FINAL WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

OZAN CREEKS WATERSHED

Hempstead County, Arkansas

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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ADDENDUM
December 1975

OZAN CREEKS WATERSHED

HEMPSTEAD COUNTY
ARKANSAS

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A D D E N D U M

OZAN CREEKS WATERSHED

INTRODUCTION

This addendum was developed in accordance with phase-in procedures adopted by the Water Resources Council for level C plans for which field studies, analysis, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97, as supplemented and amended.

The Ozan Creeks Watershed plan was developed using 1973 prices for structural installation and non-agricultural benefits; a 6 7/8 percent discount rate, current normalized prices for agricultural products, and current prices for values other than agricultural products.

Part 1 of this addendum shows the effect of evaluating the structural measures using 1975 installation costs, a 6 1/8 percent discount rate, current normalized prices for agricultural products, and current prices for values other than agricultural products.

Part 2 of the addendum displays the effects of the selected plan as evaluated for each of the separate accounts - national economic development, environmental quality, regional development, and social well-being. Values for costs, prices, and rates are those used in the watershed work plan.

Part 3 of the addendum displays an abbreviated alternative plan developed to emphasize environmental quality. This is a hypothetical plan, not to be installed, which presents information for comparison with the selected plan. The basis for costs, benefits, and discount rates are equivalent to those used for the watershed work plan.

December 1975

A D D E N D U M P A R T 1

OZAN CREEKS WATERSHED
PLAN

EFFECT OF USING CURRENT VALUES FOR EVALUATIONS

The following tabulation shows the effect of evaluating the structural measures using a 6 1/8 percent discount rate, 1975 installation costs, current prices for values other than agricultural products, and current normalized prices for agricultural products.

Average Annual Costs	$258,080
Average Annual Benefits:	
Primary Benefits	264,840
Secondary	68,280
Total Benefits	$333,120
Benefit to Cost Ratios:	
Total Benefits to Cost	1.3:1.0
Without Secondary Benefits	1.0:1.0

Tables with details of these costs and benefits are on Addendum, Part 1, pages 2 through 6.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Ozan Creeks Watershed, Arkansas

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/ Public Law 566 Funds SCS 3/	FS 3/	Total	Other SCS 3/	FS 3/	Total	Total
Land Treatment									
Land Areas 2/									
Cropland	Acre	9,000	-	-	-	104,500	-	104,500	104,500
Grassland	Acre	22,000	-	-	-	352,000	-	352,000	352,000
Forest Land	Acre	6,100	-	-	-	-	149,400	149,400	149,400
Other Land	Acre	450	-	-	-	500	-	500	500
Cooperative Fire Protection Program	Acre	20,900	-	-	-	-	15,000 5/	15,000	15,000
Technical Assistance		-	37,400	21,200	58,600	28,600	5,800 4/	34,400	93,000
Soil Survey	Acre	47,384	4,900	-	4,900	440	-	440	5,340
TOTAL LAND TREATMENT	-	-	42,300	21,200	63,500	486,040	170,200	656,240	719,740
STRUCTURAL REASURES									
Constr ction									
Floodwater Retarding Strcctures 1 thru 22	No.	22	2,709,900	-	2,709,900	-	-	-	2,709,900
Land Stabilization			175,000	-	175,000	-	-	-	175,000
Subtotal - Construction			2,884,900	-	2,884,900	-	-	-	2,884,900
Engineering Services			259,160	-	259,160	-	-	-	259,160
Relocation Payments			-	-	-	-	-	-	-
Project Administration									
Construction Inspection			242,000	-	242,000	-	-	-	242,000
Other			254,100	-	254,100	12,100	-	12,100	266,200
Subtotal - Administration			496,100	-	496,100	12,100	-	12,100	508,200
Other Costs									
Land Rights			-	-	-	502,300	-	502,300	502,300
Subtotal - Other			-	-	-	502,300	-	502,300	502,300
TOTAL STRUCTURAL MEASURES			3,640,160	-	3,640,160	514,400	-	514,400	4,154,560
TOTAL PROJECT			3,682,460	21,200	3,703,660	1,000,440	170,200	1,170,640	4,874,300

1/ Price Base: 1975
2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated area.
3/ Federal agency responsible for assisting in installation of works of improvement.
4/ Includes $500 from the going Cooperative Forest Management Program.

