Illinois State Water Survey
HYDROLOGY DIVISION

SWS Contract Report 511

CHANNEL STABILIZING STRUCTURES FOR THE UPPER CACHE RIVER

by
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Office ***of*** *Sediment &* ***Wetland Studies***

Prepared for the
Illinois Department of Conservation

Champaign, Illinois
July 1991

Illinois Department of Energy and Natural Resources

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INTRODUCTION

This report is a summary of the most recent analysis performed by the Illinois State Water Survey conceming grade stabilizing structures in the Upper Cache River. A similar analysis was initially performed based on old survey data, and recommendations were made in Water Survey Contract Report 485, *Cache River Basin: Hydrology, Hydraulics, and Sediment Transport, Vol. 2: Mathematical Modeling* (Demissie et al., 1990). The analysis reported here was required because of the availability of new survey data and further discussions with Illinois Department of Conservation (IDOC) personnel on the locations and adequacy of the structure recommended in the previous report.

BACKGROUND

The nature of the problem in the Upper Cache River - Post Creek Cutoff and the need for Channel stabilizing structures can be summarized as follows: The main source of the problem for Heron Pond and the Little Black Slough wetland area is the entrenchment of the Cache River stream Channel, which started with the construction of the Post Creek Cutoff in 1905. The construction of the cutoff initiated a stream entrenchment process that has resulted in one of the deepest gorges in Illinois. The upstream progression of the streambed entrenchment into the Upper Cache River has resulted in serious problems for the wetlands and ponds along that stream. As the low-water level in the stream drops, the hydraulic gradient between the ponds and wetlands and the stream increases. The increase in the hydraulic. gradient results in increased seepage and drainage from the ponds and wetlands towards the stream Channel. The increased seepage and drainage change the hydrologic balance required to maintain the ponds and wetlands in their natural states.

Another problem associated with stream Channel entrenchment is the formation of lateral guilies with respect to the main Channel. As the Channel bed is lowered, the drainage system towards the stream is also altered, resulting in very deep gullies in a lateral direction from the main Channel. The formation of diese lateral gullies erodes very important and valuable areas and also increases the drainage from the ponds and wetlands.

The problems along the Post Creek Cutoff and the Upper Cache River are identified as increased drainage from ponds and wetlands and the formation of lateral gullies. One method of dealing with these problems is to control the channel entrenchment process. This can be accomplished by installing grade stabilizing channel weirs along the river.

The recommendation in Water Survey Report 485 was to construct a new weir or repair the existing weir at the Old Forman Gaging Station site. However, it was also pointed out that one weir alone would not re-establish a pre-Post Creek Cutoff profile along the Upper Cache River.

Further discussion with IDOC staff was conducted concerning the locations of possible weirs and their sizes. IDOC staff wanted to have weirs that will eventually re-establish the pre-Post Creek Cutoff channel profile. After that discussion it was collectively decided that two structures would be better than one for the purpose of re-establishing the old profile. Furthermore, IDOC staff recommended two sites for the structures, one located upstream of the Belknap Road bridge and another near Heron Pond, just downstream of the junction of Dutchman Creek with the Cache River. At the same time, it was also decided to conduct a new survey of the area from the Belknap Road bridge to Heron Pond.

The engineering design and construction award for the weirs went to Southern Engineering Corporation. That firm conducted its own survey at the two locations and prepared preliminary designs for the two structures. The survey data of Southern Engineering Corporation did not match the surveys that has been conducted by the Soil Conservation Service (SCS) in 1972, which raised some concern about the height of the structures. Thus, a more detailed survey was required, with the whole area referenced to a consistent benchmark. IDOC awarded this surveying contract to J.H. Bass & Associates. The Water Survey received the results of the survey in March 1991 (J.H. Bass & Assoc, 1991).

The current analysis is based on the results of the new survey conducted by J.H. Bass & Associates. Because of the significant difference between the old data and the new data and also because of the different locations selected for the structures, all of the Water Survey's HEC-6 simulations had to be rerun.

RESULTS OF ANALYSIS BASED ON HEC-6 SIMULATIONS

The present analyses include the following components:

1) Comparison of J.H. Bass & Associates 1991 survey and SCS 1972 survey
2) Evaluation of weir heights and locations
3) Evaluation of the weirs' impact on channel scour and aggradation
4) Evaluation of the weirs' impact on the 100-year flood elevation
5) Evaluation of the weirs' impact on low-flow levels

