

ECONOMIC EVALUATION

May Branch, Fort Smith, Arkansas

SCOPE

This documentation presents economic analysis of a 10-yr channel plan (Plan C-10), which is the NED plan that provides the greatest excess benefits over cost of the project. Also designated is the selected or locally preferred plan (LPP) which is a combination of the 100-yr channel plan (Plan C-100) for Reaches 1 and 2, and the 10-yr plan (Plan C-10) for Reaches 3 and 4. Benefits for Reaches 3 and 4 are the same for both the 10-yr and 100-yr plans; since cost for the 10-yr plan is lower than for the 100-yr, it is preferable to recommend a 10-yr plan for these two reaches. Although there is increased cost with the 100-yr plan, the City prefers this option with higher benefits for Reaches 1 & 2. The LLP, in the opinion of the sponsor, best meets the needs of the local community, and provides the greatest reduction in flood damages while remaining economically feasible. The LPP removes 127 structures out of the 100-yr flood plain, 40 more structures than removed with the NED plan.

Evaluation began with field reconnaissance to record the number, types, and value of structures in the flood plain. Annualized damages were computed for the without project condition and for alternative flood reduction plans. Total annualized benefits were compared with annualized costs of implementing proposed flood reduction plans.

SOURCES OF DATA

Much of the information collected for the economic analysis was provided by the county tax assessor's office. It included types of businesses, as well as floor elevations, structure values, and type of construction for both residential and business structures. OMB-approved questionnaires were sent out by the City of Fort Smith to obtain additional economic data including values for automobiles, equipment and contents of structures. In addition, a local contractor gathered data from business owners in the May Branch flood plain to establish estimates of content values and start-of-damage points.

In this study, depth-damage functions for residential properties were obtained from Economic Guidance Memorandum (EGM) 01-03 (4 December 2000). These functions were developed from information obtained by the Flood Damage Data Collection Program and are based on actual losses from flood events that occurred in various parts of the United States in 1996, 1997, and 1998. The purpose of this program is to provide standardized relationships for estimating flood damage and other costs of flooding.

Damages to commercial structures and contents were estimated using depth-damage relationships appropriate for the particular type of establishment and were developed from information obtained from extensive field surveys conducted during current and previous studies in the area.

The May Branch flood plain area was delineated into four damage reaches, sectioned by beginning and ending stations along the stream. These reaches were used to define data for plan evaluations and to aggregate structure and other flood damage information by flood frequencies. A total of 136 structures were identified in the 500-yr flood plain for existing conditions (see Table 1), and the total value of these structures, including contents, was estimated at \$44,196,700.

	Damage Category		Total
	Residential	Commercial	
Existing Conditions			
Reach 1	8	22	30
Reach 2	25	11	36
Reach 3	2	16	18
Reach 4	37	15	52
Totals	72	64	136
10yr Channel Plan			
Reach 1	7	11	18
Reach 2	22	4	28
Reach 3	0	0	0
Reach 4	0	0	0
Totals	29	15	46
Locally-Preferred Plan			
Reach 1	7	10	17
Reach 2	21	2	23
Reach 3	0	0	0
Reach 4	0	0	0
Totals	28	12	40

	Existing Conditions		10-yr Plan		50-yr Plan		100-yr Plan		200-yr Plan		LPP Plan	
	100yr	500yr	100yr	500yr	100yr	500yr	100yr	500yr	100yr	500yr	100yr	500yr
Floodplain												
Reach 1	25	30	15	18	1	18	0	17	0	17	0	17
Reach 2	36	36	25	28	1	28	0	23	0	23	0	23
Reach 3	15	18	0	0	0	0	0	0	0	0	0	0
Reach 4	51	52	0	0	0	0	0	0	0	0	0	0
Totals	127	136	40	46	2	46	0	40	0	40	0	40

SINGLE EVENT DAMAGES

Table 3 provides without and with-project estimates of single-event damages in each of the reaches in the study area for specified frequency events; the damages shown are at current price levels.