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Ozan Creeks Watershed, Arkansas
(Dollars) 1/

Item	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds					Total Installation Cost
	Construction	Engineering Services	Land Rights	Total P. L. 566	Construction	Engineering Services	Land Rights	Water Rights	Total Other	
Floodwater Retarding Structure Number										
1	95,000	8,480	-	103,480	-	-	25,100	-	25,100	128,580
2	75,700	6,760	-	82,460	-	-	11,400	-	11,400	93,860
3	65,000	5,810	-	70,810	-	-	12,500	-	12,500	83,310
4	130,400	11,650	-	142,050	-	-	37,400	-	37,400	179,450
5	148,800	13,290	-	162,090	-	-	25,100	-	25,100	187,190
6	95,800	8,560	-	104,360	-	-	20,600	-	20,600	124,960
7	110,500	9,860	-	120,360	-	-	18,000	-	18,000	138,360
8	82,300	7,350	-	89,650	-	-	7,900	-	7,900	97,550
9	82,900	7,400	-	90,300	-	-	8,600	-	8,600	98,900
10	172,900	15,430	-	188,330	-	-	23,800	-	23,800	212,130
11	132,700	11,850	-	144,550	-	-	23,400	-	23,400	167,950
12	120,500	10,760	-	131,260	-	-	11,800	-	11,800	143,060
13	105,900	9,450	-	115,350	-	-	13,800	-	13,800	129,150
14	104,400	9,320	-	113,720	-	-	16,200	-	16,200	129,920
15	99,400	8,870	-	108,270	-	-	11,600	-	11,600	119,870
16	146,400	13,070	-	159,470	-	-	19,600	-	19,600	179,070
17	117,900	10,530	-	128,430	-	-	28,100	-	28,100	156,530
18	170,200	15,200	-	185,400	-	-	27,300	-	27,300	212,700
19	179,600	16,040	-	195,640	-	-	28,400	-	28,400	224,040
20	178,200	15,910	-	194,110	-	-	47,400	-	47,400	241,510
21	114,300	10,210	-	124,510	-	-	28,200	-	28,200	152,710
22	181,100	16,170	-	197,270	-	-	28,200	-	28,200	225,470
Subtotal	2,709,900	241,970	-	2,951,870	-	-	474,400	-	474,400	3,426,270
Land Stabilization Measures	175,000	17,190	-	192,190	-	-	27,900	-	27,900	220,090
Project Administration	-	-	-	496,100	-	-	-	-	12,100	508,200
GRAND TOTAL	2,884,900	259,160	-	3,640,160	-	-	502,300	-	514,400	4,154,560

1/ Price Base: 1975

TABLE 4 - ANNUAL COST

Ozan Creeks Watershed, Arkansas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structures Numbers 1 through 22 and Land Stabilization Measures	223,920	2,950	226,870
Project Administration	31,210	-	31,210
GRAND TOTAL	255,130	2,950	258,080

1/ Price Base: 1975.
2/ 100 years at 6 1/8 percent interest.

