Johnny Cosgrove - RE: Hide-A-Way Lake Dam - H&H

From: Johnny Cosgrove
To: Bynum, Kirk
Date: 3/7/2007 3:20 PM
Subject: RE: Hide-A-Way Lake Dam - H&H

Hello again, Kirk:

[redacted] In order to determine if the church does not significantly impact the carrying capacity of the spillway structure, it would need to be demonstrated for the required design storm. Therefore, the existing hydrologic and hydraulic analyses that have been conducted should be revised to reflect the required design storm, or 100% of the PMF.

We would encourage you to exhaust the possiblities you mentioned (taking a second look at the time of concentration - attenuation from routing through the upstream lake and stream system) and revise the hydrologic and hydraulic analyses that were submitted to TCEQ. If the revised version demonstrates that the church improvements do not cause any adverse impact to the spillway's capacity during a simulated PMF event, then we can respond to the original complaintant and inform them that the church's improvements have no impact. We cannot presently make this claim, as we do not have analyses based on the required design storm (even though I fully expect the 100% PMF simulation to demonstrate "no adverse impact", as well). If the revised analyses still show the dam to be hydraulically inadequate, then we will deal with that as a separate issue. This way, the original complaint is satisfactorily dealt with regardless of the hydraulic adequacy of the dam.

As far as any "other thoughts", or suggestions in revising the submitted hydrologic and hydraulic analyses, I'm sorry, but I have none to offer.

Please let me know if you have any questions, or would like to discuss the situation further.

Appreciate your time and assistance,

Johnny Cosgrove, PE
TCEQ Dam Safety Program
(512) 239-4307

>>> "Kirk Bynum" <bynum@brannoncorp.com> 3/6/2007 10:18 AM >>>

Good Morning Johnny,

I have not gone back and re-looked at the assumptions previously made. I was hoping you guys were looking into the dam classification. I have thought about going through and revisiting the "time of concentration" and recalculating by hand to see if I can get a more favorable time – and hopefully that would lead to a lesser PMP flow. My original numbers did not take into account any attenuation or routing through the upstream lake and stream system – I simply added time for channelized flow. I have not however, talked to the Client. I am in a little bit of a dilemma, myself – in that I have actually done what they authorized. As we discussed, I was hired to see if the "improvements" the church had made within the spillway had adversely impacted the carrying capacity thereof. My calculations show the church did not significantly impact the carrying capacity of the spillway structure. The fact that we have found other capacity issues for the lake and spillway system, in general, is really outside of what they hired me to do. The original cause of complaint, lodged with the TCEQ, by

someone unfriendly toward the Hide-Away Church, has resulted in the "opening of a can of worms".

I was going to try and call them this week and give them a "heads up" and see if they wanted me to do anything toward assisting them with the "problem" they now have. I do not know if it would be better for the bad news to come from you guys or from me. Either way I am sure there are going to be some "unhappy campers".

With regard to the second question concerning raising the lake level – I have not been contacted by anyone associated with Hide-Away Lake. I agree, if they are indeed wishing to raise the lake level it would be advantageous to address the spillway capacity at the same time.

I take it from your note that the TCEQ is certain that the Lake in question is a "high hazard" structure. Anything else you can think of for me to look at other than time of concentration? Any other thoughts?

Kirk

Kirk R. Bynum, P.E.

The C. T. Brannon Corporation

- Consulting Civil Engineers - Urban Planners -

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bynum@brannoncorp.com

From: Johnny Cosgrove [mailto:JCosgrov@tceq.state.tx.us]
Sent: Friday, March 02, 2007 2:57 PM
To: Kirk Bynum
Subject: Hide-A-Way Lake Dam - H&H

Hello Kirk:

I just wanted to touch base with you briefly on the Hide-A-Way Lake Dam (H&H evaluation of the spillway). Did you, by chance, take a second look at 'the details'? Find anything/assumptions that were maybe too conservative that might prove favorably in a re-run of the analysis?

On another note, Hide-A-Way Lake Club called me a couple weeks back. They were inquiring about raising the crest of the spillway to raise the lake level a bit (about a foot or so). Did they contact you regarding such an inquiry? If so, what was your recommendation? I suppose I figured that if they wished to pursue such a modification, the redesign of the spillway would also include the necessary improvements to address the apparent lack of capacity in passing 100% of the PMF.

Essentially, I need to write a letter back to Hide-A-Way Lake Club regarding our review of the submitted H&H analysis. I was hoping to find out from you if you've informed them of their structure (now) apparently being hydraulically inadequate. I didn't want to 'drop the bomb' on them without corresponding with you first,

though.

Let me know, please.

Thanks,
Johnny Cosgrove, PE
TCEQ Dam Safety Program
(512) 239-4307

Hideaway Lake

To: Johnny Cosgrove fax 512/239-0404

From: Dennis Godoy fax 903-882-7021

phone 903-882-6151

Comments

The Brannon Corporation

FAX 903/597-3346 1321 SOUTH BROADWAY PO BOX 7487 TYLER, TEXAS 75711 903/597-2122

28 December 2006

Mr. Dennis Godoy
General Manager, Hideaway Lake
101 Hide-A-Way Lane Central
Hideaway, Texas 75771

&

Mr. Jerry M. Lang
Hide-A-Way Lake Community Church
1500 Lake Park Circle
Lindale, Texas 75771

Re: Hydrology and Hydraulic Evaluation of the Spillway System for Hide-A-Way Lake Dam No.1

Dear Mr. Godoy and Mr. Lang,

In a letter dated 24 August 2006, the Texas Commission on Environmental Quality (TCEQ) informed Hide-A-Way Lake Club, Inc. that they, the TCEQ, had received a complaint regarding Hide-A-Way Lake Dam No.1. The concern of the complaint was that improvements have been made within the limits of the spillway that serves Hide-A-Way Lake Dam No.1, and that these improvements are potential obstructions to the capacity and have deleterious effects on the flow characteristics of the spillway. The letter was initiated as a result of a complaint registered with the TCEQ by a local resident. The TCEQ goes on to state the following in their 24 August 2006 letter:

> During a significant flood event, the spillway of Hide-A-Way Lake Dam No.1 must be able to function as it was designed. Obstructions within the spillway have the potential to create a rising backwater effect, possibly flooding homes along the shores of Hide-A-Way Lake No.1. Furthermore, spillway blockage and the resulting reduction in discharge capacity could result in premature overtopping of the embankment of Hide-A-Way Lake Dam No.1. This could potentially lead to a dam failure and the subsequent inundation of homes along the shores of downstream Hide-A-Way Lake No.2.

In order to address the concerns and comments of the TCEQ The C.T. Brannon Corporation was contracted to perform a Hydrologic and Hydraulic evaluation of the spillway for the subject lake.

Hydrology is the study of the hydrologic cycle wherein water is evaporated to become clouds, falls as precipitation in one form or another, and runs back to oceans, lakes, and seas to be evaporated again. Hydrology for the purpose of this study is confined to the delineation of the watershed contributory to Hide-A-Way Lake No.1, and determination of the corresponding peak discharges for rainfall runoff under varying conditions of precipitation and development.

Hydraulics, on the other hand, is the study of fluids, in this case water, and the effects of fluids on their surroundings as well as the effects of their surroundings on the fluids. Hydraulics is governed by certain "laws of science". The "laws" that govern flow of water through an open channel make it possible for engineers to calculate the elevation of a water surface for a given flow rate in a channel of given dimensions such as the subject spillway.

Therefore, the requisite hydrologic and hydraulic evaluation of the existing spillway configuration required the following steps:

- The contributory drainage area for Hide-A-Way Lake No.1 was delineated. The Smith County 2-foot contour maps were used for this purpose. The area was double checked against the corresponding USGS, 7.5 minute series, quadrangle map.
- The *Soil Survey of Smith County, Texas* prepared by the United States Department of Agriculture was used to classify the general soil types for the drainage area to facilitate the assignment of runoff characteristics to the drainage area.
- A computer program was used to calculate the peak discharges for a variety of rainfall events.
- A topographic survey was made of the spillway including "improvements" made by the Hide-Away Community Church within the confines of the emergency overflow channel.
- A computer program was used to calculate the water surface elevations within the spillway corresponding to the previously calculated peak discharges for a variety of rainfall events.
- Results were then analyzed and reported.

Two computer programs were used in evaluating the spillway for Hide-A-Way Lake No.1. Pondpack by Haestad Methods was used to generate the peak discharges and to predict the water surface elevations and storage capacity of the lake itself and the spillway at its interface with the lake for various rainfall events. HECRAS, also by Haestad Methods, was used to evaluate the effects of channel geometry and "obstructions" in the channel and/or overbanks on the carrying capacity of the discharge channel and corresponding water surface elevations for the peak discharges and lake elevations generated by Pondpack.

Peak discharges for storm water runoff associated with the 5-yr, 10-yr, 25-yr, 50-yr, 100-yr, and probable maximum precipitation (PMP) storm events were generated in Pondpack. (The PMP storm is labeled as 500-yr in the computer runs due to limitations in the program allowing only the use of integers to label storm events.) The 5-yr storm is that storm event having a probability of recurrence of one in five, or 20-percent, in any given year. The 10-yr, 25-yr, 50-yr and 100-yr storm events are similarly defined with the 100-yr storm having a probability of recurrence of 1.0-percent in any given year. One common way of expressing any of these storms is that it they are the storm that can be expected to be equaled or exceeded once in whatever time frame is selected (i.e. the 100-yr storm can be expected to occur once every 100 years). There is a fallacy in thinking of them in that light, however. There is no reason why an area can not experience a 100-yr storm event on back-to-back rainfall events, it is just not statistically probable. The PMP is, as the name implies, the maximum rainfall that is statistically probable to fall within a 10 square mile area over a 6-hour period. For

Smith County the PMP storm would result in approximately 31.25 inches of rainfall in one 6-hour period. It should be noted that the total average annual rainfall for Smith County is only 38 to 46 inches. Clearly the PMP storm is a significant rainfall event. The peak discharge associated with the PMP storm is an order of magnitude greater and many times more than that associated with the 100-yr storm.

For this study peak discharges were calculated using the Soil Conservation Service (SCS) criteria assuming a Type III, 24 hour storm distribution for the 5-yr through 100-yr storm events. An SCS Type III, 24 hour storm was interpolated and used for the PMP evaluation. In accordance with TCEQ design guidelines for dams three-quarters of the PMP storm was used in this evaluation. The calculated peak discharges were then "routed" through the lake and spillway to generate discharge flows out of the lake.

Using the routed flows out of the lake and their corresponding water surface elevations at the crest of the spillway (i.e. the start of the discharge channel) the HECRAS computer program was used to generate a "back water model" of the flow through the emergency spillway. The resultant backwater model includes such information as velocity of flow, the depth of flow, and water stored in the channel at any one moment. These values, as well as many others, are computed for each of the storms modeled.

Everyone has seen the effect on flow in a stream caused by trees, rocks, bridges, and other man-made structures. The HECRAS computer program can model these obstructions. Model input requires knowledge or description of several factors regarding flow of water in a stream, or in this case the emergency spillway:

- ❑ Extent of vegetation or roughness in the overbank and channel areas.
- ❑ The degree of expansion and/or contraction in the channel itself as it meanders through the reach.
- ❑ Encroachments by filling or construction of buildings in the overbank area(s).
- ❑ Relative steepness or flatness of the channel
- ❑ Silt and sediment build-up in the channel.
- ❑ Walls, fences, or other manmade obstacles.

Roughness factors used by drainage engineers are for the most part empirical (based on testing) and most often the product of the engineer's experience. For open channel flow as in the subject spillway the factor most often used (and used herein) is called the "Manning's 'n'" value. The lower the 'n' value the less impediment to flow. For example, a typical Manning's 'n' value for asphalt or paved overbanks is 0.025. The same overbank if covered with short grass with no trees or brush would reflect a value of 0.035. Add trees and underbrush and the 'n' value goes to 0.045 or higher depending on the amount of brush present. The fact that the church has paved part of the flow channel of the emergency spillway is in no way detrimental to the flow. If anything, paving part of the channel overbanks has resulted in a slight improvement in the roughness coefficient associated with the corresponding channel sections.

The existing emergency spillway is characterized by a trapezoidal main channel that acts as the principal spillway for the lake. When the lake is at normal pool level(i.e. full) any water entering

the lake causes an equal amount of water to be discharged through the main channel section. The main trapezoidal channel is plated with a combination of concrete and asphalt paving. The asphalt portions thereof are in various stages of deterioration. For the most part the concrete sections are in generally good condition. The main trapezoidal channel is essentially cut into the center of a secondary larger trapezoidal channel that acts as the emergency spillway for Hide-A-Way Lake No.1. **According to the calculations performed herein and their corresponding assumptions and basis *all of the storms analyzed up to and including the 100-yr storm are contained within the confines of the main channel.***

The discharge for the PMP storm event, as modeled, is the only storm which floods into the secondary trapezoidal channel composing the emergency spillway. Nevertheless, the PMP is well contained within the existing emergency spillway's configuration. Since the PMP is the only storm event not contained within the main channel, the improvements constructed by the church have no impact on any storm event modeled except the PMP. According to the HECRAS modeling, the presence of the elevator adjacent to the south-eastern edge of the emergency spillway channel has no significant impact on the water surface elevation interior to the spillway during the PMP storm event. Modeling the elevator as a vertical wall, thereby limiting the overback flow area available to carry the calculated discharge, in the sections immediately adjacent to the elevator resulted in a localized rise in water surface elevation of less than one foot. The noted rise in the computed water surface elevation had dissipated within a distance of 150 feet and had no effect on the water surface elevation at the crest of the spillway. In like manner, the presence of the access ramp, which was also constructed into the southeastern side of the emergency spillway channel, has no significant impact on the calculated water surface elevation within the discharge channel. In no instance modeled was the spillway channel in danger of being overtopped.