Table 3 Single Event Damages May Branch, Fort Smith, Arkansas						
	Recurrence Interval (Years)					
	2-Year	5-Year	10-Year	50-Year	100-Year	500-Year
Existing Conditions						
Reach 1 damage [structures]	\$254 [1]	\$3,489 [4]	\$223,258 [16]	\$969,475 [24]	\$1,515,917 [25]	\$3,115,681 [30]
Reach 2 damage [structures]	\$673 [3]	\$702,995 [23]	\$595,622 [33]	\$944,707 [36]	\$1,365,874 [36]	\$2,232,190 [36]
Reach 3 [structures]	\$261,353 [9]	\$984,625 [12]	\$1,250,187 [13]	\$1,730,943 [15]	\$2,038,308 [15]	\$2,136,092 [18]
Reach 4 [structures]	\$5,711 [13]	\$473,548 [43]	\$680,029 [44]	\$1,932,410 [51]	\$2,306,520 [51]	\$2,629,920 [52]
10yr Channel Plan						
Reach 1 [structures]	0	0	0	\$10,878 [9]	\$123,970 [15]	\$336,400 [18]
Reach 2 [structures]	0	0	0	\$3,354 [9]	\$213,467 [25]	\$554,738 [28]
Reach 3	0	0	0	0	0	0
Reach 4	0	0	0	0	0	0
Locally - Preferred Plan						
Reach 1 [structures]	0	0	0	0	0	\$233,596 [17]
Reach 2 [structures]	0	0	0	0	0	\$121,785 [23]
Reach 3	0	0	0	0	0	0
Reach 4	0	0	0	0	0	0

ANNUALIZED DAMAGES

The HEC-FDA computer program was used to estimate flood damages in the study area for the without-project and with-project plans. This program provides for the evaluation of flood-damage reductions plans using risk-based analytical methods. The program essentially correlates

the depth-damage relationship for each structure and first floor elevation with water-surface profiles from HEC-RAS output to estimate damages for each frequency event. Thus, for each reach, a stage-damage function is developed providing estimates of damages by damage category for a range of frequency events. These frequencies cover probabilities ranging from .500 through .002. The HEC-FDA Flood Damage Reduction Model (HEC-FDA) was used for computing annualized damages. Once a plan and analysis year has been specified, the FDA program computes stage-damage functions for each of the damage reach index locations by damage category. In this study, damage categories included residential and commercial structures and automobile damages, and other flood-related costs including emergency costs, utility damages, and nonphysical losses.

Flood insurance benefits were calculated based on the Fiscal Year 2004 Economic Guidance Memorandum current operating cost per policy of \$161. From FEMA, the City of Fort Smith obtained a list of 380 current flood insurance policies within the city; based on the addresses of the policies, there are 81 within the floodplain area of the May Branch study.

Numbers and values of vehicles were obtained from OMB questionnaires, field visits, and interviews with structure owners, as well as stage-damage data that was also derived from information from car dealerships in the Fort Smith area and from other Little Rock District studies. Auto damages were computed with FDA analysis.

Emergency costs are incurred by government agencies in the aftermath of the flood events and are determined using procedures developed in a study by the U.S. Army Engineer District, Louisville, Kentucky. This study, titled Flood Damage Report for Frankfort, Kentucky, July 1981, provides a basis for estimating these types of costs. Emergency costs were computed using a unit cost for each structure based on the number of structures flooded by frequency in the FDA program and relative duration of flooding. Unit costs are expected to remain constant from the Frankfort report. Changes in duration compensate for differences for the long single event in Frankfort and the short, flashy events that occur on May Branch. Flood events may create adverse socioeconomic effects that vary in duration from a few days to several months or even years following the particular event. Data from the Frankfort report was used to estimate costs associated with flood events in the May Branch study area. Emergency cost items include protection of life, health, and property; evacuation and reoccupation; emergency care; emergency preparedness; and administrative costs. The Frankfort data was adjusted for price changes as well as being modified to reflect local area conditions with regard to flood durations.

Emergency costs were calculated for the 0.02, 0.01, 0.004, and 0.002 events. Table 4 and Table 5 provide an example of calculating emergency costs and additional living expenses. The tables are taken from the C-10/C-100 Locally Preferred Plan for the 0.002 event.

