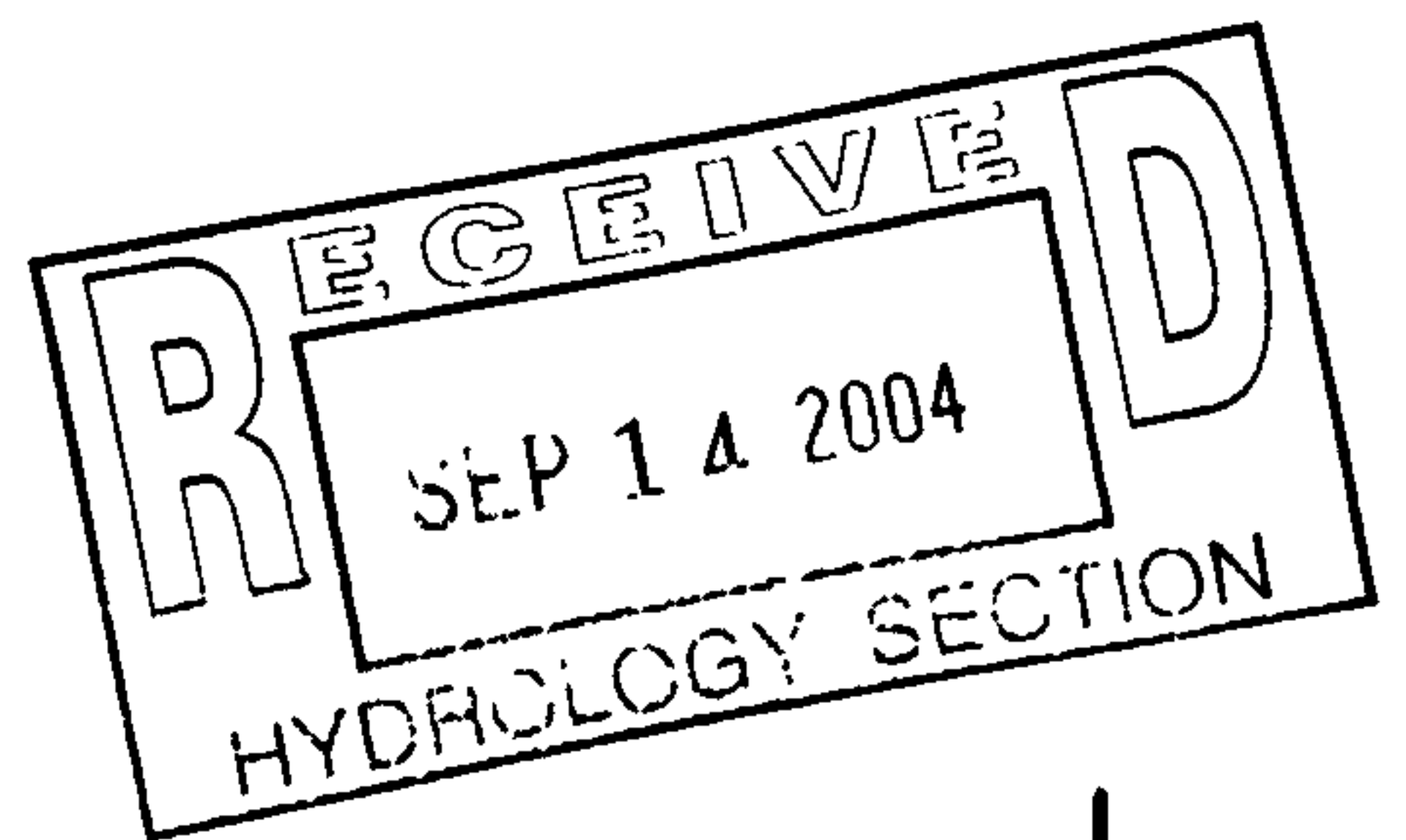




N-09/D006B



MARK GOODWIN

& ASSOCIATES
CONSULTING ENGINEERS

dmg

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DRAINAGE REPORT
for
THE AMOLE CHANNEL
from Confluence with Snow Vista Channel
down to the Amole Dam

Prepared for
Albuquerque Metropolitan Arroyo Flood Control Authority
2600 Prospect NE
Albuquerque, NM 87107
(505) 884-2215

Prepared by
Mark Goodwin & Associates, PA
P.O. Box 90606
Albuquerque, NM 87199
(505) 828-2200

July 2004

PURPOSE & SCOPE

The purpose of this report is to document the adequacy of the proposed Amole Channel from the confluence of the Snow Vista Channel down to the Amole Dam. It includes Hydrology and Hydraulic calculations together with maps of the drainage basins and plans of the proposed shot-crete channel and bridges proposed at 98th Street and Blake Road. It includes a proposed levee in two locations and a hydraulic model of the existing bridge at Gibson Boulevard, and five (5) major junctions both existing and proposed. Freeboard and super elevation calculations are summarized in the Hydraulic Summary Table. Hydrology analysis is provided for both Existing and Future Developed Conditions. The hydraulic calculations use only the higher Future Developed flows since the lower existing flows will probably be contained if the higher ones are contained.

Chapter I

HYDROLOGY

Purpose & Existing Conditions

The purposes of this re-study is to determine both existing and future developed flows for the reach of the channel being designed by this project, from the confluence of the Snow Vista and Amole channels down to the Amole channel rundown into the Amole Dam. This is necessary because previous studies are either inaccurate or incomplete, or both. The 1999 Amole-Hubble DMP is the approved plan that governs development in the watershed. It's ponding requirements have generally been enforced, but it's drainage patterns have been changed. Typically the change is a shift in the point of discharge for several sub-basins to a different place on the channel, usually to a lower place on the channel, though not always lower (see Drainage Basin Maps in Appendix A). Most of the 15 or so existing ponds have been constructed since the 1999 DMP so the specifics of each pond were not modeled in the 1991 DMP. This re-study attempts to model actual constructed conditions and further differentiates the theoretical (planned but not precisely implemented) from the true field condition. As-Built plans are in Appendix A and each pond was inspected. Engineering judgment was used in determining the extent to which the plans and the as-built plans matched actual field conditions. Further surveys of the pond were beyond the scope of the project so some assumptions were made where field conditions deviated from plans. Generally the permanent ponds accomplish their intended function in accordance with the 1999 DMP (see Table 1 for Comparison of Results). But most of the temporary ponds either don't exist at all or don't function as intended. The improperly functioning ponds only impact existing conditions, not future developed conditions, and they do not adversely impact the design or function of the section of the Amole channel that is under consideration in this report.

Existing and future developed conditions for the Westgate Dam and power line basins remain the same as they were in the 1999 Amole -Hubble Drainage Management Plan. Westgate Dam is capable of handling the probable maximum flood (PMF), and it only discharges 78 cfs whether the watershed is developed or not. The power line basin discharges 501 cfs under existing conditions and 19 cfs under developed conditions. The highest flows in this channel may result from an interim condition where the power line basin remains undeveloped and the lower basins are developed. That condition is not modeled in this study. This report assumes that construction of the power line ponds will be a prerequisite to any further development of the basins that will free discharge to the Amole Arroyo above the confluence of the Snow Vista channel.

Existing conditions in the Snow Vista and Amole basins are updated in this report to more accurately reflect significant development since the 1999 DMP. The new basin maps are based on 2004 property lines, 2003 orthophoto and 2001 topography. Fifteen (15) existing ponds were re-analyzed using as-built records and field observation. Several were so poorly constructed that they were not modeled. Several new split flows were identified and added to the model.

To more accurately identify the magnitude of the flows at each location where flow enters the channel, the single most significant flow change is basin 365, where a significant portion of the basin was diverted south into the Amole channel and the new time of concentration is longer than previously modeled. Also, basin 105 is mostly diverted east into the Tierra Bieta basin by a split both in existing and future developed conditions. Basin 310 is served by pond 10E and no further ponding is necessary for development there.

Developed conditions in the Snow Vista watershed are dominated by peak shaving ponds. It is likely that the future ponds will store more of the leading edge of the hydrographs than conservatively modeled here so actual peak future flows will probably be less than this report predicts. Developed conditions in the Amole watershed are based on two current studies; 1) the Gibson Blvd Drainage Plan by Bohannon-Huston, Inc., dated November 21, 2003, and 2) the Drainage Report for Longford Homes by Wilson Engineering, dated June 23, 2004. The sub-basins in those reports were combined into larger basins in this report, and composite estimates of future predictions in those reports. Pipe and channel routings were not used unless they had a significant impact on the timing of the peak. They were not used where peak shaving ponds dominate the shape and timing of the hydrographs, or where timing of the peak can more easily be accounted for by time of concentration calculations for larger basins. Conveyance factors from Table B-1 of the DPM, Section 22.2 were used except that a factor of 7 was used for pipes 48" or smaller and a factor of 11 was used for pipes 48" or larger. Table 3 summarizes time of concentration calculations. Table 2 summarize the Input parameters and resulting flows from AHYMO for both existing and future developed conditions.

Also, considered but not relied on heavily, are the following references:

LOMR for Sunrise Ranch West, January 30, 2002
CLOMR for Amole Arroyo, November 2003.

TABLE 1
COMPARISON OF RESULTS

AP #	Existing Conditions		Developed Conditions	
	2004	1998	2004	1998
<i>Tower Road</i>	149.23	203.91	453.66	419.19
22.0	572.18	407.20	755.65	747.11
22.1	811.58	641.92	989.20	916.28
23	1,287.04	1,864.58	1,474.43	2,058.10
<i>Westgate 5</i>	73.15	73.15	73.47	73.47
<i>Powerline 6</i>	501.27	501.27	19.34	19.34
7	754.22	608.81	848.16	693.16
8	1,961.94	1,989.94	2,234.06	
<i>Gibson 9</i>	2,021.45	2,201.53	2,577.32	2,824.84
<i>Blake 10</i>	2,021.45	2,236.63	3,032.43	3,310.59
<i>Bend</i>	2,021.45	2,134.94	35,120.65	3,411.82
12	2,693.17	3,022.36	4,046.03	4,709.47

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
EXISTING CONDITIONS											
Undeveloped	100	80.9	0.1264	70	0	20	10	0.17	127.97		100
Undeveloped	105	20.1	0.0314	25	0	10	65	0.14	66.19		100 & 105
	split # 105								12.00	139.97	
Undeveloped	110	29.4	0.0459	80	0	10	10	0.13	51.22		110
	pond 1e		0.0000						49.94	189.91	100 - 110
Undeveloped	115	13.4	0.0209	90	0	10	0	0.13	19.29	208.32	100 - 115
Undeveloped	120	32.2	0.0503	78	5	10	7	0.15	48.19	209.48	100 - 120
Undeveloped	125	39.1	0.0611	78	5	10	7	0.15	58.54	260.42	100 - 120
	pond 4e									132.45	100 - 120
Developed	130	4.5	0.0070	0	14	30	56	0.13	16.05	61.58	100 - 130
Developed	180	22.8	0.0356	0	14	30	56	0.13	81.54		180
	pond 6e		0.0000						49.95	110.33	100 - 180
Undeveloped	190	22.8	0.0356	50	0	40	10	0.17	41.14	110.33	100 - 190
Developed	200	12.4	0.0194	0	10	70	20	0.13	38.41	137.09	100 - 200
	pond 7e									62.85	100 - 200
Undeveloped	240	27.5	0.0430	85	0	10	5	0.13	43.84	86.07	240 & Pond 4 spillway
Developed	250	17.4	0.0272	0	14	30	56	0.18	52.96	109.78	240 - 250
Developed	260	30.2	0.0473	0	14	30	56	0.19	89.30	145.83	240 - 260
	channel total	??								149.24	100 - 260
Developed	270	10.8	0.0169	0	14	30	56	0.15	35.75		270
	pond 8e								10.56	146.78	100 - 270
Developed	280	18.5	0.0289	0	14	30	56	0.22	50.11		280
	pond 9e								21.86	162.33	100 - 280
Developed	300	19.7	0.0308	30	0	20	50	0.13	61.04		300
	pond 2e								5.59		300
Developed	305	17.1	0.0267	0	0	20	80	0.13	69.09	70.36	305
	pond 3e									4.01	300 - 305

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
Developed	310	52.3	0.0817	0	14	30	56	0.18	56.47	59.67	300 - 310
Developed	320	39.0	0.0609	0	14	30	56	0.13	139.48	191.72	300 - 320
	split to pond 10e									35.73	
Developed	330	10.1	0.0158	0	14	30	56	0.13	36.20	72.13	330 & split from 300-320
	pond 10e								10.63	161.26	300-330
Developed	340	71.2	0.1113	0	14	30	56	0.15	235.02	390.44	300 - 340
	add split from 250	238.7								427.48	300-340 & split from 250
	channel total									572.18	100-340
Undeveloped	351	29.5	0.0461	100	0	0	0	0.15	34.40	34.40	351
Developed	352	17.1	0.0267	0	14	30	56	0.13	61.16	94.21	351 - 352
	pond 12e									39.83	351 - 352
Developed	353	67.3	0.1052	0	14	30	56	0.15	222.18	258.58	351 - 353
	pond 13e									188.57	351 - 353
Developed	354	23.8	0.0372	0	20	35	45	0.21	61.06	248.11	351 - 354
	channel total	137.7								811.58	100 - 354
Undeveloped	355	15.8	0.0247	100	0	0	0	0.16	17.55	17.55	355
Developed	356	21.2	0.0331	0	14	30	56	0.19	62.50	80.05	355 - 356
Developed	357	18.0	0.0281	0	14	30	56	0.16	56.89	56.89	357
	pond 15e								8.70	85.90	355 - 357
Undeveloped	358	17.9	0.0280	67	0	20	13	0.16	30.40	102.35	355 - 358
	channel total	210.6								897.28	100-358
Undeveloped	361	12.3	0.0192	100	0	0	0	0.13	16.22		361
	split to 365									11.49	split from 361

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
Undeveloped	362	23.0	0.0359	100	0	0	0	0.18	22.83	9.60	361 & 362
	split to 365									17.96	split from 361 & 362
Developed	363	11.9	0.0186	0	14	30	56	0.13	42.61	52.21	361 - 363
Undeveloped	364	6.9	0.0108	75	0	25	0	0.13	11.35	63.56	361 - 364
	pond 14e									4.90	361 - 364
	split to 370								0.00	0.00	361 - 364
Developed	365	186.6	0.2916	0	20	30	50	0.34	362.53	381.37	361 - 365
Developed	370	27.9	0.0436	0	20	35	45	0.23	68.52	68.52	370
	split to 365								34.26	410.21	361 - 370
Undeveloped	371	33.4	0.0522	100	0	0	0	0.13	44.09	44.09	370 - 371
Developed	372	57.2	0.0894	0	20	35	45	0.32	113.62	168.26	370 - 372
	split to 365								24.56	433.08	361 - 372
	channel total									1287.04	100 - 372
Developed	373	17.0	0.0266	0	20	35	45	0.13	57.39	181.26	370 - 373
	Westgate								73.15	73.15	10006 - 10018
	power line								501.27	556.61	
Undeveloped	374	76.5	0.1195	75	10	10	5	0.21	88.98	558.89	10006 - 10018 & 374
City Park /Open space	375	31.5	0.0492	60	20	10	10	0.15	52.65	561.99	10006 - 10018 & 374 - 375
Developed	376	25.6	0.0400	0	20	35	45	0.17	74.57	74.57	376
Developed	377	14.5	0.0227	0	14	30	56	0.13	52.00	582.00	10006 - 10018 & 374 - 377
Developed	378	50.3	0.0787	0	14	30	56	0.13	180.18	754.22	10006 - 10018 & 374 - 378
Developed	379	13.2	0.0206	0	14	30	56	0.13	47.19	1961.94	100 - 379 & 10006 - 10018

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
Undeveloped	380	268.8	0.4200	95	5	0	0	0.30	197.48	2021.45	100 - 380 & 10006 - 10018
Undeveloped	381	668.9	1.0452	90	5	5	0	0.33	472.19		381
Undeveloped	382	147.5	0.2305	95	5	0	0	0.27	114.15	492.18	381 - 382
Undeveloped	383	365.9	0.5717	80	10	10	0	0.50	185.95	671.72	381 - 383
	channel total	1451.1								2693.17	all
FUTURE DEVELOPED CONDITIONS											
Future	100	80.8	0.1263	0	5	10	85	0.17	327.89		100
	pond 100								105.08		100
Future	105	20.1	0.0314	0	5	10	85	0.14	82.11		105
	split # 105								12.00	117.08	100 - 105
Future	110	43.5	0.0680	0	5	10	85	0.13	177.17		110
	pond 110		0.0000						56.55	173.64	100 - 110
Future	120	26.5	0.0414	0	5	10	85	0.15	107.91		120
	pond 120								34.45	208.09	100 - 120
Developed	130	24.2	0.0378	0	5	10	85	0.13	98.79		130
	pond 130								31.46	239.55	100 - 130
Future	140	33.7	0.0527	0	7	14	79	0.13	128.65		140
	pond 140								43.85	283.40	100 - 140
Future	150	16.1	0.0252	0	10	20	70	0.13	61.28		150
	pond 150								20.93	304.33	100 - 150
Future	160	14.2	0.0222	0	10	20	70	0.13	53.96		160

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
	pond 160								18.46	322.79	100 - 160
Future	170	2.2	0.0034	0	14	30	56	0.13	8.03	330.82	100 - 170
Developed	180	22.8	0.0356	0	14	30	56	0.13	81.54		180
	pond 6e		0.0000						49.95	378.17	100 - 180
Future	190	22.8	0.0356	0	5	10	85	0.17	92.79		100 - 190
	Pond 190								29.64	407.81	190
Developed	200	12.4	0.0194	0	10	70	20	0.13	38.41	434.58	100 - 200
	pond 7e									395.57	100 - 200
Developed	250	17.4	0.0272	0	14	30	56	0.18	52.96		250
Developed	260	30.2	0.0473	0	14	30	56	0.19	89.30	121.08	250 - 260
	channel total	1818.2								453.66	100 - 260
Developed	270	10.8	0.0169	0	14	30	56	0.15	35.76		270
	Pond 8e								10.56	460.25	100 - 270
Developed	280	18.5	0.0289	0	14	30	56	0.22	50.11		280
	Pond 9e								21.86	481.76	100 - 280
Developed	300	19.7	0.0308	30	0	20	50	0.13	61.04		300
	pond 2e								5.59		300
Developed	305	17.1	0.0267	0	0	20	80	0.13	69.09	70.36	300 - 305
	pond 3e									4.01	300 - 305
Developed	310	52.3	0.0817	0	14	30	56	0.18	187.04	189.93	300 - 310
Developed	320	39.0	0.0609	0	14	30	56	0.13	139.48	329.42	300 - 320
	split to pond 10e								154.41		
Developed	330	10.1	0.0158	0	14	30	56	0.13	36.20	190.60	330 & split from 300 - 320
	pond 10e								21.52	190.42	330 & split from 300 - 320
Developed	340	71.2	0.1113	0	14	30	56	0.15	235.02	417.89	300 - 340

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
	add split from 250									437.73	300 - 340 & split from 250
	channel total									755.65	100 - 340
Undeveloped	351	35.7	0.0558	0	14	30	56	0.13	105.59		351
	Pond 351								38.35		
Developed	352	17.1	0.0267	0	14	30	56	0.13	61.16	99.51	351 - 352
	pond 12e									42.41	351 - 352
Developed	353	67.3	0.1052	0	14	30	56	0.15	222.18	259.93	351 - 353
	pond 13e									189.14	351 - 353
Developed	354	23.8	0.0372	0	20	35	45	0.21	61.06	248.58	351 - 354
	channel total									989.20	100 - 354
Future	355	15.8	0.0247	0	13	26	61	0.16	57.86	1004.14	100 - 355
Developed	356	21.2	0.0331	0	14	30	56	0.19	62.50		
Developed	357	18.0	0.0281	0	14	30	56	0.16	56.89		357
	pond 13e								8.70	68.36	356 - 357
Future	358	17.9	0.0280	0	13	26	61	0.16	65.58	125.41	355 - 358
	channel total									1083.15	100 - 358
Developed	365	186.6	0.2916	0	20	30	50	0.34	362.53		361 - 365
Developed	370	27.9	0.0436	0	20	35	45	0.23	68.52		370
	split to 365								32.79	376.80	365 - 370
Developed	372	57.2	0.0894	0	20	35	45	0.32	113.62	127.90	370 - 372
	split to 365								14.47	391.28	361 - 372 @ 365
	channel total									1474.43	100 - 372 @ 365
Developed	373	17.0	0.0266	0	20	35	45	0.13	57.39	146.95	370 - 373

TABLE 2
SUMMARY OF HYDROLOGY
Input and Resulting Flows for Existing and Future Developed Conditions

Description	Basin ID	Area Acres	Area Sq. Mi.	Land Treatment				Tp (hr)	100-YR Peak Flow		Contributing basins
				A	B	C	D		Inc. (cfs)	Cumm (cfs)	
	power line									19.34	10006 - 10018
Undeveloped	374	156.2	0.2441	0	14	30	56	0.40	287.74	341.83	10006 - 10018 & 374
	380								258.59	522.52	380
City Park / Open space	375	31.5	0.0492	60	20	10	10	0.15	52.65	543.60	10006 - 10018, 374 -375 & 380
Developed	376	25.6	0.0400	0	20	35	45	0.17	74.57		10006 - 10018 & 374 -376
Developed	377	14.5	0.0227	0	14	30	56	0.13	52.00	758.61	10006 - 10018 & 374 -377
Developed	378	50.3	0.0787	0	14	30	56	0.13	180.18	848.16	10006 - 10018 & 374 -378
	channel total									2234.06	100 - 378 & 10006 - 10018
Developed	379	13.2	0.0206	0	14	30	56	0.13	47.19	2251.45	100 - 379 & 10006 - 10018
Future	381	147.8	0.2309	0	11	21	68	0.22	423.47	2577.32	100 - 381
Future	382	197.6	0.3088	0	11	21	68	0.22	563.76	3032.43	381 - 382
Future	383	200.3	0.3130	0	14	30	56	0.21	547.32	3520.65	381 - 383
Future	384	153.5	0.2398	0	17	33	50	0.21	420.19	3905.30	
Future	385	14.9	0.0233	0	14	30	56	0.13	55.45	3934.60	
Future	386	61.6	0.0963	0	17	33	50	0.17	192.22	4046.03	

100 YEAR PRECIPITATION (From Figures D, E and F, and Eq. 28 of DPM 22.2)
 $P_{60} = 1.90"$, $P_{300} = 2.20"$, $P_{1440} = 2.67"$, $P_{10 \text{ days}} = 10.0 \cdot [24.9 / (2.67")^{1.4}] = 3.70"$

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

Basin ID	Length (ft)	Slope %	K	V (fps)	Tc (min)	Tp (hr)
100	400	3.3	0.7	1.27	5.2	
	1600	4.0	2.0	4.00	6.7	
	1100	3.4	3.0	5.53	3.3	
					15.2	0.17
105	400	2.0	1.0	1.41	4.7	
	900	1.6	2.0	2.53	5.9	
	350	3.4	2.0	3.69	1.6	
					12.2	0.14
110 & 115	400	4.0	0.7	1.40	4.8	
	1600	3.8	2.0	3.90	6.8	
					11.6	0.13
120 & 125	400	4.0	0.7	1.40	4.8	
	1600	3.1	2.0	3.52	7.6	
	400	2.5	3.0	4.74	1.4	
					13.7	0.15
130	MINIMUM					0.13
180	MINIMUM					0.13
190	400	4.0	0.7	1.40	4.8	
	700	2.6	2.0	3.22	3.6	
	500	0.4	2.0	1.26	6.6	
					15.0	0.17
200	MINIMUM					0.13
240	400	4.0	0.7	1.40	4.8	
	1600	3.4	2.0	3.69	7.2	
					12.0	0.13
250	100	0.5	0.7	0.50	3.4	
	300	0.5	2.0	1.41	3.5	

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

Basin ID	Length (ft)	Slope %	K	V (fps)	Tc (min)	TP (hr)
	1600	2.0	2.0	2.83	9.4	
					16.3	0.18
260	100	0.5	0.7	0.50	3.4	
	300	2.0	1.0	1.41	3.5	
	1600	1.6	2.0	2.53	10.5	
					17.4	0.19
270	100	2.5	0.7	1.11	1.5	
	250	4.0	1.0	2.00	2.1	
	850	0.5	2.0	1.41	10.0	
					13.6	0.15
280	100	0.5	0.7	0.50	3.4	
	200	2.0	2.0	2.83	1.2	
	1300	0.5	2.0	1.41	15.3	
					19.9	0.22
300	MINIMUM					0.13
305	MINIMUM					0.13
310	400	6.0	0.7	1.71	3.9	
	950	4.4	2.0	4.20	3.8	
	900	0.7	2.0	1.67	9.0	
					16.6	0.18
320	MINIMUM					0.13
330	MINIMUM					0.13
340	100	1.0	0.7	0.70	2.4	
	300	2.0	1.0	1.41	3.5	
	600	4.0	2.0	4.00	2.5	
	2400	3.0	5.0	8.66	4.6	
	400	1.5	11.0	13.47	0.5	
					13.5	0.15
351	400	6.0	0.7	1.71	3.9	
	700	4.3	2.0	4.15	2.8	
	600	0.5	2.0	1.41	7.1	
					13.8	0.15

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

<i>Basin ID</i>	<i>Length (ft)</i>	<i>Slope %</i>	<i>K</i>	<i>V (fps)</i>	<i>Tc (min)</i>	<i>Tp (hr)</i>
352	MINIMUM					0.13
353	100	0.5	0.7	0.50	3.4	
	300	0.5	1.0	0.71	7.1	
	1600	4.0	7.0	14.00	1.9	
	1200	3.0	11.0	19.05	1.1	
					13.4	0.15
354	100	0.5	0.7	0.50	3.4	
	150	0.5	1.0	0.71	3.5	
	1750	4.0	2.0	4.00	7.3	
	1400	3.3	3.0	5.45	4.3	
					18.5	0.21
355	400	3.0	0.7	1.21	5.5	
	1100	1.0	2.0	2.00	9.2	
					14.7	0.16
356	400	3.5	0.7	1.31	5.1	
	800	1.0	2.0	2.00	6.7	
	1500	1.0	5.0	5.00	5.0	
					16.8	0.19
357	100	2.0	0.7	0.99	1.7	
	300	0.7	1.0	0.84	6.0	
	800	1.8	2.0	2.68	5.0	
	400	2.5	2.0	3.16	2.1	
					14.7	0.16
358	400	2.0	0.7	0.99	6.7	
	300	2.0	2.0	2.83	1.8	
	1300	0.5	5.0	3.43	6.3	
					14.8	0.16

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

Basin ID	Length (ft)	Slope %	K	V (fps)	Tc (min)	TP (hr)
361	MINIMUM					0.13
362	400	6.0	0.7	1.71	3.9	
	550	3.3	2.0	3.63	2.5	
	800	0.5	2.0	1.41	9.4	
					15.8	0.18
363	MINIMUM					0.13
364	MINIMUM					0.13
365	100	0.5	0.7	0.50	3.4	
	300	4.0	1.0	2.00	2.5	
	600	0.5	2.0	1.41	7.1	
	1000	1.5	2.0	2.45	6.8	
	1850	3.6	3.0	5.69	5.4	
	2250	2.2	5.0	7.42	5.1	
					30.2	0.34
370	100	0.5	0.7	0.50	3.4	
	300	0.5	1.0	0.71	7.1	
	250	0.5	2.0	1.41	2.9	
	1600	3.5	2.0	3.74	7.1	
					20.5	0.23
371	400	4.5	0.7	1.48	4.5	
	600	4.3	2.0	4.15	2.4	
	500	0.7	2.0	1.67	5.0	
					11.9	0.13
372	100	0.5	0.7	0.50	3.4	
	300	0.5	1.0	0.71	7.1	
	900	1.0	2.0	2.00	7.5	
	700	2.3	2.0	3.03	3.8	
	800	3.5	3.0	5.61	2.4	
	1200	1.8	3.0	4.02	5.0	
					29.1	0.32
373	MINIMUM					0.13
374	400	4.5	0.7	1.48	4.5	

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

Basin ID	Length (ft)	Slope %	K	V (fps)	Tc (min)	Tp (hr)
	1600	3.1	2.0	3.52	7.6	
	2000	3.0	3.0	5.20	6.4	
					18.5	0.21
375	400	3.8	0.7	1.36	4.9	
	1600	3.1	2.0	3.52	7.6	
	800	2.8	11.0	18.41	0.7	
					13.2	0.15
376	100	0.5	0.7	0.50	3.4	
	300	3.1	1.0	1.76	2.8	
	1900	3.1	2.0	3.52	9.0	
					15.2	0.17
377	MINIMUM					0.13
378	MINIMUM					0.13
379	MINIMUM					0.13
380	400	3.4	0.7	1.29	5.2	
	1600	3.3	2.0	3.63	7.3	
	4600	3.2	3.0	5.37	14.3	
					26.8	0.30
381	400	12.0	0.7	2.42	2.7	
	1600	7.0	2.0	5.29	5.0	
	2000	5.5	3.0	7.04	4.7	
	4000	3.7	3.0	5.77	11.6	
	1700	2.9	3.0	5.11	5.5	
					29.6	0.33
382	400	4.0	0.7	1.40	4.8	
	1000	3.0	2.0	3.46	4.8	
	2100	3.5	3.0	5.61	6.2	
	2200	2.0	3.0	4.24	8.6	
					24.5	0.27
383	Use the lag method where L=12900', Lca=7400', and s=3.9%					
DEV 374	100	0.5	0.7	0.50	3.4	

TABLE 3
TIME OF CONCENTRATION COMPUTATIONS

Basin ID	Length (ft)	Slope %	K	V (fps)	Tc (min)	TP (hr)
	300	0.5	1.0	0.71	7.1	
	1300	0.5	2.0	1.41	15.3	
	2000	0.5	5.0	3.54	9.4	
	800	2.9	11.0	18.73	0.7	
					35.9	0.40
DEV 380	100	0.5	0.7	0.50	3.4	
	300	2.5	1.0	1.58	3.2	
	1600	3.3	2.0	3.63	7.3	
	1800	1.0	5.0	5.00	6.0	
					19.9	0.22
DEV 381-2	100	1.0	0.7	0.70	2.4	
	300	3.0	1.0	1.73	2.9	
	1000	1.0	2.0	2.00	8.3	
	2400	3.3	7.0	12.72	3.1	
	3500	3.0	11.0	19.05	3.1	
					19.8	0.22
DEV 383-4	100	1.0	0.7	0.70	2.4	
	300	0.5	1.0	0.71	7.1	
	500	3.0	2.0	3.46	2.4	
	1000	3.0	7.0	12.12	1.4	
	1600	0.5	11.0	7.78	3.4	
	2600	2.5	11.0	17.39	2.5	
					19.2	0.21
DEV 386	100	1.0	0.7	0.70	2.4	
	300	3.0	1.0	1.73	2.9	
	600	3.0	2.0	3.46	2.9	
	500	1.0	2.0	2.00	4.2	
	1400	0.7	11.0	9.20	2.5	
					14.9	0.17

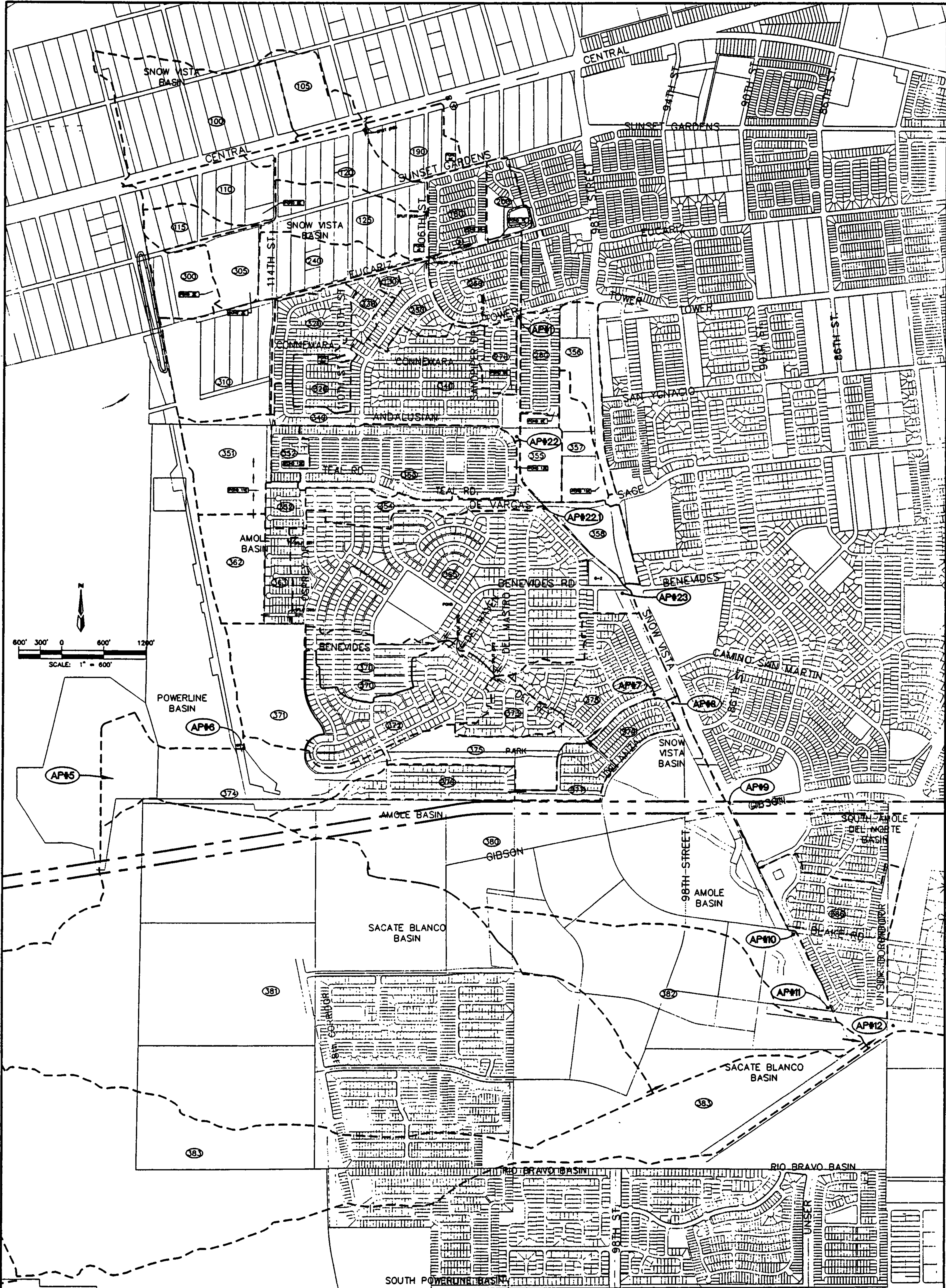
TABLE 4 HYDRAULIC SUMMARY

River Sta	Q (cfs)	Dpth (ft)	Vel Chnl (ft/s)	Top Wdth (ft)	Froude #	Radius (ft)	Super elev (ft)	Req'd Dpth at curve	Freeboard Req'd. (ft)	Min Dpth w/ freeboard	Min Dpth w/ Frbd & Super	Act Dpth LT	Act Dpth RT
80.00	1474.43	4.67	10.76	38.68	1.01				1.71	6.38	6.38	7.00	7.00
79.00	1474.43	3.21	17.36	32.85	1.90				1.85	5.06	5.06	7.00	7.00
78.00	2234.06	4.23	13.72	46.93	1.30				1.79	6.02	6.02	7.00	7.00
77.37*	2234.06	6.34	8.26	55.35	0.66				1.67	8.01	8.01	7.00	7.00
76.74	2234.06	7.07	7.16	58.28	0.55				1.64	8.71	8.71	7.00	7.00
75.74	2251.45	6.70	10.78	31.17	0.73				1.76	8.46	8.46	7.00	7.00
74.00	Bridge								1.40	1.40	1.40	Varies	Varies
72.25	2251.45	4.65	15.55	31.17	1.27	500	0.30	4.95	1.85	6.50	6.81	Varies	Varies
71.88	2251.45	5.12	14.55	40.47	1.31	500	0.35	5.47	1.84	6.96	7.30	5.00	5.00
70.9427*	2251.45	5.00	15.00	40.01	1.37	500	0.36	5.36	1.85	6.85	7.21	5.00	5.00
70.0054*	2251.45	4.95	15.21	39.80	1.39	500	0.37	5.32	1.85	6.80	7.18	5.00	5.00
69.0681*	2251.45	4.91	15.37	39.65	1.41				1.86	6.77	6.77	5.00	5.00
68.1309*	2251.45	4.91	15.39	39.63	1.41				1.86	6.77	6.77	5.00	5.00
67.1936*	2251.45	4.89	15.44	39.58	1.42				1.86	6.75	6.75	5.00	5.00
66.2563*	2251.45	4.89	15.46	39.56	1.42				1.86	6.75	6.75	5.00	5.00
65.3190*	2251.45	4.90	15.43	39.59	1.42	500	0.38	5.28	1.86	6.76	7.14	5.00	5.00
64.3818*	2251.45	4.89	15.46	39.56	1.42	500	0.38	5.27	1.86	6.75	7.13	5.00	5.00
63.4445*	2251.45	4.88	15.51	39.51	1.43				1.86	6.74	6.74	5.00	5.00
62.5072*	2251.45	4.88	15.50	39.53	1.42				1.86	6.74	6.74	5.00	5.00
61.57	2251.45	4.88	15.49	39.54	1.42				1.86	6.74	6.74	5.00	5.00
61.03	2251.45	3.92	18.44	31.17	1.64				1.91	5.83	5.83	Varies	Varies
60.00	Bridge								1.40	1.40	1.40	Varies	Varies
59.70	2251.45	3.40	21.24	31.17	2.03				1.96	5.36	5.36	Varies	Varies
59.15	2577.32	6.41	12.26	45.62	1.01				1.80	8.21	8.21	Varies	Varies
58.2272*	2577.32	4.54	19.54	38.15	1.85				1.97	6.51	6.51	4.60	4.60
57.3045*	2577.32	4.18	21.75	36.72	2.13	1000	0.35	4.53	2.01	6.19	6.54	4.60	4.60
56.3818*	2577.32	4.00	23.01	36.00	2.30	1000	0.38	4.38	2.04	6.04	6.42	4.60	4.20
55.4590*	2577.32	3.90	23.81	35.58	2.41	1000	0.41	4.31	2.06	5.96	6.36	4.60	4.20
54.5363*	2577.32	3.84	24.27	35.35	2.47	500	0.84	4.68	2.06	5.90	6.75	4.60	5.50
53.6136*	2577.32	3.80	24.58	35.20	2.51	500	0.86	4.66	2.07	5.87	6.73	3.80	5.50
52.6909*	2577.32	3.77	24.82	35.08	2.54	500	0.87	4.64	2.08	5.85	6.72	3.80	5.50
51.7681*	2577.32	3.75	24.98	35.01	2.56	500	0.88	4.63	2.08	5.83	6.71	3.80	5.50
50.8454*	2577.32	3.74	25.07	34.96	2.58	250	1.77	5.51	2.08	5.82	7.59	3.80	5.50
49.9227*	2577.32	3.73	25.13	34.94	2.58	250	1.78	5.51	2.08	5.81	7.59	5.50	3.80

River Sta	Q (cfs)	Dpth (ft)	Vel Chnl (ft/s)	Top Wdth (ft)	Froude #	Radius (ft)	Super elev (ft)	Req'd Dpth at curve	Freeboard Req'd. (ft)	Min Dpth w/ freeboard	Min Dpth w/ Frbd & Super	Act Dpth LT	Act Dpth RT
49.00	2577.32	3.74	25.10	34.95	2.58	250	1.78	5.52	2.08	5.82	7.60	5.70	4.40
48.0833*	2577.32	4.02	22.85	36.09	2.28	250	1.52	5.54	2.04	6.06	7.58	5.70	4.40
47.1666*	2577.32	4.20	21.60	36.80	2.11	250	1.39	5.59	2.01	6.21	7.60	5.70	4.40
46.25*	2577.32	4.31	20.89	37.24	2.02	250	1.31	5.62	1.99	6.30	7.62	5.70	4.40
45.3333*	2577.32	4.37	20.52	37.48	1.98	250	1.27	5.64	1.99	6.36	7.63	5.70	5.70
44.4166*	2577.32	4.40	20.33	37.60	1.95	250	1.25	5.65	1.98	6.38	7.64	4.40	5.70
43.50	2577.32	4.41	20.29	37.63	1.95	250	1.25	5.66	1.98	6.39	7.64	4.40	5.70
42.91*	2577.32	4.22	21.49	36.87	2.10	250	1.37	5.59	2.01	6.23	7.60	4.40	5.70
42.32	2577.32	4.09	22.36	36.36	2.21	250	1.47	5.56	2.03	6.12	7.58	4.40	5.70
41.93	2577.32	3.53	23.40	31.17	2.19	250	1.38	4.91	2.02	5.55	6.93	Varies	Varies
41.12	Bridge								1.40	1.40	1.40	Varies	Varies
41.11	2577.32	4.22	19.60	31.17	1.68				1.95	6.17	6.17	Varies	Varies
41.04	3032.43	6.51	11.64	40.00	0.80				1.78	8.29	8.29	Varies	Varies
40.67	3032.43	7.00	12.73	48.01	1.01				1.83	8.83	8.83	Varies	Varies
39.803*	3032.43	5.13	19.55	40.51	1.76	250	1.25	6.38	1.99	7.12	8.37	7.00	5.20
38.936*	3032.43	4.73	21.76	38.92	2.03	250	1.49	6.22	2.04	6.77	8.26	7.00	5.20
38.069*	3032.43	4.53	23.05	38.11	2.19	250	1.63	6.16	2.07	6.60	8.23	7.00	5.20
37.202*	3032.43	4.40	23.92	37.60	2.30	250	1.74	6.14	2.09	6.49	8.22	7.00	4.50
36.335*	3032.43	4.33	24.42	37.33	2.36	250	1.80	6.13	2.10	6.43	8.22	7.00	6.20
35.468*	3032.43	4.28	24.79	37.13	2.41	250	1.84	6.12	2.10	6.38	8.23	4.30	6.20
34.601*	3032.43	4.25	25.07	36.98	2.44	250	1.88	6.13	2.11	6.36	8.24	4.30	6.20
33.734*	3032.43	4.22	25.26	36.88	2.47	250	1.90	6.12	2.11	6.33	8.23	4.30	6.20
32.867*	3032.43	4.20	25.40	36.81	2.49	250	1.92	6.12	2.12	6.32	8.23	4.30	6.20
32.00	3032.43	4.19	25.49	36.76	2.50	250	1.93	6.12	2.12	6.31	8.24	6.20	4.80
31.1425*	3032.43	4.44	23.63	37.77	2.26	250	1.70	6.14	2.08	6.52	8.22	6.20	4.80
30.285*	3032.43	4.62	22.47	38.46	2.11	250	1.57	6.19	2.05	6.67	8.24	6.20	4.80
29.4275*	3032.43	4.73	21.74	38.94	2.02	250	1.49	6.22	2.04	6.77	8.25	6.20	4.80
28.57	3032.43	4.80	21.33	39.21	1.97	250	1.44	6.24	2.03	6.83	8.27	9.00	7.00
27.82	3520.65	6.47	12.67	55.88	1.00	250	0.72	7.19	1.81	8.28	9.01	9.00	7.00
26.848*	3520.65	5.09	17.20	50.37	1.50	250	1.20	6.29	1.92	7.01	8.21	9.00	7.00
25.876*	3520.65	4.80	18.51	49.21	1.66	250	1.36	6.16	1.95	6.75	8.11	9.00	7.00
24.904*	3520.65	4.65	19.27	48.60	1.75				1.96	6.61	6.61	7.50	6.50
23.932*	3520.65	4.56	19.72	48.25	1.81				1.97	6.53	6.53	7.50	6.50
22.96*	3520.65	4.51	20.03	48.02	1.85				1.98	6.49	6.49	7.50	6.50
21.988*	3520.65	4.47	20.24	47.87	1.87				1.98	6.45	6.45	7.50	6.50

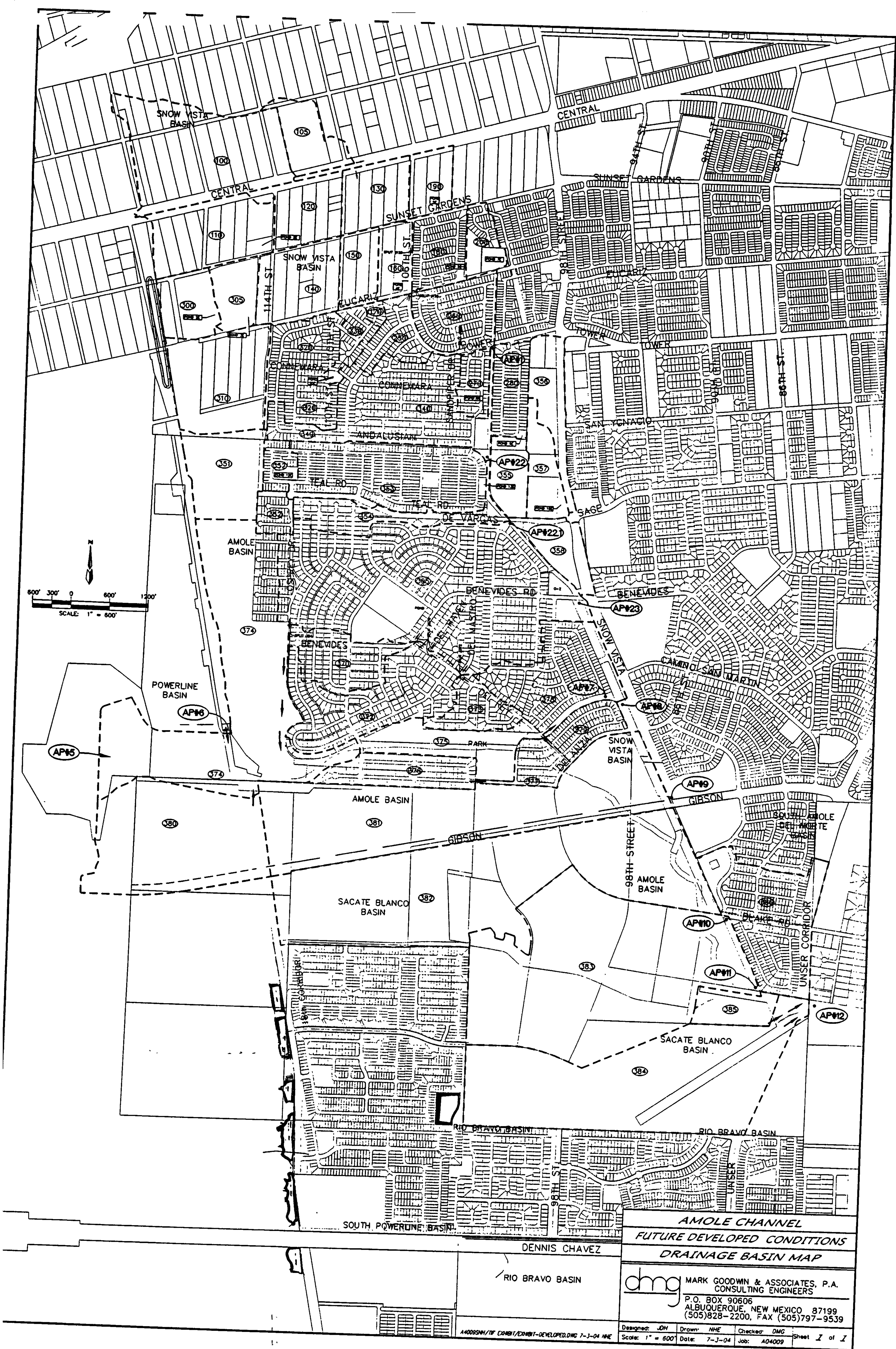
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River Sta	Q (cfs)	Dpth (ft)	Vel Chnl (ft/s)	Top Wdth (ft)	Froude #	Radius (ft)	Super elev (ft)	Req'd Dpth at curve	Freeboard Req'd. (ft)	Min Dpth w/ freeboard	Min Dpth w/ Frbd & Super	Act Dpth LT	Act Dpth RT
21.016*	3520.65	4.44	20.38	47.77	1.89				1.99	6.43	6.43	7.50	6.50
20.044*	3520.65	4.43	20.48	47.70	1.90				1.99	6.42	6.42	7.50	6.50
19.072*	3520.65	4.41	20.54	47.65	1.91	1000	0.41	4.82	1.99	6.40	6.80	7.50	6.50
18.10	3520.65	4.41	20.54	47.66	1.91	1000	0.41	4.82	1.99	6.40	6.81	7.00	7.00
17.90	4046.03	7.00	13.14	58.00	1.00	1000	0.20	7.20	1.84	8.84	9.04	7.00	7.00
16.925*	4046.03	5.60	17.55	52.39	1.47	1000	0.33	5.93	1.95	7.55	7.87	7.00	7.00
15.95*	4046.03	5.28	18.91	51.11	1.63	1000	0.37	5.65	1.98	7.26	7.62	7.00	7.00
14.975*	4046.03	5.10	19.72	50.41	1.72	1000	0.40	5.50	1.99	7.09	7.49	7.00	7.00
14.00	4046.03	5.00	20.22	50.01	1.78	1000	0.41	5.41	2.00	7.00	7.42	7.00	7.00
13.*	4046.03	5.15	19.47	50.62	1.69	1000	0.39	5.54	1.99	7.14	7.53	7.00	7.00
12.*	4046.03	5.24	19.09	50.95	1.65	1000	0.37	5.61	1.98	7.22	7.59	7.00	7.00
11.*	4046.03	5.26	18.98	51.04	1.64	1000	0.37	5.63	1.98	7.24	7.61	7.00	7.00
10.00	4046.03	5.28	18.90	51.12	1.63	1000	0.37	5.65	1.98	7.26	7.62	7.00	7.00



DENNIS CHAVEZ		AMOLE CHANNEL	
RIO BRAVO BASIN		EXISTING CONDITIONS	
		DRAINAGE BASIN MAP	
		dmg MARK GOODWIN & ASSOCIATES, P.A. CONSULTING ENGINEERS	
		P.O. BOX 90606 ALBUQUERQUE, NEW MEXICO 87199 (505)828-2200, FAX (505)797-9539	
Designed: JCH	Drawn: NHE	Checked: DMG	Sheet 2 of 2
Scale: 1" = 600'	Date: 7-3-04	Job: A04009	

A4009SNH/TIF EXHIBIT/EXHIBIT-EXISTING.DWG 8-10-04 NHE



2002-34

**AGREEMENT FOR IMPROVEMENT OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

N-09/0006B

This Agreement is entered into this 22 day of August, 2002 by and between the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), a political subdivision of the State of New Mexico, and Curb, Inc., a New Mexico corporation.

RECITALS:

WHEREAS, AMAFCA's Amole-Hubbell Drainage Management Plan (DMP), adopted by AMAFCA July 22, 1999, and the City of Albuquerque Amole Arroyo Corridor Plan, adopted in October, 1991, recommended improvement of the Amole Arroyo from the Snow Vista Channel to west of Delgado Road Crossing (the PROJECT), to include design, construction, construction management, and FEMA LOMR and fees as shown on Exhibit B. and

WHEREAS, the Amole Arroyo crosses the City of Albuquerque Parks and Recreation park site; and

WHEREAS, by separate agreement with AMAFCA, the City Parks and Recreation Department currently has plans and funding available to participate in construction of proposed improvements for the Amole Arroyo; and

WHEREAS, Curb, Inc. has plans to construct a residential development along portions of the Amole Arroyo and has indicated willingness to participate in the funding of proposed improvements to the Amole Arroyo; and

WHEREAS, Curb, Inc., and AMAFCA wish to cooperate on the improvement of the Amole Arroyo; and

**AGREEMENT FOR IMPROVEMENT OF THE
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FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

WHEREAS, the proposed improvements for the Amole Arroyo have been previously discussed and agreed to by the City Parks and Recreation Department, Curb, Inc., and AMAFCA as shown on the attached Amole Arroyo Improvements Plan (Exhibit A); and

WHEREAS, AMAFCA Resolution 1982-4 Cost-Sharing with Land Owners, provides for the private sector to share in the cost of flood control facilities; and

WHEREAS, the PROJECT is appropriate for AMAFCA and Curb, Inc. in that it:

- a. Is consistent with AMAFCA's mission
- b. Provides permanent all weather crossing of Del Rey Road
- c. Improves a major arroyo which was addressed in AMAFCA's DMP
- d. Continues channelization of the Amole Arroyo for eventual delivery of drainage to the Amole Dam
- e. Provides flood protection for the proposed City park site
- f. Provides a flood-control facility capable of accepting future developed flows as described in the Amole-Hubbell DMP for Amole Arroyo, Alternative #2
- g. Removes approximately two (2) acres from the flood plain; and

WHEREAS, COA has the capability to maintain the PROJECT after construction; and

WHEREAS, the COA and AMAFCA will jointly monitor the status of development in the upstream contributing basin for the need to construct improvements to the Powerline Channel system, as identified in the Amole-Hubbell Drainage Management Plan, and

WHEREAS, AMAFCA has the operational capability and staffing to contract for the construction of the PROJECT, and shall comply with the State Procurement Code for Public Works Contracts, with construction anticipated to begin in 2003; and

**AGREEMENT FOR IMPROVEMENT OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

WHEREAS, COA has prepared the Trails and Bikeways Facility Plan, which was endorsed by the AMAFCA Board of Directors via Resolution 1994-2, which identifies a multi use trail along the flood control facility in this reach; and

WHEREAS, said PROJECT also offers opportunities for other purposes, such as open space, parks, trails, and other appropriate public uses, subject to the primacy of the drainage function; and

WHEREAS, Curb, Inc. proposes that it would be in the public interest for AMAFCA to construct the PROJECT on a cost-sharing basis as set forth in paragraphs 1 through 3 below; and

WHEREAS, the AMAFCA Board of Directors at its Regular Meetings of March 21, April 25, May 16, 2002, and June 28, 2002 considered the cost sharing concept and at the July 25, 2002 Regular Board meeting, directed staff to proceed with the cost share agreement.

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

1. AMAFCA agrees to:

a) Construct the Amole Arroyo Channel in existing City right-of-way from the Snow Vista Channel to approximately 850 feet west of Delgado Drive. The Channel improvements will consist of the following three (3) channel reaches.

Reach 1. Construct an above ground, lined channel using tinted shot-crete lining from the Snow Vista Channel westerly to the western right-of-way of Del Rey Road, including construction of the Amole Arroyo/Snow Vista Channel confluence. Construction also includes a permanent, all-weather crossing structure for Del Rey Road.

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FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

Reach 2. Construct an above ground, lined channel using tinted shot-crete lining from Del Rey Road westerly through the existing City of Albuquerque Park site to Delgado Drive.

Reach 3. Construct an above ground, lined channel using soil cement and/or rip-rap rock bank protection from Delgado Drive westerly approximately 850 feet.

b) Procure a work-order authorization from the COA for Project construction within the City right-of-way and comply with applicable City rules, regulations and requirements for construction within the City right-of-way.

c) Commence construction in 2003, with the understanding that AMAFCA will provide PROJECT funding in the following amounts for each following channel Reach.

Reach 1: 40% of the estimated design and construction cost (estimated at \$9,600 for design and \$172,800 for construction) of the channel improvements, including the Snow Vista confluence, and excluding the cost of the Del Rey Road crossing structure.

Reach 2: 85% of the estimated design and construction cost (estimated at \$28,560 for design and \$514,080 for construction) of the channel improvements. By separate agreement with AMAFCA, the City of Albuquerque is funding part of Reach 2.

Reach 3: 100% of the estimated design and construction cost (estimated at \$15,000 for design and \$270,000 for construction) of the channel improvements.

For a total AMAFCA cost of \$1,010,080.

d) Continue to operate and maintain the upstream inlet structure entrance from Westgate Dam into the new channel of the completed PROJECT.

e) Upon approval of the final pay estimate for the PROJECT, AMAFCA will invoice Curb, Inc. for any overruns in the construction of the

**AGREEMENT FOR IMPROVEMENT OF THE
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FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

PROJECT, or will reimburse the same for any under runs in the PROJECT. All other project costs including the contingency, will be reconciled and, subject to the provisions of paragraphs 2.e and 3.a hereof, allocated between AMAFCA, and Curb, Inc.

2) Curb, Inc. agrees to:

- a) Provide the final design plans and specifications for the PROJECT, to include the flood control facilities designed for fully developed conditions, and ready to bid, construction plans, contract documents and specifications, approved by AMAFCA, and the COA Development Review Committee.
- b) Provide all necessary submittals and Agency approvals for the PROJECT, including but not limited to COA Development Review Board and Design Review Committee, U.S. Army Corps of Engineers Section 404 permit, and New Mexico State Historic Preservation Officer Cultural and Archaeological Clearances.
- c) Provide all engineering information necessary and obtain approval for LOMR submittal to FEMA including any required review fees necessary for CLOMR and LOMR submittals to FEMA. LOMR requests will be coordinated with the City Floodplain Administrator.
- d) Provide funding for design and construction of the PROJECT as follows for each channel Reach:

Reach 1. 60% of the design and construction costs for channel improvements and including the Snow Vista Channel confluence (estimated at \$11,520 for design and \$207,360 for construction), and 100% of the design and construction costs for the permanent all-weather crossing structure at Del Rey Road (estimated at \$6,000 for design and \$108,000 for construction).

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Reach 2. 15% of the design and construction cost for channel improvements (estimated at \$5,040 for design and \$90,720 for construction).

- e) Provide all funding for design of the PROJECT, and for FEMA CLOMR/LOMR documents and fees. For purposes of allocating costs, PROJECT design and preparation of CLOMR/LOMR documents in the amount of \$98,600.00 (plus applicable NM gross receipts taxes) and FEMA fees of \$7,400.00 are considered fixed.
- f) Provide all fees to FEMA (estimated at \$7,400.00) for submittal and review of the CLOMR/LOMR.
- g) Provide to AMAFCA PROJECT construction funding in the amount of \$404,760 for Reach 1 and Reach 2 seven (7) days prior to award of a construction contract, which amount shall be the Curb, Inc. portion of the PROJECT. This amount is an estimated amount based on preliminary cost estimates for the PROJECT, not including contingencies. The final PROJECT funding for the Curb, Inc. share of design and construction cost is adjustable at the discretion of AMAFCA as based on the final completed costs of the PROJECT.
- f) Provide necessary permanent and temporary construction right-of-way and/or easements for construction and operation of the PROJECT.
- g) Pay to AMAFCA, within 30 days of receipt of invoice from AMAFCA, the Curb, Inc. share of any overruns in the PROJECT.

4. All parties agree as follows:

- a. That they are sharing the project costs as provided herein to include design, FEMA CLOMR and LOMR, construction engineering and construction costs in accordance with the cost sharing percentages contained herein and as shown on Exhibit B.. For

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**AGREEMENT FOR IMPROVEMENT OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

computation of the final costs of the PROJECT, the design cost of \$98,600 (plus applicable NM gross receipts taxes) is considered a fixed amount, as is the FEMA fee cost of \$7,400. Construction and construction management costs will be allocated based on actual costs in accordance with the percentages for each Reach identified herein. AMAFCA's Project Manager will be responsible for allocating the PROJECT costs to each project Reach.

- b. The facilities and right of way described herein have the primary purpose of conveying and managing storm water flows, and other interests granted by any party shall be subservient to that purpose.
- c. This Agreement does not relieve Curb, Inc. of the requirement to construct (or financially guarantee construction of) such facilities that AMAFCA and COA may deem necessary.
- d. Disputes under this Agreement shall be referred to binding arbitration under the provisions of the New Mexico Uniform Arbitration Act.
- e. This Agreement may not be assigned by any of the parties without the written consent of the other parties, which consent shall not be unreasonably withheld.
- f. Except as otherwise specifically provided herein, this Agreement shall be in writing and shall be delivered personally, sent via confirmed telefax, or sent postage prepaid by United States certified mail, return receipt requested, to the addresses set forth below or such other addresses as hereinafter specified in writing by one party to the other:

Albuquerque Metropolitan Arroyo
Flood Control Authority
2600 Prospect NE
Albuquerque, NM 87107
FAX: 884-0214

Curb, Inc.
6301 Indian School Rd. NE
Albuquerque, NM 87110
FAX: 899-2851

**AGREEMENT FOR IMPROVEMENT OF THE
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FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

- g. This Agreement contains the entire Agreement between the parties hereto and all prior understandings, oral or in writing, by the parties hereto with respect to this Agreement are hereby null and void. No variations, modifications, supplements, waivers or changes herein or hereof shall be binding upon any party hereto unless set forth in a document duly executed by or on behalf of such party.
- h. If any provision of this Agreement or the application thereof to any person or circumstance shall be invalid or unenforceable to any extent, the remainder of this Agreement and the application of such provisions to other persons or circumstance shall not be affected thereby and such provisions shall be enforced to the greatest extent permitted by law. In the event any action is instituted by any party for the purpose of enforcing or interpreting any provision of this Agreement, the prevailing party in such action shall be entitled to its reasonable attorney's fees and costs.
- i. This Agreement shall inure to the benefit of and be binding upon the undersigned parties and their respective successors and assigns. Whenever in this Agreement a reference to Curb, Inc. is made, such references shall be deemed to include a reference to successor owners of the Curb, Inc. property.
- j. Each individual signing for each of the parties hereunder warrants and represents that he/she is an authorized agent of such party, on whose behalf he/she is executing this Agreement, and is authorized to execute the same.
- k. Each party agrees to execute such other and further instruments and documents as may be necessary or proper in order to complete the transactions contemplated by this Agreement.

**AGREEMENT FOR IMPROVEMENT OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING**

- l. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, and said counterparts shall constitute but one and the same instrument which may sufficiently be evidenced by one counterpart.
- m. Funds for this project may be contingent upon AMAFCA's successful sale of General Obligation Bonds.
- n. It is specifically agreed between the parties that this Agreement does not, and is not intended to, create in the public, or any member thereof, any rights whatsoever, such as but not limited to, the rights of a third party beneficiary, nor to authorize anyone not a party to this Agreement to maintain a suit for wrongful death or any other claim, whatsoever.
- o. As between the parties, each shall be solely responsible for any and all liability from personal injury, including death or damage to property, arising from any negligent or intentional act or failure to act of the respective party, its officials, agents, contractors or employees pursuant to this Agreement. The liabilities of each applicable party shall be subject to the immunities and limitations of the Tort Claims Act, §§41-4-1, et seq., NMSA, 1978, and any amendments thereto. By entering into this Agreement, the COA and its "public employees" as defined in the New Mexico Tort Claims Act, and AMAFCA and its "public employees" as defined in the New Mexico Tort Claims Act, do not waive sovereign immunity, and do not waive any defense and/or do not waive any limitation of liability pursuant to law. No provision in this Agreement modifies or waives any provision of the New Mexico Tort Claims Act.

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• 1

Executed the day and year first set out above.

**ALBUQUERQUE METROPOLITAN
ARROYO FLOOD CONTROL
AUTHORITY**, a political subdivision
of the State of New Mexico

ATTEST:

**Ronald D. Brown, Chair
Board of Directors**

**Tim Eichenberg, Secretary-Treasurer
Board of Directors**

[illegible]

This instrument was acknowledged before me on August, 22 by Ronald D. Brown, Chair of the Albuquerque Metropolitan Arroyo Flood Control Authority, a political subdivision of the State of New Mexico.

Gren Jeffries
Notary Public

My commission expires:

June 1, 2003

AGREEMENT FOR IMPROVEMENT OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM SNOW VISTA CHANNEL TO WEST OF DELGADO ROAD CROSSING

CURB, INC.,
a New Mexico Corporation

Charles A. Haegelin
Charles Haegelin, President, Curb, Inc.

STATE OF NEW MEXICO)
)ss.
COUNTY OF BERNALILLO)

This instrument was acknowledged before me on August 22, 2002 by
Charles Haegelin, President of Curb, Inc. , a New Mexico Corporation.

Richard J. Squires
Notary Public

My commission expires:



OFFICIAL SEAL
RICHARD J. SQUIRES
NOTARY PUBLIC-STATE OF NEW MEXICO
My commission expires: 9-17-2003

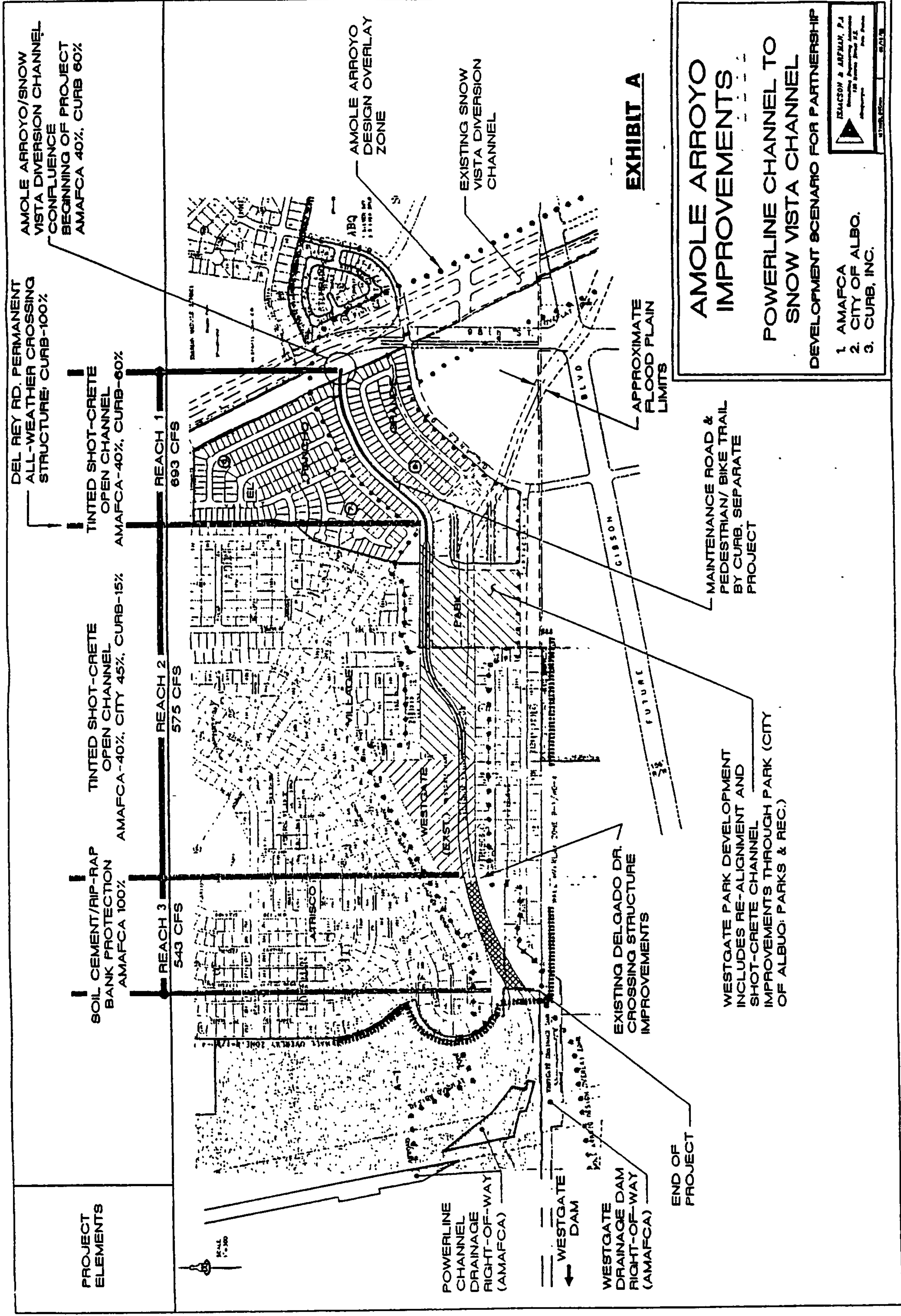


EXHIBIT A

AMOLE ARROYO IMPROVEMENTS

POWERLINE CHANNEL TO SNOW VISTA CHANNEL

DEVELOPMENT SCENARIO FOR PARTNERSHIP

1. AMAFCA
2. CITY OF ALBU.
3. CURB, INC.

ISAACSON & ARFMAN, P.A.
 Consulting Engineers & Architects
 128 Avenue of the Americas
 New York, N.Y. 10038
 212-691-8200

8/21/88

Exhibit A

Amole Arroyo, Delgado to Snow Vista Channel

Open Channel Thru Park, one crossing structure

Cost Sharing Allocation Based on Project Elements
July 25, 2002

Project Elements				Total Cost
Amole Arroyo / Snow Vista Confluence				
40% 60% AMAFCA / Curb				
Open Channel	1	LS	80,000	80,000
Design, 6%				4,800
Construction Management, 8%				6,400
Right of Way				25,000
Subtotal				116,200

Amole Arroyo Reach One				
40% 60% AMAFCA / Curb				
Open Channel	1,600	LF	200	320,000
Design, 6%				19,200
Construction Management, 8%				25,600
Right of Way				0
Subtotal				364,800

Del Ray Crossing Structure				
100% Curb				
Crossing Structure	1	LS	100,000	100,000
Design, 6%				6,000
Construction Management, 8%				8,000
Right of Way				0
Subtotal				114,000

Amole Arroyo Reach Two				
40% 45% 15% AMAFCA / City / Curb				
Open Channel	2,800	LF	200	560,000
Design, 6%				33,600
Construction Management, 8%				44,800
Right of Way				0
Subtotal				638,400

Amole Arroyo Reach Three				
100% AMAFCA				
Open Channel	1	LS	250,000	250,000
Design, 6%				15,000
Construction Management, 8%				20,000
Right of Way				0
Subtotal				285,000

FEMA LOMR				
100% Curb				
Engineering Design and FEMA CLOMR/LOMR				20,000
FEMA Review Fees				7,400
Subtotal				27,400

Total Project Costs 1,545,800

AMAFCA	Curb	City
32,000	48,000	
1,920	2,880	
2,560	3,840	
	25,000	
36,480	79,720	0

128,000	192,000	
7,680	11,520	
10,240	15,360	
145,920	218,880	0

	100,000	
	6,000	
	8,000	
0	114,000	0

224,000	84,000	252,000
13,440	5,040	15,120
17,920	6,720	20,160
0	0	0
255,360	95,760	287,280

250,000		
15,000		
20,000		
0		
285,000	0	0

	20,000	
	7,400	
0	27,400	0

722,760	535,760	287,280
46.8%	34.7%	18.6%

Project Cost Sharing Elements	
Construction	1,310,000
Design	98,600
Constr. Mgt.	104,800
Right of Way	25,000
FEMA Fees	25,000
	1,563,400

Project Cost Contributions by Party		
AMAFCA	Curb	City
617,960	404,760	287,280
0	98,600	
104,800		
	25,000	
	7,400	
722,760	535,760	287,280

Cash for Construction
Design by Curb
Cash for CM services
Right of Way Dedication
FEMA Fees

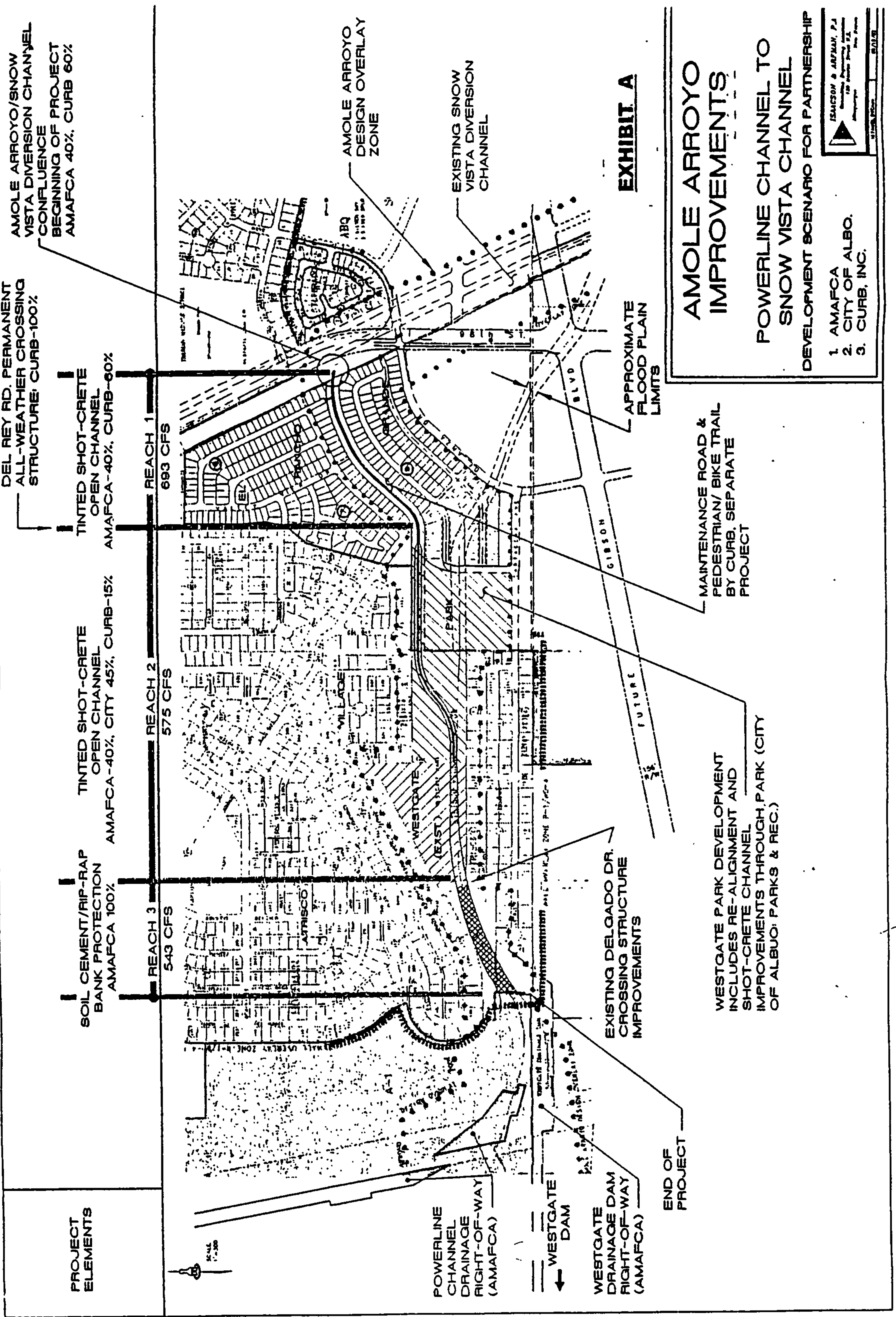


Exhibit A

2003-47
JW
20/4
N-09/D006B

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

This Agreement is entered into this 18 day of December, 2003 by and between the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), a political subdivision of the State of New Mexico, and Curb, Inc. (CURB), a New Mexico corporation.