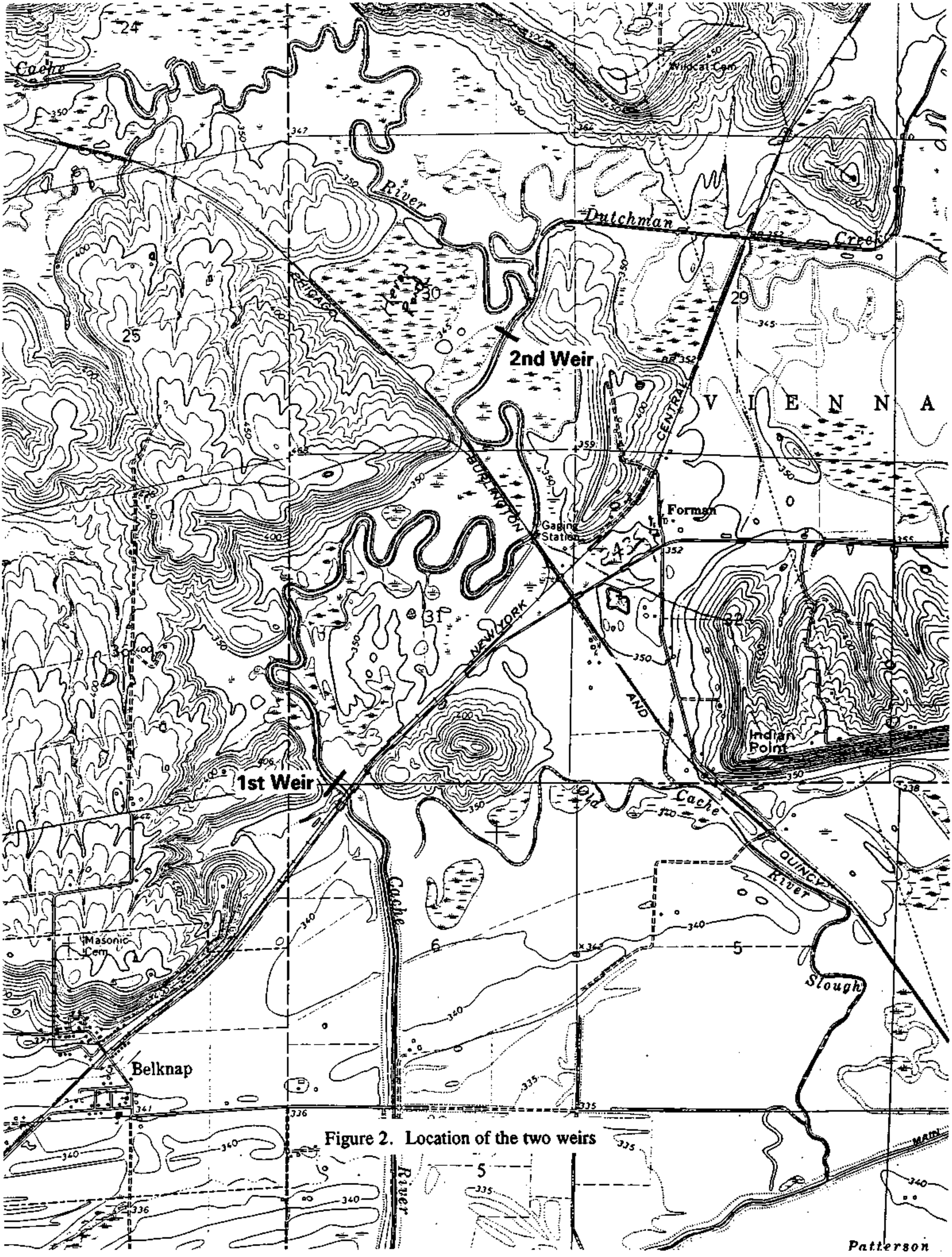


Figure 2. Location of the two weirs

Once the location of the weirs was decided, the next question to be answered was the size of the structures. To answer these questions, several different combinations of weir heights were considered, as well as their effectiveness on scour protection and their potential to increase flooding. Weir heights from 5 to 10 feet were considered. The various options are given in table 1, and their relative heights with respect to the channel cross sections are shown in figure 3.

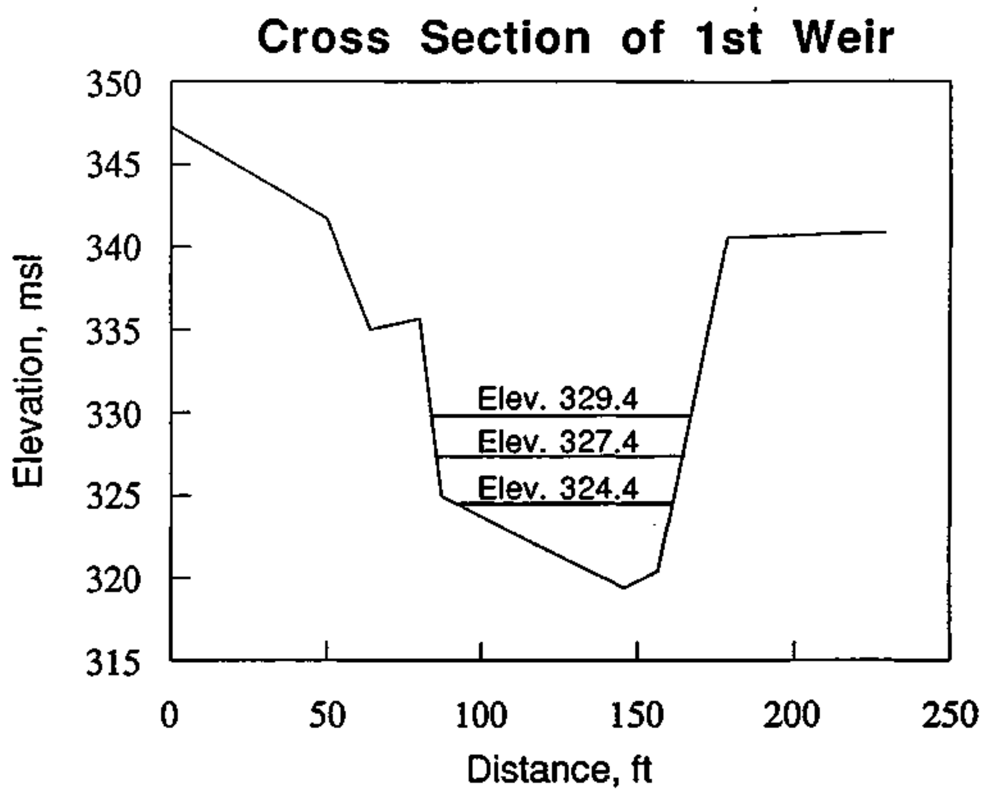
Table 1. Combination of Weir Heights Analyzed Using HEC-6 Simulations

Option	*Height of weir #;* *(feet)*	*Height of weir if #2* *(feet)*
1	10	**8**
2	10	5
3	8	**8**
4	8	5
5	5	5
6 (no weir)	0	**0**

Evaluation of the Weirs' Impact on Channel Scour Aggradation

The impact of the weirs on channel scour and aggradation is of course the most important consideration, since they are being constructed to stabilize a degrading stream channel. The influence of the weirs on long-term channel scour or channel aggradation was evaluated by using a 5-year (1981 to 1986) flow hydrograph. The details of the hydraulic modeling, including all the input data, are found in the initial report (Demissie et al., 1990).

The results of the HEC-6 simulations for the no-weir conditions and the different weir height combinations are summarized in table 2 and compared in figure 4. The results show that all the weir combinations are better than the no-weir condition. All of them either create channel aggradation or reduce the scour rate to some extent. For the downstream weir, the 10-foot height performs better than the others because it creates channel aggradation for the whole reach from weir #1 to weir #2, except for a small segment just downstream of the second weir. For some of the lower channel bed segments, the aggradation reaches 4 to 5 feet. The most important factor, however, is that channel scour will be eliminated for most of the reach from weir #1 to weir #2.