Table 4
Estimated Emergency Costs
0.002 Event, Locally Preferred Plan
May Branch - Ft. Smith, AR
(March 2004)

Cost Item	Unit Cost Per day (dollars) (1)	No. of Units Affected		Average Duration(days)		Total Costs	
		Without Project (2)	With Project (2)	Without Project	With Project	Without Project	With Project
R-1							
Protection of life, health & property (3)	\$67	30	17	5	3	\$10,107	\$3,436
Evacuation, transition & reoccupation (4)	\$67	8	7	30	20	\$16,172	\$9,434
Emergency & mass care (4)	\$150	8	7	10	6	\$12,025	\$6,313
Emergency Preparedness	\$83	30	17	5	3	\$12,440	\$4,230
Administrative Costs	\$135	30	17	30	20	\$121,288	\$45,820
Emergency Costs by Project Condition R-1						\$172,032	\$69,233
Average Annual Emergency Costs R-1						\$344	\$138
R-2							
Protection of life, health & property (3)	\$67	36	23	5	3	\$12,129	\$4,649
Evacuation, transition & reoccupation (4)	\$67	25	21	30	20	\$50,537	\$28,301
Emergency & mass care (4)	\$150	25	21	10	6	\$37,579	\$18,940
Emergency Preparedness	\$83	36	23	5	3	\$14,928	\$5,722
Administrative Costs	\$135	36	23	30	20	\$145,546	\$61,992
Emergency Costs by Project Condition R-2						\$260,717	\$119,603
Average Annual Emergency Costs R-2						\$521	\$239
R-3							
Protection of life, health & property (3)	\$67	18	0	5	3	\$6,064	\$0
Evacuation, transition & reoccupation (4)	\$67	2	0	30	20	\$4,043	\$0
Emergency & mass care (4)	\$150	2	0	10	6	\$3,006	\$0
Emergency Preparedness	\$83	18	0	5	3	\$7,464	\$0
Administrative Costs	\$135	18	0	30	20	\$72,773	\$0
Emergency Costs by Project Condition R-3						\$93,350	\$0
Average Annual Emergency Costs R-3						\$187	\$0
R-4							
Protection of life, health & property (3)	\$67	52	0	5	3	\$17,519	\$0
Evacuation, transition & reoccupation (4)	\$67	37	0	30	20	\$74,794	\$0
Emergency & mass care (4)	\$150	37	0	10	6	\$55,616	\$0
Emergency Preparedness	\$83	52	0	5	3	\$21,562	\$0
Administrative Costs	\$135	52	0	30	20	\$210,233	\$0
Emergency Costs by Project Condition R-4						\$379,725	\$0
Average Annual Emergency Costs R-4						\$759	\$0
Total Emergency Costs by Project Condition						\$905,825	\$188,836
Average Annual Emergency Costs						\$1,812	\$378
(1) Data from 1981 Report, Flood Damage Report for Frankfort, Kentucky, July 1981. Dollar values adjusted for price level changes and locality conditions. (2) Numbers of units with damages from FDA Model runs. (3) includes commercial and residential units (4) residential units							

Examples of nonphysical losses are additional living expenses for individuals and families while in temporary housing, increased costs of eating out, laundering, caring for children and pets, and other miscellaneous expenses incurred by residents while displaced from their homes. Lodging expense was a calculated average nightly rate for a room with two double beds from three local hotels. Increased living expense based on per-diem rate for meals, adjusted for miscellaneous expenses and price levels.

Table 5 Additional Living Expenses 0.002 Event, Locally Preferred Plan May Branch - Ft. Smith, AR (Mar 2004)							
Cost Item	Unit Cost Per day (dollars)	No. of Units Affected		Average Duration(days)		Total Costs	
		Without Project (2)	With Project (2)	Without Project	With Project	Without Project	With Project
R-1							
Lodging	\$91	8	7	30	20	\$21,958	\$12,809
Increased Living Expense (1)	\$137	8	7	30	20	\$32,802	\$19,135
Total Living Expense Costs R-1						\$54,760	\$31,943
Average Annual Living Expense Costs R-1						\$110	\$64
R-2							
Lodging	\$91	25	21	30	20	\$68,618	\$38,426
Increased Living Expense (1)	\$137	25	21	30	20	\$102,507	\$57,404
Total Living Expense Costs R-2						\$171,125	\$95,830
Average Annual Living Expense Costs R-2						\$342	\$192
R-3							
Lodging	\$91	2	0	30	20	\$5,489	\$0
Increased Living Expense (1)	\$137	2	0	30	20	\$8,201	\$0
Total Living Expense Costs R-3						\$13,690	\$0
Average Annual Living Expense Costs R-3						\$27	\$0
R-4							
Lodging	\$91	37	0	30	20	\$101,554	\$0
Increased Living Expense (1)	\$137	37	0	30	20	\$151,710	\$0
Total Living Expense Costs R-4						\$253,264	\$0
Average Annual Living Expense Costs R-4						\$507	\$0
Total Living Expense Costs						\$492,839	\$127,773
Average Annual Living Expenses (Non-Physical Losses)						\$986	\$256
(1) \$54.89 expense/per person/per day X 2.49 persons per house hold							
(2) Numbers of units with damages from FDA Model runs							