RECITALS:

WHEREAS, AMAFCA's Amole-Hubbell Drainage Management Plan (DMP), adopted by AMAFCA July 22, 1999, recommended improvement of the Amole Arroyo from the Amole Basin To the Snow Vista Channel; and

WHEREAS, CURB is constructing drainage improvements for development of residential subdivisions to connect to a portion of the Amole Arroyo shown on attached Map "A" (the PROJECT); and

WHEREAS, AMAFCA requires drainage improvements to arroyo systems as development proceeds in order to protect adjacent developed properties from erosion and flooding damage; and

WHEREAS, CURB has indicated a willingness to participate in the funding of proposed improvements to the Amole Arroyo; and

WHEREAS, CURB, and AMAFCA wish to cooperate on the improvement of the Amole Arroyo; and

WHEREAS, the cost of the proposed improvements for the Amole Arroyo and roadway crossing structures for Unser, Blake, and Gibson Roads, have been previously discussed and agreed to by CURB, and AMAFCA, as shown on the attached Amole Arroyo Improvements Plan (Map A) and proposed channel cross sections shown on Map B, and as further described for Amole Arroyo, in the attached Cost Summary Table, Exhibit 1; and

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

WHEREAS, CURB and AMAFCA have agreed to the distribution of costs for the Amole Arroyo Improvements as shown in the Cost Summary Table, Exhibit 1; and

WHEREAS, AMAFCA Resolution 1982-4 Cost-Sharing with Land Owners, provides for the private sector to share in the cost of flood control facilities; and

WHEREAS, the PROJECT is appropriate for AMAFCA and CURB in that it:

- a. Is consistent with AMAFCA's mission
- b. Provides a major arroyo which was addressed in AMAFCA's DMP
- c. Continues channelization of the Amole Arroyo for eventual delivery of drainage to the Amole Dam
- d. Will provide flood protection for the proposed residential development
- e. Provides a flood-control facility capable of accepting future developed flows as described in the Amole-Hubbell DMP for Amole Arroyo, Alternative #2

WHEREAS, AMAFCA and CURB have previously agreed for CURB to fund a portion of improvement of the Amole Arroyo associated with El Rancho Grande 1, Unit 9, Residential Subdivision, in the amount of \$296,765, via the "Agreement for Improvement of a Portion of the Amole Arroyo Drainage Facility for El Rancho Grande 1, Unit 9, Residential Subdivision" dated March 21, 2003, recorded by the Bernalillo County Clerk as document number 2003087981 on May 27, 2003; and

WHEREAS, AMAFCA has the capability to maintain the PROJECT after construction; and

WHEREAS, the City of Albuquerque and AMAFCA will jointly monitor the status of development in the upstream contributing basin for the need to construct improvements to the Amole Arroyo system, as identified in the Amole-Hubbell Drainage Management Plan; and

WHEREAS, the City of Albuquerque has prepared the Trails and Bikeways Facility Plan, which was endorsed by the AMAFCA Board of Directors via Resolution 1994-2, which identifies a multi-use trail along the flood control facility in this reach; and

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

WHEREAS, said PROJECT also offers opportunities for other purposes, such as open space, parks, trails, and other appropriate public uses, subject to the primacy of the drainage function; and

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

SECTION ONE: The purpose of this agreement is to:

1. Provide for the design and construction of the Amole Arroyo from the Amole Dam upstream to the Snow Vista Channel confluence, to include crossing structures at Blake Road and Gibson Blvd. No crossing will be built in the alignment of future Unser Blvd. Two sets of contract documents will be provided for construction of separate reaches of the project by CURB and AMAFCA. A FEMA CLOMR for the entire project will be provided, with a LOMR provided for those portions of the Project constructed by CURB.

SECTION TWO: CURB Agrees to:

1. CURB will provide design and construction plans for the full project, from the Amole Dam to the Snow Vista Channel Confluence. Construction plans and specifications will be divided into two individual plan sets as follows:

- a. Plan Set 1, to be built by AMAFCA, will include Reach 1, Reach 2 (including the channel portion of the Unser Blvd. Crossing) and Reach 5, with associated project manual to conform to normal AMAFCA requirements based on the 1994 NMDOT Standard Specifications for Highway and Bridge Constructions.
- b. Plan Set 2, to be built by CURB, will include Reach 3, Reach 4A and 4B, the Blake Road crossing and the Gibson Blvd. crossing, including appropriate transitions at the project ends;
- c. The project shall be designed per the cross sections shown on the attached Map B using tinted shotcrete lining (San Diego Buff, 1 lb. per sack of cement), bottom width as shown on the cross sections for each channel reach, 2:1 side slopes, shotcrete lining to extend to the 100-year water surface elevation, with freeboard

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

slopes contained within the right-of-way, to include large radius channel meanders to provide aesthetics of the drainage corridor, and offline storm water quality drainage swales in locations to be coordinated with AMAFCA during final design of the Project.

- d. Both plan sets shall be provided to AMAFCA in mylar and electronic format. Project manuals for both projects shall be delivered in one hard copy plus electronic format

2. CURB will provide and pay FEMA review fees, as part of the design of the Project, FEMA Conditional Letter of Map Revision (CLOMR) for the entire Project and final Letter of Map Revision (LOMR) for all portions of the project limits to be constructed by CURB.

3. CURB agrees to construct improvements to the Amole Arroyo, to include Reach 3, with appropriate downstream transition, Reach 4A and 4B, the Gibson Blvd. crossing, with appropriate upstream transition, and Blake Road crossing.

4. CURB shall provide AMAFCA financial guarantees, in increments acceptable to AMAFCA as based on the acreage of phased of development of the CURB-owned property in the area, in proportion to the total CURB-owned property in the area, not to exceed the amount of \$2,543,350. Financial guarantees shall be in the form of a certified bank letters of credit or bonds satisfactory to AMAFCA for the necessary improvements, until such improvements are built.

SECTION THREE, AMAFCA agrees to:

1. AMAFCA agrees to release CURB from the "Agreement for Improvement of a Portion of the Amole Arroyo Drainage Facility for El Rancho Grande 1, Unit 9, Residential Subdivision" dated March 21, 2003, recorded by the Bernalillo County Clerk as document number 2003087981 on May 27, 2003; and, to immediately release the Letter of Credit No. 300157, dated May 14, 2003, drawn on Charter Bank, filed with AMAFCA as guarantee for the required

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

improvements, upon receipt of the financial guarantees as cited in Section 4 above, when such financial guarantees total or exceed \$296,765.

2. AMAFCA agrees to construct drainage improvements for the Amole Arroyo identified as Reach 1, the channel section through the Unser Crossing, Reach 2, and Reach 5 from the Amole Dam to Reach 3, and from the Snow Vista Channel to the Gibson Blvd. crossing, when determined necessary and/or desirable by AMAFCA, subject to availability of funds.

3. The decision on the sufficiency of funds shall be at the discretion of the AMAFCA Board of Directors. In the event that subsequent analysis by AMAFCA indicates that the drainage improvements in Reaches 1, 2, or 5 need not be constructed or that different drainage improvements shall be constructed, then AMAFCA shall have the right to elect not to build the drainage improvements or to build different drainage improvements.

4. AMAFCA agrees to convey to CURB approximately 3.0 acres of unused Amole Channel right-of-way for an amount of \$40,000 per acre or the appraised value of the property, which ever is the greater amount, subject to the requirements of AMAFCA Resolution 2003-4, **Disposal of Excess Lands**. Payment by CURB to AMAFCA shall be in the form of a combination of cash and consideration for improvement costs in excess of the CURB cost share, an amount of \$89,266. The difference between the exact acreage to be acquired (to be determined), multiplied by \$40,000 per acre or the appraised value of the property (to be determined), which ever is the greater amount, and the improvement costs in excess of the Curb cost. (\$89,266) shall be paid to AMAFCA at the time of transfer of the property. The appraisal shall reflect conditions as of the effective date of this Agreement. AMAFCA shall use one of its on-call appraisers as selected by CURB to appraise the surplus property. Cost of the appraisal shall be split evenly between AMAFCA and Curb.

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

SECTION FOUR: BOTH PARTIES Agree as follows:

1. AMAFCA and CURB are sharing the project costs by building separate and distinct reaches of the Project, with the reaches based upon the cost sharing percentages contained herein and as shown on Cost Summary Table, Exhibit 1. Should actual cost vary for either party, no cost adjustments will be made.
2. This cost sharing by CURB will represent the full responsibility of CURB cost participation for this section of the Amole Arroyo Improvements, for CURB's current landholdings within the area. Should CURB acquire additional property within the Sacate Blanco Arroyo watershed, as it exists at the time of this agreement, AMAFCA and CURB shall negotiate a reasonable contribution by CURB for Amole Arroyo Reaches 1 and 2, including the Unser Blvd. crossing, to be the subject of separate agreement tied to the development of the additional property acquired by CURB.
3. The facilities and right of way described herein have the primary purpose of conveying and managing storm water flows, and other interests granted by any party shall be subservient to that purpose.
4. This Agreement does not relieve CURB of the requirement to construct (or financially guarantee construction of) such facilities that AMAFCA and City of Albuquerque may deem necessary.
5. This Agreement shall not preclude the application by CURB to the City of Albuquerque or, should the City and County become consolidated, to the resulting governmental entity, for impact fee credits related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo Improvements. AMAFCA agrees that CURB may enter into discussions simultaneous with, or following, the execution of this Agreement, with the City of Albuquerque for an agreement by which CURB, in the future, may apply for and receive impact fee credits for related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

Improvements. AMAFCA will not oppose CURB receiving such impact fee credits, and will, to the extent allowed by law and provided that it incurs no cost or expense, reasonably cooperate with CURB's efforts to establish, in the future, impact fee credits related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo Improvements.

6. Disputes under this Agreement shall be referred to binding arbitration under the provisions of the New Mexico Uniform Arbitration Act.

7. This Agreement may not be assigned by any of the parties without the written consent of the other parties, which consent shall not be unreasonably withheld.

8. Except as otherwise specifically provided herein, this Agreement shall be in writing and shall be delivered personally, sent via confirmed telefax, or sent postage prepaid by United States certified mail, return receipt requested, to the addresses set forth below or such other addresses as hereinafter specified in writing by one party to the other:

**Albuquerque Metropolitan Arroyo
Flood Control Authority**
2600 Prospect NE
Albuquerque, NM 87107
FAX: 884-0214

Curb, Inc.
6301 Indian School Rd. NE,
Suite 201
Albuquerque, NM 87110
FAX: 875-1723
and 899-2851

9. This Agreement contains the entire Agreement between the parties hereto and all prior understandings, oral or in writing, by the parties hereto with respect to this Agreement are hereby null and void. No variations, modifications, supplements, waivers or changes herein or hereof shall be binding upon any party hereto unless set forth in a document duly executed by or on behalf of such party.

10. If any provision of this Agreement or the application thereof to any person or circumstance shall be invalid or unenforceable to any extent, the remainder of this Agreement and the application of such provisions to other persons or circumstance shall not be affected thereby and such provisions shall be enforced to the greatest extent permitted by law. In the event any action is instituted by any party for the purpose of enforcing or interpreting any

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

provision of this Agreement, the prevailing party in such action shall be entitled to its reasonable attorney's fees and costs.

11. This Agreement shall inure to the benefit of and be binding upon the undersigned parties and their respective successors and assigns. Whenever in this Agreement a reference to CURB is made, such references shall be deemed to include a reference to successor owners of the CURB property.

12. Each individual signing for each of the parties hereunder warrants and represents that he/she is an authorized agent of such party, on whose behalf he/she is executing this Agreement, and is authorized to execute the same.

13. Each party agrees to execute such other and further instruments and documents as may be necessary or proper in order to complete the transactions contemplated by this Agreement.

14. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, and said counterparts shall constitute but one and the same instrument which may sufficiently be evidenced by one counterpart.

15. Funds for AMAFCA's reaches of the Project will be contingent upon AMAFCA's successful sale of General Obligation Bonds.

16. It is specifically agreed between the parties that this Agreement does not, and is not intended to, create in the public, or any member thereof, any rights whatsoever, such as but not limited to, the rights of a third party beneficiary, nor to authorize anyone not a party to this Agreement to maintain a suit for wrongful death or any other claim, whatsoever.

17. As between the parties, each shall be solely responsible for any and all liability from personal injury, including death or damage to property, arising from any negligent or intentional act or failure to act of the respective party, its officials, agents, contractors or employees pursuant to this Agreement. The liabilities of each applicable party shall be subject to the immunities and limitations of the Tort Claims Act, §§41-4-1, et seq., NMSA, 1978, and any amendments thereto. AMAFCA and its "public employees" as defined in the New Mexico Tort Claims Act, do not waive sovereign immunity, and do not waive any defense and/or do not waive any limitation of

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

Curb, Inc.
a New Mexico Corporation

Charles A. Haegelin
Charles Haegelin, President, Curb, Inc.

STATE OF NEW MEXICO)
)ss.
COUNTY OF BERNALILLO)

This instrument was acknowledged before me on JANUARY 14th, 2003 by
Charles Haegelin, President of Curb, Inc., a New Mexico Corporation.

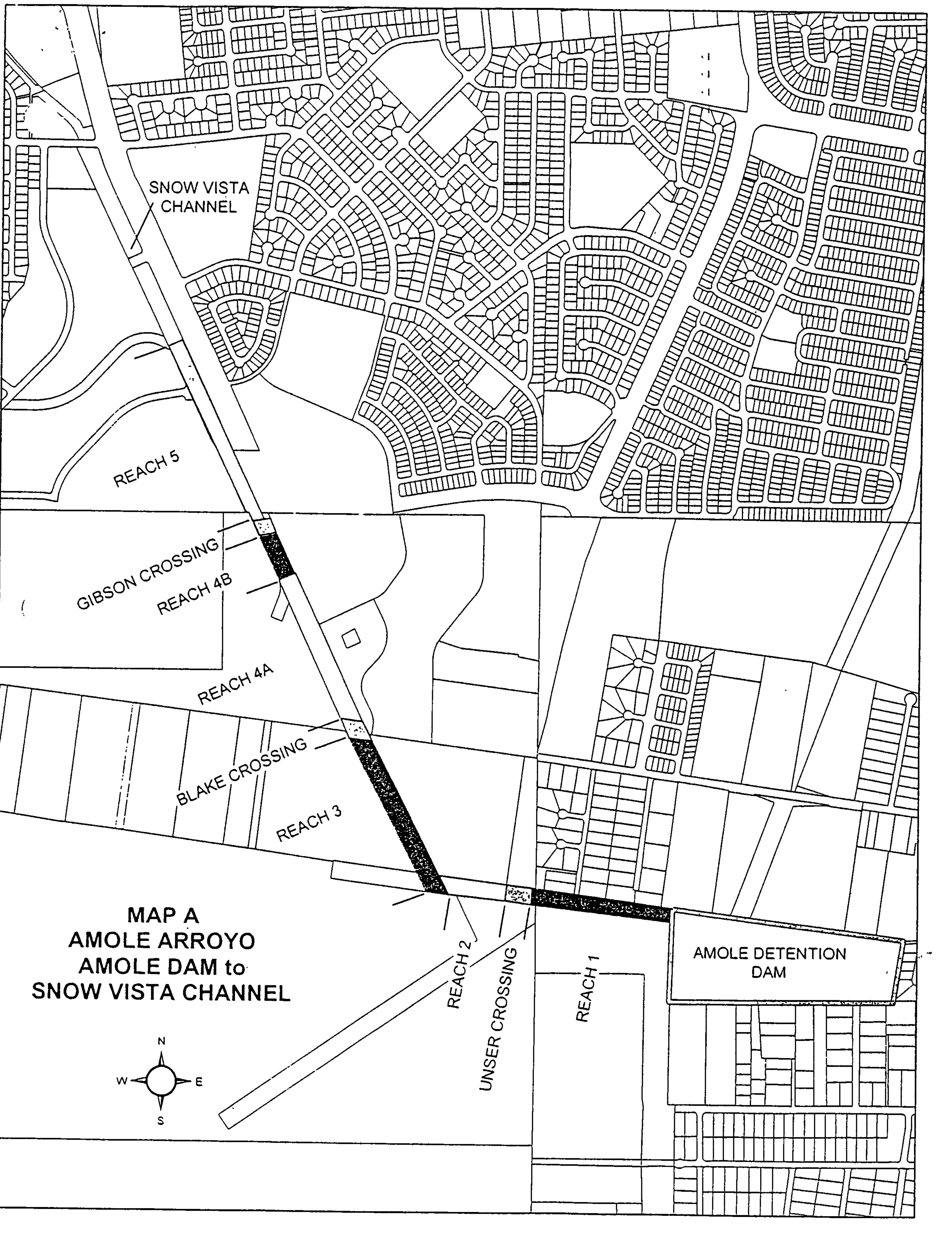
Richard J. Squires
Notary Public

My commission expires:



OFFICIAL SEAL
RICHARD J. SQUIRES
NOTARY PUBLIC-STATE OF NEW MEXICO

My commission expires: 10/1/2007



SNOW VISTA
CHANNEL

REACH 5

GIBSON CROSSING
REACH 4B

REACH 4A

BLAKE CROSSING

REACH 3

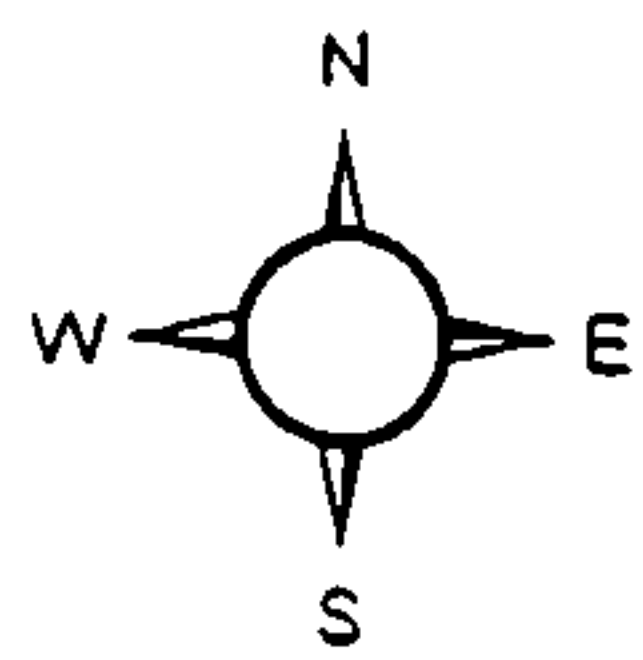
REACH 2

UNSER CROSSING

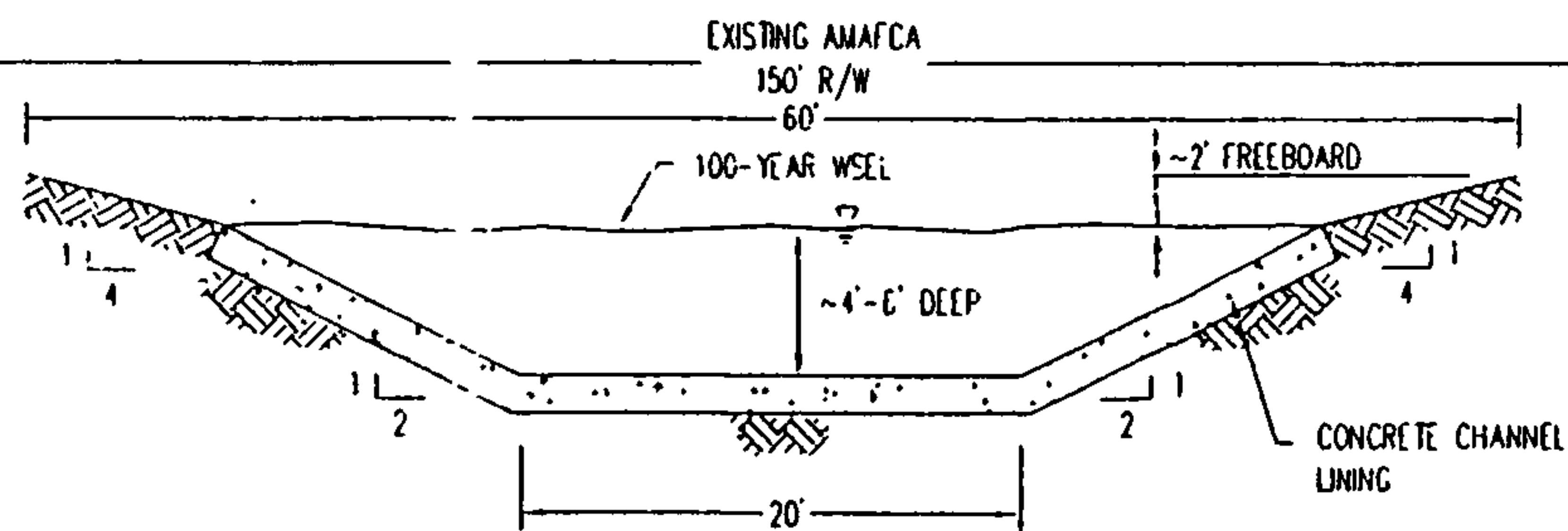
REACH 1

AMOLE DETENTION
DAM

MAP A
AMOLE ARROYO
AMOLE DAM to
SNOW VISTA CHANNEL



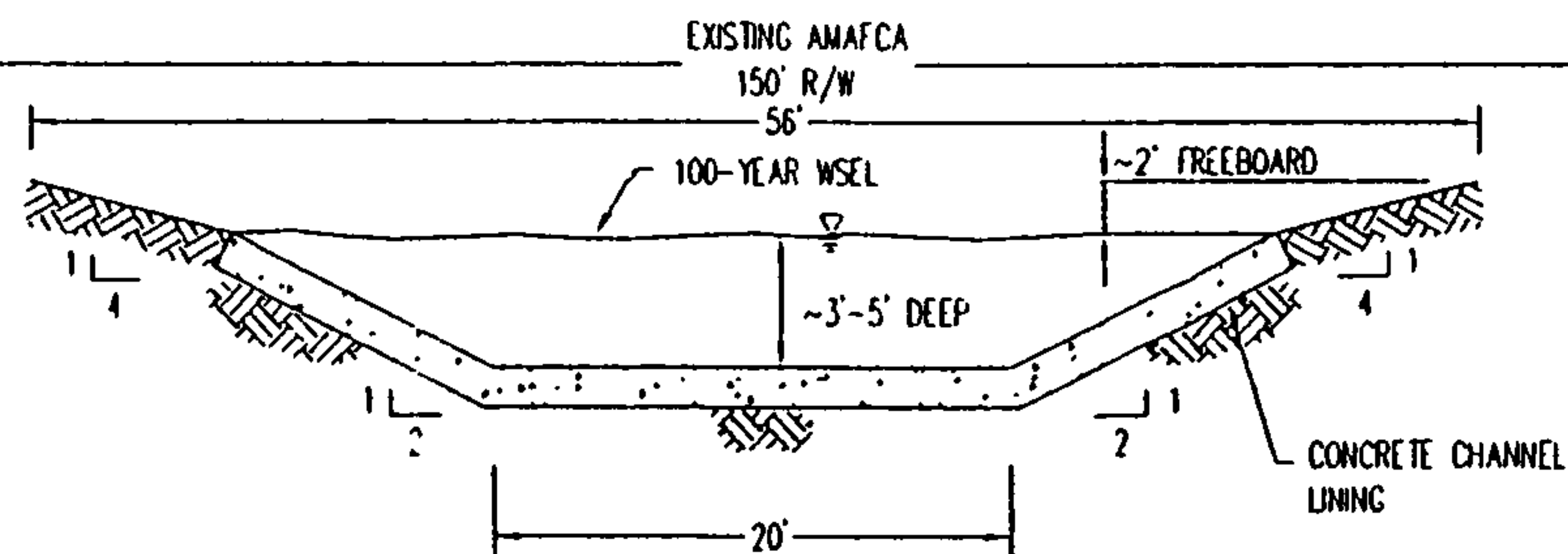
EL RANCHO GRANDE



SECTION C-C / REACHES 4b & 5

SCALE: 1"=10'

EL RANCHO GRANDE

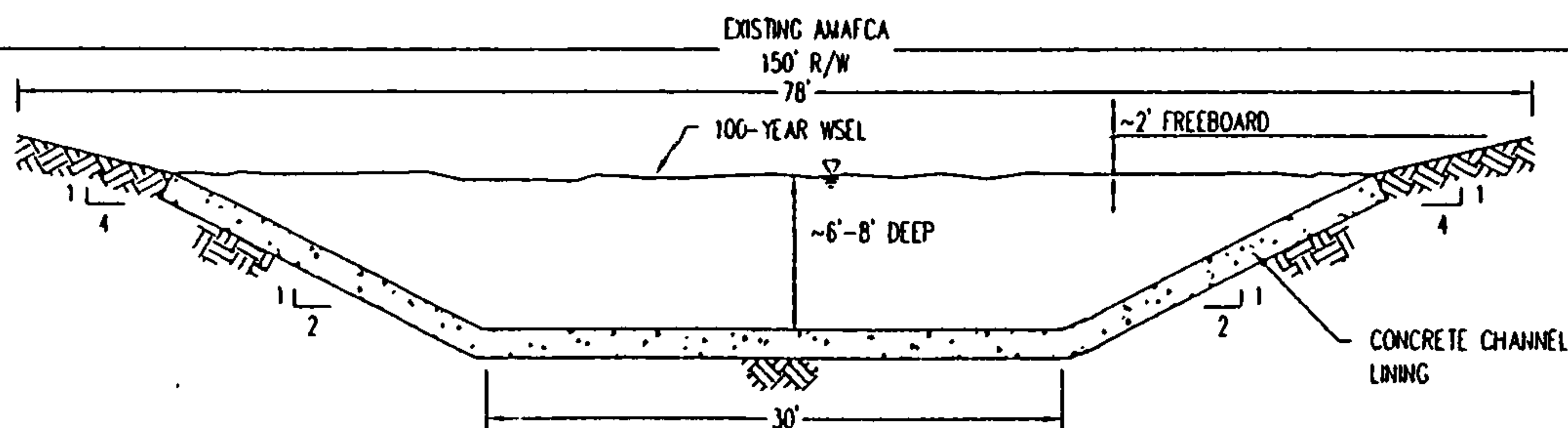


SECTION B-B / REACHES 3 & 4a

SCALE: 1"=10'



EL RANCHO GRANDE



SECTION A-A / REACHES 1 & 2

SCALE: 1"=10'

AMOLE ARROYO
PROPOSED SECTIONS

Bokanman Huston

Company: 1000 Jefferson St. NE, Albuquerque, NM 87106-0001
ENGINEERING SPECIALISTS ADVANCED TECHNOLOGIES

MAP B

Map Scale: 1"=100' - Drawings: 100' x 100'

Amole Arroyo, Amole Dam to Snow Vista Channel Confluence									
Cost Sharing Allocation Based on Project Elements December 10, 2003									
Project Elements									
Reach One Amole Arroyo, Amole Dam to Unser Blvd									
		AMAFCA	Curb North	Curb South	Curb West				
		58%	Lump Sum	10%	0%				
Open Channel			191,699			1000	LF	\$ 500	500,000
Sacate Blanco Confluence			32%			50	LF	\$ 400	20,000
									520,000
Design, 6%									31,200
Construction Management, 8%									41,600
Subtotal									592,800
Unser Xing Amole Arroyo, Unser Blvd Crossing, 8" Channel Section Only									
		AMAFCA	Curb North	Curb South	Curb West				
		90%	0%	10%	0%				

AMAFCA	Curb North	Curb South	Curb West
299,843	168,157	52,000	0
17,901	10,089	3,120	
23,987	13,453	4,160	
341,821	191,699	59,280	0

Project Cost Sharing Elements	
Construction	3,727,500
Design	243,650
Constr Mgt	298,200
Right of Way	0
FEMA Fees	7,400
	4,276,750

Amount Due from Curb	
Curb North	296,765
Curb South	100,890
Curb West	2,056,429
	2,454,084

Cost Summary				
	Construction	Design	CM	Total
Reach 1	520,000	31,200	41,600	592,800
Unser	80,000	4,800	6,400	91,200
Reach 2	285,000	17,100	22,800	324,900
Reach 3	665,000	39,900	53,200	758,100
Blake Crossing	250,000	15,000	20,000	285,000
Reach 4a	655,500	39,330	52,440	747,270
Reach 4 b	152,000	9,120	12,160	173,280
Gibson Crossing	400,000	24,000	32,000	456,000
Reach 5	720,000	43,200	57,600	820,800
FEMA CLOMR/LOMR		20,000		20,000
FEMA Fees				7,400
	3,727,500	243,650	298,200	4,276,750

Proposed Breakout of Project Construction		
Curb to build Reach 3, Blake, 4a & 4 b & Gibson		
AMAFCA to Build Reach 1, Unser, Reach 2, Reach 5		
Curb builds these Reaches (Constr + CM)		AMAFCA builds these Reaches AMAFCA Costs (Constr. + CM)
		561,600 1,733,400 Constr & CM
		86,400 120,000 ROW
		307,800 1,853,400
		(30,734) Cash from Curb
		1,822,666 AMAFCA Share
		777,600
		1,733,400
		by Curb
		1,733,400
Subtotal	2,299,700	
Add Design	243,650	
Curb In Fund	2,543,350	
	2,454,084	Total Curb Share
	89,266	Amount over Curb Share
	120,000	Curb Acquires AMAFCA Acreage (30 Acres Valued at \$40,000/acre)
	30,734	Cash to AMAFCA

AMENDMENT ONE TO THE
AGREEMENT FOR IMPROVEMENT OF
A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

contract file

~~2005-31~~

2003-47

KW

~~N-09/D023~~

N-09/D006B

This Agreement is entered into this 16th day of August, 2005, by and between the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), a political subdivision of the State of New Mexico, and Curb, Inc. (Curb), a New Mexico corporation.

RECITALS:

WHEREAS, AMAFCA and Curb entered into an agreement dated December 18, 2003, to cooperate on the improvement of the Amole Arroyo (the "Original Agreement"); and

WHEREAS, improvements for Amole Arroyo, Reach Five, of the Original Agreement were limited to channel improvements for the Amole Arroyo; and

WHEREAS, the updated plan now includes construction of the 98th Street crossing of the Amole Arroyo, related roadway and trail improvements, and a major sanitary sewer trunk line in addition to the channel improvements; and

WHEREAS, Curb, Inc. and the City have acquired additional funding for the construction of the ultimate improvements for Reach Five, including the 98th Street crossing of the Amole Arroyo and sanitary sewer trunk line; and

WHEREAS, it is desirable to construct all improvements as part of a single construction project;

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

AMENDMENT ONE TO THE
AGREEMENT FOR IMPROVEMENT OF
A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

SECTION 1:

The purpose of this agreement is to:

1. Amend the Original Agreement to include additional participation by Curb for Construction Management and to provide for additional project design.

SECTION 2:

Add the following to Section Two, Item 1 of the Original Agreement:

Curb agrees to:

- 1.a. Provide design, construction plans, and contract documents for the full project for Reach Five, including the channel segments, box culvert, 98th Street crossing and intersection connection with 86th Avenue, trail improvements, and the sanitary sewer trunk line extending from Blake Road to the north end of the project. (City Project No. 756291)
- 1.e. Provide right-of-way surveying and/or platting, and legal descriptions necessary for final project right-of-way.

Modify Section Two of the Original Agreement to include Item 5 as follows:

5. Curb will provide to AMAFCA a lump sum of \$100,000.00 for Construction Management Services for the project. AMAFCA will invoice Curb any time after award of bid for construction contract, and Curb will make payment to AMAFCA no later than 30 days after receipt of invoice from AMAFCA.

AMENDMENT ONE TO THE
AGREEMENT FOR IMPROVEMENT OF
A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

Unless otherwise stated herein, the terms and conditions of the Original Agreement remain unchanged and in full force and effect unless there is a conflict between the Original Agreement and this Amendment Number One, in which event the terms and conditions of this Amendment Number One shall control.

AMENDMENT ONE TO THE
AGREEMENT FOR IMPROVEMENT OF
A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

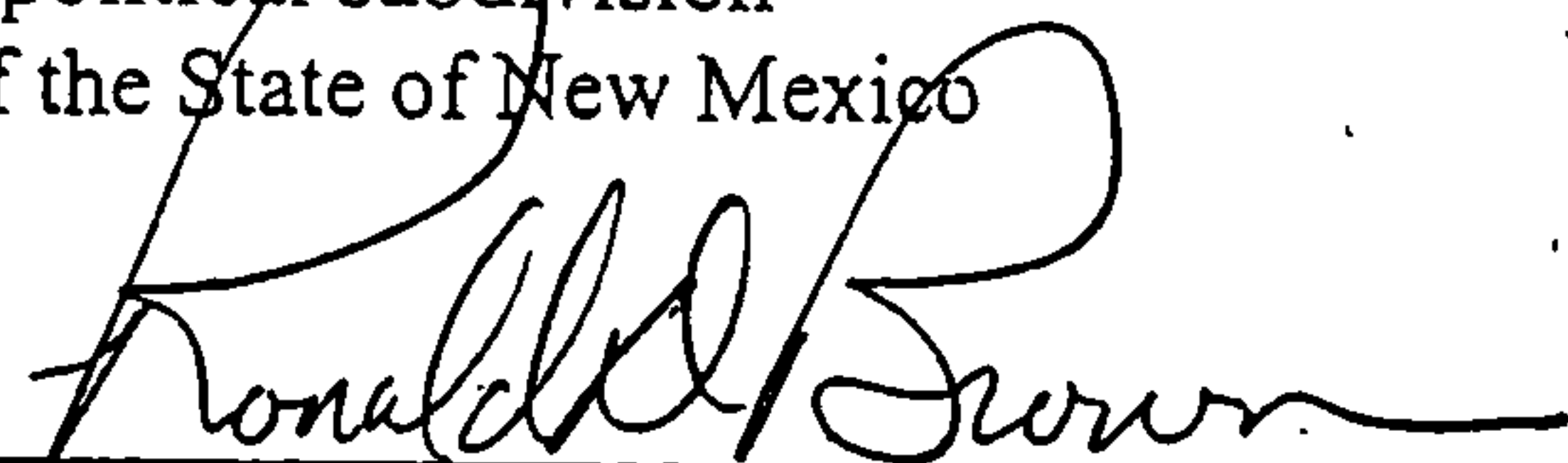
Executed the day and year first set out above.

ALBUQUERQUE METROPOLITAN
ARROYO FLOOD CONTROL
AUTHORITY,

a political subdivision
of the State of New Mexico

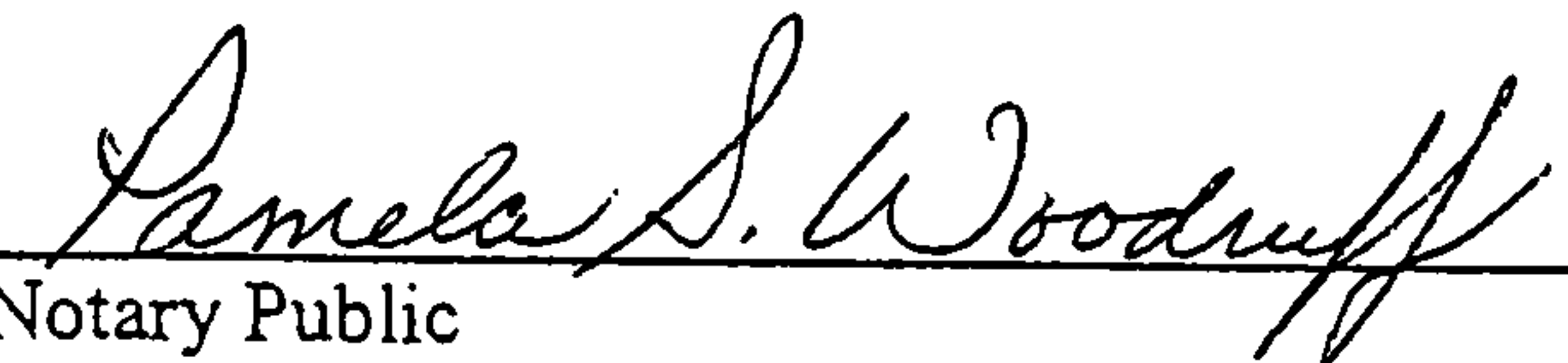
ATTEST:


Tim Eichenberg, Secretary-Treasurer
Board of Directors


Ronald D. Brown, Chair
Board of Directors

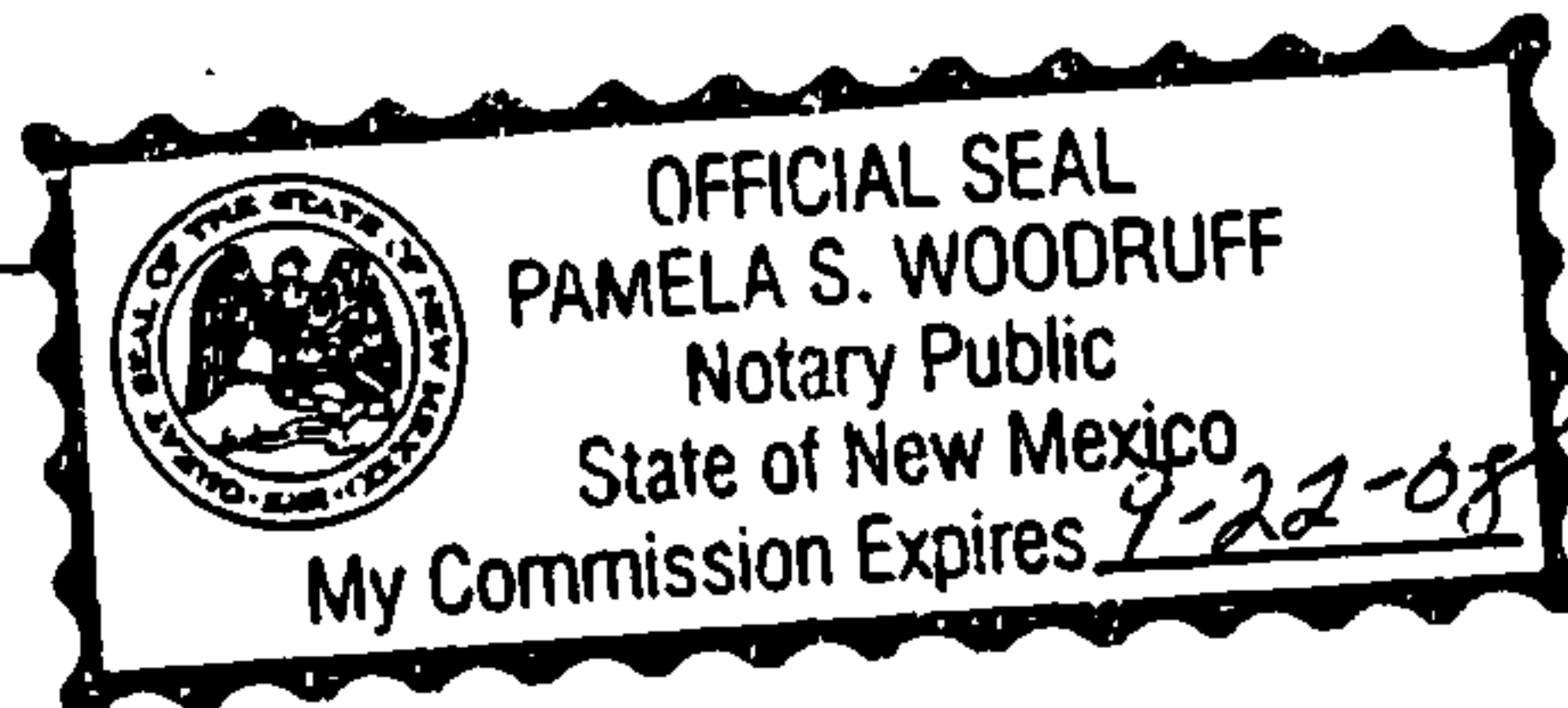
STATE OF NEW MEXICO)
) ss.
COUNTY OF BERNALILLO)

This instrument was acknowledged before me on August 11, 2005 by
Ronald D. Brown, Chair of Board of Directors of the Albuquerque Metropolitan Arroyo Flood
Control Authority, a political subdivision of the State of New Mexico.


Notary Public

My commission expires:

9-22-08



AMENDMENT ONE TO THE
AGREEMENT FOR IMPROVEMENT OF
A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

CURB, INC.,
a New Mexico Corporation

Charles a Haegelin
Charles Haegelin, President, Curb, Inc.

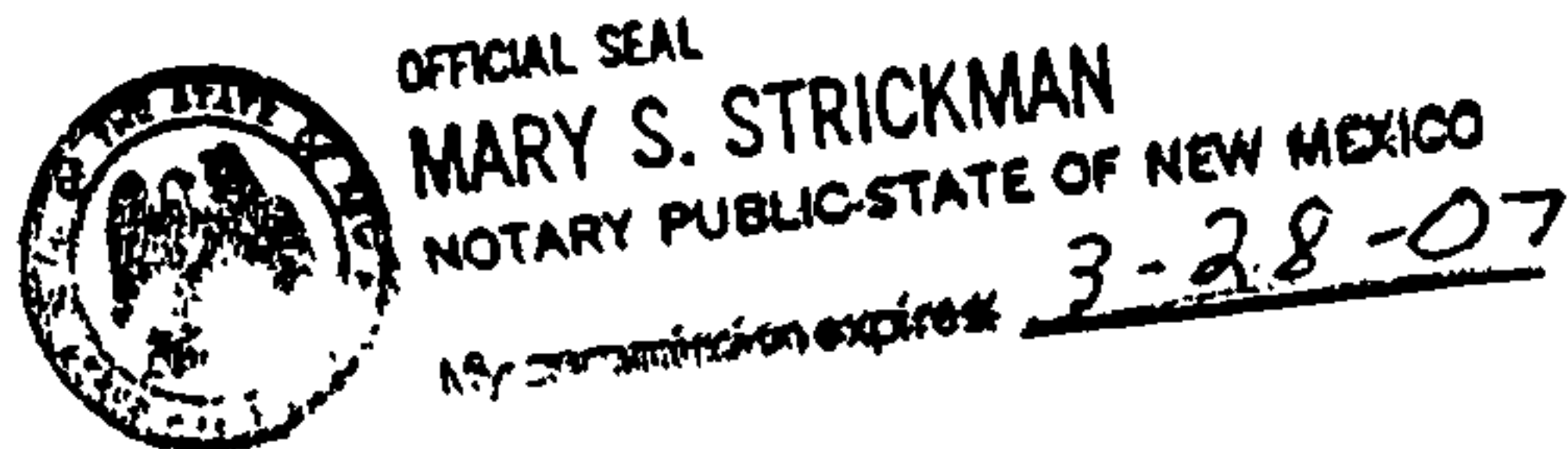
STATE OF NEW MEXICO)
)ss.
COUNTY OF BERNALILLO)

This instrument was acknowledged before me on August 16, 2005 by
Charles Haegelin, President of Curb, Inc., a New Mexico Corporation.

Mary S Strickman
Notary Public

My commission expires:

3-28-07



AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

This Agreement is entered into this 18 day of December, 2003 by and between the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA), a political subdivision of the State of New Mexico, and Curb, Inc. (CURB), a New Mexico corporation.

RECITALS:

WHEREAS, AMAFCA's Amole-Hubbell Drainage Management Plan (DMP), adopted by AMAFCA July 22, 1999, recommended improvement of the Amole Arroyo from the Amole Basin To the Snow Vista Channel; and

WHEREAS, CURB is constructing drainage improvements for development of residential subdivisions to connect to a portion of the Amole Arroyo shown on attached Map "A" (the PROJECT); and

WHEREAS, AMAFCA requires drainage improvements to arroyo systems as development proceeds in order to protect adjacent developed properties from erosion and flooding damage; and

WHEREAS, CURB has indicated a willingness to participate in the funding of proposed improvements to the Amole Arroyo; and

WHEREAS, CURB, and AMAFCA wish to cooperate on the improvement of the Amole Arroyo; and

WHEREAS, the cost of the proposed improvements for the Amole Arroyo and roadway crossing structures for Unser, Blake, and Gibson Roads, have been previously discussed and agreed to by CURB, and AMAFCA, as shown on the attached Amole Arroyo Improvements Plan (Map A) and proposed channel cross sections shown on Map B, and as further described for Amole Arroyo, in the attached Cost Summary Table, Exhibit 1; and

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

WHEREAS, CURB and AMAFCA have agreed to the distribution of costs for the Amole Arroyo Improvements as shown in the Cost Summary Table, Exhibit 1; and

WHEREAS, AMAFCA Resolution 1982-4 Cost-Sharing with Land Owners, provides for the private sector to share in the cost of flood control facilities; and

WHEREAS, the PROJECT is appropriate for AMAFCA and CURB in that it:

- a. Is consistent with AMAFCA's mission
- b. Provides a major arroyo which was addressed in AMAFCA's DMP
- c. Continues channelization of the Amole Arroyo for eventual delivery of drainage to the Amole Dam
- d. Will provide flood protection for the proposed residential development
- e. Provides a flood-control facility capable of accepting future developed flows as described in the Amole-Hubbell DMP for Amole Arroyo, Alternative #2

WHEREAS, AMAFCA and CURB have previously agreed for CURB to fund a portion of improvement of the Amole Arroyo associated with El Rancho Grande 1, Unit 9, Residential Subdivision, in the amount of \$296,765, via the "Agreement for Improvement of a Portion of the Amole Arroyo Drainage Facility for El Rancho Grande 1, Unit 9, Residential Subdivision" dated March 21, 2003, recorded by the Bernalillo County Clerk as document number 2003087981 on May 27, 2003; and

WHEREAS, AMAFCA has the capability to maintain the PROJECT after construction; and

WHEREAS, the City of Albuquerque and AMAFCA will jointly monitor the status of development in the upstream contributing basin for the need to construct improvements to the Amole Arroyo system, as identified in the Amole-Hubbell Drainage Management Plan; and

WHEREAS, the City of Albuquerque has prepared the Trails and Bikeways Facility Plan, which was endorsed by the AMAFCA Board of Directors via Resolution 1994-2, which identifies a multi-use trail along the flood control facility in this reach; and

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

WHEREAS, said PROJECT also offers opportunities for other purposes, such as open space, parks, trails, and other appropriate public uses, subject to the primacy of the drainage function; and

NOW, THEREFORE, THE PARTIES AGREE AS FOLLOWS:

SECTION ONE: The purpose of this agreement is to:

1. Provide for the design and construction of the Amole Arroyo from the Amole Dam upstream to the Snow Vista Channel confluence, to include crossing structures at Blake Road and Gibson Blvd. No crossing will be built in the alignment of future Unser Blvd. Two sets of contract documents will be provided for construction of separate reaches of the project by CURB and AMAFCA. A FEMA CLOMR for the entire project will be provided, with a LOMR provided for those portions of the Project constructed by CURB.

SECTION TWO: CURB Agrees to:

1. CURB will provide design and construction plans for the full project, from the Amole Dam to the Snow Vista Channel Confluence. Construction plans and specifications will be divided into two individual plan sets as follows:

- a. Plan Set 1, to be built by AMAFCA, will include Reach 1, Reach 2 (including the channel portion of the Unser Blvd. Crossing) and Reach 5, with associated project manual to conform to normal AMAFCA requirements based on the 1994 NMDOT Standard Specifications for Highway and Bridge Constructions.
- b. Plan Set 2, to be built by CURB, will include Reach 3, Reach 4A and 4B, the Blake Road crossing and the Gibson Blvd. crossing, including appropriate transitions at the project ends;
- c. The project shall be designed per the cross sections shown on the attached Map B using tinted shotcrete lining (San Diego Buff, 1 lb. per sack of cement), bottom width as shown on the cross sections for each channel reach, 2:1 side slopes, shotcrete lining to extend to the 100-year water surface elevation, with freeboard

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

slopes contained within the right-of-way, to include large radius channel meanders to provide aesthetics of the drainage corridor, and offline storm water quality drainage swales in locations to be coordinated with AMAFCA during final design of the Project.

- d. Both plan sets shall be provided to AMAFCA in mylar and electronic format. Project manuals for both projects shall be delivered in one hard copy plus electronic format
2. CURB will provide and pay FEMA review fees, as part of the design of the Project, FEMA Conditional Letter of Map Revision (CLOMR) for the entire Project and final Letter of Map Revision (LOMR) for all portions of the project limits to be constructed by CURB.
3. CURB agrees to construct improvements to the Amole Arroyo, to include Reach 3, with appropriate downstream transition, Reach 4A and 4B, the Gibson Blvd. crossing, with appropriate upstream transition, and Blake Road crossing.
4. CURB shall provide AMAFCA financial guarantees, in increments acceptable to AMAFCA as based on the acreage of phased of development of the CURB-owned property in the area, in proportion to the total CURB-owned property in the area, not to exceed the amount of \$2,543,350. Financial guarantees shall be in the form of a certified bank letters of credit or bonds satisfactory to AMAFCA for the necessary improvements, until such improvements are built.

SECTION THREE, AMAFCA agrees to:

1. AMAFCA agrees to release CURB from the "Agreement for Improvement of a Portion of the Amole Arroyo Drainage Facility for El Rancho Grande 1, Unit 9, Residential Subdivision" dated March 21, 2003, recorded by the Bernalillo County Clerk as document number 2003087981 on May 27, 2003; and, to immediately release the Letter of Credit No. 300157, dated May 14, 2003, drawn on Charter Bank, filed with AMAFCA as guarantee for the required

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

improvements, upon receipt of the financial guarantees as cited in Section 4 above, when such financial guarantees total or exceed \$296,765.

2. AMAFCA agrees to construct drainage improvements for the Amole Arroyo identified as Reach 1, the channel section through the Unser Crossing, Reach 2, and Reach 5 from the Amole Dam to Reach 3, and from the Snow Vista Channel to the Gibson Blvd. crossing, when determined necessary and/or desirable by AMAFCA, subject to availability of funds.

3. The decision on the sufficiency of funds shall be at the discretion of the AMAFCA Board of Directors. In the event that subsequent analysis by AMAFCA indicates that the drainage improvements in Reaches 1, 2, or 5 need not be constructed or that different drainage improvements shall be constructed, then AMAFCA shall have the right to elect not to build the drainage improvements or to build different drainage improvements.

4. AMAFCA agrees to convey to CURB approximately 3.0 acres of unused Amole Channel right-of-way for an amount of \$40,000 per acre or the appraised value of the property, whichever is the greater amount, subject to the requirements of AMAFCA Resolution 2003-4, Disposal of Excess Lands. Payment by CURB to AMAFCA shall be in the form of a combination of cash and consideration for improvement costs in excess of the CURB cost share, an amount of \$89,266. The difference between the exact acreage to be acquired (to be determined), multiplied by \$40,000 per acre or the appraised value of the property (to be determined), whichever is the greater amount, and the improvement costs in excess of the Curb cost, (\$89,266) shall be paid to AMAFCA at the time of transfer of the property. The appraisal shall reflect conditions as of the effective date of this Agreement. AMAFCA shall use one of its on-call appraisers as selected by CURB to appraise the surplus property. Cost of the appraisal shall be split evenly between AMAFCA and Curb.

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

SECTION FOUR: BOTH PARTIES Agree as follows:

1. AMAFCA and CURB are sharing the project costs by building separate and distinct reaches of the Project, with the reaches based upon the cost sharing percentages contained herein and as shown on Cost Summary Table, Exhibit 1. Should actual cost vary for either party, no cost adjustments will be made.
2. This cost sharing by CURB will represent the full responsibility of CURB cost participation for this section of the Amole Arroyo Improvements, for CURB's current landholdings within the area. Should CURB acquire additional property within the Sacate Blanco Arroyo watershed, as it exists at the time of this agreement, AMAFCA and CURB shall negotiate a reasonable contribution by CURB for Amole Arroyo Reaches 1 and 2, including the Unser Blvd. crossing, to be the subject of separate agreement tied to the development of the additional property acquired by CURB.
3. The facilities and right of way described herein have the primary purpose of conveying and managing storm water flows, and other interests granted by any party shall be subservient to that purpose.
4. This Agreement does not relieve CURB of the requirement to construct (or financially guarantee construction of) such facilities that AMAFCA and City of Albuquerque may deem necessary.
5. This Agreement shall not preclude the application by CURB to the City of Albuquerque or, should the City and County become consolidated, to the resulting governmental entity, for impact fee credits related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo Improvements. AMAFCA agrees that CURB may enter into discussions simultaneous with, or following, the execution of this Agreement, with the City of Albuquerque for an agreement by which CURB, in the future, may apply for and receive impact fee credits for related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo

**AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL**

Improvements. AMAFCA will not oppose CURB receiving such impact fee credits, and will, to the extent allowed by law and provided that it incurs no cost or expense, reasonably cooperate with CURB's efforts to establish, in the future, impact fee credits related to the costs to be expended by CURB pursuant to this Agreement for the Amole Arroyo Improvements.

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7. This Agreement may not be assigned by any of the parties without the written consent of the other parties, which consent shall not be unreasonably withheld.

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Albuquerque Metropolitan Arroyo
Flood Control Authority
2600 Prospect NE
Albuquerque, NM 87107
FAX: 884-0214

Curb, Inc.
6301 Indian School Rd. NE,
Suite 201
Albuquerque, NM 87110
FAX: 875-1723
and 899-2851

9. This Agreement contains the entire Agreement between the parties hereto and all prior understandings, oral or in writing, by the parties hereto with respect to this Agreement are hereby null and void. No variations, modifications, supplements, waivers or changes herein or hereof shall be binding upon any party hereto unless set forth in a document duly executed by or on behalf of such party.

10. If any provision of this Agreement or the application thereof to any person or circumstance shall be invalid or unenforceable to any extent, the remainder of this Agreement and the application of such provisions to other persons or circumstance shall not be affected thereby and such provisions shall be enforced to the greatest extent permitted by law. In the event any action is instituted by any party for the purpose of enforcing or interpreting any

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

provision of this Agreement, the prevailing party in such action shall be entitled to its reasonable attorney's fees and costs.

11. This Agreement shall inure to the benefit of and be binding upon the undersigned parties and their respective successors and assigns. Whenever in this Agreement a reference to CURB is made, such references shall be deemed to include a reference to successor owners of the CURB property.

12. Each individual signing for each of the parties hereunder warrants and represents that he/she is an authorized agent of such party, on whose behalf he/she is executing this Agreement, and is authorized to execute the same.

13. Each party agrees to execute such other and further instruments and documents as may be necessary or proper in order to complete the transactions contemplated by this Agreement.

14. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, and said counterparts shall constitute but one and the same instrument which may sufficiently be evidenced by one counterpart.

15. Funds for AMAFCA's reaches of the Project will be contingent upon AMAFCA's successful sale of General Obligation Bonds.

16. It is specifically agreed between the parties that this Agreement does not, and is not intended to, create in the public, or any member thereof, any rights whatsoever, such as but not limited to, the rights of a third party beneficiary, nor to authorize anyone not a party to this Agreement to maintain a suit for wrongful death or any other claim, whatsoever.

17. As between the parties, each shall be solely responsible for any and all liability from personal injury, including death or damage to property, arising from any negligent or intentional act or failure to act of the respective party, its officials, agents, contractors or employees pursuant to this Agreement. The liabilities of each applicable party shall be subject to the immunities and limitations of the Tort Claims Act, §§41-4-1, et seq., NMSA, 1978, and any amendments thereto. AMAFCA and its "public employees" as defined in the New Mexico Tort Claims Act, do not waive sovereign immunity, and do not waive any defense and/or do not waive any limitation of

AGREEMENT FOR IMPROVEMENT OF A PORTION OF THE
AMOLE ARROYO DRAINAGE FACILITY
FROM AMOLE DAM TO SNOW VISTA CHANNEL

Curb, Inc.
a New Mexico Corporation

Charles A. Haegelin
Charles Haegelin, President, Curb, Inc.

STATE OF NEW MEXICO)
)ss.
COUNTY OF BERNALILLO)

This instrument was acknowledged before me on JANUARY 14th, 2003⁴ by
Charles Haegelin, President of Curb, Inc., a New Mexico Corporation.

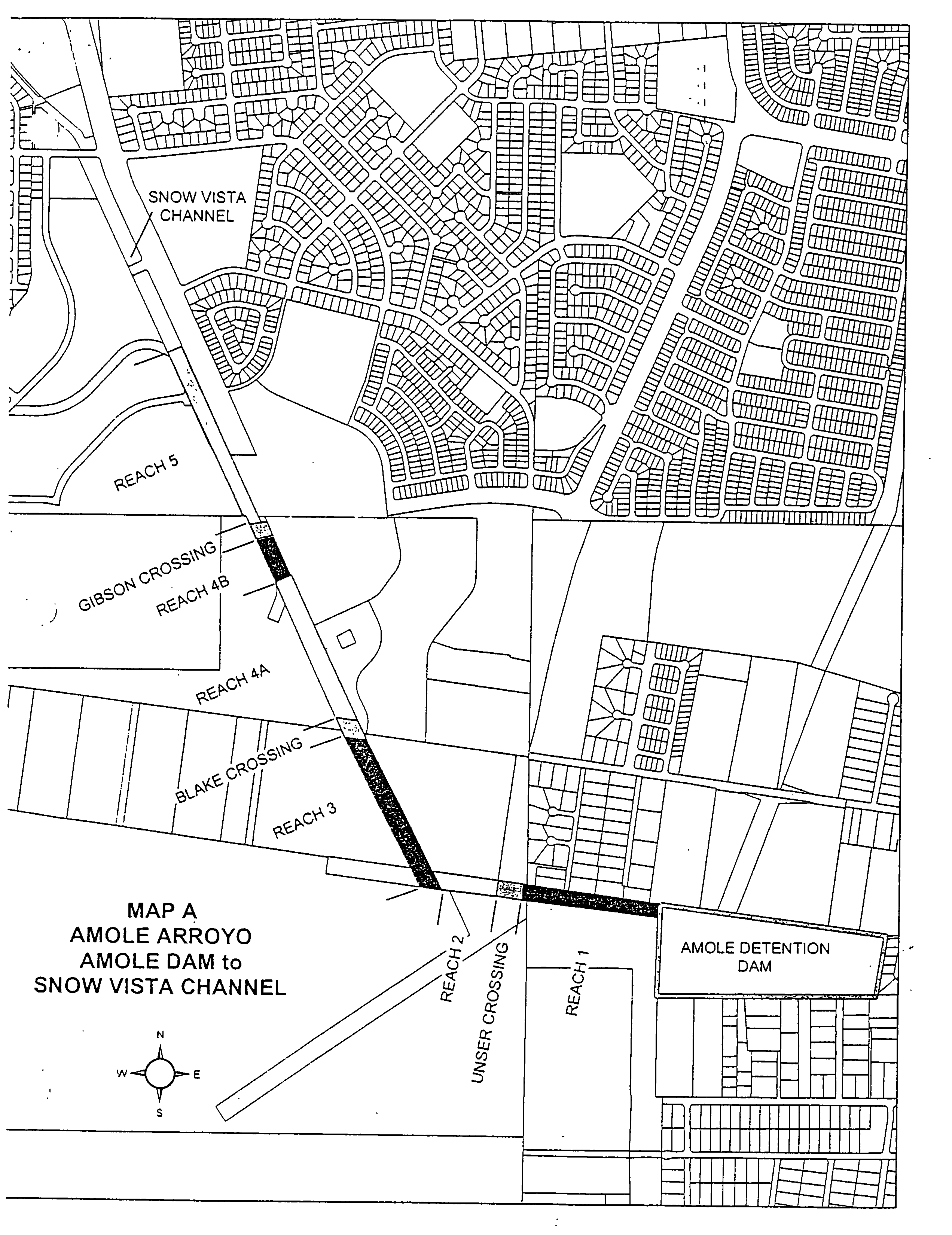
Neil J. J.
Notary Public

My commission expires:



OFFICIAL SEAL
RICHARD J. SQUIRES
NOTARY PUBLIC-STATE OF NEW MEXICO

My commission expires: 10/1/2007



SNOW VISTA
CHANNEL

REACH 5

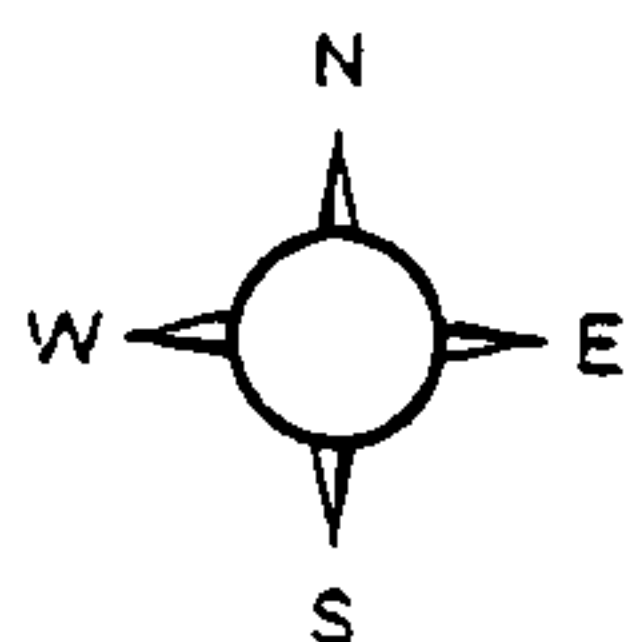
GIBSON CROSSING
REACH 4B

REACH 4A

BLAKE CROSSING

REACH 3

MAP A
AMOLE ARROYO
AMOLE DAM to
SNOW VISTA CHANNEL

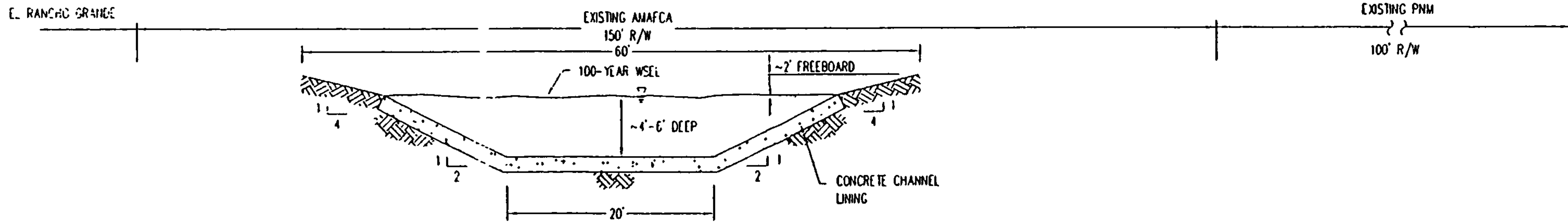


REACH 2

UNSER CROSSING

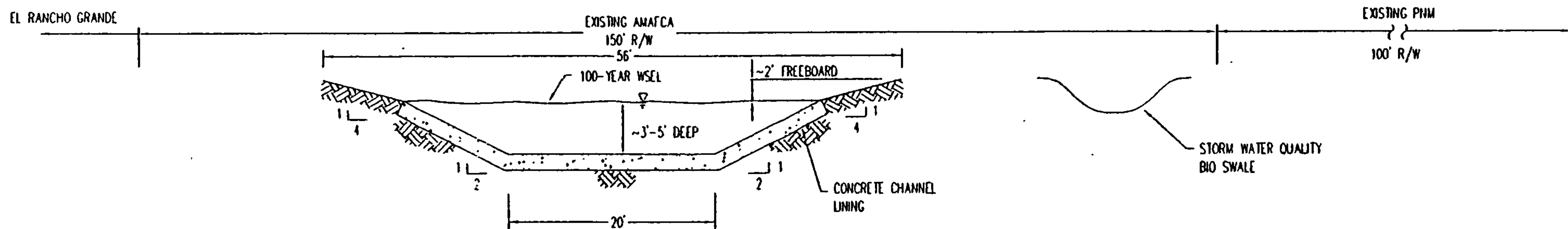
REACH 1

AMOLE DETENTION
DAM



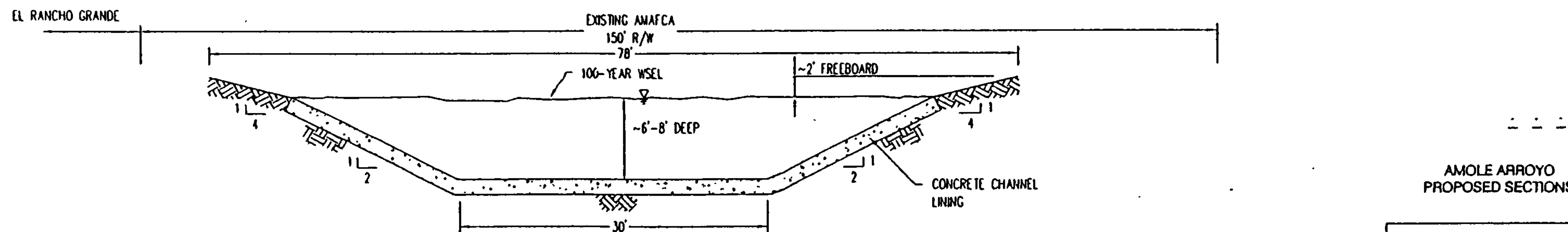
SECTION C-C / REACHES 4b & 5

SCALE: 1" = 10'



SECTION B-B / REACHES 3 & 4a

SCALE: 1" = 10'



SECTION A-A / REACHES 1 & 2

SCALE: 1" = 10'

AMOLE ARROYO
PROPOSED SECTIONS

Bolton **Huston**

Geography: 7000 Johnson St. NE Albuquerque, NM 87110-4000
ENGINEERING SPATIAL DATA ADVANCED PLANNING & DESIGN

MAP B

map: 10000 VMC, OVERVIEW LINES
12/2/04

CDA

DESIGN ANALYSIS REPORT

FOR THE

AMOLE DEL NORTE

STORM DIVERSION FACILITY

PHASES I & II

FROM THE AMOLE DETENTION BASIN
NORTH TO BRIDGE BLVD.