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Ozan Creeks Watershed, Arkansas

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	342,450	239,890	102,560
Other Agricultural	25,700	16,600	9,100
Nonagricultural Road and Bridges	70,950	52,610	18,340
Subtotal	439,100	309,100	130,000
Sediment			
Overbank Deposition	15,070	3,910	11,160
Land Voiding	2,740	620	2,120
Subtotal	17,810	4,530	13,280
Erosion			
Floodplain Scour	7,840	3,130	4,710
Indirect	46,480	31,680	14,800
TOTAL	511,230	348,440	162,790

1/ Price Base: Crop and pastcre ccrrent normalized prices; all other 1975 prices.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Ozan Creeks Watershed, Arkansas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost 3/	Benefit-Cost Ratio
	Flood Prevention						
	Damage Reduction 2/	More Intensive Land Use	Redevelopment	Secondary	Total		
Floodwater Retarding Structures Numbers 1 through 22 and Land Stabilization Measures	154,000	81,720	29,120	68,280	333,120	226,870	1.5:1
Project Administration	-	-	-	-	-	31,210	-
GRAND TOTAL	154,000	81,720	29,120	68,280	333,120	258,080	1.3:1

1/ Price Base: Crop and pasture benefits current normalized prices; all other benefits 1975 prices.
2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $8,790 annually.
3/ From Table 4.

SELECTED ALTERNATIVE

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measures of effects 1/ (dollars)
Beneficial effects:	
A. The value to users of increased output of goods and services	
1. Flood prevention	232,670
2. Utilization of unemployed and underemployed labor resources	
Project construction and OM&R	29,120
Total beneficial effects	261,790

Components	Measures of effects 1/ (dollars)
Adverse effects:	
A. The value of resources required for a plan	
1. Floodwater retarding structures and land stabilization measures	
Project installation (structural measures)	214.720
Project administration	29,560
OM&R	2,950
Total adverse effects	247,230
Net beneficial effects	14,560

1/ Average annual at 6 7/8 percent for 100 years.

SELECTED ALTERNATIVE

ENVIRONMENTAL QUALITY ACCOUNT

OZAN CREEKS WATERSHED
ARKANSAS

COMPONENTS	MEASURES OF EFFECTS
Beneficial and adverse effects:	
A. Areas of natural beauty.	1. Funds and resources made available by the project can be used to enhance the appearance of 240 farms on 63,618 acres.
	2. Revegetate 250 acres of critically eroding areas to remove unpleasant scenes from the landscape.
	3. Convert 536 acres of grassland, 301 acres of woodland, and 19 acres of cropland to reservoirs, embankments, and spillways along 14 miles of ephemeral natural streams.
	4. Enhance the beauty of the watershed by the creation of 687 acres of open water and 30 miles of shoreline.
B. Quality consideration of water, land, and air resources.	1. Practically all land in the watershed will receive some treatment and 9,000 acres of cropland, 22,000 acres of grassland, and 6,100 acres of forest land will receive all needed treatment during the installation period.
	2. Sheet erosion will be reduced 17 percent.

3. The 45 farm ponds will encourage uniform grazing and reduce the chance of the development of critically eroding areas.

4. Suspended sediment will be reduced from 660 milligrams per liter to 370 milligrams per liter in Ozan Creek at the watershed outlet.

5. Air, water, and noise pollution will be increased slightly during project construction.

6. Low-flow releases (6,804 gallons per minute) will aid in making perennial flow below structures in the channels which are presently ephemeral (28 miles) and intermittent (24 miles).

C. Biological resources and selected ecosystems.

1. Generally, brush management and weed control practices will alter wildlife food and cover.

2. Habitat will be developed on odd areas for farm wildlife species.

3. Revegetation of 250 acres of critically eroded areas will be fenced and will provide wildlife habitat.

4. The 664 acres of water in reservoirs will create still water fish habitat.

5. About 30 miles of shoreline will be created.

	6.	Low-flow releases of 6,804 gallons per minute will provide more permanent habitat for forage fish, young-of-the-year sport and food fish, amphibians, aquatic reptiles, and aquatic invertebrates.
	7.	Wildlife habitat will be created on 192 acres of embankments and emergency spillways.
	8.	A loss of 856 acres of upland wildlife habitat will occur at structure locations.
D. Historical, archeological, and geological.	1.	Archeological sites that occur in the watershed may be protected from degradation by erosion and floodwater.
	2.	Salvage of any archeological sites in construction areas will destroy the sites but will preserve data and information for future generations.
	3.	Henry's Chapel Monument which is in the watershed, will be unaffected by the project.