Damages to utilities include telephone and electric transmission lines and sewerage systems; utility damages were estimated by applying a percentage factor of 15.6% to total physical losses from the FDA model. The percentage factor was determined from actual experienced losses resulting from historical floods in local areas.

Table 6 Utilities Benefits May Branch - Ft. Smith, AR (Mar 2004)					
Reach	Structural Without Project	Structural With Project	Utility (1) Without Project	Utility (1) With Project	Utility Benefits
1	\$98,430	\$585	\$15,355	\$910	\$15,264
2	\$341,207	\$0	\$53,228	\$0	\$53,228
3	\$467,320	\$0	\$72,902	\$0	\$72,902
4	\$257,829	\$0	\$40,221	\$0	\$40,221
Total			\$181,707	\$91	\$181,615
Average Annual Utilities Benefits					\$181,615
(1) 15.6% of total structural damages from actual experienced losses from historical floods in local area					

For this study, the future without-project condition was assumed to be similar to the existing condition, since additional development in the flood plain is not expected. There has been very little new residential development in recent years, and the same is true for the commercial category. Furthermore, current flood plain management policy limits development within flood plain areas.

Annualized damages and benefits for the 10-yr, 50-yr, 100-yr and 200-yr plans are shown by reach and by damage category in Table 7. Economic Analysis by Plan with B/C ratios is shown in Table 8. Included with the benefits in this table are the P Street Sewer repair savings. For Reach 4, the new channel will replace the storm sewer, thereby saving the repair and maintenance costs of the sewer. The storm sewer will remain in Reaches 1 – 3.

Table 9 displays the Economic Analysis by Reach for the Locally Preferred Plan, and Table 10 presents the plan's Cost Apportionment. The Economic Analysis for the total of Reaches 1-4 with the LPP is shown in Table 11.

Table 7
Average Annual Project Benefits
May Branch - Ft. Smith, AR

Reach 1 Category	Existing Damage	10-yr Plan		50-yr Plan		100-yr & LPP		200-yr Plan	
		Damage	Benefits	Damage	Benefits	Damage	Benefits	Damage	Benefits
Structure	98,430	4,527	93,903	2,345	96,085	585	97,845	476	97,954
Other	22,355	2,656	19,699	764	21,591	373	21,982	300	22,055
Auto	3,770	209	3,561	88	3,682	13	3,757	9	3,761
Flood Ins.	3,059	1,771	1,288	161	2,898	161	2,898	161	2,898
Totals	127,614	9,163	118,451	3,358	124,256	1,132	126,482	946	126,668
Reach 2 Category	Existing Damage	10-yr Plan		50-yr Plan		100-yr & LPP		200-yr Plan	
		Damage	Benefits	Damage	Benefits	Damage	Benefits	Damage	Benefits
Structure	341,207	7,349	333,858	861	340,346	0	341,207	0	341,207
Other	68,775	5,400	63,375	1465	67,310	471	68,304	451	68,324
Auto	13,368	742	12,626	315	13,053	0	13,368	0	13,368
Flood Ins.	3,703	2,576	1,127	161	3,542	0	3,703	0	3,703
Totals	427,053	16,067	410,986	2,802	424,251	471	426,582	451	426,602
Reach 3 Category	Existing Damage	10-yr Plan		50-yr Plan		100-yr & LPP		200-yr Plan	
		Damage	Benefits	Damage	Benefits	Damage	Benefits	Damage	Benefits
Structure	467,320	0	467,320	0	467,320	0	467,320	0	467,320
Other	76,286	0	76,286	0	76,286	0	76,286	0	76,286
Auto	11,140	0	11,140	0	11,140	0	11,140	0	11,140
Flood Ins.	2,093	0	2,093	0	2,093	0	2,093	0	2,093
Totals	556,839	0	556,839	0	556,839	0	556,839	0	556,839
Reach 4 Category	Existing Damage	10-yr Plan		50-yr Plan		100-yr & LPP		200-yr Plan	
		Damage	Benefits	Damage	Benefits	Damage	Benefits	Damage	Benefits
Structure	257,829	0	257,829	0	257,829	0	257,829	0	257,829
Other	62,873	0	62,873	0	62,873	0	62,873	0	62,873
Auto	22,155	0	22,155	0	22,155	0	22,155	0	22,155
Flood Ins.	4,186	0	4,186	0	4,186	0	4,186	0	4,186
P-St Sewer	11,100	0	11,100	0	11,100	0	11,100	0	11,100
Totals	358,143	0	358,143	0	358,143	0	358,143	0	358,143
Total R.1-4 Category	Existing Damage	10-yr Plan		50-yr Plan		100-yr & LPP		200-yr Plan	
		Damage	Benefits	Damage	Benefits	Damage	Benefits	Damage	Benefits
Structure	1,164,786	11,876	1,152,910	3,206	1,161,580	585	1,164,201	476	1,164,310
Other	230,288	8,056	222,233	2,229	228,059	844	229,444	751	229,537
Auto	50,433	951	49,482	403	50,030	13	50,420	9	50,424
Flood Ins.	13,041	4,347	8,694	322	12,719	161	12,880	161	12,880
P-St Sewer	11,100	0	11,100	0	11,100	0	11,100	0	11,100
Totals	1,469,648	25,230	1,444,419	6,160	1,463,488	1,603	1,468,045	1,397	1,468,251