CITY OF ALBUQUERQUE

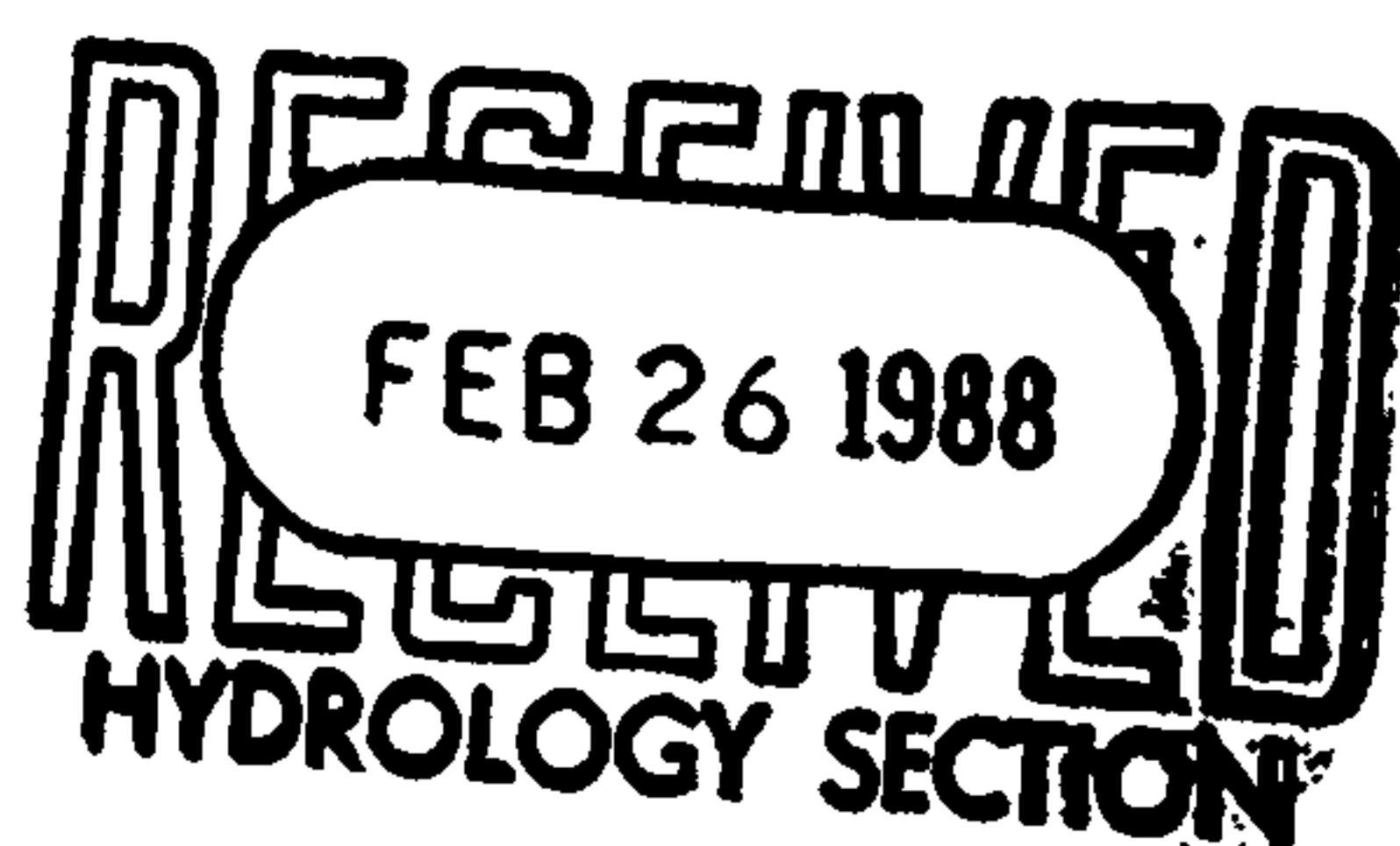


Boyle
Engineering
Corporation

consulting engineers

Suite D
3939 San Pedro N.E.
Albuquerque, New Mexico 87110

505/883-7700



PROJECT NO. 2480

ALBUQUERQUE, NEW MEXICO

JANUARY 1986

209/2006

Boyle Engineering Corporation

Suite D
3939 San Pedro N.E.
Albuquerque, New Mexico 87110

consulting engineers

505 / 883-7700

City of Albuquerque
Municipal Development Department
P.O. Box 1293
Albuquerque, New Mexico 87103

January 17, 1986
AL-A01-116-01

ATTN: Mr. Jim Fink, Planning & Programming Hydrologist

RE: DESIGN ANALYSIS REPORT, PHASES I & II
AMOLE DEL NORTE STORM DIVERSION FACILITY, PROJECT 2480

In accordance with paragraph A.1.h. of Exhibit I of A/E Services Agreement No. 85-26 dated July 23 1985, we are pleased to submit five copies of the final Design Analysis Report for the Amole Del Norte project, Phases I and II.

This report contains the detailed analysis for the complete design of Phase I of the project, which extends from the Amole Detention Basin north to Station 38+45.

Detailed earthwork calculations for Phase II were not included at this time, as a supplemental design analysis report must be issued at a later date for that phase. That supplement will also incorporate our findings in response to the City's request to investigate diversion a portion of the the West Bluff-Phase III drainage into the Amole Del Norte Phase II detention basin between Bridge Blvd. and Tower Road. Our office has completed approximately 90% of this additional hydraulic analysis, but the results must still be discussed with the West Bluff consultant.

We appreciate the comments and discussions of the City's technical staff in the preparation of this report.

Sincerely,

BOYLE ENGINEERING CORPORATION

Thornton D. Schwenk

Thornton D. Schwenk, P.E.
Senior Civil Engineer II



DESIGN ANALYSIS REPORT

for the

AMOLE DEL NORTE
STORM DIVERSION FACILITY
PHASES I & II

from the Amole Detention Basin
to Bridge Boulevard

CITY OF ALBUQUERQUE

PROJECT NO. 2480

January 1986

prepared by

BOYLE ENGINEERING CORPORATION
3939-D San Pedro, N.E.
Albuquerque, New Mexico 87110

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5. ROAD CROSSING INFORMATION	6
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8. SOILS INVESTIGATIONS	13

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TABLE 2 NORMAL CHANNEL DEPTHS USING MANNINGS'S EQUATION

APPENDIX

Boyle Digital Terrain Model (BDTM) Earthwork Computations

Water Surface Profiles using LAWSPG Computer Program

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1. INTRODUCTION

The Amole Del Norte Drainage Basin located on Albuquerque's West Mesa, encompasses an area of approximately 6.6 square miles. The basin lies west of Coors Blvd., extends south from the Ladera Detention system and is bounded on the south by the Amole Detention Basin and on the west by the Snow Vista Channel. West Central Avenue crosses the area at about the northerly third point.

Drainage facilities for this area have been in various stages of analysis and preliminary design for several years. Channel right-of-way maps were completed in September 1980, and construction drawings for the first 2800 feet of channel were prepared by Boyle in January 1982. With the evolution of new drainage criteria provided by the Albuquerque Development Process Manual (DPM) adopted in April 1982, and enactment of a revised Drainage Ordinance in October 1982, in combination with new land developments on the West Mesa and concern over increasing projected construction costs of the facility, it became apparent that a total re-evaluation of the Amole Del Norte basin was in order.

At the request of the City, Boyle Engineering conducted this re-evaluation study, the results of which were reported in two separate documents under A/E Agreement 83-29, dated February 3, 1984.

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1. "Investigation Phase Report for the Re-Evaluation Study of the Amole Del Norte Storm Diversion Facility", dated July 30, 1984, and
 2. "Design Development Report for the Re-Evaluation Study of the Amole Del Norte Storm Diversion Facility", dated February 28, 1985.

Based on this re-evaluation study, the City selected the recommended alternate for design of a concrete-lined channel having a 10-ft bottom width. The 12,000-ft channel would extend south from a 35-acre-ft detention basin between Bridge Blvd. and Tower Road to the AMAFCA-owned Amole Detention Basin, which is 1100 feet south of Blake Road.

The facility will be constructed in at least two phases to correlate with the availability of funding. It is anticipated that approximately \$2.16 million will be available to begin construction of Phase I in 1986. Additional funding may become available in 1988 and 1990. Construction of Phase I will commence at the south end of the facility and extend as far north as funding for that phase will permit. Based on preliminary opinions of costs, this location will be in the vicinity of Sta. 38+52, 2700 feet north of Blake Road.

2. SCOPE

This report is limited to a detailed analysis of the channel hydraulics and certain other design considerations, which were not covered in the above-mentioned study. The Engineer's Opinion

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of Preliminary Construction Cost is included only for Phase I. At the time this report was prepared, the City had asked that Boyle investigate the possibility of modifying the Phase II detention basin at Bridge Blvd., to accept approximately 760 cfs from the West Bluff - Phase III basin. Therefore Phase II costs were not included until this investigation and basin design have been completed.

3. AUTHORITY

This report is submitted in compliance with the requirements of A/E Services Agreement 85-26 dated July 23, 1985, by and between the City of Albuquerque and Boyle Engineering Corporation, with specific reference to Exhibit I, Paragraph A, BASIC SERVICES for "Preliminary Design for Construction Phase I and Phase II".

4. RE-ALIGNMENT OF CONSTRUCTION CENTERLINE

4.1 Horizontal Re-alignment

Right-of-way requirements for the main channel, side channel inlets and roadway crossings were originally computed in 1980, and legal descriptions were filed with the Bernalillo County Clerk on September 11, 1980. Modifications were made to that alignment through June 1982, in response to requests made to the City's Property Management Division from affected property owners. After that time no further alignment changes were allowed, and acquisition of the right-of-way was carried out by the City.

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Channel bottom widths for the earlier designs of 1980 and 1982 varied from a minimum of 30 feet at the upstream end to 55 feet at the outfall into the Amole Detention Basin. Major side flows were introduced into the main channel at channel intersections, with increased channel widths occurring downstream of these intersections. As a consequence of the discontinuity in the channel widths, the construction centerline of the channel was also discontinuous, with offsets of five feet occurring at two locations. These widths, combined with profile grade requirements and existing topography, resulted in right-of-way requirements ranging from 125 feet to 160 feet. In the current (1985) design, the channel was lowered on the average of seven feet and the bottom width was held at a constant 10 feet. These two design changes resulted in several changes to the channel alignment as follows. All centerline re-alignments were evaluated to insure that the new position of the channel would still be confined within the existing right-of-way.

1. The two 5.0-ft offsets in the centerline at Sta. 20+29.81 and at Sta. 55+00 were eliminated.
2. The 1500-ft curve at Sage Road was split into two 1500-ft curves separated by a straight segment, to allow for construction of a straight trapezoidal box culvert under the roadway.
3. Hydraulics of the supercritical flow regime at these two curves at Sage Road required the design of upstream and downstream hydraulic easement curves per DPM 22.3.C.3.9(2).

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These four curves were calculated to have a length of 55 feet and a centerline radius of 3000 feet.

4. A right-of-way conflict with the North/South Coors Connection, F.A.U.P. M-4001(2), required that the centerline of the channel be shifted further west at Tower Road to align with the new retention/detention basin between Tower Road and Bridge Blvd.

4.2 Vertical Re-alignment

As noted in the Amole Del Norte Design-Development Report, the preferred alternate for the concrete-lined channel consisted of a subcritical reach to Sta 59+18 and a supercritical reach north from that point to Tower Road at Sta 118+50. A vertical alignment was designed which would eliminate the need to relocate or lower the existing 36-inch diameter potable water line, which lies approximately 15 feet north of the existing centerline of Arenal Road.

4.3 Elevation Equation for Vertical Datum

After the aerial photography of the Amole Del Norte Basin was flown in 1979, Boyle discovered that the vertical control datum used by the photogrametrists in scribing the topographic contours was 0.32 feet below the City of Albuquerque (ACS) datum. Boyle brought this problem to the attention of Dan Montano of the City Surveyor's office on September 22, 1982.

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To overcome this problem, Boyle recommended that a vertical equation be noted on every sheet of the drawings which contains elevation data. This note will contain language to the effect that 0.32 feet should be added to the elevations shown in the drawings to bring them up to ACS datum. In addition Boyle proposed to set semi-permanent bench marks at points along the channel alignment to provide the contractor with on-site vertical control. Thus the contractor would not have to bring in his own vertical control, which is generally over 2000 feet away. On October 7, 1982, MDD engineer Rick Roybal, with the concurrence of then-City Engineer Richard Heller, agreed to these recommendations, if Boyle would set these monuments at no expense to the City. Monument information will appear on the drawings for Contractor use.

5. ROAD CROSSING INFORMATION

Based on the 1985 Long Range Major Street Plan (LRMSP), channel crossings were located at Blake, Arenal, Sage and Tower Roads. Information on probable ultimate right-of-way, number of traffic lanes, and bike lanes requirements were furnished by Jerry Widdison of the City's Transportation Department on September 4, 1985 as shown in Table 1.

Planning studies for the Gibson West Extension indicate that that principal arterial street could possibly utilize the 86-ft existing right-of-way of Arenal in the vicinity of channel Sta 67+00. However any future right-of-way taking must come off the north side of Arenal; i.e., an ultimate right-of-way of either 156 feet

or as much as 200 feet would be measured north from the existing south right-of-way line of Arenal. Right-of-way acquisition on the south side of Arenal cannot be permitted by Federal regulation because of interference with the existing Tom Tenorio Park 300 feet east of the channel.

San Ygnacio Road is not programmed to cross the Amole Del Norte channel. To avoid a dead end of both the east and west approaches, excess right-of-way 50-ft wide was acquired for connection of San Ygnacio to Tower and to Sage Roads. As shown on the 1980 right-of-way maps, a 1120-ft connection links San Ygnacio to Sage Road to the south along an extension of 75th Street east of the channel and a 1150-ft connection links San Ygnacio to Tower Road to the north, running on the west side of and adjacent to the channel right-of-way.

6. HYDRAULICS

6.1 Water Surface Profile Analysis

Water surface profiles were determined for 100-year flows for developed conditions using the Los Angeles County Flood Control District Water Surface and Pressure Gradient (LAWSPG) computer program. Computer printouts of the results are attached for reference. The computational procedure used in the program is based on solving Bernoulli's equation for total energy at each section and Manning's formula for friction loss between the sections in a reach. The open channel flow procedure utilizes the standard step method and confluences are analyzed using pressure

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and momentum theory. The effects of high water surface elevations within the Amole Del Norte Detention Basin on the channel backwater curve were not examined since peak channel flows occur when the water depth in the basin is 4 to 5 feet. It was determined in both channel conditions that normal depths are obtained in the longer channel reaches (See Table 2). Concrete channel lining depths were established using 1.50 feet of freeboard for the subcritical channel and 2.00 feet of freeboard for the supercritical channel.

One of the major concerns in the channel hydraulic design was the stabilization of the hydraulic jump formed at the transition from supercritical to subcritical flow just south of Arenal Road. The low Froude number (around 1.3) for normal flow conditions in the channel had to be increased. This was done by steepening a section of the channel so the Froude number at the entrance to the jump is 1.9. Although the jump will not be a strong jump, it will be stable and should not be conducive to the formation of standing waves. Care was taken throughout the supercritical reach of the channel to assure that channel flow would not be forced to subcritical conditions due to transitions and confluences, thus preventing the formation of other jumps.

Within the subcritical reach of the channel, the Blake Road crossing structure and the drop sections are the only hydraulic complications. The water surface through the trapezoidal box culvert is depressed due to the 1.5:1 side slopes, but not the point where the structure acts as a choke. The drop sections

will create conditions favorable to forming a stable jump at low flows and the jumps are drowned out at 100-year flows.

6.2 Energy Dissipator

The energy dissipator was designed according to the procedures outlined in the Bureau of Reclamation, Engineering Monograph No. 25, "Hydraulic Design of Stilling Basins and Energy Dissipators," Section 9. The design discharge was 45.75 cfs per foot of width (40-foot wide dissipator). Other unit discharge were analyzed, but as the unit discharge increased so did the cost of the structure because of the additional structural requirements for higher side walls. Lower unit discharges resulted in a wider dissipater which increased the cost of structural excavation and the baffled slab.

6.3 Road Crossing Structures

The road crossing structures were designed as trapezoidal box culverts with 1.5:1 side slopes in the subcritical reach and 2:1 side slopes in the supercritical reach. This type of structure was found to be the most economically and hydraulically favorable when compared with multiple rectangular box culverts. From the standpoint of channel maintenance, the trapezoidal box culvert is preferred as support piers are not required and the section is hydraulically "clean". The transition to 1.5:1 side slopes for the Blake Road structure slopes can be done using the typical 7-inch thick channel section, as opposed to a special more-expensive transition section which would have been required

in order to match a rectangular box culvert. Using 2:1 side slopes for the culverts in the supercritical reach reduces the cost of the structure without sacrificing the desirable hydraulic characteristics, since both rectangular box culverts and trapezoidal box culverts with 1.5:1 sideslopes choked the flow to subcritical conditions creating undesirable hydraulic jumps upstream of the boxes. The boxes were hydraulically sized assuming full development and the 100-year 6-hour storm within the basin. Storm flows collected at the road crossings will enter the channel through conduits placed downstream of each culvert.

6.4 Channel Inlet Design

In the "Design Development Report for the Re-evaluation Study of the Amole Del Norte Storm Diversion Facility" prepared by Boyle in February 1985, storm runoff from developed conditions was intended to enter the channel through storm sewer conduits. Until development progresses to the point where these storm sewers are installed, all of the runoff will be overland flow. The parallel side channels shown on the drawings are designed to intercept this flow and admit it to the main channel at selected locations. Inlets to the main channel are spaced to maximize the side channel capacity for developed conditions in the adjacent drainage basin without exceeding a flow velocity of 3.0 feet per second at a depth of 1.0 feet. In general the inlet flow is less than 2.0% of the main channel flow.

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Major channel intersections are not required to allow side flows to enter the main channel since at no location along the channel length do inlet flows equal or exceed 25 percent of the main channel flow. Arenal and Sage Roads intercept a major portion of the existing overland flows and are expected to contain future storm sewers. RCP conduit inlets were sized for these locations to meet the developed flow requirements assuming a maximum velocity of 10 feet per second and a Manning's $n=0.014$.

Installation of culvert pipes at this time solves the problem of admitting flows from the roads and eliminates cutting or damage of the channel lining if the conduits had to be installed in the future. The same approach was taken for the conduit inlet at Station 20+85.

Invert elevations of channel inlets are set above the channel water surface for 100-year flows. If this invert elevation was above the adjacent existing ground then the area was filled with material excavated from the channel so overland flow was directed toward the inlet.

7. EARTHWORK COMPUTATIONS

Earthwork volumes were determined using the Boyle Digital Terrain Model computer program to analyze digitized cross-sections. Computer printouts are attached for reference and the results are tabulated below for 30% shrinkage (100 c.y. of excavated material compacts to 70 c.y. of fill). These results only include earthwork for Phase I.

EARTHWORK SUMMARY

PHASE I:

CUT

Channel Excavation	77,800	CY
--------------------	--------	----

FILL

Channel Fill	15,800	CY
--------------	--------	----

Fill Adjacent to Channel (Areal Fill)	59,100	CY
---------------------------------------	--------	----

Fill Construction for Blake Road	2,900	CY
----------------------------------	-------	----

Required Spoil or Borrow	0	CY
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To achieve an earthwork balance for Phase I, the amount of fill placed in the abandoned sewage lagoons was adjusted. Filling of the lagoons to direct water toward the final channel will be completed in Phase II channel construction. Once the grading requirements for the detention basin north of Tower Road have been determined, the earthwork quantities for Phase II will be finalized and evaluated.

Temporary construction easements and/or additional right-of-way purchases are required for the fill area south of Blake Road and for a small area north of Arenal Road. The remainder of the channel construction can take place within the existing right-of-way. However, further analysis is required to determine the land needed for the detention basin north of Tower Road.

8. SOILS INVESTIGATIONS

Results of the following Geotechnical Investigation Reports for the Amole Del Norte project, prepared by Sergeant, Hauskins &

Beckwith, were utilized in the design of embankments, hydraulic structures, and the open channel:

1. SHB Job No. E79-1140, dated January 11, 1980
2. SHB Job No. E81-1124, dated January 11, 1982
3. Addendum No. 1 to SHB Job No. E81-1124, dated November 15, 1985

Copies of these reports may be examined at the offices of Boyle Engineering Corporation.

AMOLE DEL NORTE STORM DIVERSION FACILITY

TABLE 1

ROAD CROSSING INFORMATION

<u>STREET</u>	<u>BLAKE</u>	<u>ARENAL</u>	<u>SAGE</u>	<u>TOWER</u>
1. FUNCTIONAL CLASS.(1)	COLLECTOR	PRINCIPAL ARTERIAL	MINOR ARTERIAL	MINOR ARTERIAL
2. EXISTING R.O.W.(1)	64	86	60	100
3. PROBABLE ULT. R.O.W.(1)	68	156(2,3)	86	100
4. PROBABLE NO. OF LANES(1)	4 (PLUS BIKE LANE)	6 (PLUS BIKE TRAIL)	4	4 (PLUS BIKE TRAIL)
5. DESIGN SPEED	35	40	40	40
6. DETOUR DESIGN SPEED	35	35	35	35
7. CHANNEL STA. AT INTERSECTION W/ C/L ULT. R.O.W.	11+30.47	67+24.88	94+12.89	
8. BEARING OF CHANNEL C/L AT CROSSING	N20°51'09"E N20°52'45"E N17°39'29"E			
9. BEARING OF ROAD C/L	S82°31'13"E S81°10'00"E N75°46'08"E N75°34'00"E			
10. SKEW ANGLE OF CULVERT	13°22'22" LEFT FWD	12°02'45" LEFT FWD	31°53'21" LEFT FWD	

- (1) Data furnished 9-4-85 by Jerry Widdison, City of Albuquerque, Transportation Dept.
- (2) Possible future re-alignment and as much as 200 feet of R.O.W., as part of Gibson West Extension currently under study.
- (3) Measured from existing South R.O.W., personal communication 10-1-85 from Jerry Widdison

AMOLE DEL NORTE STORM DIVERSION FACILITY

TABLE 2

NORMAL CHANNEL DEPTHS USING MANNING'S EQUATION

Channel Reach	Flow Rate (cfs)	Normal Depth (ft.)	Velocity (fps)	Critical Depth (ft.)
STA 0+50 to STA 22+26	1830	8.62	7.80	6.69
STA 22+60 to STA 36+70	1720	8.38	7.67	6.49
STA 37+00 to STA 49+17	1665	8.25	7.61	6.38
STA 49+50 to STA 59+18	1600	8.10	7.53	6.25
STA 59+18 to STA 65+50	1600	5.43	14.13	6.25
STA 65+50 to STA 93+00	1360	5.02	13.53	5.76
STA 93+00 to STA 118+50	1220	4.75	13.15	5.44

Note: Value of Manning's $n = 0.014$

APPENDIX

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BOYLE DIGITAL TERRAIN MODEL (BDTM)
EARTHWORK COMPUTATIONS

ROYLE ENGINEERING CORPORATION

EARTHWORK QUANTITIES

THU, DEC 5, 1905, 3:46 PM

ANOLE DEL NORTE STORM DIVERSION FACILITY, PHASE I, NOVEMBER '85

--- S T A T I O N I N G ---
BASELINE DESIGNLINE

CROSS SECTION AREA
CUT FILL

INCREMENTAL
CUT FILL

ACCUMULATED
CUT FILL

0 + 13.69	0 + 12.00	714.5	-600.0	0	0	0	HAUL
1 + 01.69	1 + 00.00	377.3	-823.1	1779	-2332	-2332	-553
2 + 01.69	2 + 00.00	349.1	-967.9	1345	-3317	-5649	-2524
3 + 01.69	3 + 00.00	377.9	-594.3	1346	-2093	-8542	-4071
4 + 01.69	4 + 00.00	304.0	-554.2	1412	-2127	-10669	-4786
5 + 01.69	5 + 00.00	402.1	-632.9	1457	-2198	-12067	-5527
6 + 01.69	6 + 00.00	363.0	-691.1	1417	-2452	-15319	-6562
7 + 01.69	7 + 00.00	352.5	-703.5	1325	-2503	-17902	-7019
8 + 01.69	8 + 00.00	399.0	-342.3	1393	-1937	-19030	-8363
9 + 01.69	9 + 00.00	411.3	-270.1	1502	-1134	-20972	-7995
10 + 01.69	10 + 00.00	410.4	-310.2	1537	-1075	-22047	-7533
10 + 96.16	10 + 94.47	335.4	-161.2	1319	-825	-22072	-7039
11 + 01.69	11 + 00.00	335.2	-163.2	69	-33	-22905	-7004
11 + 60.16	11 + 66.47	340.9	-123.0	842	-353	-23258	-6515
12 + 01.69	12 + 00.00	352.9	-156.4	436	-174	-23432	-6253
13 + 01.69	13 + 00.00	410.0	-112.1	1414	-497	-23930	-5336
14 + 01.69	14 + 00.00	377.5	-147.0	1460	-480	-24409	-4356
15 + 01.69	15 + 00.00	422.0	-104.9	1401	-466	-24876	-3342
16 + 01.69	16 + 00.00	510.1	-42.3	1741	-273	-25148	-1074
17 + 01.69	17 + 00.00	590.4	-14.3	2053	-105	-25253	74
18 + 01.69	18 + 00.00	643.5	-3.7	2285	-33	-25207	2326
19 + 01.69	19 + 00.00	630.2	-41.9	2359	-84	-25371	4600
20 + 01.69	20 + 00.00	627.0	-4.6	2330	-86	-25457	6044
21 + 01.69	21 + 00.00	591.9	-5.6	2259	-19	-25476	9004
22 + 01.69	22 + 00.00	462.9	-0.7	1953	-27	-25502	11011
23 + 01.69	23 + 00.00	542.0	-5	1862	-17	-25519	12056
24 + 01.69	24 + 00.00	607.1	0	2278	-1	-25520	15133
25 + 01.69	25 + 00.00	675.6	0	2524	0	-25520	17656
26 + 01.69	26 + 00.00	645.2	0	2446	0	-25520	20102
27 + 01.69	27 + 00.00	741.7	0	2568	0	-25520	22670
28 + 01.69	28 + 00.00	933.0	0	3103	0	-25520	25773
29 + 01.69	29 + 00.00	1011.7	0	3603	0	-25520	29376
30 + 01.69	30 + 00.00	1073.4	0	3861	0	-25520	33237
31 + 01.69	31 + 00.00	1016.0	0	3069	0	-25520	37106
32 + 01.69	32 + 00.00	941.7	0	3625	0	-25520	40732
33 + 01.69	33 + 00.00	759.0	0	3151	0	-25520	43803
34 + 01.69	34 + 00.00	616.3	0	2548	0	-25520	46431
35 + 01.69	35 + 00.00	551.0	0	2162	0	-25520	48593
36 + 01.69	36 + 00.00	384.2	-3.8	1732	-7	-25527	50318
37 + 01.69	37 + 00.00	216.8	-105.4	1113	-202	-25730	51228
38 + 01.61	38 + 00.00	159.1	-156.6	696	-485	-26215	51439
38 + 26.54	38 + 25.00	160.1	-155.2	148	-144	-26359	51443

BOYLE ENGINEERING CORPORATION

SLOPE STAKE INFORMATION

MOLE DEL NORTE STORM DIVERSION FACILITY, PHASE I, NOVEMBER '85

THU, DEC 5, 1985, 3:46 PM

--- S T A T I O N I N G ---		--- PROFILE ---		-----		DESIGNLINE		-----		SLOPE		L E F		T		R I G H		SLOPE		T	
BASELINE		DESIGNLINE		ELEV		OFFSET		SLOPE		CATCH PT		PVT		EDGE		CATCH PT		PVT		EDGE	
0	+ 13.69	0	+ 12.00	4905.380	16.62	200.0	16.62	200.0	16.62	-520.59	200.0	0.00	0.00	0.00	0.00	55.00	57.92	3.0	3.0	57.92	.00
1	+ 01.69	1	+ 00.00	4905.430	11.40	200.0	11.40	200.0	11.40	-485.84	200.0	0.00	0.00	0.00	0.00	55.00	72.67	-3.0	-3.0	72.67	.00
2	+ 01.69	2	+ 00.00	4905.504	10.92	200.0	10.92	200.0	10.92	-485.79	200.0	0.00	0.00	0.00	0.00	55.00	72.66	-3.0	-3.0	72.66	.00
3	+ 01.69	3	+ 00.00	4905.570	11.43	200.0	11.43	200.0	11.43	-483.62	200.0	0.00	0.00	0.00	0.00	55.00	71.98	-3.0	-3.0	71.98	.00
4	+ 01.69	4	+ 00.00	4905.636	11.56	200.0	11.56	200.0	11.56	-395.75	200.0	0.00	0.00	0.00	0.00	55.00	69.04	-3.0	-3.0	69.04	.00
5	+ 01.69	5	+ 00.00	4905.703	11.05	200.0	11.05	200.0	11.05	-437.34	200.0	0.00	0.00	0.00	0.00	55.00	69.50	-3.0	-3.0	69.50	.00
6	+ 01.69	6	+ 00.00	4905.769	11.16	200.0	11.16	200.0	11.16	-476.92	200.0	0.00	0.00	0.00	0.00	55.00	73.33	-3.0	-3.0	73.33	.00
7	+ 01.69	7	+ 00.00	4905.835	10.98	200.0	10.98	200.0	10.98	-392.91	200.0	0.00	0.00	0.00	0.00	55.00	72.26	-3.0	-3.0	72.26	.00
8	+ 01.69	8	+ 00.00	4905.901	11.02	200.0	11.02	200.0	11.02	-273.50	200.0	0.00	0.00	0.00	0.00	55.00	68.06	-3.0	-3.0	68.06	.00
9	+ 01.69	9	+ 00.00	4905.967	12.02	200.0	12.02	200.0	12.02	-210.30	200.0	0.00	0.00	0.00	0.00	55.00	67.21	-3.0	-3.0	67.21	.00
10	+ 01.69	10	+ 00.00	4906.033	12.14	200.0	12.14	200.0	12.14	-281.35	200.0	0.00	0.00	0.00	0.00	55.00	66.07	-3.0	-3.0	66.07	.00
10	+ 96.16	10	+ 94.47	4906.095	11.90	-3.0	11.90	-3.0	11.90	-65.00	-3.0	0.00	0.00	0.00	0.00	55.00	59.47	-3.0	-3.0	59.47	.00
11	+ 01.69	11	+ 00.00	4906.099	11.90	-3.0	11.90	-3.0	11.90	-65.77	-3.0	0.00	0.00	0.00	0.00	55.00	59.45	-3.0	-3.0	59.45	.00
11	+ 68.16	11	+ 66.47	4906.143	12.18	-3.0	12.18	-3.0	12.18	-48.57	-3.0	0.00	0.00	0.00	0.00	55.00	60.00	-2.2*	-2.2*	60.00	.00
12	+ 01.69	12	+ 00.00	4906.165	11.88	-3.0	11.88	-3.0	11.88	-49.27	-3.0	0.00	0.00	0.00	0.00	55.00	65.00	-2.8*	-2.8*	65.00	.00
13	+ 01.69	13	+ 00.00	4906.231	12.01	-3.0	12.01	-3.0	12.01	-50.50	-3.0	0.00	0.00	0.00	0.00	55.00	64.74	-3.0	-3.0	64.74	.00
14	+ 01.69	14	+ 00.00	4906.297	11.30	3.0	11.30	3.0	11.30	-62.97	3.0	0.00	0.00	0.00	0.00	55.00	66.17	-3.0	-3.0	66.17	.00
15	+ 01.69	15	+ 00.00	4906.363	11.99	3.0	11.99	3.0	11.99	-62.92	3.0	0.00	0.00	0.00	0.00	55.00	63.99	-3.0	-3.0	63.99	.00
16	+ 01.69	16	+ 00.00	4906.430	13.26	3.0	13.26	3.0	13.26	-64.65	3.0	0.00	0.00	0.00	0.00	55.00	59.32	-3.0	-3.0	59.32	.00
17	+ 01.69	17	+ 00.00	4906.496	14.10	3.0	14.10	3.0	14.10	-65.41	3.0	0.00	0.00	0.00	0.00	55.00	56.48	-3.0	-3.0	56.48	.00
18	+ 01.69	18	+ 00.00	4906.562	14.67	3.0	14.67	3.0	14.67	-65.42	3.0	0.00	0.00	0.00	0.00	55.00	54.56	-3.0	-3.0	54.56	.00
19	+ 01.69	19	+ 00.00	4906.628	14.37	3.0	14.37	3.0	14.37	-65.27	3.0	0.00	0.00	0.00	0.00	55.00	60.53	-3.0	-3.0	60.53	.00
20	+ 01.69	20	+ 00.00	4906.694	14.59	3.0	14.59	3.0	14.59	-62.30	3.0	0.00	0.00	0.00	0.00	55.00	54.42	-3.0	-3.0	54.42	.00
21	+ 01.69	21	+ 00.00	4906.760	14.33	3.0	14.33	3.0	14.33	-58.08	3.0	0.00	0.00	0.00	0.00	55.00	54.36	-3.0	-3.0	54.36	.00
22	+ 01.69	22	+ 00.00	4906.804	12.11	3.0	12.11	3.0	12.11	-58.42	3.0	0.00	0.00	0.00	0.00	55.00	49.20	-3.0	-3.0	49.20	.00
23	+ 01.69	23	+ 00.00	4908.070	12.98	3.0	12.98	3.0	12.98	-59.90	3.0	0.00	0.00	0.00	0.00	55.00	46.55	-3.0	-3.0	46.55	.00
24	+ 01.69	24	+ 00.00	4908.936	14.32	3.0	14.32	3.0	14.32	-62.86	3.0	0.00	0.00	0.00	0.00	55.00	49.39	3.0	3.0	49.39	.00
25	+ 01.69	25	+ 00.00	4909.002	14.25	3.0	14.25	3.0	14.25	-61.84	3.0	0.00	0.00	0.00	0.00	55.00	40.98	3.0	3.0	40.98	.00
26	+ 01.69	26	+ 00.00	4909.060	14.00	3.0	14.00	3.0	14.00	-60.45	3.0	0.00	0.00	0.00	0.00	55.00	47.87	3.0	3.0	47.87	.00
27	+ 01.69	27	+ 00.00	4909.134	14.70	3.0	14.70	3.0	14.70	-64.12	3.0	0.00	0.00	0.00	0.00	55.00	50.00	3.0	3.0	50.00	.00
28	+ 01.69	28	+ 00.00	4909.200	16.80	3.0	16.80	3.0	16.80	-62.02	3.0	0.00	0.00	0.00	0.00	55.00	56.89	3.0	3.0	56.89	.00
29	+ 01.69	29	+ 00.00	4909.266	16.96	3.0	16.96	3.0	16.96	-69.81	3.0	0.00	0.00	0.00	0.00	55.00	57.85	3.0	3.0	57.85	.00
30	+ 01.69	30	+ 00.00	4909.332	17.43	3.0	17.43	3.0	17.43	-72.21	3.0	0.00	0.00	0.00	0.00	55.00	58.20	3.0	3.0	58.20	.00
31	+ 01.69	31	+ 00.00	4909.398	17.09	3.0	17.09	3.0	17.09	-68.76	3.0	0.00	0.00	0.00	0.00	55.00	57.78	3.0	3.0	57.78	.00
32	+ 01.69	32	+ 00.00	4909.464	16.55	3.0	16.55	3.0	16.55	-66.28	3.0	0.00	0.00	0.00	0.00	55.00	55.72	3.0	3.0	55.72	.00
33	+ 01.69	33	+ 00.00	4909.530	15.88	3.0	15.88	3.0	15.88	-59.71	3.0	0.00	0.00	0.00	0.00	55.00	51.71	3.0	3.0	51.71	.00
34	+ 01.69	34	+ 00.00	4909.596	13.99	3.0	13.99	3.0	13.99	-50.01	3.0	0.00	0.00	0.00	0.00	55.00	48.17	3.0	3.0	48.17	.00
35	+ 01.69	35	+ 00.00	4909.662	13.30	3.0	13.30	3.0	13.30	-48.40	3.0	0.00	0.00	0.00	0.00	54.99	46.40	3.0	3.0	46.40	.00
36	+ 01.69	36	+ 00.00	4909.728	11.39	3.0	11.39	3.0	11.39	-42.21	3.0	0.00	0.00	0.00	0.00	54.99	45.58	-3.0	-3.0	45.58	.00
37	+ 01.69	37	+ 00.00	4909.794	8.21	-3.0	8.21	-3.0	8.21	-41.35	-3.0	0.00	0.00	0.00	0.00	54.99	52.63	-3.0	-3.0	52.63	.00
38	+ 01.61	38	+ 00.00	4991.502	6.75	-3.0	6.75	-3.0	6.75	-39.96	-3.0	0.00	0.00	0.00	0.00	51.44	56.31	-3.0	-3.0	56.31	.00
38	+ 26.54	38	+ 25.00	4991.600	6.70	-3.0	6.70	-3.0	6.70	-39.87	-3.0	0.00	0.00	0.00	0.00	49.51	56.22	-3.0	-3.0	56.22	.00

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WATER SURFACE PROFILES
USING
LOS ANGELES COUNTY FLOOD CONTROL DISTRICT
WATER SURFACE & PRESSURE GRADIENT COMPUTER PROGRAM
(LAWSPG)

AMOLF DEL NORTE STORM DIVERSION FACILITY
 WATER SURFACE ANALYSIS DEC. 1905
 STA. 0+12 TO 38+25 (PHASE I)

00002
 00003
 00004

F 0 5 1 5 P

WATER SURFACE PROFILE - ELEMENT CARD LISTING

ELEMENT NO	1 IS A SYSTEM OUTLET	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						12.00	4985.86	2	
ELEMENT NO	2 IS A REACH	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1027.58	4986.53	2	
ELEMENT NO	3 IS A TRANSITION	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1077.50	4986.56	4	
ELEMENT NO	4 IS A REACH	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1094.47	4986.57	4	
ELEMENT NO	5 IS A WALL EXIT	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1094.47	4986.57	5	
ELEMENT NO	6 IS A REACH	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1166.47	4986.62	5	
ELEMENT NO	7 IS A WALL ENTRANCE	*	*	*	U/S DATA	STATION	INVERT	SECT	*
						1166.47	4986.62	4	
									FP
									.200

N .014

N .014

N .014

N .014

W S ELEV
 4992.66

RADIUS .00
 ANGLE .00
 ANG PT .00
 MAN H 0

RADIUS .00
 ANGLE .00
 ANG PT .00
 MAN H 0

RADIUS .00
 ANGLE .00
 ANG PT .00
 MAN H 0

ELEMENT NO	8 IS A REACH	U/S DATA	STATION	INVERT	SECT	N	RADIUS	ANGLE	ANG PT	MAN H
ELEMENT NO 8	IS A REACH	U/S DATA	1103.36	4986.63	4	.014	.00	.00	.00	0
ELEMENT NO 9	IS A TRANSITION	U/S DATA	1233.36	4986.67	2	.014				
ELEMENT NO 10	IS A REACH	U/S DATA	2070.00	4907.22	2	.014				
ELEMENT NO 11	IS A JUNCTION	U/S DATA	2100.00	4987.24	2	.014				
ELEMENT NO 12	IS A TRANSITION	U/S DATA	2133.33	4909.24	3	.014				
ELEMENT NO 13	IS A REACH	U/S DATA	3725.00	4990.29	3	.014				
ELEMENT NO 14	IS A REACH	U/S DATA	3754.17	4992.03	3	.014				
ELEMENT NO 15	IS A REACH	U/S DATA	4500.00	4992.53	3	.014				
ELEMENT NO 16	IS A SYSTEM HEADWORKS	U/S DATA	4500.00	4992.53	3	.014				

* Q3 .0 Q4 110.0 INVERT-3 .00 INVERT-4 4987.78 PHI 3 .00 PHI 4 45.00
 * U S ELEV 5001.03
 NO EDIT ERRORS ENCOUNTERED-COMPUTATION IS NOW BEGINNING

FORM 1
WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	U.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL NO	AVRPR PIER
L/ELEM	SD					SF AVE	HF		NORM DEPTH			ZR	
12.00	4905.86	6.000	4992.660	1830.0	11.67	2.115	4994.775		6.789		2	0	.00
10.90	.00066					.001836	.02		8.717				
22.90	4905.87	7.005	4992.872	1830.0	11.13	1.923	4994.795		6.789		2	0	.00
37.93	.00066					.001614	.06		0.717				
60.83	4905.89	7.216	4993.108	1830.0	10.61	1.748	4994.856		6.789		2	0	.00
76.43	.00066					.001420	.11		8.717				
137.26	4905.94	7.433	4993.376	1830.0	10.12	1.589	4994.965		6.789		2	0	.00
131.63	.00066					.001249	.16		0.717				
268.09	4906.03	7.655	4993.605	1830.0	9.65	1.445	4995.130		6.709		2	0	.00
218.08	.00066					.001099	.24		8.717				
406.97	4906.17	7.882	4994.055	1830.0	9.20	1.313	4995.368		6.709		2	0	.00
373.92	.00066					.000966	.36		8.717				
860.89	4906.42	8.116	4994.536	1830.0	8.77	1.194	4995.730		6.789		2	0	.00
166.69	.00066					.000887	.15		0.717				
1027.50	4906.53	8.188	4994.718	1830.0	8.64	1.160	4995.878		6.789		2	0	.00
TRANS STR	.00060					.001417	.07						
1077.58	4906.56	7.312	4993.872	1830.0	12.19	2.306	4996.178		7.260		4	0	.00
15.50	.00059					.001846	.03		9.705				
1093.00	4906.57	7.541	4994.110	1830.0	11.62	2.097	4996.207		7.260		4	0	.00
1.39	.00059					.001722	.00		9.705				
1094.47	4906.57	7.562	4994.122	1830.0	11.59	2.007	4996.209		7.260		4	0	.00

WALL EXIT

FORM P WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EV.	SUPER ELEV	CRITICAL DEPTH	NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AVGPR
L/ELEV	SO					SF AVE	HF						ZR		
1094.47	4986.57	7.553	4994.123	1030.0	11.66	2.112	4996.235		7.192			5		0	.00
72.00	.00069					.001563	.11			9.404					
1166.47	4986.62	7.005	4994.425	1030.0	11.13	1.922	4996.347		7.192			5		0	.00
WALL ENTRANCE															
1166.47	4986.62	0.114	4994.734	1030.0	10.37	1.669	4996.403		7.260			4		0	.00
16.09	.00059					.001260	.02			9.705					
1183.36	4986.63	0.146	4994.776	1030.0	10.31	1.649	4996.425		7.260			4		0	.00
TRANS STR .00000															
1233.36	4986.67	9.047	4995.717	1030.0	7.33	.035	4996.552		6.789			2		0	.00
036.64	.00066					.000574	.48			8.724					
2070.00	4987.22	0.946	4996.166	1030.0	7.47	.066	4997.032		6.789			2		0	.00
JUNCT STR .00067															
2100.00	4987.24	9.090	4996.330	1720.0	6.03	.724	4997.062		6.503			2		0	.00
TRANS STR .06001															
2133.33	4989.24	6.503	4995.023	1720.0	11.55	2.072	4997.895		6.503			3		0	.00
9.77	.00066					.001065	.02			0.477					
2143.10	4989.25	6.703	4996.029	1720.0	11.01	1.003	4997.912		6.503			3		0	.00
34.49	.00066					.001640	.06			0.477					
2177.59	4989.27	6.900	4996.257	1720.0	10.50	1.712	4997.969		6.503			3		0	.00
69.53	.00066					.001442	.10			0.477					
2247.12	4989.32	7.190	4996.513	1720.0	10.01	1.557	4998.070		6.503			3		0	.00
122.55	.00066					.001260	.16			8.477					

FBI/DP
WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL PIER	NO AVRPR
L/ELEV	SD					SF AVE	HF						
2369.67	4909.40	7.414	4996.810	1720.0	9.55	1.415	4998.225		6.583		3	0	.00
205.08	.00066					.001116	.23		8.477				
2574.75	4989.53	7.636	4997.167	1720.0	9.10	1.286	4998.453		6.583		3	0	.00
342.81	.00066					.000901	.34		8.477				
2917.56	4989.76	7.063	4997.621	1720.0	8.68	1.169	4998.790		6.583		3	0	.00
624.06	.00066					.000863	.54		8.477				
3541.62	4990.17	8.096	4998.265	1720.0	8.27	1.063	4999.320		6.583		3	0	.00
41.59	.00066					.000806	.03		8.477				
3583.21	4990.20	8.105	4998.301	1720.0	8.26	1.059	4999.360		6.583		3	0	.00
HYDRAULIC JUMP													
3503.21	4990.20	5.239	4995.435	1720.0	16.50	4.228	4999.663		6.583		3	0	.00
33.06	.00066					.005422	.10		8.477				
3616.27	4990.22	5.142	4995.360	1720.0	16.90	4.477	4999.837		6.583		3	0	.00
54.02	.00066					.006023	.33		8.477				
3670.29	4990.25	4.984	4995.230	1720.0	17.01	4.925	5000.163		6.583		3	0	.00
54.71	.00066					.006858	.38		8.477				
3725.00	4990.29	4.031	4995.121	1720.0	18.68	5.418	5000.539		6.583		3	0	.00
.53	.05965					.007263	.00		2.864				
3725.53	4990.32	4.042	4995.163	1720.0	18.61	5.376	5000.539		6.583		3	0	.00
6.33	.05965					.006786	.04		2.864				
3731.86	4990.70	4.996	4995.695	1720.0	17.74	4.887	5000.502		6.583		3	0	.00
5.31	.05965					.005961	.03		2.864				

WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL	VEL HEAD	ENERGY GRD.ELEV	SUPER ELEV	CRITICAL DEPTH	HGT/ DIA	BASE/ ID NO.	ZL PIER	NO AVRPR
L/ELEM	SO					SF AVE	HF					ZR	
3737.17	4991.02	5.155	4996.171	1720.0	16.92	4.443	5000.614		6.583		3	0	.00
4.45	.05965					.005237	.02		2.864				
3741.62	4991.28	5.317	4996.598	1720.0	16.13	4.039	5000.637		6.583		3	0	.00
3.64	.05965					.004601	.02		2.864				
3745.26	4991.50	5.484	4996.982	1720.0	15.38	3.672	5000.654		6.583		3	0	.00
2.92	.05965					.004043	.01		2.864				
3748.18	4991.67	5.655	4997.328	1720.0	14.66	3.330	5000.666		6.583		3	0	.00
2.20	.05965					.003553	.01		2.864				
3750.46	4991.01	5.031	4997.639	1720.0	13.98	3.035	5000.674		6.583		3	0	.00
1.69	.05965					.003123	.01		2.864				
3752.15	4991.91	6.011	4997.921	1720.0	13.33	2.759	5000.680		6.583		3	0	.00
1.14	.05965					.002744	.00		2.864				
3753.29	4991.98	6.197	4998.175	1720.0	12.71	2.500	5000.683		6.583		3	0	.00
.66	.05965					.002413	.00		2.864				
3753.95	4992.02	6.387	4998.404	1720.0	12.12	2.280	5000.684		6.583		3	0	.00
.22	.05965					.002121	.00		2.864				
3754.17	4992.03	6.503	4998.613	1720.0	11.55	2.072	5000.685		6.583		3	0	.00
9.85	.00067					.001865	.02		0.446				
3764.02	4992.04	6.783	4998.820	1720.0	11.01	1.883	5000.703		6.583		3	0	.00
34.85	.00067					.001640	.06		0.446				
3798.07	4992.06	6.988	4999.040	1720.0	10.50	1.712	5000.760		6.583		3	0	.00
70.43	.00067					.001442	.10		8.446				

FOOT
WATER SURFACE PROFILE LISTING

STATION	INVERT	DEPTH	U.S.	VEL	VEL	ENERGY	SUPER	CRITICAL	HGT/	BASE/	ZI	NO	AVPR
	ELEV	OF FLOW	ELEV	HEAD	GRD. EL.	ELEV		DEPTH	DIA	ID NO.		PIER	
L/ELFH	SO			SF AVE	HF			NORM DEPTH	ZR				

3869.30	4992.11	7.190	4999.305	1720.0	10.01	1.557	5000.862	6.503	3	0	.00		
124.60	.00067			.001268	.16			8.446					
3993.90	4992.19	7.414	4999.605	1720.0	9.55	1.415	5001.020	6.583	3	0	.00		
209.68	.00067			.001116	.23			8.446					
4203.50	4992.33	7.636	4999.967	1720.0	9.10	1.286	5001.253	6.583	3	0	.00		
296.42	.00067			.000989	.29			8.446					
4500.00	4992.53	7.833	5000.363	1720.0	8.73	1.184	5001.547	6.583	3	0	.00		

00002
00003
00004

PAGE NO 2

00' 23" 14

[illegible]

[illegible]

WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL.	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL PIER	NO AVRPR
L/ELFM	50					SF AVE	IF						ZR	
4920.72	4993.04	5.104	4998.147	1600.0	15.98	3.965	5002.112		6.351			3	0	.00
.51	.05999					.004989	.00			2.756				
4921.23	4993.07	5.124	4998.197	1600.0	15.80	3.916	5002.113		6.351			3	0	.00
3.52	.05999					.004646	.02			2.756				
4924.75	4993.29	5.285	4998.570	1600.0	15.14	3.560	5002.130		6.351			3	0	.00
2.82	.05999					.004082	.01			2.756				
4927.57	4993.45	5.451	4998.905	1600.0	14.44	3.236	5002.141		6.351			3	0	.00
2.19	.05999					.003587	.01			2.756				
4929.76	4993.59	5.622	4999.207	1600.0	13.77	2.942	5002.149		6.351			3	0	.00
1.62	.05999					.003152	.01			2.756				
4931.38	4993.60	5.797	4999.400	1600.0	13.12	2.675	5002.155		6.351			3	0	.00
1.13	.05999					.002771	.00			2.756				
4932.51	4993.75	5.976	4999.726	1600.0	12.51	2.432	5002.150		6.351			3	0	.00
.64	.05999					.002435	.00			2.756				
4933.15	4993.79	6.160	4999.949	1600.0	11.93	2.211	5002.160		6.351			3	0	.00
.19	.05999					.002140	.00			2.756				
4933.34	4993.80	6.351	5000.151	1600.0	11.37	2.009	5002.160		6.351			3	0	.00
9.41	.00066					.001801	.02			8.208				
4942.75	4993.81	6.545	5000.351	1600.0	10.04	1.826	5002.177		6.351			3	0	.00
33.14	.00066					.001654	.05			8.208				
4975.89	4993.83	6.744	5000.572	1600.0	10.34	1.660	5002.232		6.351			3	0	.00
66.60	.00066					.001455	.10			8.208				

F
WATER SURFACE PROFILE LISTING

STATION	INVERT ELEV	DEPTH OF FLOW	W.S. ELEV	Q	VEL.	VEL HEAD	ENERGY GRD.EV.	SUPER ELEV	CRITICAL DEPTH	NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL NO	AVDPR PIER
L/ELFM														
5042.57	4993.07	6.948	5000.020	1600.0	9.86	1.509	5002.329		6.351			3	0	.00
115.67	.00066					.001279	.15			8.208				
5158.24	4993.95	7.157	5001.105	1600.0	9.40	1.372	5002.477		6.351			3	0	.00
193.47	.00066					.001125	.22			8.208				
5351.71	4994.00	7.372	5001.447	1600.0	8.96	1.247	5002.694		6.351			3	0	.00
324.89	.00066					.000990	.32			8.208				
5676.60	4994.29	7.593	5001.802	1600.0	8.54	1.134	5003.016		6.351			3	0	.00
579.31	.00066					.000870	.50			8.208				
6255.91	4994.67	7.819	5002.409	1600.0	8.15	1.031	5003.520		6.351			3	0	.00
84.74	.00066					.000010	.07			8.208				
6340.65	4994.73	7.037	5002.563	1600.0	8.12	1.023	5003.586		6.351			3	0	.00
HYDRAULIC JUMP														
6340.65	4994.73	5.039	4999.765	1600.0	16.30	4.123	5003.800		6.351			3	0	.00
38.73	.00066					.005574	.22			8.208				
6379.38	4994.75	4.923	4999.674	1600.0	16.08	4.425	5004.099		6.351			3	0	.00
51.99	.00066					.006246	.32			8.208				
6431.37	4994.79	4.771	4999.556	1600.0	17.71	4.868	5004.424		6.351			3	0	.00
52.45	.00066					.007113	.37			8.208				
6483.82	4994.82	4.623	4999.443	1600.0	18.57	5.355	5004.790		6.351			3	0	.00
JUNCT STR .03033														
6560.00	4997.74	5.111	5002.851	1360.0	13.55	2.052	5005.703		5.855			7	0	.00
96.36	.00363					.003609	.35			5.104				

4-36164

STATION	INVERT ELEV	DEPTH OF FLOW	M.S. ELFV	Q	VEL.	VEL HEAD	ENERGY GRD.EL.	SUPER ELEV	CRITICAL DEPTH	NORM DEPTH	HGT/ DIA	BASE/ ID NO.	ZL	NO PIER	AUTPR
I./ELFM	SO					SF AVE	HF						ZR		

6656.36	4998.09	5.114	5003.204	1360.0	13.54	2.047	5006.051		5.055			7		0	.00
WALL EXIT															
6656.36	4998.09	5.113	5003.203	1360.0	13.54	2.049	5006.052		5.764			8		0	.00
132.94	.00361					.003599	.48			5.110					
6709.30	4998.57	5.115	5003.684	1360.0	13.54	2.045	5006.529		5.855			6		0	.00
1979.27	.00360					.003601	7.13			5.115					
8768.57	5005.70	5.115	5010.011	1360.0	13.54	2.045	5013.656		5.055			6		0	.00
481.43	.00360					.003619	1.74			5.115					
9250.00	5007.43	5.103	5012.533	1360.0	13.59	2.066	5015.399		5.055			6		0	.00
JUNCT STR	.01060					.003615	.10								
9300.00	5008.36	4.857	5013.217	1220.0	13.14	2.681	5015.898		5.543			6		0	.00
61.07	.00360					.003590	.22			4.853					
9361.07	5008.58	4.058	5013.430	1220.0	13.14	2.679	5016.117		5.543			6		0	.00
WALL EXIT															
9361.07	5000.50	4.857	5013.437	1220.0	13.14	2.680	5016.117		5.484			8		0	.00
103.64	.00357					.003598	.37			4.064					
9464.71	5000.95	4.853	5013.003	1220.0	13.16	2.688	5016.491		5.543			6		0	.00
1076.02	.00360					.003604	3.88			4.853					
10540.73	5012.83	4.053	5017.679	1220.0	13.16	2.680	5020.367		5.543			6		0	.00
459.27	.00360					.003771	1.73			4.853					
11000.00	5014.40	4.750	5019.230	1220.0	13.59	2.868	5022.090		5.543			6		0	.00



City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

December 12, 2003

Bradley T. Dixon, PE
Bohannon Huston, Inc
7500 Jefferson NE
Albuquerque, NM 87109

Re: Gibson/Amole CBC Project Hydraulic Analysis Report
Engineer's Stamp dated 10-29-03, (N9/D6)

Dear Mr. Dixon,

Based upon the information provided in your submittal dated 10-29-03, the above referenced report is approved for Work Order requirements of the crossing structure. Keep in mind that the drainage proposed to drain into the channel from Gibson must be downstream of the box culvert since you did not include provision for extra flows in your analysis. AMAFCA must sign the construction documents.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Bradley L. Bingham, PE
Sr. Engineer, Planning Dept.
Building and Development Services

C: Loren Meinz, AMAFCA
file

W.O.

·1 Courtyard I
·1 7500 Jefferson St. NE
·1 Albuquerque, NM
87109-4335
www.bhinc.com
voice: 505.823.1000
facsimile: 505.798.7988
toll free: 800.877.5332

CLIENT/COURIER TRANSMITTAL

To: Brad Bingham
COA - Hydrology Development
Plaza del Sol - 2nd Floor West

Requested by: Scott Steffen

Date: October 29, 2003

Time Due: ☐ This A.M.
☒ This P.M.
☐ Rush _____
☐ By Tomorrow

Phone: 924-3986

Job No.: 040111

Job Name: Gibson Boulevard Improvements

DELIVERY VIA

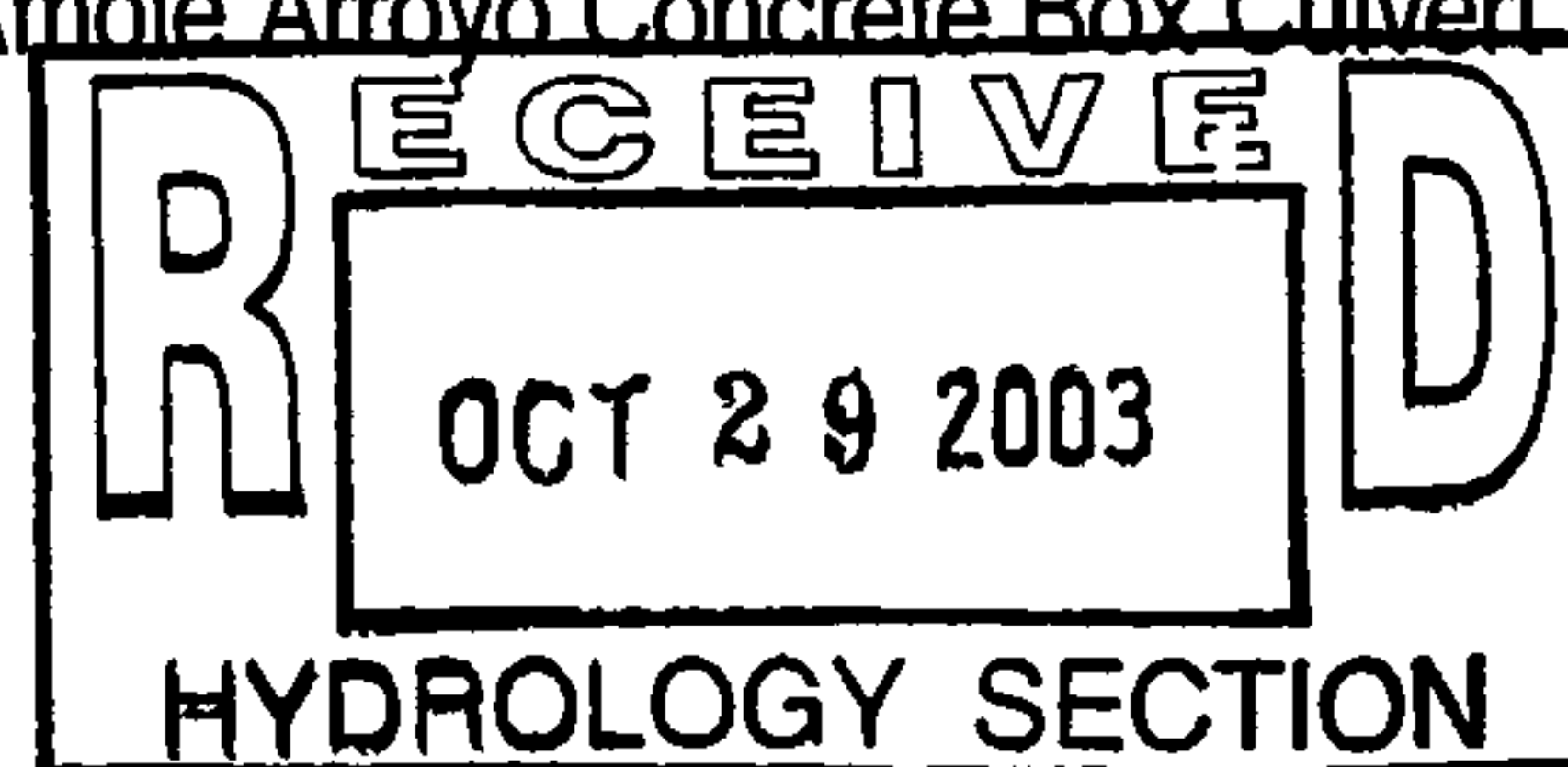
☒ Courier ☐ Federal Express
☐ Mail ☐ UPS
☐ Other

PICK UP

Item: _____

ITEM NO. QUANTITY DESCRIPTION

1 1 Design Analysis Report for the Gibson Blvd/Amole Arroyo Concrete Box Culvert

**COMMENTS / INSTRUCTIONS**

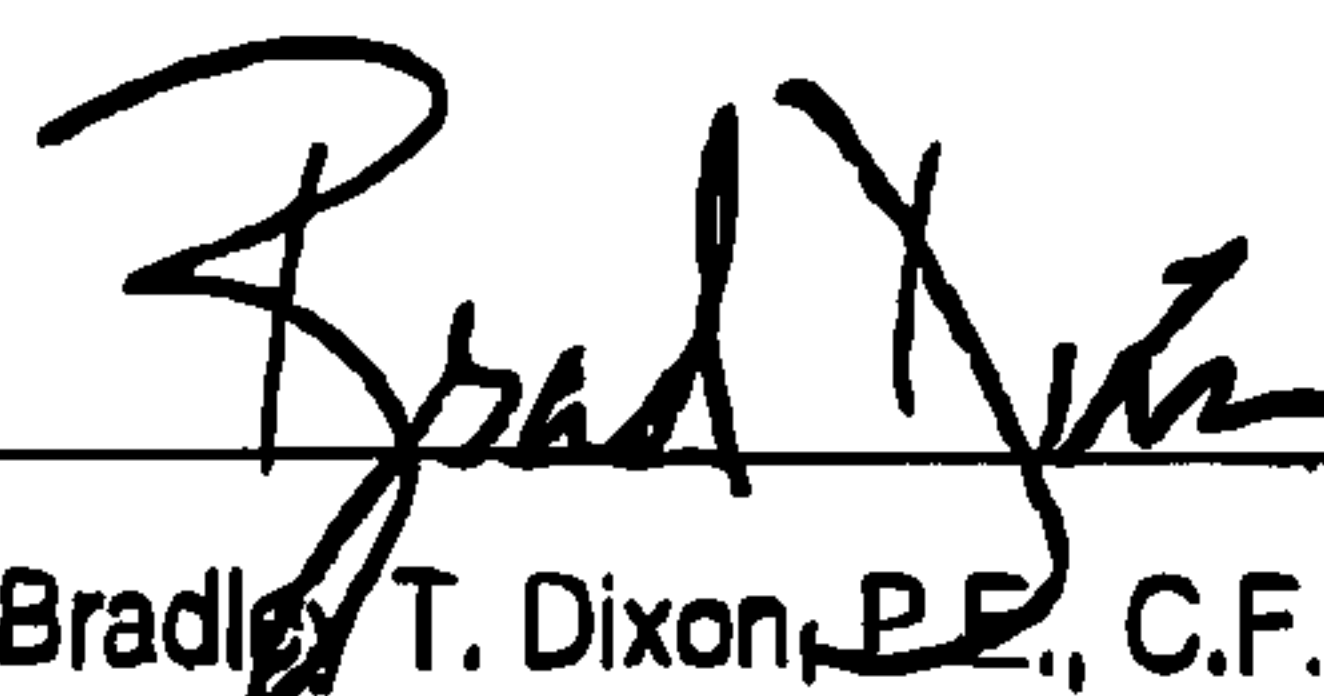
Enclosed is the DAR for the Gibson/Amole CBC. The construction plans were submitted to DRC this morning. The DRC hearing is scheduled for November 10, 2003 at 2:30 pm. The DAR and plans were also submitted to Loren Mainz at AMAFCA today.

REC'D BY: _____ **DATE:** _____ **TIME:** _____

ENGINEERING ▲**SPATIAL DATA ▲****ADVANCED TECHNOLOGIES ▲**

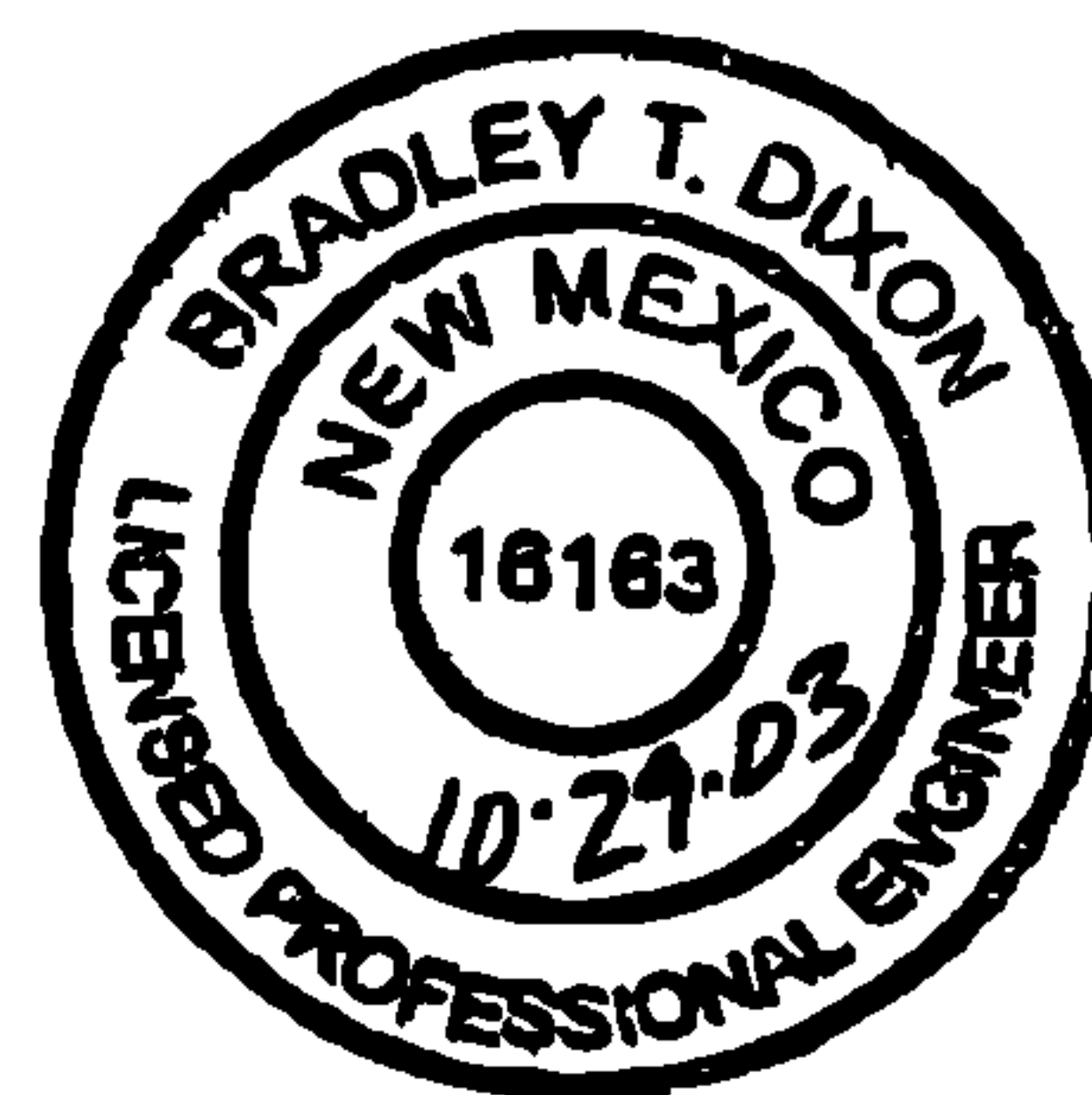
**GIBSON BOULEVARD CROSSING OF AMOLE ARROYO
HYDRAULIC ANALYSIS OF PROPOSED CONCRETE BOX CULVERT**

I, Bradley T. Dixon, hereby certify that I am a Registered Professional Engineer, registered in the state of New Mexico, and that the following report was prepared under my direction and is true and correct to the best of my knowledge and belief.



Bradley T. Dixon, P.E., C.F.M.

NMPE No. 16163



MEMORANDUM

TO: Loren Meinz, P.E.
Albuquerque Metropolitan Arroyo Flood Control Authority

FROM: Brad Dixon, P.E. and
Craig W. Hoover, P.E.
Bohannon Huston, Inc.

