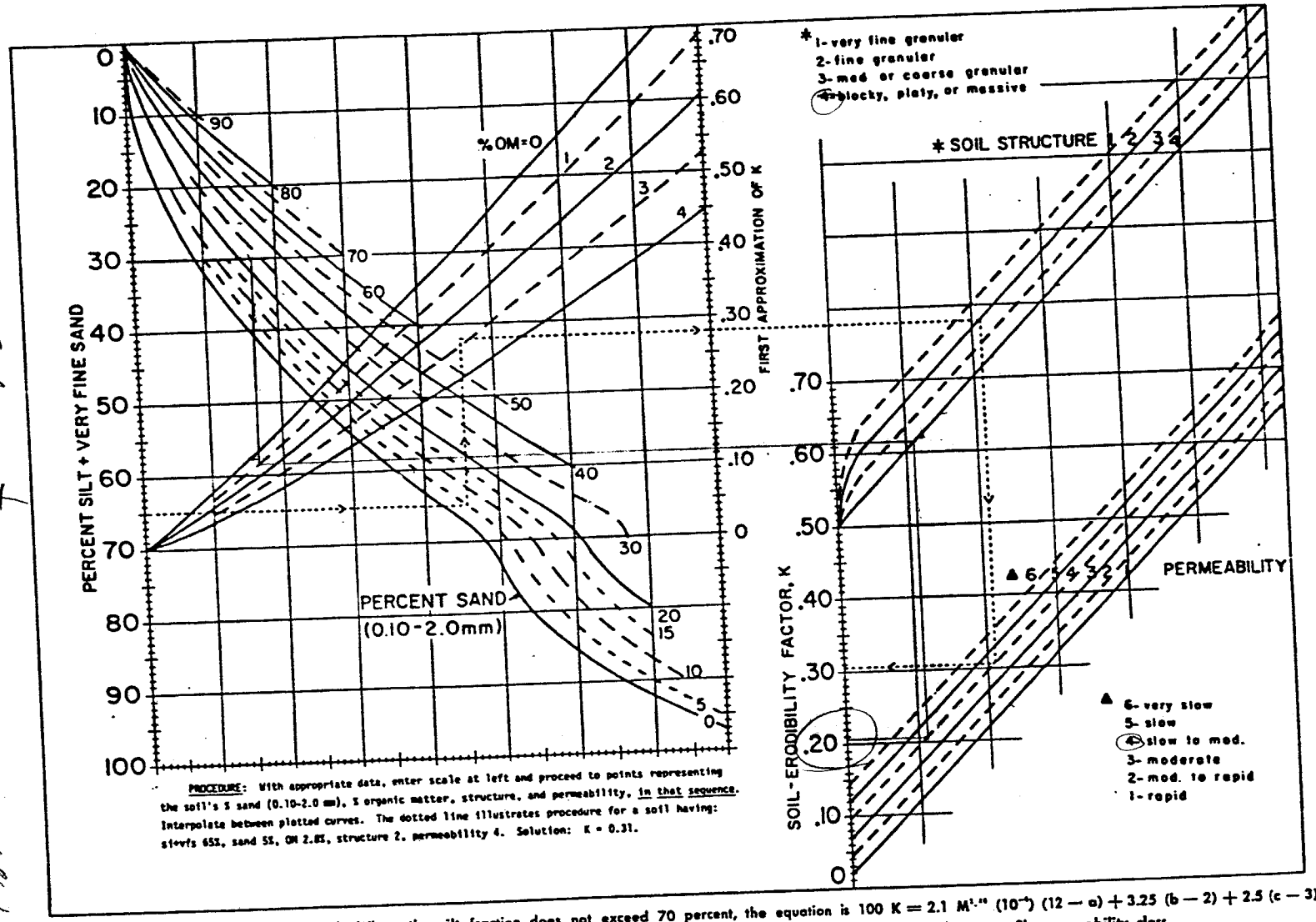


FIGURE 1

EASTERN MARICOPA AND NORTHERN PINAL COUNTIES AREA, ARIZONA — SHEET NUMBER 1




LIMIT OF SOIL SURVEY



PROCEDURE: With appropriate data, enter scale at left and proceed to points representing the soil's % sand (0.10-2.0 mm), % organic matter, structure, and permeability, in that sequence. Interpolate between plotted curves. The dotted line illustrates procedure for a soil having: si+vfs 65%, sand 5%, OM 2.8%, structure 2, permeability 4. Solution: K = 0.31.

The soil-erodibility nomograph. Where the silt fraction does not exceed 70 percent, the equation is $100\ K = 2.1\ M^{1.14}\ (10^{-4})\ (12 - a) + 3.25\ (b - 2) + 2.5\ (c - 3)$ where M = (percent si + vfs) (100 — percent c), a = percent organic matter, b = structure code, and c = profile permeability class.

FIGURE 2: Soil Erodibility (K) Nomograph for Use in USLE (From EPA, 1973)

Turbidity 55% gravel, 30% < 1mm, 25% between .1 & 2.

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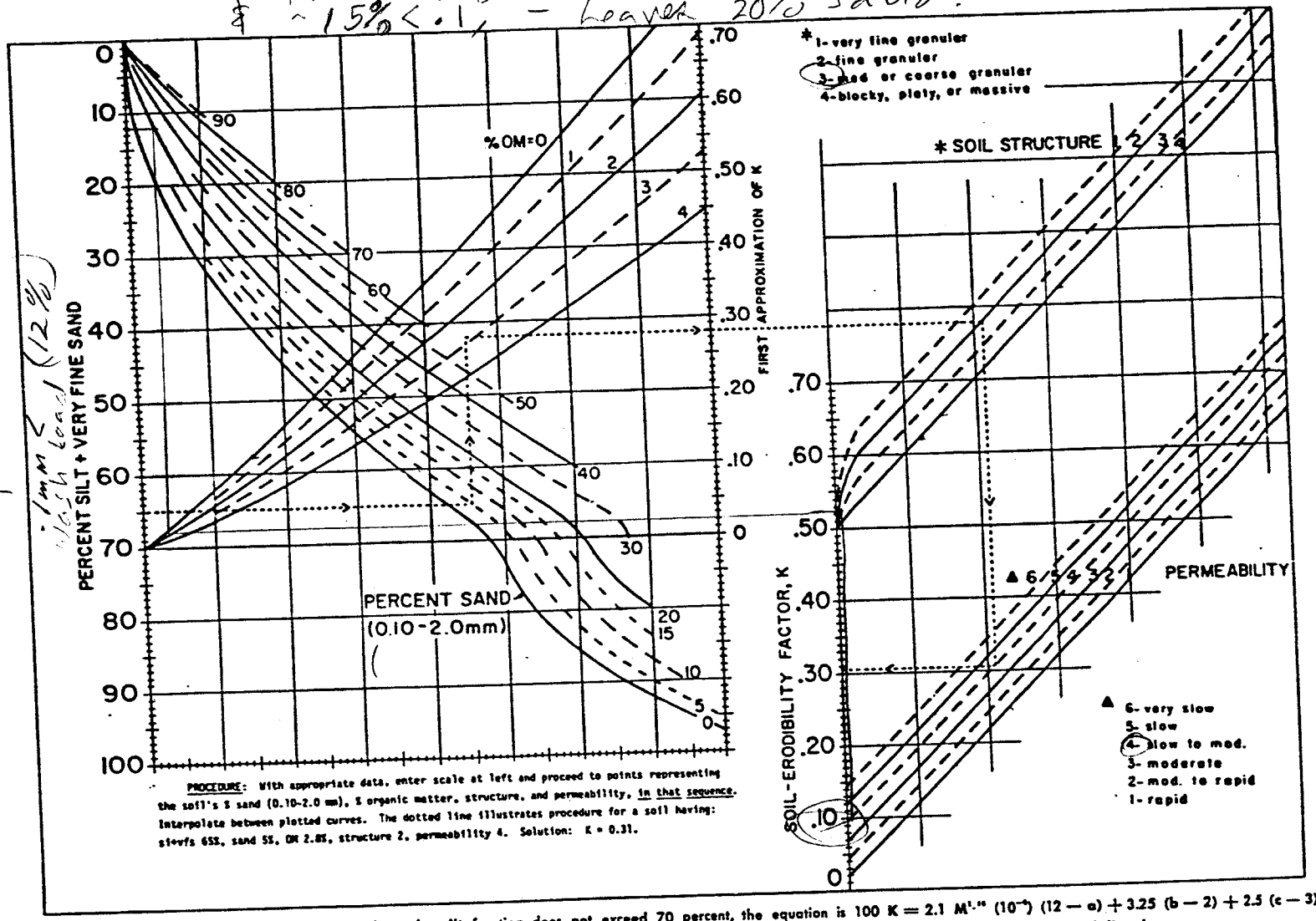
if 65% gravel (see description for PvC)
then 35% < 2mm
& ~15% < .1, – heavier 20% sand.



The soil-erodibility nomograph. Where the silt fraction does not exceed 70 percent, the equation is $100\,K = 2.1\,M^{1.14}\,(10^{-4})\,(12 - a) + 3.25\,(b - 2) + 2.5\,(c - 3)$ where M = (percent si + vfs) (100 — percent c), a = percent organic matter, b = structure code, and c = profile permeability class.

PvC Pneumant

.1mm < wash load (12%)

FIGURE 2: Soil Erodibility (K) Nomograph for Use in USLE (From EPA, 1973)

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Cover & Management factor:

From soils data, 39% of the Ro Complex is actually rock outcrops. That is 39% of the 68% of the Schenco-Rock Outcrop Complex covering the basin. So, rock outcrops cover an estimated 27% of the watershed, leaving the remaining soils (73% of the basin) covered by Sonoran desert vegetation.

Type I - Canopy Cover (C_I)

Canopy Cover is estimated to be approximately 20%, with average fall height ≈ 0.5 m or less. From figure B.2 in ADWR "Design Manual for Engineering Analysis of Fluvial Systems";

$C_I = 0.83$

Type II - Mulch factor (C_{II})

The percent of soil surface covered by Mulch is estimated to be approximately 10%. Using figure B.3 in the above reference (ADWR)

$C_{II} \approx .76$

Type III - Root Factor (C_{III})

The root network is estimated to be ≈ 20% that of a good rotation meadow. Using fig B.4 (weeds) $C_{III} = 0.42$

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Topographic Factor LS

Average Slope Length (λ) = 600'
Average slope = 25%

These data were derived by sampling 29 randomly placed overland slope lengths covering both upland & valley areas of the watershed.

$n = 0.5$

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Tatum Wash - Sedimentation Analysis

Sediment Yield Computation
MODIFIED UNIVERSAL SOIL LOSS EQUATION (MUSLE), Ys = Rw * K * LS * C * P

A. **Rw, STORM ENERGY RUNOFF FACTOR; Rw = a(V*q)^b**
Hydrographs for Tatum Wash, based on FCDMC HEC-1

Drainage Area at CP1F = 1.77 sq. mi.
Area Contributing Sediment = 1.77 sq. mi.

Recurrence Interval	Volume, V (ac-ft)	Flow Peak (cfs)	a	b	Rw
Q-2	39	328	95	0.56	18950
Q-5	66	650	95	0.56	37380
Q-10	80	820	95	0.56	47336
Q-25	117	1400	95	0.56	79020
Q-50	139	1719	95	0.56	97626
Q-100	168	2212	95	0.56	125019

B. **K, SOIL ERODIBILITY FACTOR: Figure 3, SCS Ag. Handbook #537**

Soil Group	% Silt & v.f.sand	% Sand	% Organic Material	Soil Structure	Permea-bility	K	% of Basin
PvC	12	18	1	Subangular Blocky	Mod Slow	0.10	21
TrB	30	25	1	Massive	Mod Slow	0.21	2
Ru						0.07	8
Ro						0.03	69
					Weighted K Factor:		0.05

Above data and K-Factors from: "Soil Survey of Eastern Maricopa and Northern Pinal Counties Area, Arizona", USDA-SCS, 1974, and "Soil Survey of Aguila Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, USDA-SCS, 1981. Data also from Figure B.1 in "Design Manual for Engineering Analysis of Fluvial Systems", ADWR, 1985. Also see the project file for more details.

C. **C, COVER AND MANAGEMENT FACTOR; Figures 5-7, SCS Ag. Handbook #537**

Cover Type	% of Basin	Canopy Factor	Mulch Factor	Root Factor	Composite C Factor	Weighted C Factor
Sonoran desert	73	0.83	0.76	0.42	0.26	0.19
Bedrock	27	0.00	0.00	0.00	0.00	0.00
			Composite Weighted C Factor=			0.193

D. **LS, TOPOGRAPHIC FACTOR; LS = ((L/72.6)^n)*(0.65+0.0454*S+0.0065*S^2)**

Slope Lengths: 600 ft (Basin Average)
Slope Angles: 25 % (Basin Average)
n = 0.5
Eq'n 8.4 ADWR Manual, Appendix B

LS = 15.13

E. **P, EROSION CONTROL FACTOR**

No Practice, Natural or Regulated
Weighted P for Contributing Watershed = 1

F. **RESULTS:**

Recurrence Interval	Rw	K	LS	C	P	Ys (tons)	Unit Ys (AF/sq.mi)	CP1F 1.92mi²	CP2E 2.17mi²
Q-2	18950	0.05	15.13	0.19	1.00	2855	0.93	1.79	2.02
Q-5	37380	0.05	15.13	0.19	1.00	5373	1.74	3.34	
Q-10	47336	0.05	15.13	0.19	1.00	7133	2.31	4.44	5.01
Q-25	79020	0.05	15.13	0.19	1.00	11358	3.68		
Q-50	97626	0.05	15.13	0.19	1.00	14711	4.77	9.16	10.35
Q-100	125019	0.05	15.13	0.19	1.00	18839	6.11	11.73	13.26
WEIGHTED AVERAGE ANNUAL SEDIMENT YIELD:						**3745**	**1.21**	1.32	2.65

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Equivalent avg. sed. concentrations based on Musle & HEC-1 Results.

Musle Results

Recurrence interval	Q	Ys (Tons)	Flow Volume (ac ft)	Equivalent suspended sed. conc (mg/l, or ppm)
2	328	2855	38.6	54,391
10	820	7133	80.0	65,568
50	1719	14,711	139.3	77,661
100	2212	18,839	168.3	82,316

Estimate of suspended sed. concentration:

Assuming sediment density = 50 lb/ft³

$$Ys\,(Tons) \times \frac{2000\,lb}{1\,Ton} \times \frac{453590\,mg}{1\,lb} \times \left[\text{Flow Volume (ac ft)} \times \frac{43560\,ft^2}{1\,ac} \times \frac{28.32\,l}{ft^3}\right]$$

or

$$\frac{Ys\,(Tons)}{\text{Flow Vol (acf)}} \times 735.38 = mg/l$$

(Note: No SDR was applied - so these concentrations may be a little high).

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Zeller - Fullerton Bedload Equation (ADNR, 1985)

$$Q_s = 0.0064 \left(\frac{N^{1.77} V^{4.32} G^{0.45}}{Y_h^{0.30} D_{50}^{0.61}} \right)$$

Q_s = UNIT SEDIMENT DISCHARGE $\left(\frac{CFS}{FT}\right)$

V = MEAN VELOCITY $(FT/S) = \frac{Q_{CH}}{AREA_{CH}}$

Y_h = HYDRAULIC DEPTH $(FT) = \frac{AREA_{CH}}{TOPWIDTH_{CH}}$

N = MANNINGS N

D_{50} = MEDIAN DIAMETER (MM)

G = GRADATION COEFFICIENT $= \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right)$

($D_{84.1}$ - PERCENT FINER)

SEDIMENT DISTRIBUTION - BY LAW-CRANDALL

$D_{84.1}$ = 33 mm (% FINER)

D_{50} = 6.3 mm

$D_{15.9}$ = 1.2 mm #(16)

$$G = 5.24 = \frac{1}{2}\left(\frac{D_{84.1}}{D_{50}} + \frac{D_{50}}{D_{15.9}}\right)$$ - EQ'N 5.4 ADNR, 1985

$$\therefore \quad Q_s = .0064 \left(\frac{(.035)^{1.77} V^{4.32} (5.24)^{0.45}}{(Y_h)^{0.30} (6.3)^{0.61}} \right)$$

$$Q_s = .0064 \left(\frac{(0.0026) V^{4.32} (2.1072)}{(Y_h)^{0.30} (3.0732)} \right)$$

$$Q = 1.16 \times 10^{-5} \left(\frac{V^{4.32}}{Y_h^{0.30}} \right)$$

.000011622

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ZIMLER - FULLERTON

DISCRETIZE HYDROGRAPHS - USE BRI ESTIMATES FROM HEC-6 WORKSHEETS

VELOCITY & DEPTH - USE HEC-2 REACH-AVERAGE DATA FOR SUPPLY REACH (XNS 6-16) TOTAL REACH (ALL XNS)

LIST OF Q'S NEEDED

5			323	
11			338	355 183-218
16			341	
27			399	
28	30	23-38	416	219-254
36			762	255-290
40 (2)			801	291 326
43			814	810
57			1265	327-362
57	60	39-74	1542	363-398
67			1577	399-434
100			1643	435-470
101	115	75-110	1690	1665
117			2195	471-506
119				
124				
147	160	111-146		
173				
222	250	147-182		
235				
289				
~~223~~				