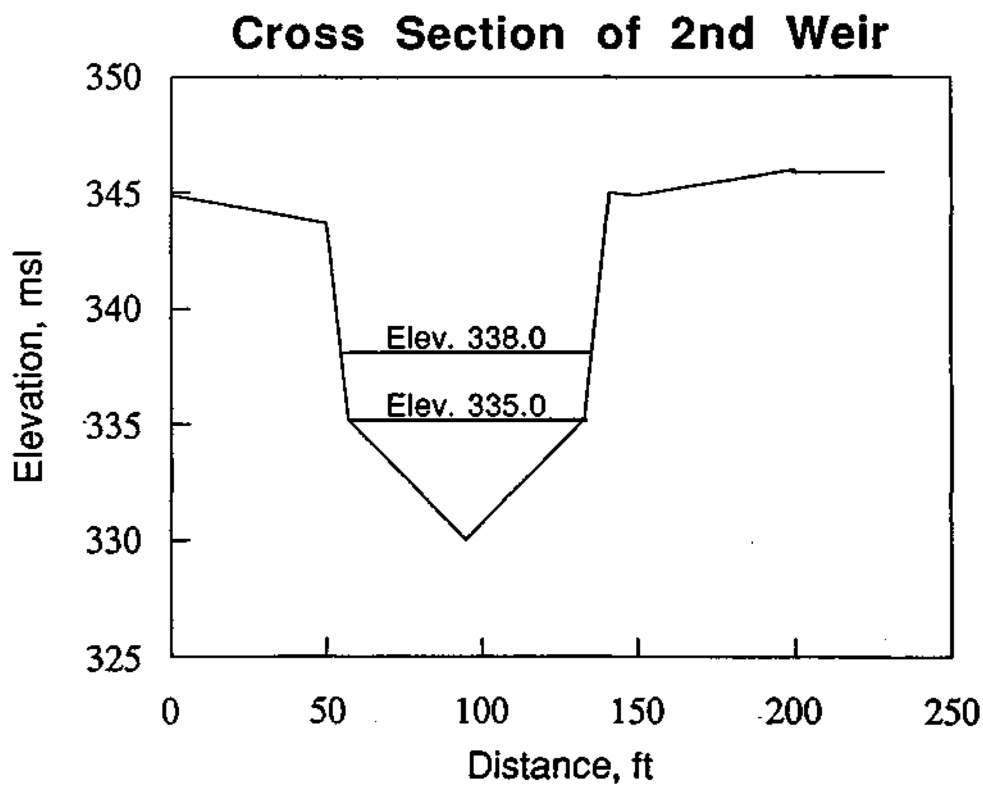


Figure 3. Relative heights of weirs evaluated

Table 2. Channel Scour/Aggradation for 5-Year Flow Hydrograph

Distance from downstream (mile)	Chanrtel bed elevation (msl)						Scour/aggragation (ft)					
	No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft	No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft
0.00	288.8	288.6	288.1	288.3	288.1	288.0	0.03	-0.19	-0.66	-0.50	-0.69	-0.76
0.02	291.3	291.3	291.3	291.3	291.3	291.3	-0.72	-0.72	-0.72	-0.72	-0.72	-0.72
0.61	293.0	293.2	293.1	293.1	292.9	292.9	0.30	0.53	0.42	0.37	0.21	0.20
0.76	290.5	290.5	290.4	290.4	290.4	290.4	-2.92	-2.95	-2.96	-2.96	-2.97	-2.97
0.78	304.0	304.0	304.0	304.0	304.0	304.0	0.00	0.00	0.00	0.00	0.00	0.00
0.80	299.4	299.2	299.0	299.1	299.0	298.9	0.85	0.70	0.48	0.56	0.49	0.36
1.50	302.3	302.3	302.1	302.2	302.0	301.9	1.33	1.29	1.13	1.15	1.01	0.94
2.07	304.3	304.0	303.7	303.8	303.7	303.6	1.78	1.46	1.23	1.30	1.21	1.13
2.69	304.0	303.9	303.9	303.9	303.9	303.9	0.17	0.12	0.11	0.12	0.11	0.10
3.45	305.7	305.7	305.7	305.7	305.7	305.7	0.08	0.08	0.07	0.07	0.07	0.07
4.20	307.4	307.4	307.4	307.4	307.4	307.4	0.05	0.06	0.06	0.06	0.06	0.06
4.38	307.8	307.7	307.7	307.7	307.7	307.7	0.39	0.32	0.32	0.32	0.33	0.32
4.62	308.0	308.0	308.0	308.0	308.0	308.0	0.44	0.44	0.41	0.40	0.40	0.40
4.66	308.7	308.6	308.8	308.6	308.7	308.5	0.69	0.62	0.77	0.63	0.69	0.52
4.73	308.1	308.1	308.1	308.0	308.1	308.0	-0.09	-0.15	-0.09	-0.16	-0.11	-0.18
5.63	310.0	310.0	309.9	310.0	309.9	310.0	0.02	-0.03	-0.06	-0.03	-0.07	-0.02
6.95	312.6	312.6	312.6	312.6	312.6	312.6	-0.27	-0.27	-0.29	-0.27	-0.28	-0.27
7.56	314.0	314.0	314.0	314.0	314.0	313.9	-0.11	-0.14	-0.15	-0.12	-0.15	-0.16
7.95	315.7	315.7	315.7	315.7	315.7	315.7	-1.82	-1.82	-1.82	-1.82	-1.82	-1.82
7.96	315.3	315.5	315.3	315.3	315.4	315.4	-1.16	-1.03	-1.16	-1.22	-1.09	-1.09
8.00	316.0	316.0	316.0	316.0	316.0	316.0	-2.04	-2.04	-2.04	-2.04	-2.04	-2.04
8.02	317.0	317.0	317.0	317.0	317.0	317.0	-1.26	-1.26	-1.26	-1.26	-1.26	-1.26
* 8.04	318.1	324.4	326.4	327.4	329.4	329.4	-1.26	0.01	0.01	0.02	0.01	0.01
8.06	318.5	319.1	320.6	321.7	325.0	324.9	-1.26	-0.68	0.81	1.93	5.23	5.13
8.08	319.9	321.0	321.2	321.6	322.0	321.8	-1.26	-0.16	0.01	0.37	0.80	0.57
8.27	319.1	319.3	319.2	319.6	320.0	319.7	1.29	1.53	1.39	1.78	2.20	1.92
8.42	319.5	320.3	320.8	321.6	323.4	323.1	0.13	0.89	1.35	2.19	3.98	3.67
8.44	320.0	320.5	320.9	321.5	322.8	322.6	0.47	0.95	1.43	1.97	3.27	3.10
8.46	320.5	320.6	320.9	321.5	323.1	322.7	0.68	0.81	1.07	1.68	3.29	2.92
8.53	318.8	319.6	319.6	320.1	321.5	321.2	-0.27	0.50	0.51	1.04	2.42	2.09
8.63	321.0	321.3	321.1	321.4	321.9	321.9	0.53	0.82	0.57	0.86	1.38	1.37
8.82	316.9	317.7	317.5	318.0	318.7	318.7	0.56	1.42	1.22	1.73	2.44	2.41
9.01	319.1	319.3	320.2	321.2	322.1	321.9	-1.05	-0.76	0.14	1.09	2.04	1.82
9.22	324.3	324.4	325.4	326.2	326.7	326.2	-1.26	-1.24	-0.19	0.63	1.10	0.57
9.39	321.1	320.9	321.3	323.0	324.2	323.5	-0.72	-0.87	-0.54	1.21	2.40	1.71
9.61	322.3	322.3	322.6	323.0	325.0	324.5	-1.26	-1.26	-1.05	-0.63	1.39	0.92
9.82	324.9	324.9	325.1	326.5	327.9	327.1	-1.23	-1.21	-1.00	0.38	1.83	0.97
10.09	321.1	321.1	321.4	326.5	328.3	328.1	-1.07	-1.10	-0.76	-0.47	1.34	1.07
10.39	326.3	326.4	326.0	328.8	329.4	327.3	1.11	1.15	0.83	3.58	4.24	2.07
10.52	323.4	323.2	323.1	323.9	326.2	325.9	-0.43	-0.62	-0.66	0.09	2.38	2.07
10.70	325.5	324.6	323.0	326.3	327.1	324.8	2.92	2.00	0.38	3.74	4.49	2.15
10.71	321.3	321.3	321.3	321.7	323.5	323.3	-1.21	-1.21	-1.20	-0.80	1.00	0.81
10.92	326.9	326.8	326.3	328.7	329.8	328.8	-0.52	-0.63	-1.13	1.31	2.38	1.35
11.00	324.2	324.1	324.0	325.0	326.1	325.7	-0.19	-0.32	-0.36	0.55	1.66	1.31