Note: "Other" includes Emergency, Nonphysical, and Utilities benefits.

Note: Reach 2 Other Damages for the LPP and the 200-yr plan, are greater than zero. Although average annual numbers for structural damage are so small that they are eventually rounded down to zero, emergency costs still exist for the .004 and .002 events.

Table 8 Economic Analysis By Plan May Branch - Ft. Smith, AR				
	Plan C-10, NED	Plan C-50	Plan C-100	Plan C-200
Interest Rate, %	5.125	5.125	5.125	5.125
Construction Period, years	3.4	3.8	3.8	3.9
Period of Analysis, years	50	50	50	50
Average Annual Benefits				
<i>Flood damage</i>	\$1,152,900	\$1,161,600	1,164,200	\$1,164,300
<i>Emergency, Non Phys, & Utility</i>	\$222,200	\$228,100	229,500	\$229,500
<i>Auto damages</i>	\$49,500	\$50,000	50,400	\$50,500
<i>Flood Insurance</i>	\$8,700	\$12,700	12,900	\$12,900
<i>P St Sewer repair savings</i>	\$11,100	\$11,100	11,100	\$11,100
Total Annual Benefits	\$1,444,400	\$1,463,500	1,468,100	\$1,468,300
Average Annual Costs				
Total Project Constr. Costs	\$19,725,800	\$21,058,400	\$21,482,600	\$21,963,900
Interest During Construction	1,730,200	2,084,300	2,126,300	2,236,300
Total Investment Costs	\$21,456,000	\$23,142,700	\$23,608,900	\$24,200,200
Average Annual Costs				
Interest	\$1,099,500	\$1,186,100	\$1,210,000	\$1,240,300
Amortization	98,500	106,200	108,300	111,000
OMRR&R	47,000	55,500	56,600	56,800
Total Annual Costs	\$1,245,000	\$1,347,800	\$1,374,900	\$1,408,100
Excess Benefits over Cost				
	\$199,400	\$115,600	\$93,200	\$60,200
Benefit/Cost Ratio				
	1.16	1.09	1.07	1.04
* Project cost includes \$5,000 for a wingwall at the upstream end of Reach 4.				