In summary, the Engineer offers the following:

- Tall grass, shrubs and/or trees within the spillway section are not desirous. If a grass spillway section is to be maintained it should be regularly mowed and fertilized to maximize coverage. Long grass, brush and trees should not be allowed to grow within the "flats" of the spillway section. Paving of the spillway, within certain parameters, is viewed as a positive. Paving reduces the possibility of erosion of the natural soils if vegetation is not well maintained. As stated in the TCEQ's 24 August 2006 letter paving should not be allowed to change the existing grades and elevations of the spillway channel.

- Parking cars within the emergency spillway is considered to be an acceptable use within reason. It is presumed that the church would not be holding a function during a significant flooding event and therefore, the spillway channel would be clear of parked vehicles. Nevertheless, care should be taken not to park in the spillway during periods of extended inclement weather, when there is a chance of severe storms, or any time there is a "Flash Flood" warning issued for Smith County. All community members should be warned against parking in the spillway and leaving their vehicles for any length of time. The church should not routinely leave vehicles parked within the spillway. It should also be noted that parking on unpaved grassy areas of the spillway channel is not recommended by either the Engineer or TCEQ

as it has the potential to damage the vegetative cover and could cause erosion. Even though the model shows all storms, including the 100-yr storm, to be contained in the main channel section of the spillway, there are multiple factors and assumptions involved in the hydrologic calculations that could cause flow characteristics not in keeping with the findings herein. Remember, "water tends to have a mind of its own and does what it wants to, theory notwithstanding."

- The current spillway configuration is capable of handling the Type III, 24-hr, 5-yr, 10-yr, 25-yr, 50-yr, and 100-yr rainfall event without overtopping the spillway crest and the discharge from the lake is contained in the main channel of the spillway.

- The current spillway configuration is capable of handling a rainfall event equal to two-thirds of the PMP without overtopping the dam or spillway crest. The resulting flow is contained within the existing spillway configuration.

- Neither the access ramp nor the elevator has any significant negative impact on the spillway's ability to pass the subject peak discharges for the subject storms.

If further information or clarification is desired, please feel free to contact me at (903) 597-2122 or at bynum@brannoncorp.com. I appreciate the opportunity to be of service to the Hide-Away Lake community and your reliance on The C.T. Brannon Corporation.

Your truly

Kirk R. Bynum, P.E.
Principal, Project Manager
The C.T. Brannon Corporation

Attachments:

Type.... Master Network Summary
Name.... Watershed
File.... O:\Hide-A-Way Lake Club 1739\06057 Spillway H&H\Calculations\MiddleLakeHydro2r.pp

MASTER DESIGN STORM SUMMARY

Network Storm Collection: Smith County

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre 5	5.8500	Synthetic Curve	TypeIII 24hr
Pre 10	7.0000	Synthetic Curve	TypeIII 24hr
Pre 25	7.6000	Synthetic Curve	TypeIII 24hr
Pre 50	9.2500	Synthetic Curve	TypeIII 24hr
Pre100	10.2500	Synthetic Curve	TypeIII 24hr
Pre500	32.4600	Synthetic Curve	TypeIII 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

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

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUT 10		JCT	5	308.238	R	21.6000	104.75		
*OUT 10		JCT	10	454.530	R	18.8500	179.88		
*OUT 10		JCT	25	536.121	R	18.2000	229.14		
*OUT 10		JCT	50	774.133	R	17.0000	398.22		
*OUT 10		JCT	100	926.073	R	16.2500	569.25		
*OUT 10		JCT	500	4763.981	R	13.2000	11922.90		
POND 10	IN	POND	5	382.886		12.6000	2300.75		
POND 10	IN	POND	10	535.975		12.5500	3286.87		
POND 10	IN	POND	25	620.258		12.5500	3832.31		
POND 10	IN	POND	50	863.826		12.5500	5395.04		
POND 10	IN	POND	100	1018.030		12.5500	6374.48		
POND 10	IN	POND	500	4867.020		12.5000	29293.05		

Type.... Master Network Summary
Name.... Watershed
File.... O:\Hide-A-Way Lake Club 1739\06057 Spillway H&H\Calculations\MiddleLakeHydro2r.pp

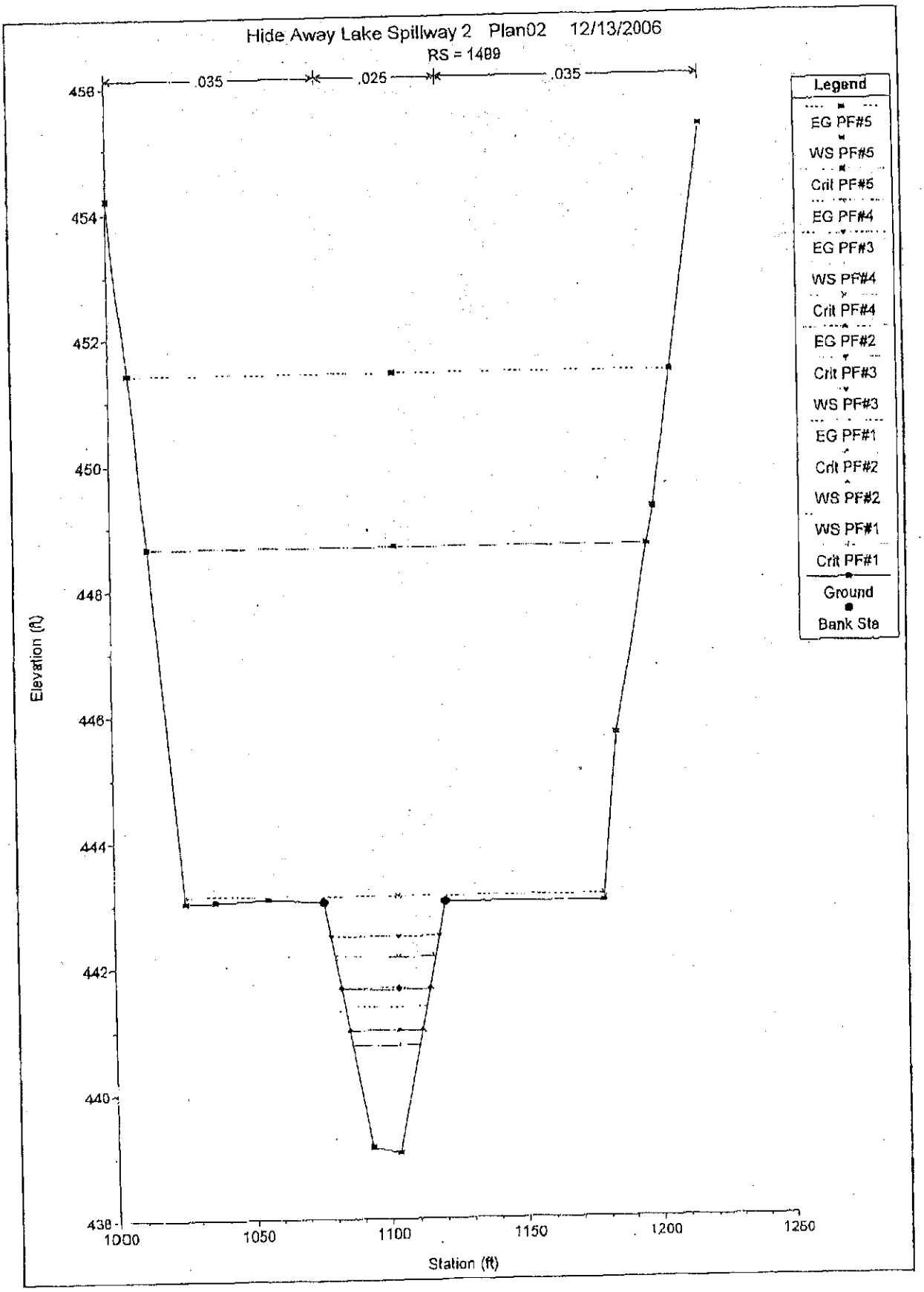
MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

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

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
POND 10	OUT POND	5	308.238	R	21.6000	104.75	440.97	296.159
POND 10	OUT POND	10	454.530	R	18.8500	179.88	441.59	395.389
POND 10	OUT POND	25	536.121	R	18.2000	229.14	441.93	449.181
POND 10	OUT POND	50	774.133	R	17.0000	398.22	442.83	598.652
POND 10	OUT POND	100	926.073	R	16.2500	569.25	443.34	684.252
POND 10	OUT POND	500	4763.981	R	13.2000	11922.90	451.37	2266.375
SUBAREA 10	AREA	5	382.886		12.6000	2300.75		
SUBAREA 10	AREA	10	535.975		12.5500	3286.87		
SUBAREA 10	AREA	25	620.258		12.5500	3832.31		
SUBAREA 10	AREA	50	863.826		12.5500	5395.04		
SUBAREA 10	AREA	100	1018.030		12.5500	6374.48		
SUBAREA 10	AREA	500	4867.020		12.5000	29293.05		

HEC-RAS Plan: multi_River: Hide-Away Spillw Reach: spillway1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	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/s)	(sq ft)	(ft)	
spillway1	1499	179.88	439.04	440.76	440.76	441.37	0.008031	6.22	28.92	24.44	1.01
spillway1	1499	229.14	439.04	441.00	441.00	441.67	0.009648	6.57	34.88	26.44	1.01
spillway1	1499	398.22	439.04	441.64	441.64	442.60	0.008006	7.42	63.87	31.98	1.01
spillway1	1499	569.25	439.04	442.17	442.17	443.16	0.007472	7.90	91.80	36.48	1.00
spillway1	1499	11922.90	439.04	448.66	448.66	451.43	0.005078	16.78	1042.26	193.14	1.04
spillway1	1448	179.88	438.35	439.61	439.61	440.27	0.009612	5.42	33.25	38.13	1.01
spillway1	1448	229.14	438.35	439.99	439.98	440.80	0.008833	5.72	40.43	41.72	0.99
spillway1	1448	398.22	438.35	440.85		441.16	0.005375	6.77	72.63	54.87	0.82
spillway1	1448	569.25	438.35	441.18		441.70	0.004237	5.90	104.26	65.48	0.76
spillway1	1448	11922.90	438.35	448.33	448.33	450.04	0.003873	15.00	1138.90	207.00	0.90
spillway1	1400	179.88	437.55	439.25	439.25	439.80	0.009152	5.94	30.28	29.10	1.01
spillway1	1400	229.14	437.55	439.47	439.47	440.08	0.008846	6.26	36.63	30.63	1.01
spillway1	1400	398.22	437.55	440.04	440.04	440.83	0.008166	7.09	56.26	38.17	1.01
spillway1	1400	569.25	437.55	440.63	440.63	441.41	0.006985	7.56	77.82	39.79	0.97
spillway1	1400	11922.90	437.55	447.47	447.47	450.10	0.004377	16.51	1117.80	205.46	0.99
spillway1	1343	179.88	436.64	438.40	438.40	438.98	0.009032	6.09	29.56	26.10	1.01
spillway1	1343	229.14	436.64	438.83	438.83	439.27	0.008742	6.41	35.74	28.46	1.01
spillway1	1343	398.22	436.64	439.24	439.24	440.05	0.008117	7.21	55.25	34.88	1.01
spillway1	1343	569.25	436.64	439.75	439.75	440.66	0.007051	7.69	75.89	49.21	0.97
spillway1	1343	11922.90	436.64	446.94	446.94	449.60	0.004297	16.78	1089.17	190.79	0.98
spillway1	1299	179.88	435.64	437.46	437.46	438.06	0.008858	6.26	28.77	24.16	1.01
spillway1	1299	229.14	435.64	437.70	437.70	438.37	0.008587	6.57	34.89	26.35	1.01
spillway1	1299	398.22	435.64	438.36	438.36	439.20	0.007991	7.40	53.84	32.19	1.01
spillway1	1299	569.25	435.64	438.87	438.87	439.84	0.007120	7.90	73.13	45.67	0.98
spillway1	1299	11922.90	435.64	445.42	445.42	447.87	0.004638	16.45	1150.41	220.57	1.00
spillway1	1199	179.88	433.45	435.28	435.28	435.91	0.008868	6.37	28.26	22.83	1.01
spillway1	1199	229.14	433.45	435.53	435.53	436.23	0.008574	6.72	34.09	24.74	1.01
spillway1	1199	398.22	433.45	436.20	436.20	437.09	0.007937	7.68	62.53	29.96	1.01
spillway1	1199	569.25	433.45	436.74	436.74	437.77	0.007529	8.17	89.69	34.14	1.01
spillway1	1199	11922.90	433.45	444.13		446.01	0.003249	14.55	1303.92	227.19	0.85
spillway1	1165	179.88	432.88	434.84	434.84	435.26	0.008829	6.29	28.59	23.48	1.00
spillway1	1165	229.14	432.88	434.89	434.89	435.57	0.008524	6.64	34.48	25.39	1.00
spillway1	1165	398.22	432.88	435.55	435.55	436.42	0.007880	7.50	53.08	30.62	1.01
spillway1	1165	569.25	432.88	436.07	436.07	437.09	0.007672	8.13	69.99	34.71	0.94
spillway1	1165	11922.90	432.88	443.43	443.43	445.84	0.004007	16.03	1187.47	220.89	
spillway1	1100	179.88	431.88	433.46	433.46	434.09	0.008846	6.38	28.21	22.69	1.01
spillway1	1100	229.14	431.88	433.71	433.71	434.41	0.008548	6.73	34.04	24.59	1.01
spillway1	1100	398.22	431.88	434.38	434.38	435.28	0.007922	7.58	52.44	29.80	1.01
spillway1	1100	569.25	431.88	434.92	434.92	435.99	0.007545	8.19	69.47	33.91	1.01
spillway1	1100	11922.90	431.88	442.42	442.42	445.03	0.004185	16.41	1130.93	208.60	0.96
spillway1	1000	179.88	429.63	431.80	431.80	432.24	0.008814	6.43	27.98	22.14	1.01
spillway1	1000	229.14	429.63	431.85	431.85	432.56	0.008934	6.78	33.78	24.08	1.01
spillway1	1000	398.22	429.63	432.53	432.53	433.44	0.007925	7.64	52.11	28.29	1.01
spillway1	1000	569.25	429.63	433.08	433.08	434.13	0.007510	8.22	69.22	33.45	1.01
spillway1	1000	11922.90	429.63	440.22	440.22	442.92	0.004544	16.77	1085.77	191.88	1.00