Table 2. Concluded

Distance from downstream (mile)	Channel bed elevation (msl)						Scour/aggragation					
	No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft	No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft
11.17	327.6	327.6	327.6	327.9	328.2	327.8	-1.26	-1.26	-1.26	-1.00	-0.75	-1.14
11.36	328.2	328.2	328.1	328.1	328.9	328.4	-0.47	-0.53	-0.56	-0.59	0.24	-0.31
11.45	325.5	325.4	325.4	325.5	325.8	325.6	-0.29	-0.43	-0.41	-0.30	0.03	-0.21
11.66	328.0	328.0	328.0	328.0	328.1	328.0	-1.16	-1.25	-1.25	-1.25	-1.08	-1.22
11.75	328.5	328.5	328.5	328.5	328.8	328.5	-1.25	-1.25	-1.25	-1.21	-0.93	-1.17
**11.85	329.3	335.0	338.0	335.0	335.0	338.0	-0.74	0.01	0.00	0.00	0.00	0.00
11.89	329.2	331.8	333.5	332.2	332.3	334.2	-1.26	1.25	3.02	1.73	1.75	3.73
11.92	331.1	332.7	334.1	332.3	332.2	334.2	-1.26	0.27	1.68	-0.08	-0.16	1.78
11.94	332.0	333.9	336.7	334.2	334.2	336.8	-1.26	0.63	3.39	0.90	0.91	3.50
11.98	330.6	331.1	332.2	331.9	331.8	332.5	-1.24	-0.66	0.43	0.12	-0.04	0.69
12.03	330.4	330.9	331.5	330.5	330.4	330.9	-0.41	0.07	0.65	-0.35	-0.37	0.10
12.22	330.6	330.9	331.7	331.2	331.3	332.0	-0.56	-0.34	0.45	-0.05	0.10	0.79
12.59	331.6	331.7	332.3	331.7	331.7	332.2	0.10	0.21	0.81	0.18	0.19	0.68
13.71	332.8	333.1	334.1	333.3	333.3	334.2	0.04	0.27	1.30	0.48	0.48	1.39
14.66	334.3	334.3	334.5	334.3	334.3	334.5	-0.32	-0.32	-0.13	-0.32	-0.31	-0.08
15.25	335.7	335.7	336.1	335.7	335.7	336.3	0.22	0.24	0.60	0.22	0.22	0.82
15.81	336.1	336.1	336.1	336.2	336.2	336.2	-0.24	-0.24	-0.23	-0.12	-0.11	-0.09
16.69	337.6	337.6	337.7	337.5	337.5	337.6	-0.22	-0.22	-0.13	-0.27	-0.28	-0.22
17.06	338.2	338.2	338.2	338.2	338.2	338.2	0.08	0.09	0.09	0.09	0.09	0.10
17.71	338.1	338.1	338.1	338.1	338.1	338.1	-0.12	-0.12	-0.11	-0.12	-0.12	-0.11
18.48	340.2	340.2	340.2	340.2	340.2	340.3	-0.01	-0.01	0.04	0.00	0.00	0.05
19.17	341.2	341.2	341.2	341.2	341.2	341.2	0.00	0.00	0.00	0.00	0.00	0.00
20.04	342.6	342.6	342.6	342.5	342.5	342.5	0.05	0.05	0.05	0.04	0.04	0.04
20.32	342.9	342.9	342.9	342.9	342.9	342.9	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
20.93	343.9	343.9	343.9	343.9	343.9	343.9	0.00	0.00	0.00	0.00	0.00	0.00
22.06	346.0	346.0	346.0	345.8	345.8	345.8	0.49	0.49	0.49	0.32	0.32	0.32
22.84	346.3	346.3	346.3	346.3	346.3	346.3	0.00	0.00	0.00	0.00	0.00	0.00
23.20	347.3	347.3	347.3	347.3	347.3	347.3	0.05	0.05	0.05	0.05	0.05	0.05
23.83	346.6	346.6	346.6	346.7	346.7	346.7	-0.16	-0.16	-0.16	-0.14	-0.14	-0.14
24.56	350.4	350.4	350.4	349.9	349.9	349.9	1.17	1.17	1.17	0.70	0.70	0.70
24.83	347.4	347.4	347.4	347.7	347.7	347.7	-0.29	-0.29	-0.29	-0.01	-0.01	-0.01
25.51	349.9	349.9	349.9	349.9	349.9	349.9	-0.32	-0.32	-0.32	-0.32	-0.32	-0.32
26.31	351.6	351.6	351.6	351.6	351.6	351.6	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26
26.57	353.0	353.0	353.0	352.7	352.7	352.7	0.87	0.87	0.87	0.64	0.64	0.64

*Location of first weir
**Location of second weir

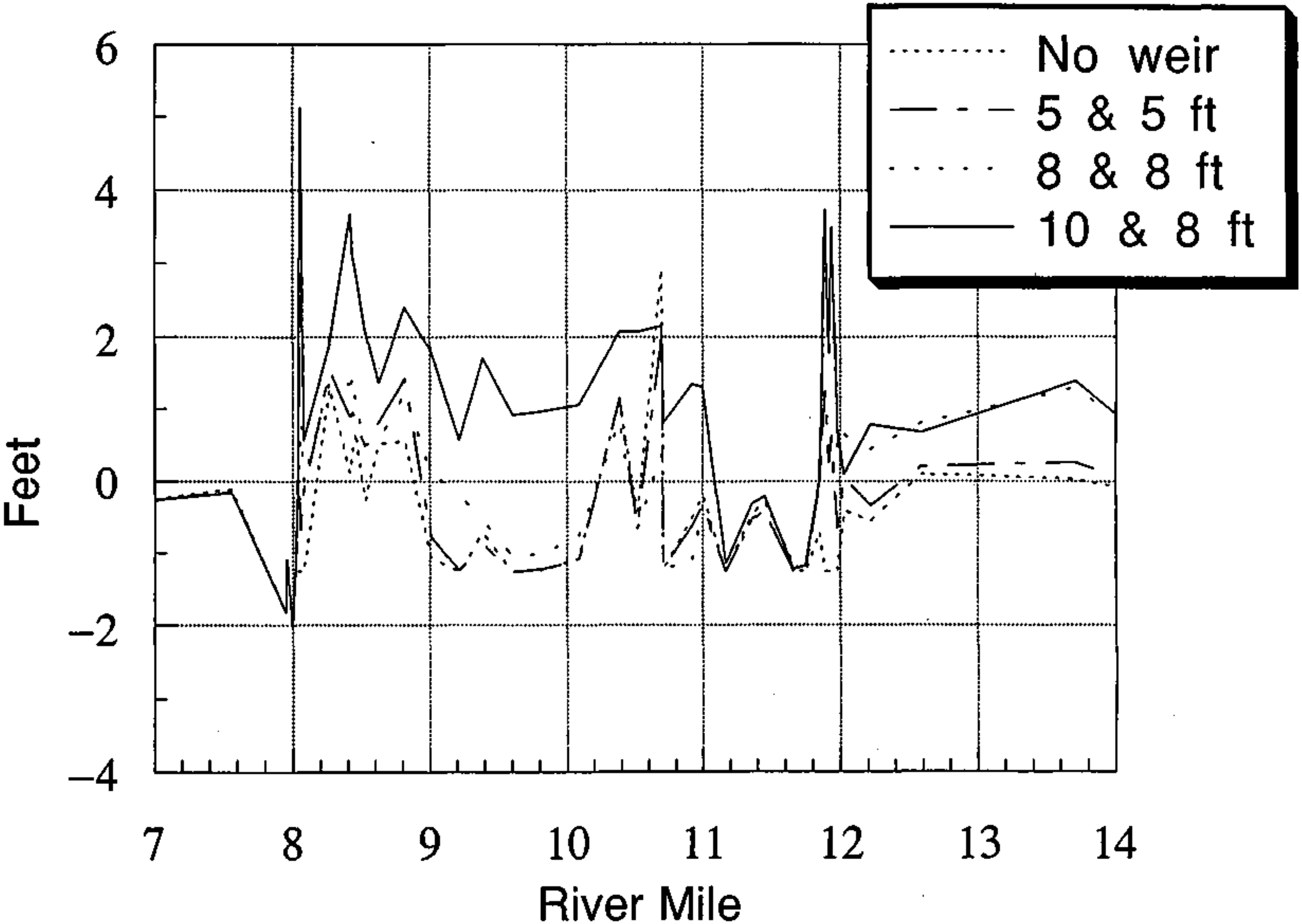


Figure 4. Comparison of scour and deposition pattern for different weir combinations and no-weir condition

For the upstream weir, the 8-foot height performs best. Channel scour is reduced for about 5 miles upstream of the weir, and channel aggradation will occur for about 2 miles.