Table 9
LPP's Economic Analysis By Reach, Plan C-100/C-10
May Branch - Ft. Smith, AR

(Interest Rate, 5.125 %)					
Reach	Reach 1	Reach 2	Reach 3	Reach 4	Reaches 1 – 4
Upstream Limit	7 th Street	Midland Ave	Short L St	Grand Avenue	Total
Annualized Benefits:					
Flood damage	\$97,900	\$341,200	\$467,300	\$257,800	\$1,164,200
Emergency, Non Phys, & Utility	22,000	68,300	76,300	62,900	229,500
Auto damages	3,700	13,400	11,200	22,100	50,400
Flood Insurance	2,900	3,700	2,100	4,200	12,900
P St Sewer repair savings	0	0	0	11,100	11,100
Total Annualized Benefits	\$126,500	\$426,600	\$556,900	\$358,100	\$1,468,100
Construction Costs:					
Project Construction Costs	\$10,412,100	\$4,077,500	3,752,200	2,894,600	\$21,136,400
Interest During Construction	1,030,600	403,600	371,400	286,500	2,092,100
Total Investment Cost	\$11,442,700	\$4,481,100	\$4,123,600	\$3,181,100	\$23,228,500
Annualized Costs:					
Interest	586,400	229,700	211,300	163,000	1,190,500
Amortization	52,500	20,600	18,900	14,600	106,600
OMRR&R	27,500	8,000	12,000	8,000	55,500
Total Annualized Costs	\$666,400	\$258,300	\$242,200	\$185,600	\$1,352,600
Excess Benefits over Cost	(\$539,900)	\$168,300	\$314,700	\$172,500	\$115,500
Benefit/Cost Ratio	0.19	1.7	2.3	1.9	1.09

Table 10 Cost Apportionment LPP May Branch - Ft. Smith, AR			
REACHES 1- 4	FEDERAL	NON-FEDERAL	TOTAL
Lands and Damages	\$ 137,000	\$ 3,140,600	\$ 3,277,600
Structures		2,639,300	2,639,300
Roads	759,100	1,261,200	2,020,300
Railroads	2,410,400	334,500	2,744,900
Channel	7,611,900	-	7,611,900
Control Structure	542,600	-	542,600
Subtotal	11,324,000	4,235,000	15,559,000
E&D	1,096,200	409,900	1,506,100
S&A	986,500	369,000	1,355,500
Subtotal	13,543,700	8,154,500	21,698,200
5% Cash	(1,084,900)	1,084,900	-
Subtotal	\$ 12,458,800	\$ 9,239,400	\$ 21,698,200
Adjustments	-	-	-
Subtotal	\$ 12,458,800	\$ 9,239,400	\$ 21,698,200
Percent of First Cost	57%	43%	100%
REACHES 5 & 6	FEDERAL	NON-FEDERAL	TOTAL
Lands and Damages	-	\$ 1,905,000	\$ 1,905,000
Construction	-	\$ 2,421,700	\$ 2,421,700
Total, Reaches 5 & 6	-	\$4,326,700	\$ 4,326,700
	FEDERAL	NON-FEDERAL	TOTAL
TOTAL FIRST COST	\$ 12,458,800	\$ 13,566,100	\$ 26,024,900
Percent of Total	48%	52%	100%

With full Federal participation in the LPP cost sharing for reaches 1 – 4.

Land costs include relocation assistance costs that are a financial cost but not an economic cost. Extension channel cost, reaches 5&6, is reduced by \$5K and reaches 1-4 cost is increased by \$5K for the cost of the wing walls.

Federal cost shown for roads and railroads is the cost of covered channel sections at crossings.

ECONOMIC JUSTIFICATION

Annualized benefits and costs, and a benefit-to-cost ratio for the proposed plan of improvement are shown in Table 11. These estimates are based on a project life of 50 years, a construction period of 3.8 years, and the current Federal discount rate of 5.125 percent. Annualized flood reduction benefits total \$1,468,100; annualized costs of the project, including O&M charges, are estimated at \$1,352,600, resulting in a 1.09 benefit-to-cost ratio.

Table 11 Economic Analysis LLP May Branch - Ft. Smith, AR	
Item	Amount
Economic Life (Years)	50
Construction Period (Years)	3.8
Interest Rate (Percent)	5.125%
Estimated Construction Cost	\$21,136,400
Interest During Construction	2,092,100
Total Investment Cost	\$23,228,500
Annualized Costs:	
Interest	\$1,190,500
Amortization	106,600
Operation & Maintenance	55,500
Total Annual Cost	\$1,352,600
Annualized Benefits:	\$1,468,100
Benefit-to-Cost Ratio	1.09
Net Benefits	\$115,500

RISK AND UNCERTAINTY

The HEC-FDA Flood Damage Reduction Model includes risk-based analysis methods that follow Federal and Corps of Engineers regulations ER 1105-2-100 and ER 1105-2-101. The program quantifies uncertainty in discharge-exceedance probability, stage discharge, and stage-damage functions and thus incorporates uncertainty into the economic analysis. In addition, uncertainty error factors are incorporated into the depth-damage functions associated with residential and commercial structures.