DATE: October 29, 2003

RE: GIBSON BOULEVARD CROSSING OF AMOLE ARROYO
HYDRAULIC ANALYSIS OF PROPOSED CONCRETE BOX CULVERT

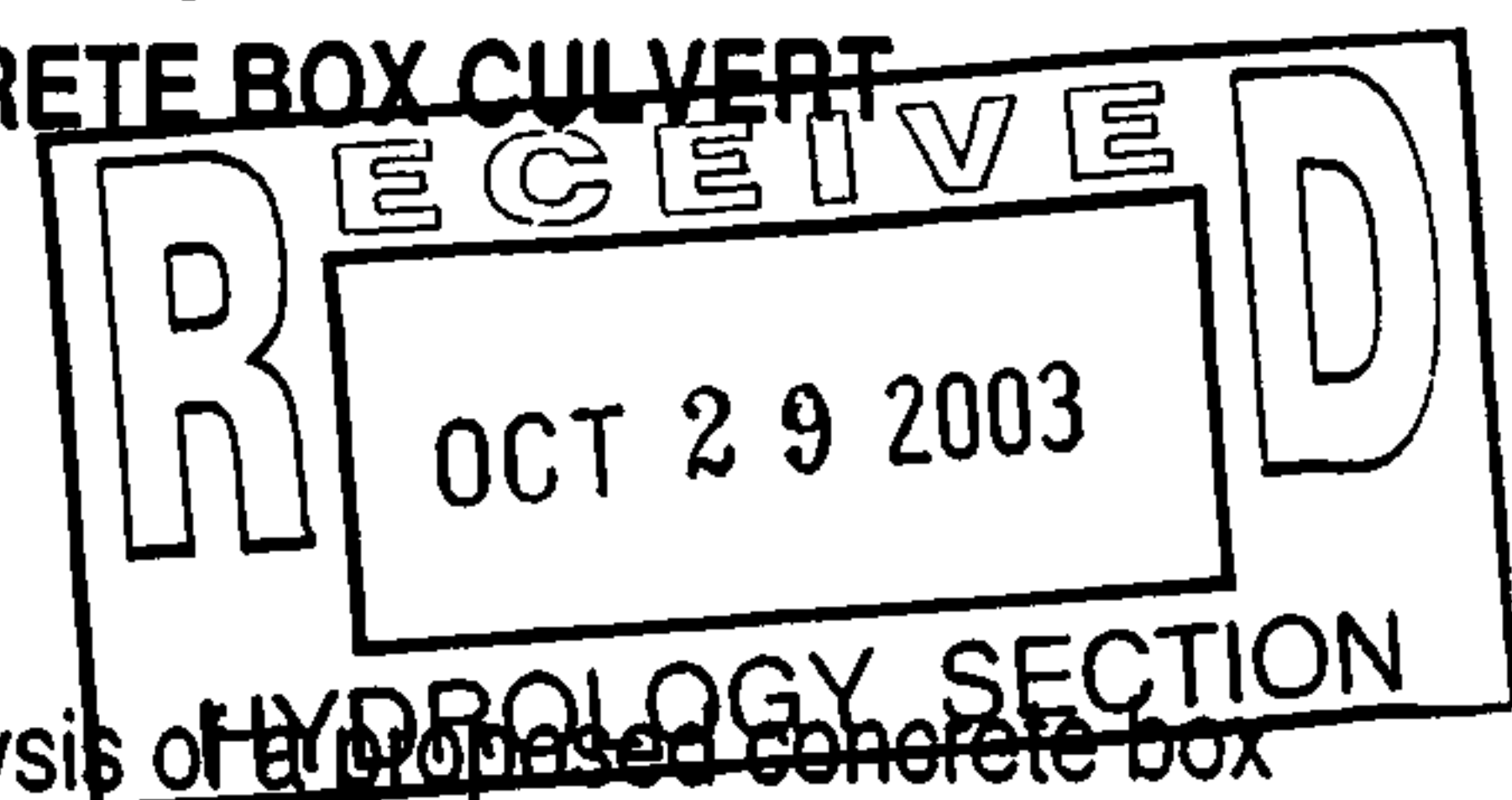
INTRODUCTION

This memo presents Bohannon Huston, Inc.'s (BHI's) analysis of a proposed concrete box culvert (CBC) within the Amole Arroyo to accommodate the westward extension of Gibson Boulevard across the arroyo. The extension of Gibson plays a major role in the backbone infrastructure development for El Rancho Grande, a master planned community being developed by Curb, Inc., in Albuquerque's southwest mesa region (Figure 1). The following sections provide:

- a summary of previous hydrology reports from which peak discharge information for the Amole Arroyo was taken
- a description of the phasing concept for the construction of the Gibson crossing, and
- a description of the Hydraulic (HEC-RAS) analyses prepared by BHI in support of the design of the proposed CBC for Gibson.

HYDROLOGY

The "Amole-Hubbell Drainage Management Plan," which was prepared in July 1999 by Leedshill-Herkenhoff, Inc., established 100-year peak discharge rates for the Amole Arroyo from Westgate Dam to the Amole Detention Basin and proposed backbone infrastructure improvements to stabilize the arroyo. Five alternatives were presented for master plan improvements to the arroyo, and Alternative 2 was recommended for implementation. This alternative included the construction of a low flow channel for the arroyo from Westgate Dam to the confluence with the



Snow Vista Arroyo and a high flow channel from this confluence to the Amole Detention Basin. The Amole Arroyo was proposed to be realigned such that its confluence with the Snow Vista Arroyo would be moved approximately 2,200 feet to the north. The construction associated with this realignment is currently under way. From the figure in the Drainage Management Plan that depicts Alternative 2, the flow rate in the Amole Arroyo in the vicinity of the Gibson Boulevard alignment ranges from 2,625 cfs to 2,925 cfs.

In February 2003, Isaacson & Arfman, P.A., published "Design Report for Amole Arroyo Including Revisions to the Amole-Hubbell Drainage Management Plan." This report provided design analysis for the realignment of the Amole Arroyo upstream of its confluence with the Snow Vista Arroyo and included a revision to the hydrologic modeling that was performed for the 1999 Drainage Management Plan. The revision reflected the discharge of a 70-acre portion of the Sacate Blanco Basin into the Amole Arroyo due to a shift in the Gibson Boulevard alignment. Because of the additional land area draining to the Amole Arroyo, the 100-year peak discharge in the Amole Arroyo below its confluence with the Snow Vista Arroyo was shown to increase from 2,625 cfs to 2,825 cfs.

Since the final hydrologic analysis and master drainage plan for El Rancho Grande is still being developed, a 100-year flow rate of 3,000 cfs was used in the HEC-RAS analyses described below. Using this flow rate, that is slightly higher than the flow rates from previous studies, will allow some flexibility regarding the community's discharge points into the arroyo.

PHASING CONCEPT FOR THE AMOLE ARROYO AND THE GIBSON BOULEVARD CROSSING

It has been proposed that the Amole Arroyo be channelized from its confluence with the Snow Vista Arroyo to its confluence with the Sacate Blanco Arroyo and, ultimately, to its outfall into the Amole Detention Basin. For the purposes of this study, it was assumed that the stabilized channel will have a 20-foot bottom width and 2:1 (H:V) sideslopes and be lined with shotcrete. Currently, in the vicinity of the proposed Gibson Boulevard crossing, the Amole Arroyo is fully lined with dumped riprap and has sideslopes of 3:1. To accommodate the development schedule of El Rancho Grande, the extension of Gibson Boulevard across the Amole Arroyo must take place before the arroyo itself is channelized as proposed in the Drainage Management Plan. Because of

this, a phased approach is being taken in the construction of the arroyo crossing. While the box culvert will ultimately have concrete transitions to match the proposed shotcrete channel, in the first phase, these transitions are proposed to be extended in the form of temporary wire-tied riprap to match the existing sideslopes of the dumped riprap channel. The extra lengths of the transitions will be removed as ultimate improvements are made to the upstream and downstream channel.

HYDRAULIC ANALYSIS

HEC-RAS Version 3.1.1 was used to analyze the Amole Arroyo through El Rancho Grande with the proposed Gibson crossing in place. Two scenarios were modeled. One representing the interim condition after the Gibson crossing is constructed but before the channel is improved, and the second representing the developed condition with both the Gibson crossing and channel improvements in place. In the first, the Amole Arroyo was left in its existing condition, and the culverts were modeled with the concrete transitions and the additional wire-tied riprap transitions described above. See Detail A on Figure 2A. The second model reflects the proposed channelization of the Amole Arroyo from Gibson Boulevard to its confluence with the Sacate Blanco Arroyo. The wire-tied riprap portion of the transition from the CBC to the downstream arroyo was removed from this model. See Detail A on Figure 2B. Figures 2A and 2B show the locations of the cross sections that were used in the analyses.

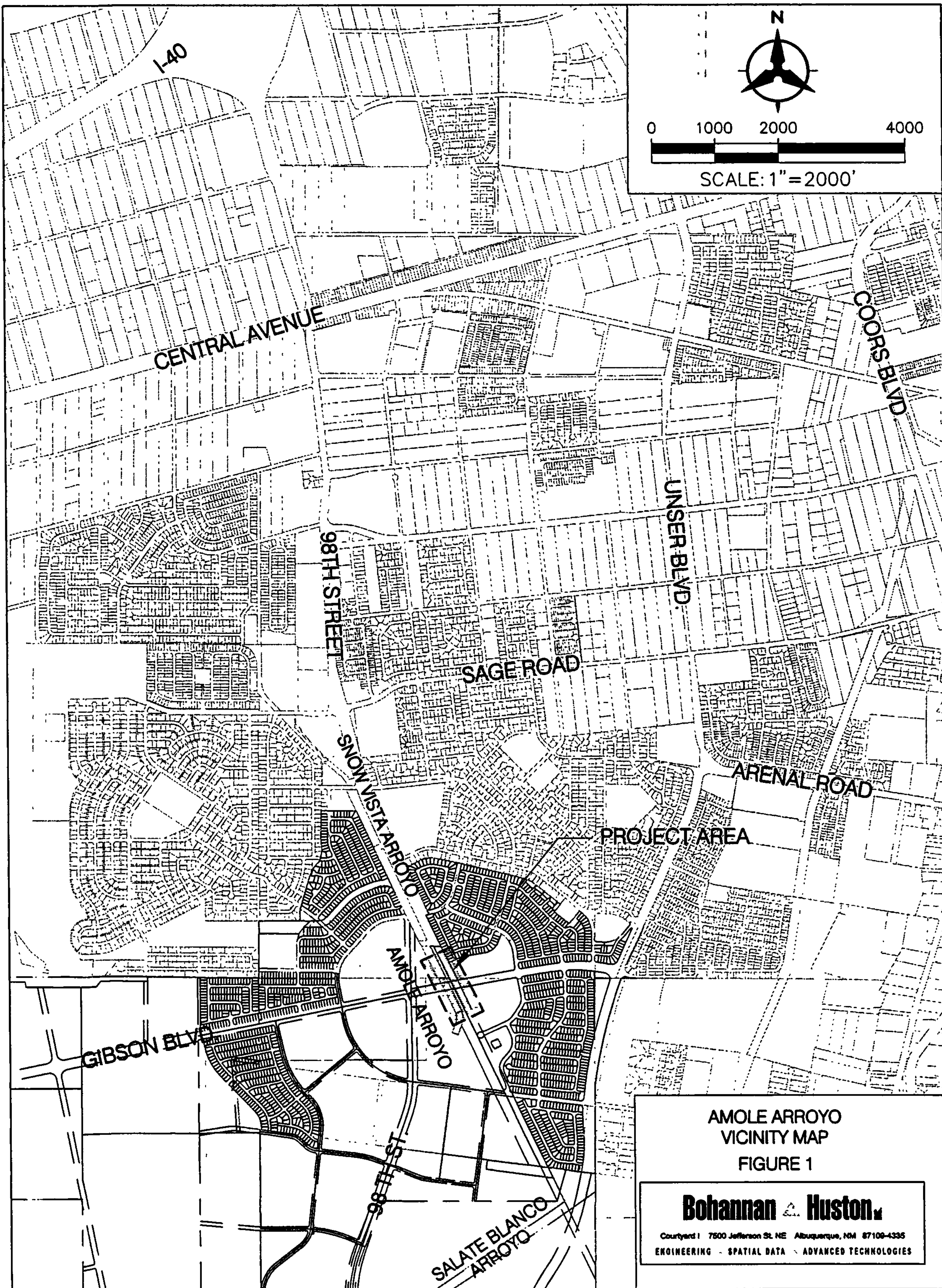
By modeling the arroyo well upstream and downstream of the proposed Gibson crossing for both interim and ultimate (developed) conditions, impacts on the water surface at the crossing due to either upstream or downstream flow conditions have been considered. The resulting output from the HEC-RAS models is included in Appendix B. As shown, the proposed culvert for the Gibson crossing will be a three-barrel 10'x7' concrete box culvert. Freeboard calculations were performed for the culvert, as specified in Chapter 22 of the City of Albuquerque Development Process Manual (DPM). These calculations are included in Appendix C. As shown, the depths of flow at the inlet to the CBC are 3.95 feet and 3.94 feet, for the interim and developed conditions models, respectively. Based upon the City DPM guidelines, the required freeboard depth is 2.05 feet for each scenario. Consequently, 6' tall CBC's (3.95' + 2.05') would meet the City DPM guidelines. However, 7' tall CBC's are proposed to provide a factor of safety due to the preliminary status of the hydrologic analysis and channel design.

CONCLUSION

The analyses described above demonstrate that a triple 10'x7' concrete box culvert will convey the 100-year peak discharge rate for the Amole Arroyo where Gibson Boulevard is proposed to cross the arroyo to provide a new transportation corridor for El Rancho Grande. The peak discharge rate used herein was taken from previous studies by Leedshill-Herkenhoff, Inc., and Isaacson & Arfman, P.A., and was increased to 3,000 cfs to allow flexibility in the drainage master planning effort for El Rancho Grande. The HEC-RAS models described herein demonstrate that under both the interim and ultimate (developed) conditions the proposed CBC crossing at Gibson is sufficient to pass the 100-year design flow rate in accordance with City Standards. Detailed design calculations for the channelization of the Amole Arroyo, including a hydrologic model updated to reflect the drainage master plan for El Rancho Grande, and final HEC-RAS model updated to reflect the final channel design will be provided to AMAFCA in a future report.

APPENDIX A

FIGURES



AMOLE ARROYO
VICINITY MAP
FIGURE 1

Bohannon & Huston

Courtyard I 7500 Jefferson St. NE Albuquerque, NM 87109-4335
ENGINEERING - SPATIAL DATA - ADVANCED TECHNOLOGIES

APPENDIX B
HEC-RAS OUTPUT

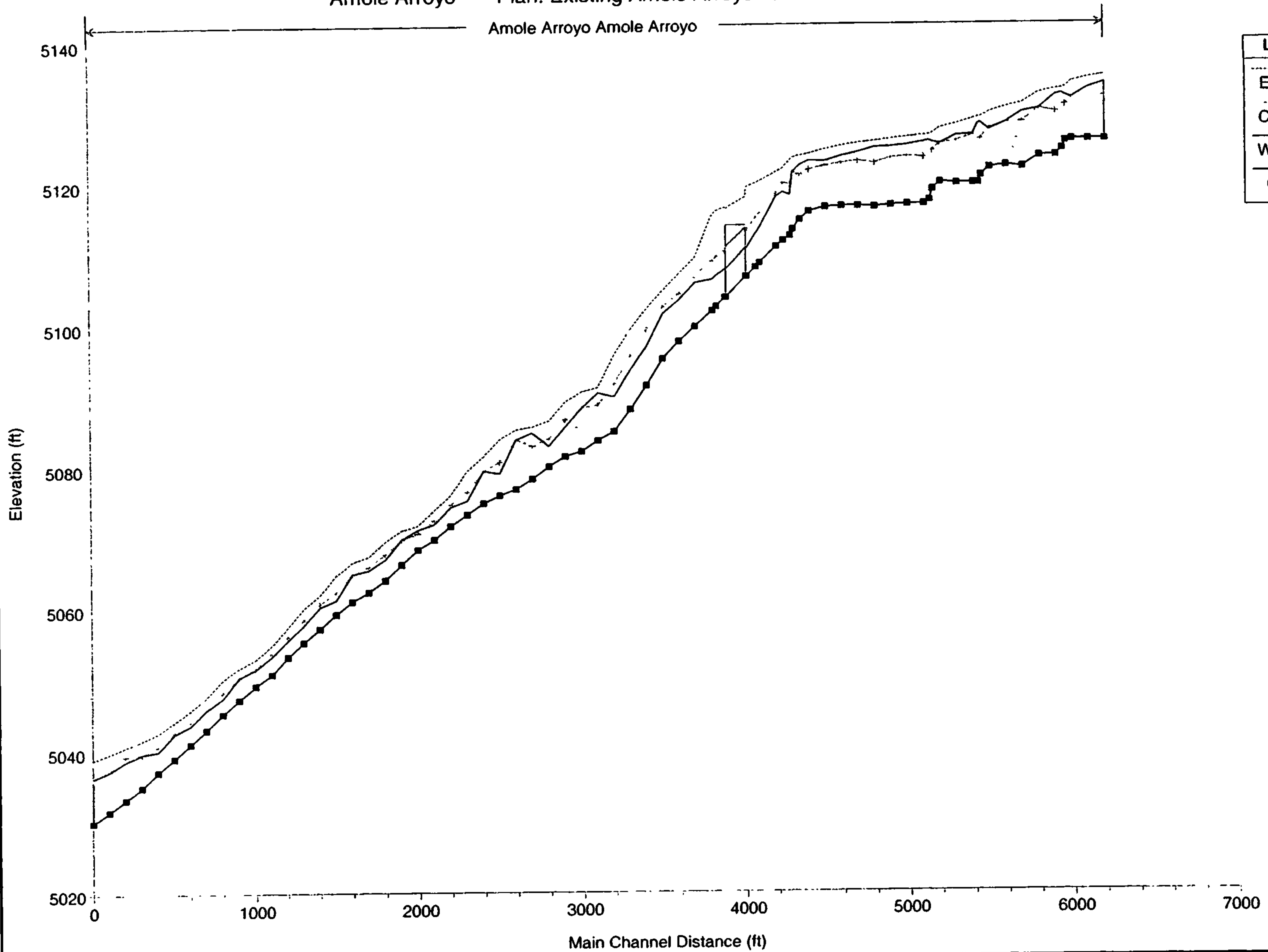
HEC-RAS Plan ex 3 @ 10x7 River Amole Arroyo Reach Amole Arroyo Profile PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W S Elev	Max Chl Dpth	Crt W S	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Amole Arroyo	8000 000	PF 1	3000 00	5125 92	5133 68	7 98	5132 00	5134 97	0 002359	9 43	435 18	81 97	0 60
Amole Arroyo	7900 000	PF 1	3000 00	5125 93	5133 15	7 22		5134 64	0 003781	11 22	378 72	80 56	0 74
Amole Arroyo	7800 000	PF 1	3000 00	5125 92	5131 80	5 88	5131 80	5134 08	0 006943	13 38	295 48	70 74	0 98
Amole Arroyo	7760 417	PF 1	3000 00	5125 86	5132 13	6 47	5130 82	5133 24	0 003016	9 05	404 18	85 17	0 65
Amole Arroyo	7740 830	PF 1	3000 00	5124 58	5132 39	7 81		5133 07	0 001522	7 53	534 98	91 45	0 48
Amole Arroyo	7700 000	PF 1	3000 00	5123 68	5132 18	8 50	5129 88	5132 98	0 001882	8 68	518 79	95 16	0 54
Amole Arroyo	7600 000	PF 1	3000 00	5123 80	5130 25	6 65	5130 25	5132 52	0 006510	13 75	303 95	70 58	0 96
Amole Arroyo	7500 000	PF 1	3000 00	5122 08	5129 81	7 75	5128 43	5131 08	0 003120	10 15	391 93	78 46	0 67
Amole Arroyo	7400 000	PF 1	3000 00	5122 29	5128 32	6 03	5128 32	5130 56	0 006567	12 90	289 52	68 62	0 95
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Amole Arroyo

Plan: Existing Amole Arroyo w/ 3 @ 10x7 10/29/2003

Amole Arroyo Amole Arroyo



Legend

EG PF 1

Crit PF 1

WS PF 1

Ground

Amole Arroyo Plan: Existing Amole Arroyo w/ 3 @ 10x7 10/29/2003

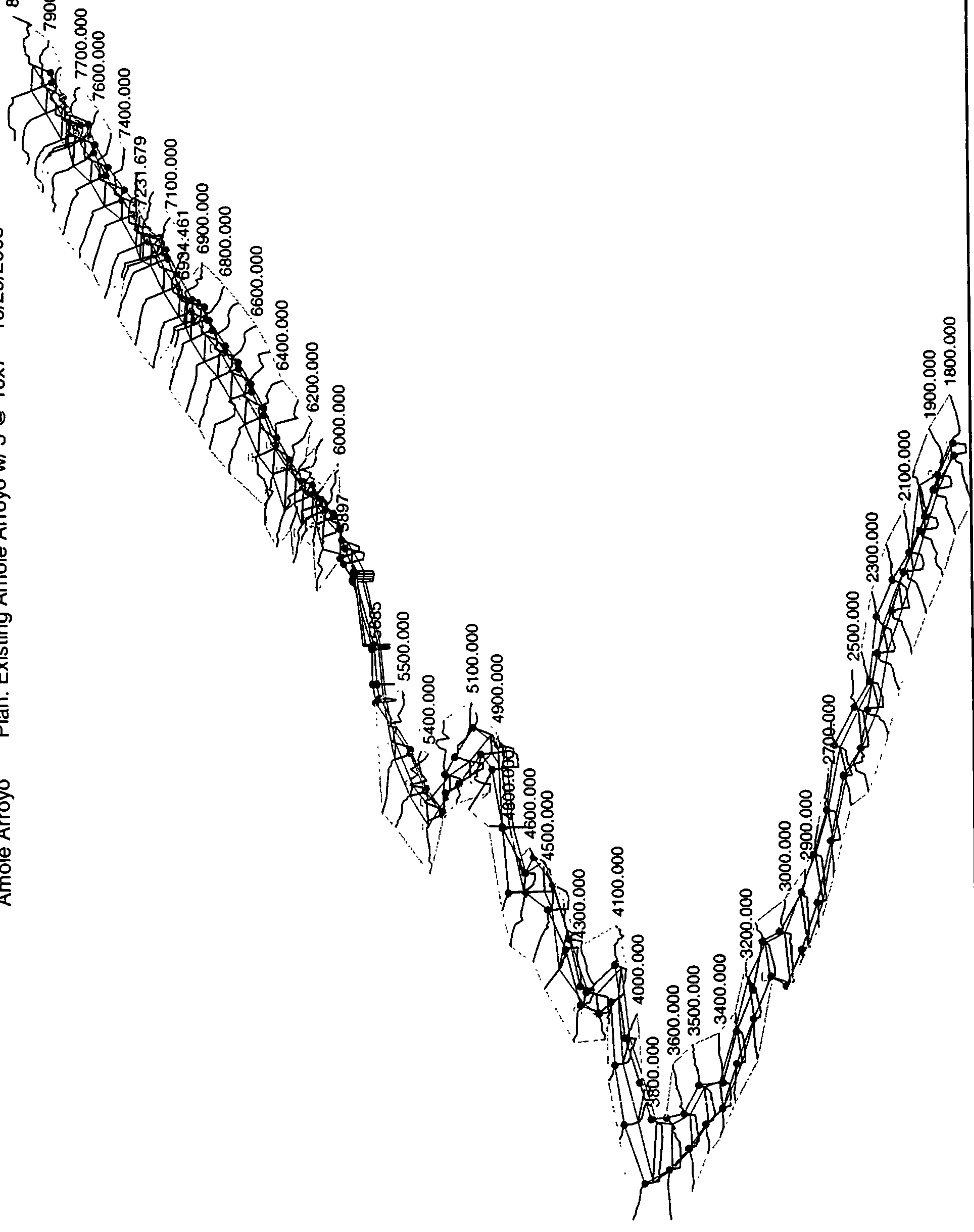
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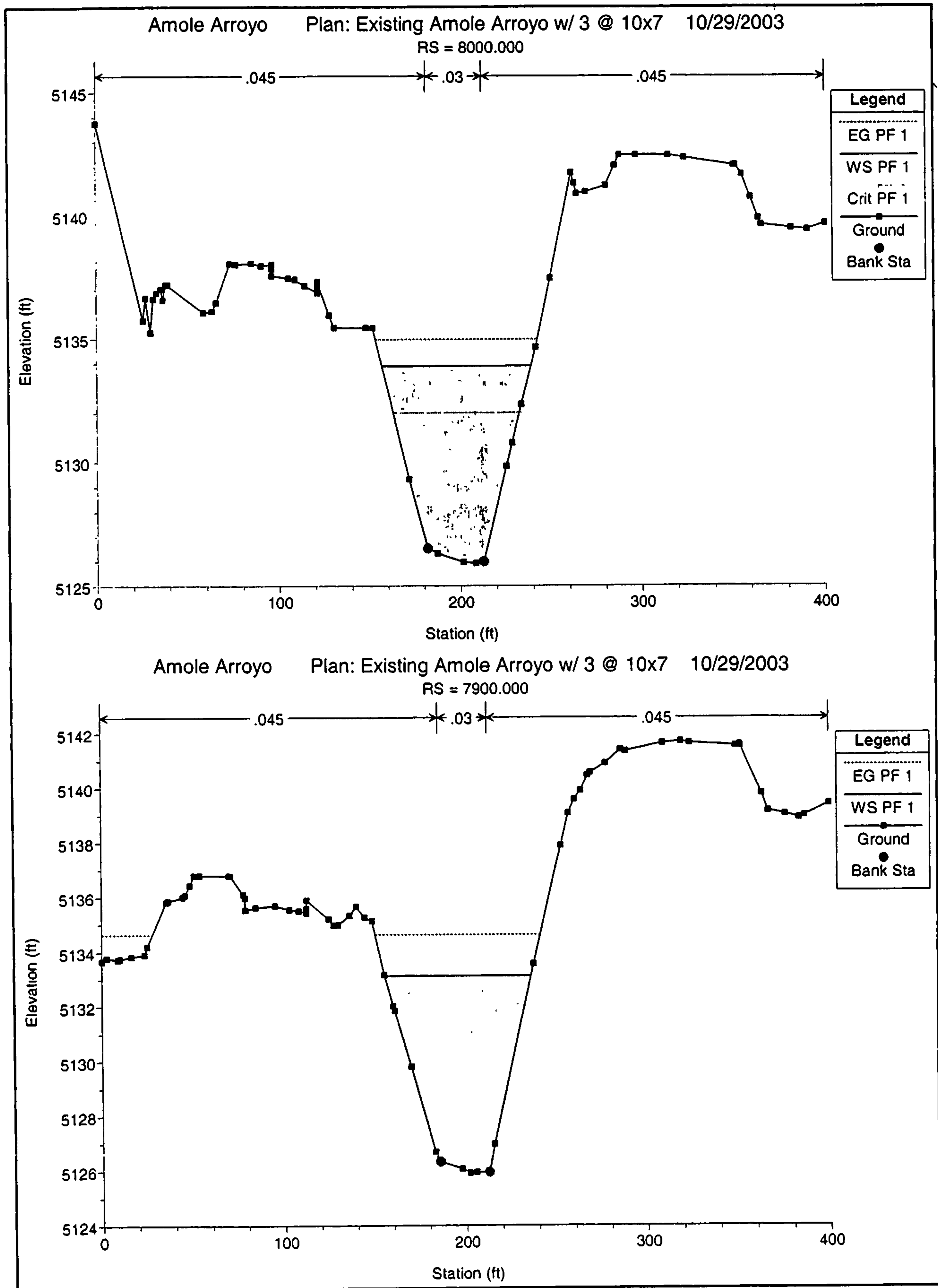
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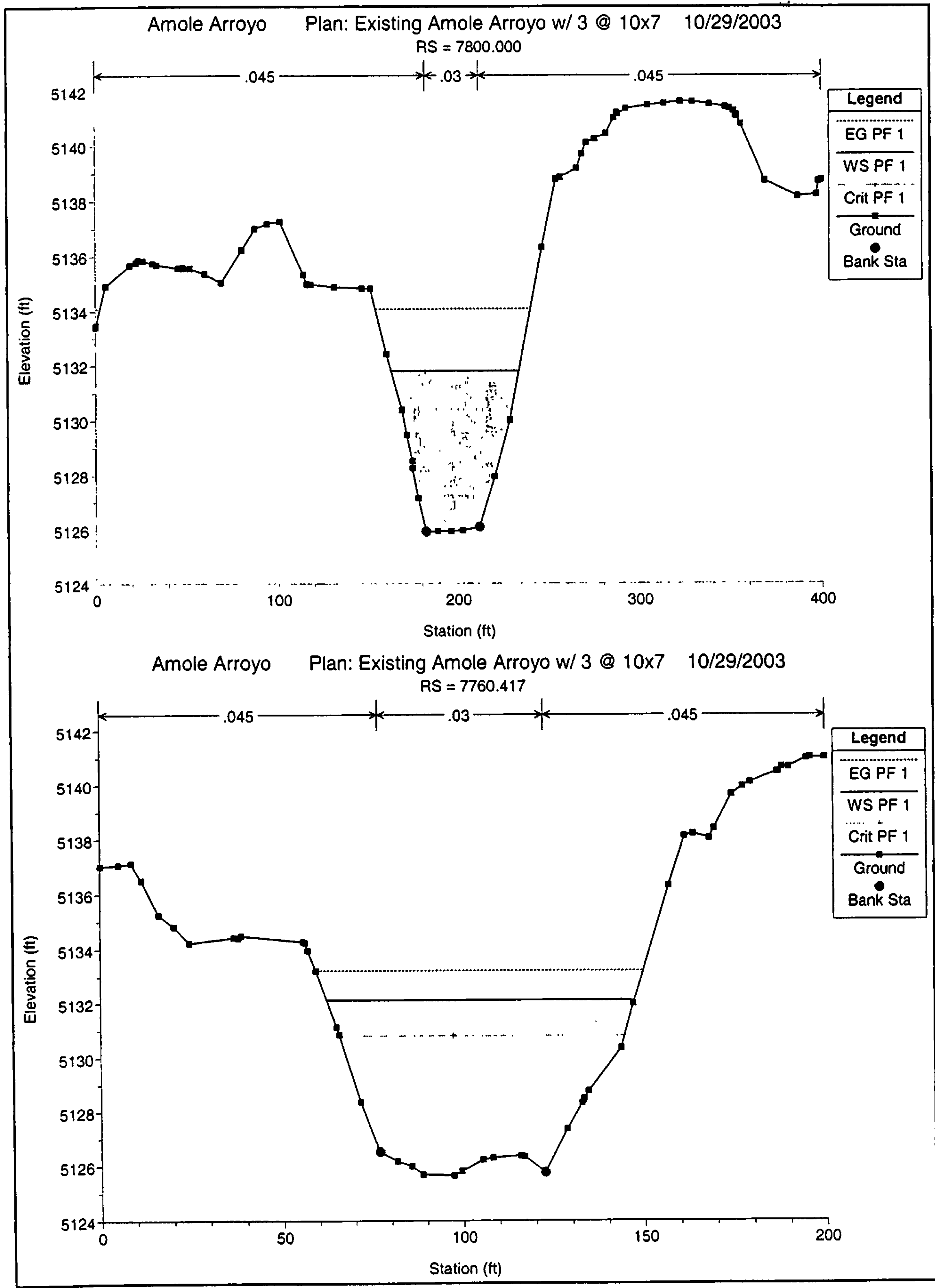
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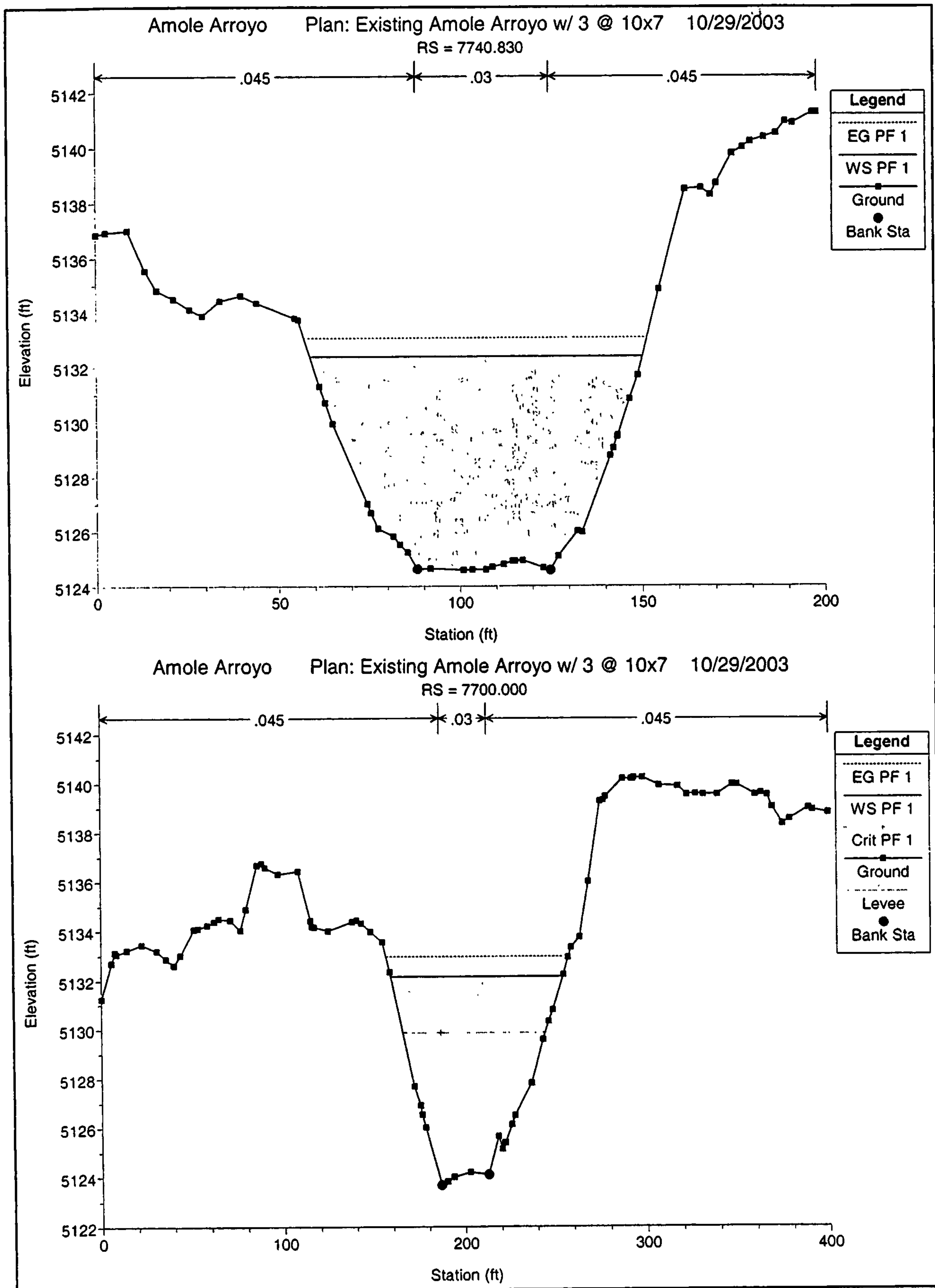
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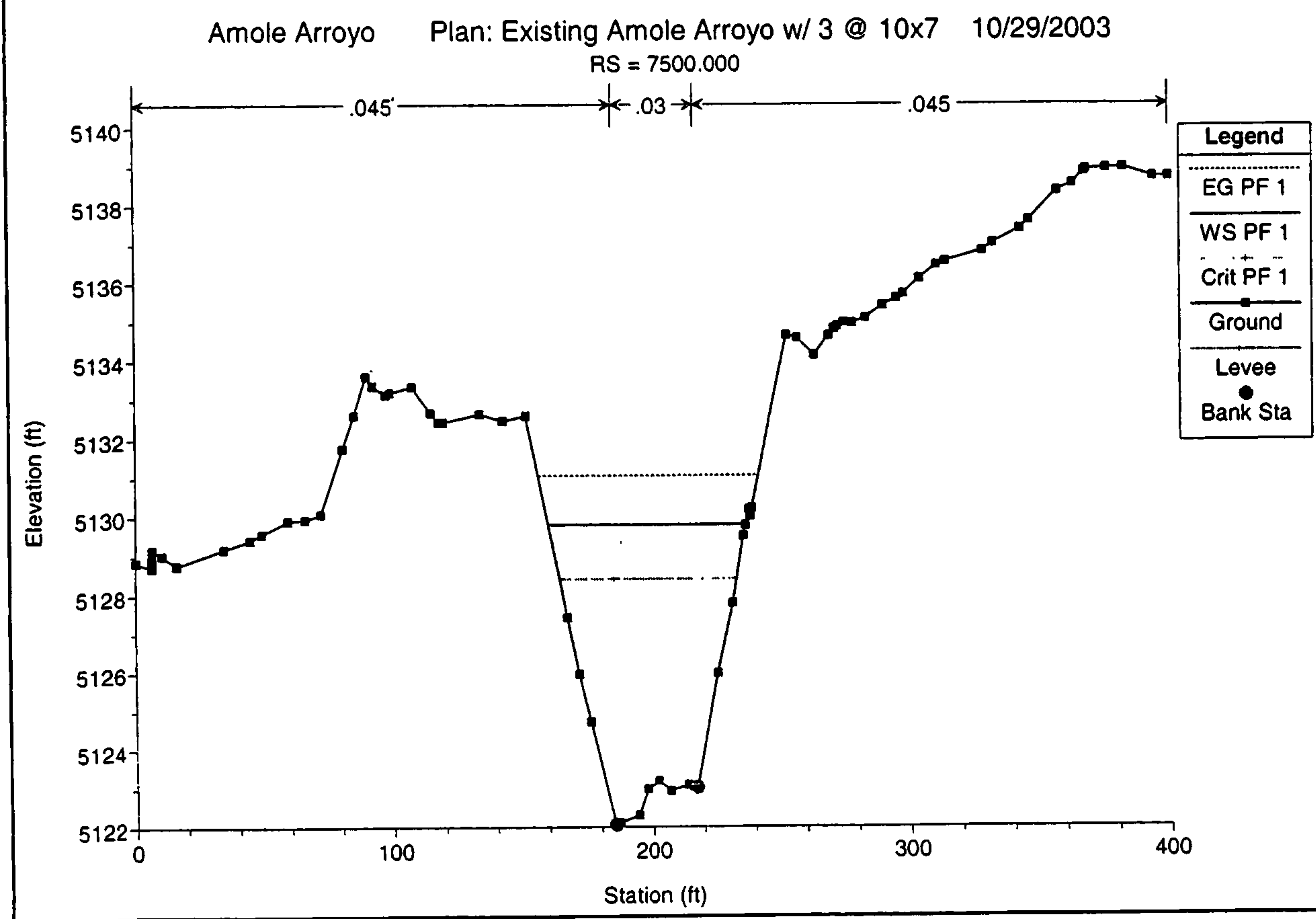
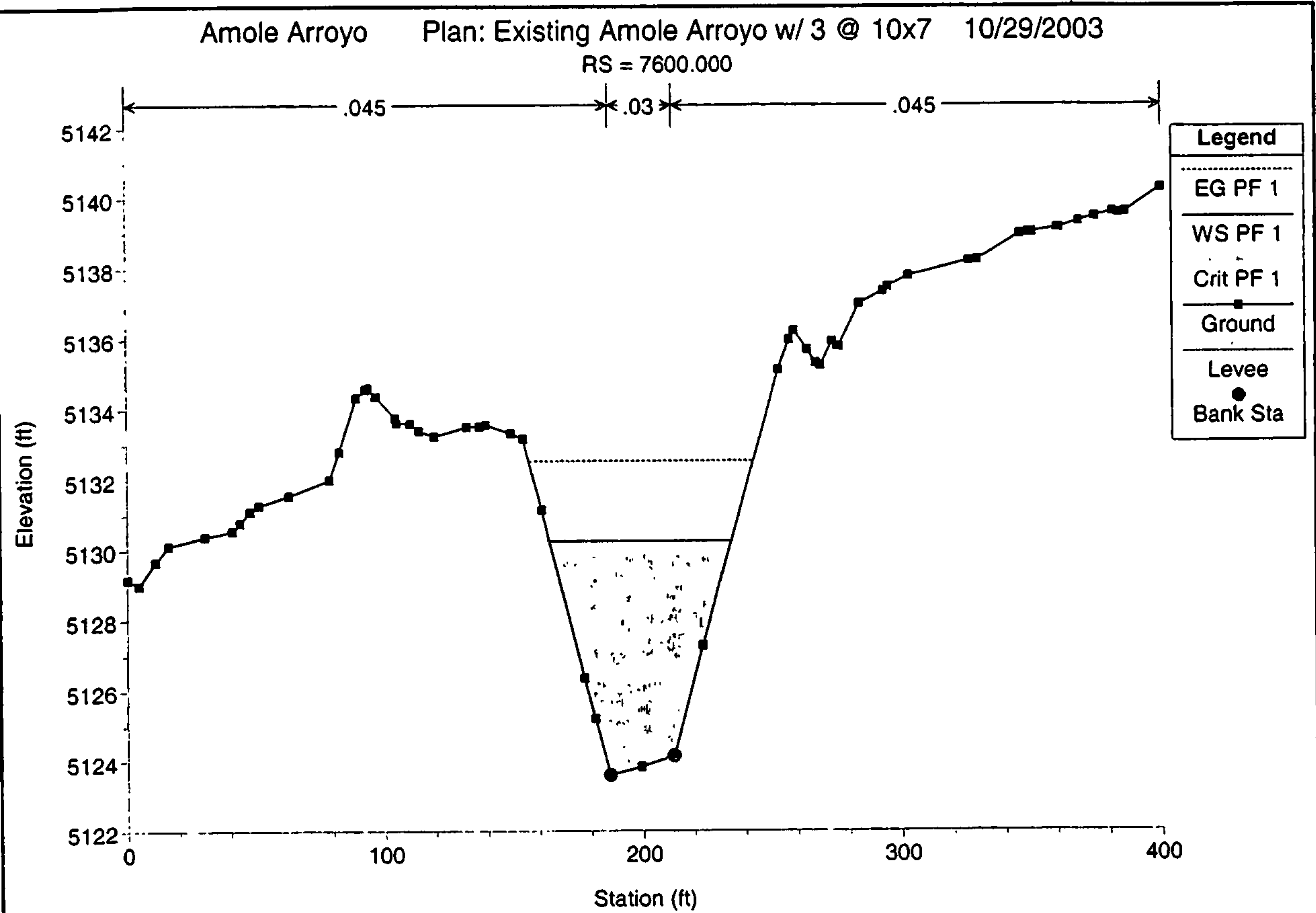
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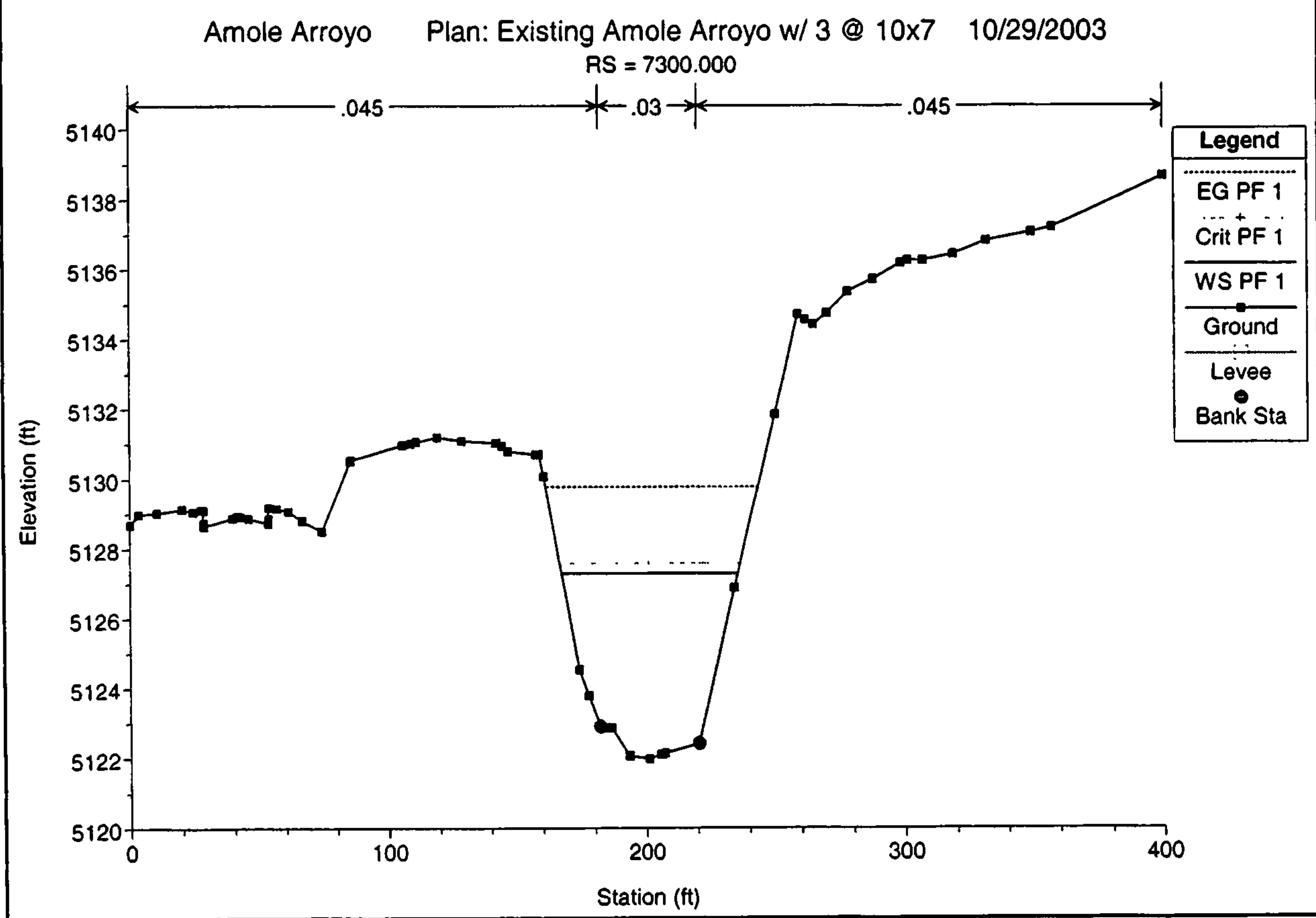
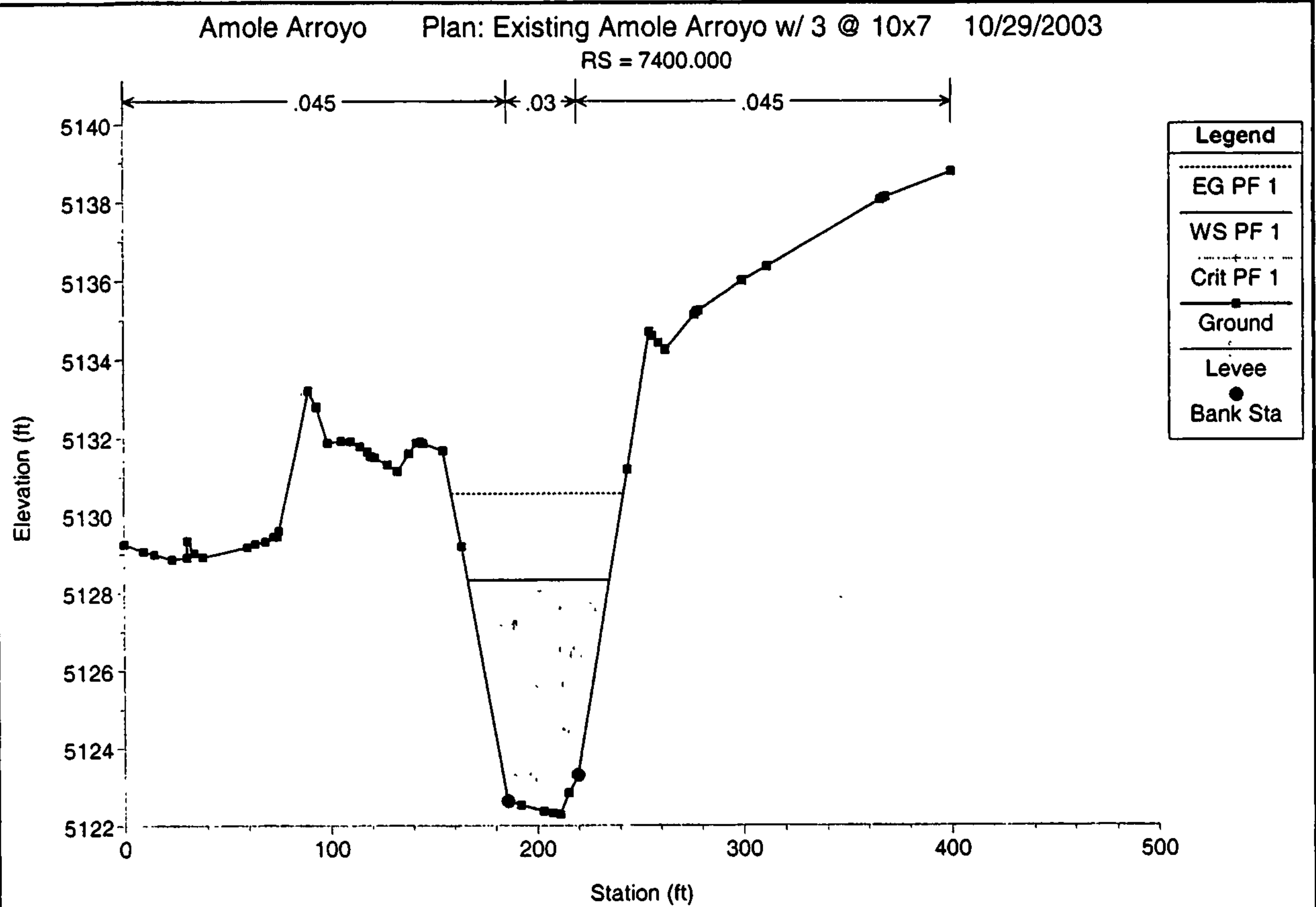


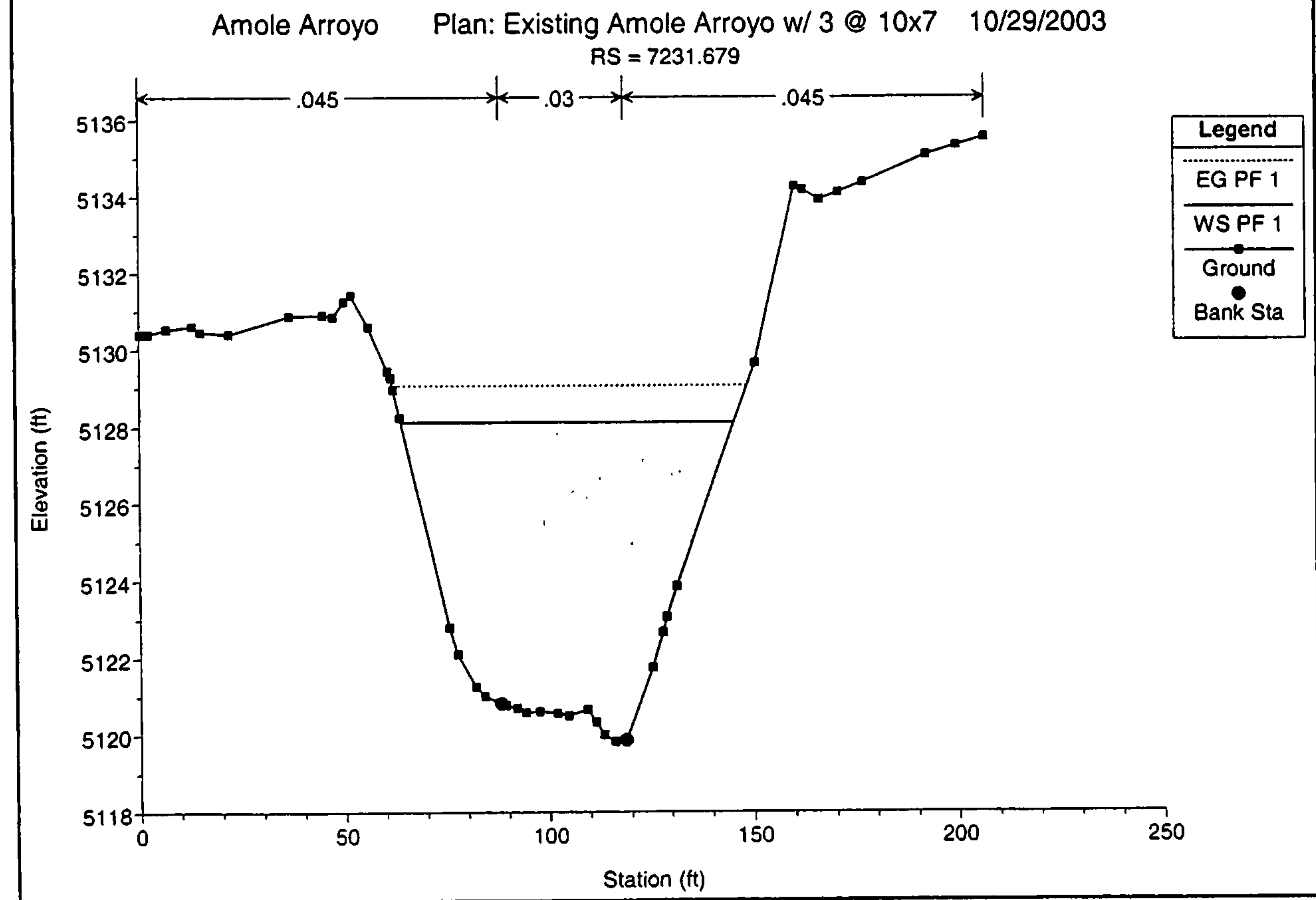
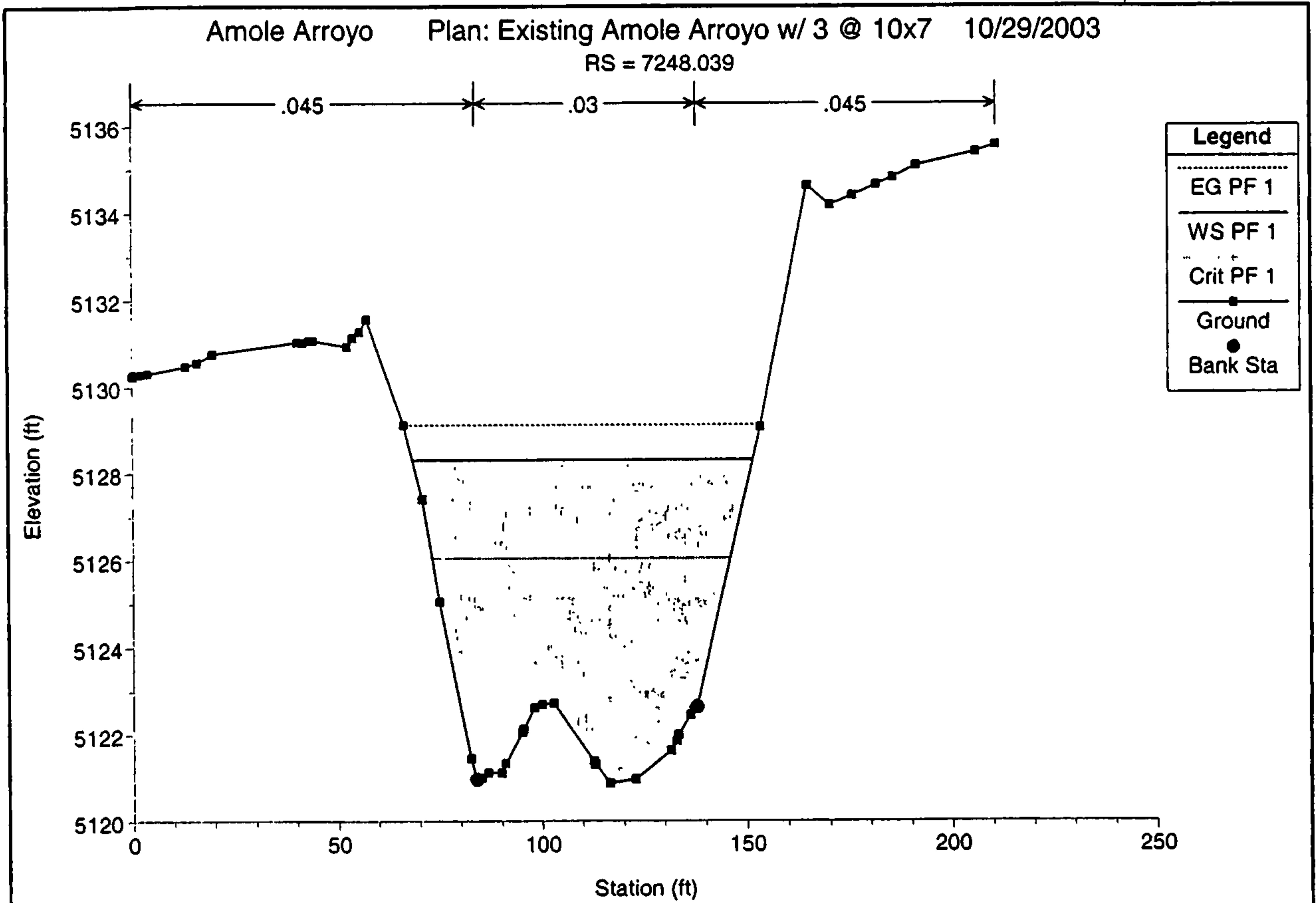


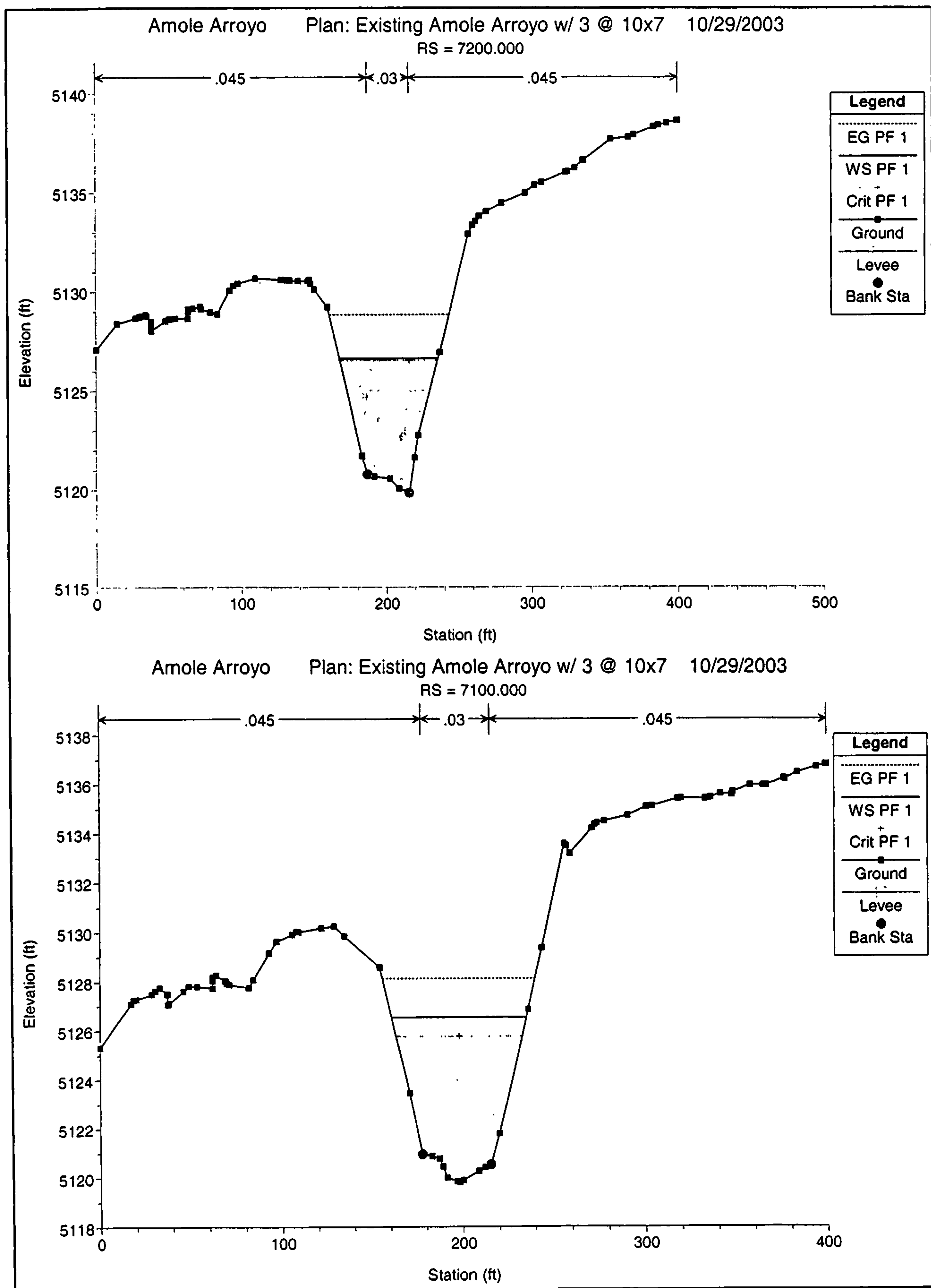


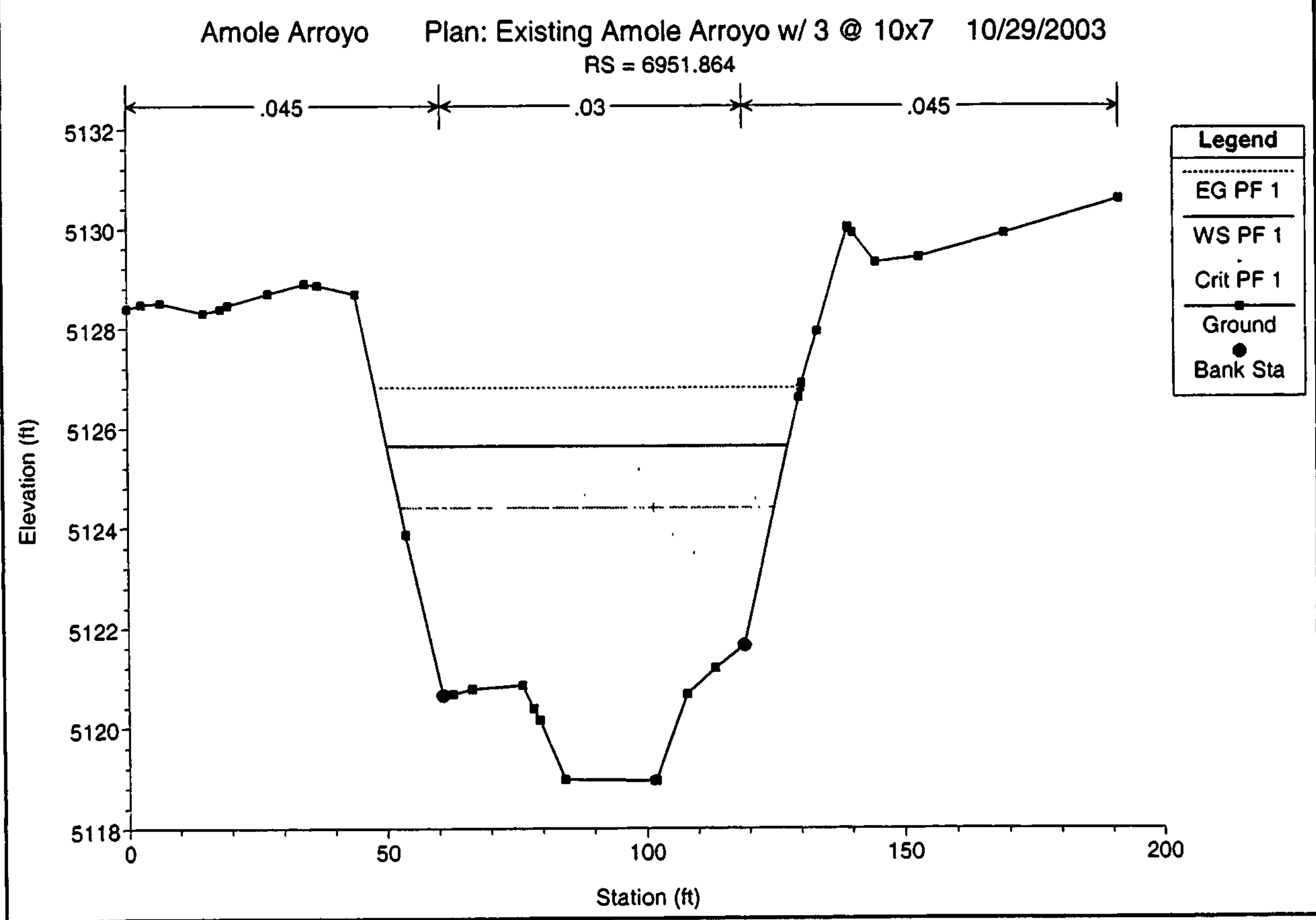
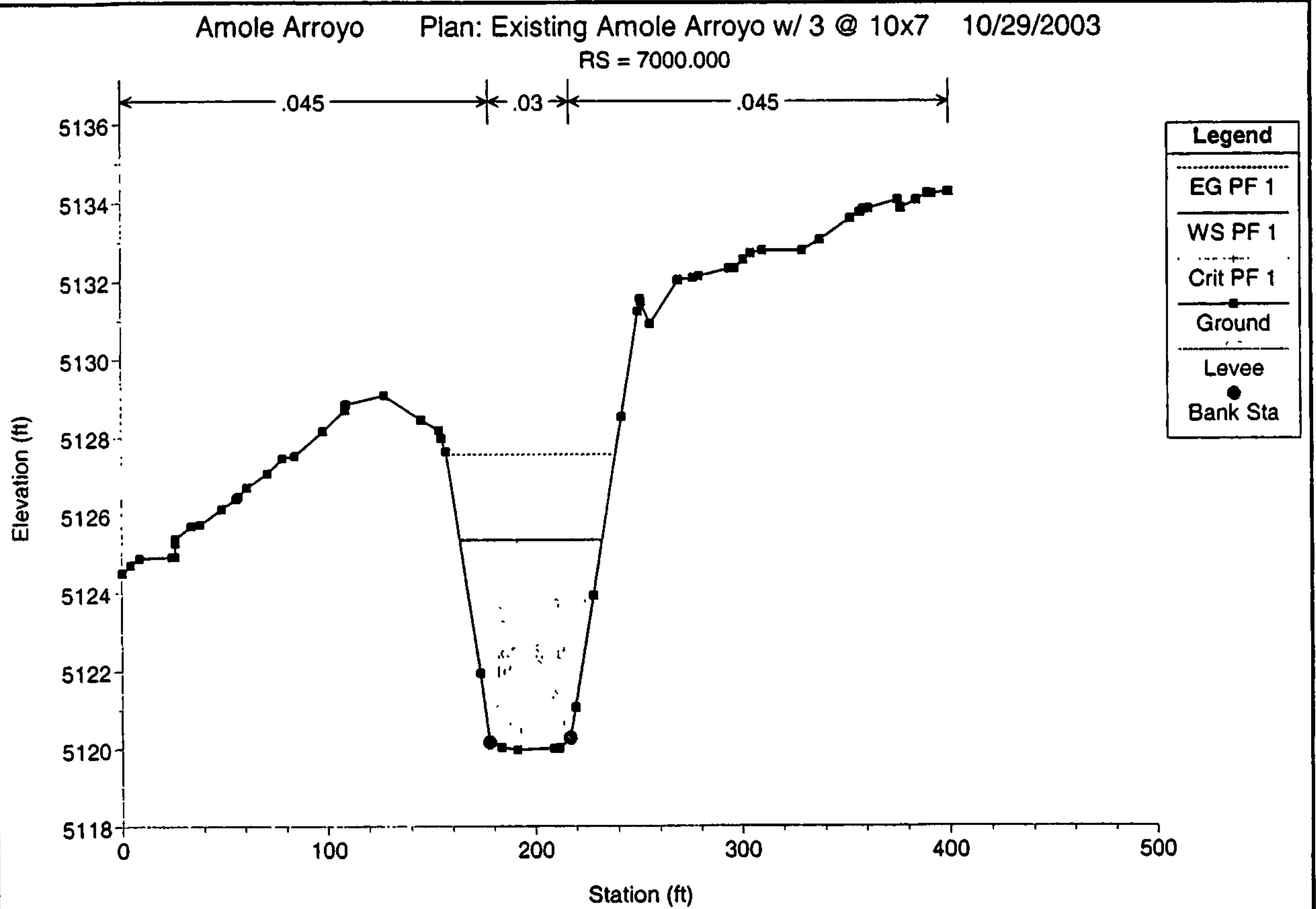