E. Irreversible or irretrievable commitment

1. The land that will be committed to the project is as follows:

Committed Use	Present Use	Acres
Embankment and emergency spillway	Cropland	1
	Grassland	138
	Woodland	53
Pools at principal spillway	Cropland	18
	Grassland	398
	Woodland	248

2. The project will require 856 acres which includes 14 miles of natural ephemeral streams.

3. Land stabilization measures will remove 250 acres from production or beneficial use for a maximum of 15 years.

SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measures of effects 1/ State of Arkansas	Measures of effects 1/ Rest of Nation
	- - - -dollars - - -	
A. Income		
Beneficial effects:		
1. The value to users of increased output of goods and services		
a. Flood prevention	232,670	-
b. Utilization of regional unemployed or underemployed labor resources		
Project construction and OM&R	29,120	-
c. Secondary	68,280	-
Total beneficial effects	330,070	-

Components	Measures of effects 1/ State of Arkansas	Measures of effects 1/ Rest of Nation
	- - - -dollars - - -	
A. Income		
Adverse effects:		
1. The value of resources contributed from within the region to achieve the outputs		
a. Floodwater retarding structures and land stabilization measures		
Project installation (structural measures)	31,420	183,300
Project administration	660	28,900
OM&R	2,950	0
Total adverse effects	35,030	212,200
Net beneficial effects	295,040	-212,200

1/ Average annual at 6 7/8 percent for 100 years.

SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT (Continued)

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measure of effects: State of Arkansas	Measure of effects: Rest of Nation
B. Employment		
Beneficial effects:		
1. Increase in number and types of jobs		
a. Agricultural employment	Utilization of 30-man-years of employment in agricultural production	-
b. Employment for project construction	62 semi-skilled jobs for 5 years	-
c. Employment for project OM&R	0.3 permanent semi-skilled jobs	-
Total beneficial effects	62 semi-skilled jobs for 5 years	-
	30 permanent semi-skilled jobs	-

Components	Measure of effects: State of Arkansas	Measure of effects: Rest of Nation
B. Employment		
Adverse effects:		
1. Decrease in number and types of jobs		
a. Lost in agricultural employment in project take area	2 man-years of agricultural employment	-
Total adverse effects	2 permanent semi-skilled jobs	-
Net beneficial effects	62 semi-skilled jobs for 5 years	-
	28 permanent semi-skilled jobs	-

SELECTED ALTERNATIVE

REGIONAL DEVELOPMENT ACCOUNT (Continued)

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measures of effects: State of Arkansas	Measures of effects: Rest of Nation
C. Population Distribution		
Beneficial effects:	Creates 62 semi-skilled jobs for 5 years. Creates 28 permanent semi-skilled jobs. Population of Hempstead County decreased 2 percent from 1960 to 1970.	-
Adverse effects:	-	-
D. Regional economic base and stability		
Beneficial effects:	The project will provide a 32 percent reduction in flood damage in an area where agriculture is the economic mainstay. Flood protection is an integral part of the success of other programs which are underway for the economic development of the area. The project creates 62 semi-skilled jobs and 28 permanent semi-skilled jobs. The unemployment rate for Hempstead County is 4.3 percent. Hempstead County is eligible for public works grants and business loans under Title IV of the Economic Development Act of 1965.	

SELECTED ALTERNATIVE

SOCIAL WELL-BEING ACCOUNT

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measures of effects
Beneficial and adverse effects:	
A. Real income distribution	1. Creates a net of 90 low to medium income jobs for area residents. There will be 28 permanent semi-skilled jobs. There will be 62 semi-skilled jobs for 5 years.
	2. Create regional income benefit distribution of $330,070 by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage of Benefits in Class
Less than 3,000	22	26
3,000-10,000	54	54
More than 10,000	24	20

SELECTED ALTERNATIVE

SOCIAL WELL-BEING ACCOUNT (Continued)

OZAN CREEKS WATERSHED
ARKANSAS

Components	Measures of effects
	3. Local costs to be borne by region total $35,030 with distribution by income class as follows:

Income Class (dollars)	Percentage of Adjusted Gross Income in Class	Percentage of Contribution in Class
Less than 3,000	22	15
3,000-10,000	54	75
More than 10,000	24	10

B. Life, health, and safety	1. Provide a 25 percent level of flood protection. There are about 75 farms in the flood plain. Flood plain land is valued at about $400 per acre.