VARIABLES NEEDED

$A_{CHL} = \frac{Q_{CH}}{V_{CH}}$

✓ Q_{CH}

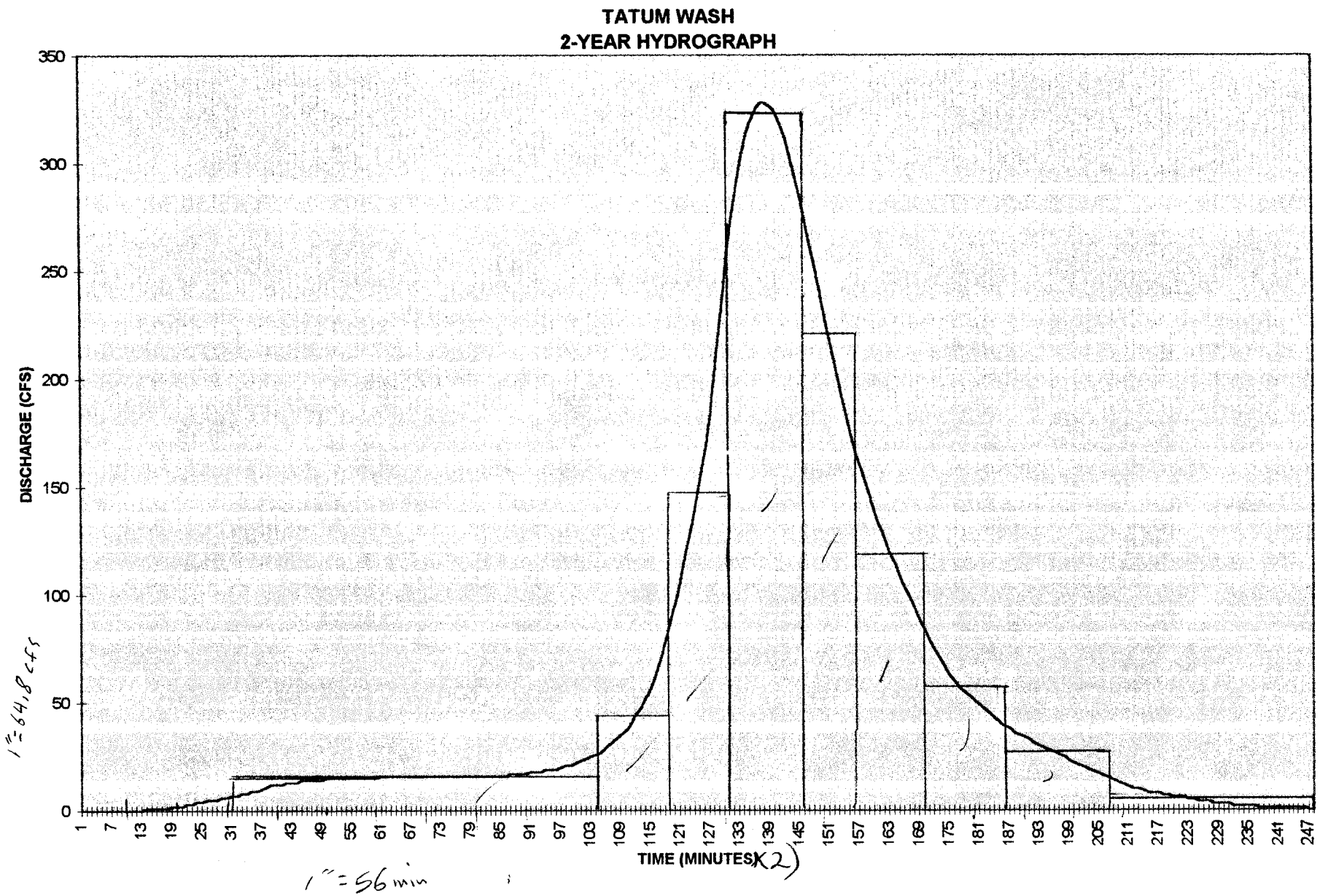
✓ LB STN

✓ RB STN

✓ V_{CH}

RB - LB = CHL WIDTH

RUN IN TATUM_C HC2



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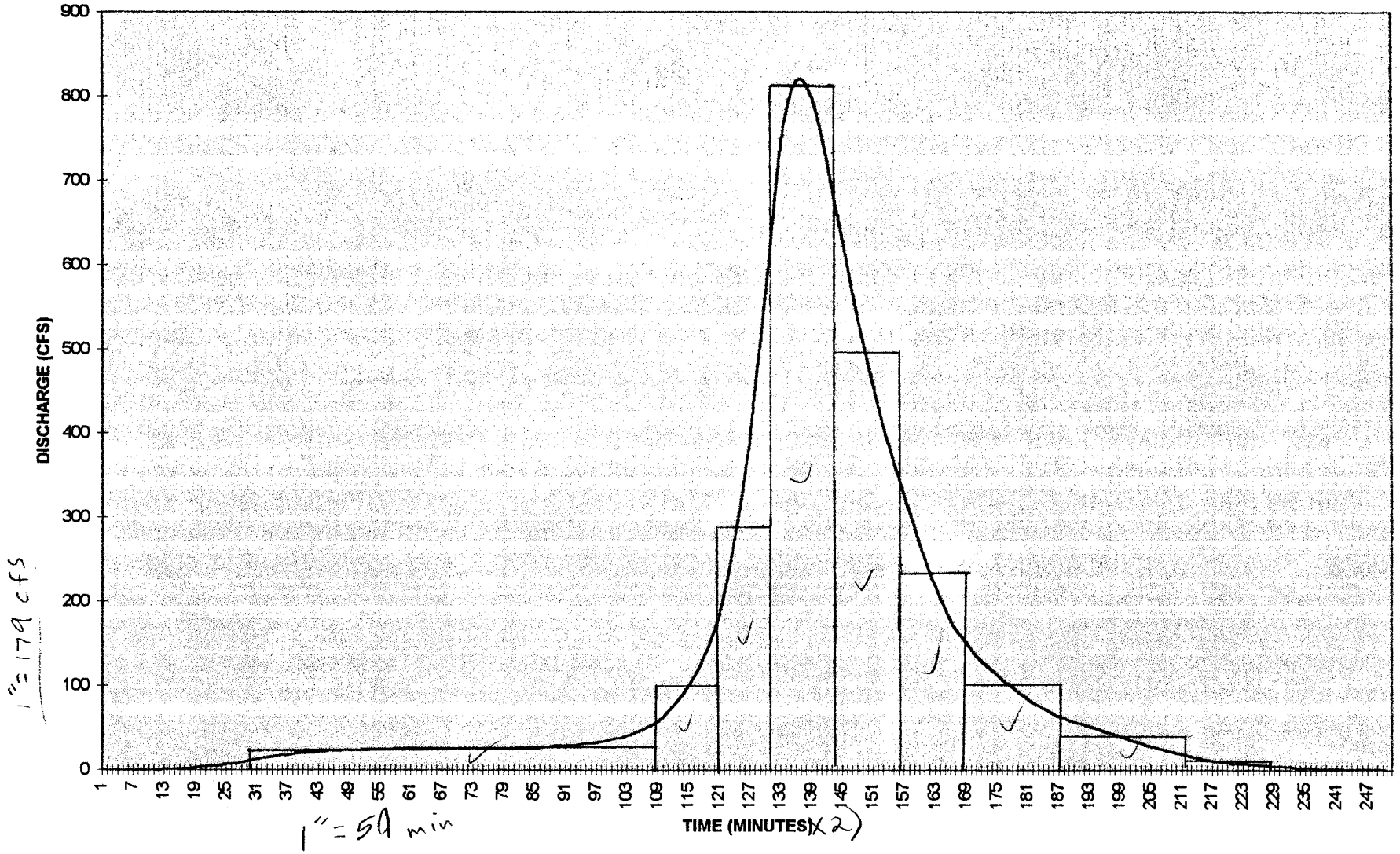
TATUM WASH 10-YEAR HYDROGRAPH



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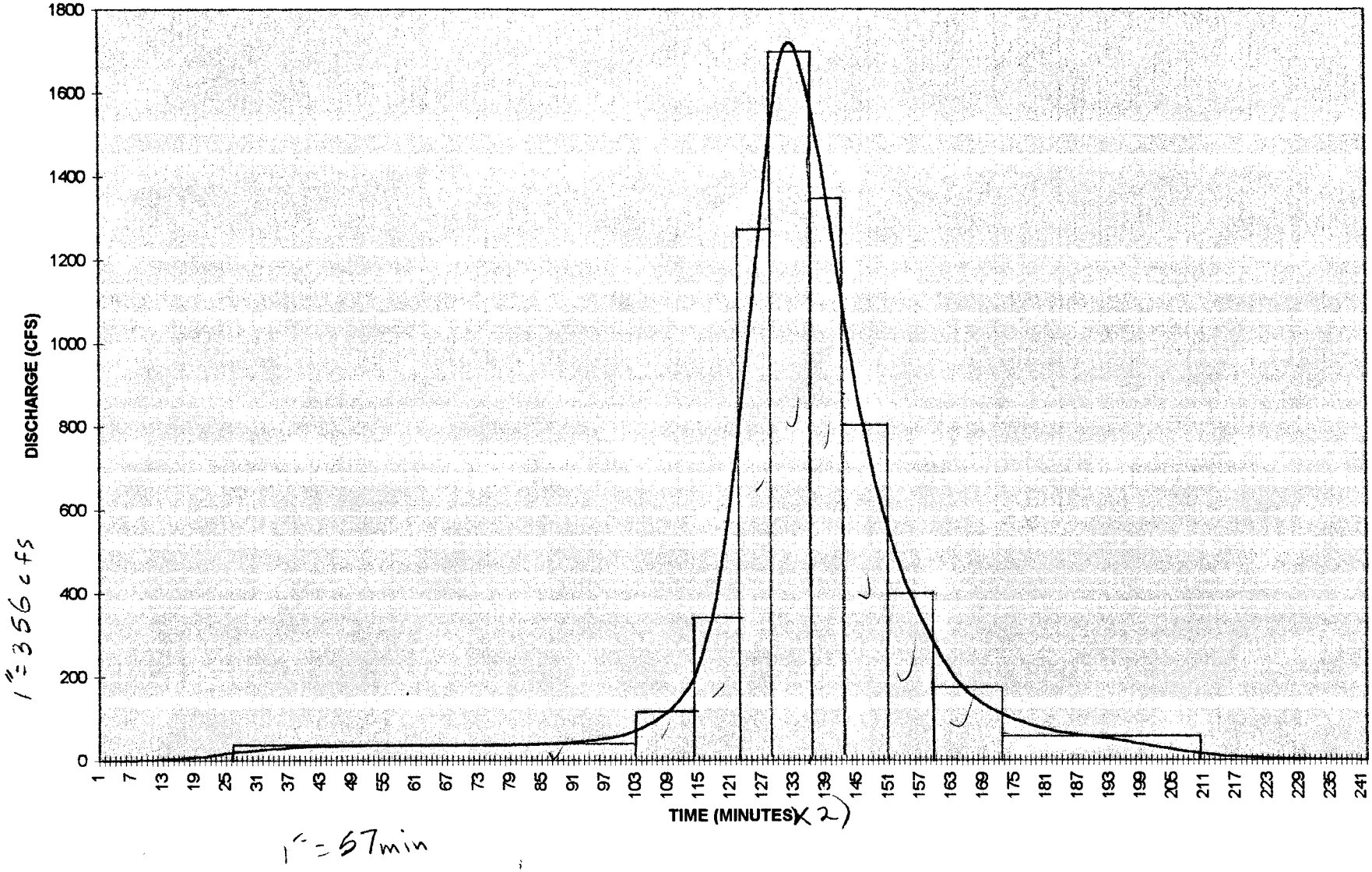
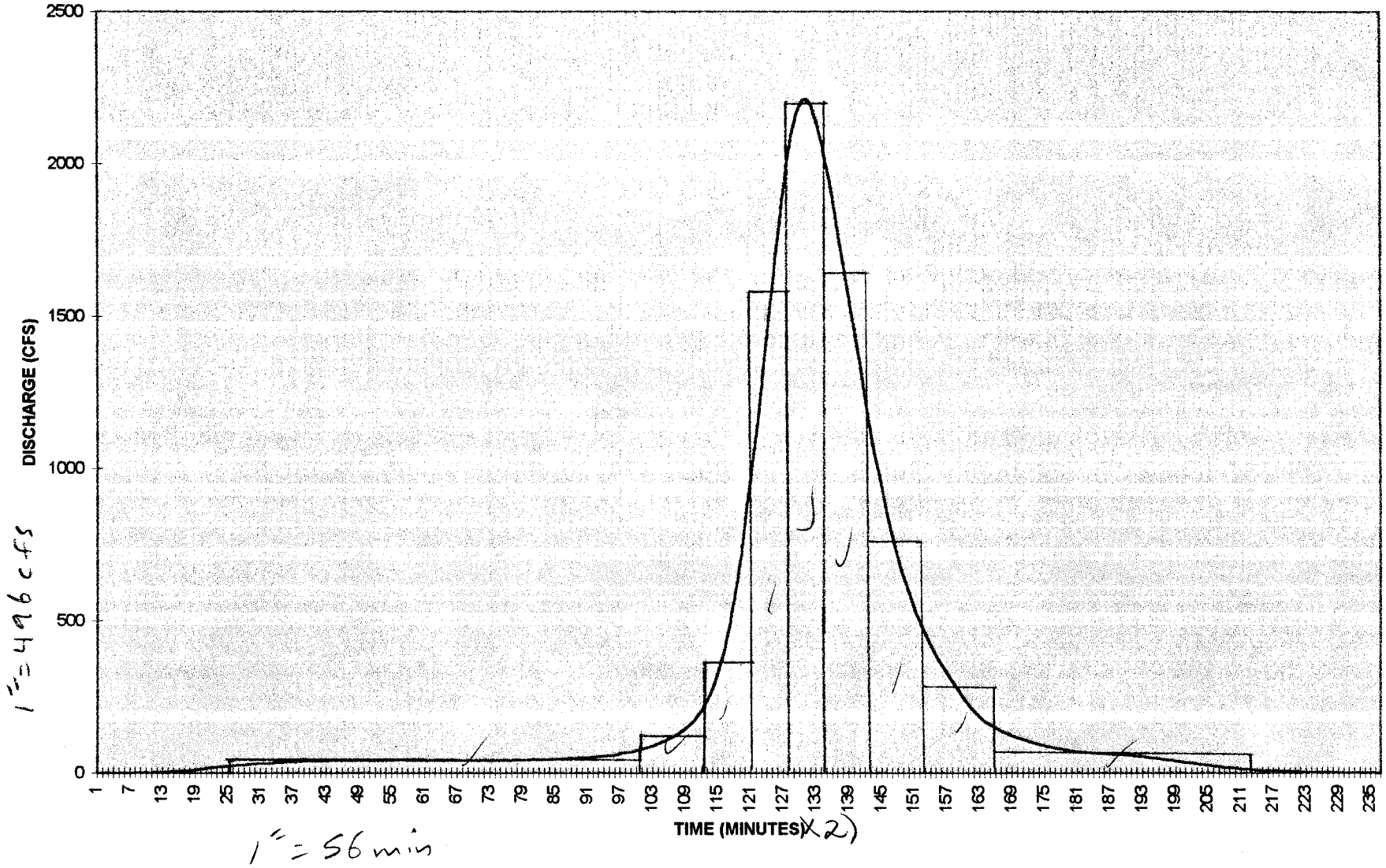
50-YEAR Chart 1

TATUM WASH ~~2~~ 50-YEAR HYDROGRAPH



TATUM WASH 9-9-96

TATUM WASH 100-YEAR HYDROGRAPH



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Tatum Wash
Discretized H-graph Data

2-Year Storm

Time Increment (minutes)	Q (cfs)
146	16
29	43
24	147
30	323
21	222
27	119
32	57
41	28
81	5

volume check = 38.6 aft
should be 38.6

50-Year Storm

Minutes	cfs
153	36
17	117
17	338
12	1265
15	1690
13	1342
17	801
17	399
26	173
76	57

volume check = 137.4 aft
should be 137.3

10-Year Storm

minutes	Q (cfs)
158	27
24	100
21	289
25	814
25	496
25	235
38	101
49	40
34	11

volume check = 79.2 aft
should be 80

100-Year Storm

minutes	Q (cfs)
151	40
18	124
17	361
14	1577
13	2195
16	1643
20	762
26	283
95	67

volume check = 165.6 aft
should be 168.3

TATUM_C

Reach Average		V	Yh	CHL WID	ACH	QCH	STCHL	STCHR
30	30	2.39	0.13	92	12	28	951.4	1043.5
60	60	2.85	0.21	92	20	56	951.4	1043.5
115	115	3.39	0.34	92	31	107	951.4	1043.5
160	160	3.67	0.44	92	40	148	951.4	1043.5
250	250	4.13	0.60	92	56	230	951.4	1043.5
355	355	4.60	0.77	92	71	325	951.4	1043.5
496	496	5.02	0.97	92	90	450	951.4	1043.5
762	762	5.79	1.28	92	118	684	951.4	1043.5
810	810	5.90	1.33	92	123	725	951.4	1043.5
1265	1265	6.78	1.78	92	164	1110	951.4	1043.5
1342	1342	6.91	1.84	92	170	1174	951.4	1043.5
1577	1577	7.27	2.04	92	188	1364	951.4	1043.5
1665	1665	7.40	2.11	92	194	1435	951.4	1043.5
2195	2195	8.06	2.49	92	229	1848	951.4	1043.5

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RESULTS - ~~ZELLER~~ FULLERTON

R.I	LOAD	
Q_{100}	0.45 AF	(15)
Q_{50}	0.37 AF	(28)
Q_{10}	0.20 AF	(40)
Q_2	0.12 AF	(52)

AVERAGE ANNUAL =

$$0.01\,(VOL_{100}) + 0.01\left(\frac{VOL_{100} + VOL_{50}}{2}\right) + 0.08\left(\frac{VOL_{50} + V_{10}}{2}\right)$$

$$+ 0.4\left(\frac{VOL_{10} + VOL_2}{2}\right) + 0.5\left(\frac{VOL_2 + 0}{2}\right)$$

$$= 0.124 \text{ AF}$$

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Tatum Wash Sedimentation Study
Zeller-Fullerton Equation - Sediment Yield