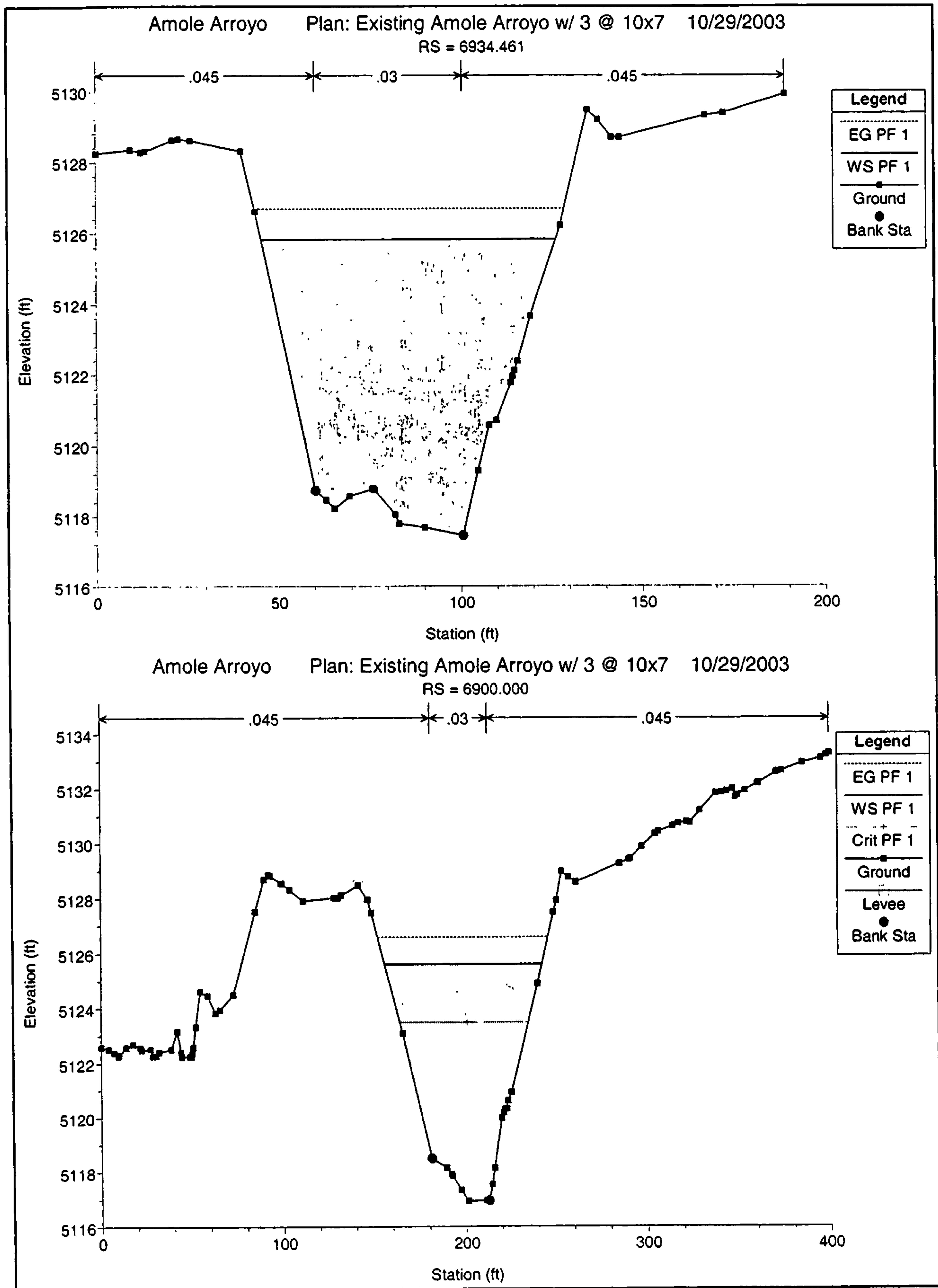


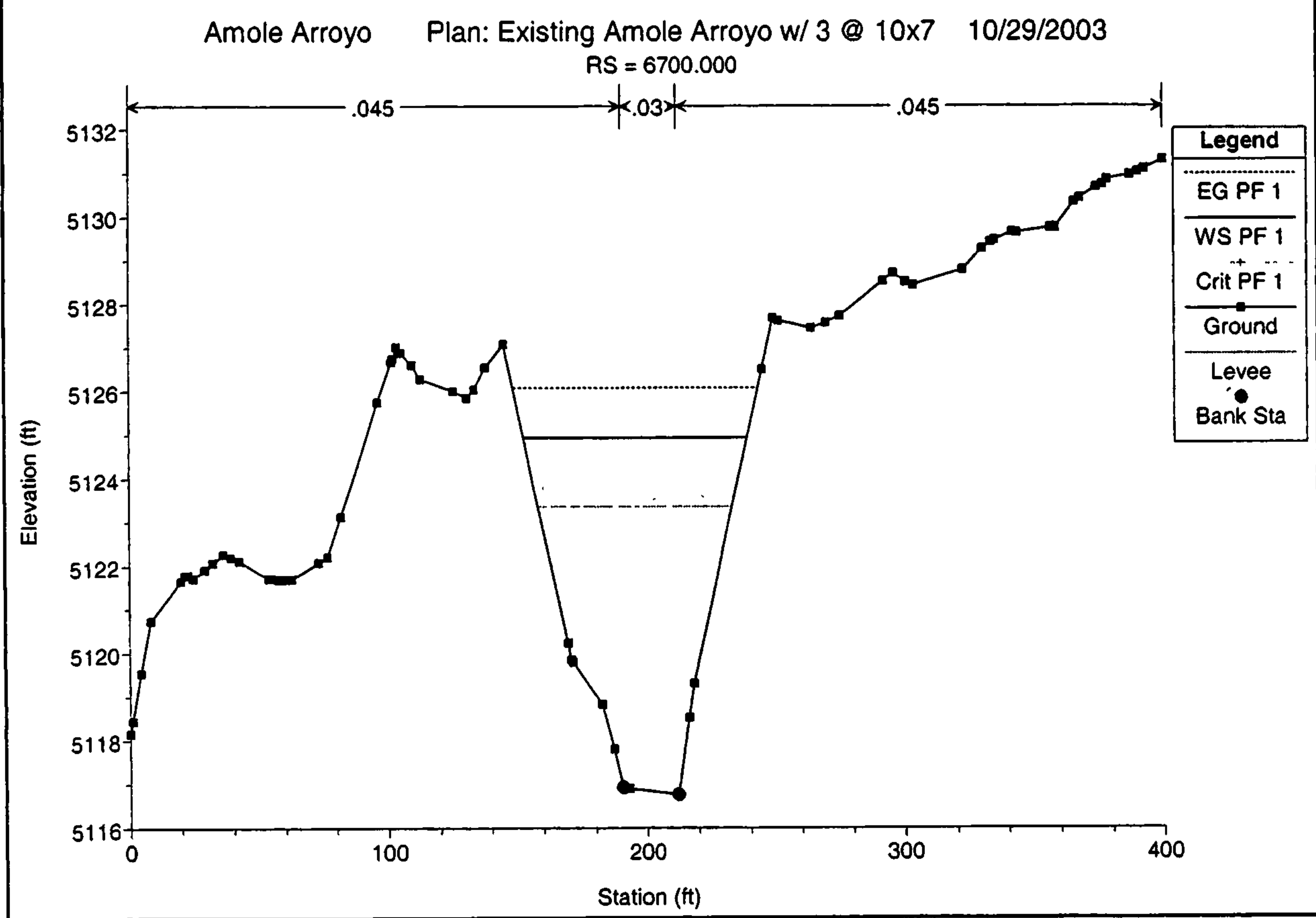
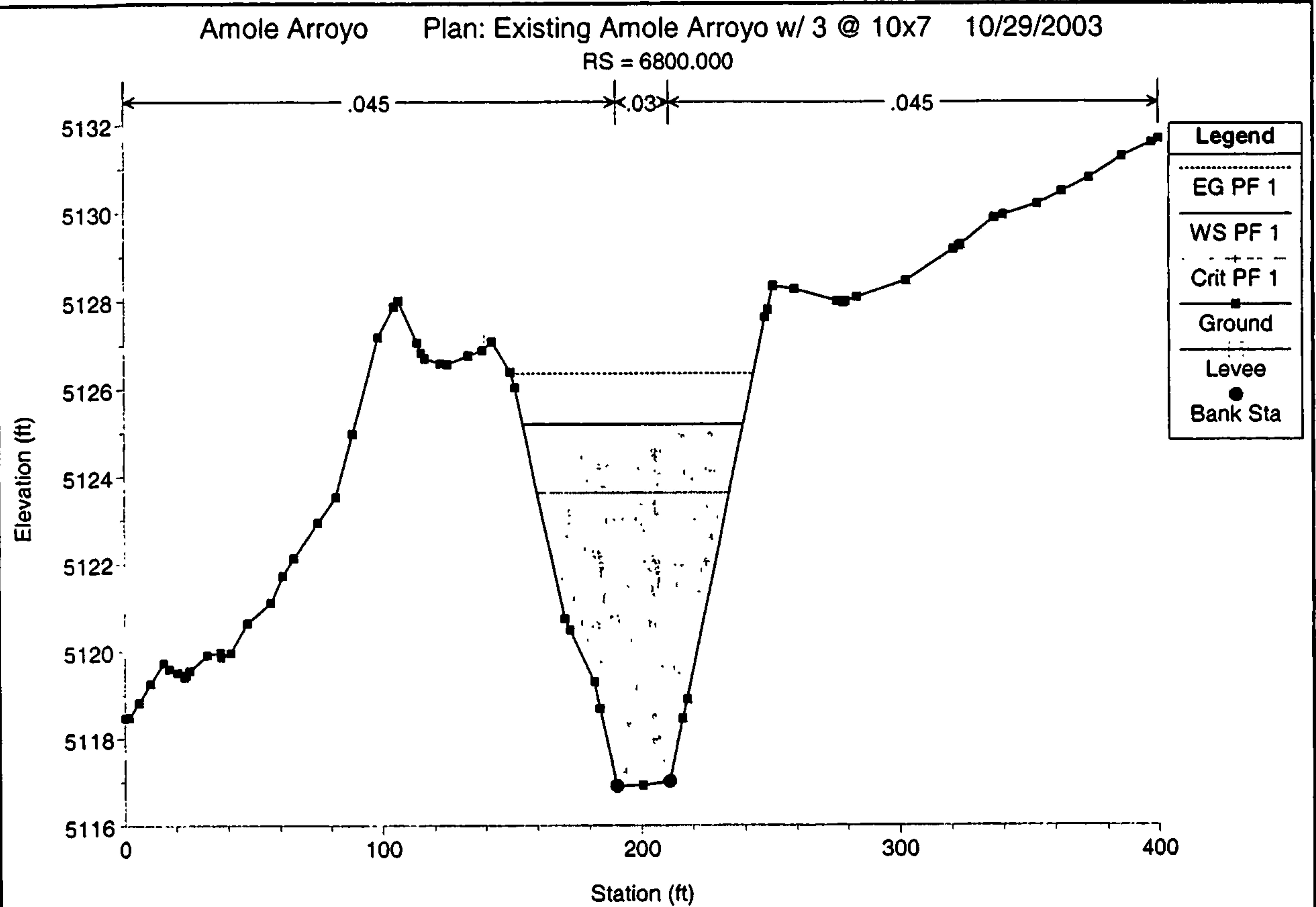


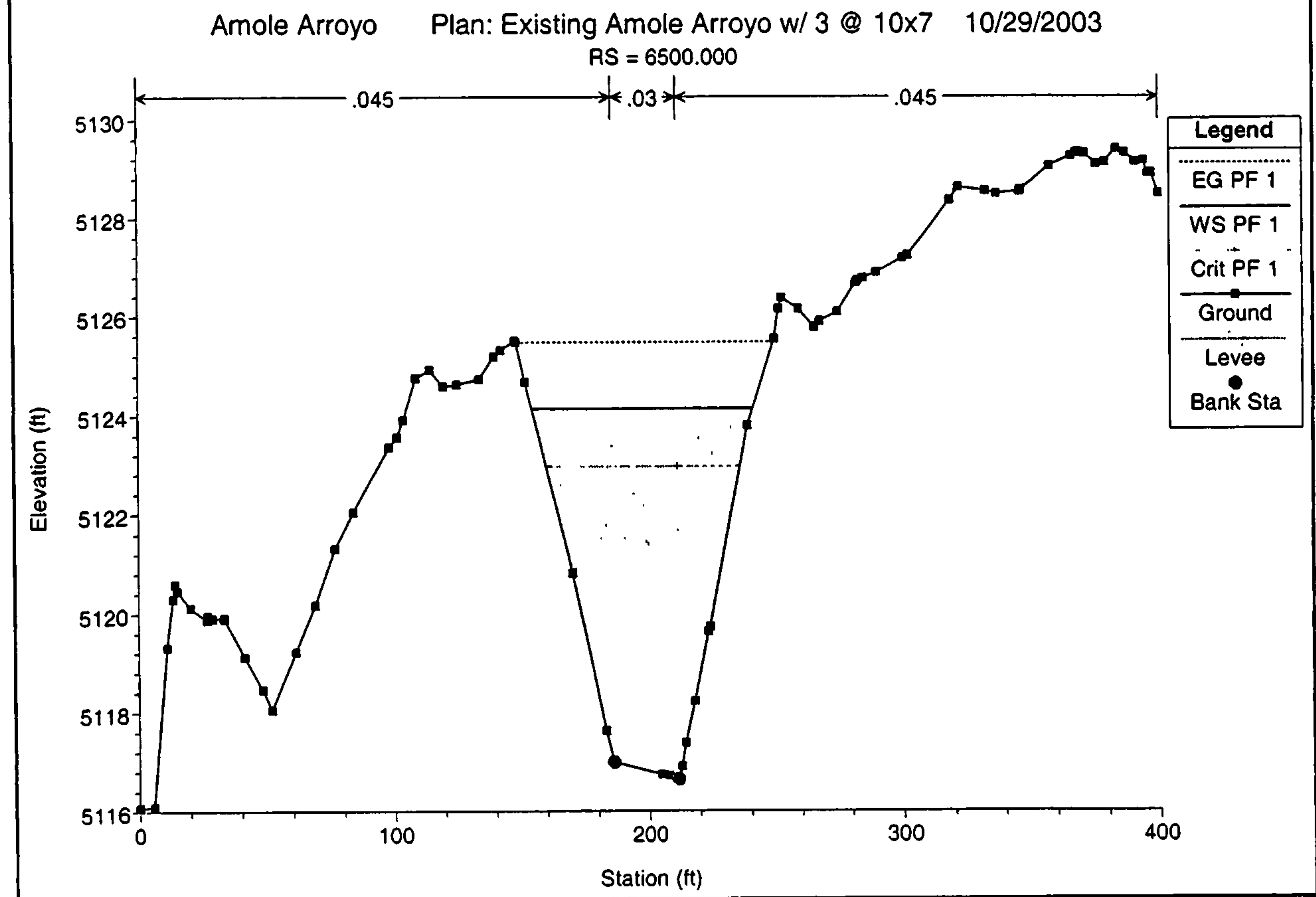
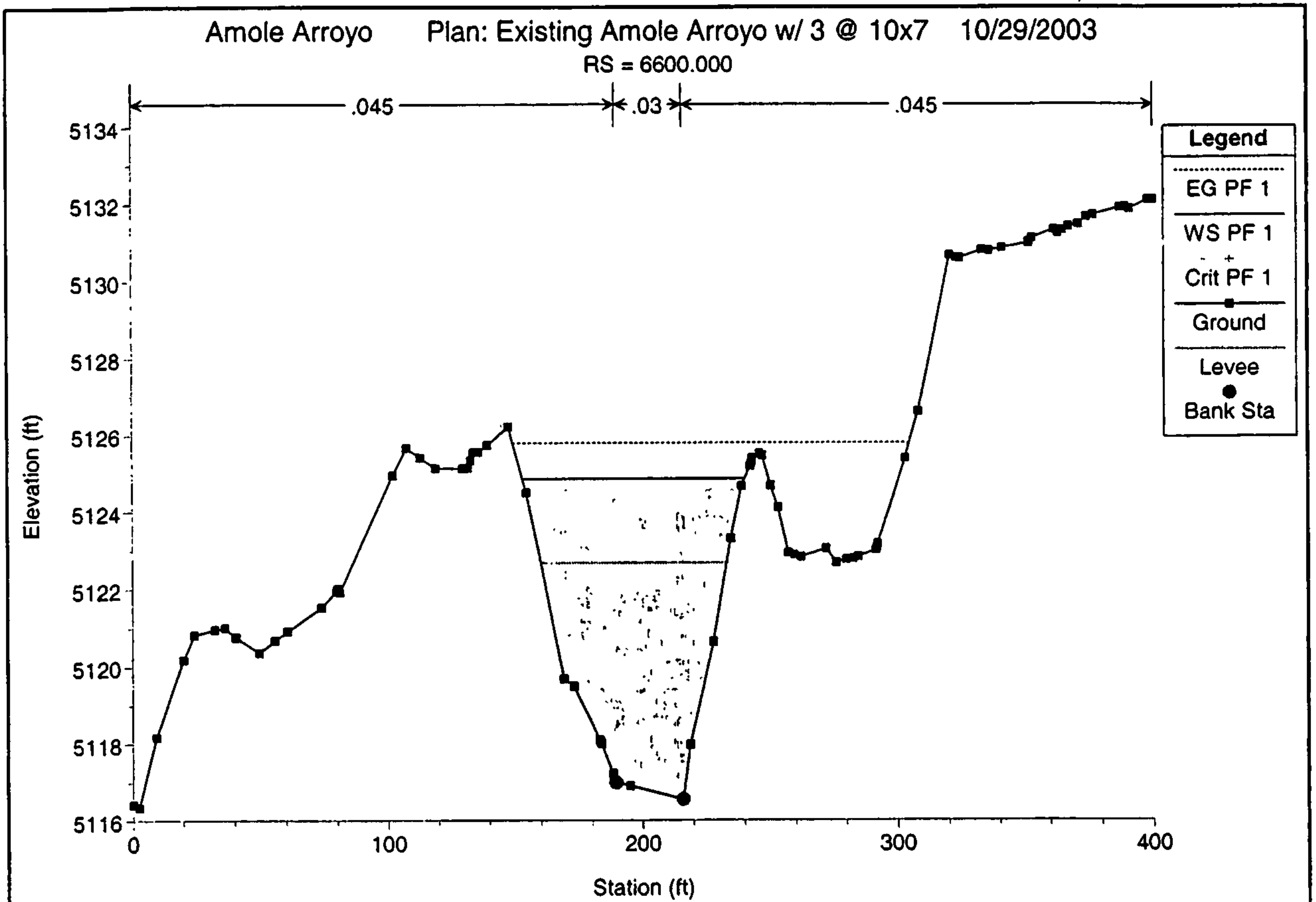


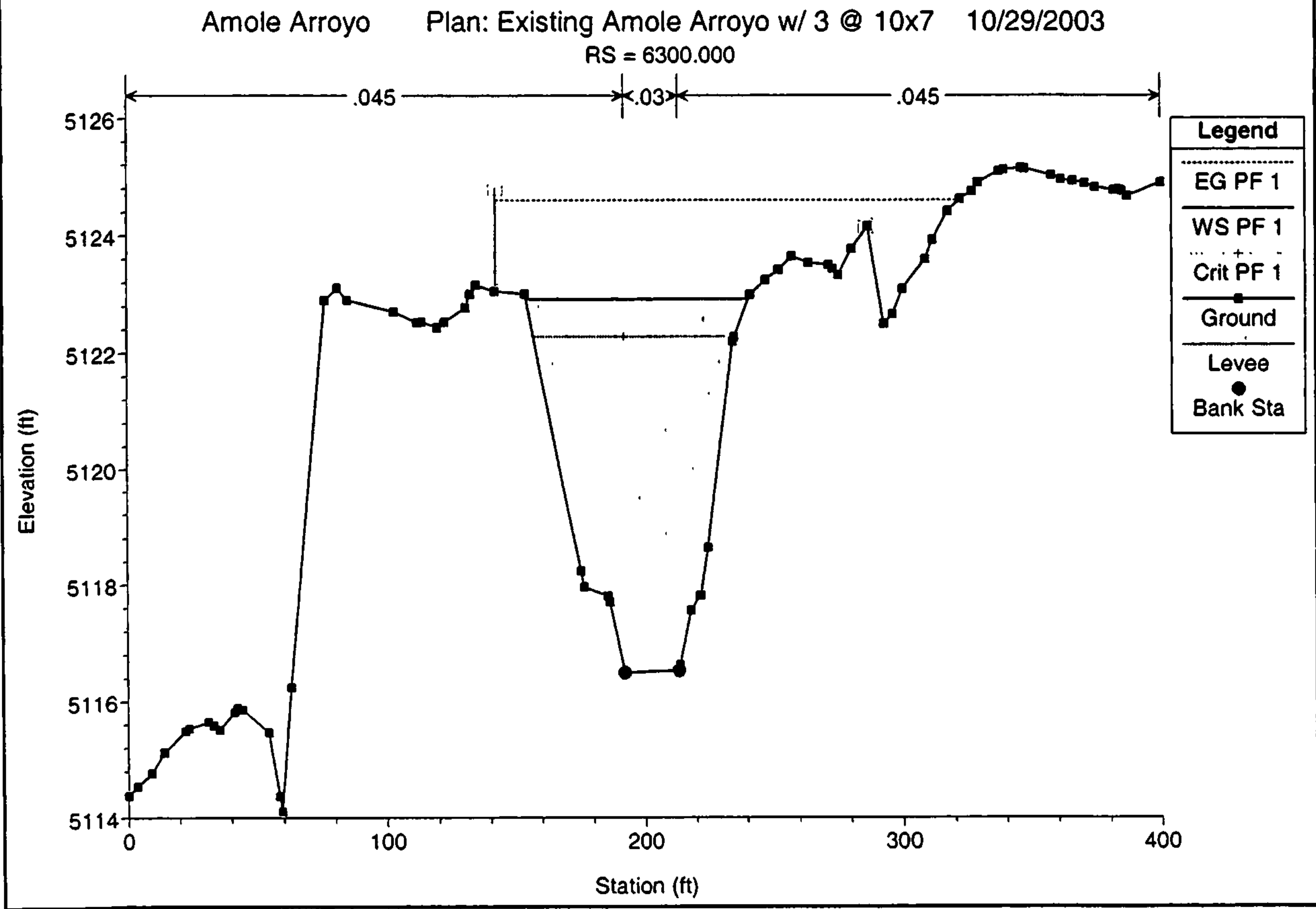
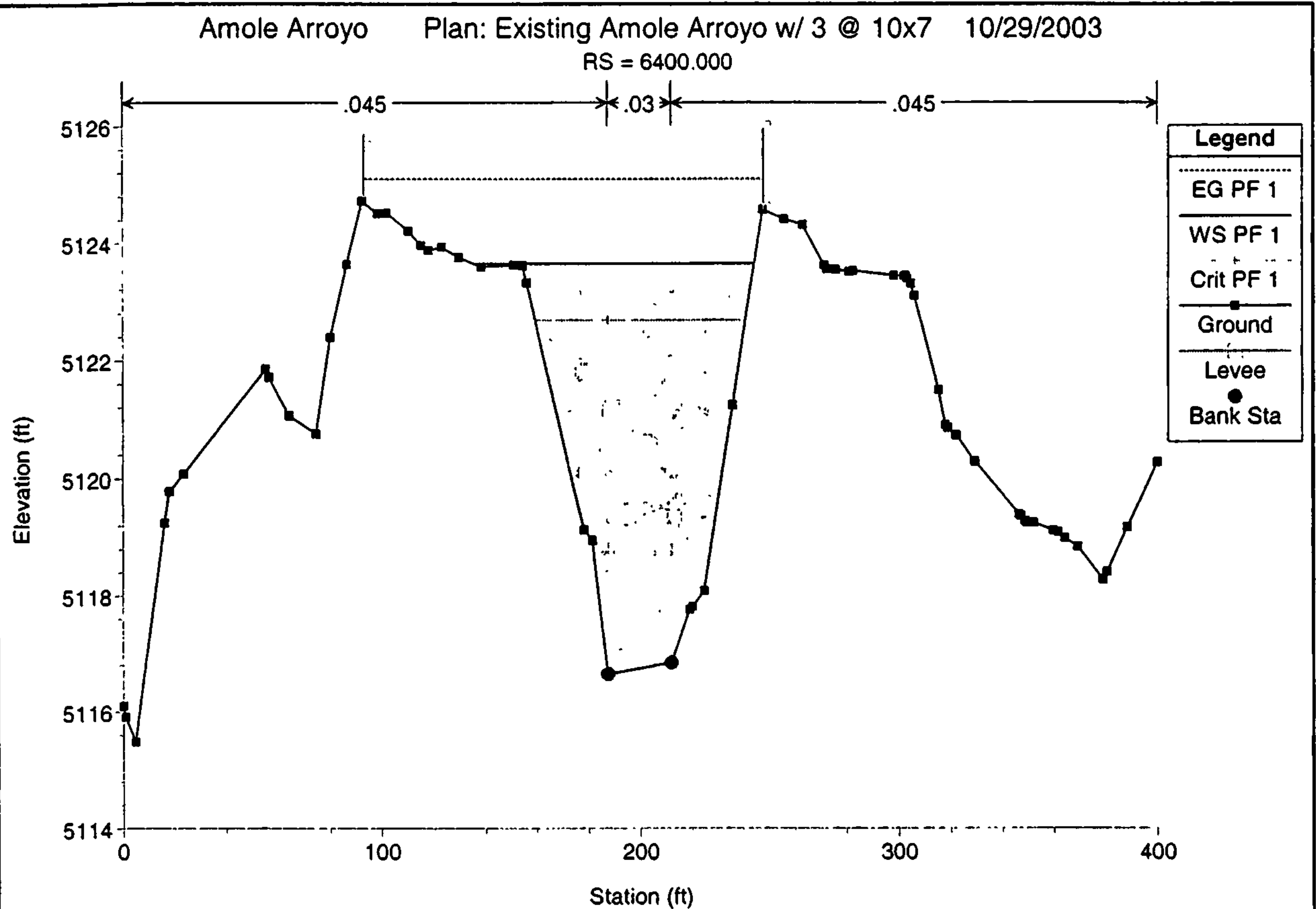


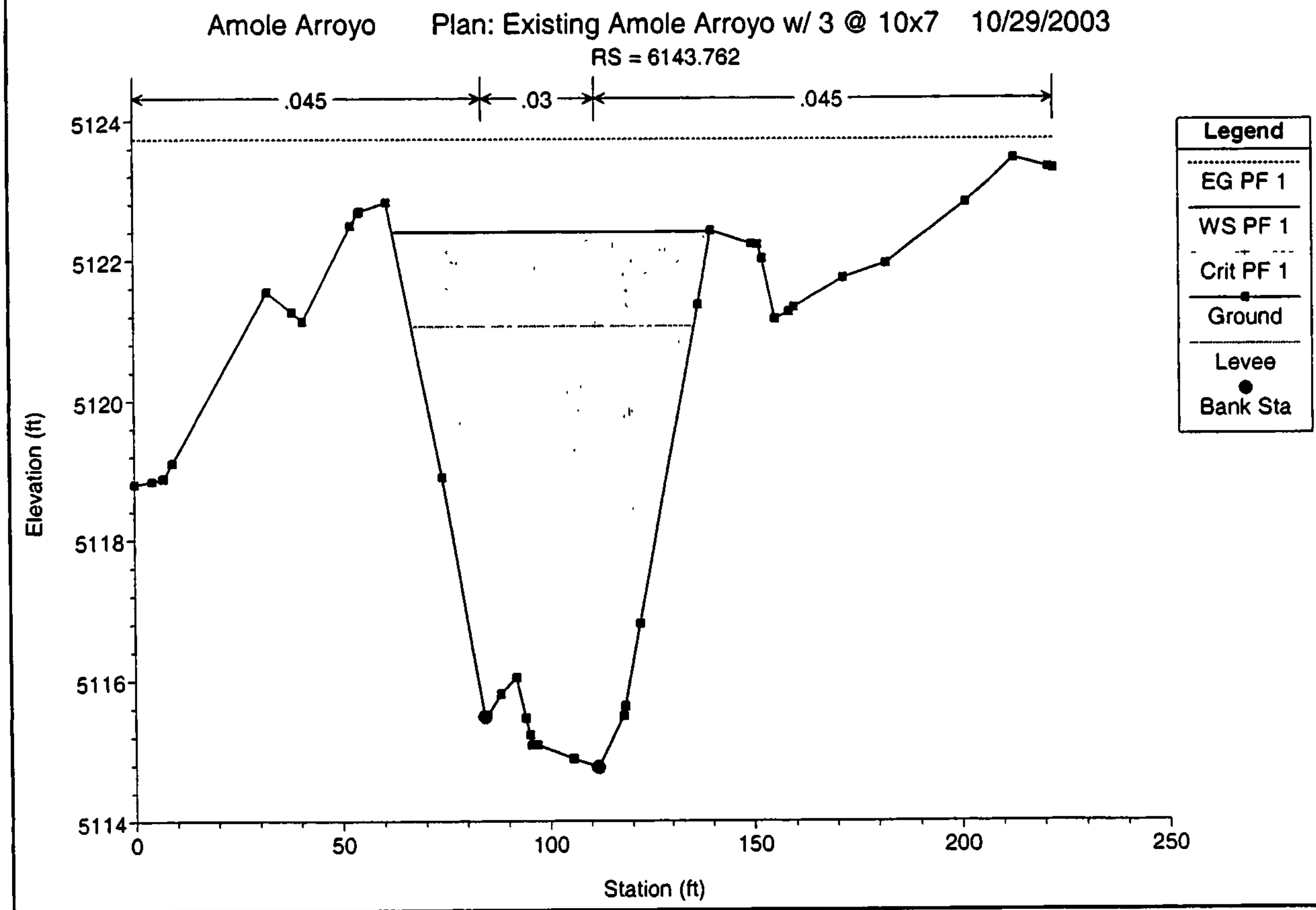
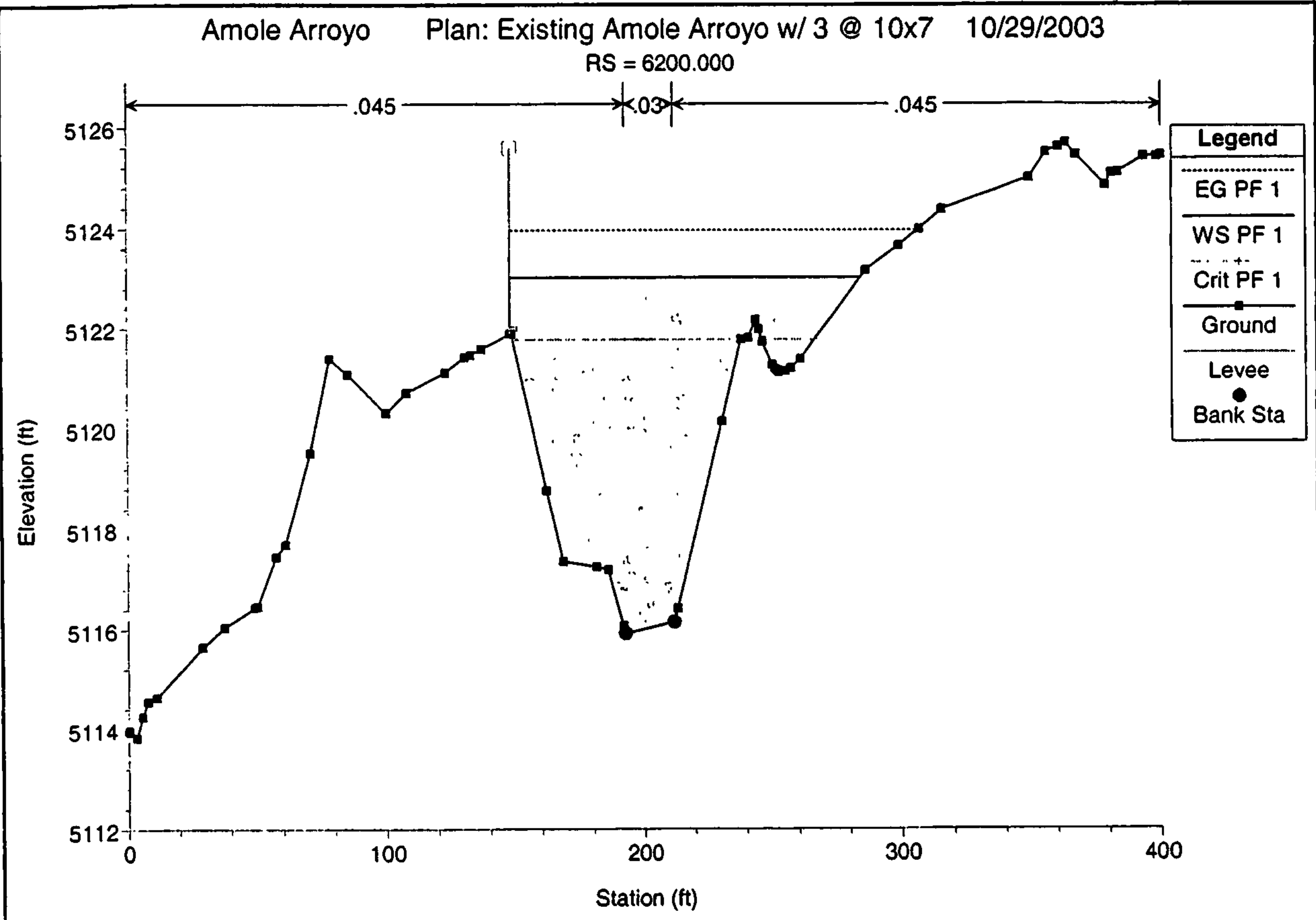


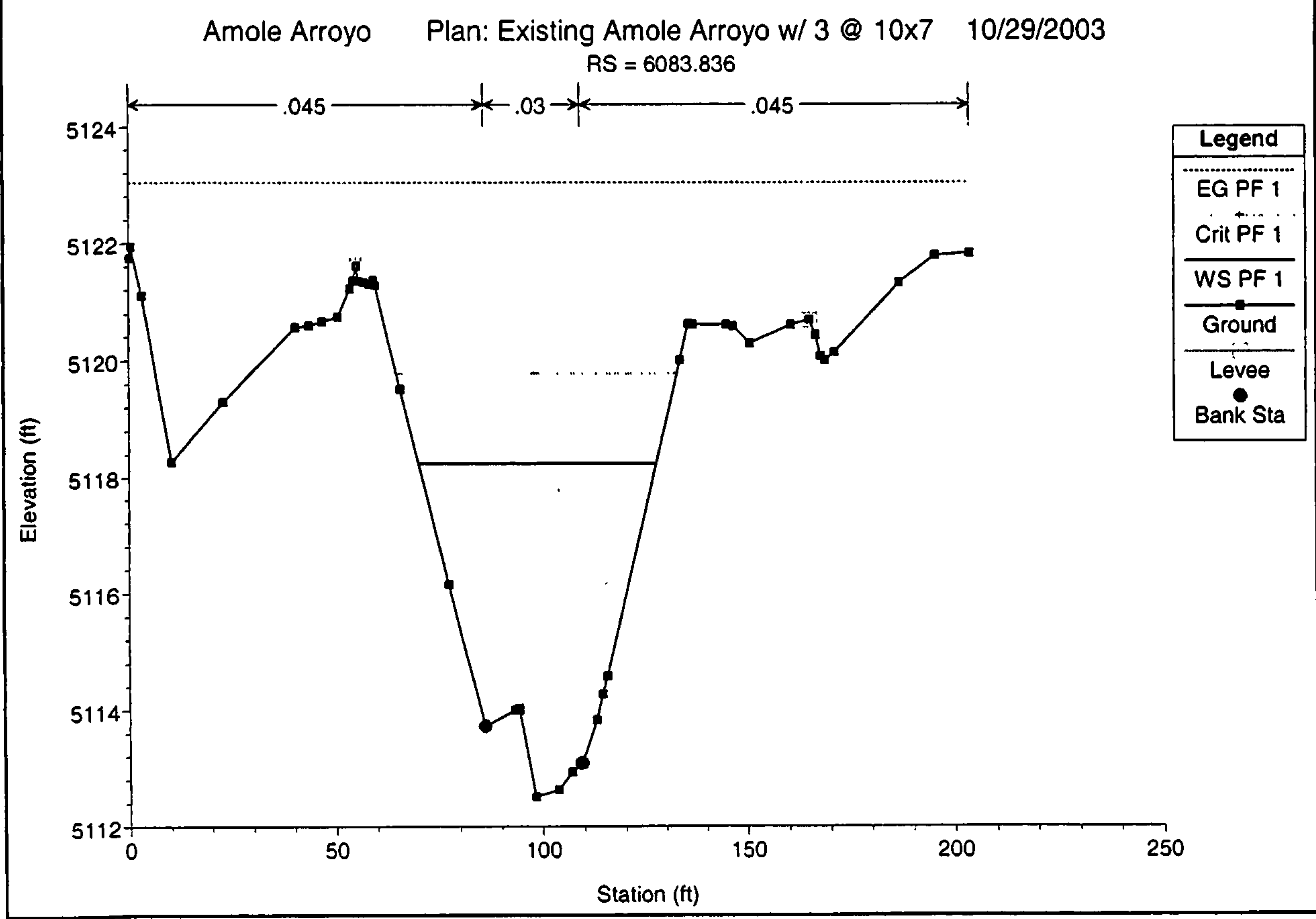
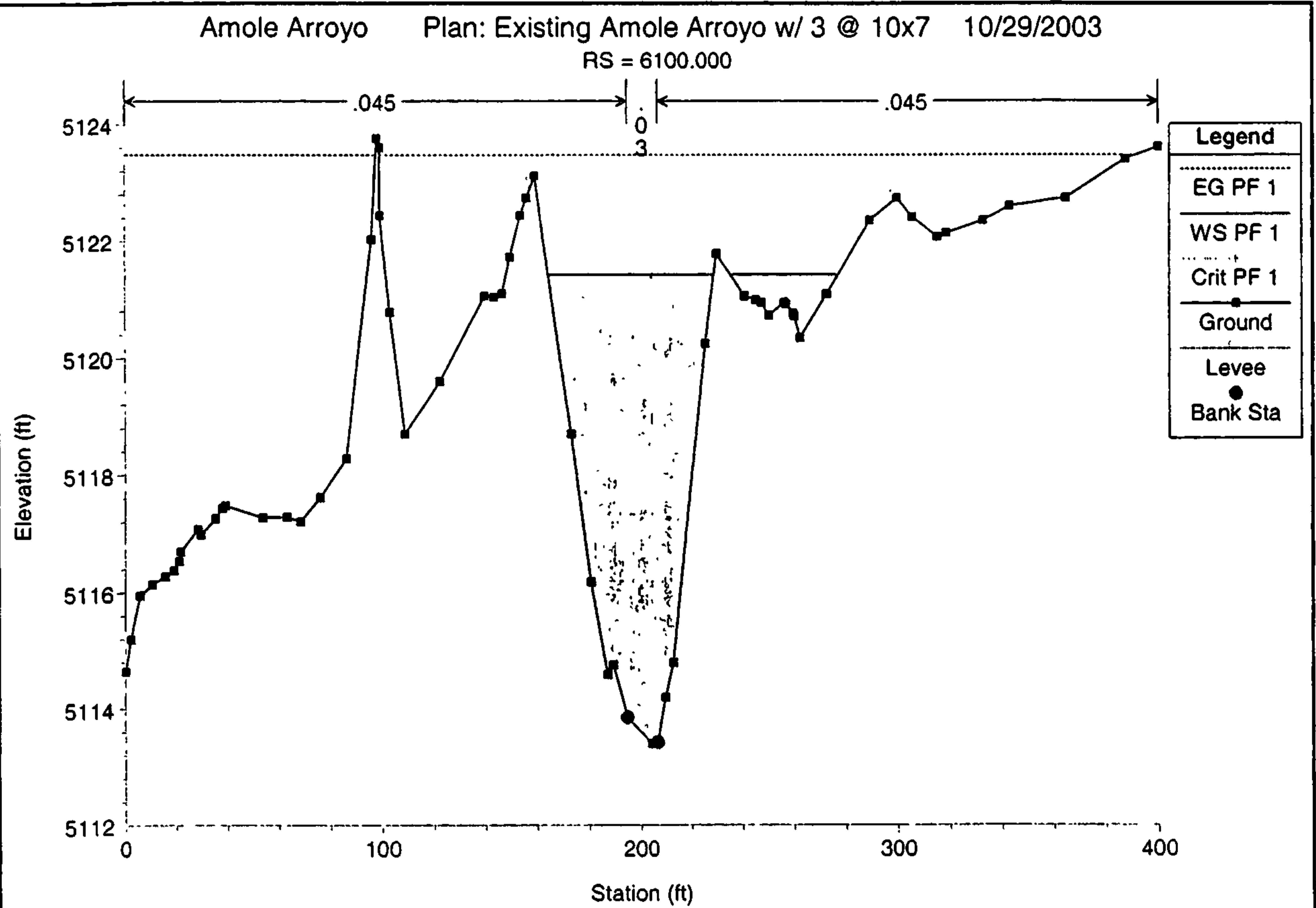


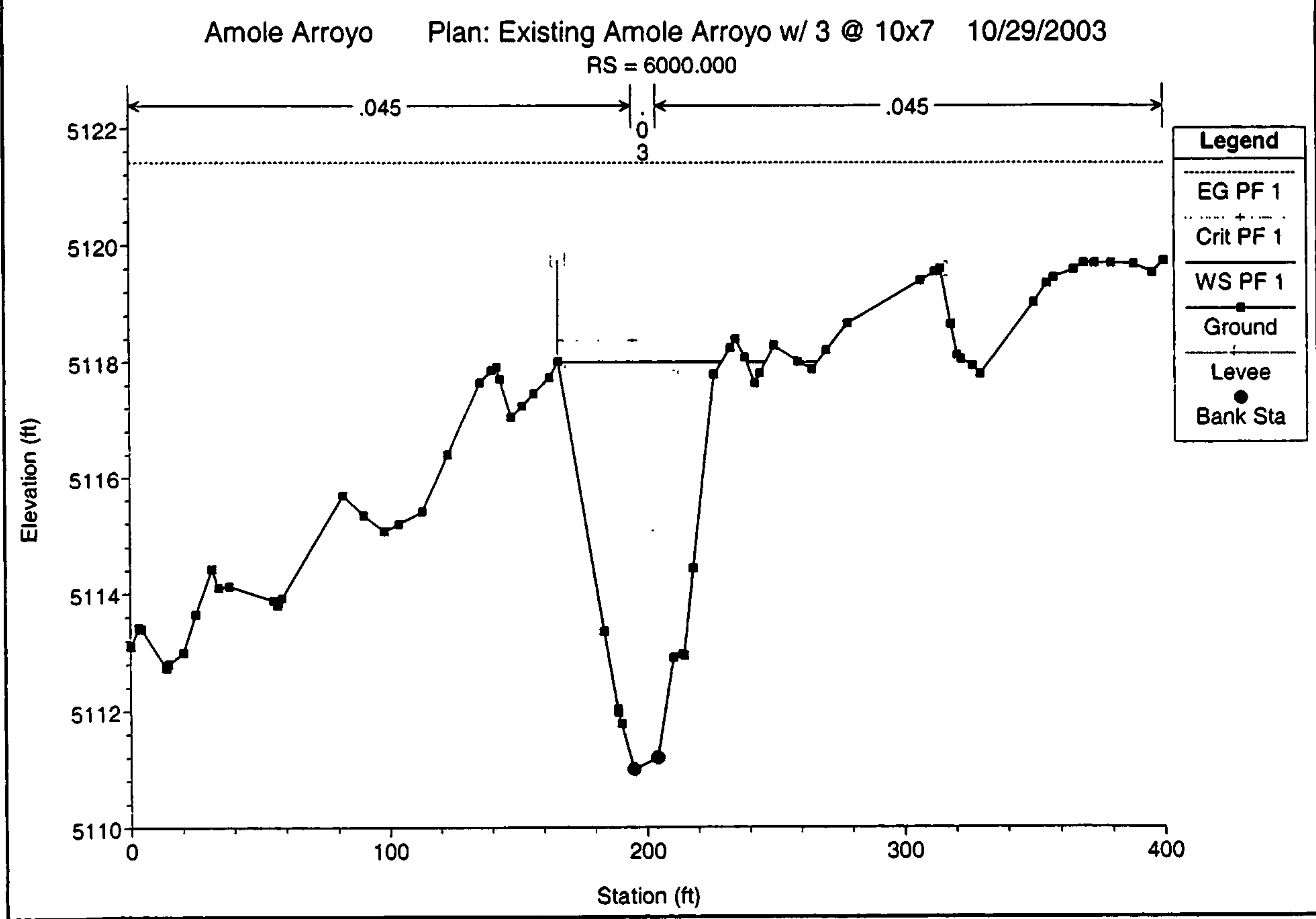
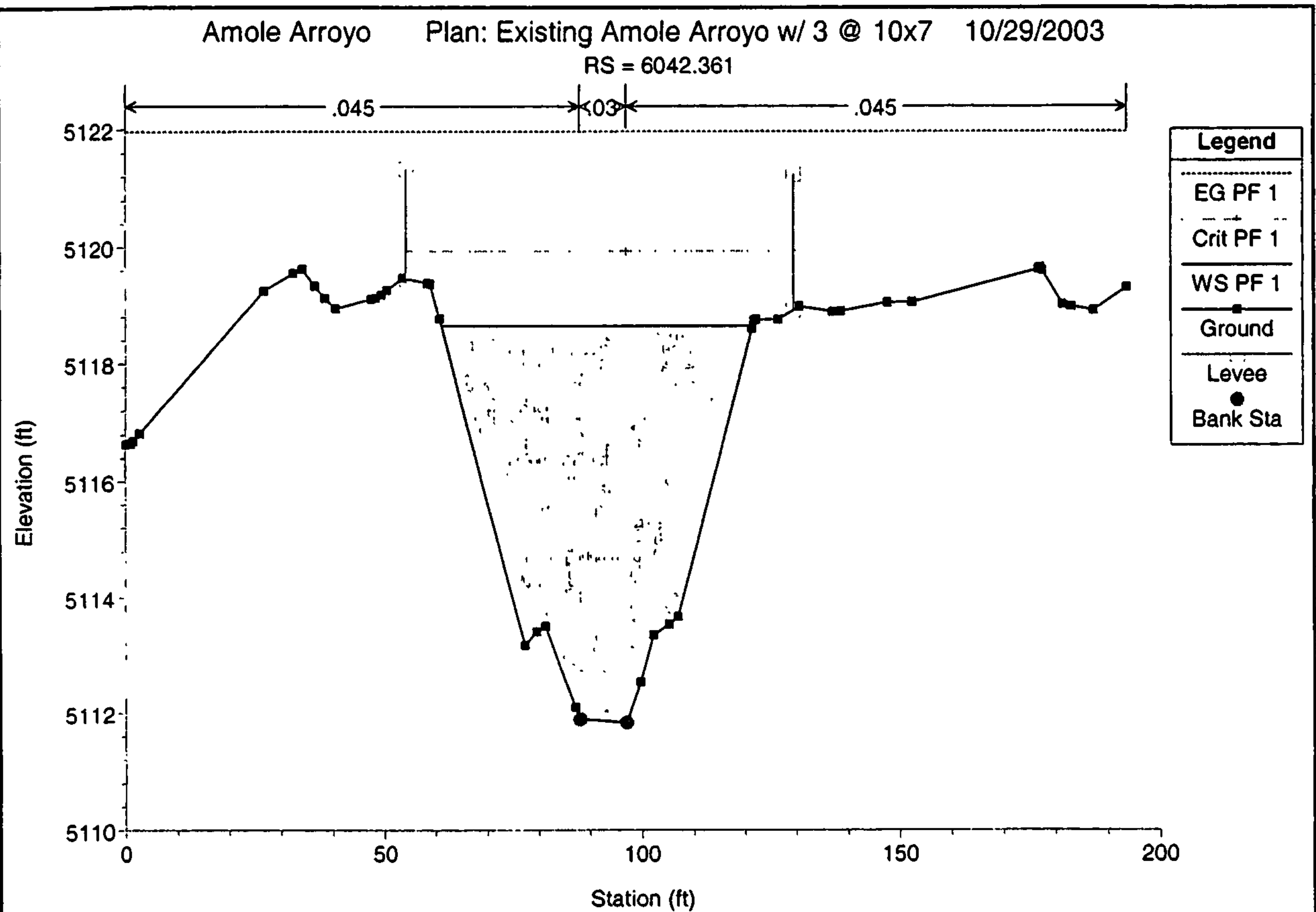