ENVIRONMENTAL QUALITY PLAN
(Abridged)

OZAN CREEKS WATERSHED

Hempstead County, Arkansas

A. Environmental Quality Problems and Component Needs.

The southern part of the watershed has 250 acres of critically eroding soils on chalk and marl formations. The areas are scattered, barren, and too small to treat as management units. The average annual sediment yield from Ozan Creeks Watershed is 68,300 tons. The source of the sediment is sheet erosion, 2.2 tons per acre; gully erosion, 29 tons per acre; stream bank erosion, 6 to 62 tons per acre; and roadside erosion, 12 tons per acre. Land voiding annually destroys 2.6 acres of the flood plain because of channel degradation and sloughing. Alternate wetting and drying of the chalk and marl in the channel bottoms contribute to the problem of channel degradation. Flood plain scour occurs on 285 acres of the flood plain. Fishing opportunities in the watershed are insufficient. Land use changes within the watershed have had an overall detrimental effect on wildlife and areas should be developed specifically for the improvement of wildlife habitat. The bottomland hardwood forests in the common flood plain should be preserved.

The component needs to achieve desired beneficial effects on the environmental quality are as follows: (1) improve natural beauty of the landscape on the unsightly, barren, critically eroding areas; (2) enhance the general appearance of farms in the watershed; (3) maintain streams in a natural stable condition; (4) create areas of open water and shoreline to blend with the landscape; (5) conserve the soil resources of the watershed; (6) reduce sediment pollution in the waters of the watershed and downstream; (7) extend the duration of flow in ephemeral streams; (8) develop wildlife habitat on odd areas that are not used for agricultural production; (9) create a still water fishery in the watershed and improve the stream fishery; (10) include wildlife habitat enhancement when vegetating or revegetating denuded areas; (11) use every reasonable effort to preserve historical, archeological, or geological resources of significant value; and (12) minimize irreversible and irretrievable commitments of resources to future uses.

B. Description of the Plan Elements, Cost, and Implementation.

The plan elements consist of accelerated conservation land treatment measures on agricultural and forested land, floodwater retarding structures, a multiple purpose (recreation) structure, the treatment of critically eroding areas, and a fish and wildlife development to preserve bottom land hardwoods.

The land treatment measures to be applied by the landowners on 7,000 acres of cropland would include land use conversions, conservation cropping systems, fertilizing, liming, proper tillage, and crop residue management to control erosion and promote good land management. Terraces would be maintained and established where needed to reduce erosion. Pasture and hayland on about 22,000 acres would be improved by proper management including brush management, weed control, fertilizing, liming, proper grazing use, renovating, and seeding additional grasses and legumes. About 45 farm ponds would be built to provide livestock water.

Landowners and operators would be encouraged to manage many odd areas and wetland areas as wildlife habitat. Most of the farm ponds would be stocked with fish for sport fishing. Landowners would be encouraged to permit full utilization of the still-water fishery that would be created and to develop those sites with recreation potentials. This would require installation of minimum sanitary facilities.

The planned woodland treatment measures would include 1,900 acres of tree planting, 4,200 acres of stand improvement, and continued fire prevention measures on all forested lands by the Arkansas Forestry Commission in cooperation with the U. S. Forest Service.

Archeological values in the watershed would be protected by cooperative agreement between the Arkansas Archeological Survey and the Soil Conservation Service. The Survey would determine and appraise resources, evaluate impacts, recommend mitigation, and perform any needed salvage.