Evaluation of the Weirs' Impact on 100-Year Flood Elevations

The impact of the weirs on flood elevations was evaluated by comparing the 100-year flood profile for the whole Upper Cache River-Post Creek Cutoff segment. The 100-year flood elevations were calculated for existing conditions (no weirs) and for the different weir height combinations. The methodology for determination of the 100-year flood discharges and the water surface elevations were discussed in detail in Water Survey Contract Report 485 (Demissie et al., 1990). The results of those calculations are summarized in table 3, and the flood profiles are compared in figure 5. As can be seen in the figure, the differences in 100-year flood elevations between the no-weir condition and the various weir height combinations are not significant. The maximum difference calculated upstream of the first weir is only 0.5 foot. Similarly the maximum difference in 100-year flood elevations upstream of the second weir is -0.01 foot.

Evaluation of the Weirs' Impact on Low-Flow Levels

Evaluation of the weirs' impact on low-flow levels is difficult because of the material to be used in constructing them. The design engineers have selected gabion units, which are unlikely to hold back significant amounts of water during periods of low flow. Assuming they perform in the same manner as concrete structures in terms of water-holding capacity, the gabion units will exert maximum influence just upstream of the structures. The different water levels for an arbitary selected low flow of 150 cubic feet per second (cfs) produced by the different weir height configurations are compared in figure 6.

As shown in the figure, the higher the weir elevation the higher the low-water level. The influence of the first weir is limited to the stretch between the two weirs. However, the influence of the second weir can reach up to 5 miles upstream of the structure. It should be noted, however, that the influence of the weir diminishes as the distance from the weir increases. Thus the influence of the weir more than 3 miles upstream is minimal.

RECOMMENDATIONS

After evaluating all the analyses and the discussions with IDOC staff, the following recommendations are offered:

1) Construct a 10-foot weir at a top elevation of 329 feet above mean sea level (msl) just upstream of the Belknap Road bridge.

Table 3. 100-Year Floodwater Surface Elevation

Distance from downstream (mile)	Water surface elevation (msl) No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft	Q cfs
0.00	294.1	294.1	294.1	294.1	294.1	294.1	17600
0.02	300.8	300.8	300.8	300.8	300.8	300.8	17600
0.61	312.2	312.2	312.2	312.2	312.2	312.2	17600
0.76	311.5	311.5	311.5	311.5	311.5	311.5	17600
0.78	317.5	317.5	317.5	317.5	317.5	317.5	17600
0.80	321.9	321.9	321.9	321.9	321.9	321.9	17600
1.50	327.0	327.0	327.0	327.0	327.0	327.0	17600
2.07	329.8	329.8	329.8	329.8	329.8	329.8	17600
2.69	332.6	332.6	332.6	332.6	332.6	332.6	17600
3.45	335.5	335.5	335.5	335.5	335.5	335.5	17600
4.20	338.0	338.0	338.0	338.0	338.0	338.0	17600
4.38	338.5	338.5	338.5	338.5	338.5	338.5	17600
4.62	339.1	339.1	339.1	339.1	339.1	339.1	16986
4.66	339.3	339.3	339.3	339.3	339.3	339.3	12304
4.73	339.3	339.3	339.3	339.3	339.3	339.3	12304
5.63	340.1	340.1	340.1	340.1	340.1	340.1	12304
6.95	341.5	341.5	341.5	341.5	341.5	341.5	12304
7.56	343.5	343.5	343.5	343.5	343.5	343.5	12304
7.95	344.7	344.7	344.7	344.7	344.7	344.7	12304
7.96	344.9	344.9	344.9	344.9	344.9	344.9	12304
8.00	344.8	344.8	344.8	344.8	344.8	344.8	12304
8.02	344.7	344.7	344.7	344.7	344.7	344.7	12304
*8.04	344.8	344.9	344.9	344.9	344.9	344.9	12304
8.06	344.8	345.0	345.1	345.1	345.3	345.3	12304
8.08	344.9	345.1	345.2	345.2	345.3	345.3	12304
8.27	345.8	345.9	346.0	346.0	346.1	346.1	12304
8.42	346.3	346.4	346.5	346.5	346.6	346.6	12304
8.44	346.4	346.5	346.6	346.6	346.7	346.7	12304
8.46	346.3	346.5	346.6	346.6	346.6	346.6	12304
8.53	346.5	346.6	346.7	346.7	346.8	346.8	12304
8.63	346.7	346.8	346.9	346.9	347.0	347.0	12304
8.82	347.5	347.6	347.7	347.7	347.8	347.8	12304
9.01	348.1	348.2	348.3	348.3	348.3	348.3	12304
9.22	348.5	348.6	348.7	348.7	348.7	348.7	12304
9.39	349.4	349.5	349.5	349.5	349.6	349.6	12304
9.61	350.2	350.2	350.3	350.3	350.3	350.3	12304
9.82	350.8	350.8	350.8	350.8	350.9	350.9	12304
10.09	351.5	351.6	351.6	351.6	351.6	351.6	12304
10.39	352.3	352.3	352.3	352.3	352.3	352.3	12304
10.52	352.6	352.6	352.7	352.7	352.7	352.7	12304
10.70	353.1	353.1	353.2	353.2	353.2	353.2	12304
10.71	353.2	353.2	353.2	353.2	353.2	353.2	12304
10.92	353.7	353.7	353.8	353.8	353.8	353.8	12304
11.00	353.9	353.9	353.9	353.9	354.0	354.0	12304

Table 3. Concluded

Distance from downstream (mile)	Water surface elevation (msl)						
	No weir	5&5 ft	8&8 ft	8&5 ft	10&5 ft	10&8 ft	Q cfs
11.17	354.3	354.3	354.3	354.3	354.3	354.3	12304
11.36	354.7	354.7	354.7	354.7	354.8	354.8	12304
11.45	354.7	354.7	354.8	354.8	354.8	354.8	12304
11.66	355.6	355.6	355.7	355.7	355.7	355.7	12304
11.75	355.9	355.9	355.9	355.9	355.9	355.9	12304
**11.85	356.2	356.0	356.0	356.0	356.0	356.0	8125
11.89	356.2	356.0	356.1	356.1	356.1	356.1	8125
11.92	356.2	356.1	356.1	356.1	356.1	356.1	8125
11.94	356.2	356.1	356.1	356.1	356.1	356.1	8125
11.98	356.3	356.2	356.2	356.2	356.2	356.2	8125
12.03	356.5	356.3	356.4	356.4	356.4	356.4	8125
12.22	356.5	356.4	356.5	356.4	356.5	356.5	8125
12.59	356.7	356.6	356.6	356.6	356.6	356.6	8125
13.71	357.2	357.1	357.1	357.1	357.1	357.1	8125
14.66	357.7	357.6	357.7	357.7	357.7	357.7	8125
15.25	358.2	358.1	358.1	358.1	358.1	358.1	8125
15.81	358.7	358.7	358.7	358.7	358.7	358.7	8125
16.69	360.6	360.5	360.5	360.5	360.5	360.5	8125
17.06	360.9	360.9	360.9	360.9	360.9	360.9	8125
17.71	361.2	361.2	361.2	361.2	361.2	361.2	8125
18.48	361.5	361.5	361.5	361.5	361.5	361.5	6266
19.17	361.7	361.7	361.7	361.7	361.7	361.7	6266
20.04	362.1	362.1	362.1	362.1	362.1	362.1	6266
20.32	362.1	362.1	362.1	362.1	362.1	362.1	6266
20.93	363.4	363.4	363.4	363.4	363.4	363.4	6266
22.06	363.8	363.8	363.8	363.8	363.8	363.8	6266
22.84	364.3	364.3	364.3	364.3	364.3	364.3	6266
23.20	364.6	364.6	364.6	364.6	364.6	364.6	6266
23.83	365.4	365.4	365.4	365.4	365.4	365.4	6266
24.56	366.4	366.4	366.4	366.4	366.4	366.4	6266
24.83	367.1	367.1	367.1	367.1	367.1	367.1	6266
25.51	368.5	368.5	368.5	368.5	368.5	368.5	6266
26.31	369.8	369.8	369.8	369.8	369.8	369.8	6266
26.57	370.1	370.1	370.1	370.1	370.1	370.1	6266