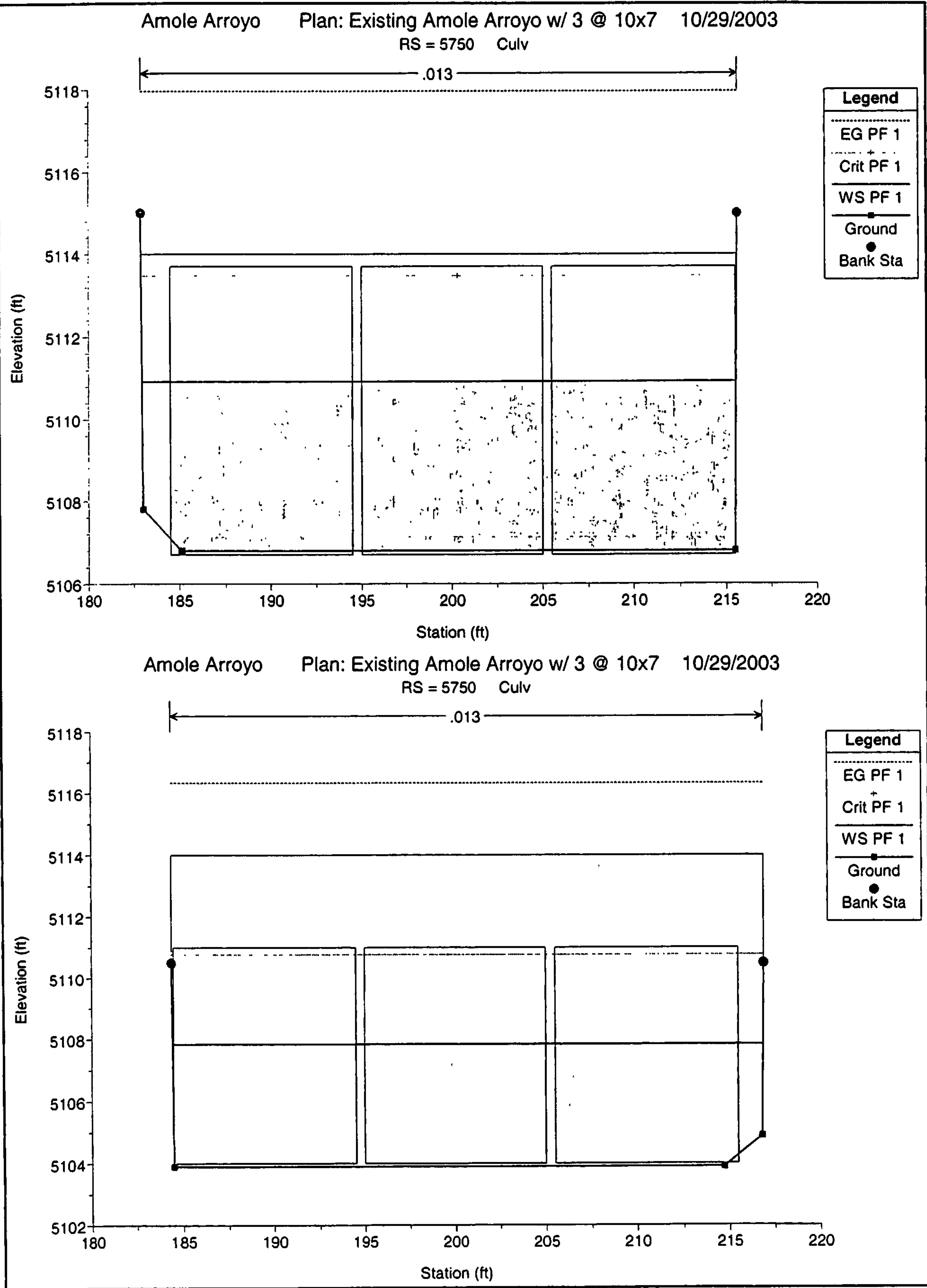


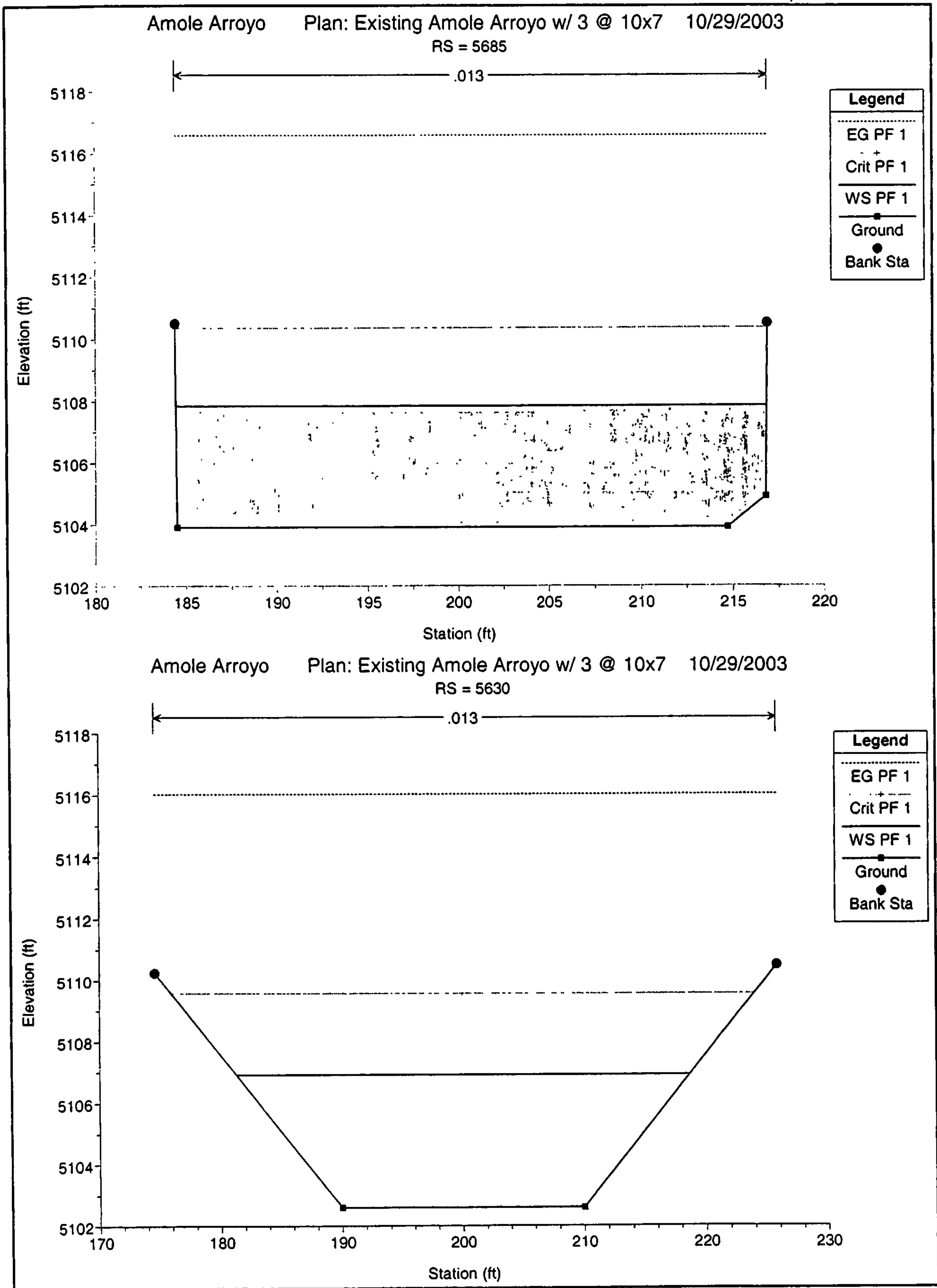


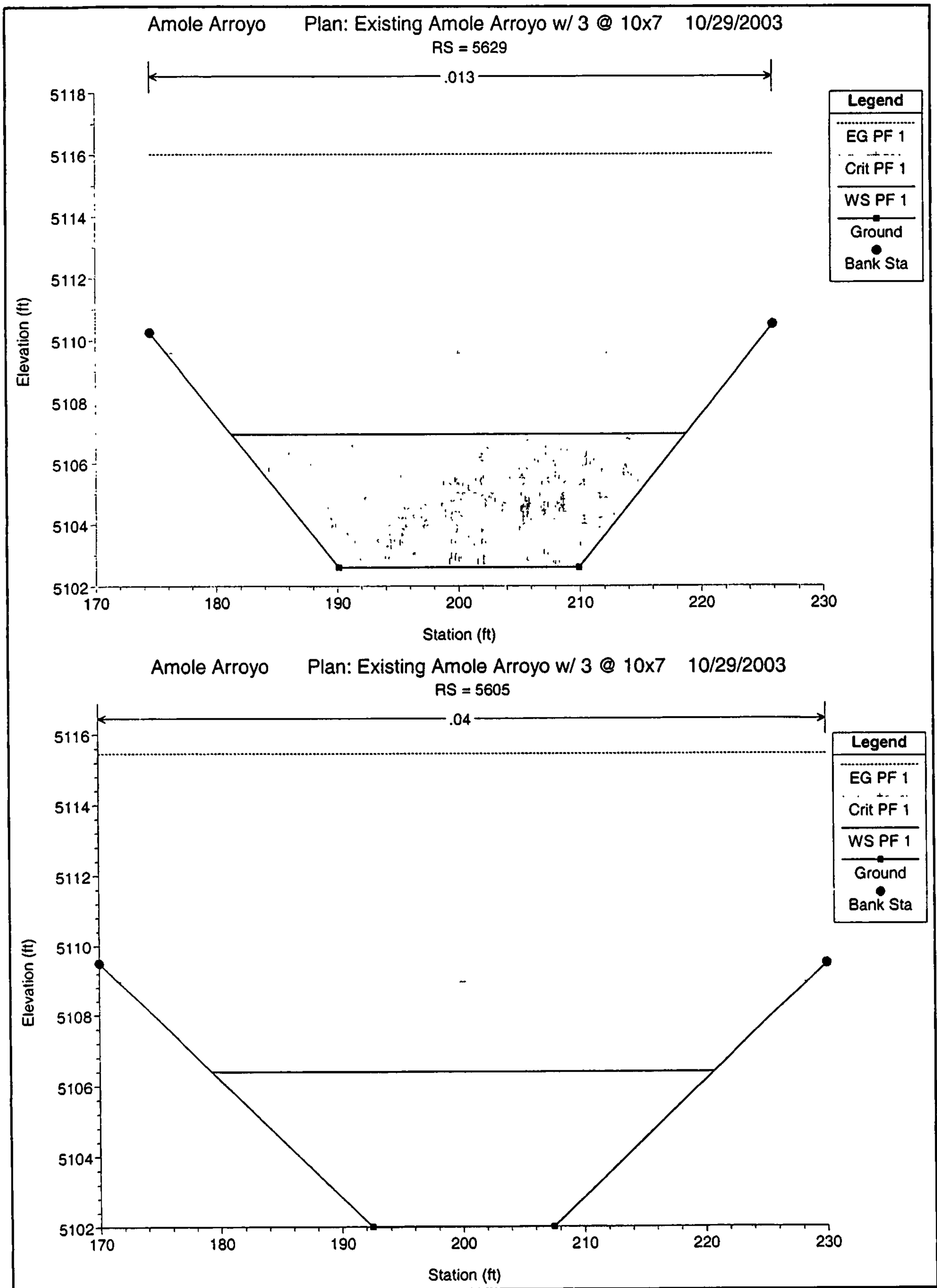


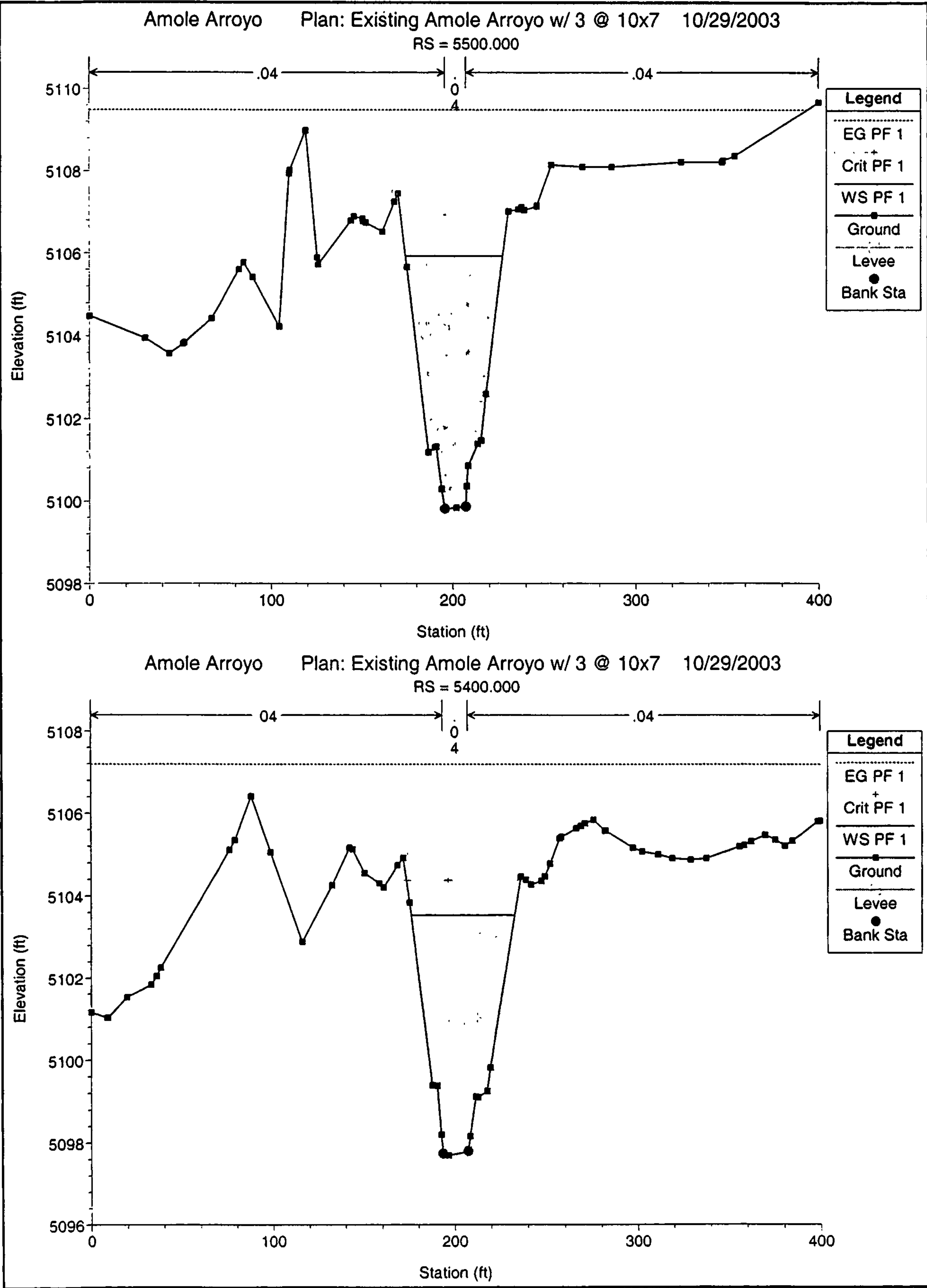


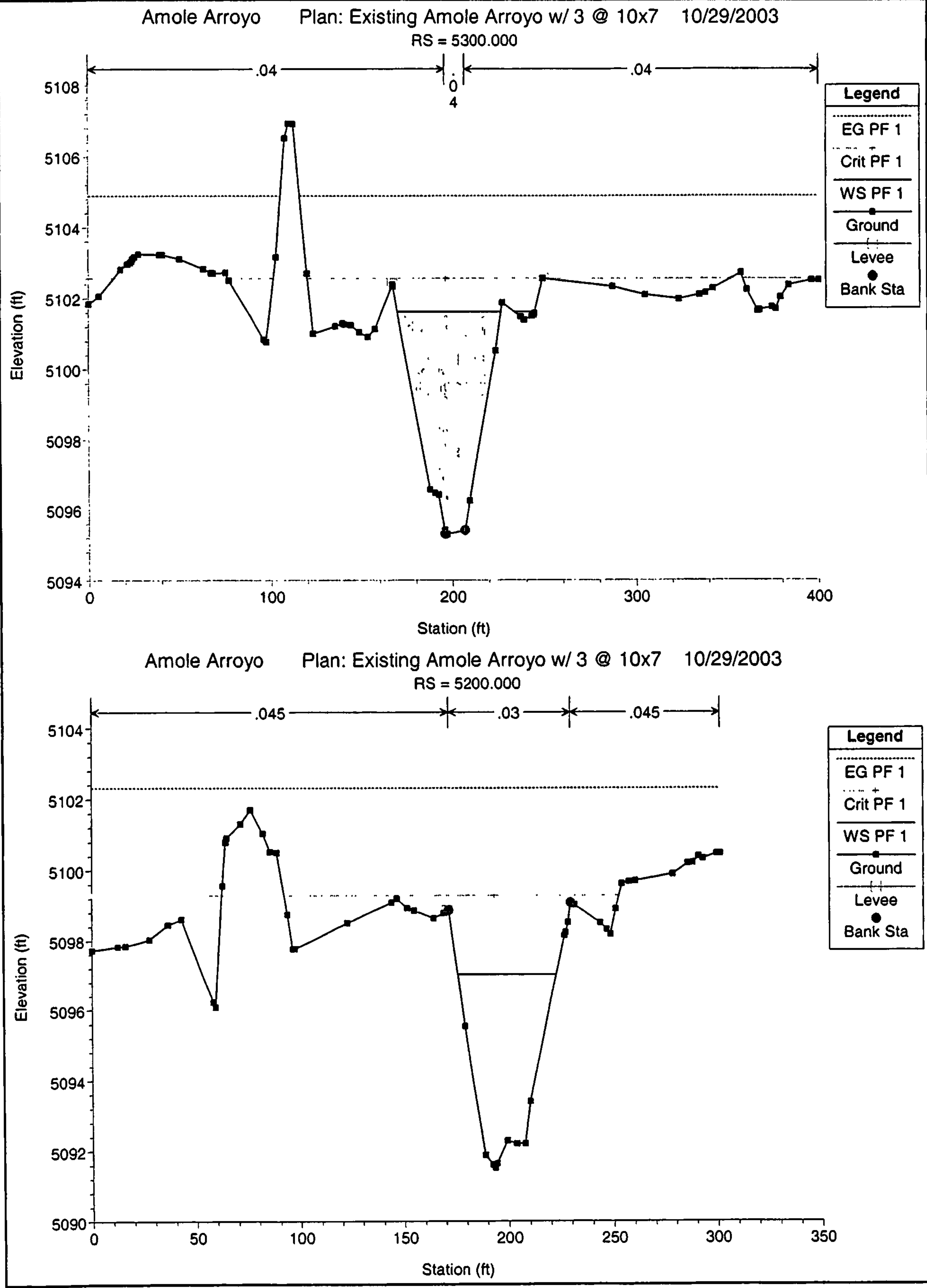


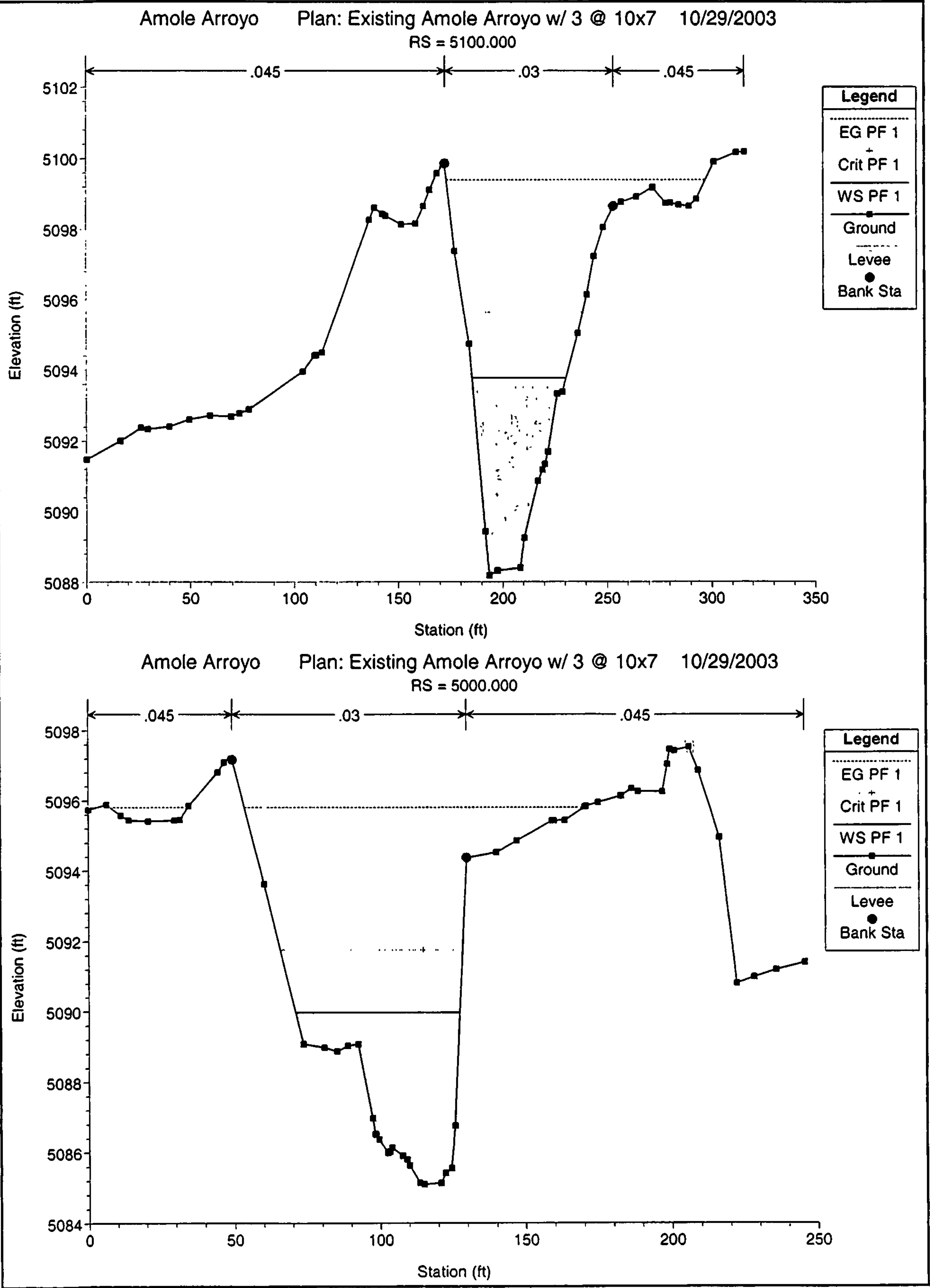


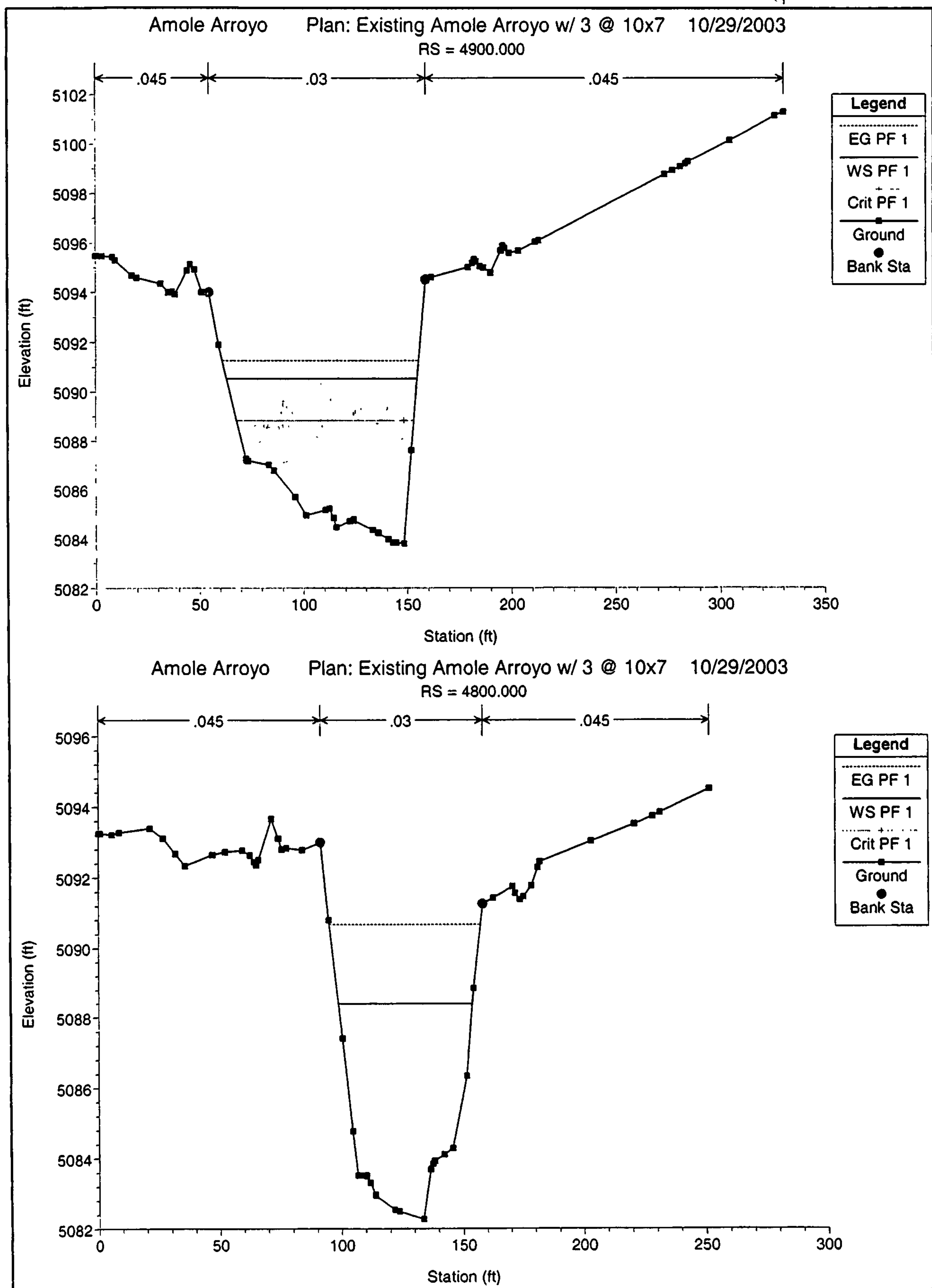


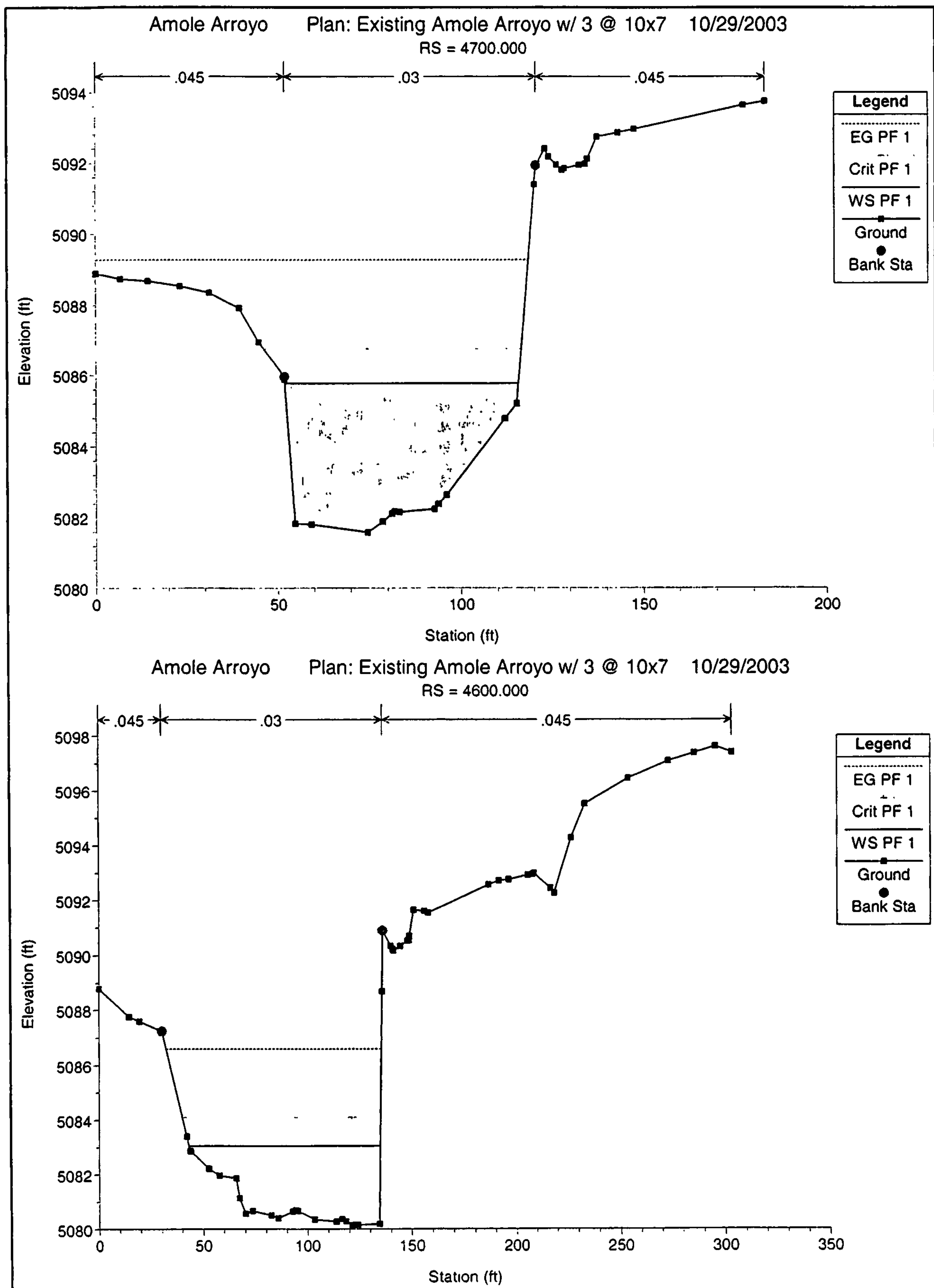


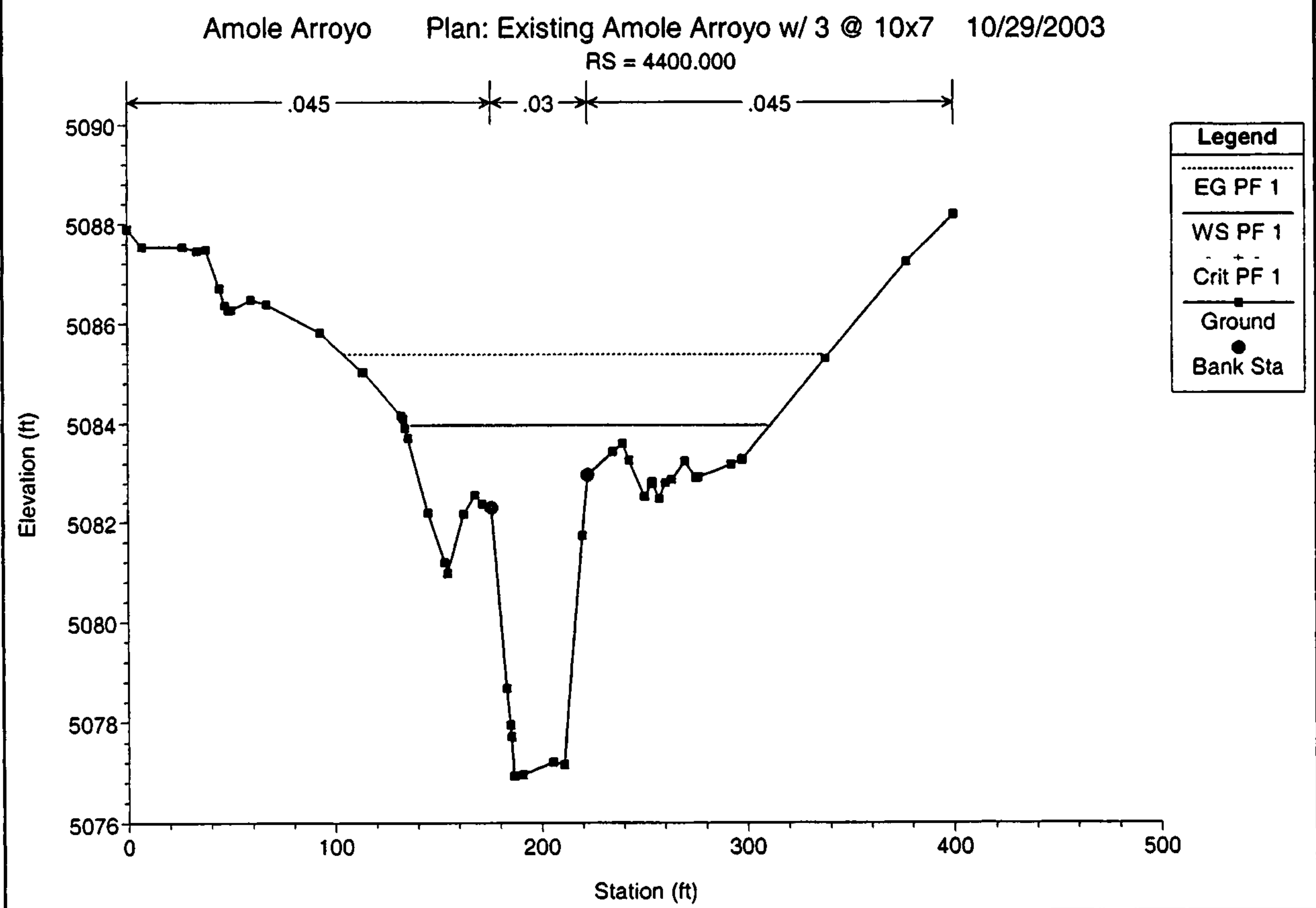
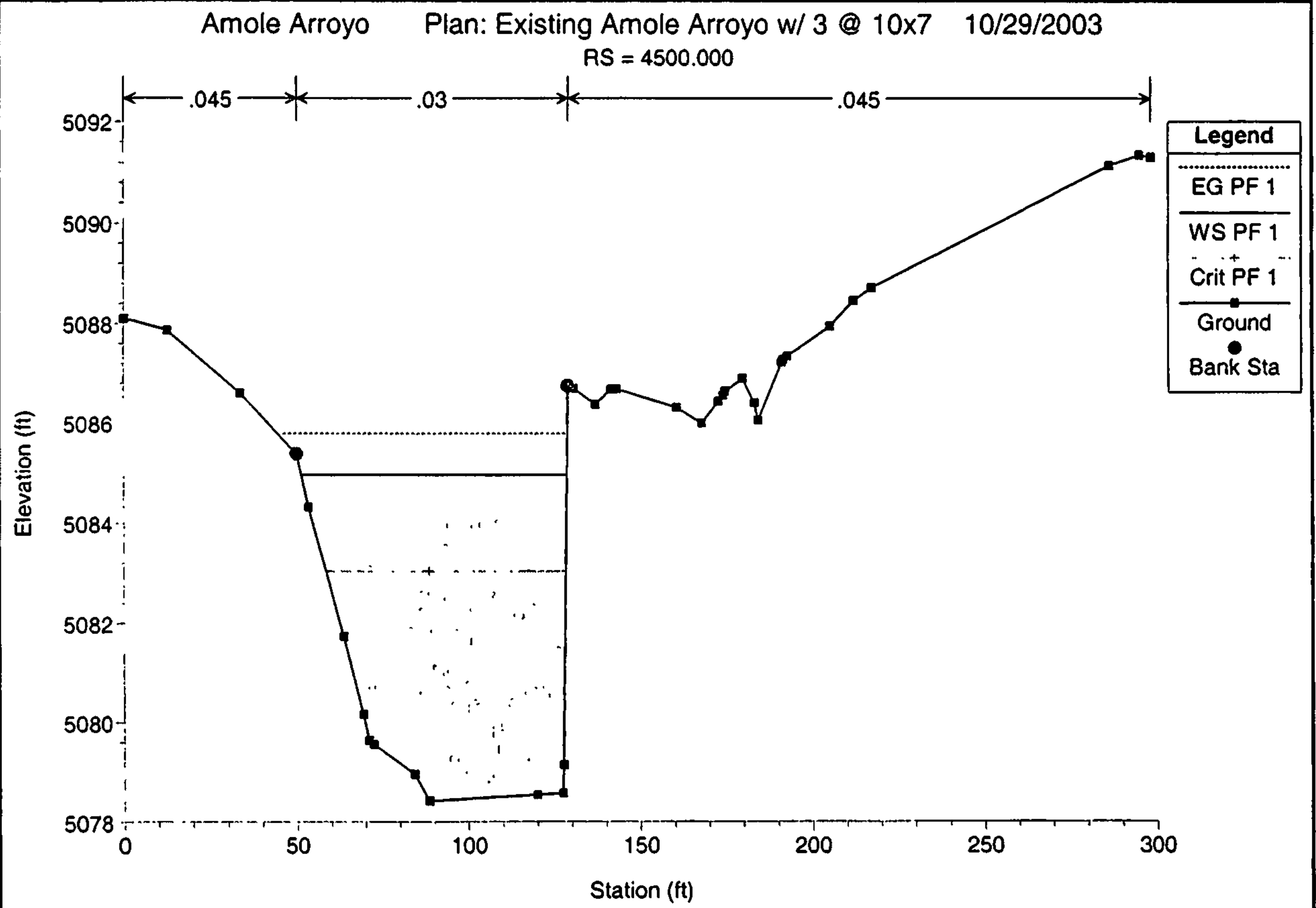


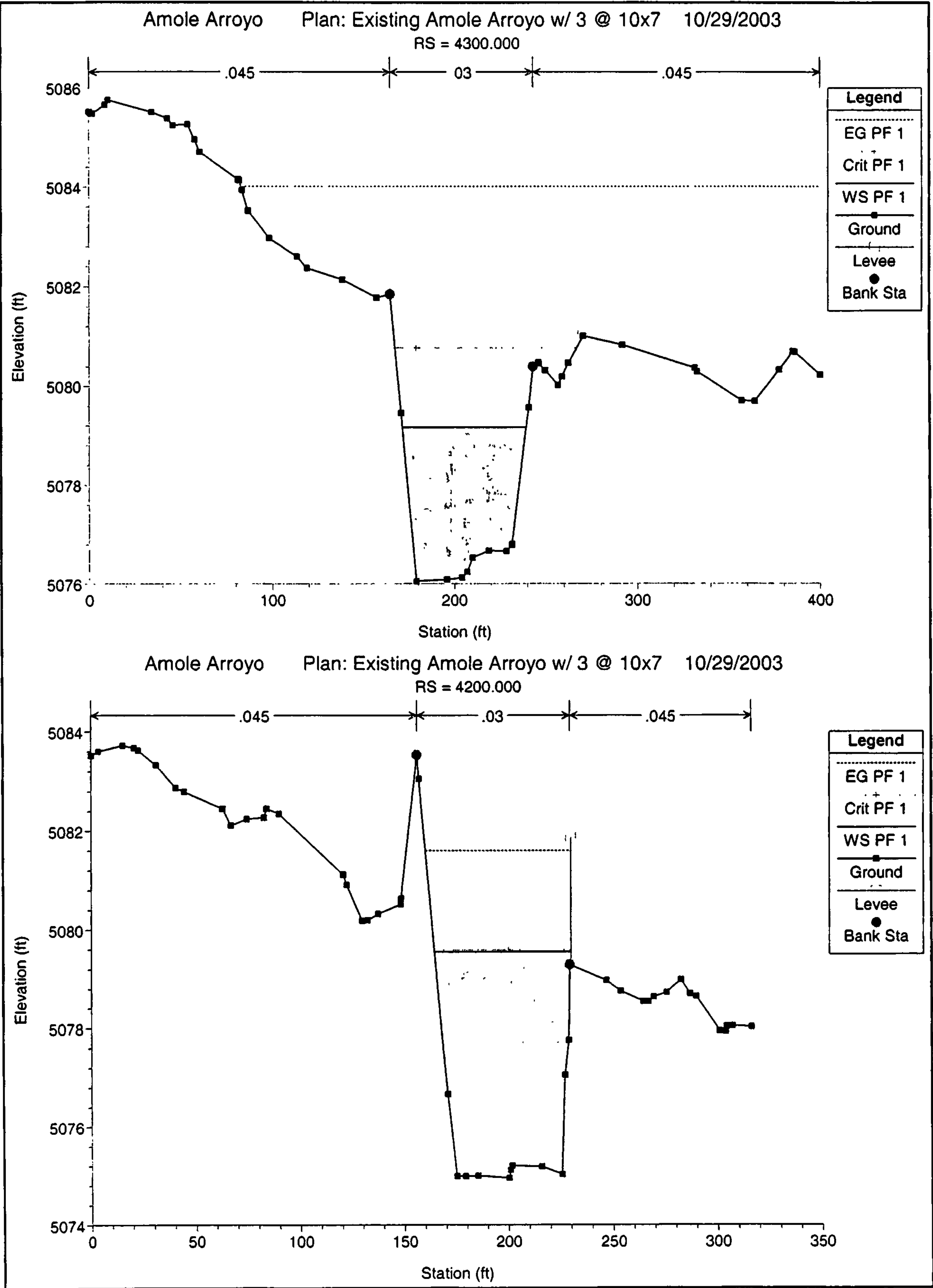


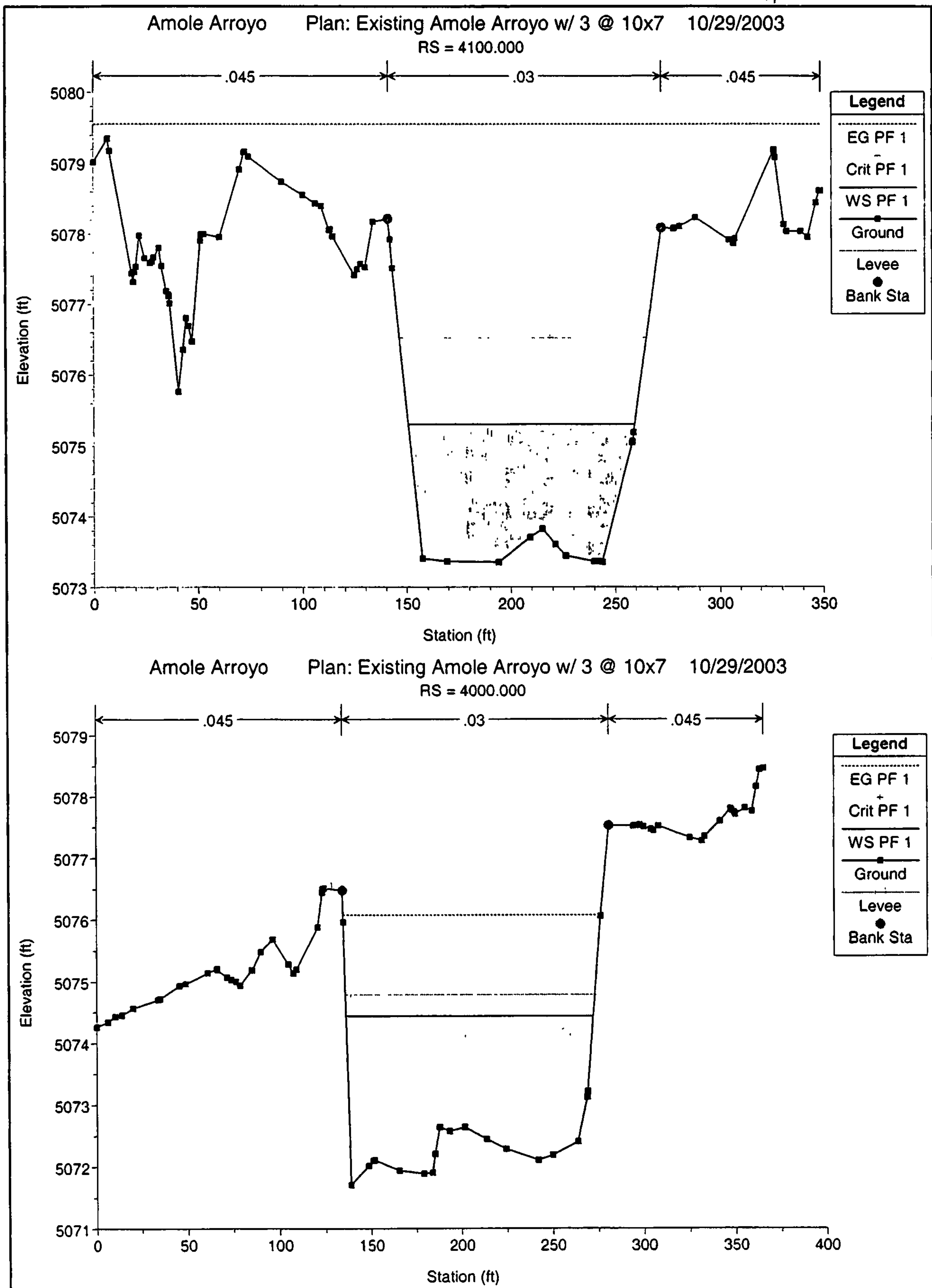


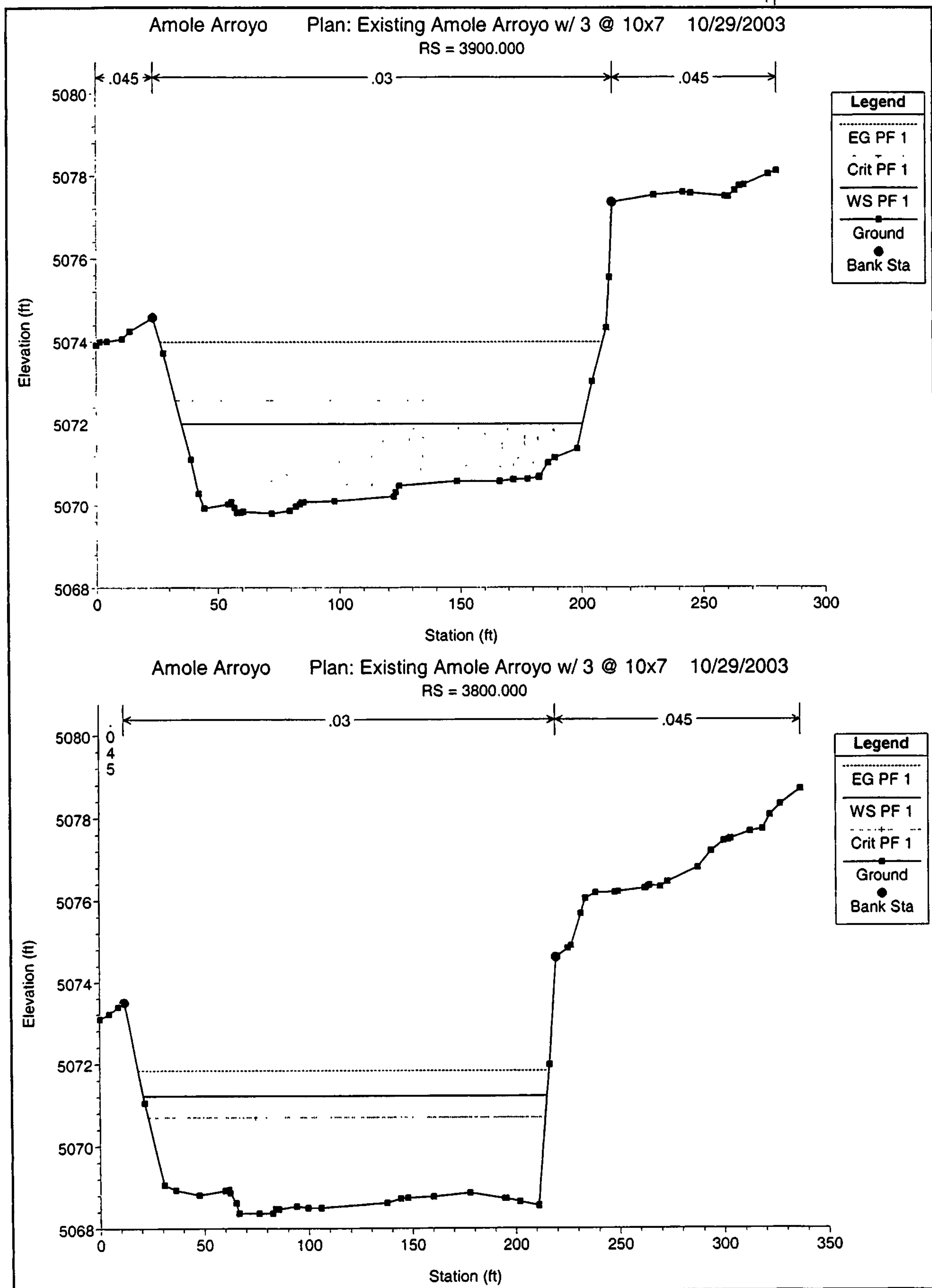


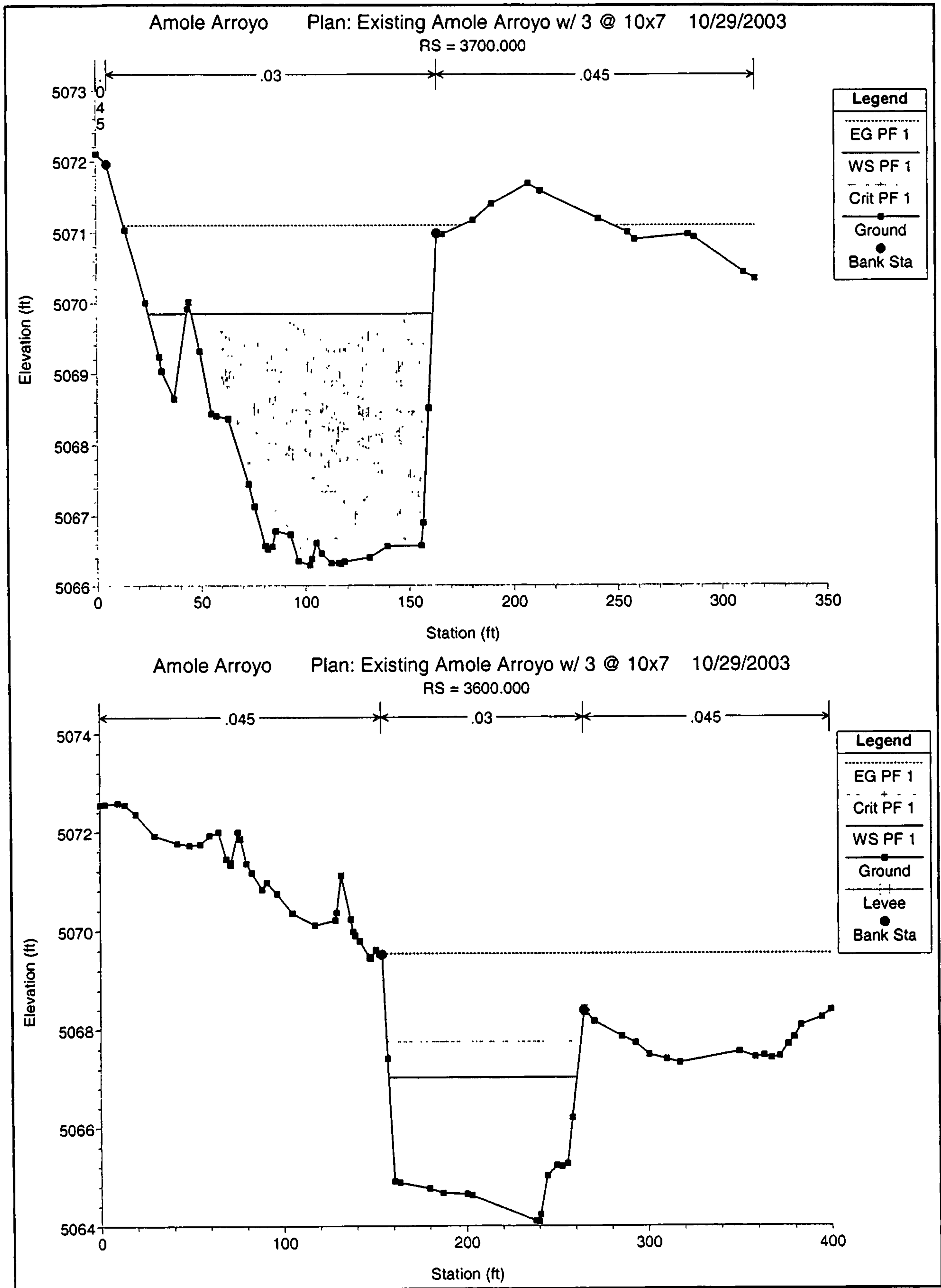


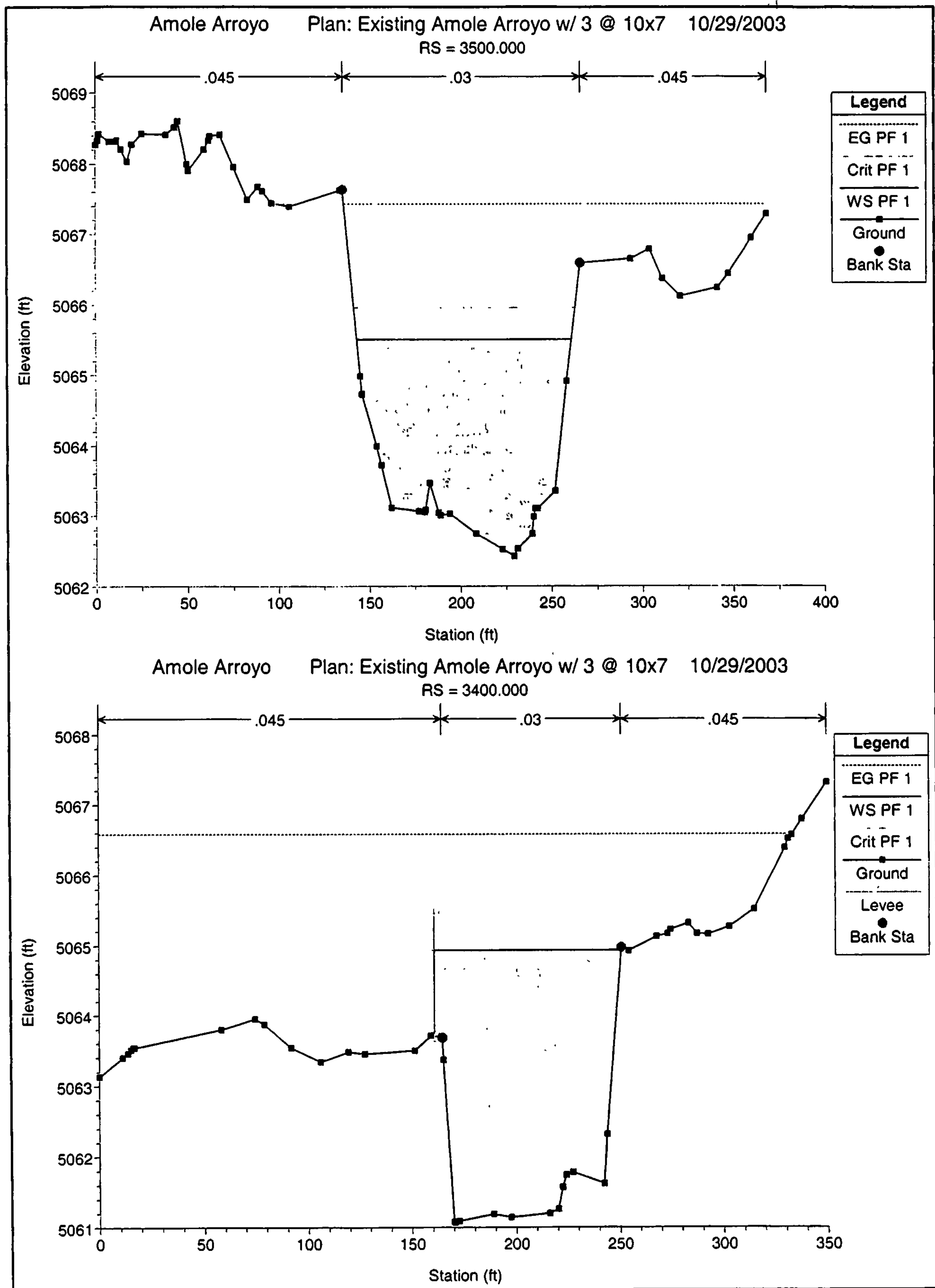


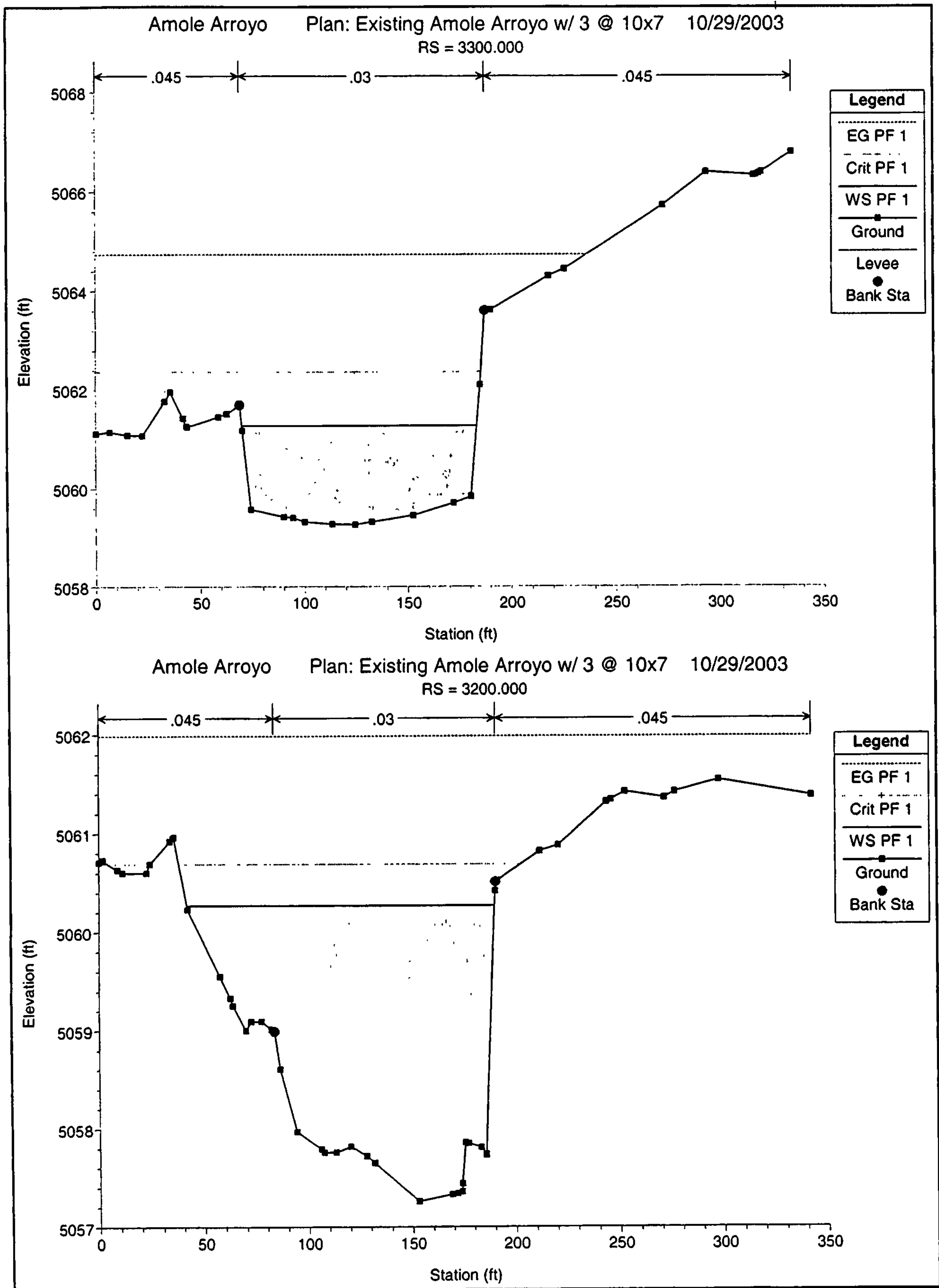


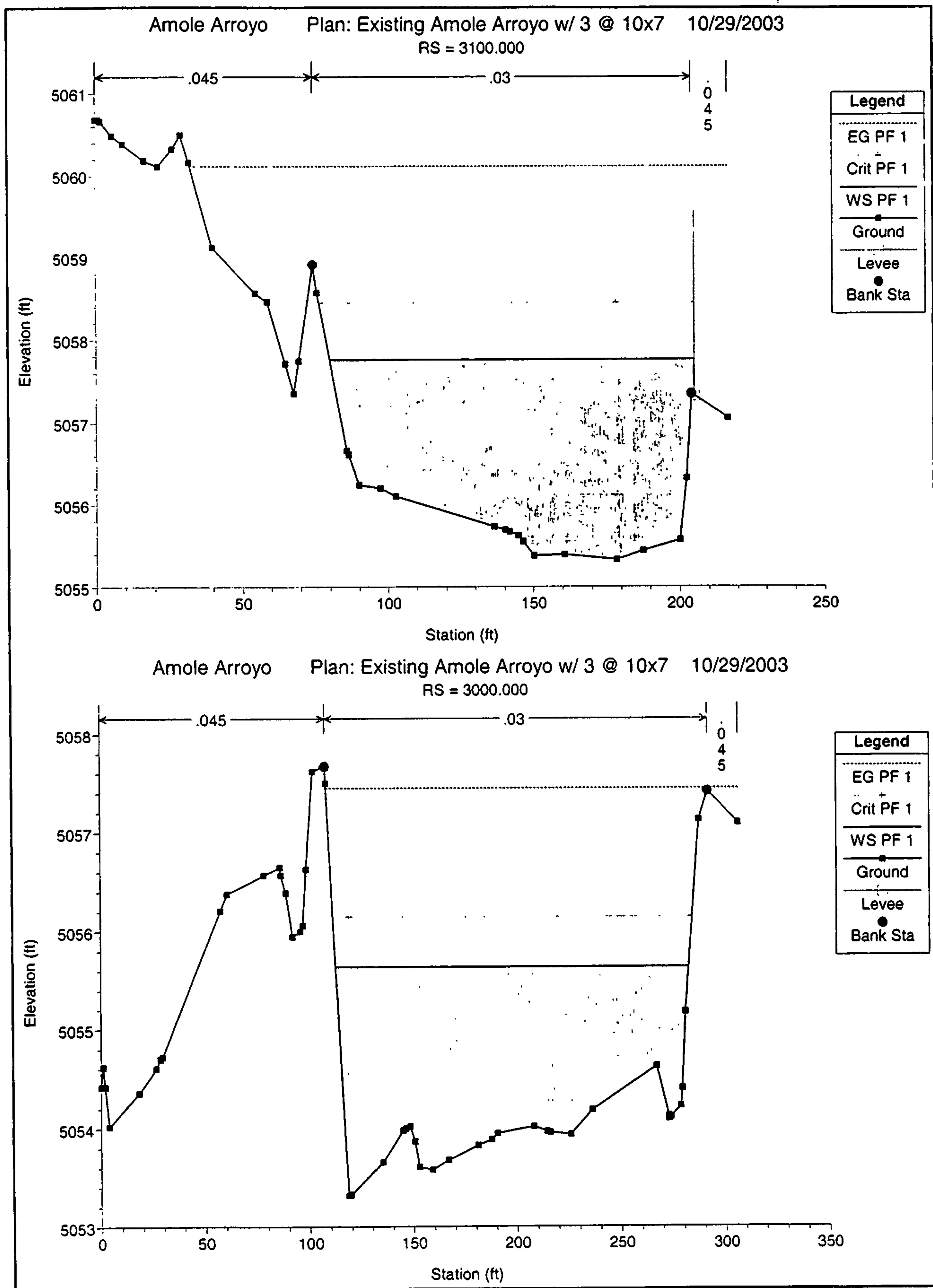


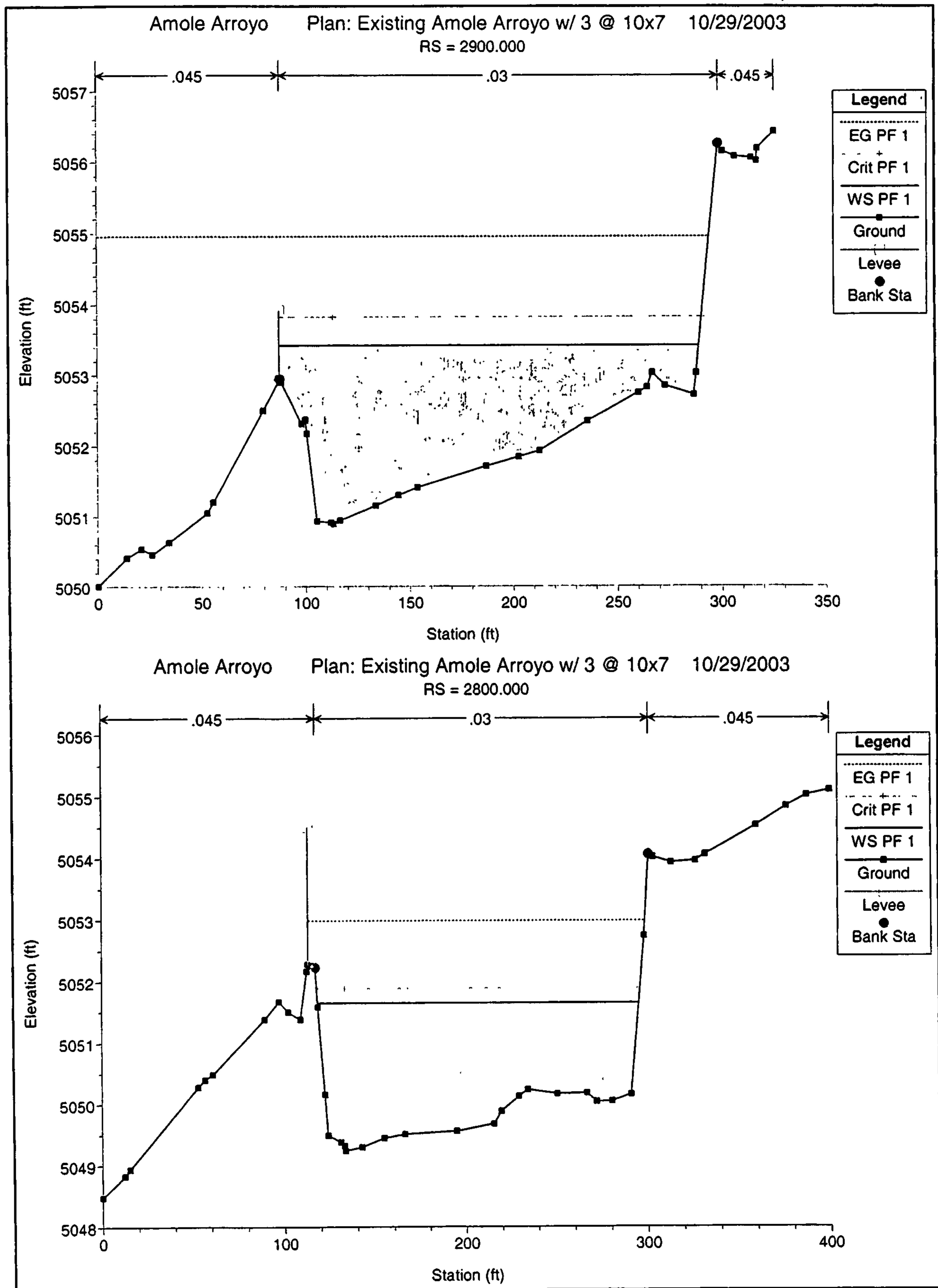


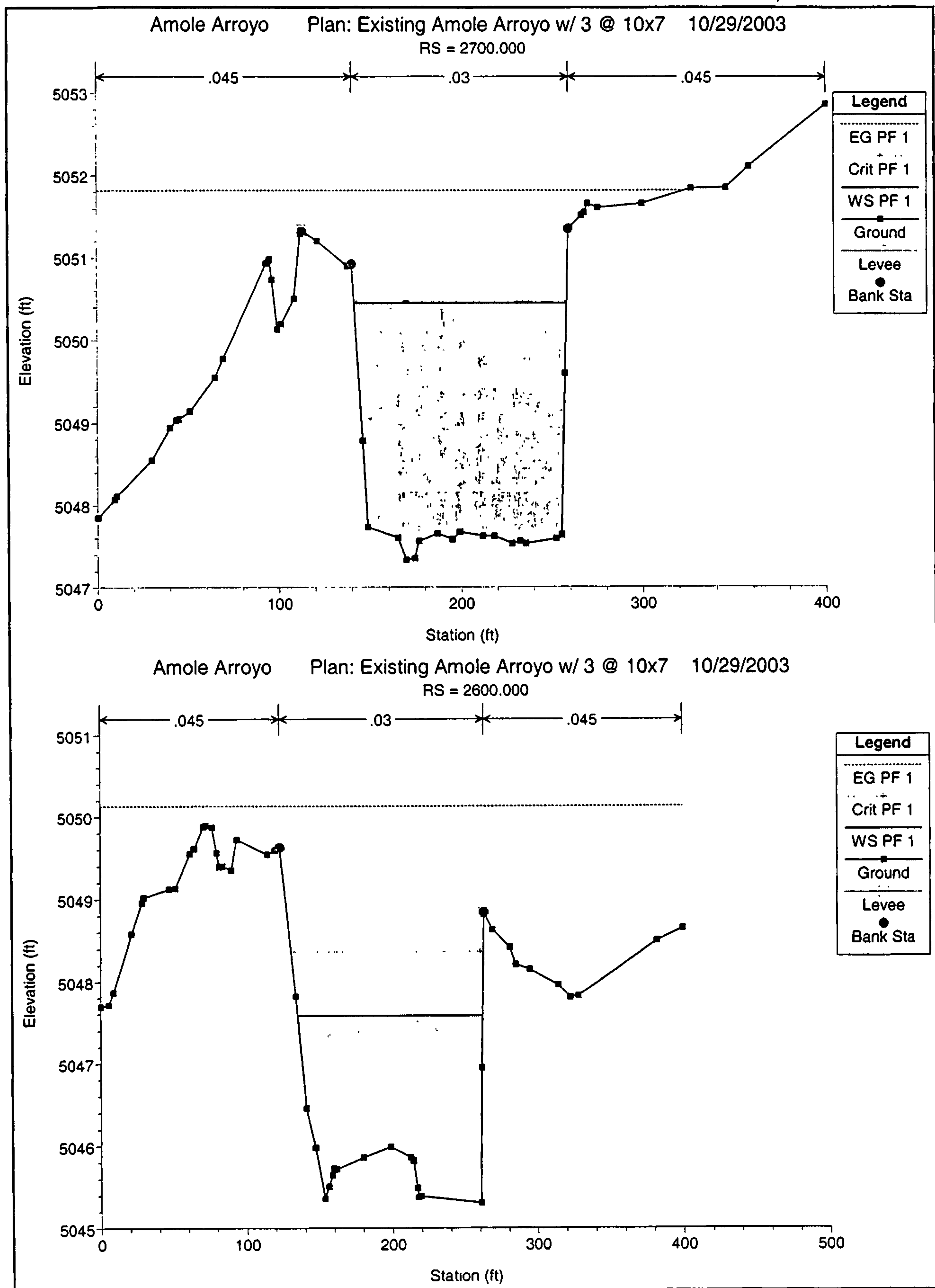


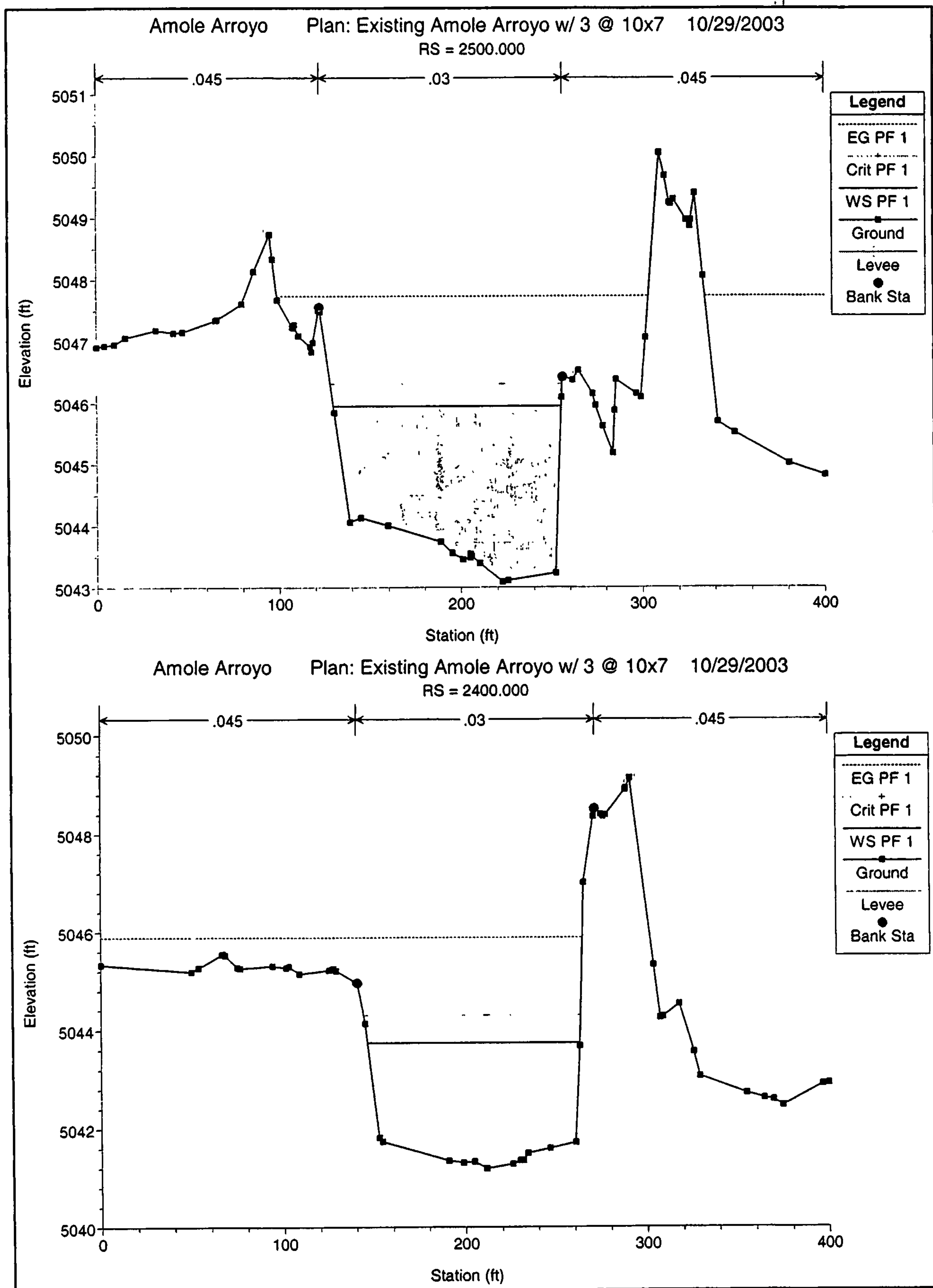


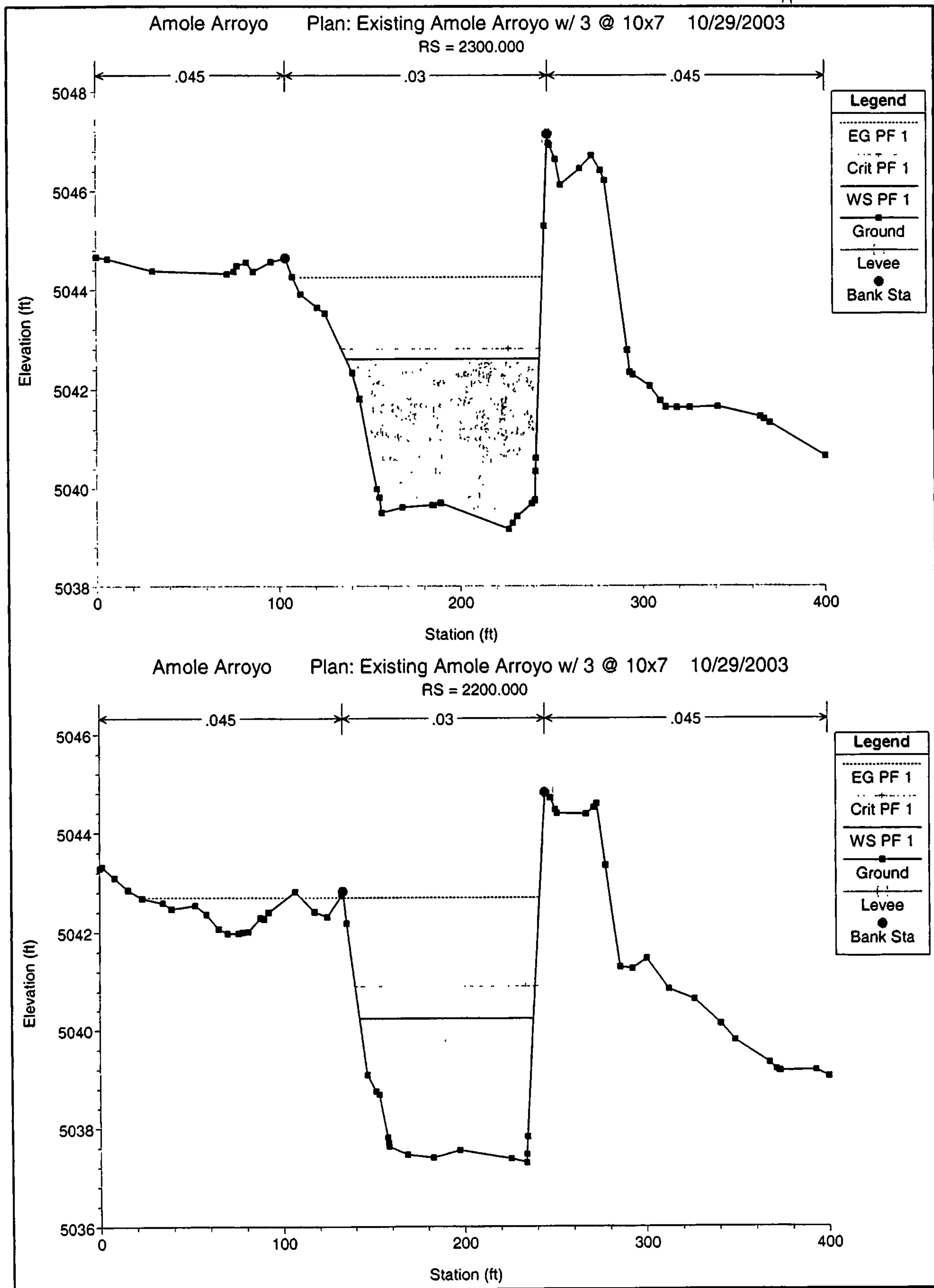


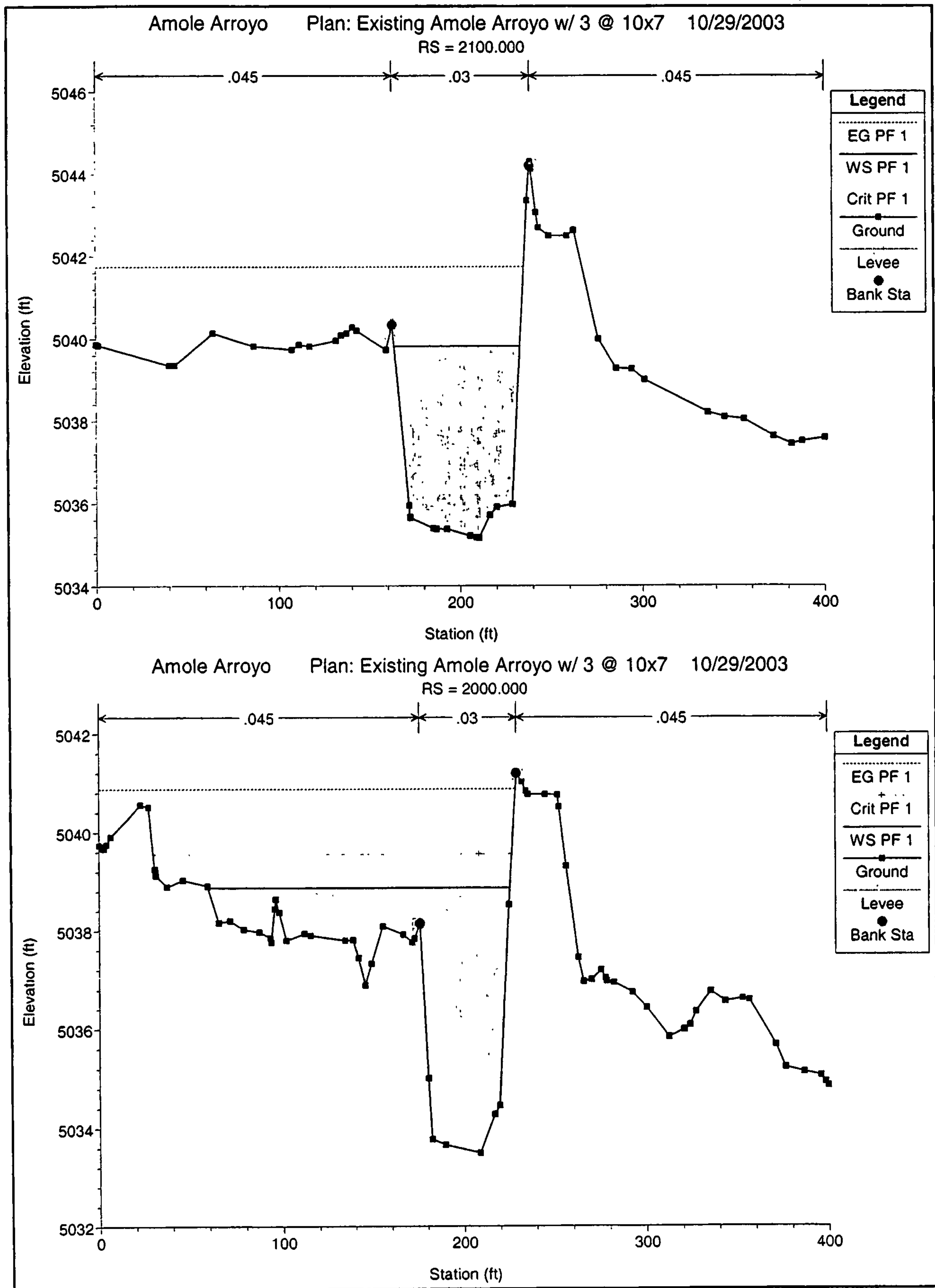


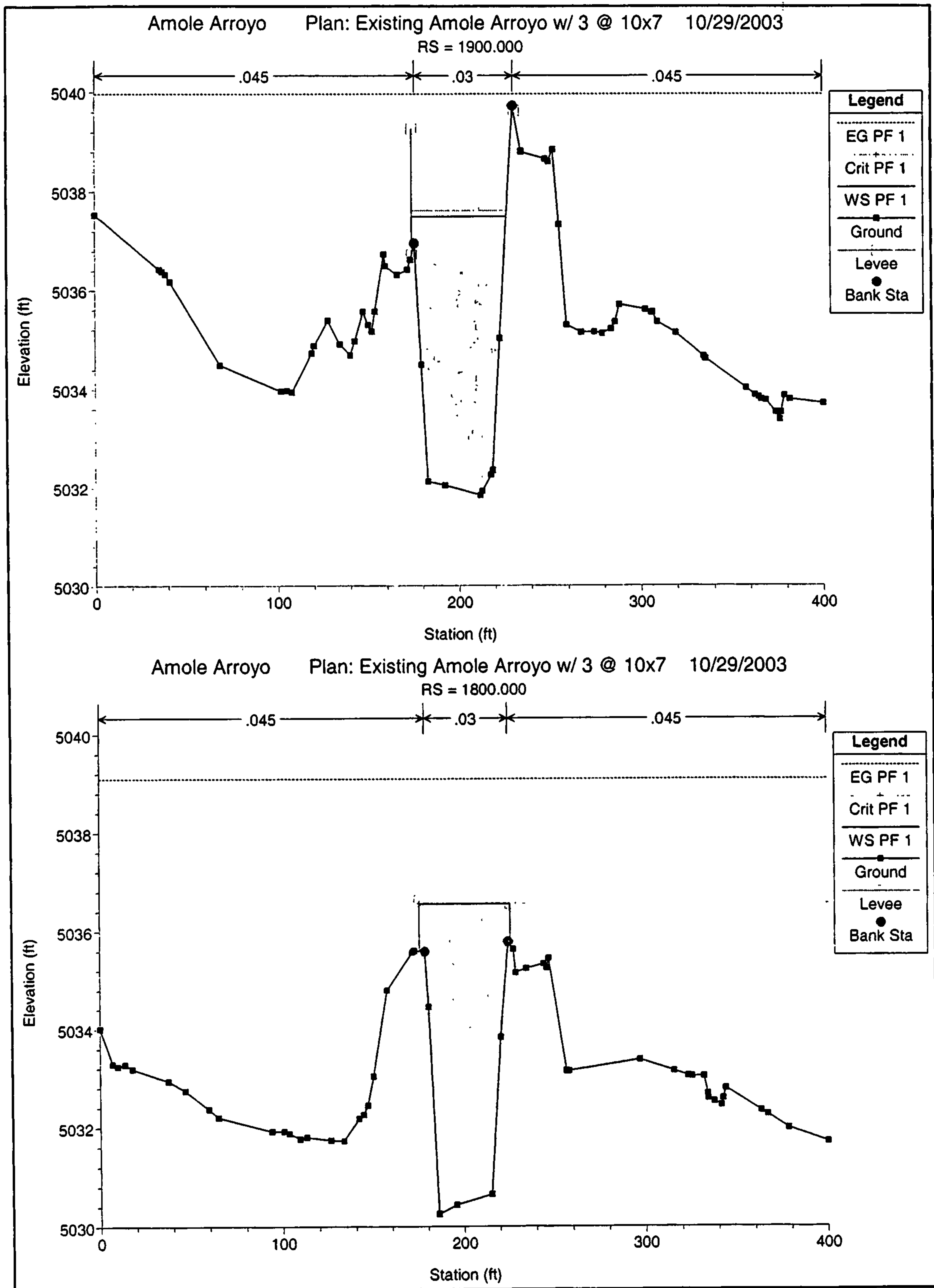












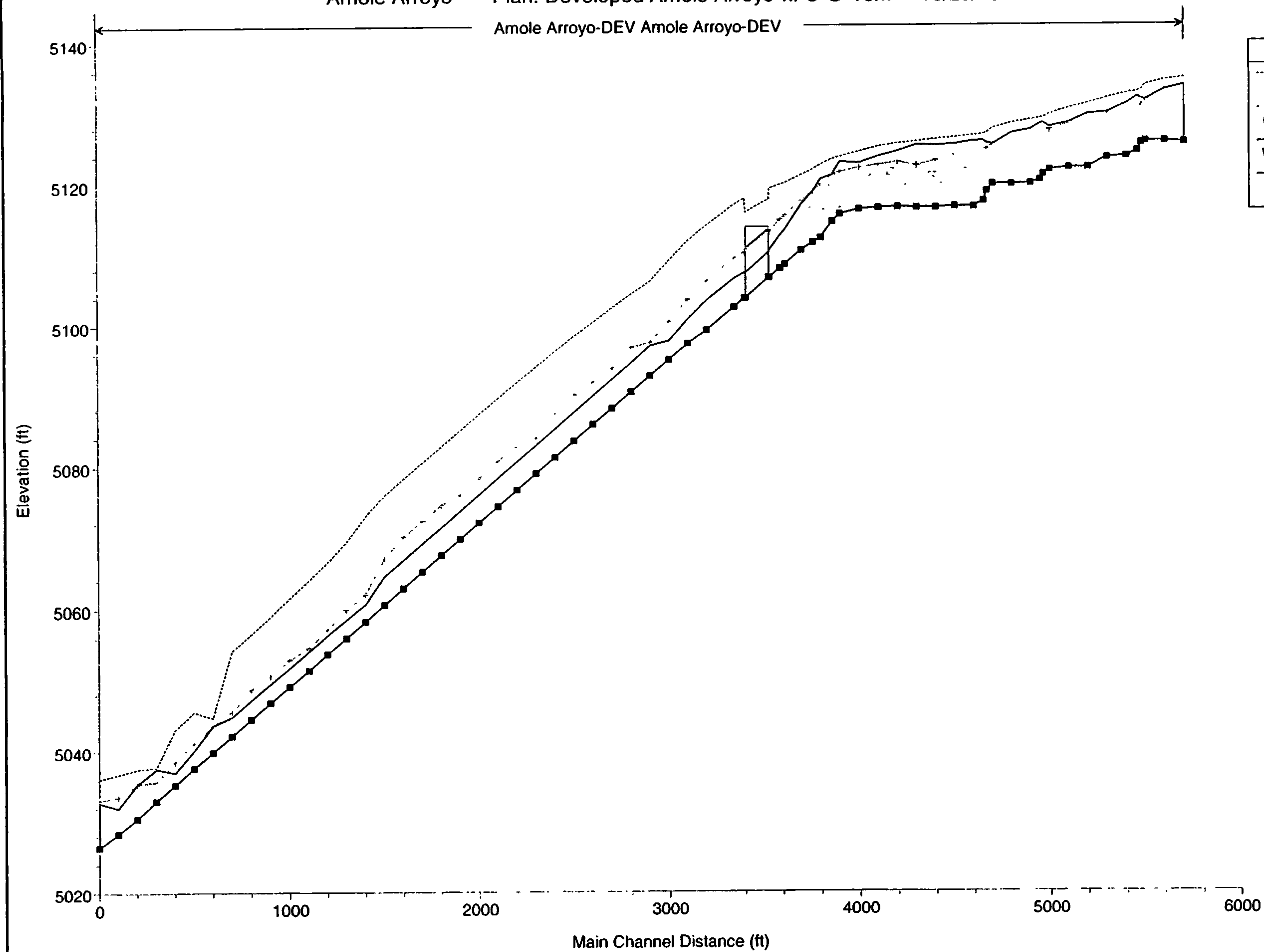
HEC-RAS Plan dev 3 @ 10x7 River Amole Arroyo-DEV Reach Amole Arroyo-DEV Profile PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W S Elev	Max Ch Dpth	Crit W S	E.G Elev	E G Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Amole Arroyo-DEV	5700 000	PF 1	3000 00	5125 83	5133 86	6 03	5132 18	5134 99	0 003321	11 33	435 41	82 37	0 71
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Amole Arroyo