A fish and wildlife development would be included to preserve about 420 acres of bottom land hardwoods in the common flood plain of the Little Missouri River. A suitable sponsor would be required to fulfill local obligations in the installation, operation, and maintenance of the development.

Structural measures that would be implemented under the provisions of Public Law 566 consist of 22 floodwater retarding structures, one multiple purpose structure (recreation) with basic recreation facilities, and about 250 acres of land stabilization measures. The 22 structures would be earthfills with vegetated emergency spillways and concrete principal spillways. Each structure would provide storage for 100 years of sediment. Ungated ports would be located at the 50-year submerged sediment level for structures 1 through 6 and 21, and at the 100-year level for the other structures to provide storage for low flows downstream. Each structure would have a drain valve to provide for fish and wildlife management practices. The 250 acres of land stabilization measures would include fencing, mechanical measures, and revegetation for erosion control and wildlife habitat.

The total estimated cost of the environmental quality plan is $4,763,100 of which $3,379,450 would be from Public Law 566 funds. The benefit cost ratio is 1.3:1

The installation cost would include $654,300 for land treatment measures and $4,108,800 for structural measures. Structural measures cost would include construction, engineering, land rights, and other costs involved in the installation of the structures, land stabilization measures, recreational development, and fish and wildlife development.

C. Description of Environmental Effects from the Environmental Quality Plan

The average annual area flooded would be reduced 25 percent on 11,426 acres. Average sheet erosion would be reduced 17 percent and erosion on the 250 acres of critically eroding areas would be reduced 92 percent. Sediment pollution would be reduced from 660 milligrams per liter to 370 milligrams per liter. The floodwater retarding structures would trap about 90 percent of the sediment entering them and reduce downstream sediment pollution. The low flow releases would maintain wet bottom ditches and aid in reducing degradation and land voiding. Flood reduction would reduce flood plain scour and maintain a more stable ecosystem in the flood plains. Sediment yield from the watershed would be reduced 43 percent. Fishery would be created on 664 acres of pools in the floodwater retarding structures. Types 5 and 6 wetland on 687 acres would be created for waterfowl resting and feeding. Wildlife habitat would be created on 442 acres of structural measures on odd areas. Low-flow releases would aid in augmenting flow in 52 miles of channels that are presently ephemeral (28 miles) and intermittent (24 miles). The aesthetic and environmental quality of the watershed would be enhanced.

The floodwater retarding structures would require 536 acres of grassland, 301 acres of woodland, and 19 acres of cropland. The project would convert 14 miles of ephemeral natural streams to reservoir sites. The present upland wildlife habitat would be lost at the structure locations. Sediment, noise, and air pollution would increase during construction. Some conservation land treatment practices would change the existing wildlife habitat. If archeological salvages are performed, their site values will be partially or completely lost.

The fishing and recreational activities in the watershed would be enhanced and could satisfy the demands in the watershed and surrounding areas. A natural area of bottom land hardwood would be preserved for wildlife habitat and the enjoyment of future generations.

FINAL WATERSHED WORK PLAN
FOR
WATERSHED PROTECTION AND FLOOD PREVENTION

OZAN CREEKS WATERSHED
Hempstead County, Arkansas

Prepared under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared By

Hempstead County Soil and Water Conservation District
Hope, Arkansas 71801

With Assistance By

United States Department of Agriculture
Soil Conservation Service
Forest Service

State of Arkansas
Department of Commerce
Division of Soil and Water Resources

November 1975

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WATERSHED WORK PLAN AGREEMENT

between the

Hempstead County Soil and Water Conservation District
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

State of Arkansas

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Ozan Creeks Watershed, State of Arkansas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for the works of improvement for the Ozan Creeks Watershed, State of Arkansas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire, with other than Public Law 566 funds, such land rights as will be needed in connection with the works of improvement. (Estimated Cost $456,400).