100-year Event				Unit Sed.			Sediment	
Q (cfs)	Dur'n (min)	Vel (ft/s)	Depth (ft)	Qs (cfs/ft)	Width (ft)	Qs (cfs)	Volume (ft3)	
40	151	2.39	0.13	0.00092	92	0.08503	770	
124	18	3.39	0.34	0.00314	92	0.28846	312	
361	17	4.60	0.77	0.00917	92	0.84379	861	
1577	14	7.27	2.04	0.04946	92	4.54997	3822	
2195	13	8.06	2.49	0.07274	92	6.69231	5220	(TON/DAY)
1643	16	7.40	2.11	0.05285	92	4.86256	4668	
762	20	5.79	1.28	0.02128	92	1.95739	2349	
283	26	4.13	0.60	0.00620	92	0.57086	891	
67	95	2.85	0.21	0.00171	92	0.15752	898	
						Total =	19790	0.45 AF

50-year Event				Unit Sed.			Sediment	
Q (cfs)	Dur'n (min)	Vel (ft/s)	Depth (ft)	Qs (cfs/ft)	Width (ft)	Qs (cfs)	Volume (ft3)	
36	153	2.39	0.13	0.00092	92	0.08503	781	
117	17	3.39	0.34	0.00314	92	0.28846	294	
338	17	4.60	0.77	0.00917	92	0.84379	861	
1265	12	6.78	1.78	0.03811	92	3.50635	2525	
1690	15	7.40	2.11	0.05285	92	4.86256	4376	
1342	13	6.91	1.84	0.04096	92	3.76850	2939	
801	17	5.90	1.33	0.02281	92	2.09891	2141	
399	17	4.60	0.77	0.00917	92	0.84379	861	
173	26	3.67	0.44	0.00409	92	0.37618	587	
57	76	2.85	0.21	0.00171	92	0.15752	718	
						Total =	16082	0.37 AF

10-year Event				Unit Sed.			Sediment	
Q (cfs)	Dur'n (min)	Vel (ft/s)	Depth (ft)	Qs (cfs/ft)	Width (ft)	Qs (cfs)	Volume (ft3)	
27	158	2.39	0.13	0.00092	92	0.08503	806	
100	24	3.39	0.34	0.00314	92	0.28846	415	
289	21	4.13	0.60	0.00620	92	0.57086	719	
814	25	5.90	1.33	0.02281	92	2.09891	3148	
496	25	5.02	0.97	0.01248	92	1.14836	1723	
235	25	4.13	0.60	0.00620	92	0.57086	856	
101	38	3.39	0.34	0.00314	92	0.28846	658	
40	49	2.39	0.13	0.00092	92	0.08503	250	
11	34	2.39	0.13	0.00092	92	0.08503	173	
						Total =	8749	0.20 AF

2-year Event				Unit Sed.			Sediment	
Q (cfs)	Dur'n (min)	Vel (ft/s)	Depth (ft)	Qs (cfs/ft)	Width (ft)	Qs (cfs)	Volume (ft3)	
16	146	2.39	0.13	0.00092	92	0.08503	745	
43	29	2.39	0.13	0.00092	92	0.08503	148	
147	24	3.67	0.44	0.00409	92	0.37618	542	
323	30	4.60	0.77	0.00917	92	0.84379	1519	
222	21	4.13	0.60	0.00620	92	0.57086	719	
119	27	3.39	0.34	0.00314	92	0.28846	467	
57	32	2.85	0.21	0.00171	92	0.15752	302	
28	41	2.39	0.13	0.00092	92	0.08503	209	
5	81	2.39	0.13	0.00092	92	0.08503	413	
						Total =	5065	0.12 AF

Wt'd Ann'l 0.12 AF

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AFFECT OF PHX MTN FIRESERVE BASIN ON SEDIMENT YIELD

① TRAPPING EFFICIENCY

CHURCHILL METHOD – BUREC, 1987 p. 542

AVERAGE ANNUAL INFLOW = (BENARD, 1977)

RESERVOIR CAPACITY = 135 AF (FCDMC, 1996)

$Q = 0.4501\ A^{-0.1449}$ A = DRAINAGE AREA (mi^2)

$= 0.4501\ (2.17)^{-0.1449}$ Q = ANNUAL RUNOFF (IN)

$= 0.4$ IN

$= 0.4\ IN \left(\frac{1\ FT}{12\ IN}\right)\left(\frac{640\ AC}{mi^2}\right)(2.17\ mi^2) =$ AF

$= 46.6$ AF

RATIO : $\frac{\text{RESERVOIR CAPACITY}}{\text{AVERAGE ANNUAL INFLOW}} = 2.9$

BRUNE METHOD (98%)

SEDIMENT TRAPPED = 93 % Fig. A-9, BUREC 1987

PMP = 40%
TRAP = 25%

CHURCHILL

$\% = 100 - (1600\ k^{-0.2} - 12)$

	PMP	SED TRAP
PERIOD OF RETENTION	1300 MIN	1300
FOR SEDIMENT TRAP CAPACITY	135 AF	35 AF
VOL = $\frac{35\ AF}{46.6} = .75$ LENGTH	832	533
MEAN VELOCITY (VOL / TIME)	.156	.402
INFLOW (PEAK / 2)	938	105
	1100	1150
AVG. XN AREA	7068	2860
K = S.I.	501188	194010

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SEDIMENT YIELD

TRAP BASIN - RECTANGULAR $\frac{870}{1490} \times \frac{L}{W}$ $L = \frac{870W}{1490}$

4.396 AC - AREA = 191402.6 FT^2

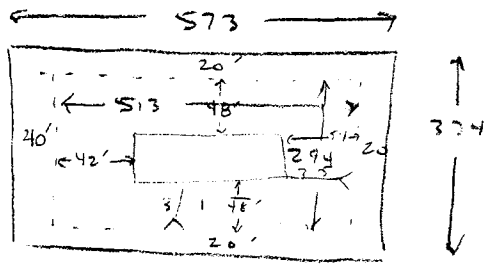
$L \cdot W = 191402.6$

$\frac{870W}{1490} W = 191402.6$

$W^2 = 327804.5$

$W = 573$

$L = 334$



TOP AREA = 294 × 513 = 150822 = 3.46 AC

BOTTOM AREA = 198 × 417 = 82566 = 1.90 AC

VOL = 43 AF AVERAGE END AREA

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SEDIMENT YIELD

- ASSUME NO DEBRIS FLOWS

∴ SED CONCENTRATION ≤ 20%

∴ ESTIMATE MAX. SED VOLUME AS 20% OF WATER VOLUME

R.I.	Shea H_2O Vol (AF)	SOURCE (HFC-1)	@ SHEA HIGH 20% SED. (AF)	@ SHEA EXTREME 40%	@ PMP 20%	@ PMP 40%
Q2	42	✓	8.4	16.8	24 ~~83~~ 7.8	15.6
Q10	89	✓	17.8	35.6	139 ~~89~~ [illegible]	32
Q50	156	✓	31.2	62.4	168 ~~156~~ [illegible]	55.6
Q100	189	✓	37.8	75.6	55.6	67.2
AVER ANNUAL	27.8	DENDY-BOLTON RENARD	5.6	11.1	9.1	18.1

Wind
Kellerhard

SEE CASTA (81) Fig 5 for

Range

	PMP		Shea	
Aver Annual	0.8 -		0.9 – 11.1	
Q2	1.9	15.6	~~1.9~~ 2.1	16.8
Q10	4.6	32	~~4.6~~ 5.2	35.6
Q50	9.6	55.6	10.8	62.4
Q100	12.2	67.2	17.8	75.6

Tatum Wash Reservoir Trapping Efficiency

Churchill Method (Small Reservoirs, settling basins)

Basin	Phx Mtn	Shea	
Capacity (AF)	135	35	
Avg. Inflow (cfs)	94	105	
Period of Retention (min)	1300	1300	
Length (ft)	832	533	
Avg. Cross Section Area (ft)	7068	2860	
Mean Velocity (ft/sec)	0.013	0.037	
S.I.	5.9E+06	2.1E+06	
Trapping Efficiency (%)	41	25	

Brune Method (Large Reservoirs, Normal Ponded Reservoirs)

Avg. Annual Inflow	46.6	46.6	
Capacity (AF)	135	35	
Ratio Capacity/Inflow	2.9	0.8	
Trapping Efficiency	98	98	Use Figure A-9, BUREC)

SEDIMENT CONTINUITY MODELING - HEC-6

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REVISE HEC-6 PER COMMENTS

① USE TOFFALETI-MPM EQUATION

MODELS — SEE TABLE 6-7 DRAFT FINAL REPORT

TATUM100.DAT → T100TMPM.DAT
T50_TMPM.DAT
T10_TMPM.DAT
T2_TMPM.DAT

P1HG_100.DAT → P1HGTMPM
P2HG_100.DAT → P2HGTMPM
P1HG_2.DAT → P1HGTMP2.DA
P2HG_2.DAT → P2HGTMP2.

YIELD ESTIMATE (TOFFALETI-MPM EQ'N)

	SED THRU XN #7693	VOL (93 LBS/FT³)
Q100	215 TONS	0.4 AF
Q50	610	0.3 AF
Q10	304	0.15 AF
Q2	102	0.05 AF
SHSA P1 Q100	1329 IN 168 OUT	0.66 - 0.08
P2 Q100	905 IN 17 OUT	0.45 - 0.008

CONVERSION: $\left(\frac{2000\ LBS}{TON}\right)\left(\frac{FT^3}{93\ LBS}\right)\left(\frac{AF}{43560\ FT^3}\right)$ ↳ (4.937×10^{-4})

268→16 P1
218→0 P2
↳ 19% FOR 2-YEAR

LOWN - 1227
HI N - 703

32% REDUCTION OF SED INFLOW BY PHASE 2 FOR Q100

YIELD ESTIMATE FROM ACKERS-WHITE EQ'N

Q100 :	0.14	AF
Q50 :	0.11	AF
Q10	0.06	AF
SHSA Q2	0.02	AF
P1 Q100 (phase 1)	341 IN 119 OUT	0.17 - 0.06
P2 Q100 (phase 2)	170 IN 12 OUT	0.08 - 0.006

FROM TABLE 6-4 DRAFT RPT

64→14 P1
38→0 P2
↳ 41% FOR 2-YR

50% REDUCTION OF Q_s-INFL BY PHASE 2 FOR Q100

TOFFALETI EQ'N → (YANG, 1991)

LAB DATA:
- PERFORMS POORLY AT HIGH CONCENTRATION (> 1000 ppm) LAB DATA
- " " HIGH FROUDE # (> 0.5)
- " " SLOPE > 0.001

DESIGNED FOR SAND (TOFFALETI, 1969)

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MEYER-PETER MULLER EQ'N

PERFORMS POORLY

BEDLOAD ONLY NOT SUSPENDED LOAD

BED MATERIAL LOAD (ADWR 1984 PER SLA)

ACKERS-WHITE EQ'N (ACKERS-WHITE, 1973)

LAB DATA
- PERFORMS WELL AT VARIOUS SEDIMENT CONCENTRATION (1-50000 ppm)
- WELL AT VARIOUS FROUDE # (0.18 - 4.0)
- WELL AT SLOPE > .001 (BEST AT 0.01-0.03)

RIVER DATA

ACKERS-WHITE BETTER AT HIGHER SLOPE
" " " " HIGHER FROUDE
" " HIGHER CONCENTRATION
(YANG)

ACKERS-WHITE BETTER FOR COARSER SEDIMENT

WILLIAMS & JULIEN 1984

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FIGURE LIST

1-1	LOCATION MAP
3-8	HEC-2 XNS
3-9	Cross section Plots

REVIEW
- STATE OBJECTIVES
- STATE RESULT

TABLES
- BORDER
- UNITS

DIDN'T MEET OBJECTIVES

TRAPPING EFFICIENCY

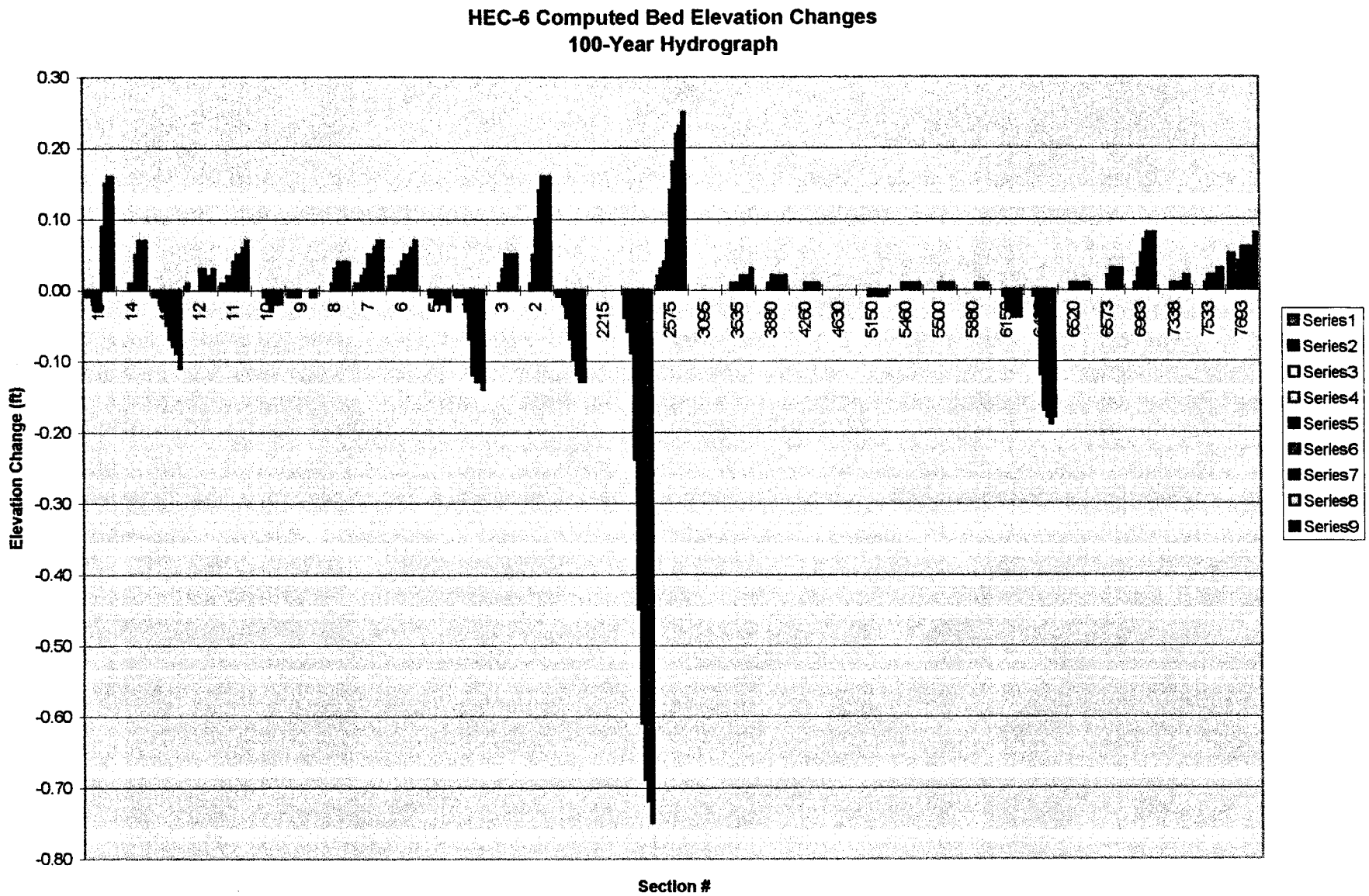
	BRUNE	ACKERS HEC-6 Q100	ACKERS HEC-6 Q2	TOFF MAM HEC-6 Q100	TOFF MAM HEC-6 Q2
SHEA Phase 1	41			87%	
PMP Phase 2	25	93%			

		BRUNE (CHURCHILL)	CHURCHILL	HEC-6 ACKERS Q100	HEC-6 ACKERS Q2	HEC-6 TOFF MAM Q100	HEC-6 TOFF MAM Q2
Phase 1 - Shea	97		25%	65%	78%	87%	94%
Phase 2 - Shea			25%	93%	100%	98%	100%
PMP	97		41%	100%	100%	100%	100%
BRUNE -			35/47		135/47		

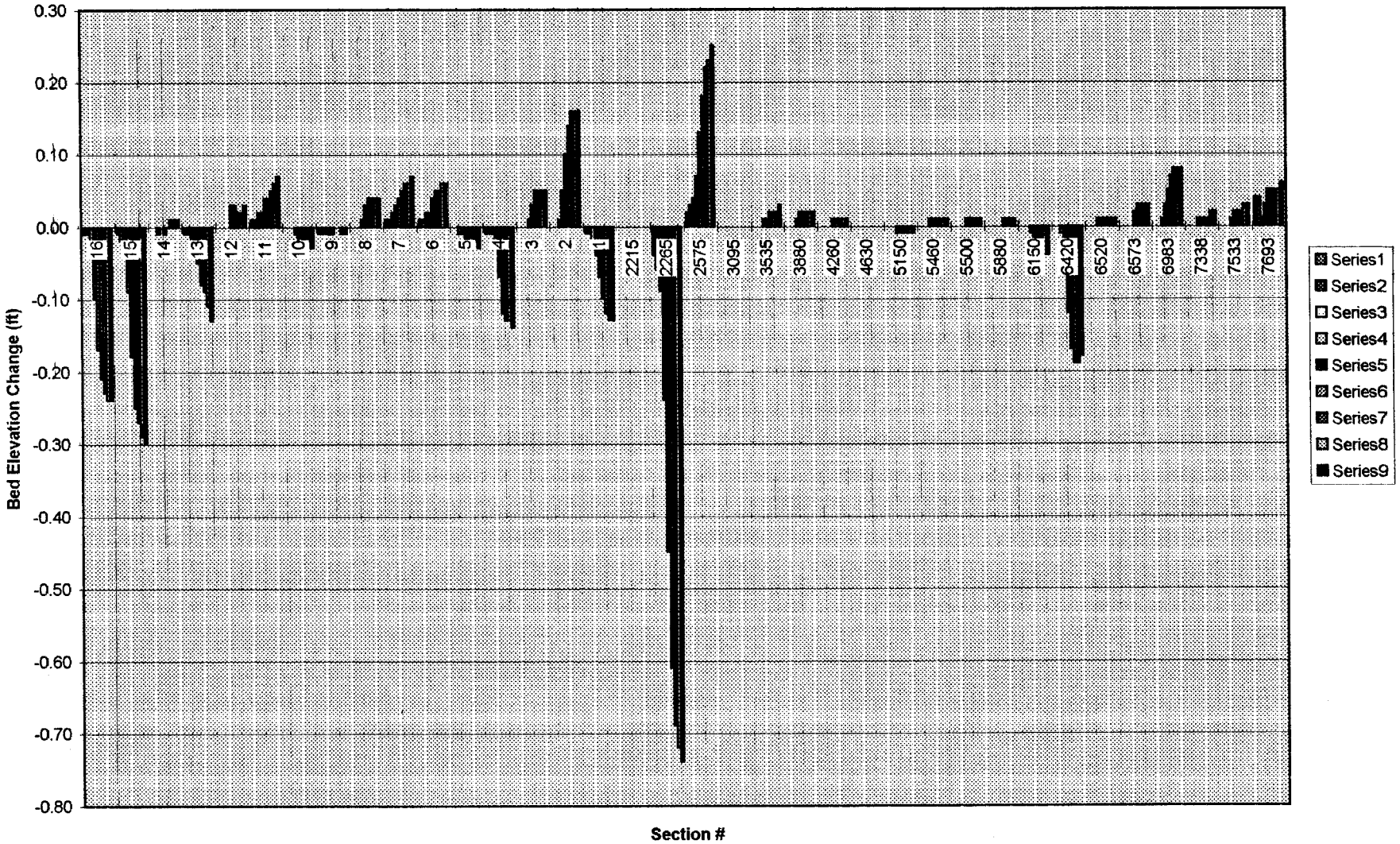
BASED ON HEC-6 NET TRANSPORT OUTPUT "SEDIMENT THRU SECTION"