*Location of first weir
**Location of second weir

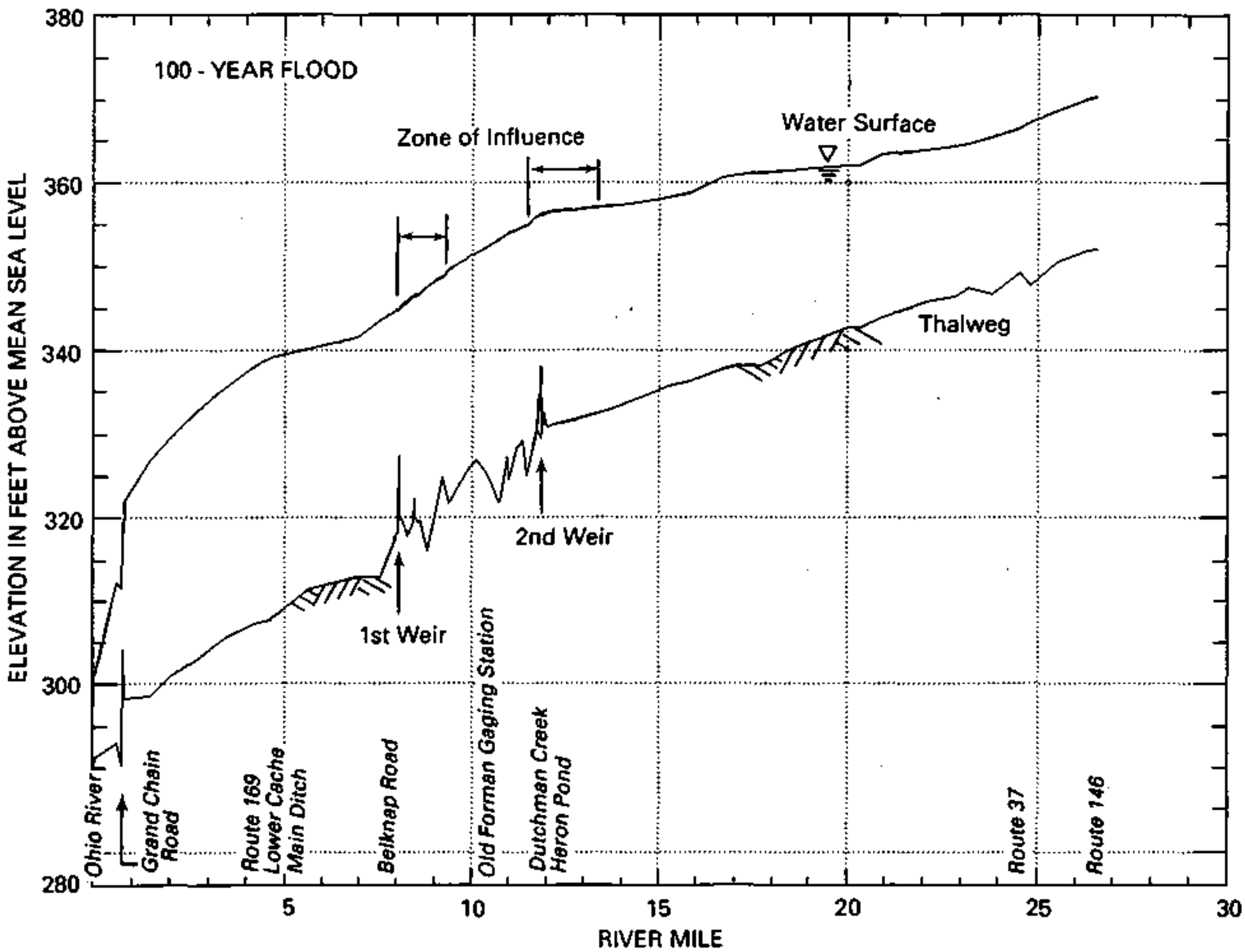


Figure 5. Comparison of the 100-year flood elevations for different weir combinations and no-weir condition