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	Sponsoring Local Organization (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	25.3	74.7	0 1/

1/ Investigation has disclosed that under present conditions, the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures Numbers 1 through 22	0	100.0	2,296,500
Land Stabilization Measures	0	100.0	148,300

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Engineering Costs (dollars)
Floodwater Retarding Structures Numbers 1 through 22	0	100.00	205,050
Land Stabilization Measures	0	100.00	13,250

6. The Sponsoring Local Organization and the Service will each bear their costs for project administration estimated at $10,300 and $420,500, respectively.

7. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving the funds of the other party. Such arrangement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any activity receiving Federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

Hempstead County Soil and Water Conservation District
Local Organization

By Norman Goodlett

Title Chairman

Hope, Arkansas 71801
Address Zip Code

Date 10-28-75

The signing of this agreement was authorized by a resolution of the governing body of the Hempstead County Soil and Water Conservation District
Local Organization

adopted at a meeting held on 10-28-75

Secretary, Local Organization

Route 3, Box 203
Hope, Arkansas 71801
Address Zip Code

Date 10-28-75

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

State Conservationist

11/3/75
Date

WATERSHED WORK PLAN

OZAN CREEKS WATERSHED

Hempstead County, Arkansas

November 1975

SUMMARY OF PLAN

Ozan Creeks Watershed is a 63,618-acre watershed located in Hempstead County in southwest Arkansas. The towns of Ozan, McCaskill, and Blevins are located in the watershed.

This work plan for watershed protection and flood prevention was prepared by the Hempstead County Soil and Water Conservation District as the sponsoring local organization. Technical assistance was furnished by the United States Department of Agriculture, Soil Conservation Service and Forest Service.

Financial assistance in the development of the plan was provided by the State of Arkansas, Department of Commerce, Division of Soil and Water Resources.

The topography of the watershed varies from relatively flat flood plain to rolling hills. Elevations range from 280 to 490 feet above mean sea level. The watershed is located in the Texas Blackland Prairie and Southern Coastal Plain Land Resource Areas. Geologic formations underlying the watershed are marl, marly sand, and chalk of the Upper Cretaceous age.

The marl and chalk soils developed from the Marlbrook Marl and Saratoga Chalk Formations are highly erosive. About 250 acres are critically eroding in the southern part of the watershed.

There are presently about 240 farms in the watershed with an average size of about 265 acres. The watershed flood plain is an 11,426-acre area subject to flood damage, as delineated by the 100-year frequency flood. Flood prevention benefits will accrue to the landowners and operators of 75 farms in the flood plain. The floods evaluated over the evaluation period produced average annual flood damages of $499,300.

The project will contribute to the economic goals of the Southwest Arkansas Planning and Development District and the Southwest Arkansas Resource Conservation and Development Project by developing, conserving, improving, and utilizing the natural resources of the area to enhance the economic and social welfare of the area's residents.

This work plan proposes the installation of land treatment and structural works of improvement to be accomplished during a 5-year installation period. The total estimated cost of the project is $4,204,600 of which $3,141,350 will be borne by Public Law 566 funds and $1,063,250 will be borne by other funds.

Landowners and operators will install and maintain land treatment measures with an estimated cost of $654,300 of which Public Law 566 funds will pay $57,750 and other funds will pay $596,550. In recent years, local interests have expended about $969,935 installing land treatment measures.

Structural measures consist of 22 floodwater retarding structures and approximately 250 acres of land stabilization measures. The total estimated cost for installation of structural measures is $3,550,300, of which Public Law 566 funds will pay $3,083,600 and other funds will pay $466,700.

The average annual benefits accruing to structural measures are distributed as follows:

Flood Prevention	
Damage Reduction	$150,950
More Intensive Land Use	81,720
Redevelopment	29,120
Secondary	68,280
Total	$330,070

The average annual cost of structural measures is estimated to be $247,230. The ratio of average annual benefits to average annual costs of structural measures is 1.3 to 1.