Tatum Wash Sedimentation Study - HEC2 vs. HEC6 Output for Q=2300 cfs

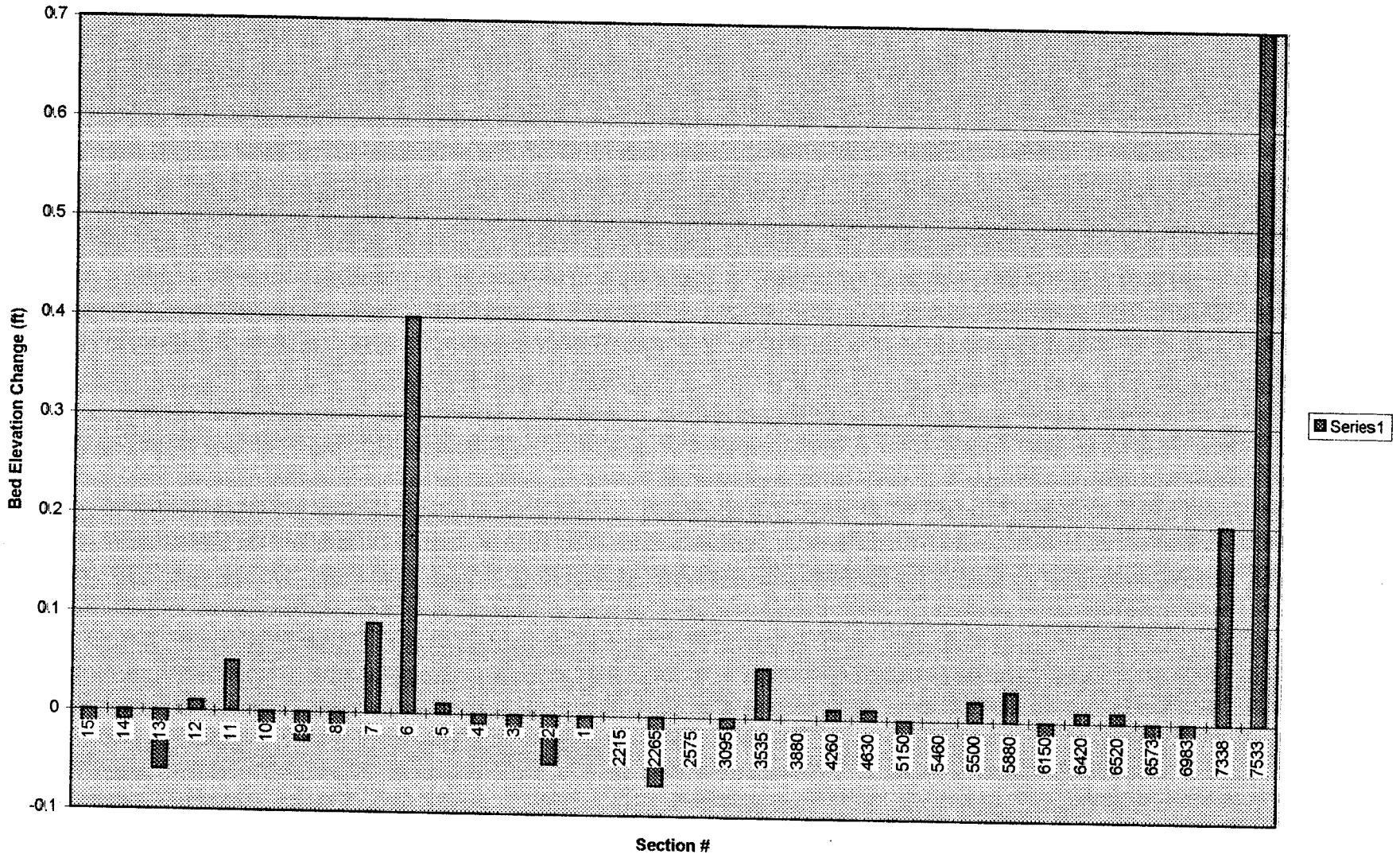
SECNO	Q	HEC-2 CWSEL	HEC-6 WSEL	Diff. (ft)	HEC-2 TOPWID	HEC-6 TW	Diff. (ft)	HEC-2 VLOB	HEC-6 LOB Vel	Diff. (ft)	HEC-2 VCH	HEC-6 CHL Vel	Diff. (ft)	HEC-2 VROB	HEC-6 ROB Vel	Diff. (ft)	AVG HEC-2 DEPTH	AVG HEC-6 DEPTH	Diff. (ft)
7693.8	2300	1397.9	1398.0	**0.0**	222	223	**-2**	0.0	0.0	**0.0**	3.8	3.7	**0.1**	5.7	5.6	**0.2**	2.1	1.5	**0.6**
7533.8	2300	1400.3	1400.2	**0.1**	352	350	**2**	0.6	0.6	**0.1**	3.5	3.7	**-0.2**	3.9	4.0	**-0.1**	1.7	1.6	**0.2**
7338.8	2300	1404.4	1404.4	**0.0**	162	177	**-15**	5.0	4.9	**0.2**	8.3	7.8	**0.5**	3.8	3.6	**0.2**	1.9	2.9	**-0.9**
6983.8	2300	1408.9	1408.8	**0.2**	104	119	**-15**	4.0	4.0	**0.0**	6.8	6.8	**0.0**	3.9	4.0	**0.0**	3.5	3.9	**-0.4**
6573.8	2300	1413.1	1412.9	**0.2**	140	140	**0**	3.3	3.8	**-0.5**	7.1	7.6	**-0.5**	3.3	3.7	**-0.5**	2.4	2.3	**0.1**
6520.8	2300	1413.5	1413.6	**-0.1**	170	170	**0**	0.0	0.0	**0.0**	8.2	7.9	**0.2**	2.8	2.8	**0.0**	1.9	2.2	**-0.3**
6420.8	2300	1415.0	1415.0	**0.0**	156	155	**1**	0.0	0.0	**0.0**	8.2	8.3	**-0.1**	3.4	3.3	**0.1**	1.9	2.3	**-0.3**
6150.8	2300	1418.8	1418.8	**0.0**	92	93	**0**	1.8	1.8	**0.0**	9.1	9.1	**0.1**	1.8	1.8	**0.0**	2.8	3.2	**-0.4**
5880.8	2300	1421.7	1421.7	**0.0**	105	105	**0**	0.0	0.0	**0.0**	6.3	6.2	**0.1**	0.0	0.0	**0.0**	3.5	3.5	**0.0**
5500.8	2300	1425.2	1425.3	**-0.1**	249	266	**-17**	3.0	2.7	**0.4**	8.1	7.7	**0.4**	4.2	3.5	**0.7**	1.5	3.2	**-1.7**
5460.8	2300	1425.4	1425.4	**0.1**	183	177	**6**	1.5	1.5	**0.0**	7.3	7.7	**-0.4**	1.5	1.5	**0.0**	1.9	2.6	**-0.6**
5150.8	2300	1431.2	1431.2	**0.0**	282	323	**-41**	0.0	0.0	**0.0**	6.5	6.0	**0.5**	0.0	0.0	**0.0**	1.3	1.2	**0.1**
4630.8	2300	1440.1	1440.1	**0.0**	280	280	**0**	0.0	0.0	**0.0**	5.4	5.4	**-0.1**	2.4	2.4	**0.0**	1.6	1.9	**-0.3**
4260.8	2300	1445.3	1445.3	**-0.1**	161	162	**0**	0.0	0.0	**0.0**	8.7	8.4	**0.3**	3.1	3.1	**0.0**	2.0	3.5	**-1.5**
3880.8	2300	1449.4	1449.3	**0.0**	95	95	**0**	2.4	2.4	**0.0**	8.4	8.4	**0.0**	0.0	0.0	**0.0**	2.9	3.2	**-0.3**
3535.8	2300	1452.9	1452.9	**0.0**	115	115	**0**	4.9	5.0	**-0.1**	9.5	9.5	**0.0**	3.9	3.3	**0.6**	2.7	4.4	**-1.7**
3095.8	2300	1458.0	1458.1	**0.0**	66	73	**-8**	0.0	0.5	**-0.5**	10.6	10.3	**0.3**	0.0	0.0	**0.0**	3.3	3.4	**-0.1**
2575.8	2300	1465.8	1465.7	**0.1**	93	92	**1**	0.0	0.0	**0.0**	8.2	8.5	**-0.3**	0.0	0.0	**0.0**	3.0	2.9	**0.1**
2265.8	2300	1470.1	1470.0	**0.0**	86	86	**0**	0.0	0.0	**0.0**	9.6	9.6	**-0.1**	0.0	0.0	**0.0**	2.8	2.8	**0.0**
2215.8	2300	1474.9	1475.0	**-0.1**	60	60	**0**	4.1	4.2	**-0.2**	12.2	11.8	**0.4**	3.6	4.2	**-0.6**	3.9	6.6	**-2.7**
1	2300	1477.2	1477.2	**0.0**	182	182	**0**	1.1	1.1	**0.0**	2.4	2.4	**0.0**	1.4	1.3	**0.0**	6.0	7.2	**-1.2**
2	2300	1477.2	1477.2	**0.0**	128	128	**0**	0.7	0.7	**0.0**	3.9	3.9	**0.0**	0.7	0.7	**0.0**	4.7	5.2	**-0.5**
3	2300	1477.3	1477.3	**-0.1**	97	98	**-1**	0.0	0.0	**0.0**	9.2	8.8	**0.3**	0.0	0.0	**0.0**	2.6	2.7	**-0.1**
4	2300	1481.5	1481.4	**0.1**	100	98	**2**	0.0	0.0	**0.0**	8.8	9.2	**-0.4**	0.0	0.0	**0.0**	2.6	2.5	**0.1**
5	2300	1484.8	1484.9	**-0.1**	115	116	**-1**	0.0	0.0	**0.0**	7.1	6.7	**0.3**	0.0	0.0	**0.0**	2.8	2.9	**-0.1**
6	2300	1486.1	1486.1	**-0.1**	170	171	**-1**	3.4	3.2	**0.2**	5.7	5.6	**0.2**	0.5	0.6	**-0.1**	2.7	3.4	**-0.7**
7	2300	1487.5	1487.6	**-0.1**	154	163	**-9**	3.1	3.0	**0.1**	9.0	8.4	**0.5**	0.0	0.0	**0.0**	1.9	3.2	**-1.2**
8	2300	1490.6	1490.5	**0.1**	162	160	**2**	1.7	1.6	**0.1**	8.1	8.3	**-0.3**	0.0	0.0	**0.0**	2.0	3.4	**-1.5**
9	2300	1492.7	1492.8	**-0.1**	165	166	**-1**	1.6	1.6	**0.0**	7.5	7.1	**0.4**	3.1	3.0	**0.1**	2.1	3.1	**-0.9**
10	2300	1494.9	1494.9	**-0.1**	90	91	**-1**	2.4	2.4	**0.0**	9.6	9.4	**0.2**	0.0	0.0	**0.0**	2.7	3.0	**-0.3**
11	2300	1497.6	1497.6	**0.0**	109	109	**0**	0.0	0.0	**0.0**	6.4	6.5	**0.0**	2.0	2.0	**0.0**	3.3	3.5	**-0.1**
12	2300	1499.3	1499.4	**-0.1**	139	142	**-3**	0.0	0.0	**0.0**	9.1	8.9	**0.2**	2.7	2.6	**0.0**	2.1	3.5	**-1.4**
13	2300	1502.7	1502.7	**0.0**	158	158	**0**	2.2	2.2	**0.0**	7.6	7.6	**-0.1**	2.1	2.1	**0.0**	1.9	2.0	**-0.1**
14	2300	1505.0	1505.0	**0.0**	191	191	**0**	3.2	3.1	**0.1**	6.9	6.7	**0.1**	1.9	1.9	**0.0**	2.0	2.5	**-0.6**
15	2300	1507.4	1507.5	**-0.1**	184	185	**-1**	4.7	4.5	**0.2**	8.8	8.4	**0.4**	0.0	0.0	**0.0**	1.9	2.9	**-1.0**
16	2300	1509.3	1509.2	**0.0**	182	182	**0**	2.1	2.1	**0.0**	5.9	5.9	**0.0**	2.1	2.1	**0.0**	2.2	2.4	**-0.2**


HEC-6 Computed Bed Elevation Changes
100-Year Hydrograph
Elevation Change (ft)
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
14
12
11
9
8
7
6
3
2
2215
2575
3095
3535
3880
4260
4630
5150
5460
5500
5880
6520
6573
7338
7533
7693
Section #
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9

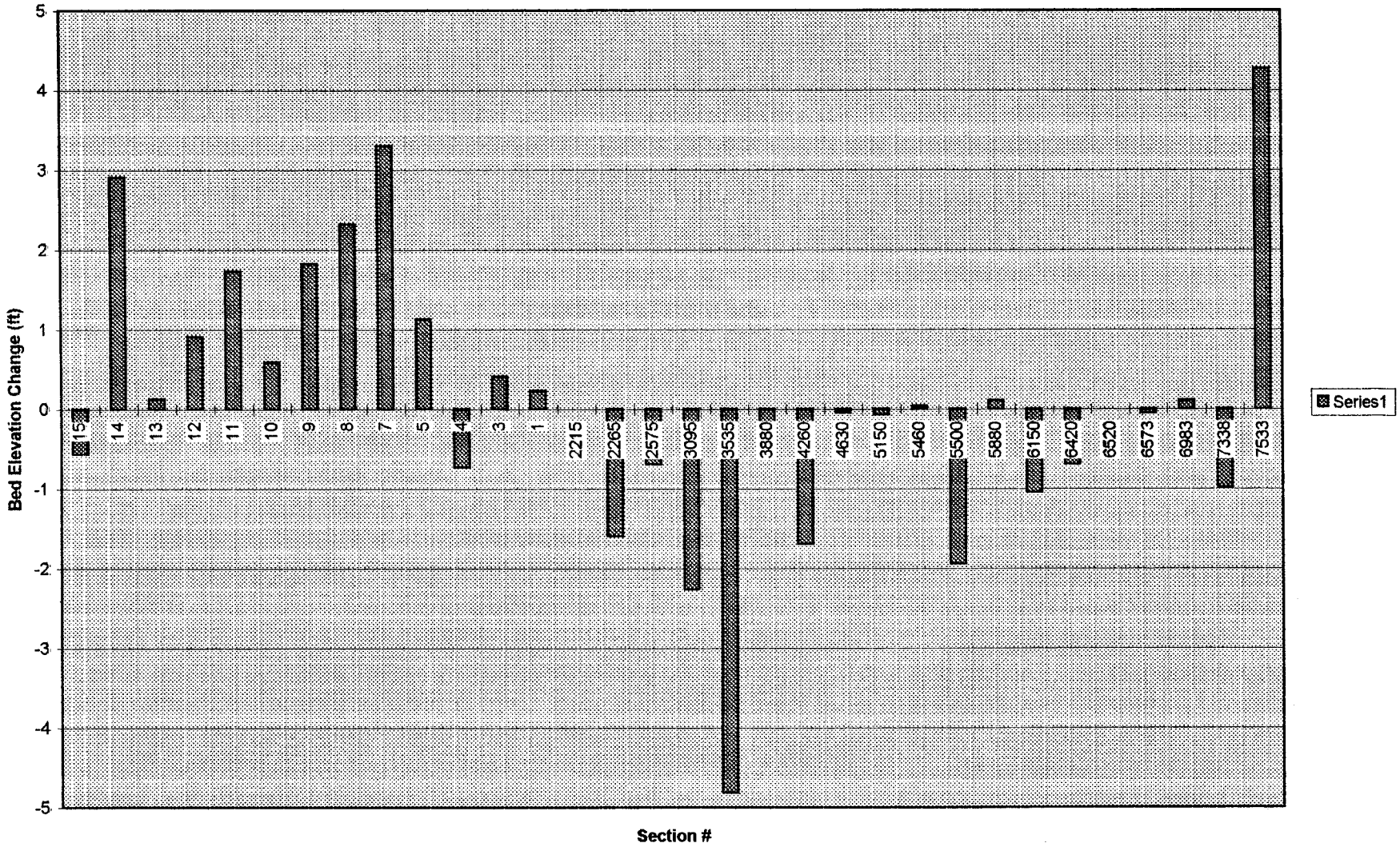
Tatum Wash HEC-6 Results Zero Sediment Inflow