In Tables 12 and 13, FDA risk analysis is shown for total benefits that include other and auto, as well as structural and content categories for the NED (10-yr) Plan and for the LPP. Annual exceedance probabilities (AEP) associated with the various alternative plans are shown in Table 14.

Table 12 Annualized Damage Reduced and Distributed for the 10-yr (10-yr Fully Modified) Plan and Analysis Year 2002 Plan was calculated with Uncertainty May Branch - Ft. Smith, AR							
Damage Reach Name	Damage Reach Description	Annualized Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
1	May Branch Reach 1	128,685	7,584	121,101	53,022	99,631	166,964
2	May Branch Reach 2	439,485	12,416	427,069	321,152	411,616	517,146
3	May Branch Reach 3	591,775	0	591,775	452,825	577,742	716,530
4	May Branch Reach 4	356,633	0	356,633	265,534	341,260	431,945
		1,516,578	20,000	1,496,578	1,092,533	1,430,249	1,832,585

* FDA includes Structure, Auto, Emergency, Nonphysical, Utilities, and Flood Insurance benefits.

Table 13 Annualized Damage Reduced and Distributed for the LPP (Locally-Preferred Plan) and Analysis Year 2002, (Damage in \$1,000's) Plan was calculated with Uncertainty May Branch - Ft. Smith, AR							
Damage Reach Name	Damage Reach Description	Annualized Damage			Probability Damage Reduced Exceeds Indicated Values		
		Total Without Project	Total With Project	Damage Reduced	.75	.50	.25
1	May Branch Reach 1	128,685	898	127,787	55,473	104,548	175,787
2	May Branch Reach 2	439,485	0	439,485	327,088	421,322	532,893
3	May Branch Reach 3	591,775	0	591,775	452,826	577,742	716,530
4	May Branch Reach 4	356,633	0	356,633	265,534	341,260	431,944
		1,516,578	898	1,515,680	1,100,921	1,444,872	1,857,154

* FDA includes Structure, Auto, Emergency, Nonphysical, Utilities, and Flood Insurance benefits.

RAILROAD FLOOD IMPACT ANALYSIS

There are four railroad lines within the May Branch study area. Three different companies: the Kansas City Southern railroad, the Arkansas-Missouri railroad, and the Union Pacific railroad own these lines. Two companies, the Fort Smith Railroad and the Arkansas Missouri Railroad operate and maintain these railroads. Hydraulic analysis determined that there are five railroad crossings subject to flooding from May Branch.

It was determined based on discussions with railroad experts that the beginning damage elevation for railroads would be 1-foot below top of rail. It was assumed that once water reaches this elevation that railroad traffic would be suspended until a track inspection could be conducted. Traffic would continue only after a visual inspection could be conducted for the section of track impacted by flooding. For four of the sites, the damage elevation was determined to be 412.5' MSL, and 413.0' MSL for the fifth site. Discussions with railroad officials and companies serviced by these lines indicated that to-date over the last 20 years no interruption of rail service had been experienced from flooding. All companies interviewed indicated that there would be no impact to their businesses unless the interruption of service was for a period longer than 48 hours. Damages to tracks and roadbeds from flooding were assumed to begin after water has stood against the track for 48 hours.

For the reasons mentioned above it was essential that a flood duration analysis be conducted for the five sites identified in the project area. The duration analysis conducted (Table 15) revealed that under existing conditions the 500-year flood event would reach the damage elevation point for 23 hours for sites 2, 3, 4, and 5 and 19 hours for site 1. Under with-project conditions, the 500-year duration was reduced to 5 hours for sites 1 and 2 and 6 hours for sites 3, 4, and 5 (Table 16).