Hide Away Lake Spillway 2 Plan02 12/13/2006
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WS PF#5
Crit PF#5
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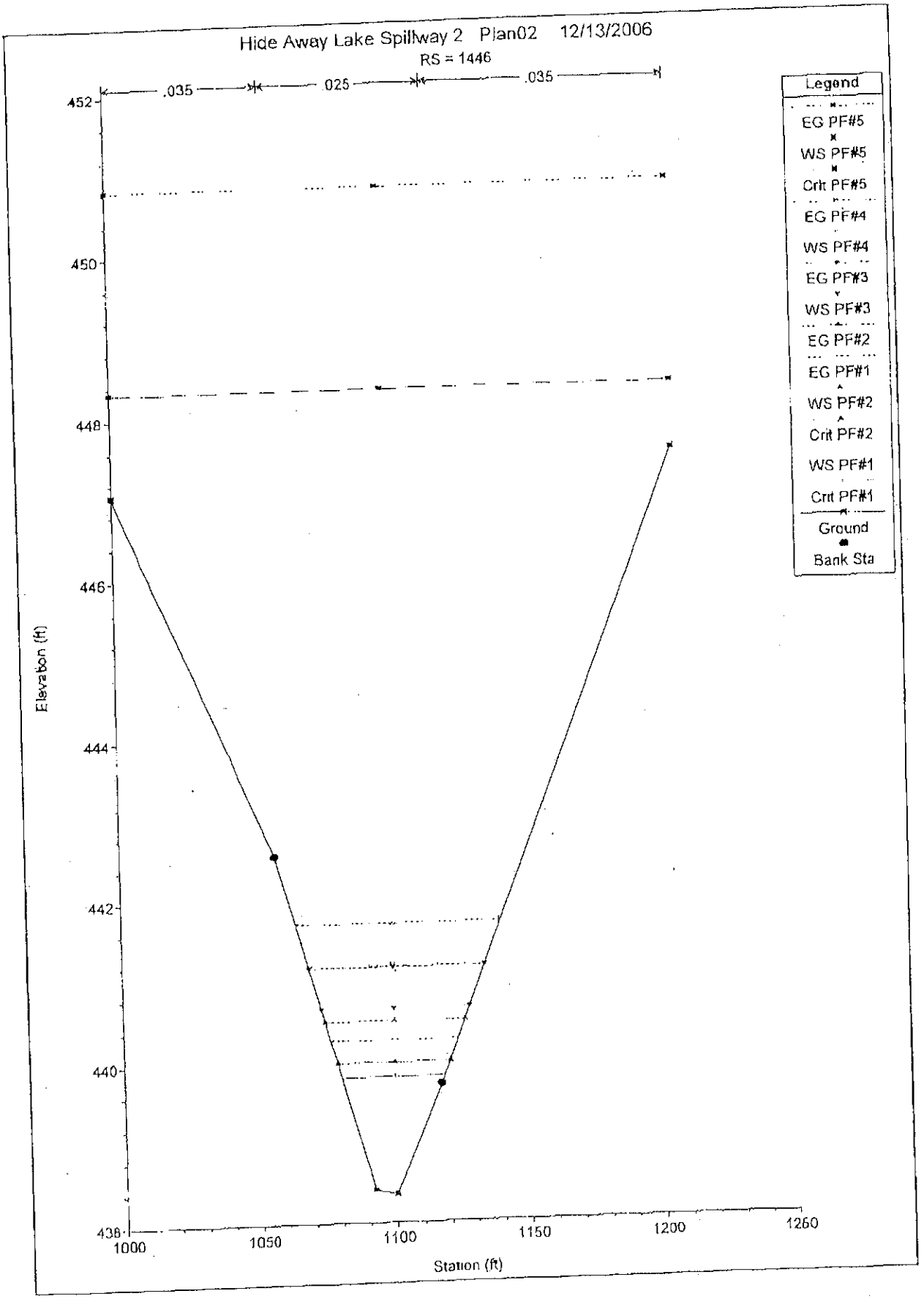
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
458
454
452
450
448
446
444
442
440
438
1000
1050
1100
1150
1200
1250
Station (ft)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452
450
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Elevation (ft)
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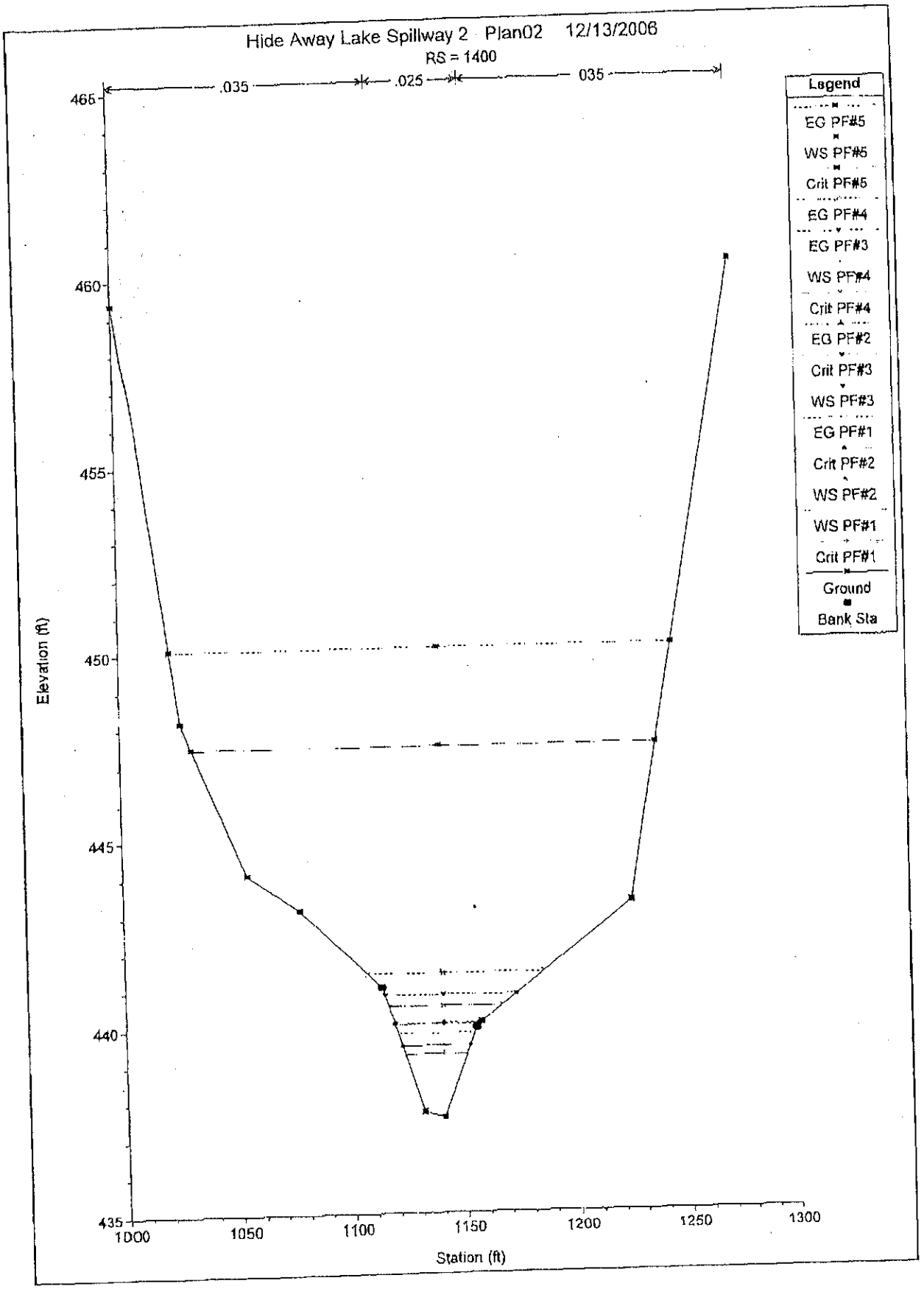
1050
1100
1150
1200
1250
Station (ft)
Legend
EG PF#5
WS PF#5
Crit PF#5
EG PF#4
WS PF#4
EG PF#3
WS PF#3
EG PF#2
EG PF#1
WS PF#2
Crit PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta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Crit PF#5
EG PF#4
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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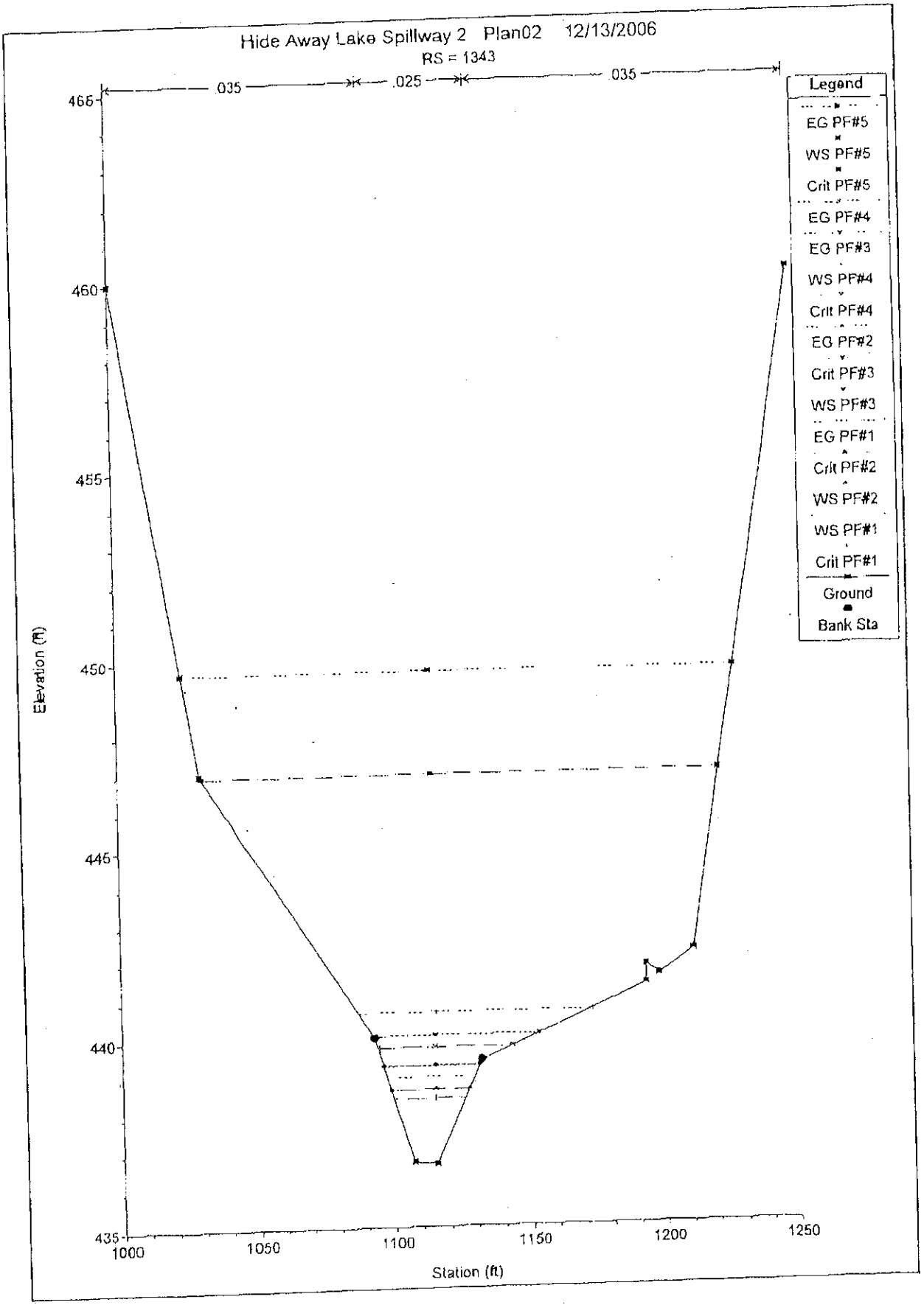
460
455
450
445
440
435
1000
1050
1100
1150
1200
1250
1300
Station (ft)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WS PF#5
Crit PF#5
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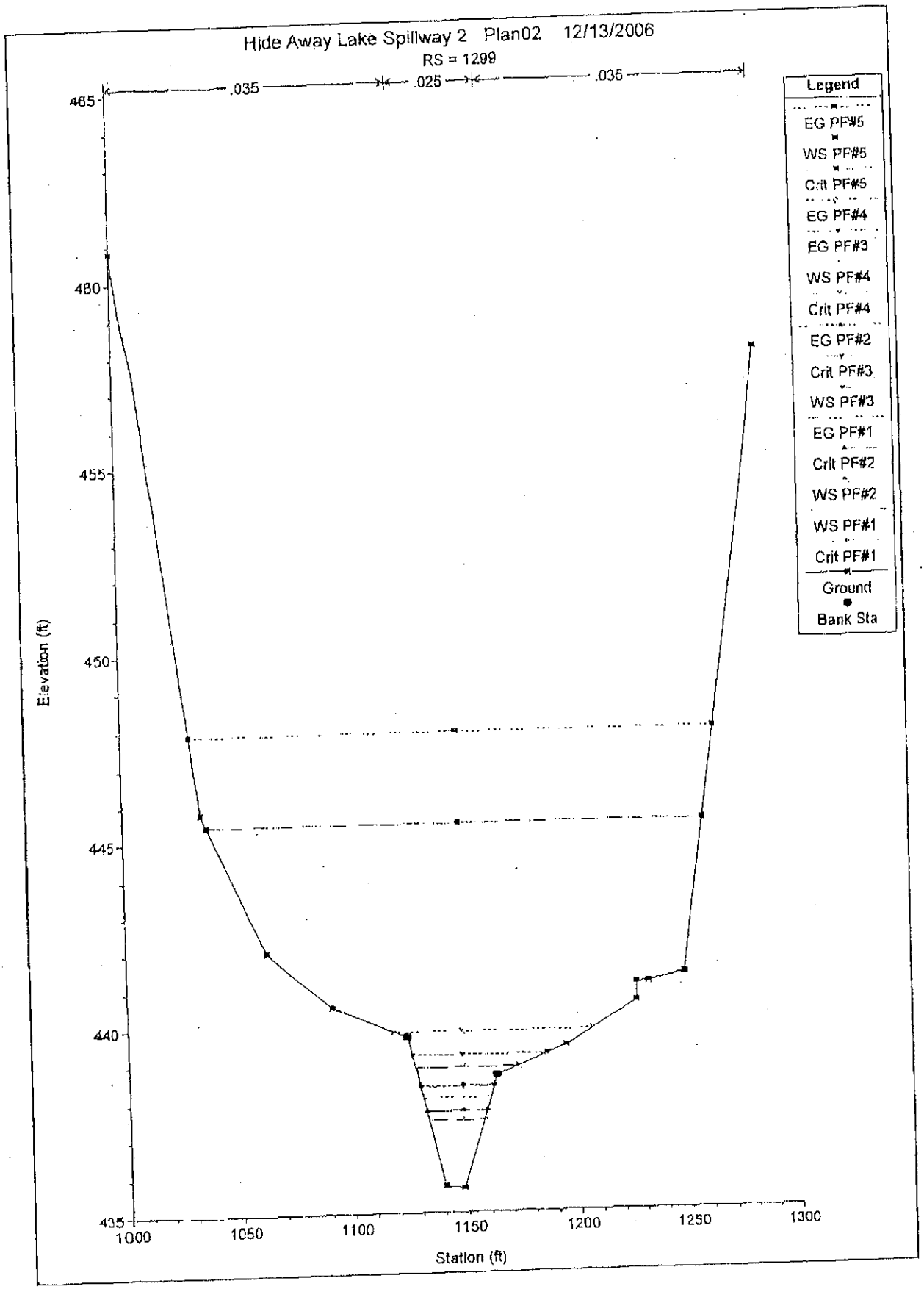
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
465
460
455
450
445
440
435
1000
1050
1100
1150
1200
1250
Station (ft)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EG PF#5
WS PF#5
Crit PF#5
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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460
455
450
445
440
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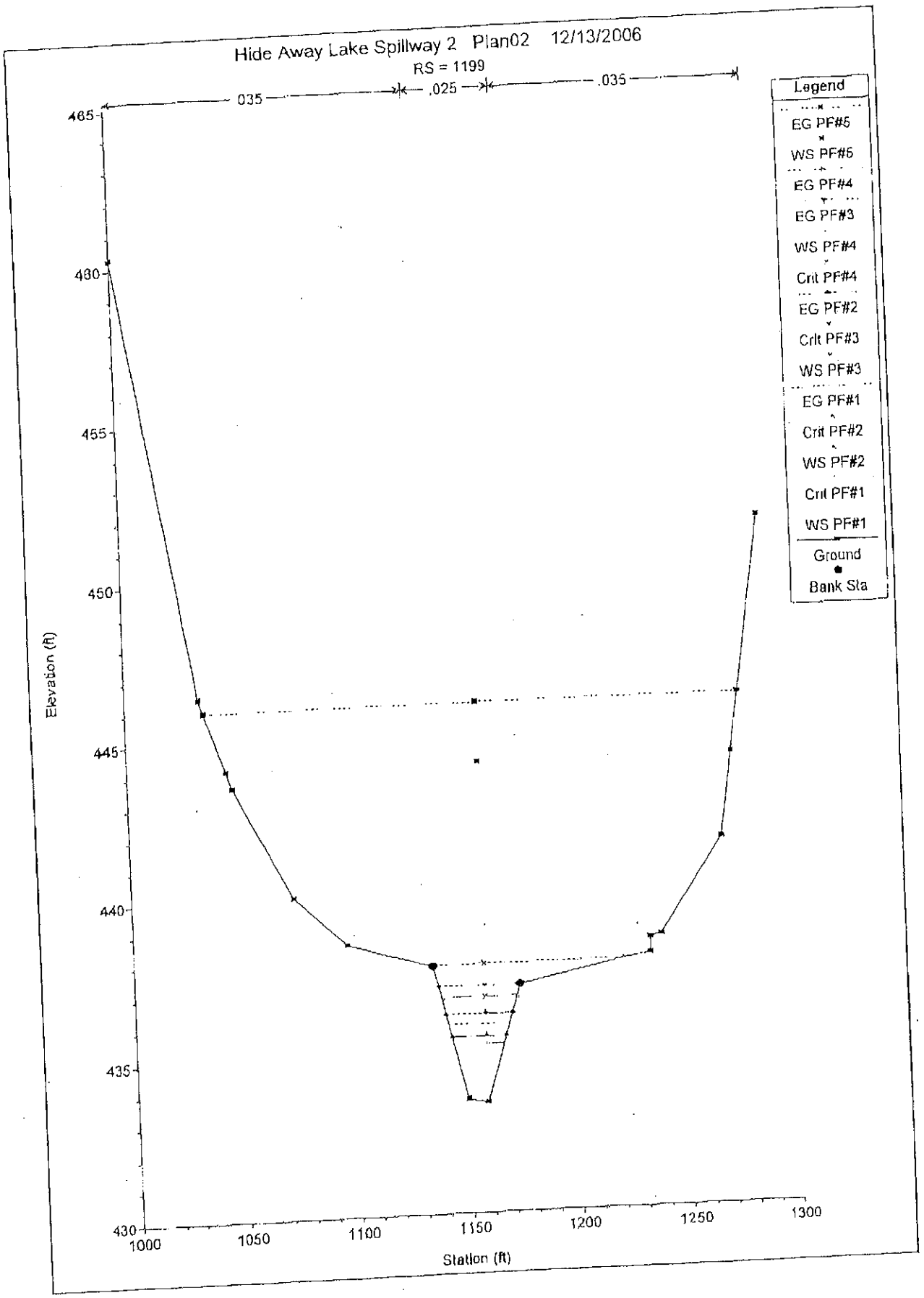
1000
1050
1100
1150
1200
1250
1300
Station (ft)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Legend
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WS PF#5
EG PF#4
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
Crit PF#1
WS PF#1
Ground
Bank Sta
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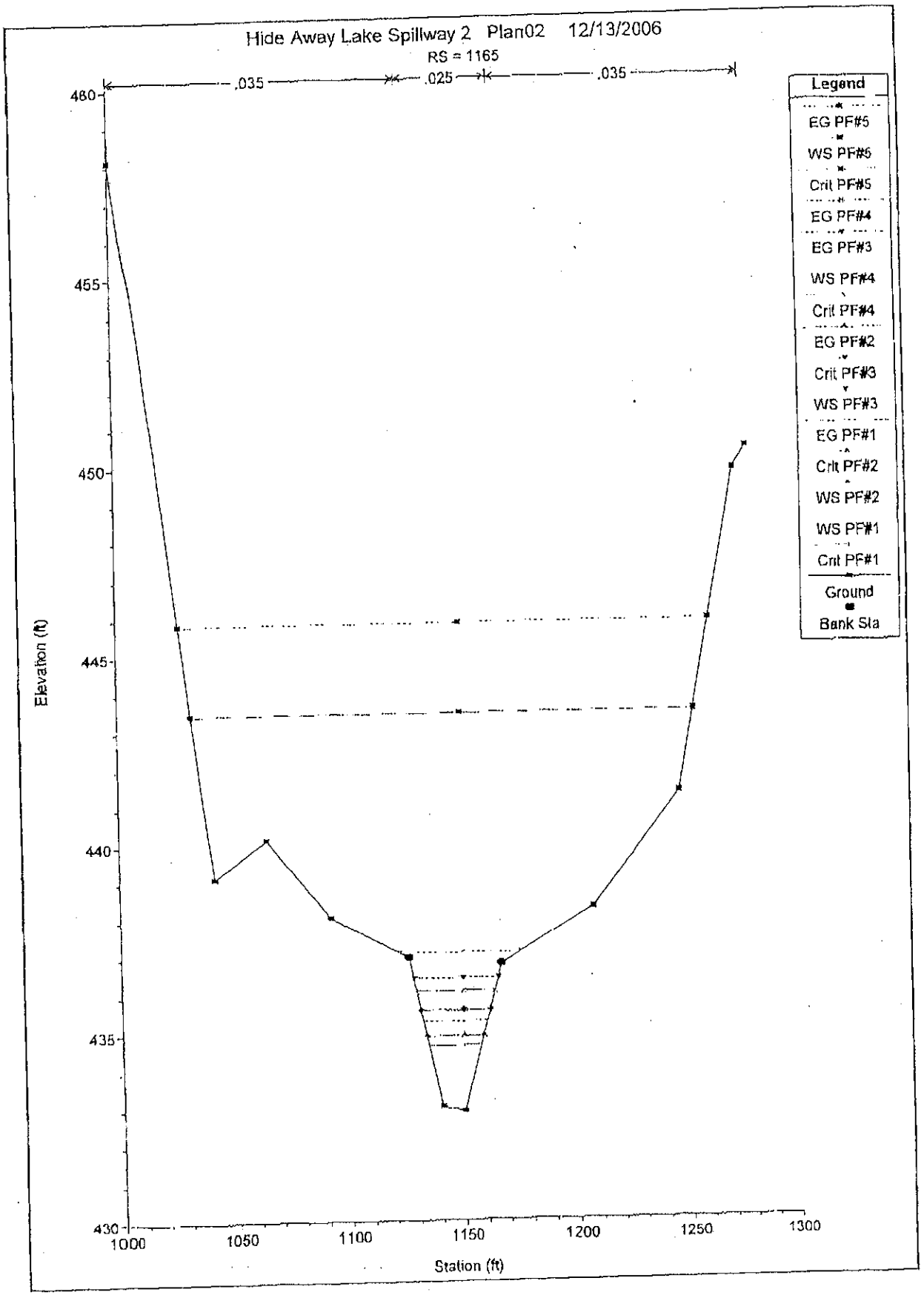
1050
1100
1150
1200
1250
1300
Station (ft)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WS PF#5
Crit PF#5
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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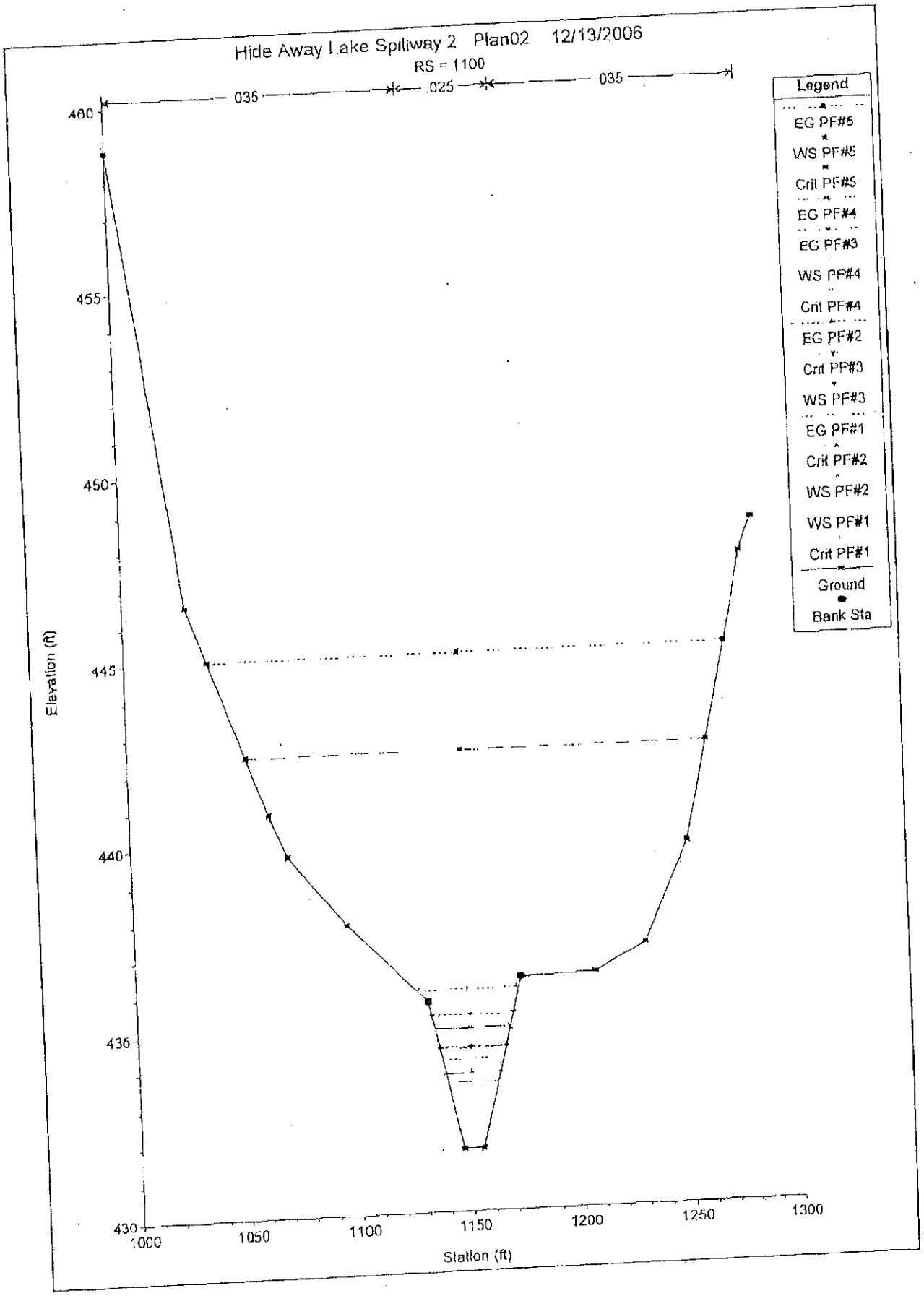
465
450
445
440
435
430
1000
1050
1100
1150
1200
1250
1300
Station (ft)