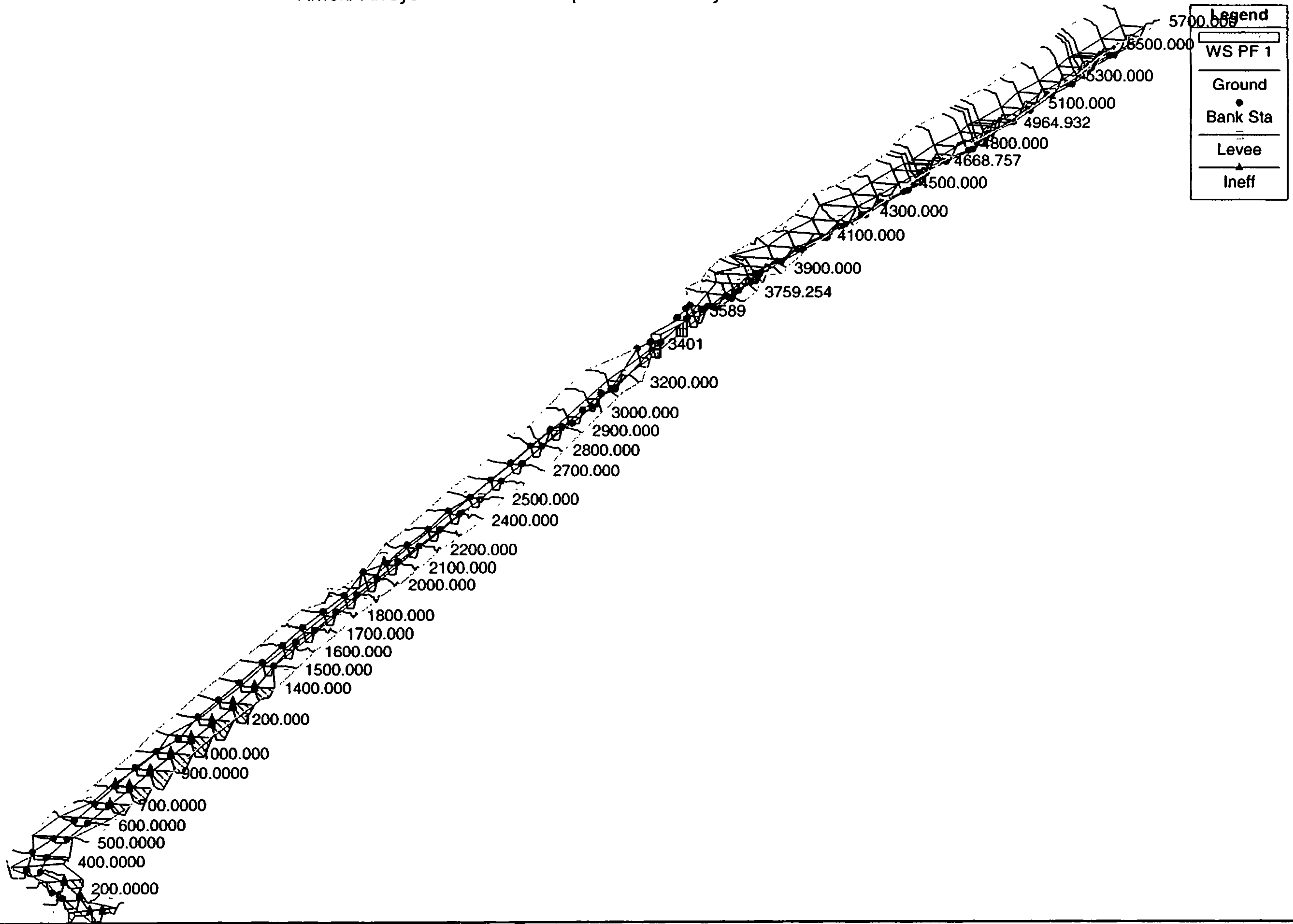
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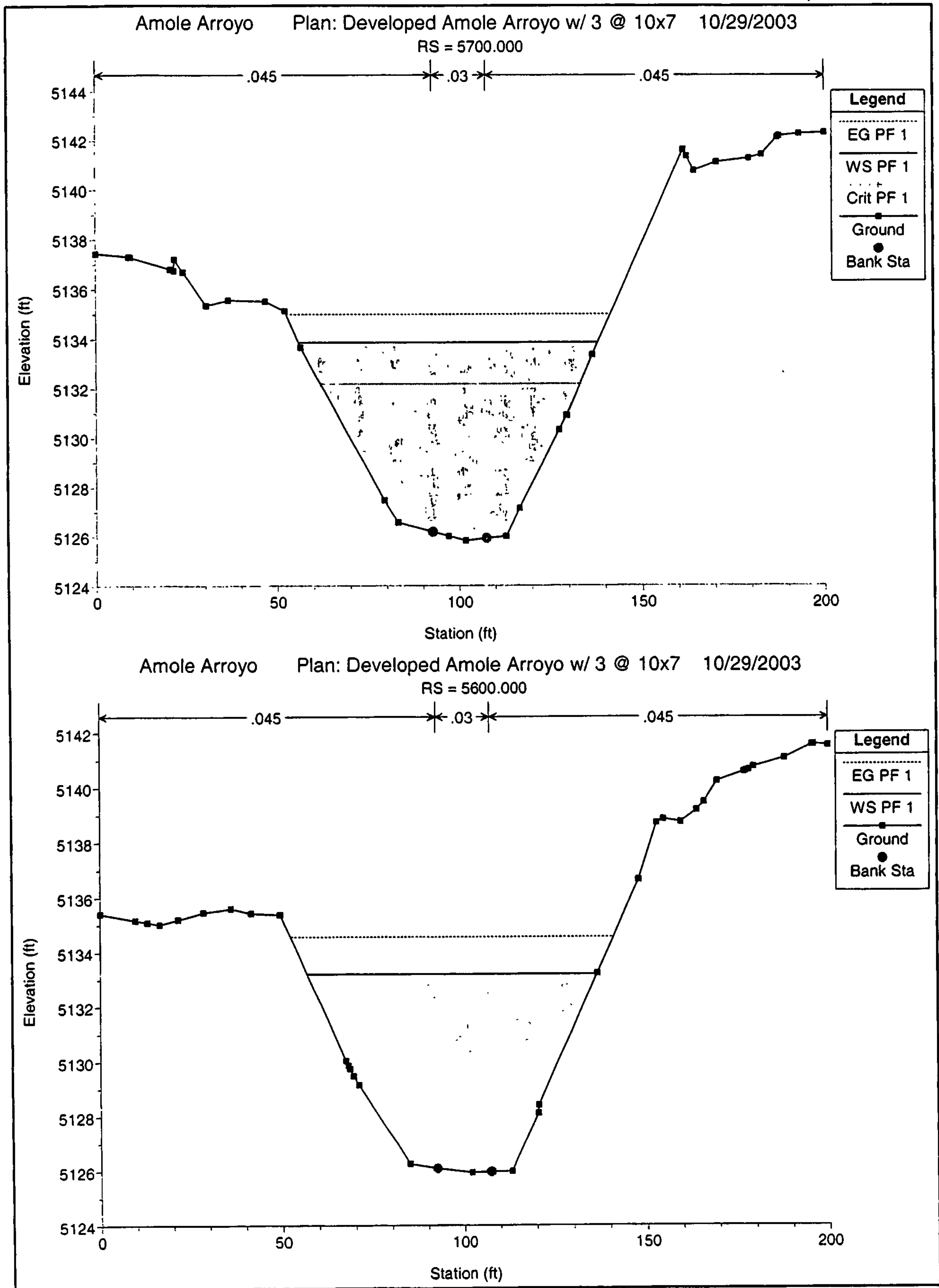
Amole Arroyo-DEV Amole Arroyo-DEV

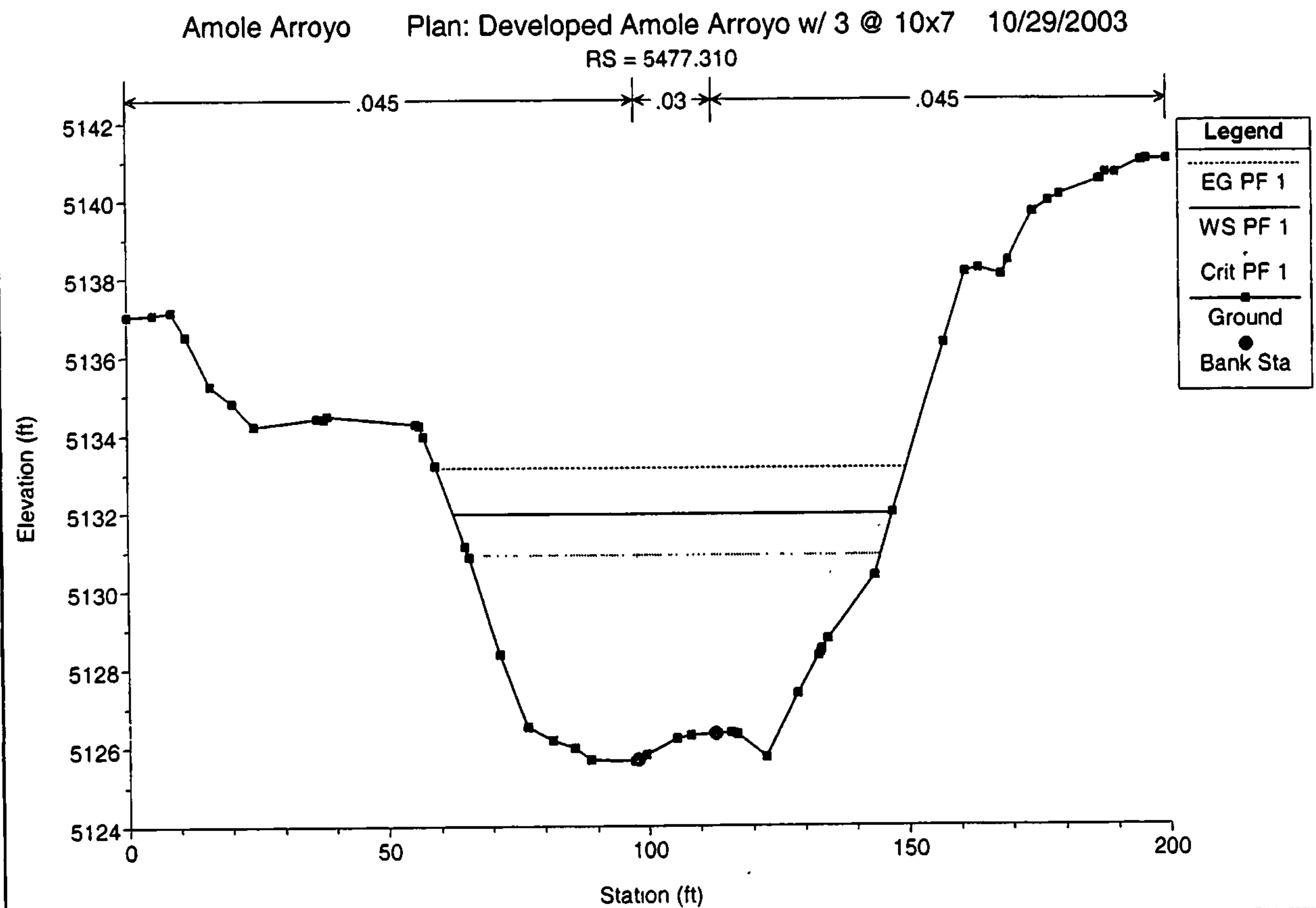
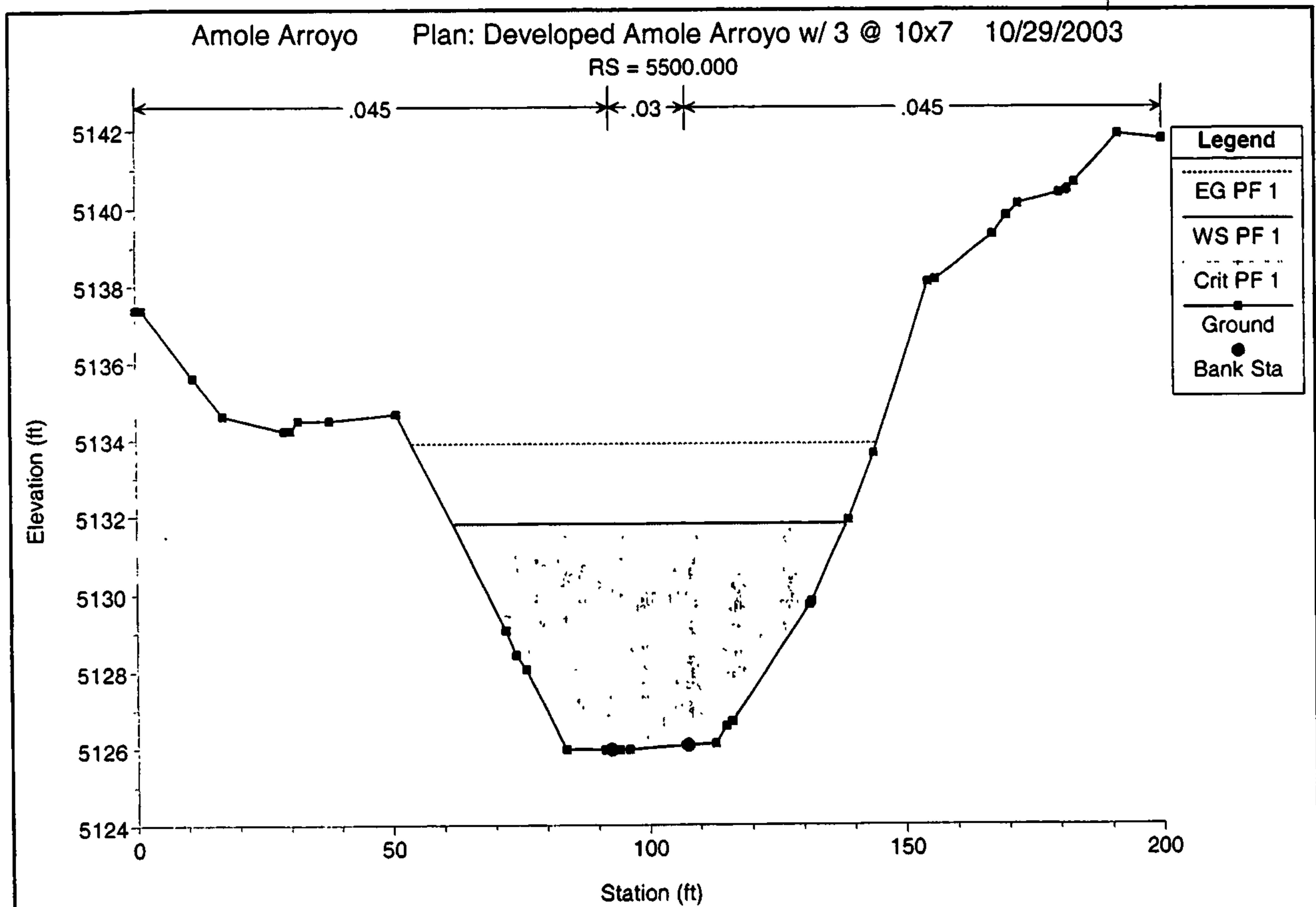


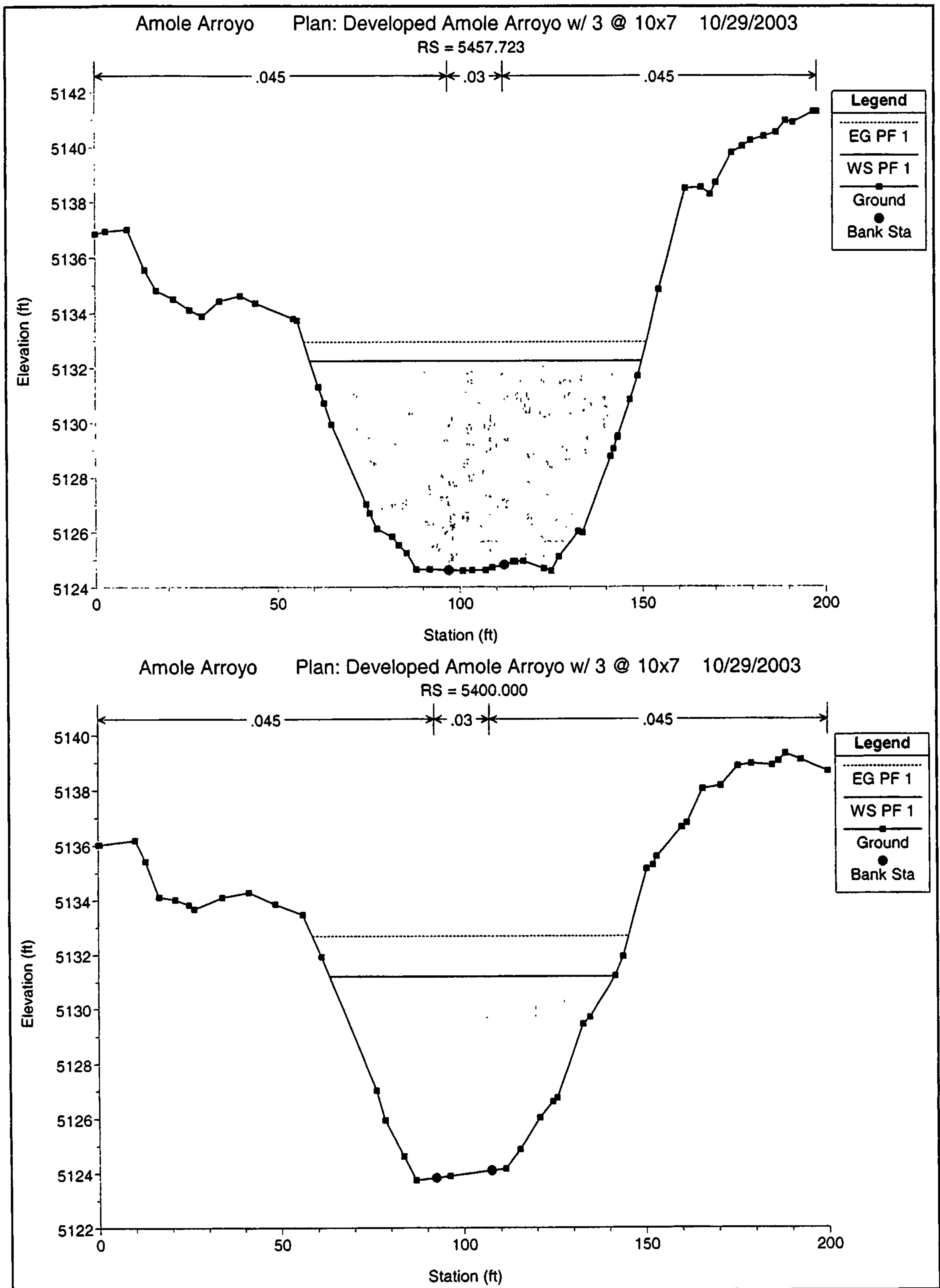
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Ground	

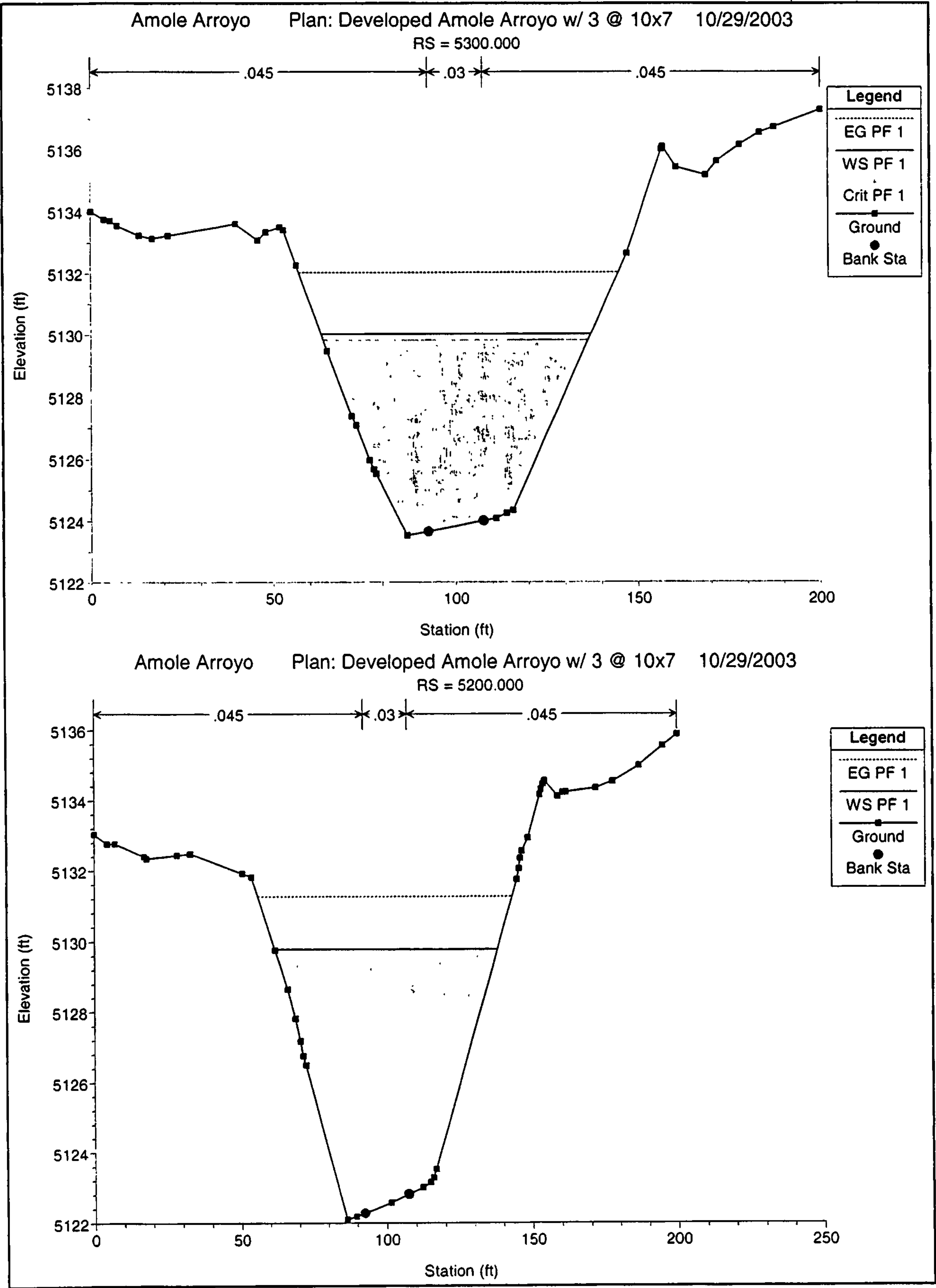
Amole Arroyo Plan: Developed Amole Arroyo w/ 3 @ 10x7 10/29/2003

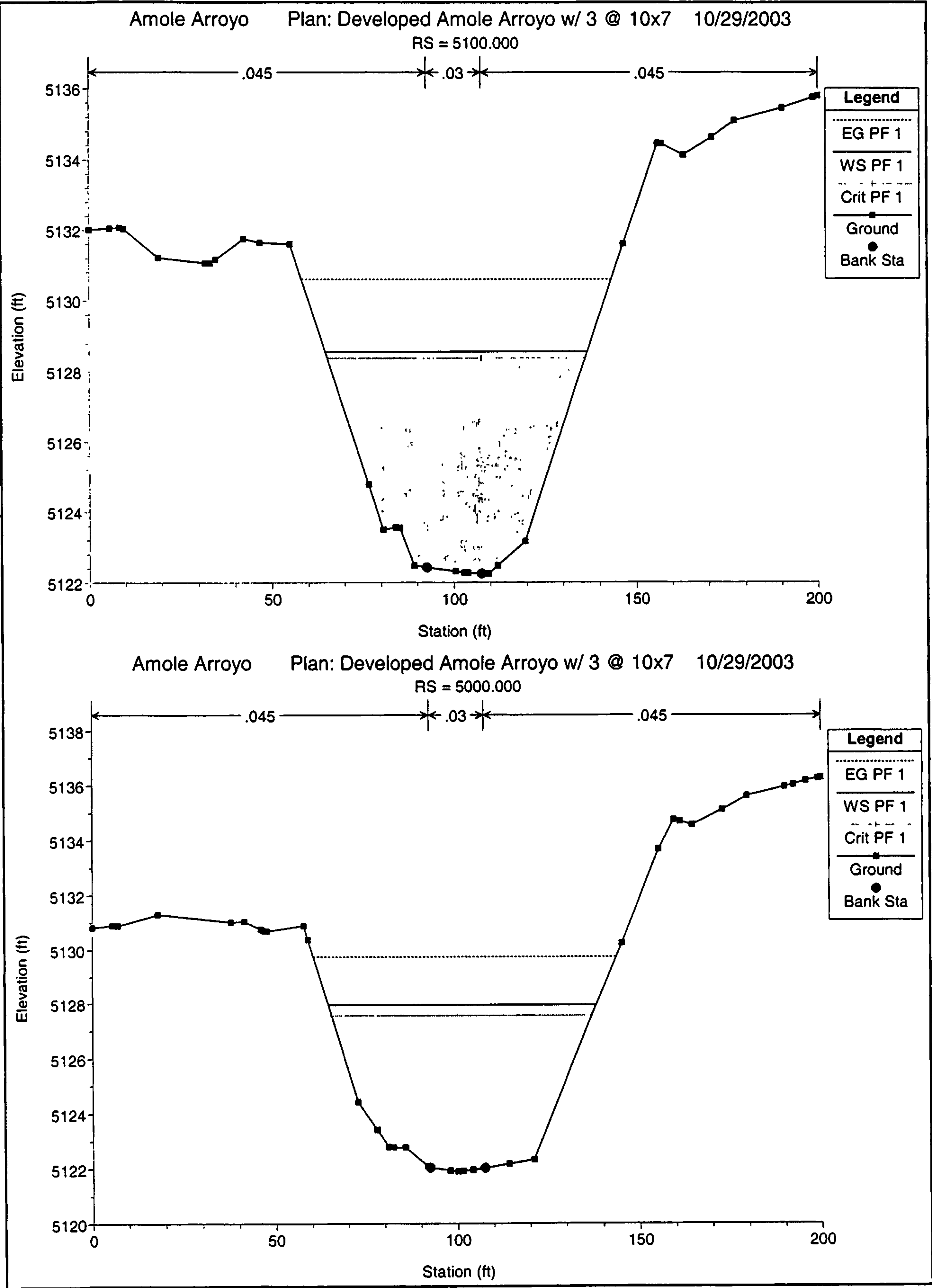


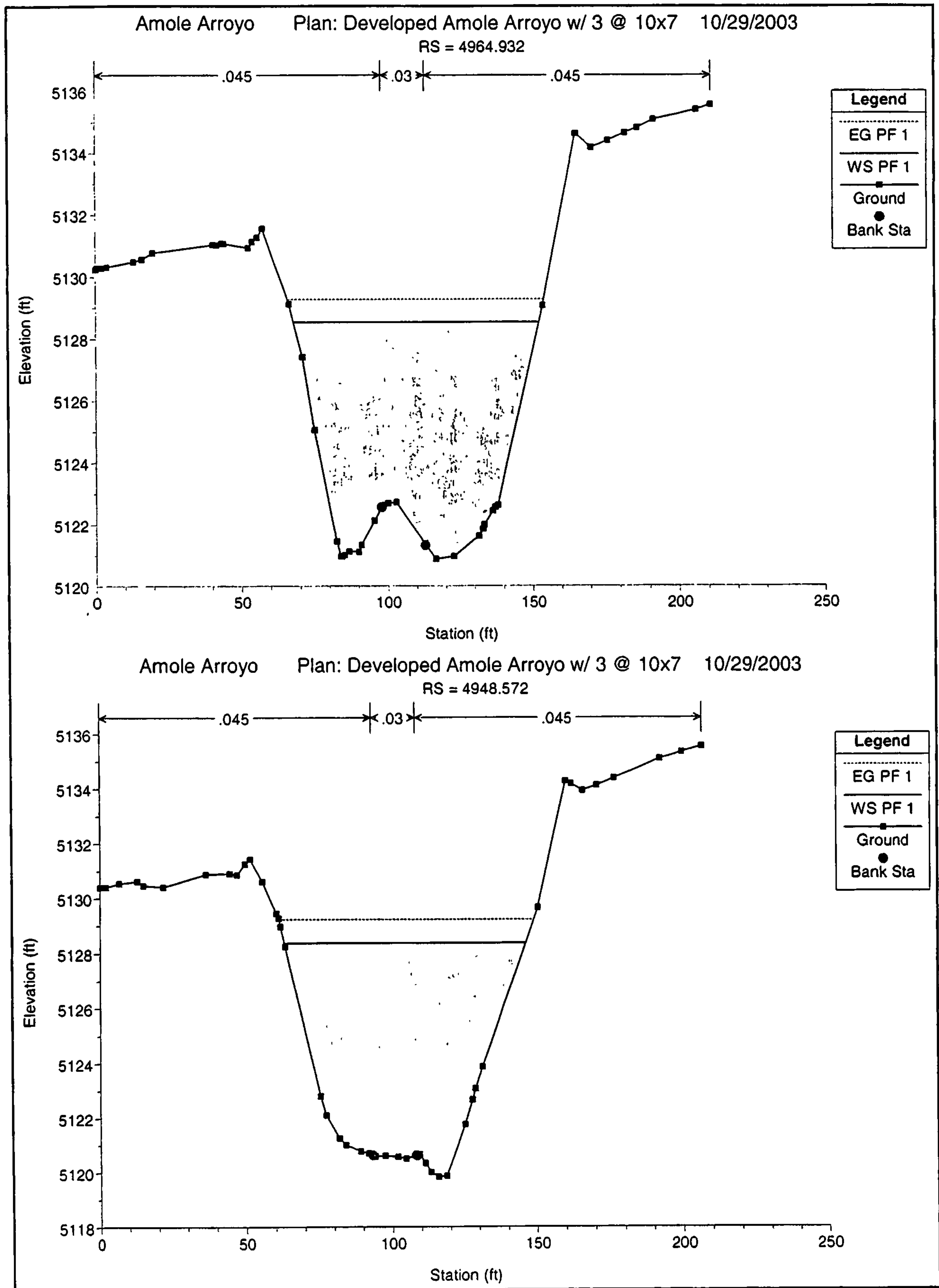


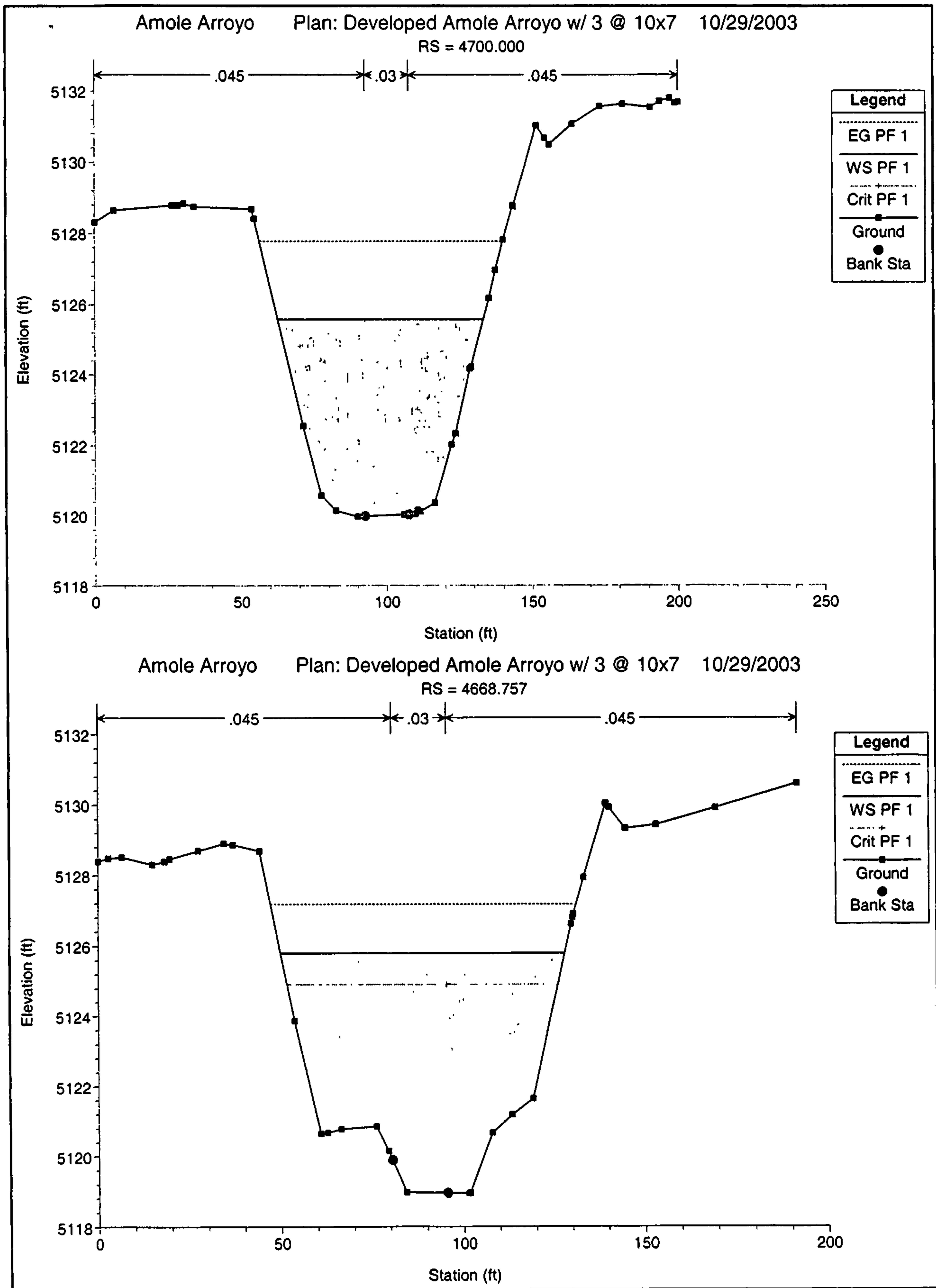


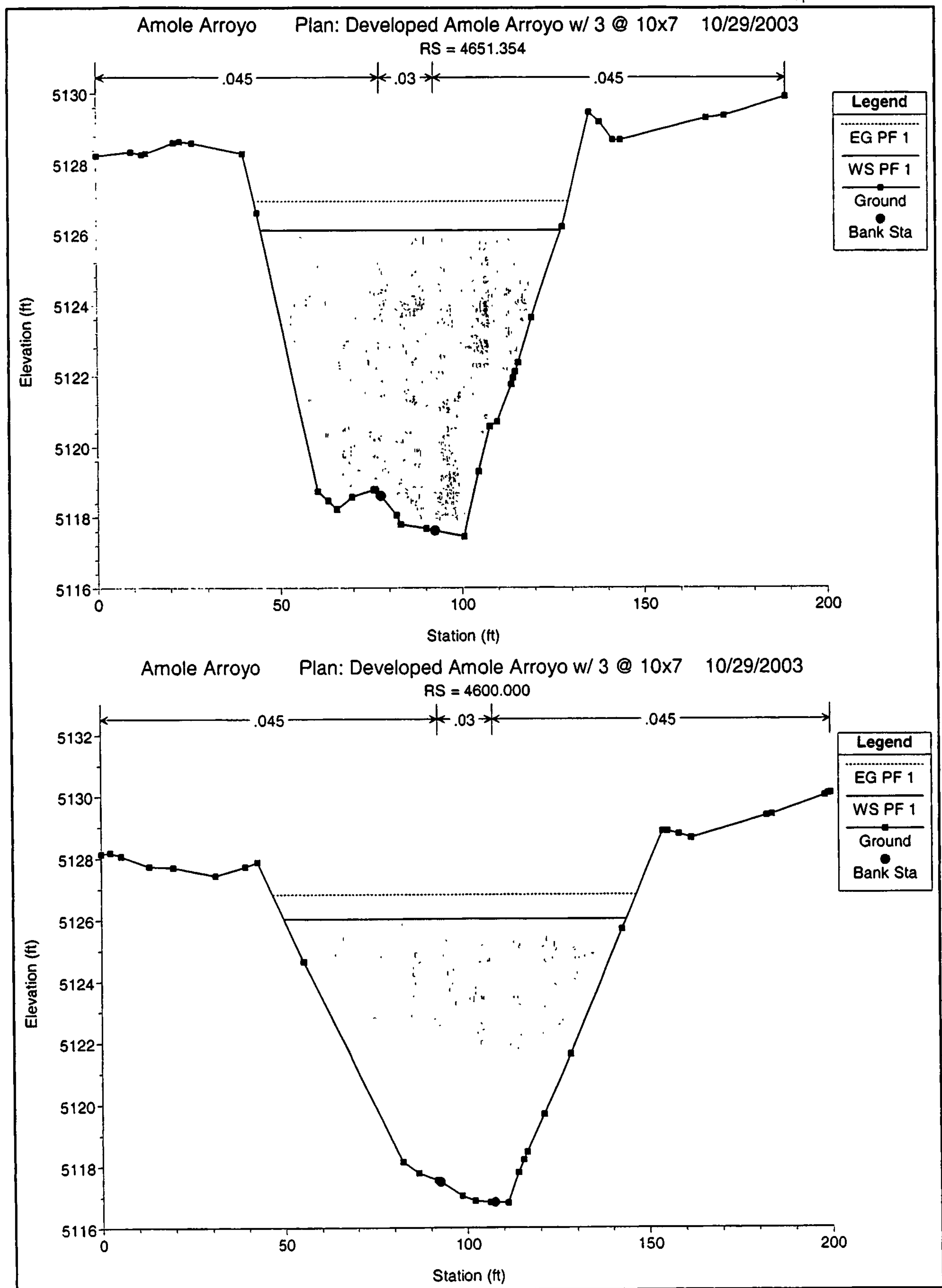


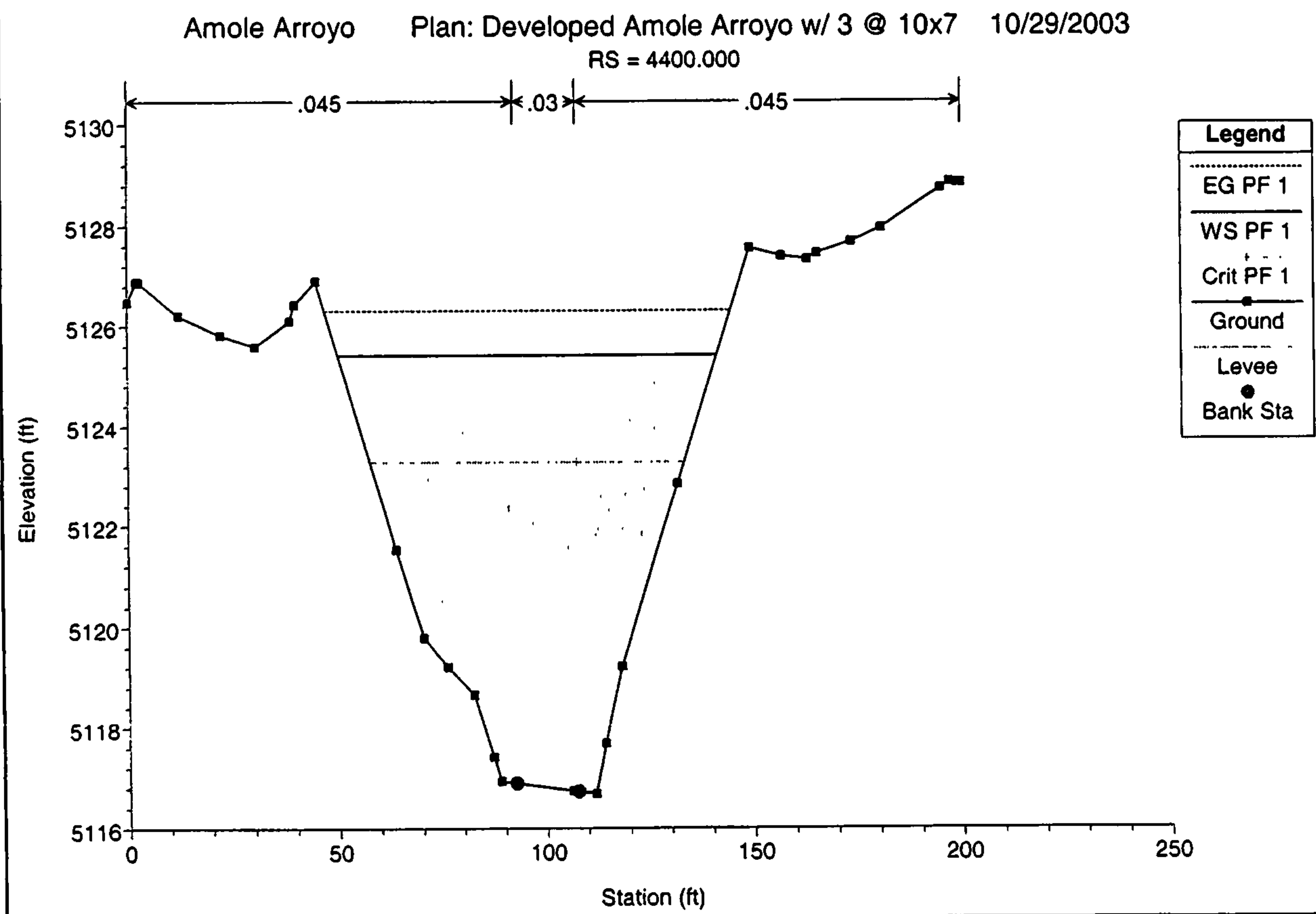
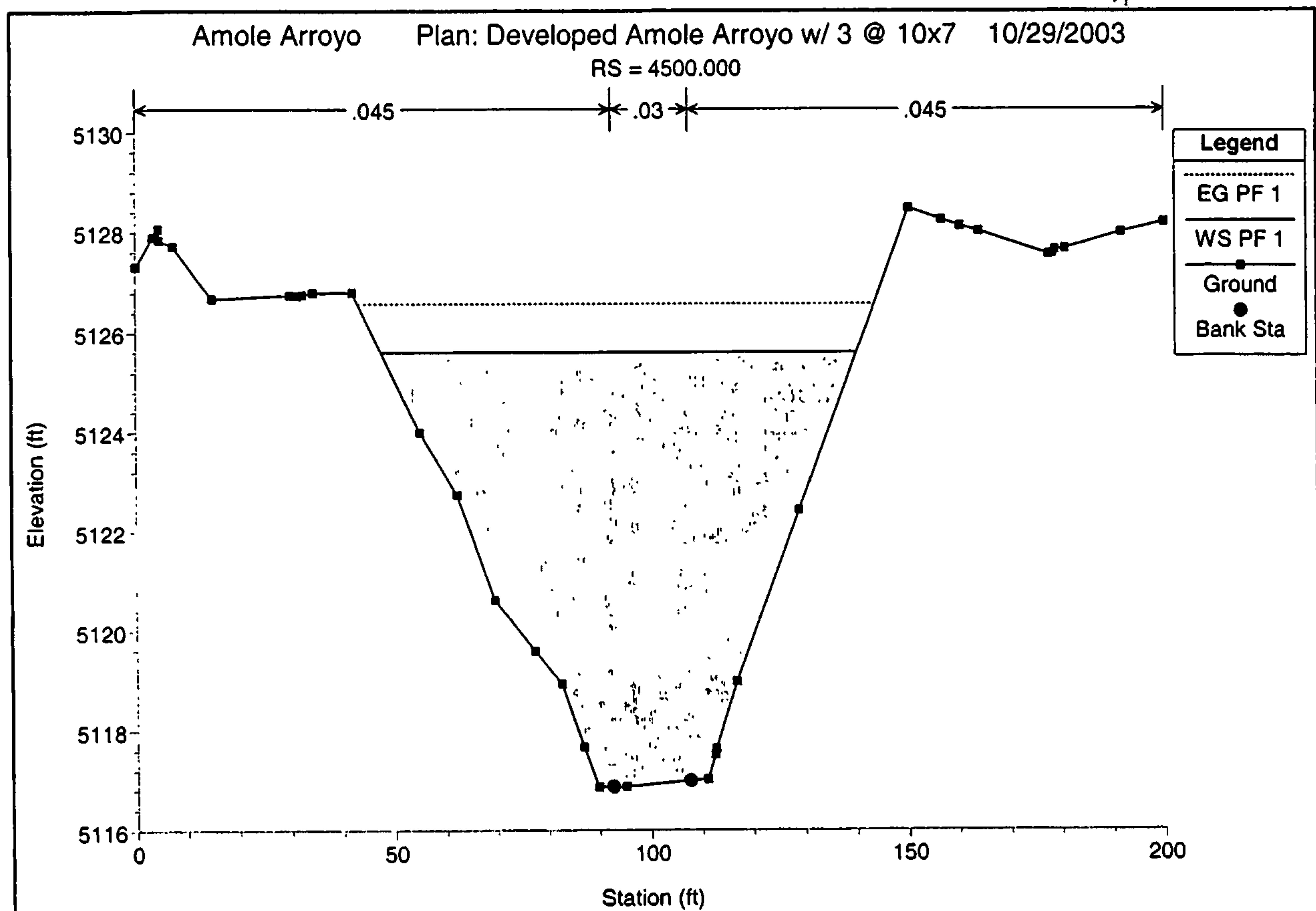