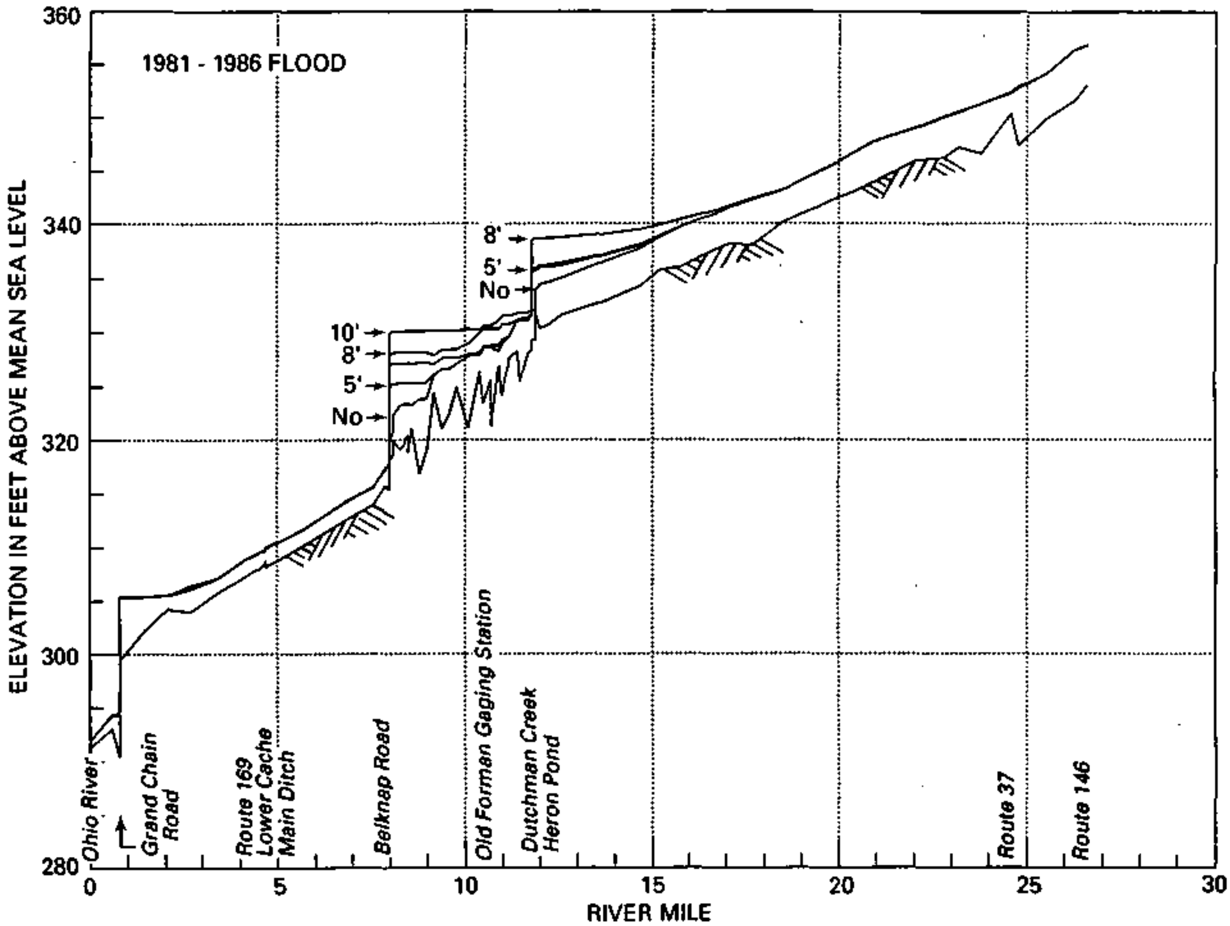


Figure 6. Comparison of low-flow levels for different weir combinations and no-weir condition

2) Construct an 8-foot weir at a top elevation of 338 feet msl near Heron Pond downstream of the junction of Dutchman Creek with the Cache River.

The relative heights of the weirs with respect to the channel cross sections are shown in figure 7. The major impact of these structures will be on channel stability. Erosion of the Cache River channel will be significantly reduced, and segments of the river close to the structures will aggrade to levels approaching the original channel bed profiles.

The influence of the structures on flooding will be minimal. The 100-year flood elevation upstream of the 8-foot weir will increase by only 0.5 foot. The difference in the 100-year flood elevation upstream of the 5-foot weir will be only -0.01 foot.

In terms of water pondage during low-flow periods, the weirs should not have significant impact because of the material with which they will be constructed in gabion units. It is very unlikely that the gabions will hold back much water during periods of low flow. In any case, the analysis assumed that the gabions would behave the same as a concrete structure in holding back water, and on this basis their potential to impound water was evaluated. It was determined that the backwater from the 10-foot weir to the 5-foot weir would extend for a distance of 3.8 miles. The backwater from the 5-foot weir will extend upstream of the junction of the Cache and the Dutchman for a distance of 5 miles.

REFERENCES

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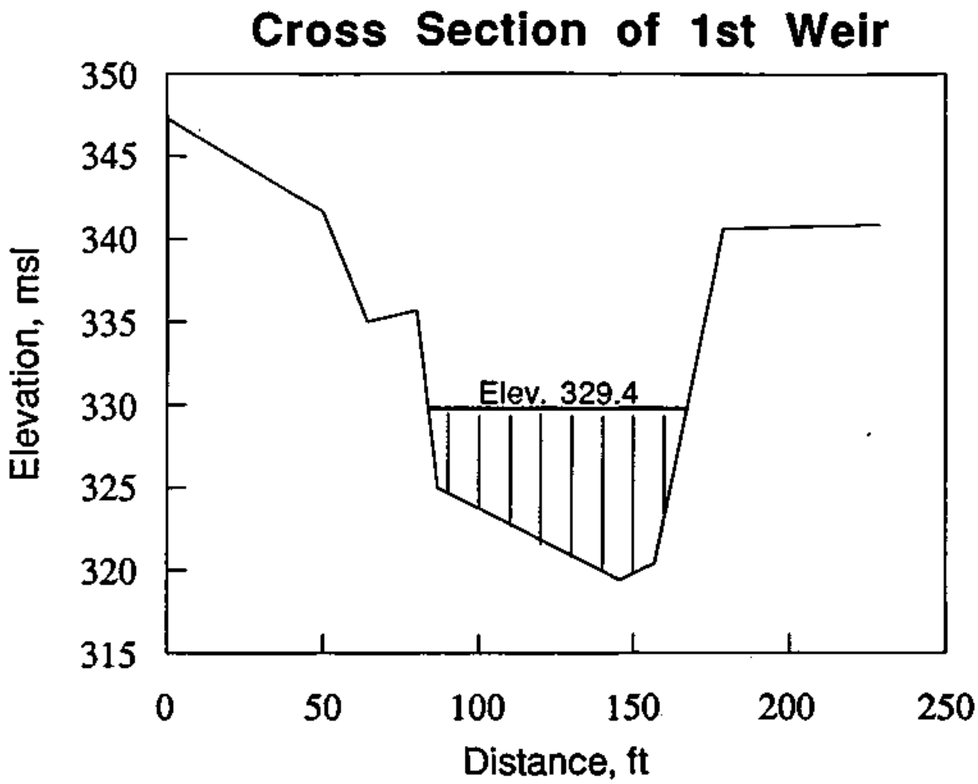
Soil Conservation Service (SCS). 1972. Unpublished cross-sectional survey data for Post-Creek Cutoff and Upper Cache River, Champaign, IL.

Southern Engineering Corporation. 1990. Program Analysis-Phase I, Preliminary Design, Phase II, Heron Pond/Little Black Slough Erosion Control, CDB Project #102-733-005, DOC Project #5-89-2, Carbondale, IL.



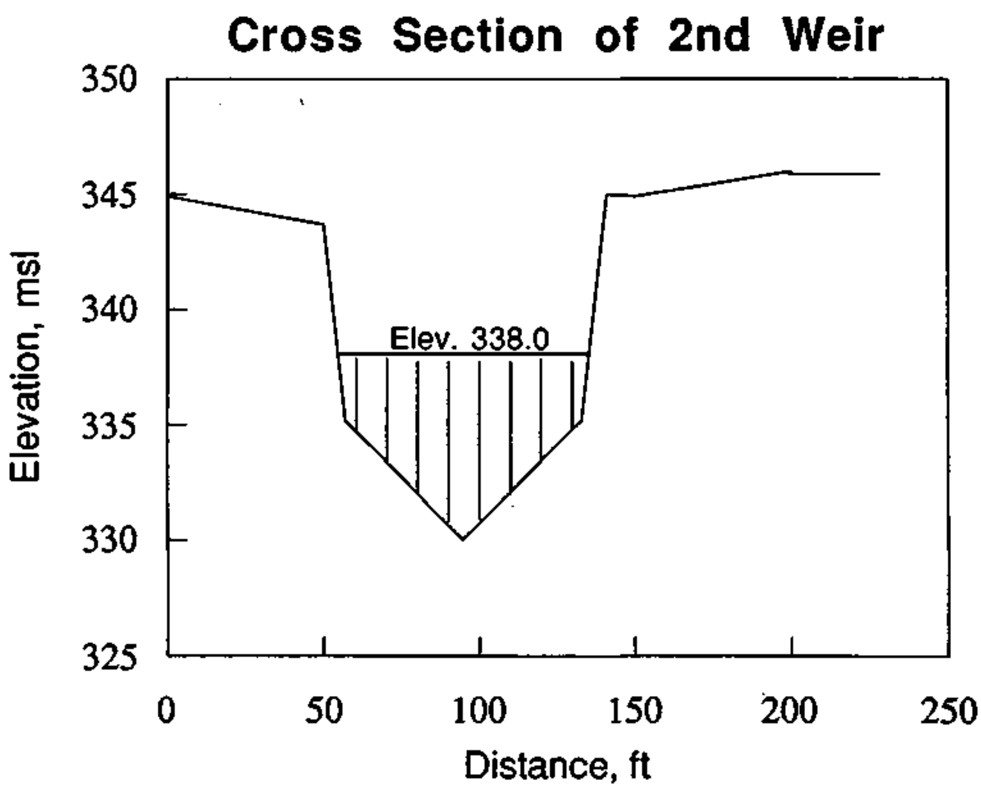


Figure 7. Relative heights of recommended weirs
with respect to channel cross sections