Hide Away Lake Spillway 2 Plan02 12/13/2006
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025
035
Legend
EG PF#5
WS PF#5
Crit PF#5
EG PF#4
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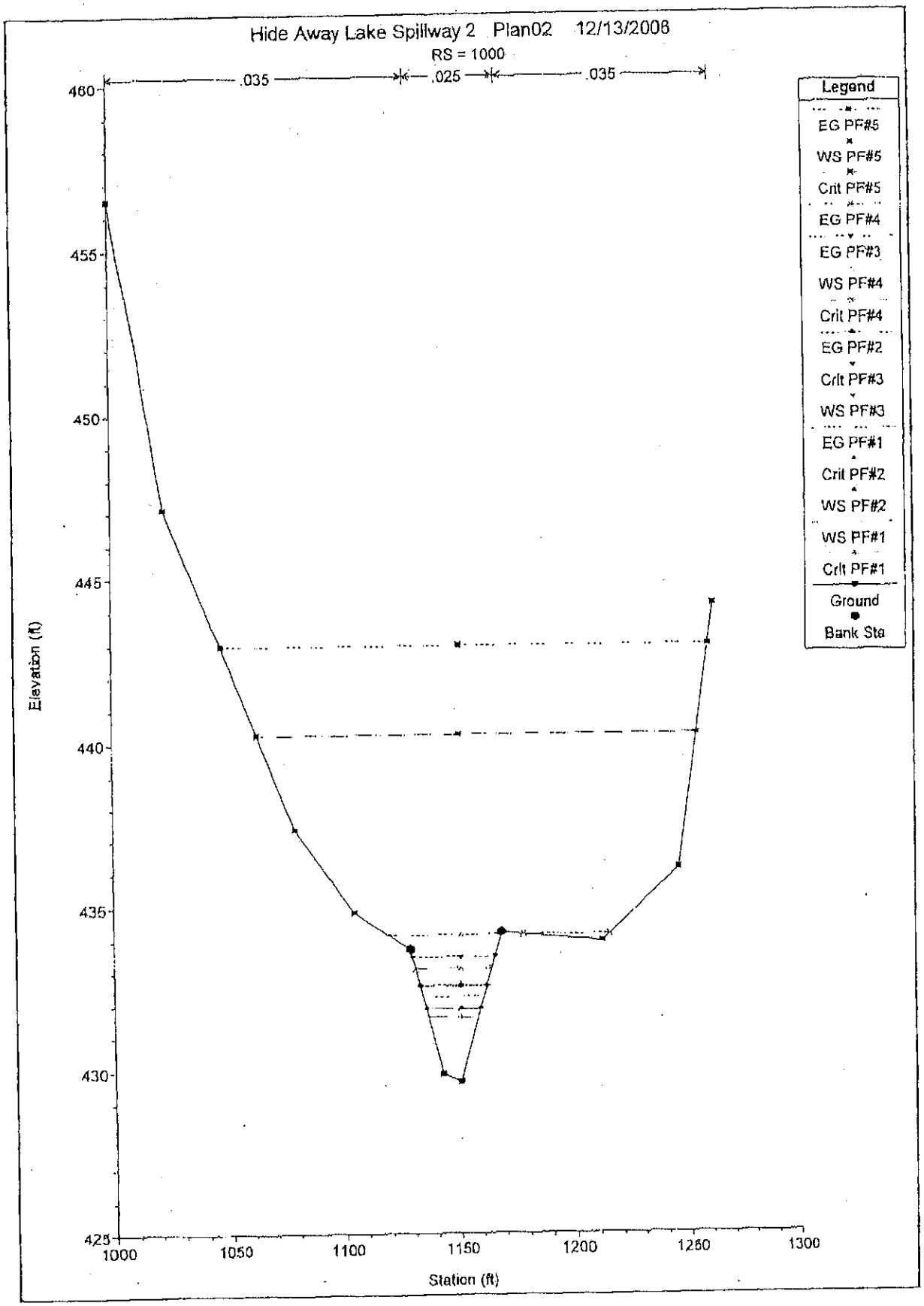
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
460
455
450
445
440
436
430
1000
1050
1100
1150
1200
1250
1300
Station (ft)