Tatum Wash HEC-6 Results Continuous Low Discharge Simulation



Tatum Wash HEC-6 Results Continuous High Flow Simulation



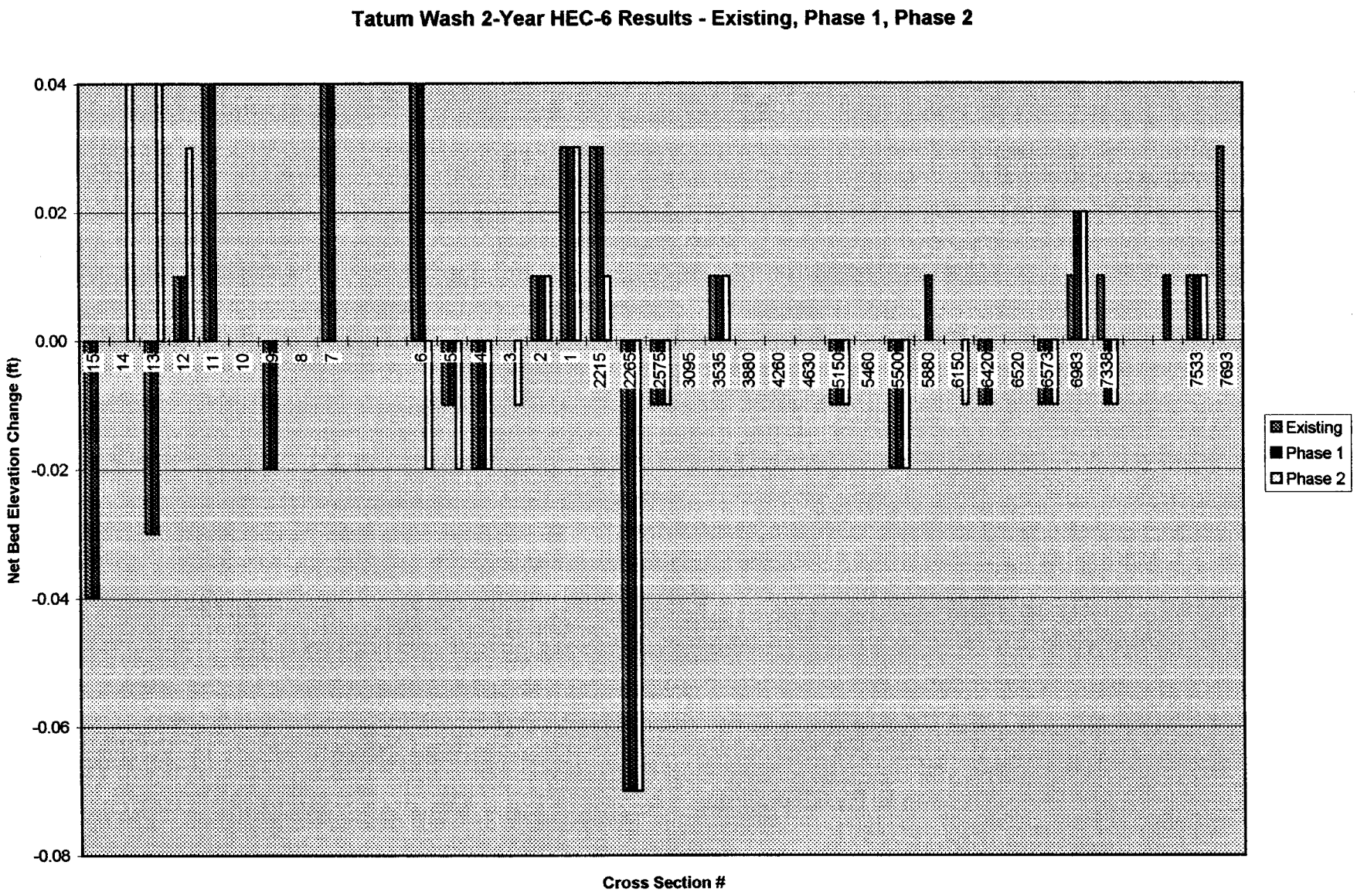
Note: Xns 16, 6, 2, & 7693 not included

Tatum Wash 2-Year HEC-6 Results

SECTION NUMBER	Q2 Pre Elev Diff (ft) Existing	Q2 Pre Elev Diff (ft) Phase 1	Q2 Pre Elev Diff (ft) Phase 2	SECTION NUMBER
16	1.72	1.72	1.72	16
15	-0.04	-0.04	0.00	15
14	0.00	0.00	0.04	14
13	-0.03	-0.03	0.04	13
12	0.01	0.01	0.03	12
11	0.04	0.04	0.00	11
10	0.00	0.00	0.00	6.41
9	-0.02	-0.02	0.00	6.4
8	0.00	0.00	0.00	6.3
7	0.04	0.04	0.00	6.2
			0.00	6.1
			0.00	6
6	0.04	0.04	-0.02	6
5	-0.01	-0.01	-0.02	5
4	-0.02	-0.02	-0.02	4
3	0.00	0.00	-0.01	3
2	0.01	0.01	0.01	2
1	0.03	0.03	0.03	1
2215	0.03	0.03	0.01	2215
2265	-0.07	-0.07	-0.07	2265
2575	-0.01	-0.01	-0.01	2575
3095	0.00	0.00	0.00	3095
3535	0.01	0.01	0.01	3535
3880	0.00	0.00	0.00	3880
4260	0.00	0.00	0.00	4260
4630	0.00	0.00	0.00	4630
5150	-0.01	-0.01	-0.01	5150
5460	0.00	0.00	0.00	5460
5500	-0.02	-0.02	-0.02	5500
5880	0.00	0.01	0.00	5880
6150	0.00	0.00	-0.01	6150
6420	-0.01	-0.01	0.00	6420
6520	0.00	0.00	0.00	6520
6573	-0.01	-0.01	-0.01	6573
6983	0.01	0.02	0.02	6983
7338	0.01	-0.01	-0.01	7338
		0.00	0.00	0.3
		0.01	0.00	0.2
7533	0.01	0.01	0.01	0.1
7693	0.03	0.00	0.00	0.01

SLIGHTLY DIFFERENT INFLOW HYDROGRAPH

tatum pre vs post hec6 results Chart 2



TATUM
HEC-6
JEF
12-96

NEW DISCRETIZED HYDROGRAPHS - EXISTING CONDITIONS

MIN INCREMENT = 0.1042 DAYS = 150 MIN ; Q ≤ 100 CFS

= 0.0694 DAYS = 100 MIN Q > 100 CFS

= 0.0347 DAYS = 50 MIN Q ≥ 1000 CFS

= 0.0174 DAYS 25 MIN Q

RI	EXISTING VOLUME C SHEA (AF)	PEAK (CFS)
2	42	334
10	89	848
50	156	1798
100	189	2315

TARGET MATCH VOLUME W/IN 5% OF HEC-1 ESTIMATE

SEE XLS PLOTTED HYDROGRAPHS

INCR	Q100 Q(CFS)	Q100 T(DYS)	Q50 Q	Q50 I	Q10		Q2	
1	70	0.149	70	.149	40	.153	30	.147
2	2000	0.035	1500	.035	750	.035	300	.035
3	200	0.069	150	.069	150	.069	40	.174
4	20	0.118	40	.132	20	.118		
5								
	Δ = 0.9%		0.5%		0.1%			

Q100_HYD.DAT Q50_HYD.DAT Q10_HYD.DAT Q2_HYD.DAT

RE-RUN HEC-6 FOR EXISTING CONDITIONS

Tatum Wash Discretized Hydrographs

100-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	70	215	0.149	21
2	2000	50	0.035	138
3	200	100	0.069	28
4	20	170	0.118	5
		Total Volume (AF) =		191
		HEC-1 Volume (AF) =		189
		Percent Difference =		-0.9

50-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	70	215	0.149	21
2	1500	50	0.035	103
3	150	100	0.069	21
4	40	190	0.132	10
		Total Volume (AF) =		155
		HEC-1 Volume (AF) =		156
		Percent Difference =		0.5

10-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	40	220	0.153	12
2	750	50	0.035	52
3	150	100	0.069	21
4	20	170	0.118	5
		Total Volume (AF) =		89
		HEC-1 Volume (AF) =		89
		Percent Difference =		-0.1

2-year Existing Conditions @ Shea Blvd.

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	30	211	0.147	9
2	300	50	0.035	21
3	40	250	0.174	14
		Total Volume (AF) =		43
		HEC-1 Volume (AF) =		42
		Percent Difference =		-2.7

Phase 2 Phoenix Mountain Preserve Basin Outflow

Q100

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	10	200	0.139	3
2	500	150	0.104	103
3	170	250	0.174	59
4	5	700	0.486	5
		Total Volume (AF) =		169
		HEC-1 Volume (AF) =		168
		Percent Difference =		-0.8

50-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	15	200	0.139	4
2	400	150	0.104	83
3	130	250	0.174	45
4	10	630	0.438	9
		Total Volume (AF) =		140
		HEC-1 Volume (AF) =		139
		Percent Difference =		-0.9

10-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

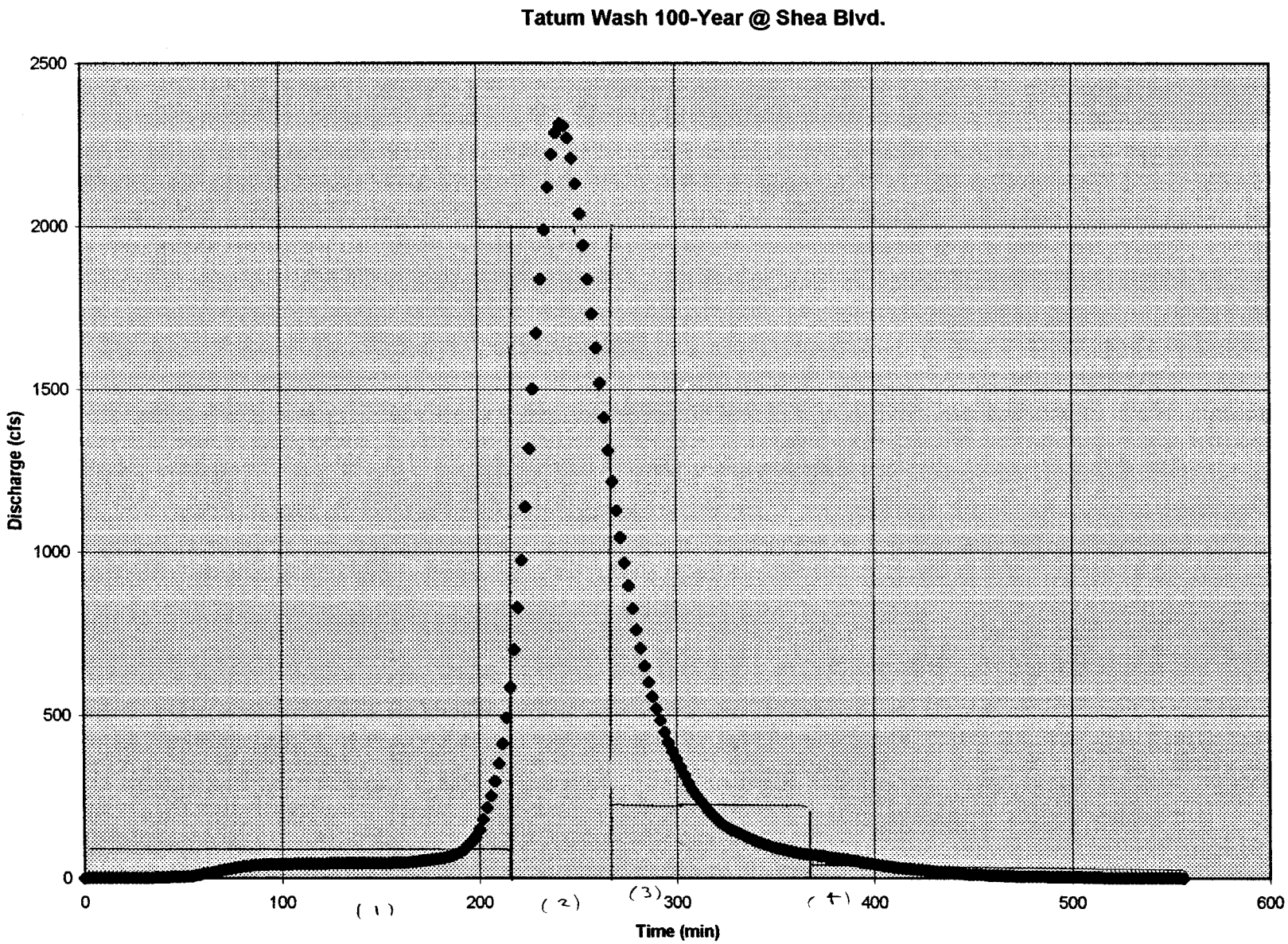
Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	10	200	0.139	3
2	215	150	0.104	44
3	85	250	0.174	29
4	5	600	0.417	4
		Total Volume (AF) =		81
		HEC-1 Volume (AF) =		80
		Percent Difference =		-0.7

2-year Phase 2 Conditions @ Phoenix Mountain Preserve Basin

Incr. #	Q (cfs)	Dur'n (min)	Dur'n (day)	Vol (AF)
1	8	200	0.139	2
2	100	150	0.104	21
3	40	250	0.174	14
4	4	500	0.347	3
		Total Volume (AF) =		39
		HEC-1 Volume (AF) =		39
		Percent Difference =		-1.0