APPENDIX

Correspondence from Misganaw Demissie

to the Southern Engineering Corporation

(Recommendation for a New Survey)

Illinois State Water Survey

Hydrology Division
2204 Griffith Drive
Champaign, Illinois 61820-7495
Telephone (217) 333-9545
Telefax (217) 333-6540

September 28, 1990

Mr. B.J. Schwegman, P.E.
President
Southern Engineering Coop.
501 W. Industrial Park Rd.
Carbondale, IL 62901

Re: Cache River Channel Structures

Dear Mr. Schwegman:

This letter is a reply to your letter dated August 30, 1990. In the letter you requested us to review your plans for the Cache River structures. We have reviewed your plans and the following are our comments.

First, we would like to clarify again the problems with elevations. The channel elevations included in the Water Survey report were obtained from old surveys conducted by the Soil Conservation Service in 1972. They should not be presented as surveys conducted recently by the Water Survey and compared to your recent surveys. As you would remember in our first meeting at Ferne Clyffe (copy of the second page of your letter summarizing our meeting is attached), I insisted that a survey be conducted before we can specify the heights for the channel stabilizing structures in the Upper Cache River. The Illinois Department of Conservation agreed with that and they have initiated a contract with a surveying firm to do the job. When the new survey results become available we will be able to run our hydraulic model and determine the best weir elevations. I believed we all agreed at the Ferne Clyffe meeting that needed to be done. Without the new survey we cannot do what you are requesting us to do.

I have talked with Mr. E.B. Hardwig of your firm several times about the problem with the differences in elevations. We rechecked the original survey data from the SCS as reported in our report. We did not find any obvious errors, unless the SCS used different reference datum than used by your surveying crew. We also compared your survey results to the general topographic elevations of the area. We feel your elevations especially for the area near Heron Pond are higher than what we expected.

However, we cannot make a definitive determination of that at this time. The only way to resolve the problem is to have a survey done for the whole area from Heron Pond to the Belknap Road bridge, as we suggested earlier. If a consistent survey, referenced to the same datum is performed, reconciling your survey with the SCS's survey will not be necessary.

We therefore recommend again that your structural designs should not be finalized before the survey for the whole area is conducted by a surveying firm. Design work related to foundations, bank erosion, and scour downstream of the structures could be performed until the surveying work is completed.

The following are our comments related to the design of the specific structures.

1. *Proposed weir near Heron Pond.*

Actual weir elevation need to be determined after the profile and cross-sectional survey is completed. As presently designed by Southern Engineering, the weir elevation is too high. The influence of the weir on flooding will be evaluated after the new survey is completed.

The major concern about the design is the adequacy of scour protection for the stream channel (bed and bank) downstream of the structure. Since areas downstream of structures are scoured due to increased velocities, adequate scour protection need to be provided. The stability of the structure will be endangered by channel bed scour downstream of the structure. Therefore we recommend that more considerations be given to channel scour protection downstream of the structures.

2. *Proposed weir west of abandoned Railroad Bridge, near County Highway 3.*

Final weir elevations need to be determined after the survey is completed. Proposed elevation does not seem unreasonable and we expect final design weir elevation will be close to the proposed elevation.

The major concern about this structure is the same one discussed for structure #1 related to the adequacy of scour protection for the channel bed and bank downstream of the structure.

3. *Proposed weir east of Route 37.*

Proposed design appears adequate except for the 18 inch allowance for settlement. We suspect that settlement after a period of time might be higher than the proposed 18 inches. We therefore recommend that a contingency plan be developed in case the settlement is higher than expected.

In summary, we appreciate the opportunity to review your designs before they were finalized. We would like to stress again that we need the survey done before finalizing the designs. Once the survey is completed we will be able to provide you with a more definitive analysis. In relation to your gabion designs, we never had an opportunity to evaluate their performance, therefore we cannot comment much on them. We are however concerned about channel scour downstream of these structures. I hope you will give the subject adequate consideration.

I hope these comments are useful. There is still much more work to be done and we will be glad to work with you as the project progresses. If you need further clarifications on any of our comments or need additional information, please let me know.

Sincerely,

Mike Demissie, P.E., Ph.D.
Director
Office of Sediment & Wetland Studies
Phone: (217)333-4753
Fax: (217)333-6540

bjh

cc: Rich Allgire (ISWS)
David Soong (ISWS)
Marvin Hubbell (IDOC)
Joe Nelson (IDOC)

Mike Demissie also stated that I.S.W.S. needed a new river profile and cross-sections every 1000+ feet along the river from a point 200+ feet below the old New York Central R.R. tressel to the Heron Pond suspension bridge. This is roughly 4 miles by river. Mr. Schwegman stated in his opinion Southern's CDB Contract did not call for any such work on Southern's behalf. Bill Reynolds said that I.D.O.C. had land surveyor, Jack Bass of Carbondale, under contract and I.D.O.C. would contact him to see if he could do this survey work for I.S.W.S. Mr. Schwegman said if Mr. Bass couldn't do it he would be willing to give CDB a proposal for an add on to his contract to do this work, but having Mr. Bass do it was find with him, if that is what I.D.O.C. wants to do. It was suggested that Structure #1 be located far enough upstream from the old New York Central R.R. tressel so as to be off the New York Central R.O.W. and far enough away from the tressel so as water flowing over the structure would have time to return to a smooth flow condition (i.e. we don't want to create a lot of turbulent flow under the old tressel that might wash out the bridge). Joe Nelson is to see if I.D.O.C. has the New York Central R.R. R.O.W. plat of the area and if they do he will send a copy to Southern. If not Southern will have to contact the Railroad Company to get a copy. Mr. Demissie said he thought the Structure #1 would probably be 10-15 feet tall. We want to keep it within the banks of the stream. Mr. Schwegman handed out a photocopy of a sheet of data on gabions which shows a gabion structure with a notch weir and a second picture showing how a stream was lined with gabions. This is just an idea and not any type of design concept at this time. A copy of this is attached for information.

Mr. Demissie said once I.S.W.S. has a new river profile and cross-sections they could better suggest the exact locations of Structures #1 and #2 and give suggested crest elevations. Structure #2 will probably only be 5'± high.

Structure #3 over near the bridge on IL 37 south of White Hill should be located east of the highway bridge between the highway bridge and the Burlington Northern R. R. Bridge (shown as Chicago & Eastern Illinois R.R. on map).
Mr. Schwegman said that at the orientation meeting he came away with the understanding the structure was to be on the west side of the IL 37 bridge to stay out of the Illinois Nature Preserve area S.E. of the bridge. Bill Reynolds said I.D.O.C. has plans to build a boat launch on the west