Hide Away Lake Spillway 2 Plan02 12/13/2008
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.025
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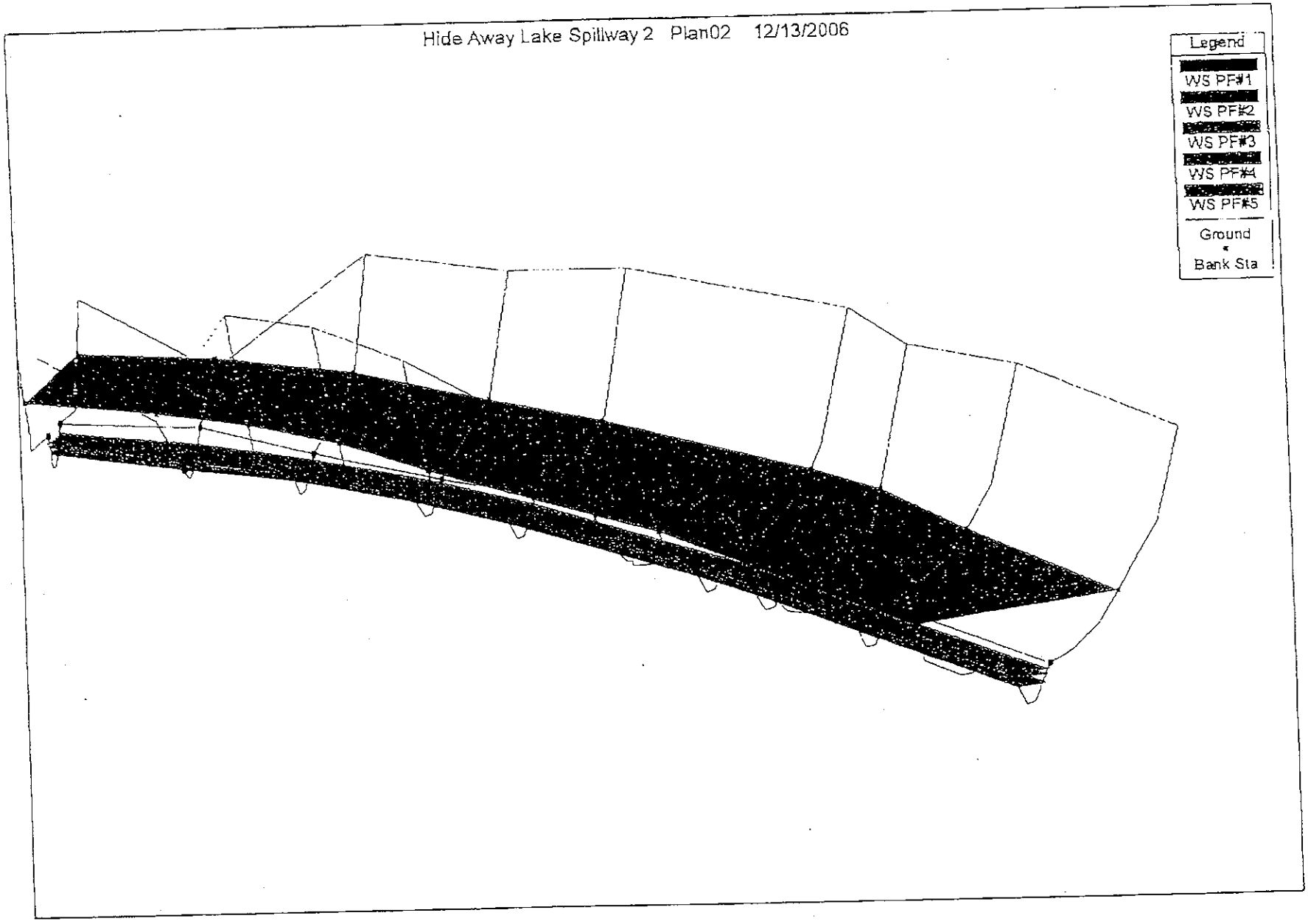
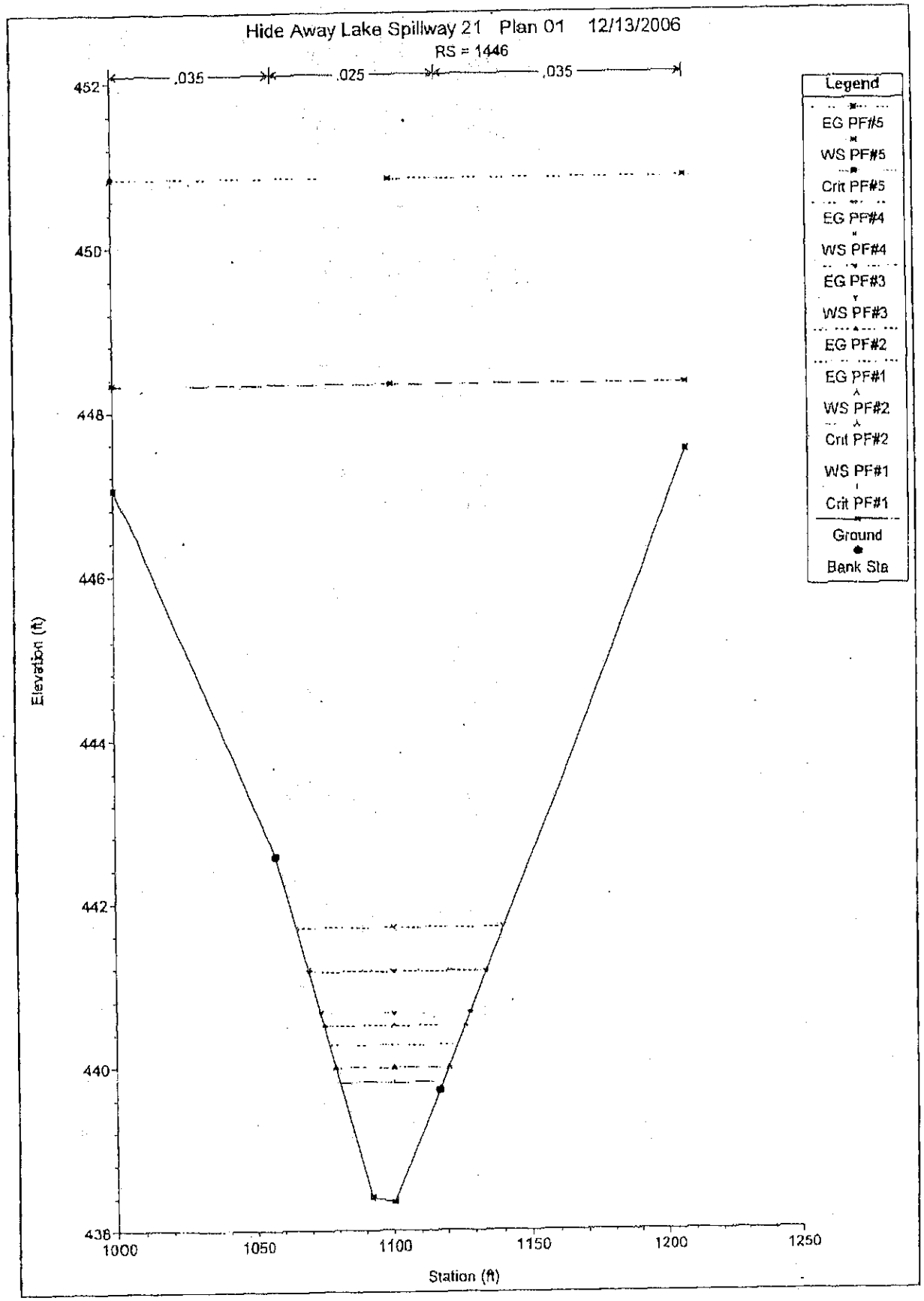
Legend
EG PF#5
WS PF#5
Crit PF#5
EG PF#4
EG PF#3
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
460
455
450
445
440
435
430
425
1000
1050
1100
1150
1200
1250
1300
Station (ft)