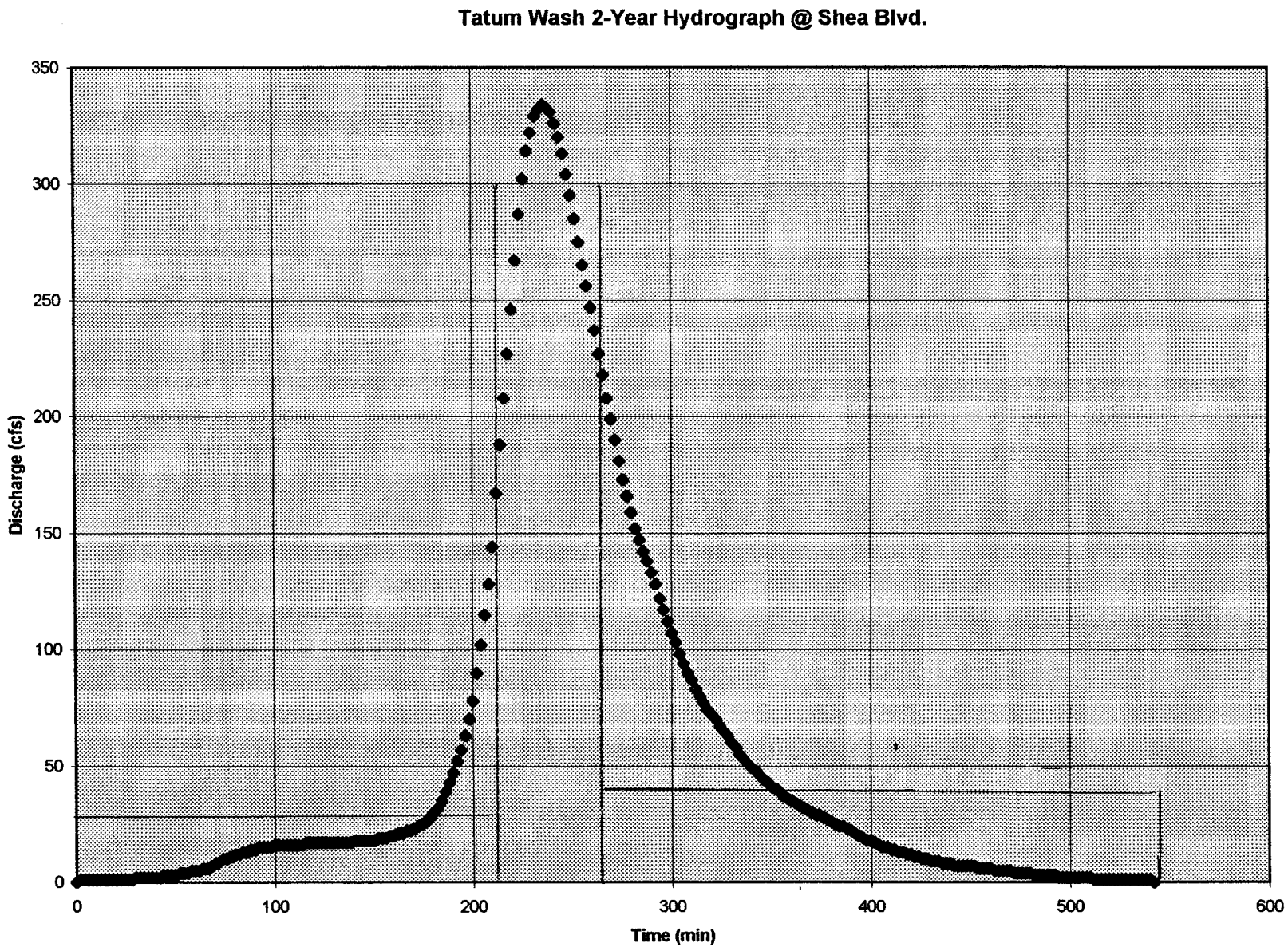
1-1.
EXISTING

TM100YR Chart 1



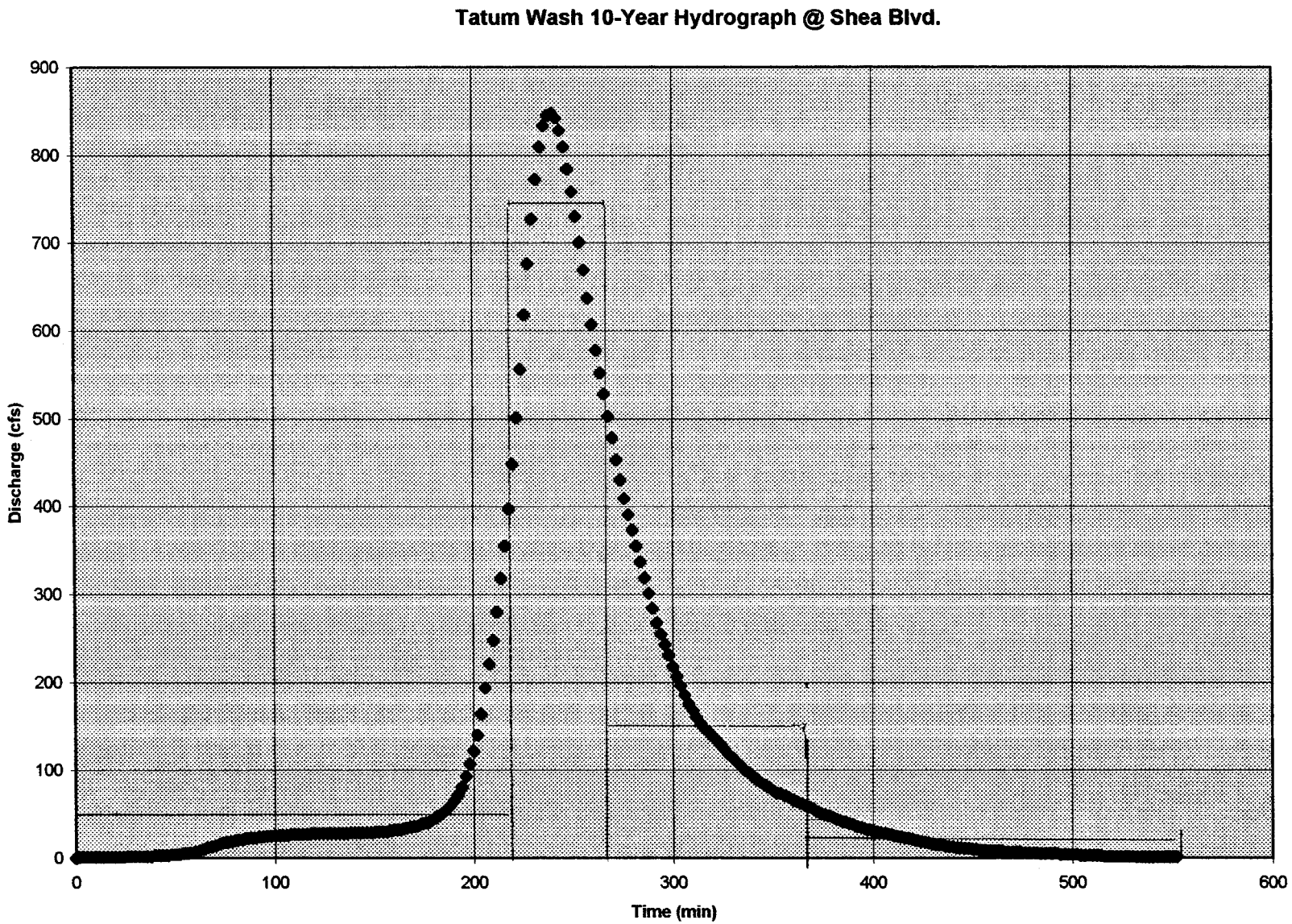
12/96

TM2YR Chart 1



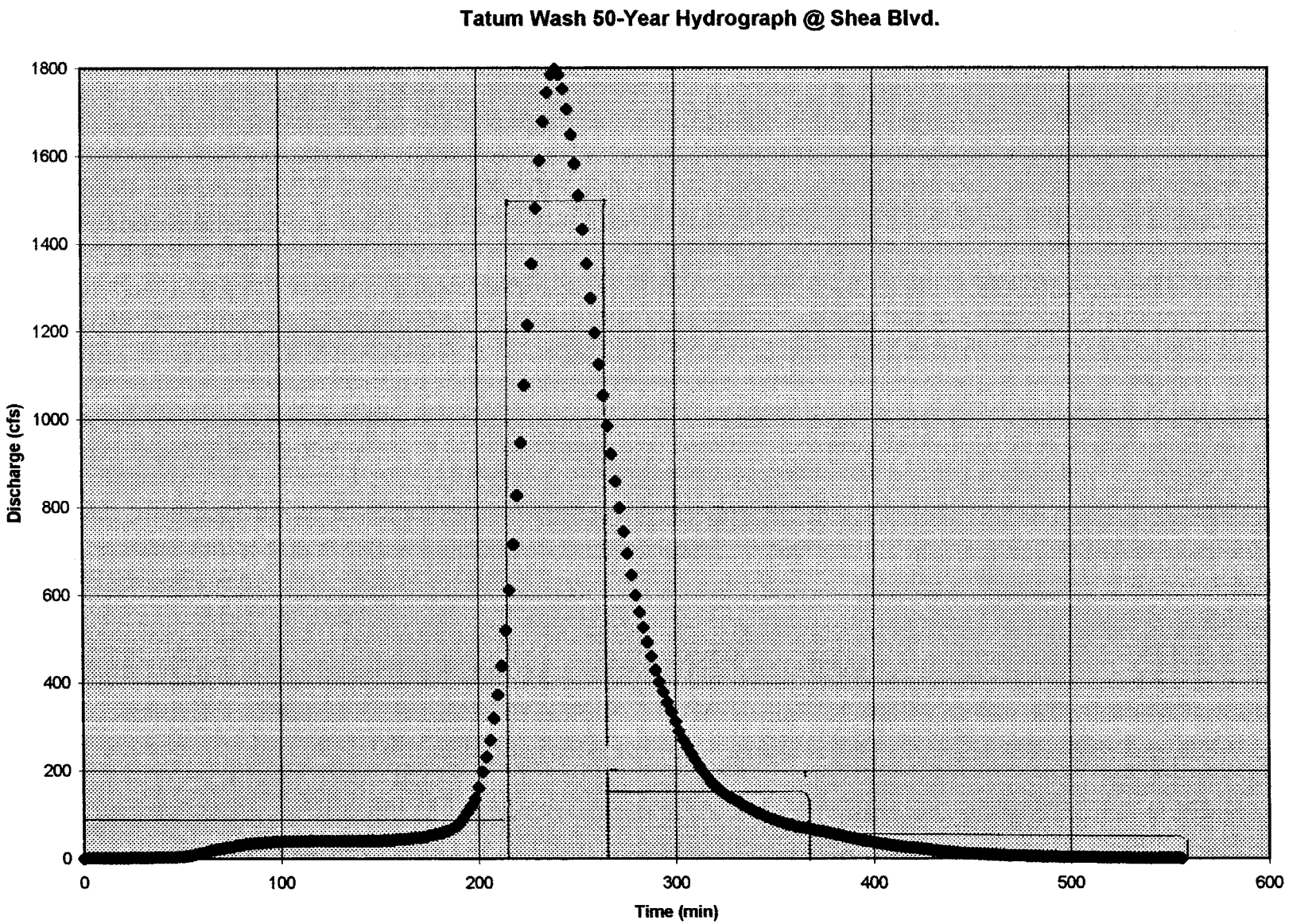
12/96
EXISTING

TM10YR Chart 1



12/16
EXISTING

TM50YR Chart 1

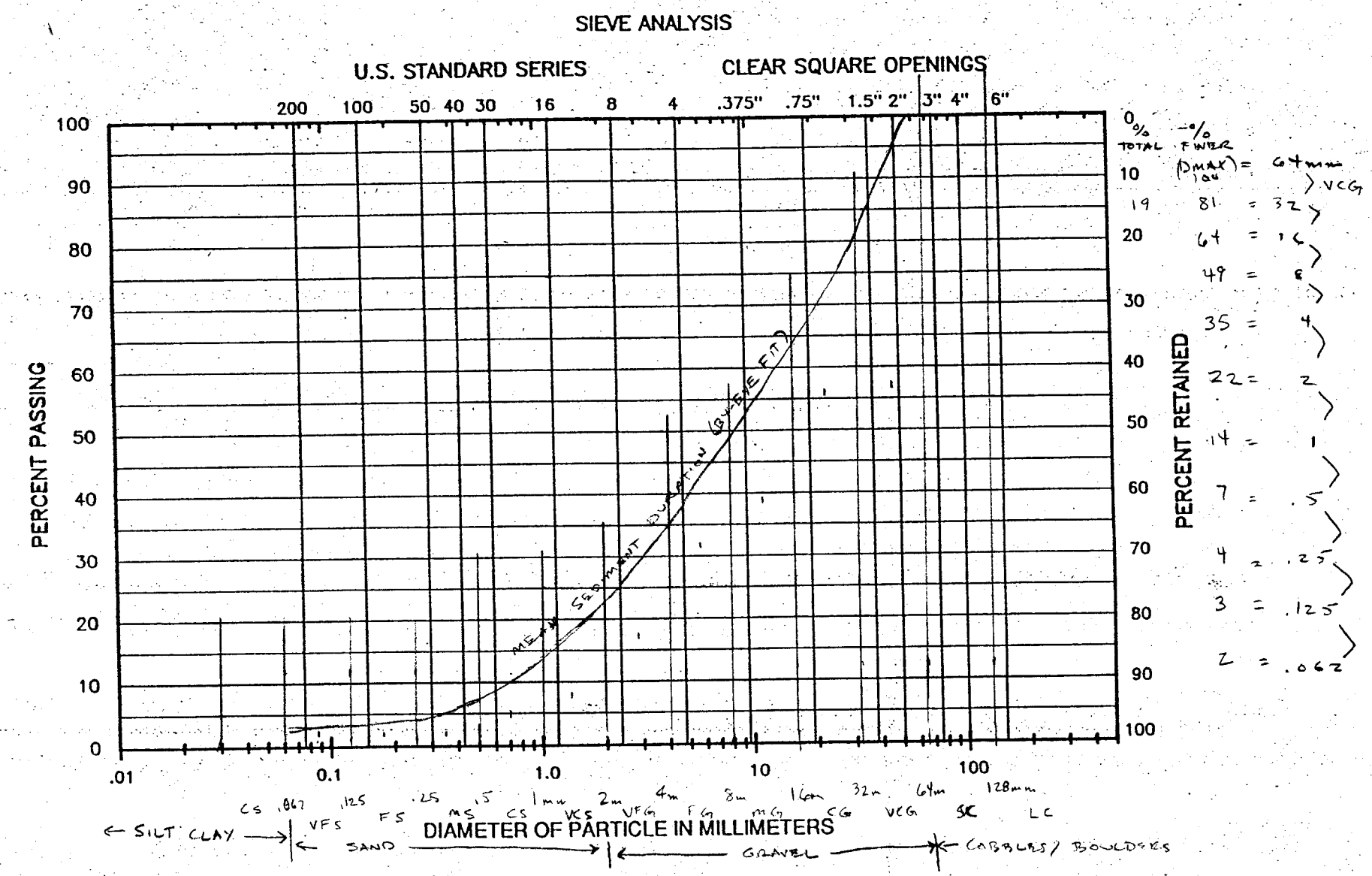


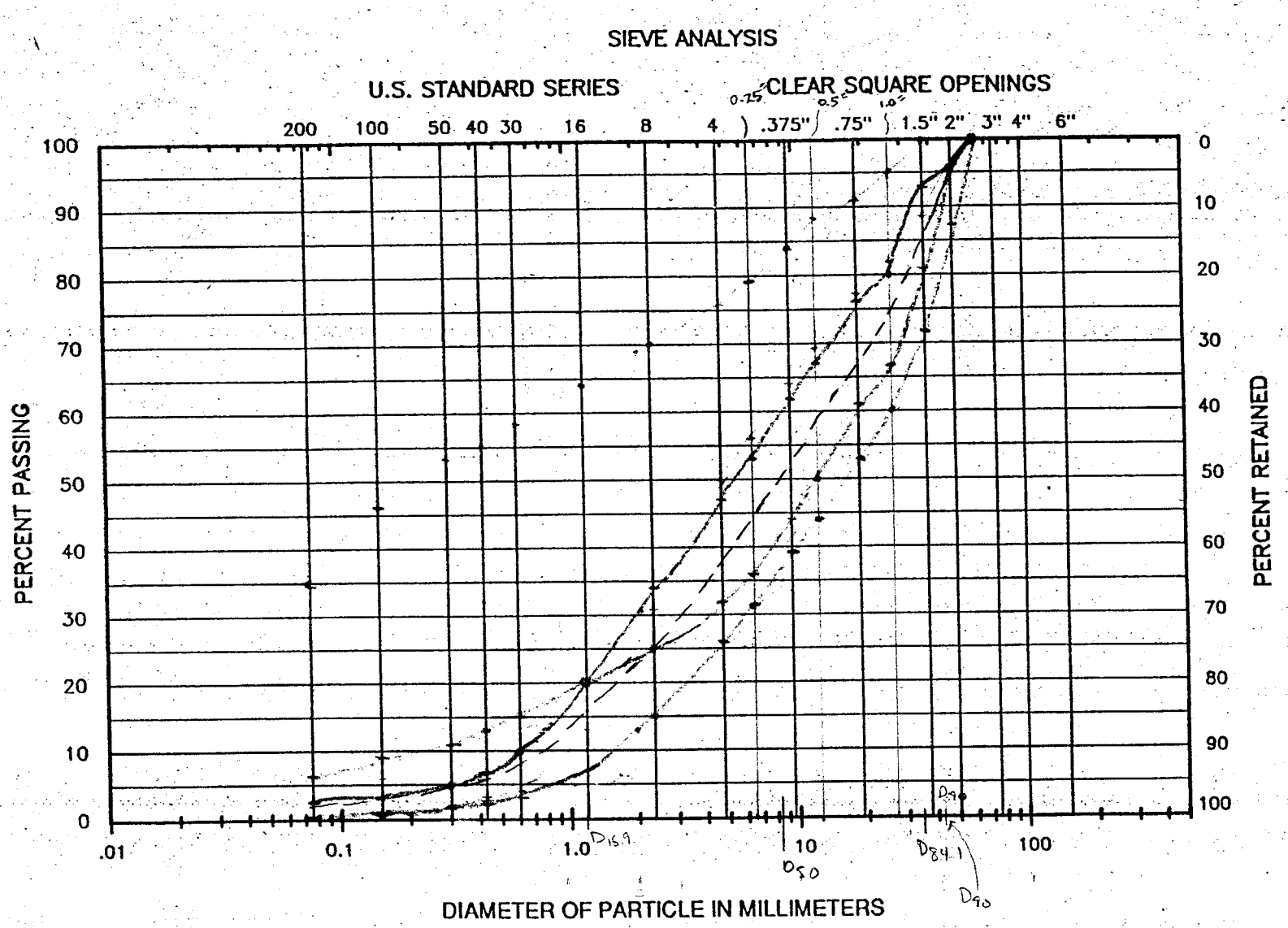
TATUM
MC-C
JEF
11-96

SEDIMENT DATA

SEDIMENT CLASSIFICATION

CODE	SAND - BOULDERS	(MM)	(m)	% PASSING AT MIDPOINT
1	VFS	.062	.125	3
2	FS	.125	.250	3
3	MS	.25	- .50	5
4	CS	.50	- 1	10
5	VCS	1	- 2	18
6	VFG	2	- 4	28
7	FG	4	- 8	42
8	MG	8	- 16	55
9	CG	16	- 32	70
10	VCG	32	- 64	92
11	SC	64	128	100
12	LC	128	256	
13	SB	256	512	
14	MB	512	1024	
15	LB	1024	2048	


SIEVE ANALYSIS
U.S. STANDARD SERIES
CLEAR SQUARE OPENINGS
200 100 50 40 30 16 8 4 .375" .75" 1.5" 2" 3" 4" 6"
PERCENT PASSING
100 90 80 70 60 50 40 30 20 10 0
PERCENT RETAINED
0 10 20 30 40 50 60 70 80 90 100
.01 0.1 1.0 10 100
CS .062 .125 .25 .5 1mm 2m 4m 8m 16m 32m 64m 128mm
VFS FS MS CS VCS VFG FG MG CG VCG SC LC
← SILT CLAY → ← SAND → ← GRAVEL → ← COBBLES / BOULDERS
DIAMETER OF PARTICLE IN MILLIMETERS
MEAN SEDIMENT DURATION (BY EYE FIT)
% TOTAL
% FINER
(DMAX) = 64mm
100 > VCG
19 81 = 32 >
20 64 = 16 >
49 = 8 >
30 35 = 4 >
40 22 = 2 >
50 14 = 1 >
60 7 = .5 >
70 4 = .25 >
80 3 = .125 >
90 2 = .062 >
100



— 4A — 2B

— 3A — 2A — — — Average (eye fit) of 3A, 2A, 2B, 1A

Temperature Data

(selected data from Tucson)

Date - Time	Gauge Location	Q	Temp °F
8/30/93 4pm	TV @ Sab. Creek.	116	84.2
1/21/93 7:15pm	Pantano Wash	30	79.7
7/18/93 7:45pm	Alamo Wash	14	87.8
3/93 8:45pm		50	80.6
8/93 7pm		130	82.4
7/21/93 4:30pm		50	86.0
5/93 7:45pm	Rillito Creek	10	82.4
30/93 4:45		60	82.4

The avg. min temp @ Sabino Canyon for July, Aug., & Sept., based on 34 yrs of data is 69.5°F. & the Max is 99.4°. The average of these is ~84°. This is a close match w/ the water temp data (whether correlated or not.)

at Paradise Valley: (14 yrs of Data)

min = 77.7 > avg = 89.3°
max = 100.9

so we will assume the water temp will be 83° F.