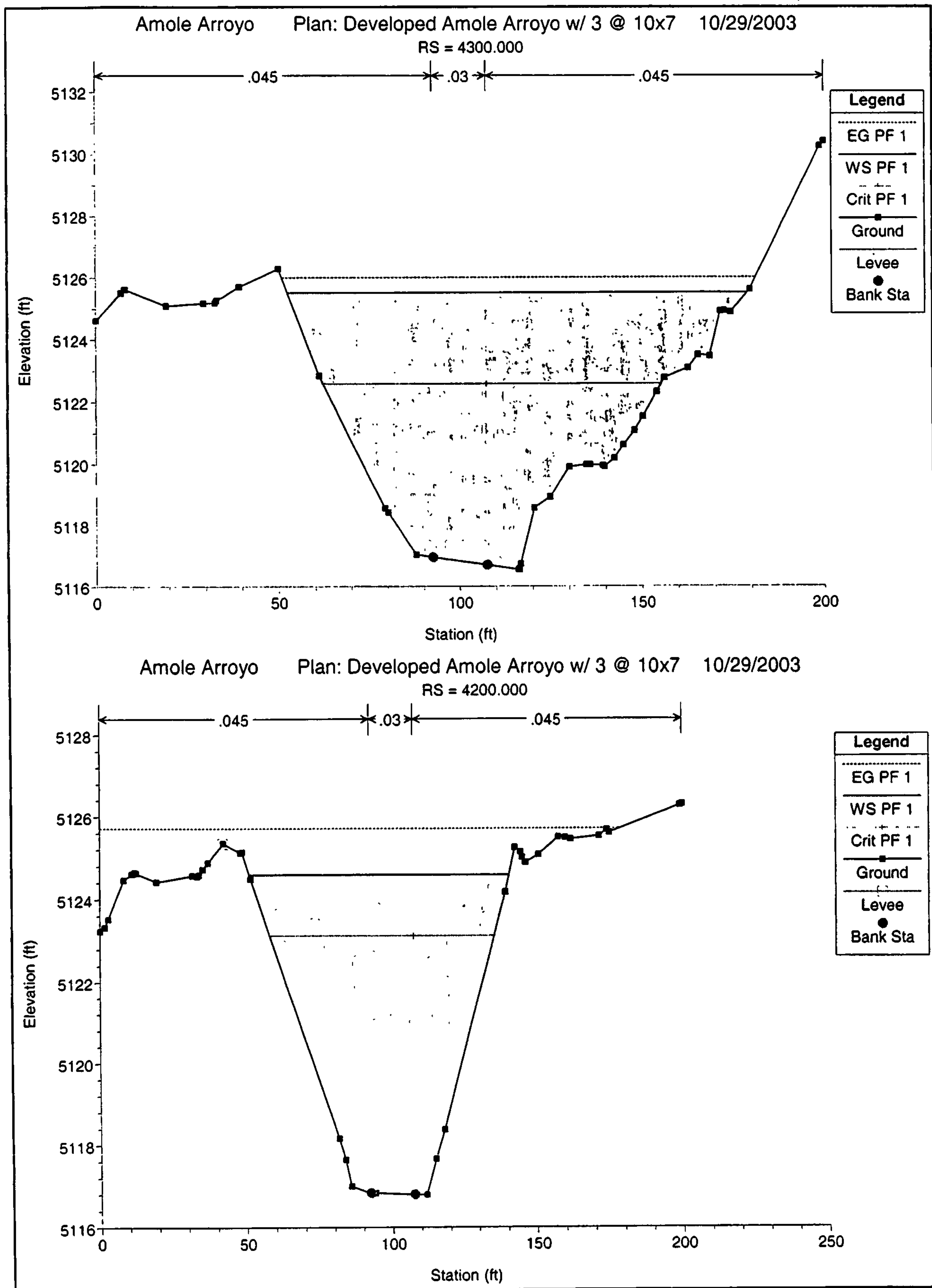


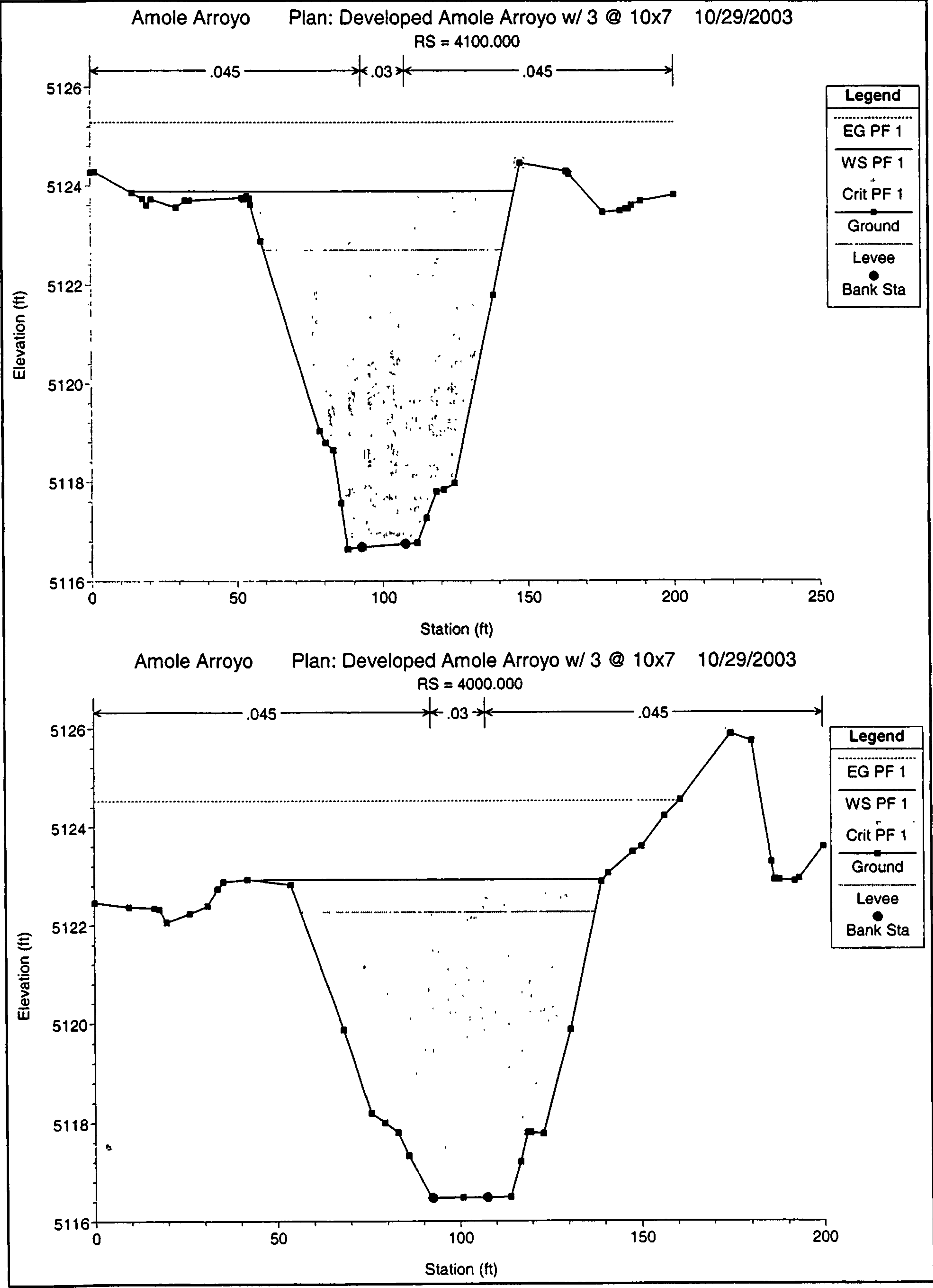


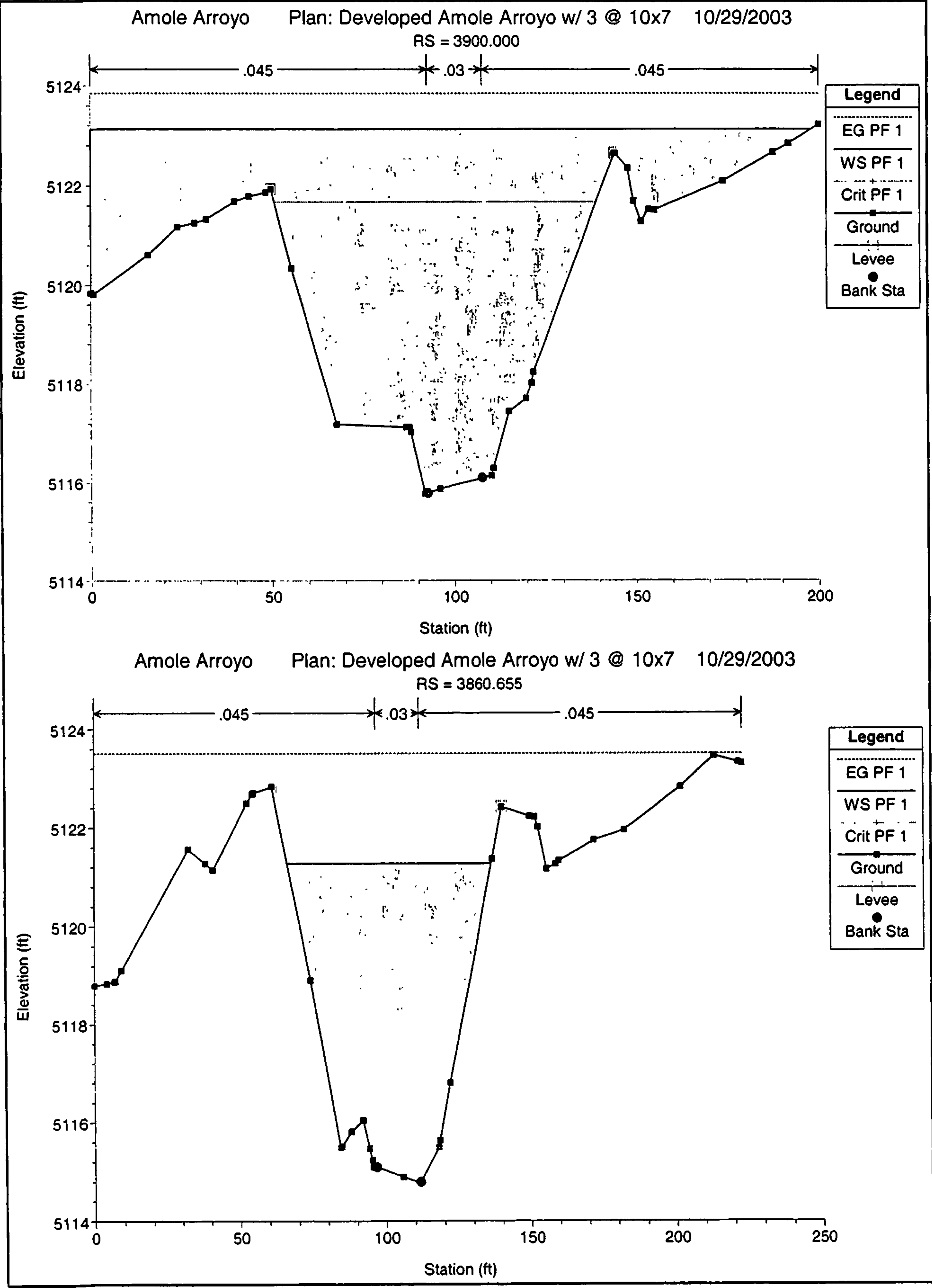


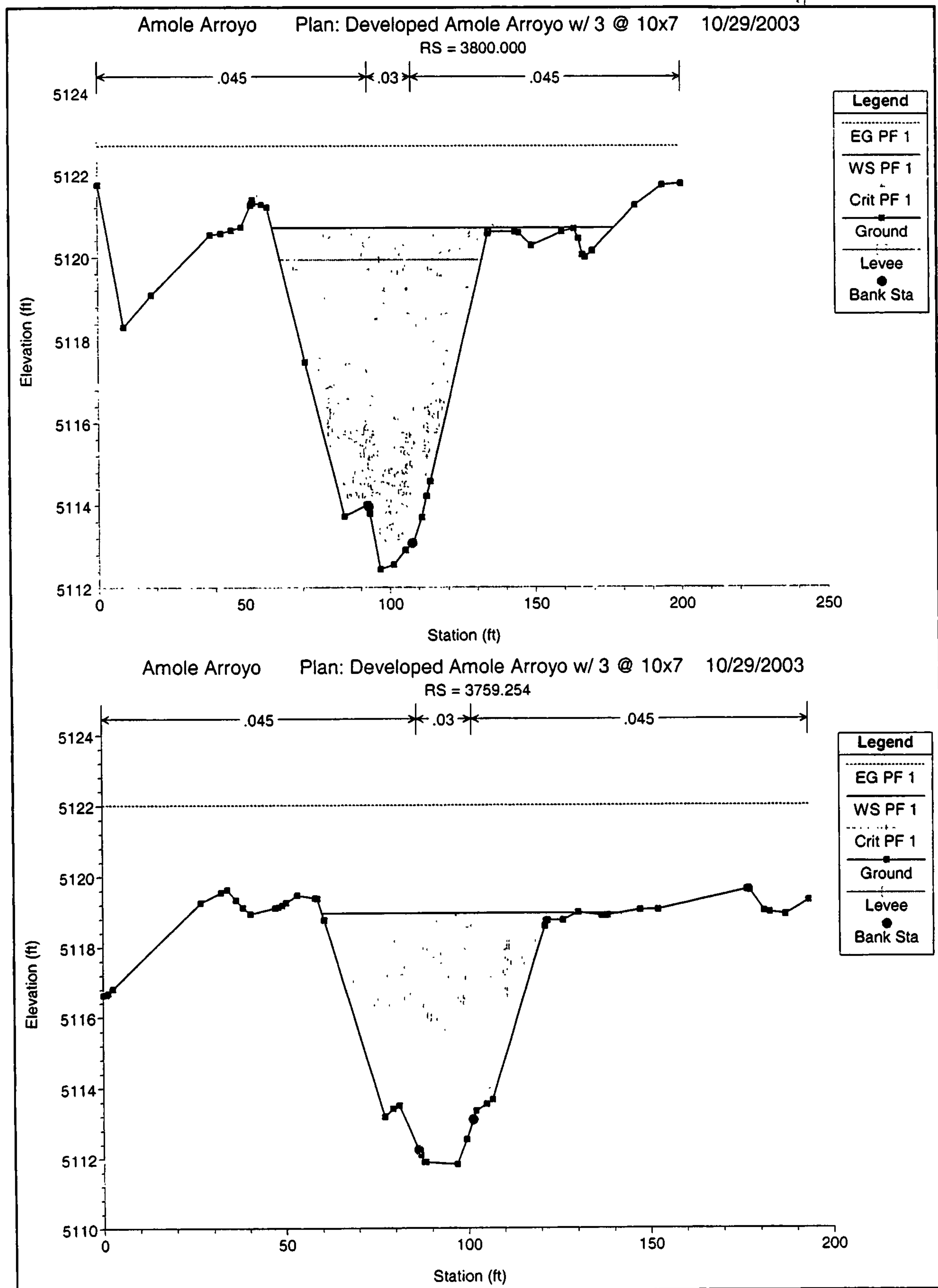


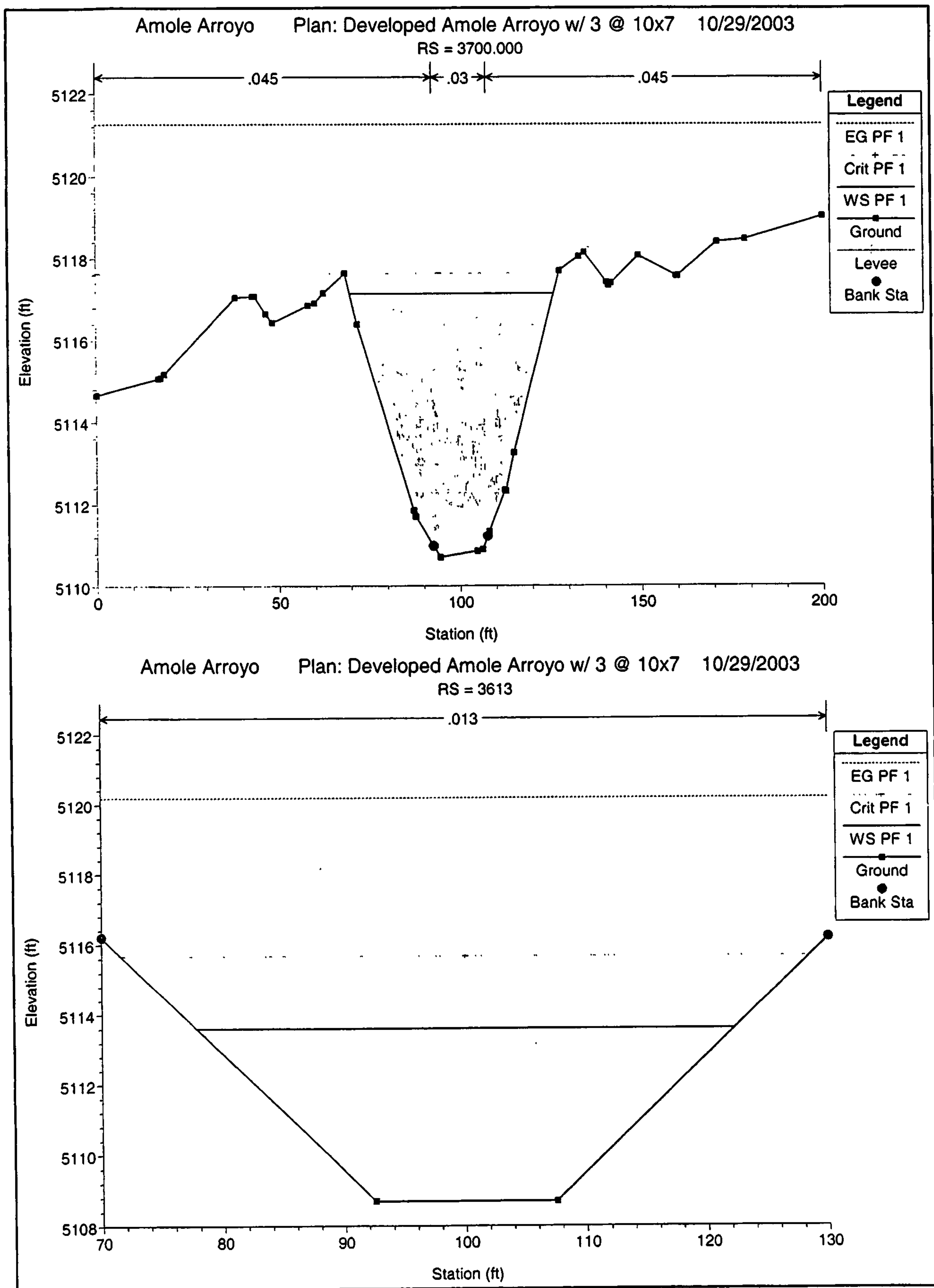


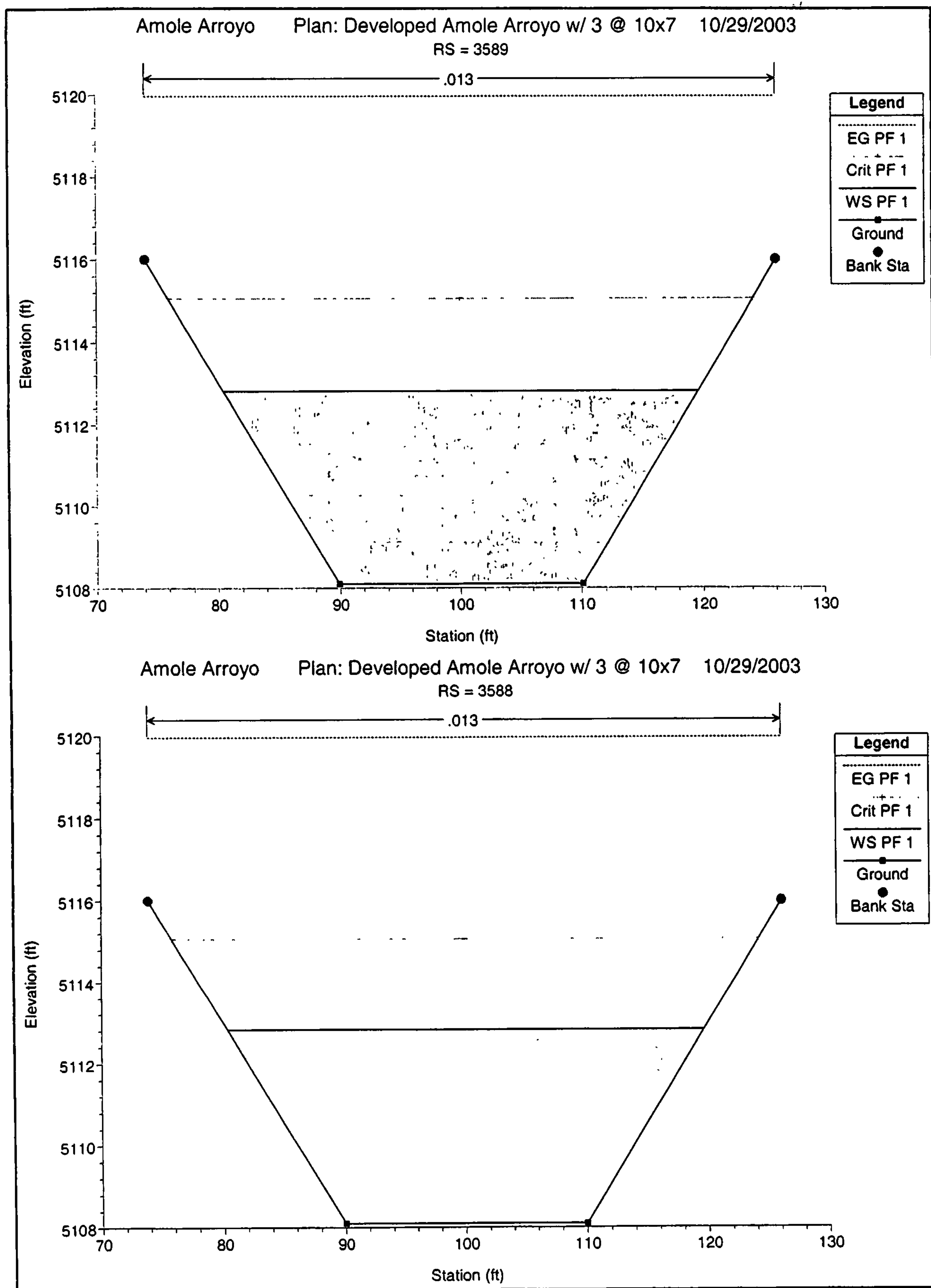


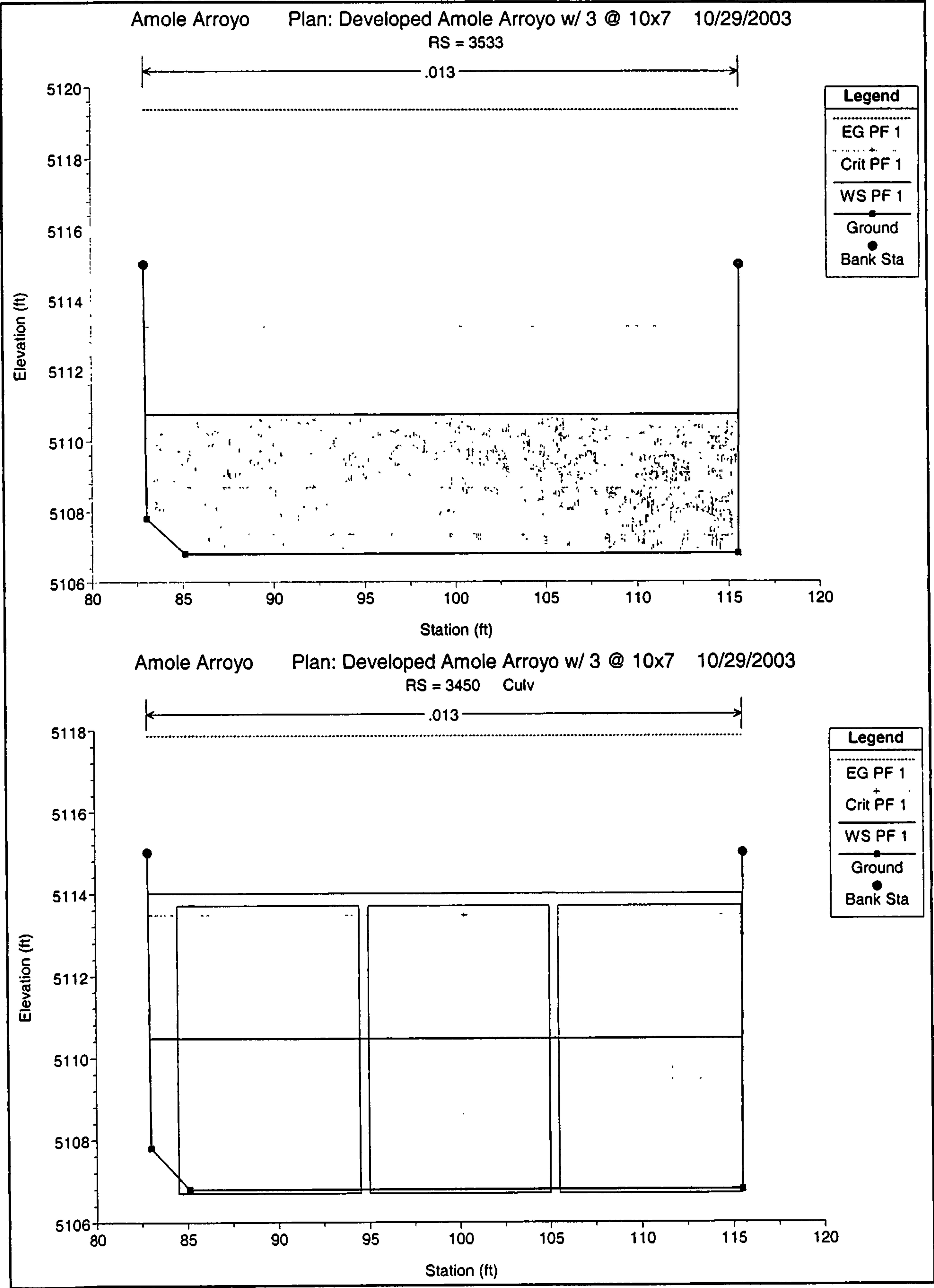


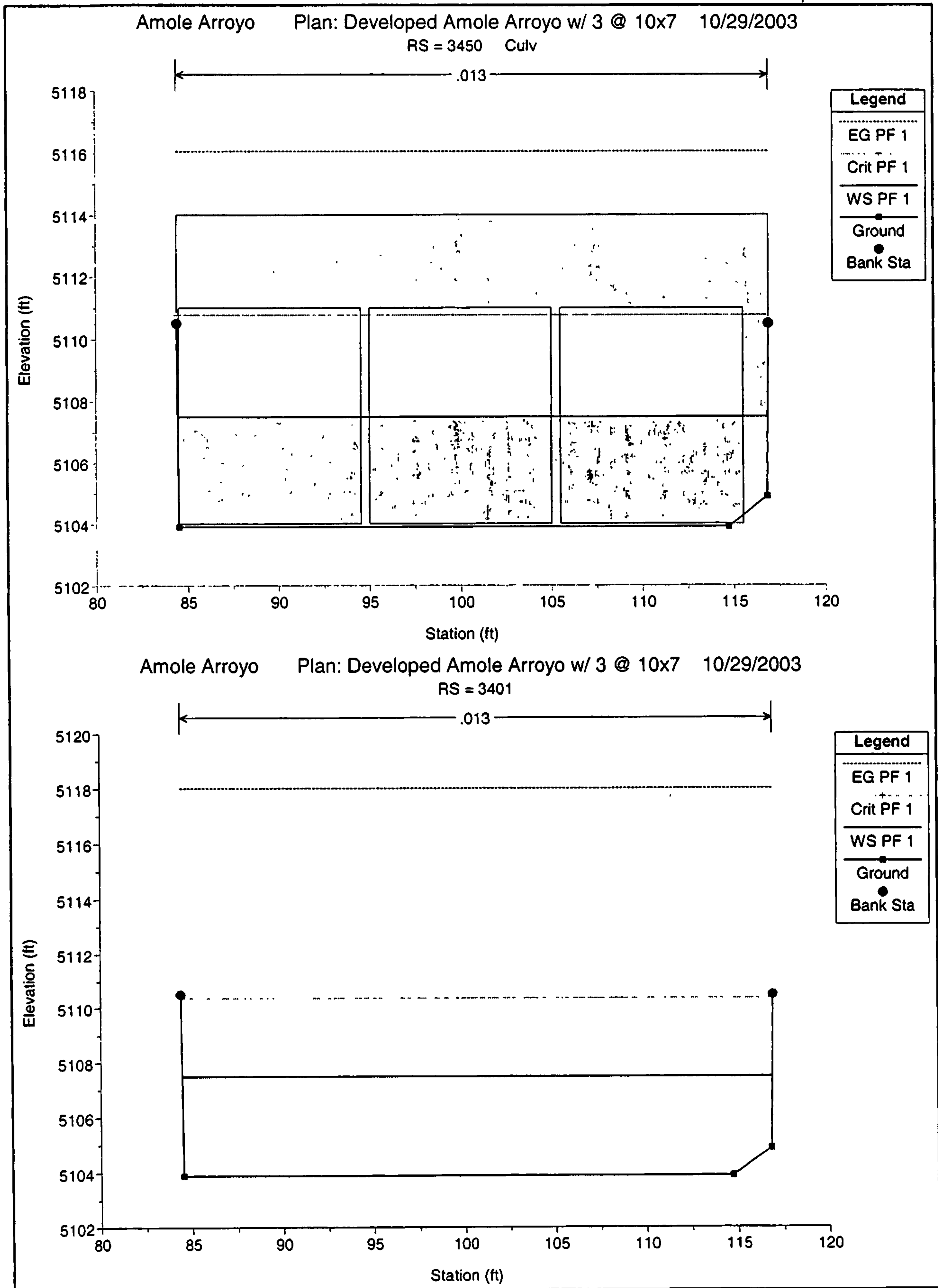


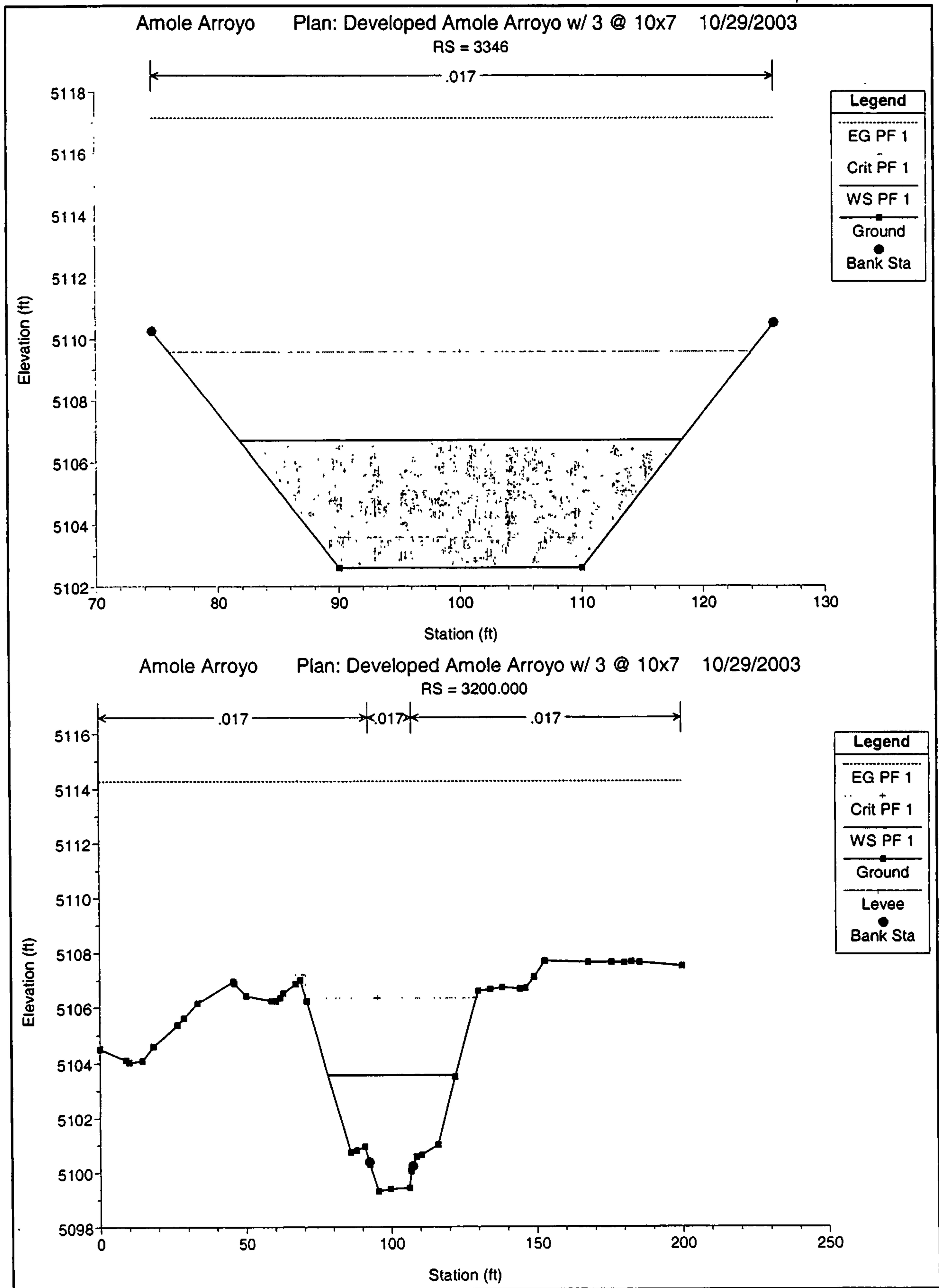


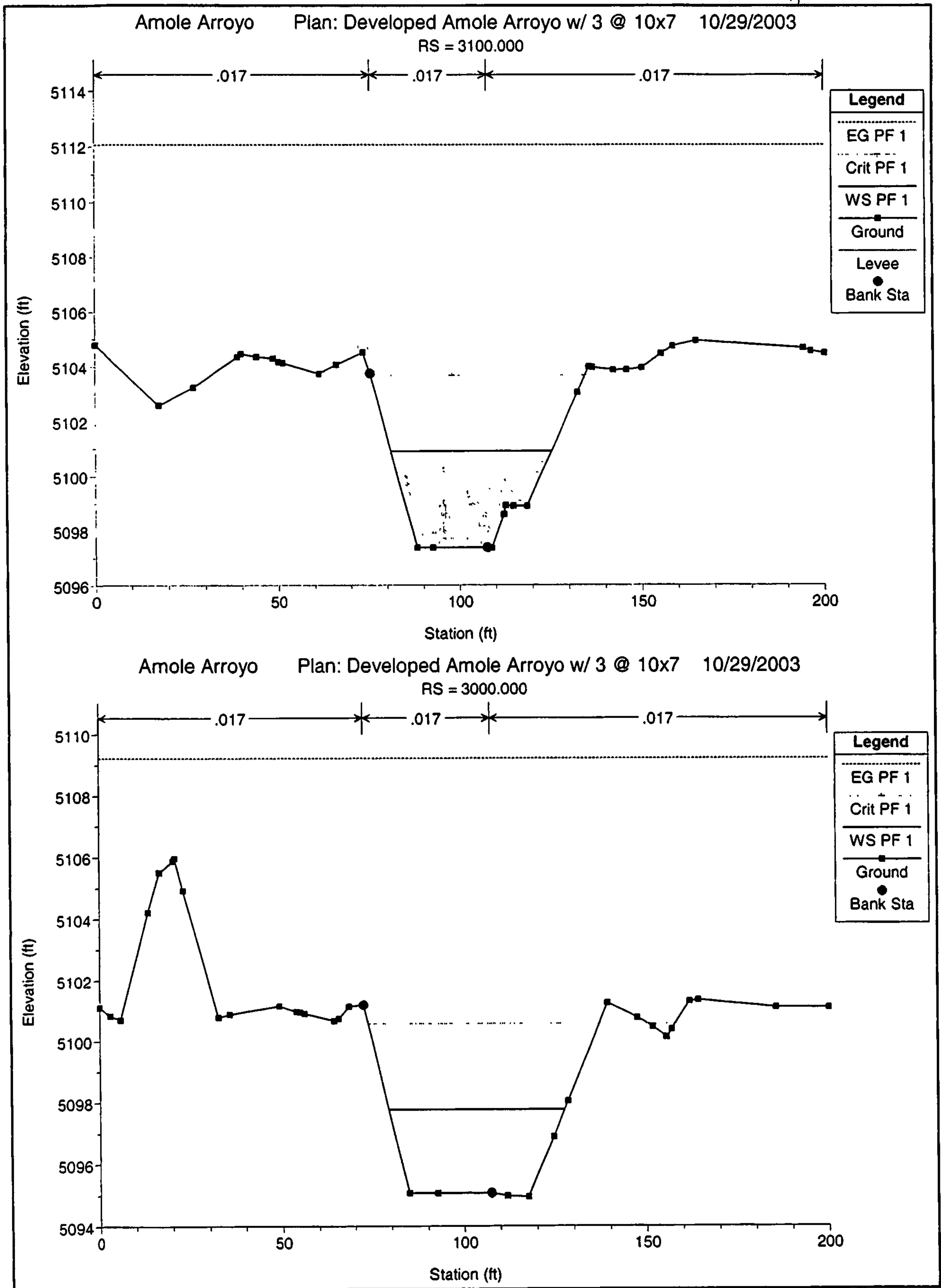


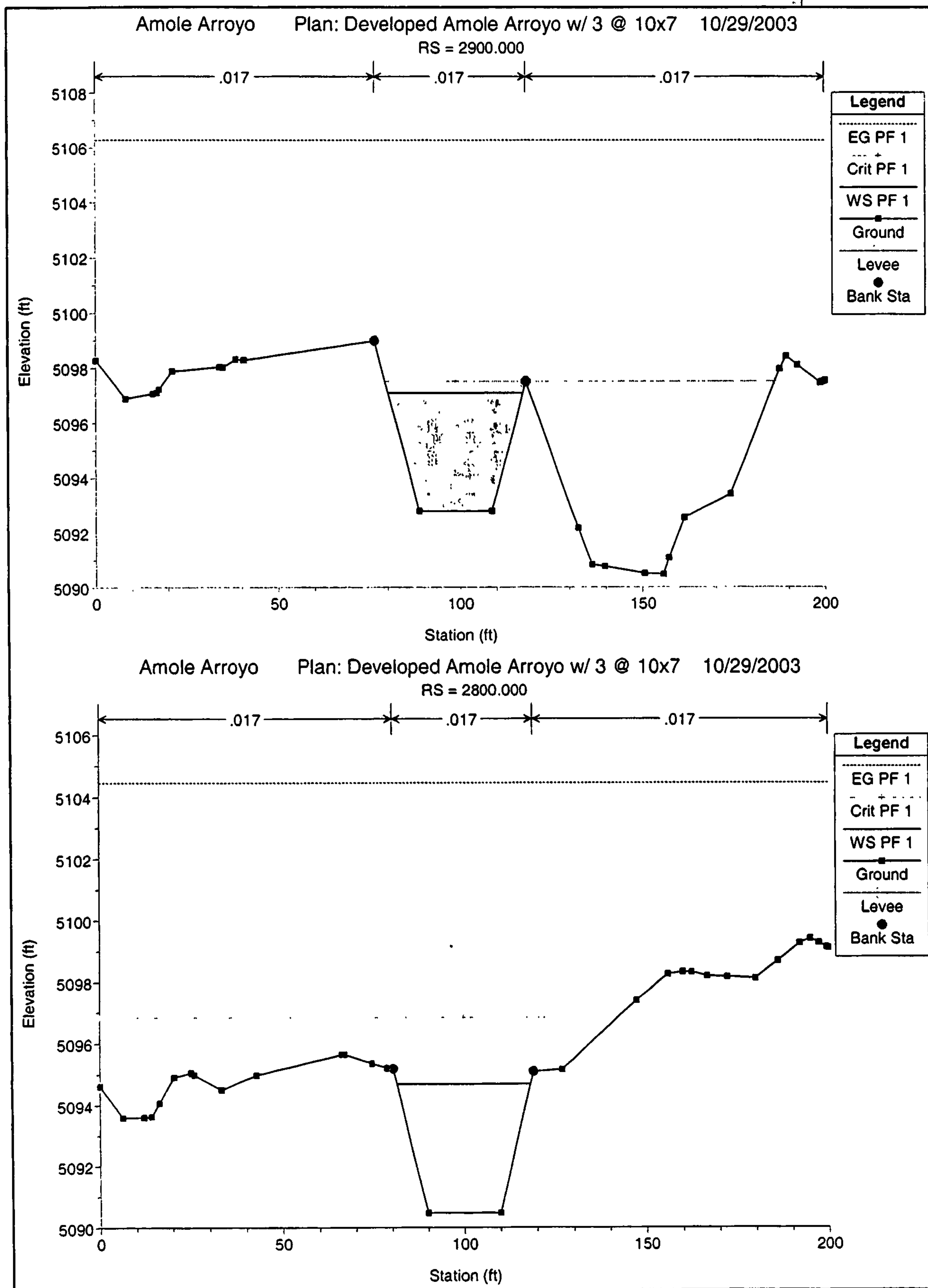


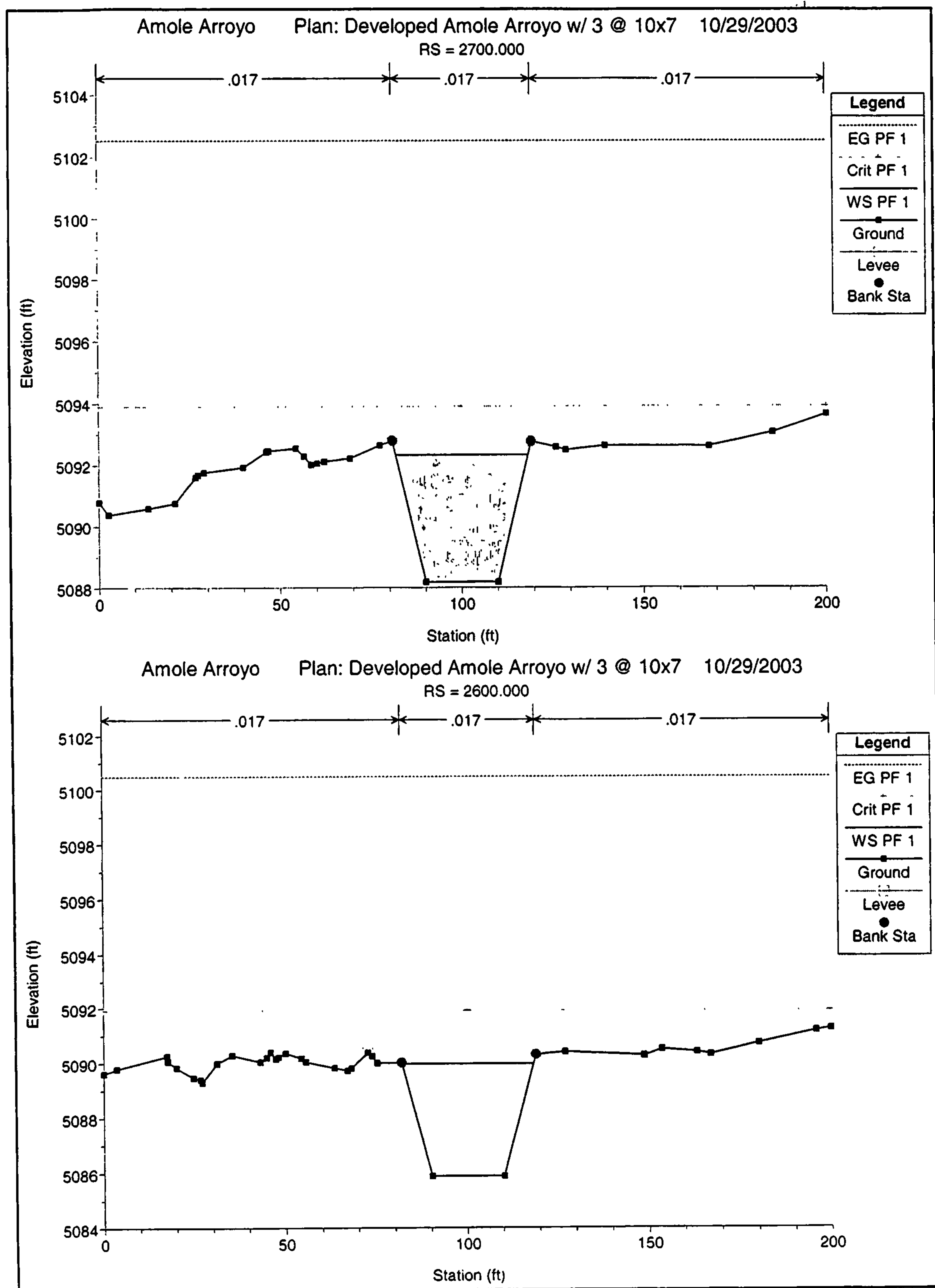


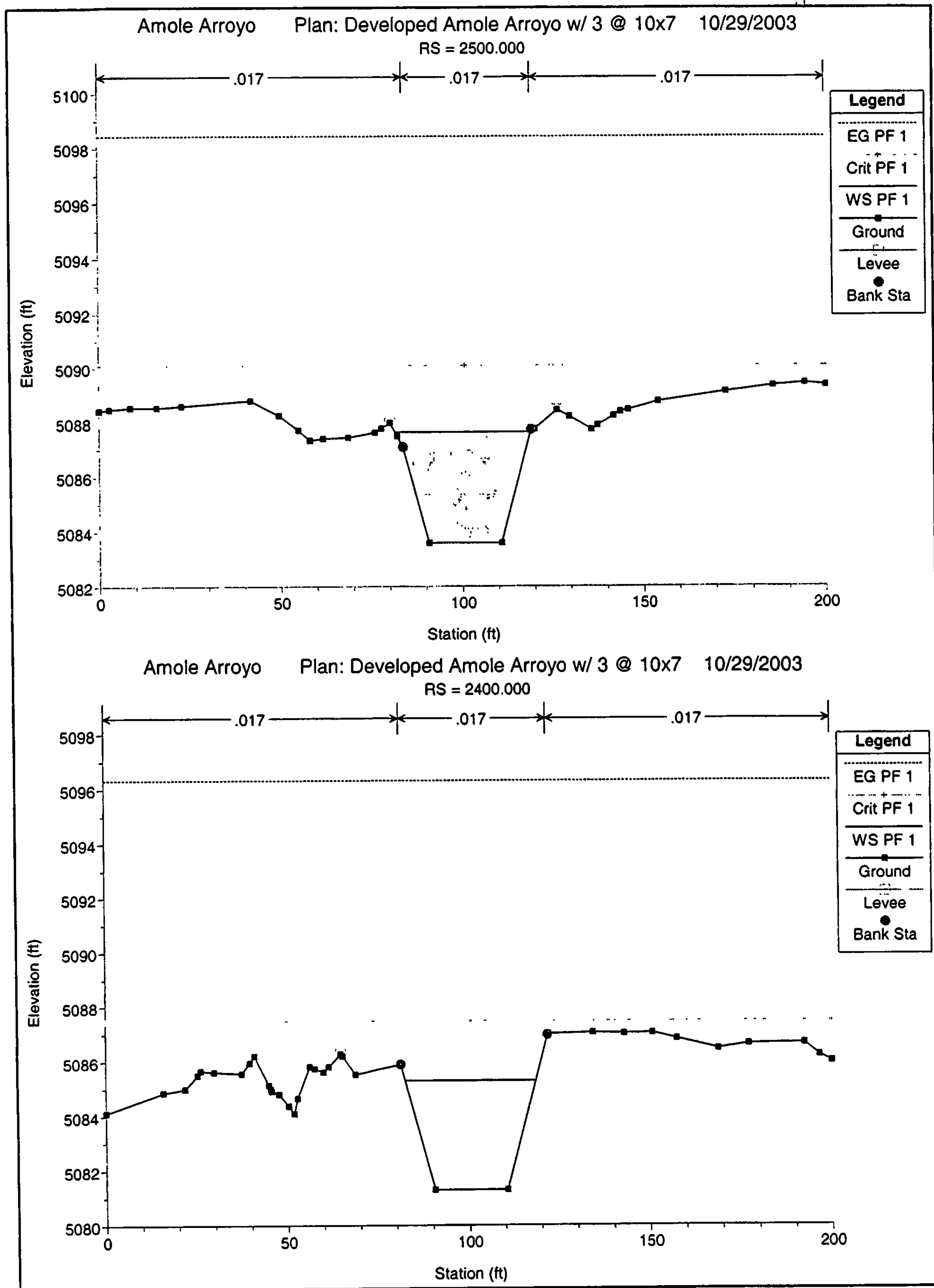


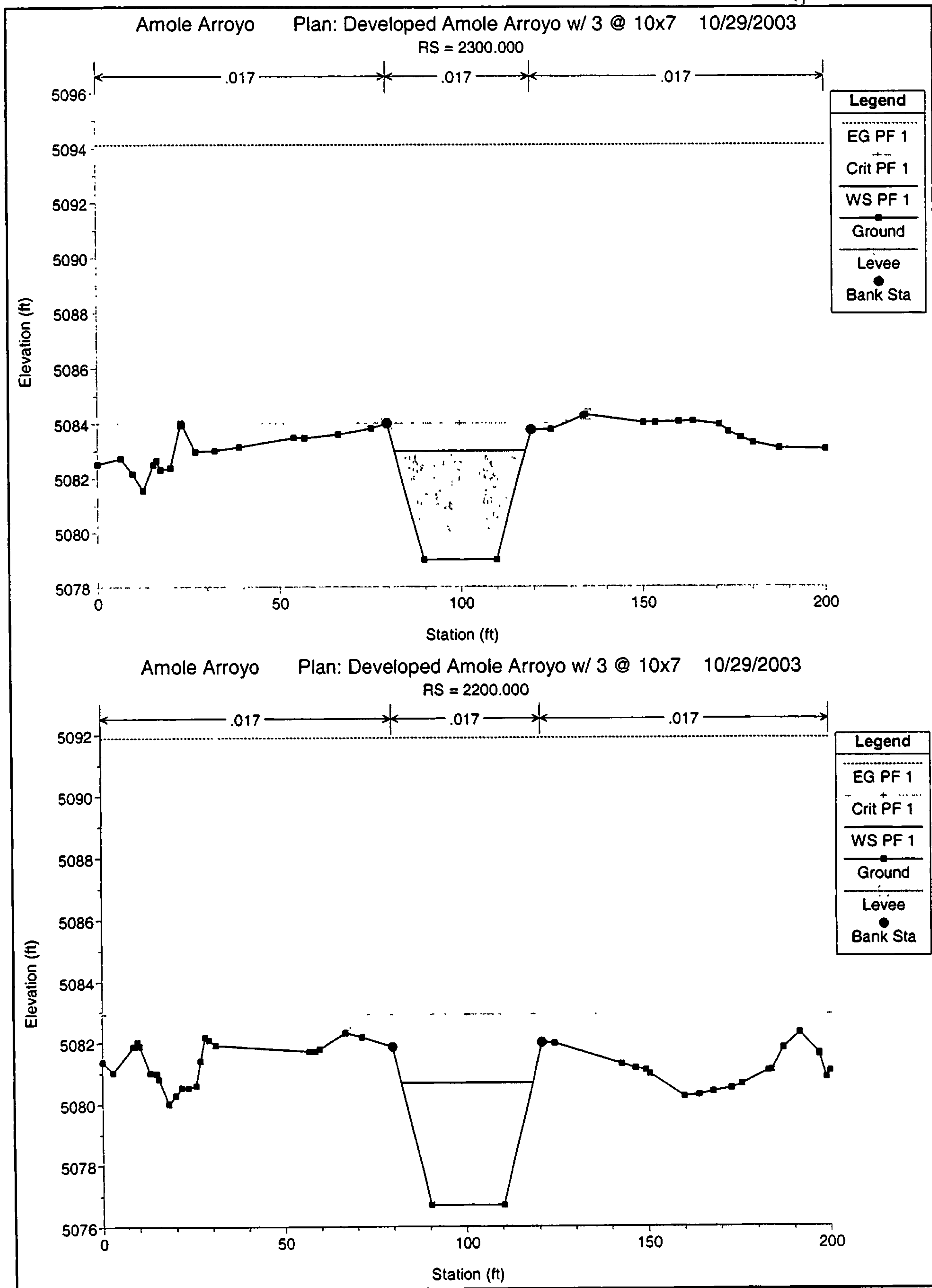


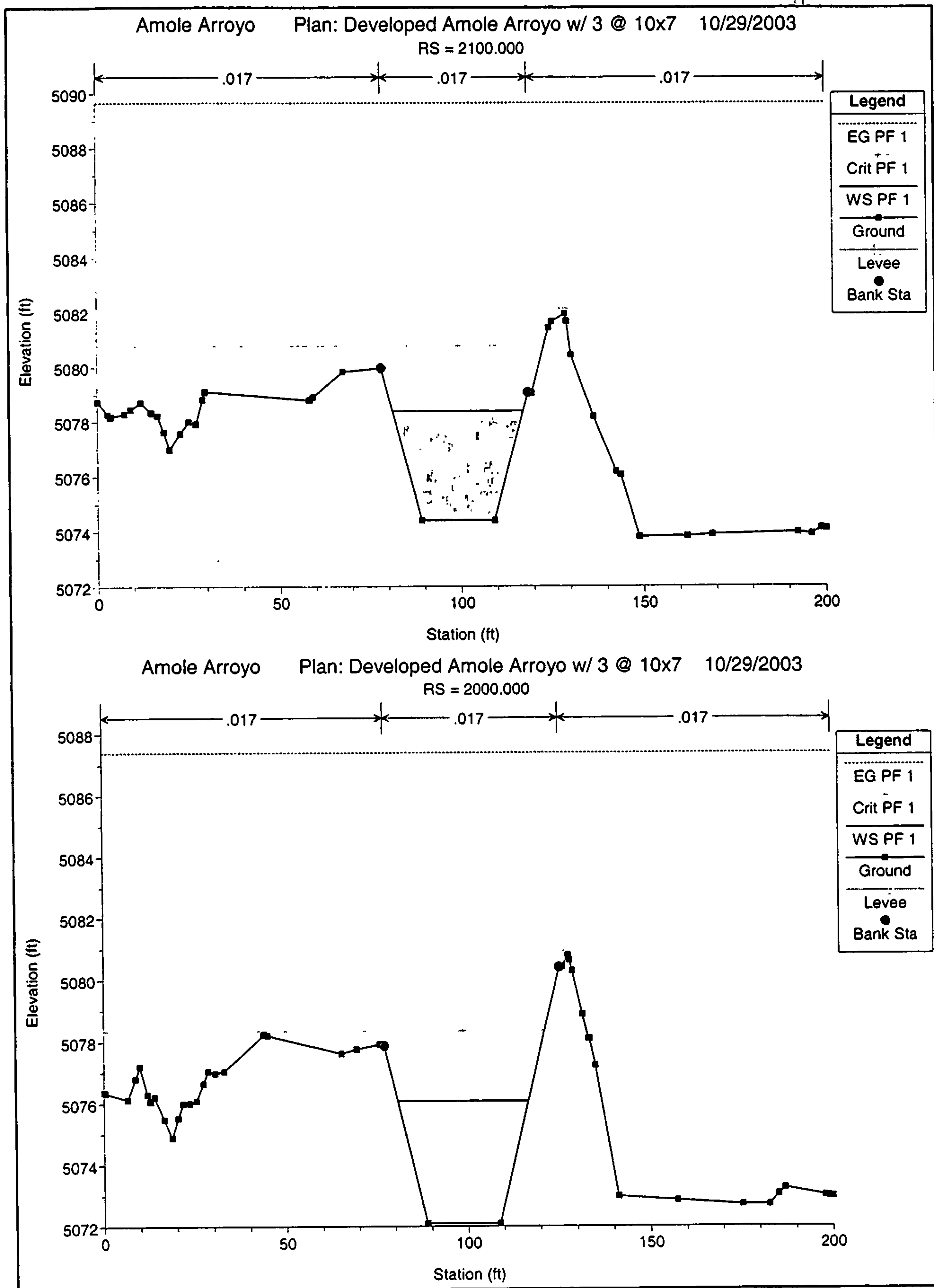


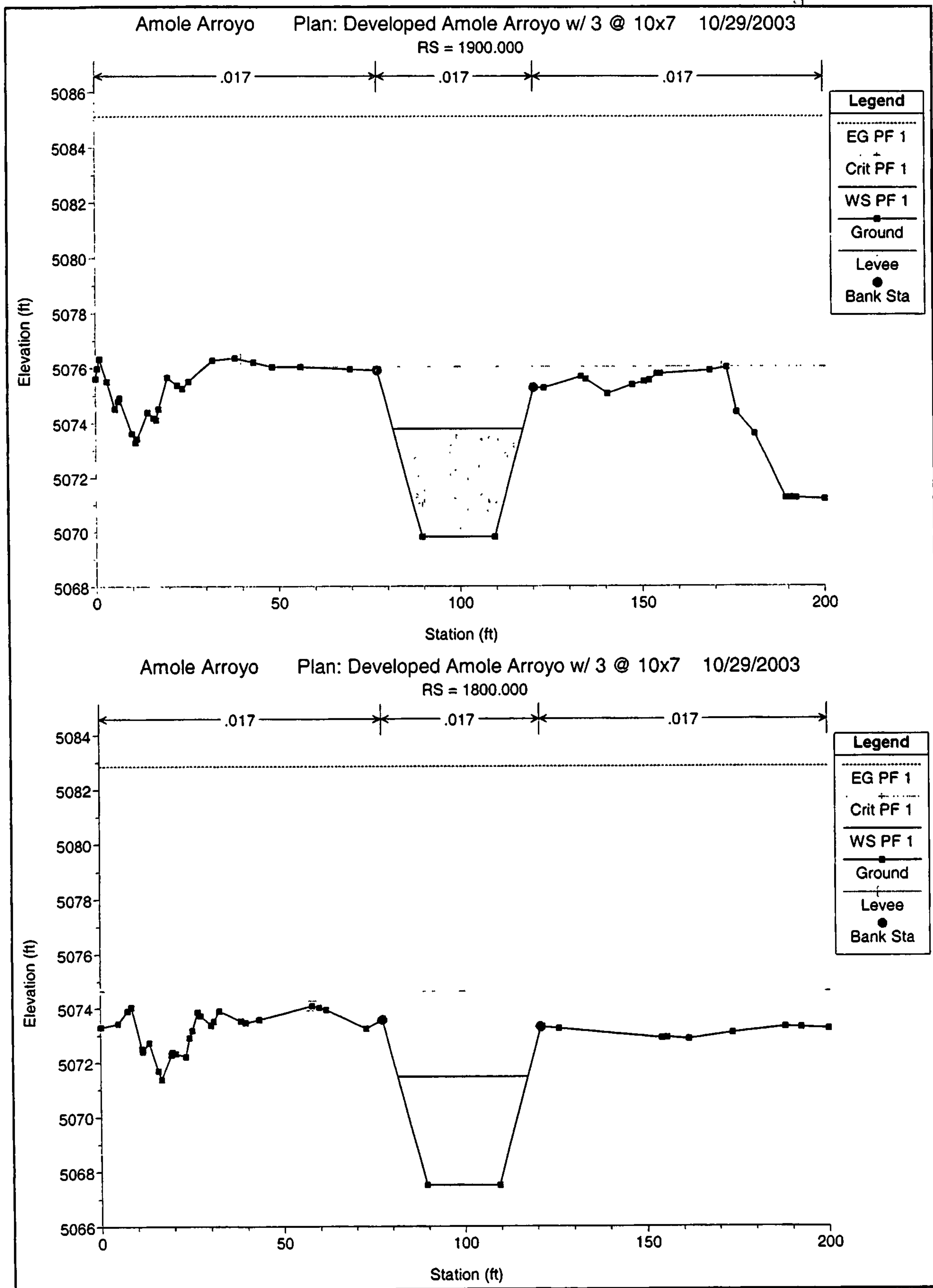


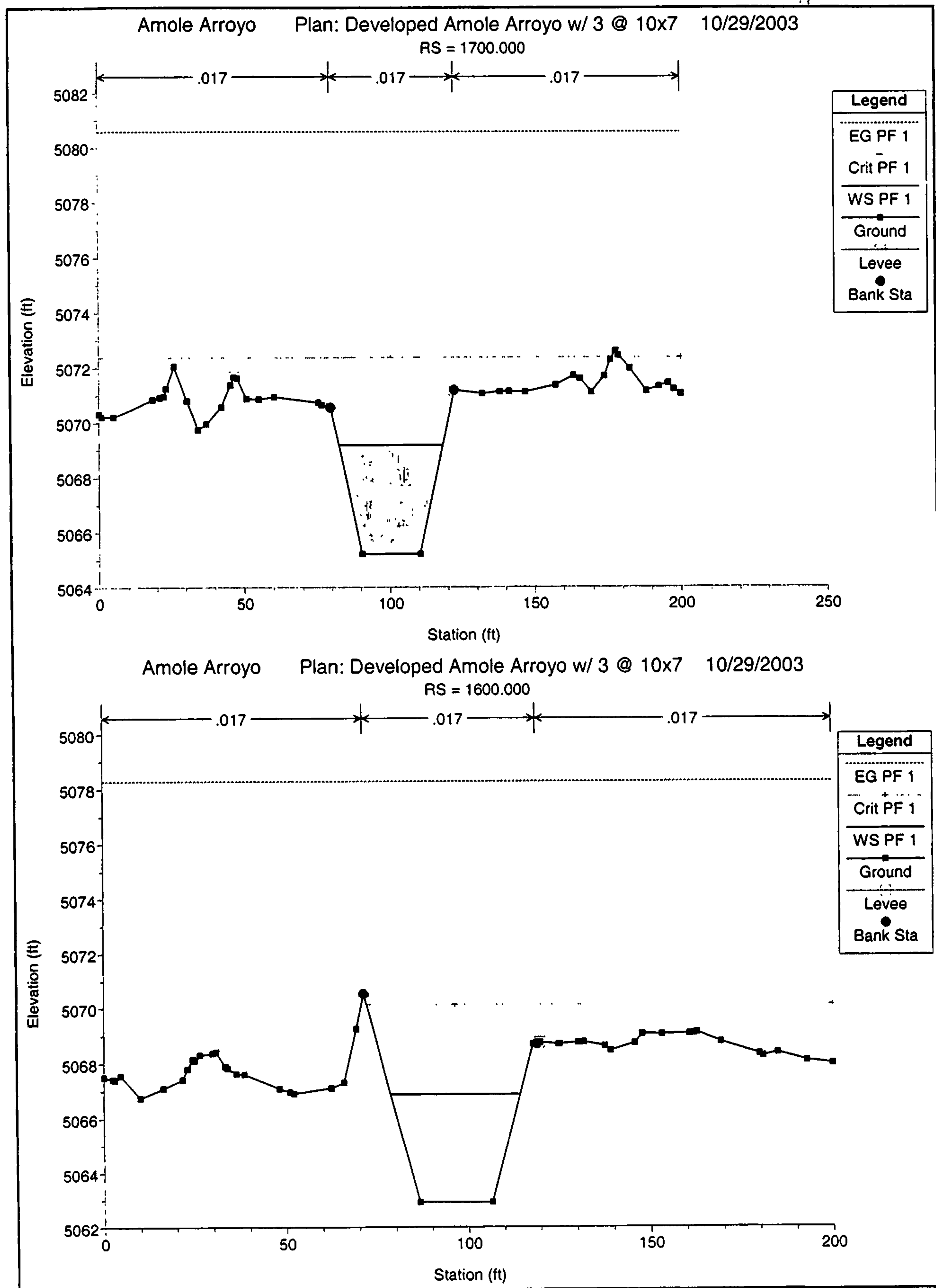


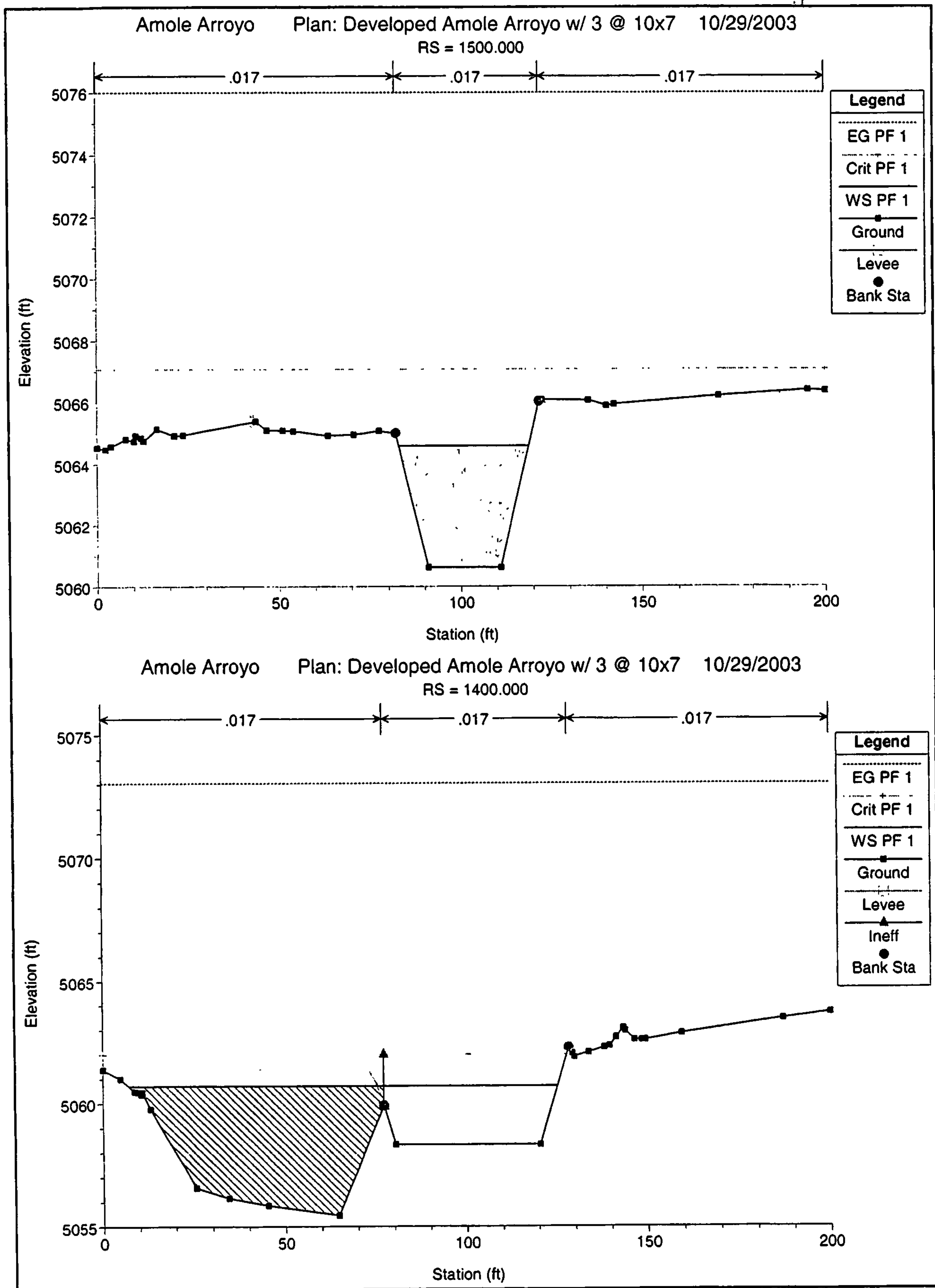


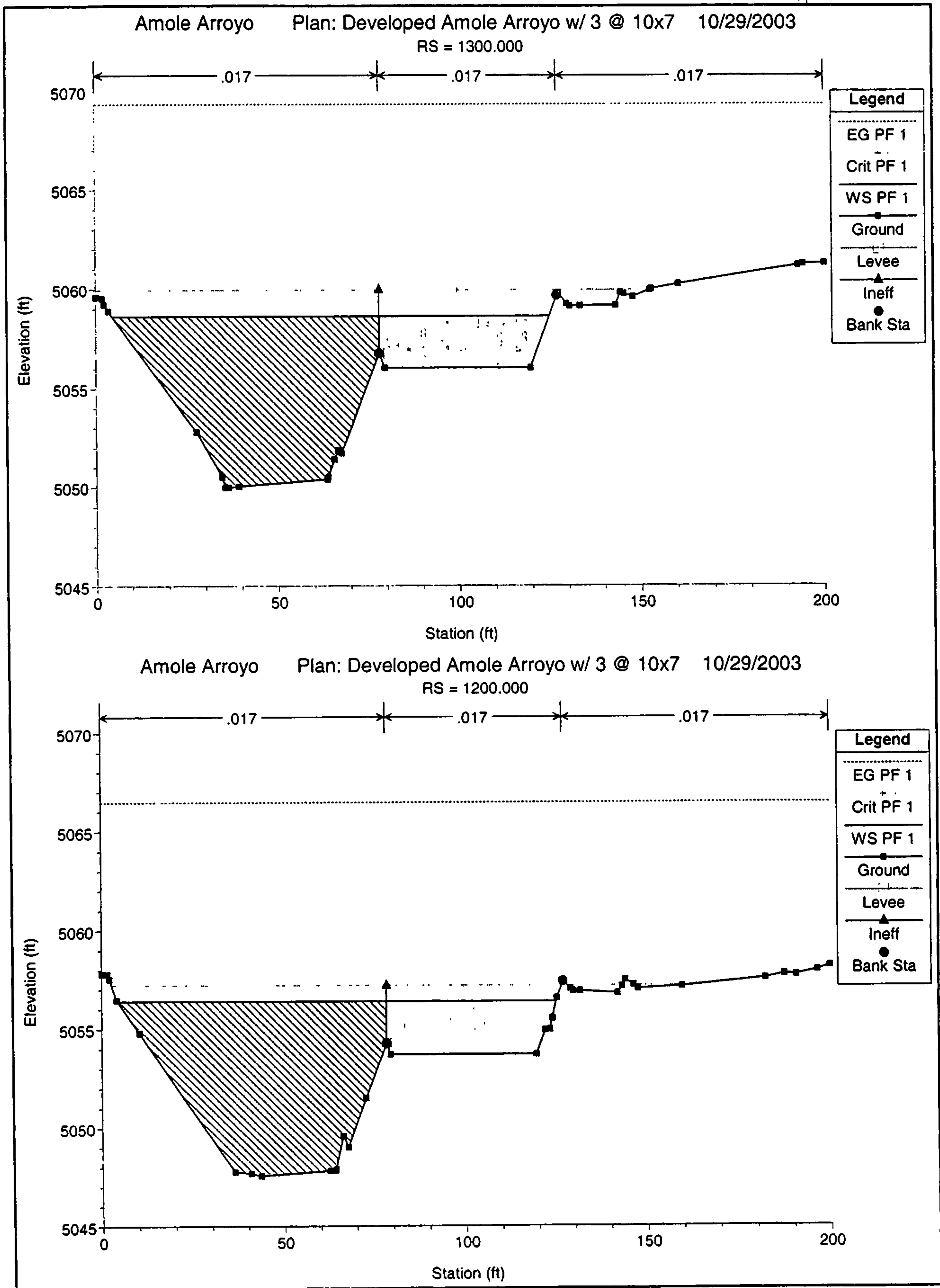


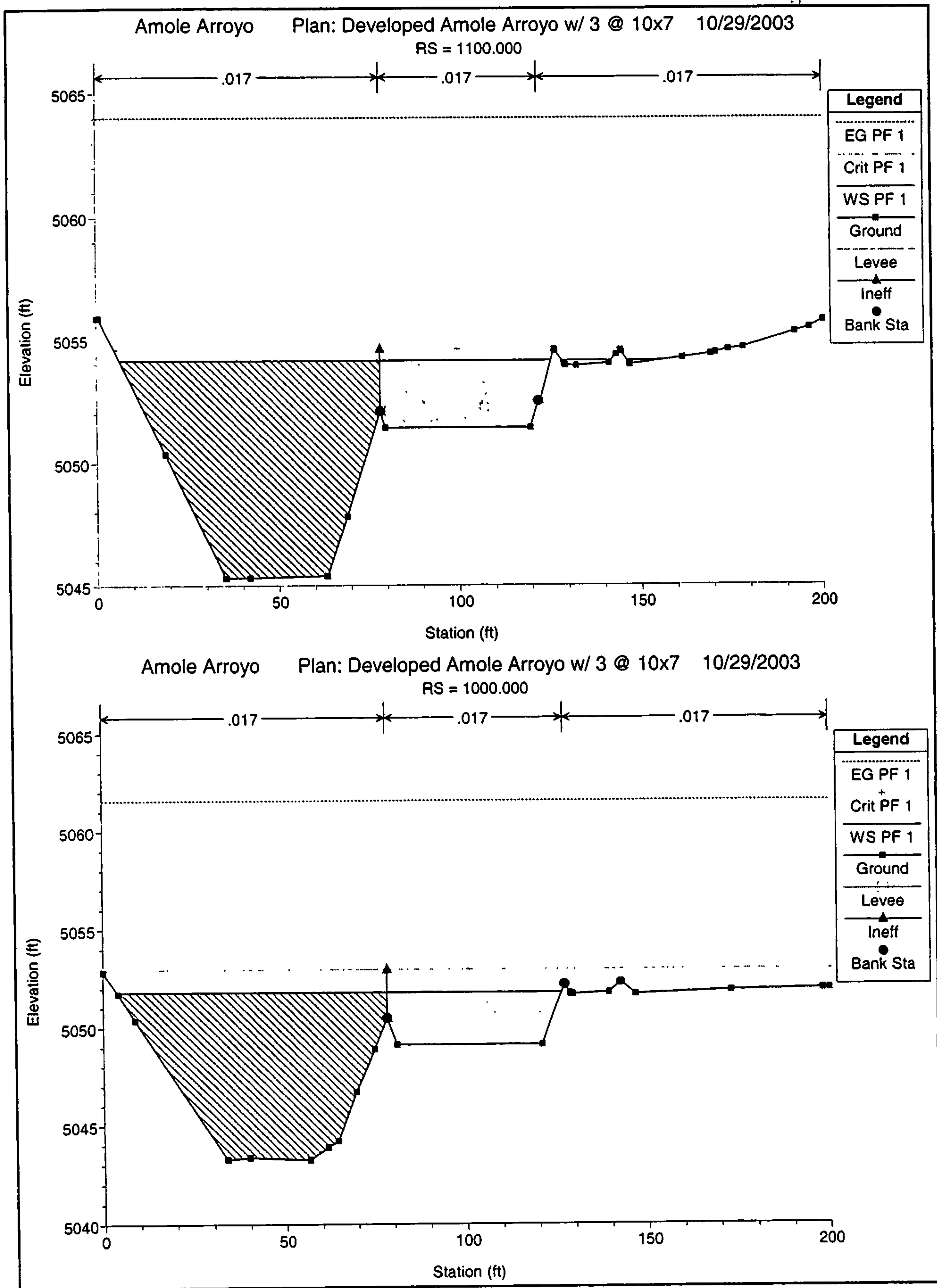


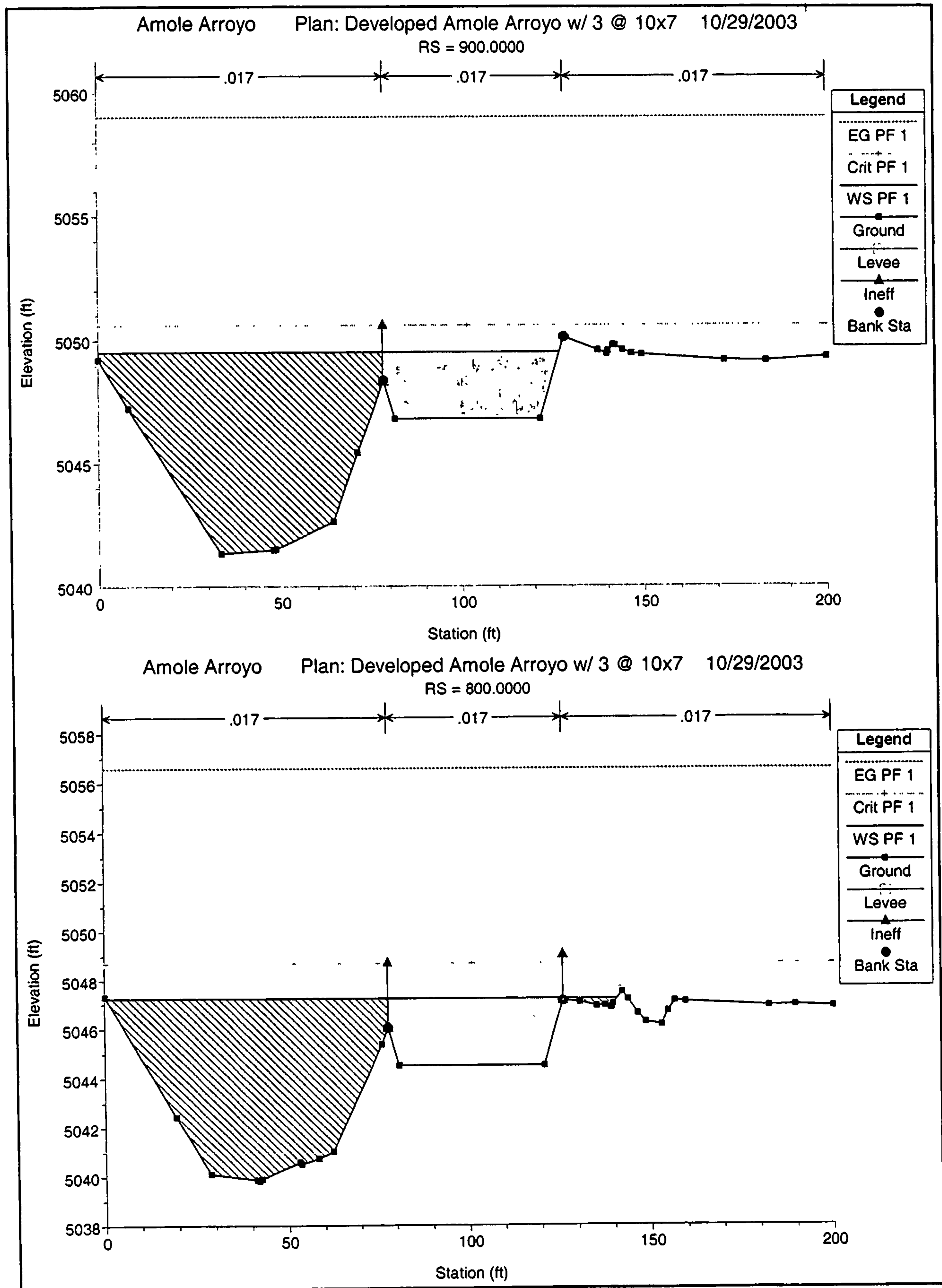


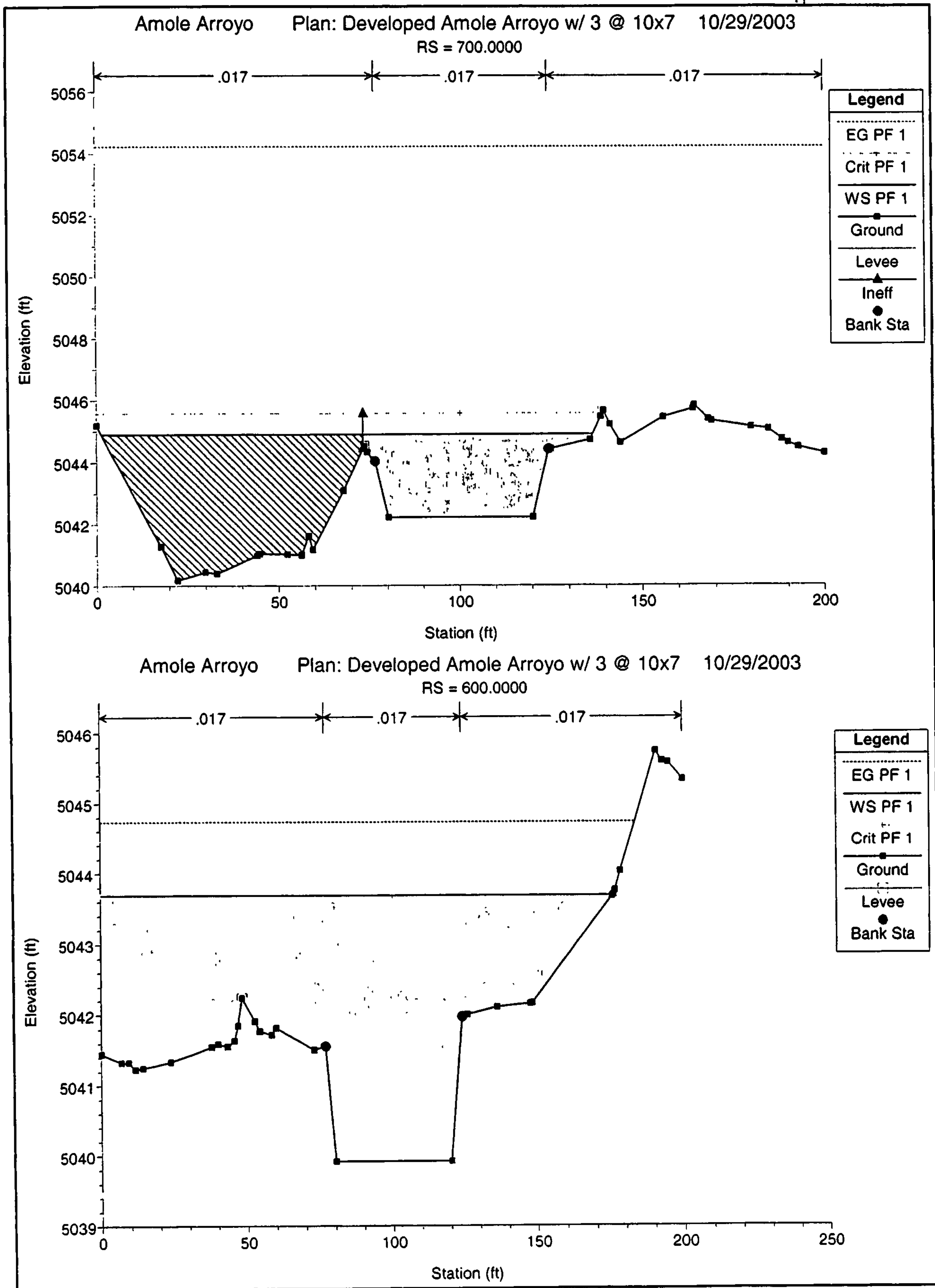


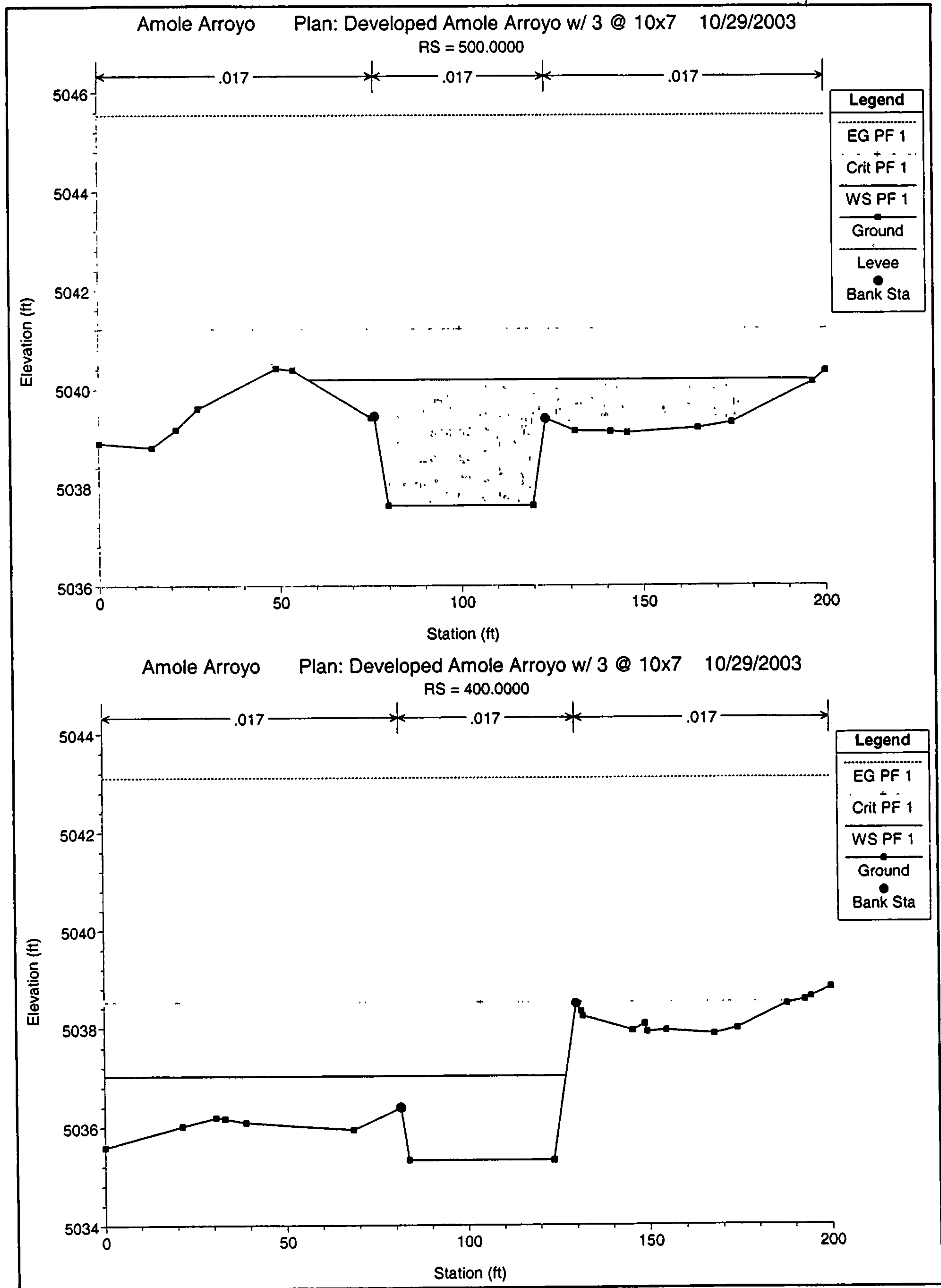


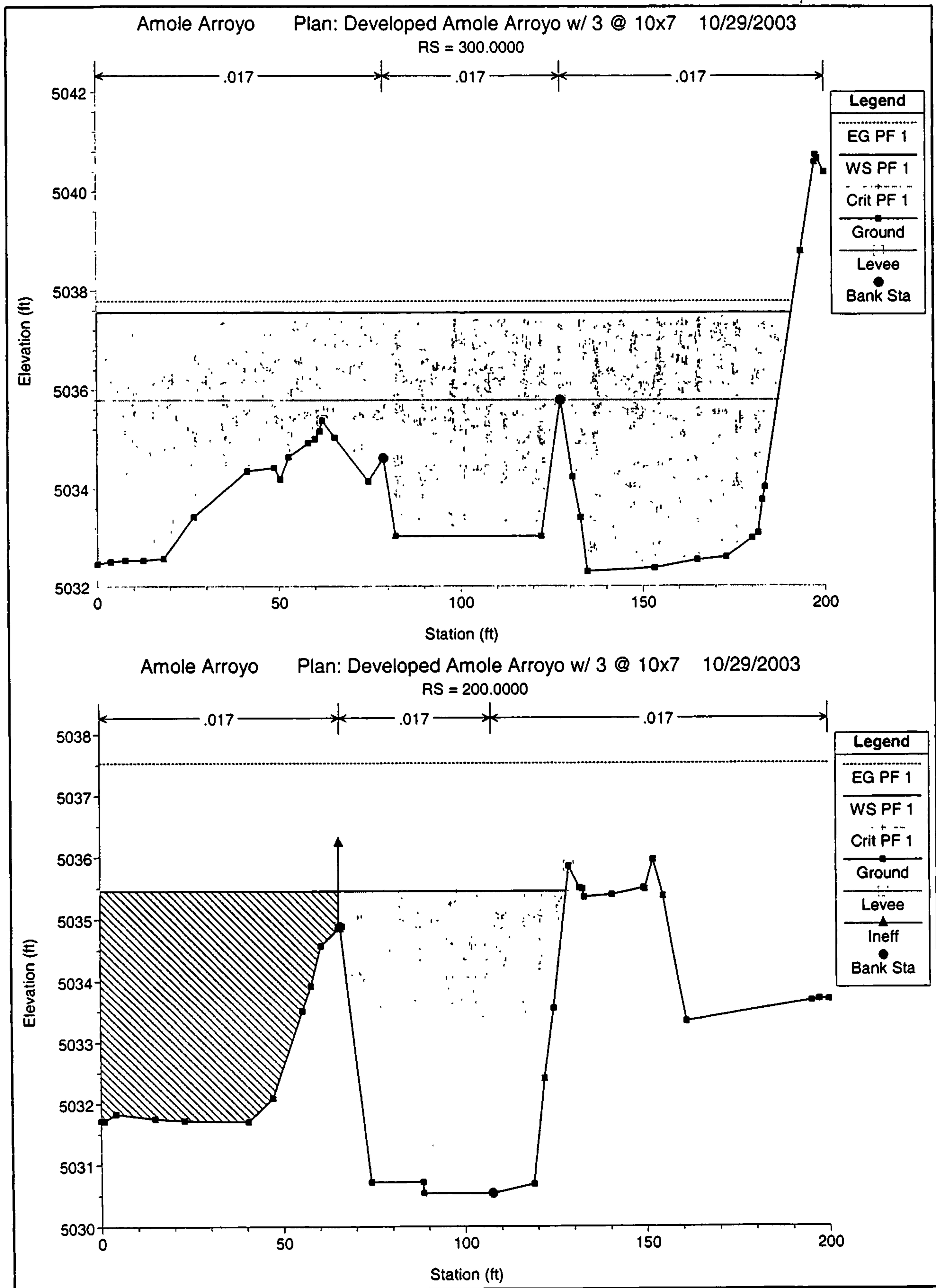


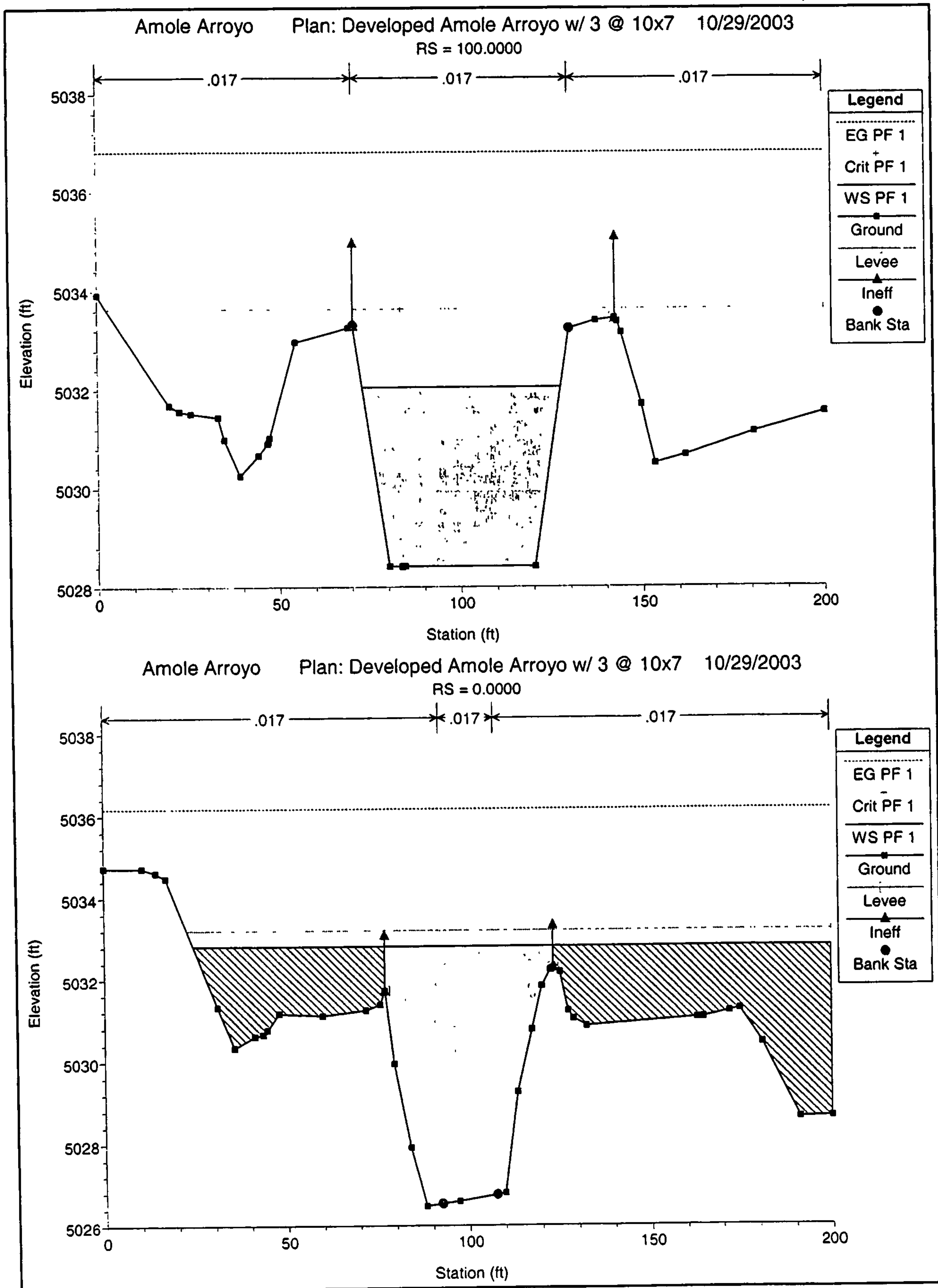












APPENDIX C

FREEBOARD CALCULATIONS

AMOLE ARROYO FREEBOARD CALCULATIONS AT GIBSON BOULEVARD CROSSING

·1
·1
·1
·1

$$\text{Freeboard (feet)} = 0.7 \left(2.0 + 0.025Vd^{1/3} \right)$$

City of Albuquerque Development Process
Manual - Chapter 22, Section 3.C.4.b.

Interim:

V = 23.52 ft/s
d = 3.95 ft
Freeboard = 2.05 ft

Developed:

V = 23.57 ft/s
d = 3.94 ft
Freeboard = 2.05 ft

Bohannon Huston

Courtyard I
7500 Jefferson St. NE
Albuquerque, NM
87109-4335

www.bhinc.com

voice: 505.823.1000

facsimile: 505.798.7988

toll free: 800.877.5332