Hide Away Lake Spillway 2 Plan02 12/13/2006
Legend
WS PF#1
WS PF#2
WS PF#3
WS PF#4
WS PF#5
Ground
Bank Sta

HEC-RAS Plan: Plan 01 River: Hide-Away Spillw Reach: spillway1

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	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/s)	(sq ft)	(ft)	
spillway1	1498	179.88	439.04	440.76	440.76	441.37	0.008931	6.22	28.92	24.44	1.01
spillway1	1499	229.14	439.04	441.00	441.00	441.67	0.008648	6.57	34.86	26.44	1.01
spillway1	1499	398.22	439.04	441.64	441.64	442.50	0.008006	7.42	53.67	31.98	1.01
spillway1	1499	569.25	439.04	442.17	442.17	443.15	0.007472	7.95	71.60	36.48	1.00
spillway1	1499	11922.90	439.04	448.66	448.66	451.43	0.005076	16.78	1042.26	183.14	1.04
spillway1	1446	179.88	438.35	439.81	439.81	440.27	0.009812	5.42	33.25	38.13	1.01
spillway1	1446	229.14	438.35	439.99	439.98	440.50	0.008833	5.72	40.43	41.72	0.99
spillway1	1446	398.22	438.35	440.65		441.16	0.005375	5.77	72.53	54.97	0.82
spillway1	1446	569.25	438.35	441.18		441.70	0.004237	5.90	104.26	65.48	0.76
spillway1	1446	11922.90	438.35	448.33	448.33	450.84	0.003673	15.00	1138.80	207.00	0.90
spillway1	1400	179.88	437.55	439.25	439.25	439.80	0.009152	5.94	30.29	28.10	1.01
spillway1	1400	229.14	437.55	439.47	439.47	440.08	0.008846	6.26	36.63	30.63	1.01
spillway1	1400	398.22	437.55	440.04	440.04	440.83	0.008166	7.09	56.26	38.17	1.01
spillway1	1400	569.25	437.55	440.53	440.53	441.41	0.006985	7.56	77.82	50.79	0.97
spillway1	1400	11922.90	437.55	448.41		450.27	0.002781	14.08	1314.33	213.44	0.80
spillway1	1343	179.88	436.64	438.40	438.40	438.98	0.009032	6.09	29.56	26.10	1.01
spillway1	1343	229.14	436.64	438.63	438.63	439.27	0.008742	6.41	35.74	28.46	1.01
spillway1	1343	398.22	436.64	439.24	439.24	440.05	0.008117	7.21	55.25	34.88	1.01
spillway1	1343	569.25	436.64	439.75	439.75	440.66	0.007051	7.69	75.69	49.21	0.97
spillway1	1343	11922.90	436.64	447.18	447.18	449.98	0.004196	16.88	1075.97	182.94	0.97
spillway1	1299	179.88	435.64	437.46	437.46	438.06	0.008958	6.25	28.77	24.18	1.01
spillway1	1299	229.14	435.64	437.70	437.70	438.37	0.008587	6.57	34.89	26.35	1.01
spillway1	1299	398.22	435.64	438.35	438.35	439.20	0.007991	7.40	53.84	32.19	1.01
spillway1	1299	569.25	435.64	438.87	438.87	439.84	0.007126	7.90	73.13	45.57	0.98
spillway1	1299	11922.90	435.64	445.59	445.59	448.23	0.004704	16.79	1097.48	196.68	1.01
spillway1	1199	179.88	433.45	435.28	435.28	435.91	0.008665	6.37	28.25	22.63	1.01
spillway1	1199	229.14	433.45	435.53	435.53	436.23	0.008574	6.72	34.09	24.74	1.01
spillway1	1199	398.22	433.45	436.20	436.20	437.09	0.007937	7.58	52.53	29.98	1.01
spillway1	1199	569.25	433.45	436.74	436.74	437.77	0.007529	8.17	69.69	34.14	1.01
spillway1	1199	11922.90	433.45	443.62	443.62	446.32	0.004743	16.92	1083.04	191.14	1.02

Reach	River Sta	Q Total	Min Ch El	W.S. Elev	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/s)	(sq ft)	(ft)	
spillway1	1165	179.88	432.88	434.64	434.64	435.26	0.008829	6.29	28.59	23.49	1.00
spillway1	1165	229.14	432.88	434.88	434.89	435.57	0.008524	6.64	34.48	25.39	1.00
spillway1	1165	398.22	432.88	435.55	435.55	436.42	0.007880	7.50	53.06	30.62	1.00
spillway1	1165	569.25	432.88	436.07	436.07	437.09	0.007573	8.13	69.99	34.71	1.01
spillway1	1165	11922.90	432.88	443.43	443.43	445.84	0.004007	16.03	1187.47	220.89	0.94
spillway1	1100	179.88	431.68	433.46	433.46	434.09	0.008846	6.38	28.21	22.69	1.01
spillway1	1100	229.14	431.68	433.71	433.71	434.41	0.008548	6.73	34.04	24.59	1.01
spillway1	1100	398.22	431.68	434.38	434.38	435.28	0.007922	7.59	52.44	29.80	1.01
spillway1	1100	569.25	431.68	434.92	434.92	435.96	0.007545	8.19	69.47	33.91	1.01
spillway1	1100	11922.90	431.68	442.42	442.42	445.03	0.004185	16.41	1130.93	206.50	0.96
spillway1	1000	179.88	429.63	431.60	431.60	432.24	0.008814	6.43	27.98	22.14	1.01
spillway1	1000	229.14	429.63	431.85	431.85	432.56	0.008534	6.78	33.78	24.06	1.01
spillway1	1000	398.22	429.63	432.53	432.53	433.44	0.007925	7.64	52.11	29.29	1.01
spillway1	1000	569.25	429.63	433.08	433.08	434.13	0.007510	8.22	69.22	33.45	1.01
spillway1	1000	11922.90	429.63	440.22	440.22	442.92	0.004544	16.77	1085.77	191.68	1.00


Hide Away Lake Spillway 21 Plan 01 12/13/2006
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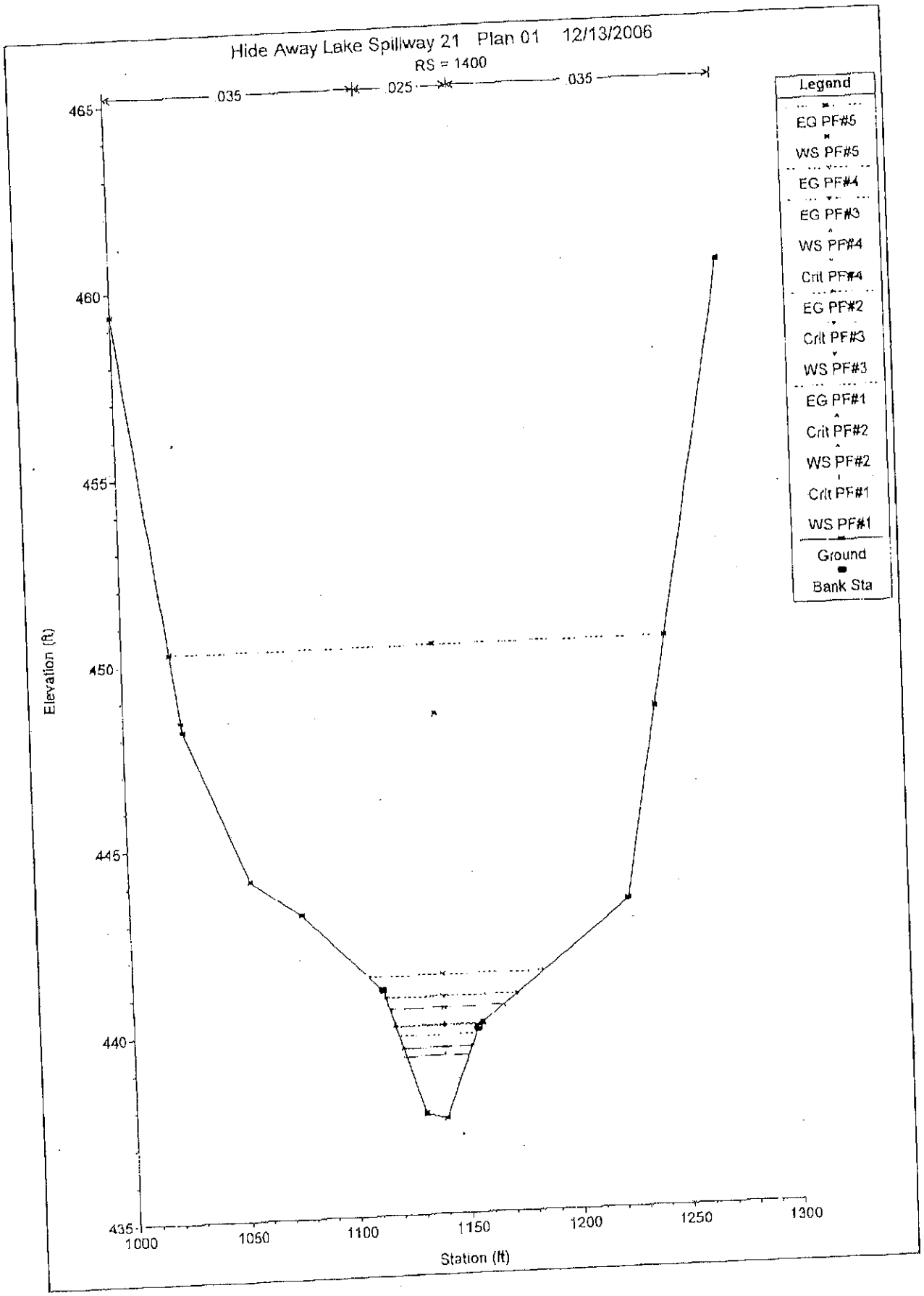
.025
.035
452
450
448
446
444
442
440
438
Elevation (ft)
1000
1050
1100
1150
1200
1250
Station (ft)
Legend
EG PF#5
WS PF#5
Crit PF#5
EG PF#4
WS PF#4
EG PF#3
WS PF#3
EG PF#2
EG PF#1
WS PF#2
Crit PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta