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HYDROGRAPHS - WITH PROJECT CONDITIONS

PHG_100.DAT = HEC-6 FILE

BOUNDARIES TYPES
1) UPSTREAM
2) DOWNSTREAM
3) INTERNAL
a) LOCAL INFLOW
b) TRIB JUNCTION PT
c) HYDRAULIC CONTROL PT

BOUNDARY CONDITIONS
1) WATER G @ U/S
2) [illegible] Q @ U/S
3) WSEL @ D/S & [illegible] CONTROL PTS

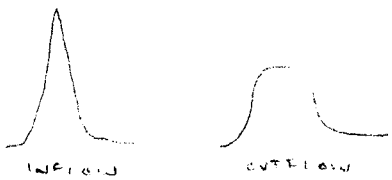
PHASE 1

1) NEED RATING CURVE FOR SHLA OUTLET

OR

2) NEED A GOOD R.I. TO MATCH WSEL W/ TIME FOR [illegible] HYDROGRAPH

3) NEED A RELOCD FOR XN 7338 -- CRITICAL DEPTH --



SOLUTION

1. USE EXISTING CONDITIONS HYDROGRAPH
2. SPECIFY WSEL FOR Q'S AT SED. BASIN (SHEA) TO MIMIC PONDING WSEL ~~ON~~ AFTER BASIN FILLED (IE, PONDING)

727 vm
DATE
12-76

PASE 2 - HEC 6

CREATE HC-G FILE

1. ENTER PHASZ_GR DAT
2. CHANGE T3
3. ENTER NEW HYDROGRAPH P2HYD_RI DAT
4. ENTER NEW RATING CURVE PH1_RATC.DAT

P2H6_100.DAT G100

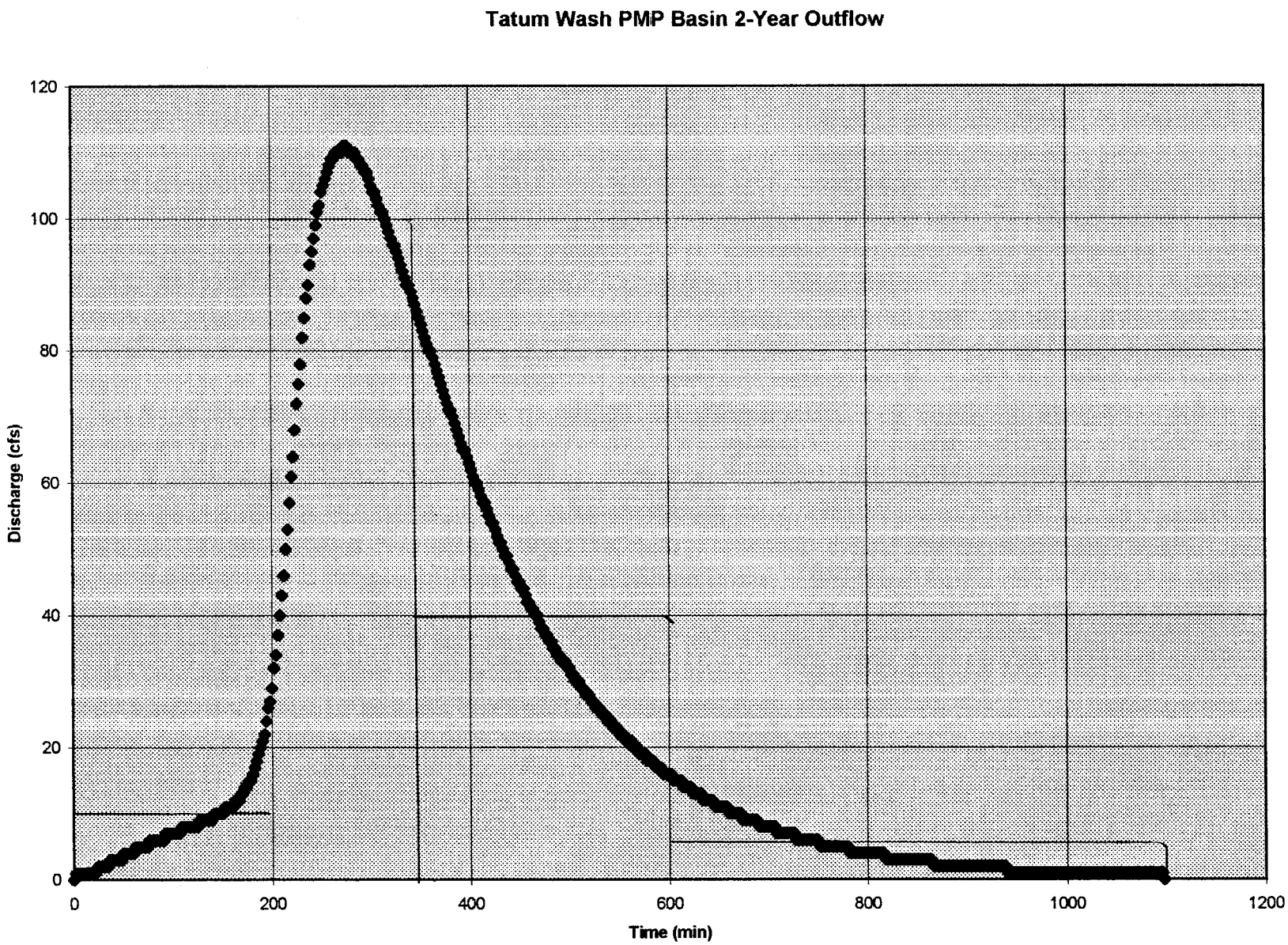
P2H6_50 DAT G50

P2H6_10 DAT Q10

P2H6_2 DAT Q2

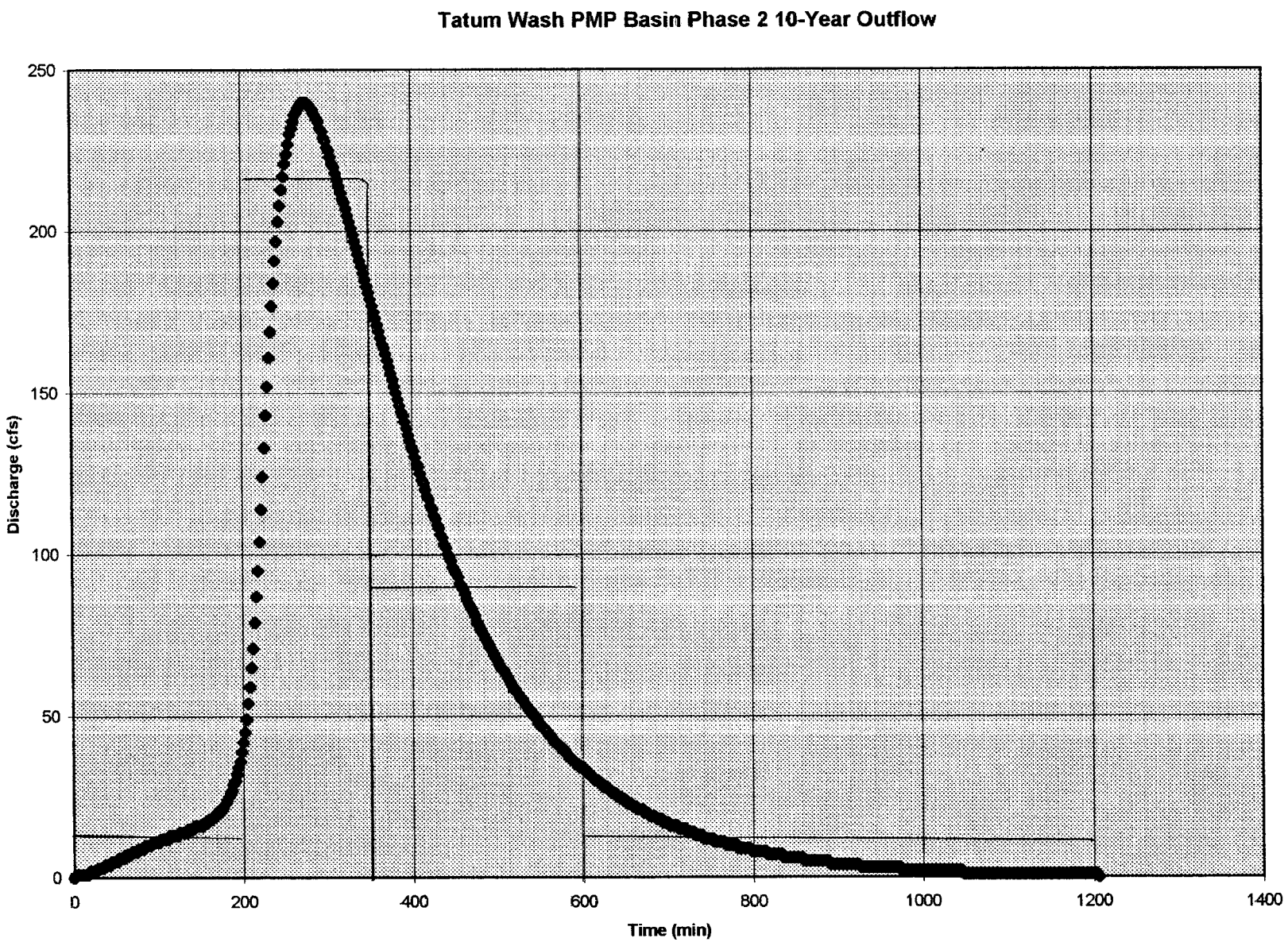
PHASE 2
12-96

P2_2YR Chart 1



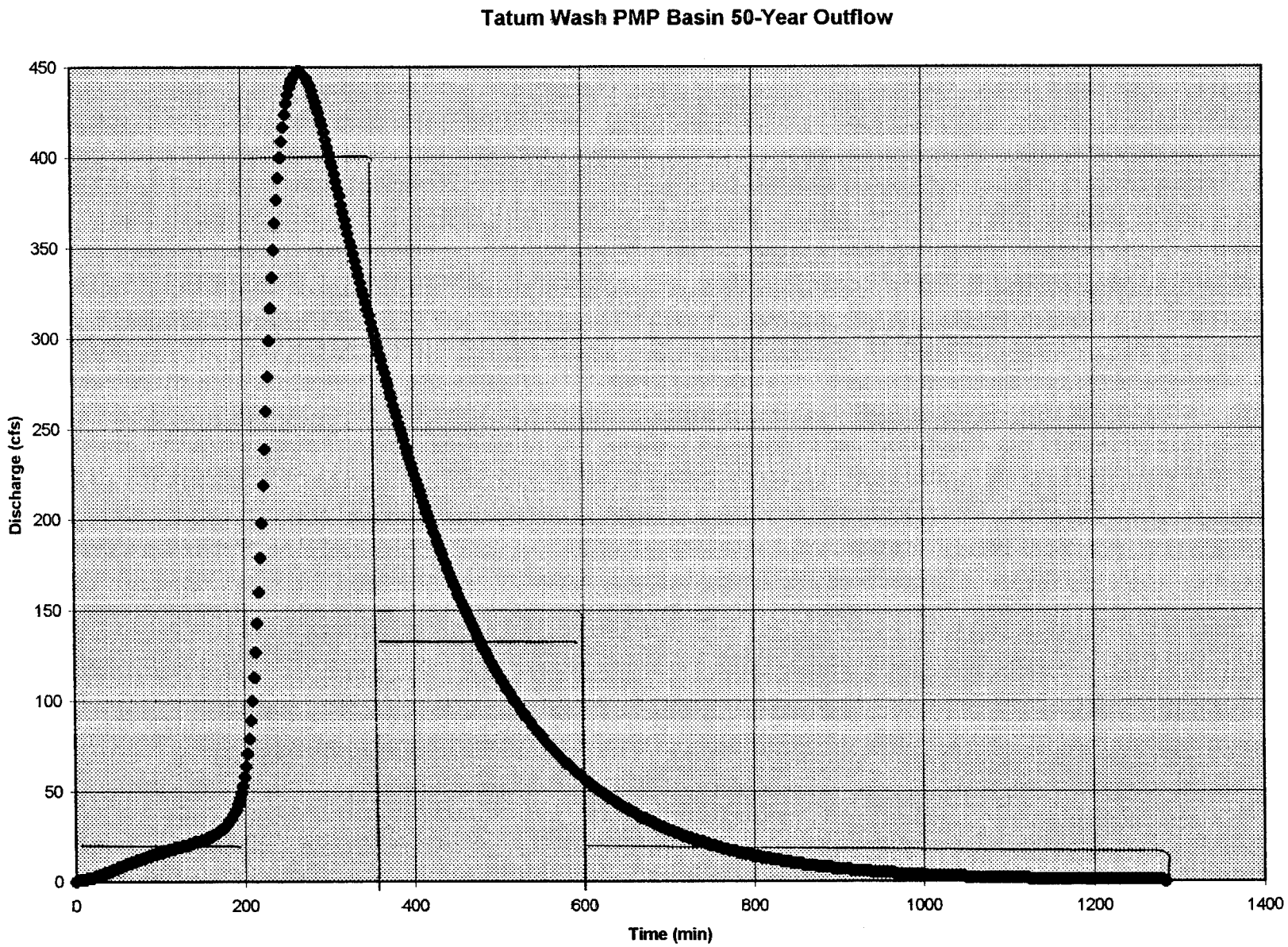
PHASE 2
12-96

P2_10YR Chart 1



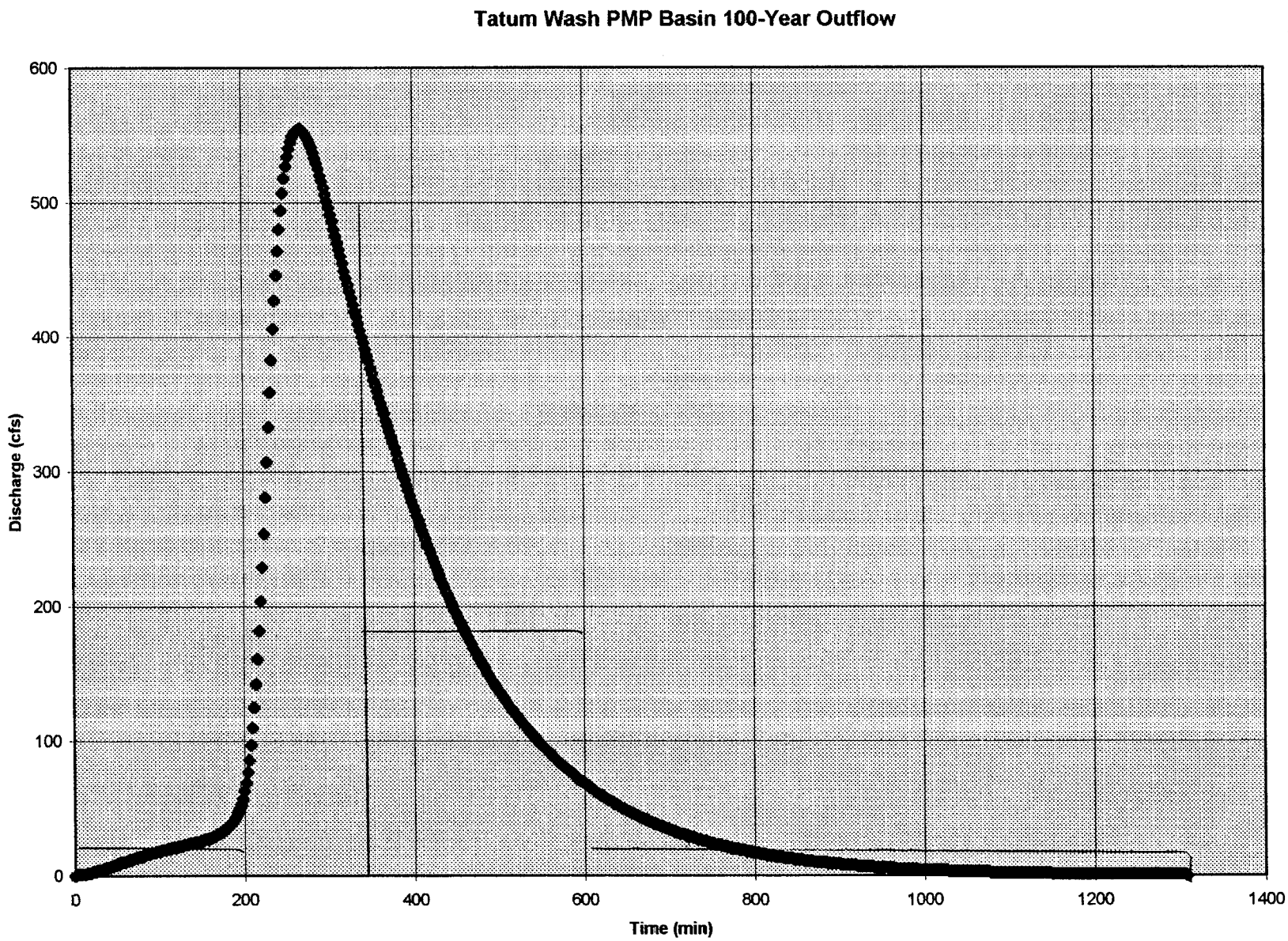
PHASE 2
12-96

P2_50YR Chart 1



PHASE 2
12-96

P2_100YR Chart 1



PHASE 1 - HSC 6

PIHG_100.DAT - Q100

PIHG_50.DAT - Q50

PIHG_10.DAT - Q10

PIHG_2.DAT - Q2

(GR DATA)

INSERT PIAS1_GR.DAT INTO TATUM(A).DAT

(RATING CURVE)

PH1_RATC.DAT "

CHANGE TO RECORD

TAB XM
HEC-6
AEF
12-96

PHASE 2

USE PHASE 2 BASIN OUTFLOW FOR HYDROGRAPH

DISCRETIZE HYDROGRAPHS - FROM HEC-1 @ PMP BASIN

*.XLS	VOL @ PMP (AF)	Q_p (CFS)	Q_p @ SHEA BASIN INLET (CFS)
P2_2YR	39 AF	111	114
P2_10YR	80 AF	240	251
P2_50YR	139 AF	448	469
P2_100YR	168 AF	555	581