Table 15 Existing Conditions Duration Analysis By Flood Frequency By Railroad Site May Branch - Ft. Smith, AR									
Site	Damage Elevation MSL	FLOOD FREQUENCY							
		2	5	10	25	50	100	200	500
		HOURS							
1	412.5	0	0	0	0	4	11	15	19
2	412.5	0	0	2	5	9	16	20	23
3	412.5	0	0	2	5	9	16	20	23
4	412.5	0	0	2	5	9	16	20	23
5	413.0	0	0	2	5	9	16	20	23

Table 16 With-Project Conditions Duration Analysis By Flood Frequency By Railroad Site May Branch - Ft. Smith, AR									
Site	Damage Elevation	FLOOD FREQUENCY							
		2	5	10	25	50	100	200	500
MSL		HOURS							
1	412.5	0	0	0	2	3	3	4	5
2	412.5	0	0	0	2	3	4	5	5
3	412.5	0	0	0	3	4	4	5	6
4	412.5	0	0	3	4	4	5	6	6
5	413.0	0	0	3	4	4	5	6	6

Inspection Cost

As previously mentioned, based on railroad guidance, track that has water to within 1-foot of the rail must be inspected prior to opening the track up to traffic. This is a cost and would be incurred regardless of the duration of the flood event. It was assumed that all of the five sites could be visually inspected in 1 day at a cost of \$1,000 per day. Under both existing and with-project conditions these inspections would be necessary since all sites evaluated would continue to flood but with shorter durations under with-project conditions.

Summary of Findings for Railroad Flood Impact Analysis

Based on the assumptions identified above and the duration analysis in Tables 8 and 9, it was determined that there would be no significant flood losses from traffic rerouting or business losses from the flood events analyzed. Track inspection will be required for both without and with-project conditions. It should be noted that damages to railroad track and roadbeds are expected to be minimal since these structures are designed to withstand years of heavy traffic load without major repairs or rehabilitation. It is acknowledged that there would be minor flood damages/costs from the flood events evaluated, but without longer durations (longer than 48 hours); significant damages are not expected to be incurred.

ABILITY-TO-PAY (Ref: EGM02 03 Able2Pay Memo)

The ability-to pay test is applied to all flood control projects. As a result of the application of the test, some projects will be cost shared at a lower level than the standard non-Federal share, which is the share that would apply to the project before any ability-to- pay consideration.

Step 1, the Benefits Test:

The B/C ratio for the selected Channel Plan, the LPP, is 1.09; when the ratio is divided by four,

the result is 0.273, which is the BBF (“benefits based floor”). The standard level of cost sharing (the non-Federal share of total first cost) is 0.43 (ref. Cost Apportionment Table). Therefore, the BBF is less than the standard level, and the project may be eligible for either a reduction or partial reduction in the non-Federal share.

Step 2, the Income Test:

The form of the EF (“Eligibility Factor”) is:

$$EF = a - b1 \times (\text{state income index}) - b2 \times (\text{county income index})$$

The state’s per capita personal income as an index number in comparison to the national average (U.S.=100) is 75.1; it is the average over three years (2000 –2002) of Arkansas’ per capita personal income index (state per capita personal income divided by national per capita personal income). And the Sebastian County income index is 87.6, which is the average over three years (2000 –2002) of the county per capita personal income index (= county per capita personal income divided by national per capita personal income). Per capita personal income data is from the Bureau of Economic Analysis (BEA) publication, dated June 2004.

The parameters a, b1, and b2 have been determined using the state and county per capita index data and the condition that a certain fraction of the counties are to have eligibility factors greater than zero. The values of the parameters are:

$$\begin{aligned} a &= 17.90057 \\ b1 &= 0.077461 \\ b2 &= 0.154922 \end{aligned}$$

If EF is one or more, the project is eligible for the full reduction in cost-share to the benefits-based floor. If EF is zero or less, the project is not eligible for a reduction. If EF is between zero and one, the non-Federal cost-share will be reduced proportionately to an amount that is greater than the BBF but less than the standard non-Federal cost-share.

Using the state income index for Arkansas, 75.1, the income index for Sebastian County, 87.6, and the values in the above EGM formula,

$$\begin{aligned} EF &= 17.90057 - (0.077461)(75.1) - (0.154922)(87.6) \\ &= 17.90057 - 5.817 - 13.571 = \mathbf{-1.488} \end{aligned}$$

The EF is less than zero; therefore, the project is not eligible for a reduction in the standard Non-Federal cost-share.