Hide Away Lake Spillway 21 Plan 01 12/13/2006
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025
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Legend
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WS PF#5
EG PF#4
EG PF#3
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
Crit PF#1
WS PF#1
Ground
Bank Sta
Elevation (ft)
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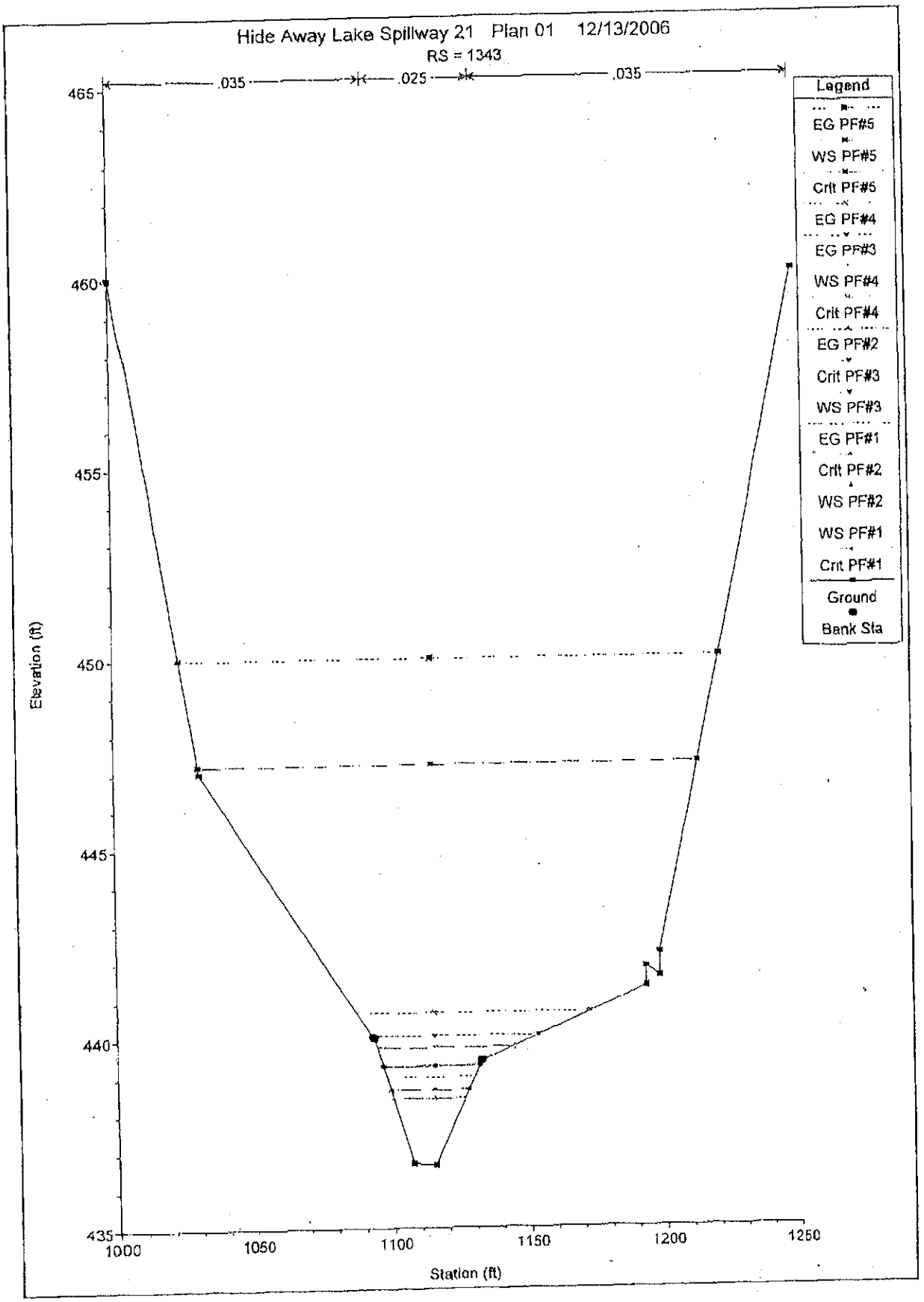
Station (ft)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WS PF#5
Crit PF#5
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Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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1050
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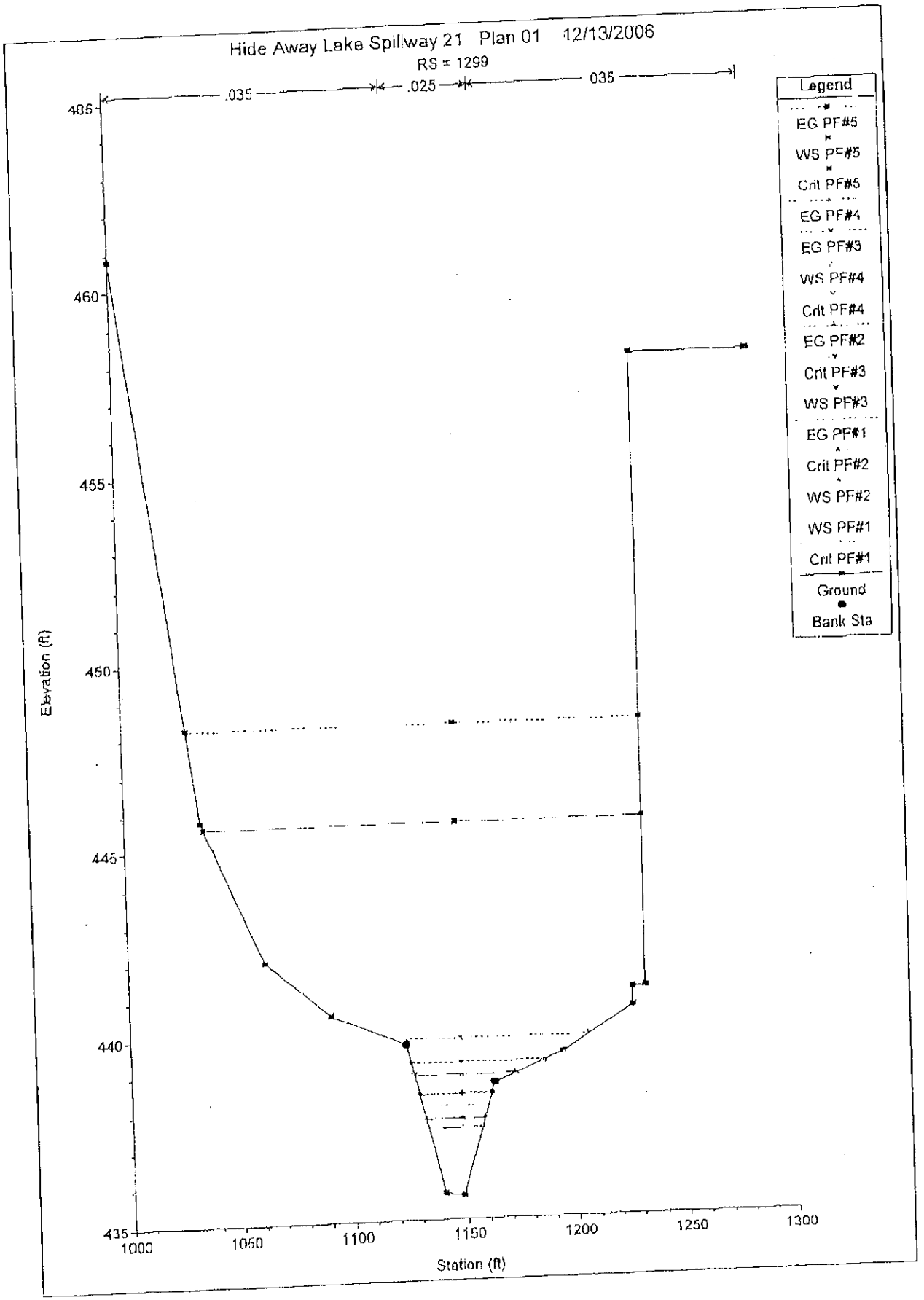
Station (ft)