	Q100		Q50		Q10		Q2	
INC	Q	DUR'N	Q	DUR'N	Q	DUR'N	Q	DUR'N
1	10	.139	15	.139	10	.139	3	.139
2	500	.104	400	.104	215	.104	100	.104
3	170	.174	130	.174	85	.174	40	.174
4	5	.486	10	.438	5	.417	4	.347
5								
% DIFF IN VOL FROM HEC-1	-0.8 %		-0.9 %		-0.7 %		-1.0 %	
	P2HYD100.DAT		P2HYD50.DAT		P2HYD_10.DAT		P2HYD_2.DAT	

REVISE R RECORDS FOR NEW Q'S

CREATE $HYD FILES ABOVE

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REVISE HEC-1 FOR WITH-PROJECT CONDITIONS

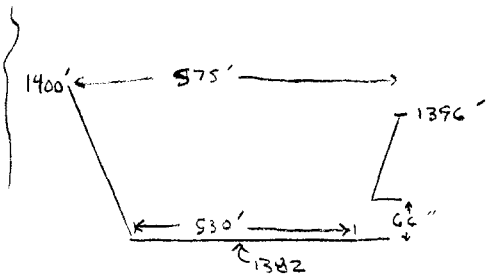
PER FCDMC (1996) - PROPOSED PLAN

a) PHASE 1 BASIN @ SHEA BLVD. (SEDIMENT TRAP)

VOL = 35 AF

OUTLET = (78" S.D.) VIA 66" RCP

Q_p OUTFLOW = 375 CFS



b) PHASE 2 BASIN IN PHX MTN PARK

VOL = 135 AF

Q_p OUTFLOW = 621 CFS

POTENTIAL BASIN LOCATIONS - CP1C - POTENTIAL SITE 1

CP1F - POTENTIAL SITE 3 (INSERT EQUESTRIAN PARK ART 5) - PHX MTN PARK SNDY

CP2E - POTENTIAL SITE 5 - SHEA BLVD

CP1E - POTENTIAL SITE 2

CP2A1 - POTENTIAL SITE 4

1. ELIMINATE BASIN 2F - 2I (SHEA WASH)
2. ADD * RECORDS BETWEEN NODES
3. ADD BASIN ROUTING FOR PHASE 2

PHASE 1

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ABC-1 RESERVOIR ROUTING

P2 BASIN (PMP)

RS
SV
SS
SL
ST

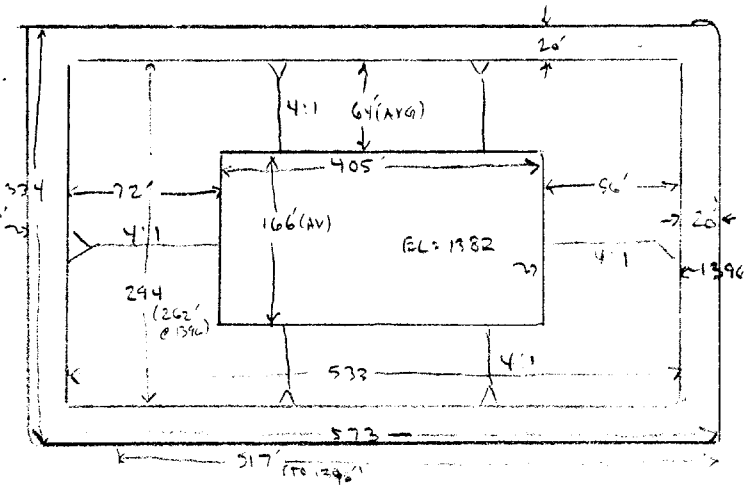
P2_100YR.HC1

P1 BASIN (SMA)

RS
SA
SE

↳ P1_100YR HC1

N.T.S.



SEDIMENTATION BASIN

AREA @ SURFACE = 4.4 AC

L: 573

W: 334

ASSUME 1) 20' SETBACK FROM PROPERTY LINES

2) 4:1 SIDE SLOPES

3) DEPTH = 18' (PLANS BY FCDMC)

= 14' @ d/s SIDE

∴ BOTTOM AREA = 1.54 AC (67,230 ⌀) (@ EL = 1382)

TOP AREA = 3.11 AC (135,450 ⌀) (@ EL = 1396)

3.60 AC @ EL = 1340

OUTLET = 66" RCP - ℄ @ = ELEV'N

↳ AREA = πr^2 = 3.14 (33")^2 = 3421 IN^2 = 23.76 ⌀

↳ APPROX. Q BY ORIFICE EQ'N (NOT TRUE ORIFICE @ LOW HEAD)

C ≅ 0.6 (BRATER & KING, p 4-8

OVERFLOW L = 294'

C = 2.6 (BROAD-CRESTED)

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PMP BASIN

135 AF STORAGE - 12 AF FOR SEDIMENT

= 123 AF

W/ PEAK Q_{OUT} = 621 CFS

HEC-1 FILES

P1_100YR.HC1 - Phase 1 Basin only

P2_100YR.HC1 - Phase 2 Basin only

P1_BASIN.HC1 - KK-RS-SS RECORDS FOR Phase1 Basin

P2_BASIN.HC - KK-RS-SS RECORDS FOR Phase2 Basin

P1_50YR.HC1 -

P1_10YR.HC1

P1_2YR.HC1

P2_50YR.HC1

P2_10YR.HC1

P2_2YR.HC1

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HEC 1 RESULTS

	Phase 1	Phase 2	
	Shea Basin	Pump Basin	Shea Basin
Q100			
Q_{in}	2315	2212	581
Q_{out}	2304	555	512
Vol Stored	38 (OF 189)	110 (of 168)	33 (OF 189)
Elev'n	1397.82	—	1396.48
Q50			
Q_{in}	1798	1719	469
Q_{out}	1771	448	358
Vol Stored	37 (OF 156 AF)	89 (OF 139)	27 (OF 156)
Elev'n	1397.47	—	1394.33
Q10			
Q_{in}	848	820	251
Q_{out}	534	240	225
Vol Stored	33 (OF 89)	48 (OF 80)	12 (OF 89)
Elev'n	1396.32	—	1388.38
Q_2			
Q_{in}	334	328	114
Q_{out}	238	111	109
Vol Stored	13 (OF 42)	22 (OF 39)	7 (OF 42)
Elev'n	1388.84	—	1386.06

TOTUM
[illegible]
[illegible]
12-96

SHEA BLVD SED. BASIN

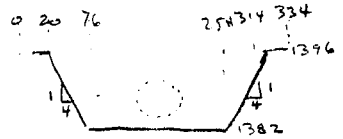
OUTFLOW RATING CURVE — FROM "P1_100YR.OUT"

1382	0	1396.05	395.88
84.50	0	96.17	443.94
87.18	187.22	96.37	567.69
87.63	202.15	96.65	803.04
88.19	219.68	97.01	1185.87
88.93	240.53	97.45	1751.84
89.90	265.75	97.97	2537.13
91.24	296.88	98.57	3577.20
93.15	336.27	99.25	4907.83
96.00	387.72	1400.00	6565.33

PHASE I RATING CURVE YES

"P1_RATE.DAT"

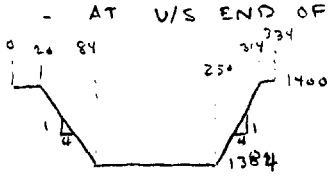
XN 0.1 — AT SHEA BLVD (LOCATE XN ½ WAY BETWEEN TOP D/S EDGE & BOTTOM OF BASIN) --- 4:1 SLOPE ASSUMED



REPLACES XNS 7693, 7533, 7338

XN 0.2 — AT U/S END OF BASIN — (LOCATE XN @ BOTTOM OF U/S 4:1 SLOPE)

(406 FT + 56 FT/2) = 462 FT U/S OF XN #1



XN 0.3 — USE TOPO ALONG U/S (WEST) SIDE OF BASIN — ELMIN = 1400 FT

ASSUME ① INLET PROTECTED FROM EROSION (SCOUR DEPTH = 0)
& BASIN BOTTOM

② INFLOW = OUTFLOW

③ BASIN BOTTOM SLOPE = ½ %

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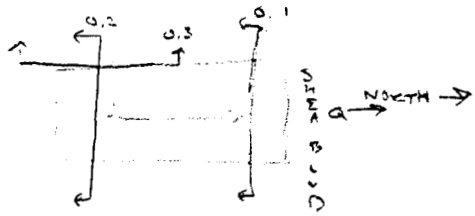
0.3 - FROM FCDMC TOPO (ELMIN = 1400

↳ USE BASIN GEOMETRY FROM XN 73388 & (1) NORMALIZE TO REQ'D ELMIN OF 1400 (2) REVISE RIGHT SIDE XN IN OVERBANK (EL = 1404 > STN 1045)

CHANNEL DIST



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PMP DET'N BASIN

ASSUME BASIN GEOMETRY - GIVEN INFO ONLY { STOR 123 AF, Q_{OUT} 621 CFS }

(1) 3:5 RECTANGULAR SHAPE

(2) 4:1 SIDE SLOPES

(3) ½% BOTTOM SLOPE

(4) MAX DEPTH: 15 FT

(5) TOP AREA = 10 AC

(6) ON-LINE BASIN

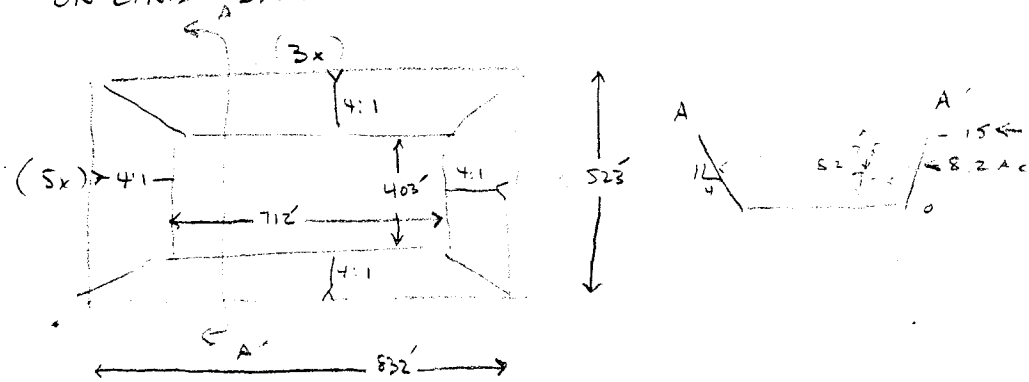
(7) SPILLWAY LENGTH = 400 FT

$Q = CLH^{3/2}$

H = 2 FT

C = 2.6

Q = 3000



$3x(5x)^{FT^2} = 8.20\ AC$

$15x^{2\ FT^2} = 357192\ FT^2$

$x^2 = 15812.8\ FT^2$

$x = 154\ FT$

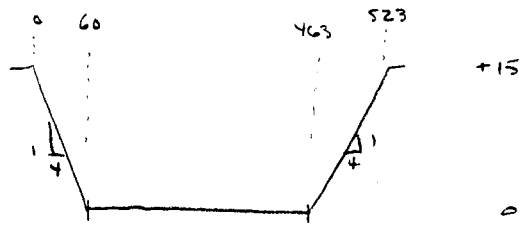
$3x = 462.9$

$5x = 771.6$

$(7.5 \times 4) \times 2 = 60$

TOP AREA = $(462.9 + 60)(771.6 + 60) = 9.98\ AC \approx 10\ AC$

BOTTOM AREA = $(462.9 - 60)(771.6 - 60) = 6.58\ AC \approx 6.6\ AC$



BY AVERAGE END AREA,

MAX STORAGE = 124.5 AF

GR-XN #6 = PMP BOUNDARY ← PLACE D/S EDGE OF BASIN @ XN#6 & EXTEND U/S 832 FT (ELIMINATES CROSS SECTIONS 6, 7, 8, 9

162 + 257.5 + 201.4 + 183.2
(7→6) (8→7) (9→8) 10-9

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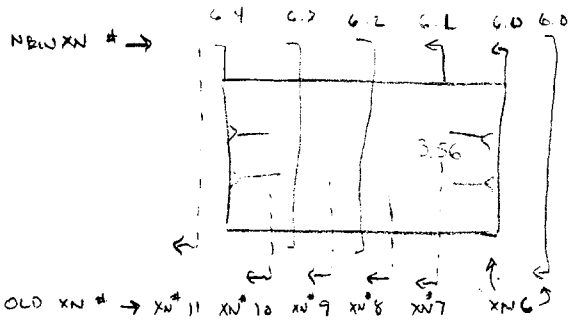
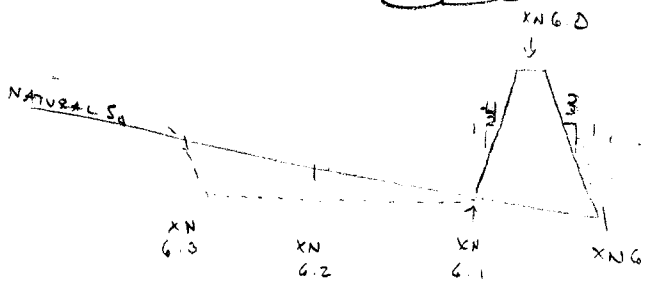
XN	D/S DIST	Σ DIST	NAT'L ELMIN (KEEP)	NEW ELMIN XN ← 6	NEW XN	NEW RS DIST
6	0	0	1480.35	1500.76	6.0	0
7	162	162	1481.85	1481.05	6.1	+60
8	257.5	419.5	1485.05	1482.83	6.2	+356
9	201.4	620.9	1487.85	1484.61	6.3	+356
		END OF BOTTOM = 772				
10	183.2	804.1	1490.45	1490.70	6.4	+60
		END BASIN = 832				
11	206.1	1037.7	1492.55			

TOPO ADJUSTMENT AND BUST FACTOR IS IN ALREADY NO X1.9 NEEDED

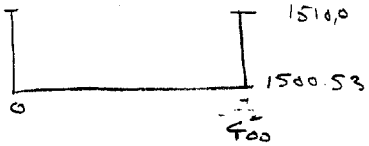
BASIN BOTTOM @ 1480.35 @ D/S END





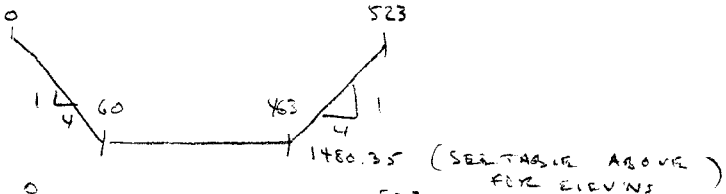
MODEL AS IF NO LOW FLOW OUTLET

XN 6.0 → @ OUTLET WEIR



ASSUME RECT BROAD-CRESTED WEIR L = 400'

XN 6.1



XN 6.4

12-20-96

Tatum Wash Sedimentation Study Unit Wt. Sediment = 93
HEC-6 Sediment Yield

Q100 — Ackers White HEC-6

Increment	Q (cfs)	T (days)	Qs (tpd)	Vol (tons)
1	70	0.118	3.09	0.36
2	2000	0.069	127.69	8.81
3	200	0.035	7648.52	267.70
4	20	0.149	77.89	11.61
			Total =	288.48 tons
				0.14 AF

Q50 — Ackers White HEC-6

Increment	Q (cfs)	T (days)	Qs (tpd)	Vol (tons)
1	70	0.149	77.89	11.61
2	1500	0.035	5685.69	199.00
3	150	0.069	69.09	4.77
4	50	0.132	10.16	1.34
			Total =	216.71 tons
				0.11 AF

Q10 — Ackers White HEC-6

Increment	Q (cfs)	T (days)	Qs (tpd)	Vol (tons)
1	40	0.153	9.66	1.48
2	750	0.035	3010.67	105.37
3	150	0.069	86.55	5.97
4	20	0.118	3.44	0.41
			Total =	113.23 tons
				0.06 AF

Q2 — Ackers White HEC-6

Increment	Q (cfs)	T (days)	Qs (tpd)	Vol (tons)
1	30	0.147	5.93	0.87
2	300	0.035	1107.79	38.77
3	40	0.174	11.53	2.01
			Total =	41.65 tons
				0.02 AF

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A. HEC-6

Q100 — LOW N VALUE

CHANGE CHANNEL N TO 0.025 TO SIMULATE

"LOWN_HG.DAT" REMOVAL OF VEGETATION FROM XN 7693

TO XN 3095 (BEGIN CONTAINED REACH)

— HIGH N VALUE USE N = .055 - DENSE

GROWTH OF BRUSH

"HI_N_HG.DAT"

— FOR Q100 ONLY (USE "TATUM100.DAT" AS BASE

RUN -- EXISTING / PRE-PROJECT CONDITIONS

— ONLY FOR PORTION LIKELY TO BE MAINTAINED FOR

VEG'N GROWTH

RESULTS AVERAGE DIFF: XNS 3095-7693 = -0.01 FT

MAX INCREASE: -0.29

MAX DECREASE: +0.23

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CHANNEL & BASIN DESIGN RECOMMENDATIONS

(1) NEED FOR GRADE CONTROL (ONLY AFTER PHASE 2)

a) UPSTREAM OF FANFOL

b) FANFOL TO SHEA - BEDROCK

- SPACING OF STREETS

(2) RECOMMENDED XN CONFIGURATION

1 - LEAVE NATURAL

2 - IF CHANNEL - DO WITH LEVEES @ EFB

- ONLY IF PROP GIVEN

(3) SCOUR & DEPOSITION @ ROADS

SCOUR

a) HEC - 6 RESULTS

b) FIELD EVIDENCE

DEPOS'N

a) QUANTIFY - DIFF.

b) PHASE 1 - ~ 0 Δ (except @ SHEA) → GRAIN SIZE

c) PHASE 2 - ↓ TOTAL (less coarse)

SCOUR PROTECTION (D_{50} = ARMOR)

(4) SEDIMENTATION BASIN

a) SIZE

- SMALLER, LESS DEEP

- OUTLET ELEVATION

TATUM

b) INLET -

LINED SLOPE - EROSION PROTECTION

c) OUTLET

- TRASH RACK

- 2 D_{50} ABOVE INVERT (SCREEN

↳ KEEP OUT LARGE ROCK

SAFETY

MISCELLANEOUS INFORMATION