Hide Away Lake Spillway 21 Plan 01 12/13/2006
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.025
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Legend
EG PF#5
WS PF#5
Crit PF#5
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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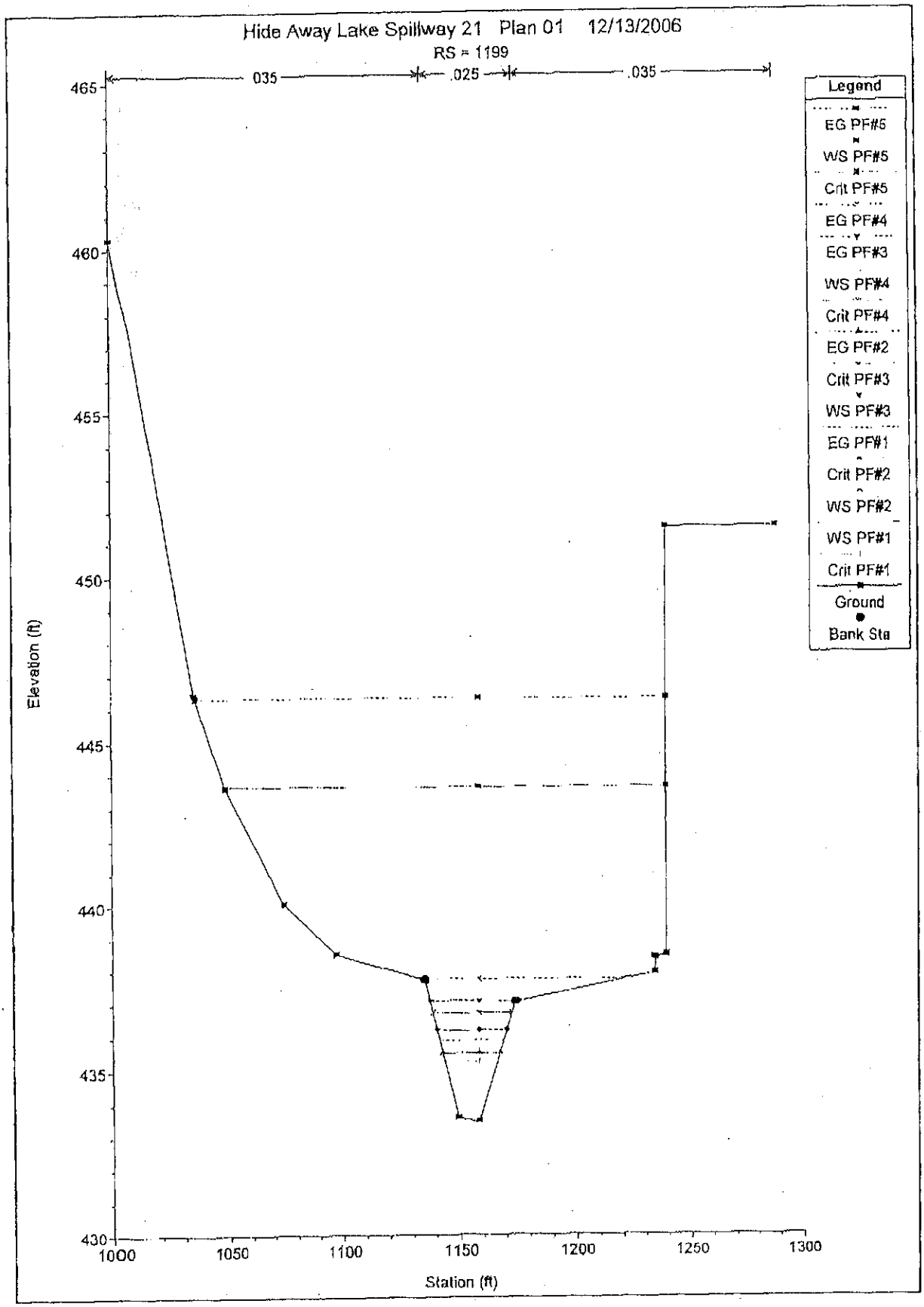
460
455
450
445
440
435
1000
1050
1100
1150
1200
1250
1300
Station (ft)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Legend
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WS PF#5
Crit PF#5
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Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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1100
1150
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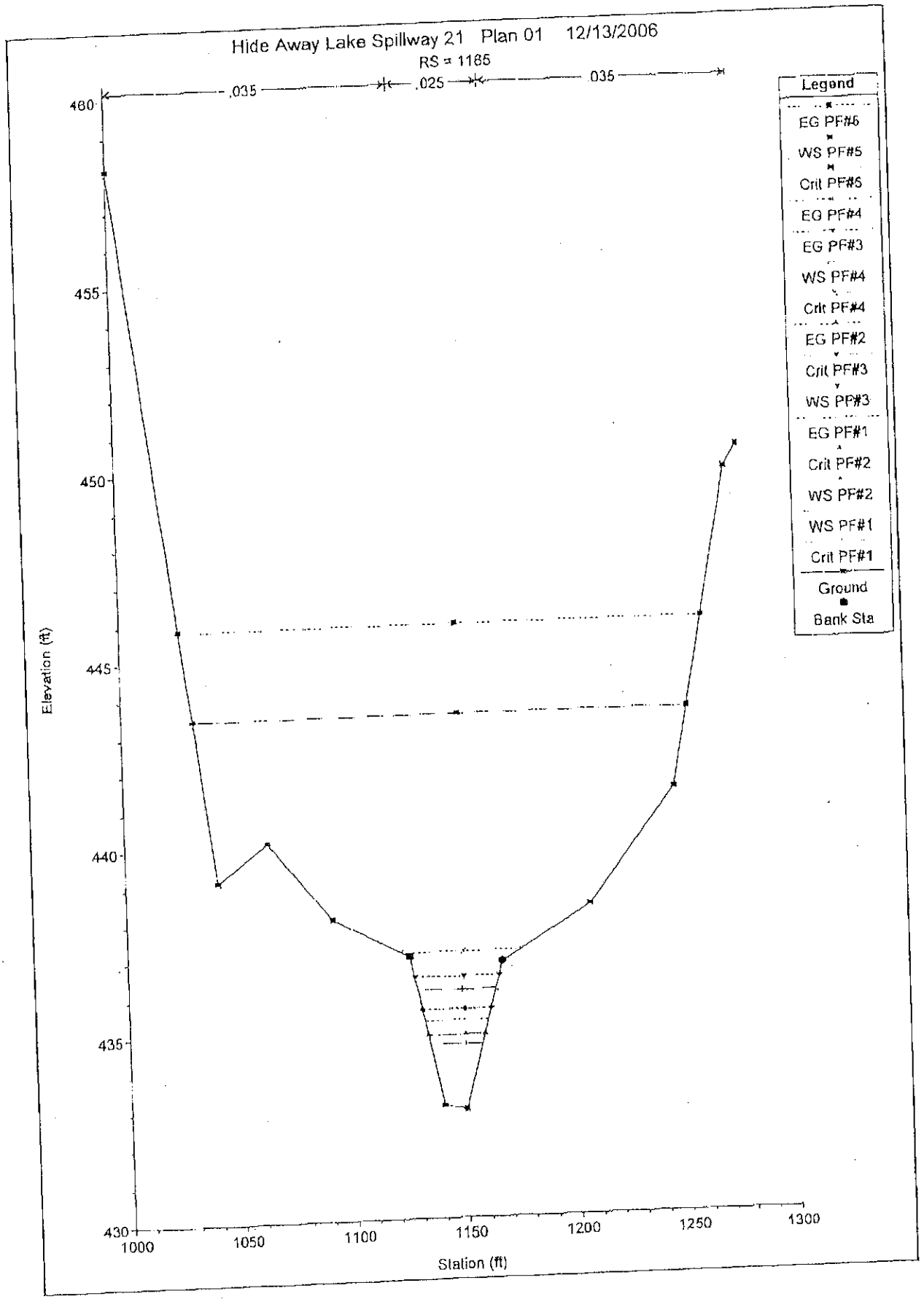
1250
1300
Station (ft)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.025
.035
Legend
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WS PF#6
Crit PF#6
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Crit PF#4
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Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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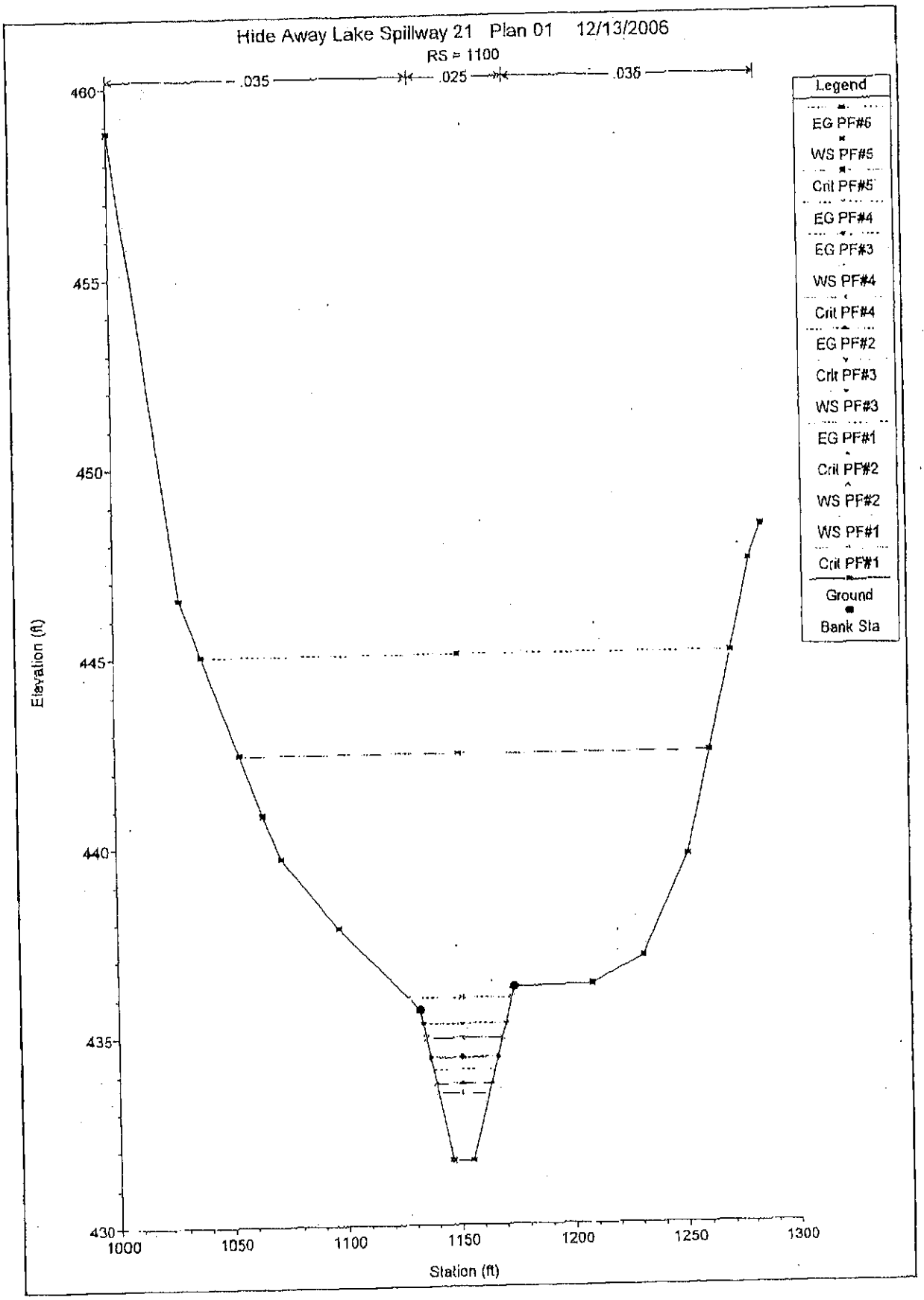
1050
1100
1150
1200
1250
1300
Station (ft)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.025
.035
Legend
EG PF#6
WS PF#6
Crit PF#5
EG PF#4
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WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
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445
440
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1000
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1100
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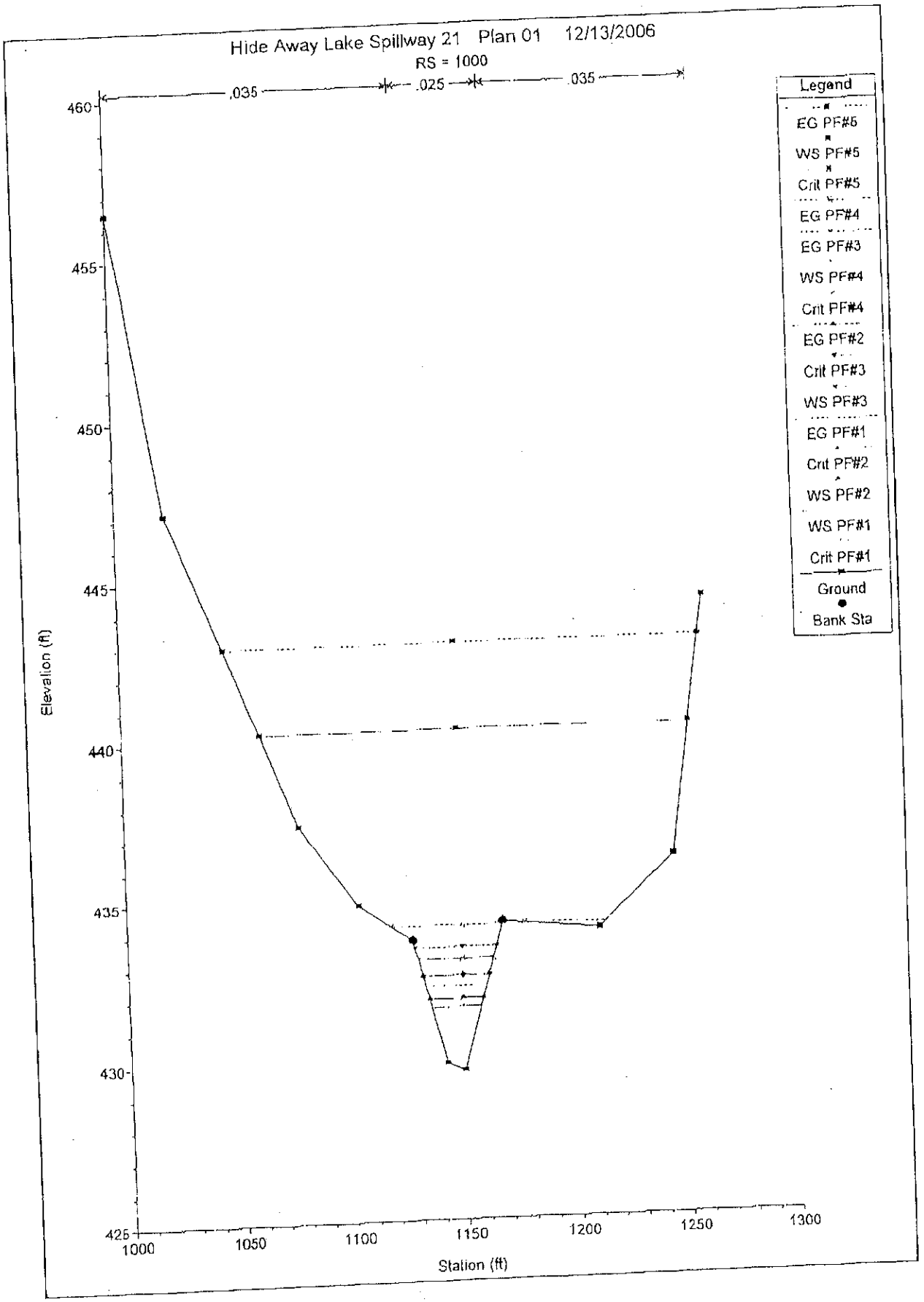
1300
Station (ft)


Hide Away Lake Spillway 21 Plan 01 12/13/2006
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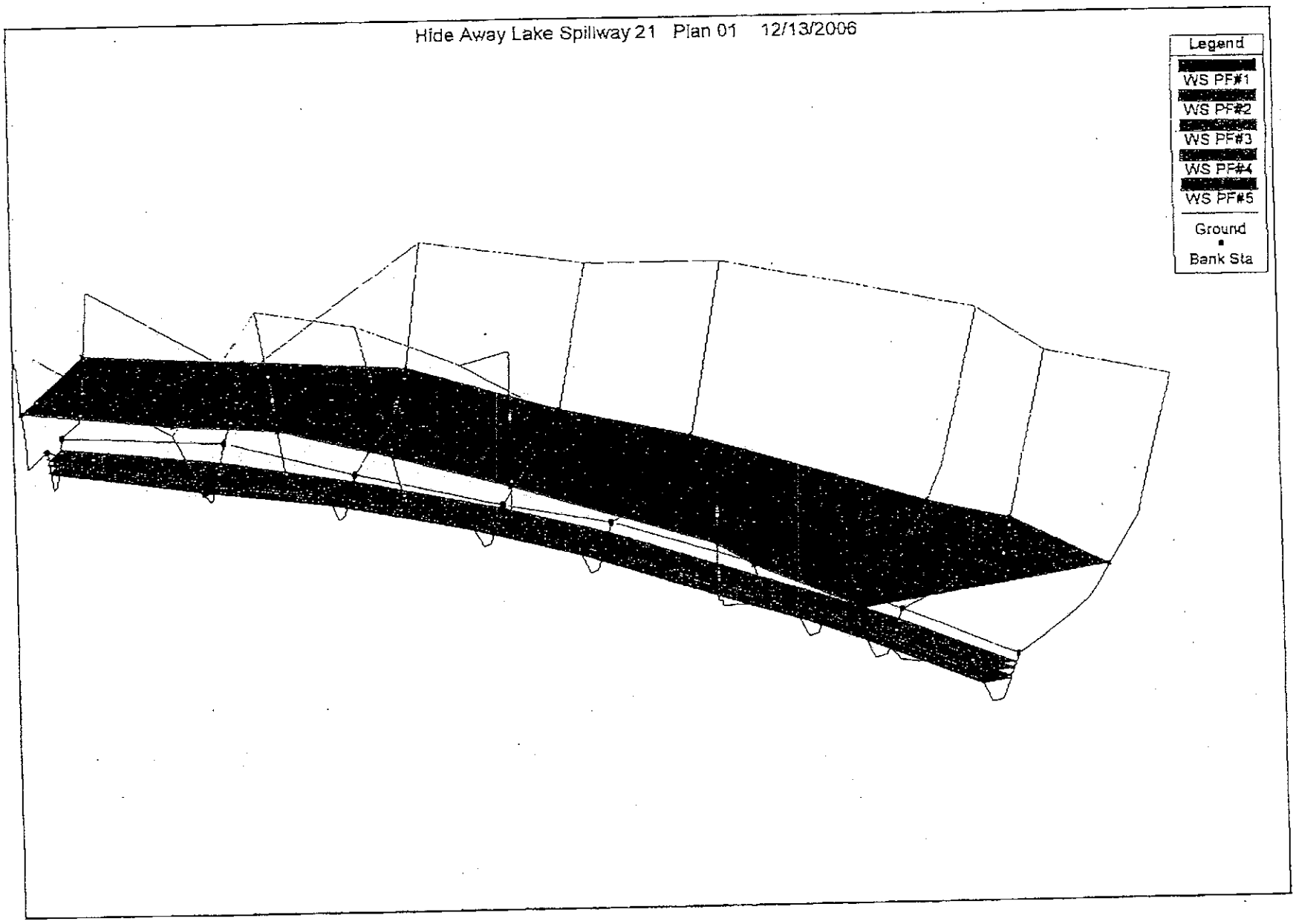
Legend
EG PF#5
WS PF#5
Crit PF#5
EG PF#4
EG PF#3
WS PF#4
Crit PF#4
EG PF#2
Crit PF#3
WS PF#3
EG PF#1
Crit PF#2
WS PF#2
WS PF#1
Crit PF#1
Ground
Bank Sta
Elevation (ft)
460
455
450
445
440
435
430
425
1000
1050
1100
1150
1200
1250
1300
Station (ft)


Hide Away Lake Spillway 21 Plan 01 12/13/2006
Legend
WS PF#1
WS PF#2
WS PF#3
WS PF#4
WS PF#5
Ground
Bank Sta