The Hempstead County Soil and Water Conservation District through the Ozan Creeks Improvement Project Area has the power under State law to secure and repay loans, assess benefits, and levy taxes, and it will provide the funds needed to meet their obligations in the installation of the planned structural measures. The district plans to obtain a watershed loan to finance its share of the project installation cost. A letter of intent to borrow has been filed with the Farmers Home Administration. Funds for the repayment of this loan will be obtained from taxes levied on the benefited area.

Structural measures will be operated and maintained by the Ozan Creeks Improvement Project Area at an estimated annual cost of $2,950.

Measurable effects on the environment will result from the reduction in flooding, erosion rates, runoff rates, and sediment yield.

Low-flow releases from the structures will aid in maintaining streamflow in the watershed. Fishery will be created in the submerged sediment and low-flow augmentation pools of the structures and wildlife habitat will be created on critical areas to be treated.

The floodwater retarding structures will require 856 acres of land for pools and the embankments and emergency spillways. The structures will convert 14 miles of natural streams with ephemeral flow conditions to reservoir areas.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING 1/

Physical Resources

The 63,618-acre watershed is in Hempstead County in southwest Arkansas. The towns of Ozan (population 134), McCaskill (population 58), and Blevins (population 265) are in the watershed. Hope, the county seat, has a population of 8,830 and is 12 miles south of the watershed (8). Most of the population in the watershed is rural.

The watershed is in the Lower Mississippi Water Resource Region (11) which is mostly flat alluvial and coastal plains and undulating loessial areas. Elevations range from sea level to 2,800 feet with most of the region below 400 feet (9). The alluvial areas are used for agricultural production and the other areas for forest production. This watershed is not typical of the region.

The watershed is in the Ouachita Water Resource Subregion (11) which is about 80 percent pine forested Southern Coastal Plain, 15 percent hardwood-pine forested Ouachita Mountains, and 5 percent Texas Blackland Prairie. About two-thirds of the watershed is in the Texas Blackland Prairie and one-third is in the Southern Coastal Plain.

1/ All information and data, except as otherwise noted, were collected during watershed planning investigation by the Soil Conservation Service and Forest Service, U. S. Department of Agriculture.

Flood damage to crops and pastures on 11,426 acres of flood plain is the major resource problem in the watershed. Improper land use and management, critical erosion on 250 acres of land, and channel erosion in the chalk and marl formations are secondary soil and water resource problems.

Most of the upland soils were formed from chalk and marl and range from shallow to deep, slowly to very slowly permeable, poorly to well drained, acid to alkaline, and calcareous, clay soils. Other upland soils were formed from coastal plain sediment and range from poorly to well drained, slowly to moderately permeable, deep, acid, loam and clay soils. The flood plain soils are poorly to somewhat poorly drained, very slowly permeable, alkaline and acid clay, and silty clay soils.

The land capability classes and subclasses of the soils in the watershed are as follows:

Class & Subclass 1/	Acres	Percent
IIe	1,130	2
IIw	2,559	4
IIIe	6,320	10
IIIw	4,018	6
IVe	31,990	50
IVw	8,850	14
Vw	2,007	3
VIe	6,744	11
Total	63,618	100

1/ Refer to Land Capability Classification, USDA, SCS, Agricultural Handbook No. 210, September 1961, for a complete description of land capabilities.

Briefly, the land capability class (the Roman Numerals) is an interpretation of the suitability of the soil for agriculture and the subclass (the lower case letters) indicates the most limiting factor in the use of the soil. Class II soils have slight limitations; Class III soils have moderate limitations; and Class IV soils have severe limitations for crop production. Soils in Classes V and VI should remain in permanent vegetation such as pasture, hay, or forest. Subclass "e" indicates a potential erosion hazard because of the nature of the soil or the steepness of the slope. Subclass "w" indicates a limitation in use because of excess water either as overflow of floodwater, ponded surface water, poor internal drainage, a shallow

water table, or combinations of these factors. Capability classifications can change if the limiting factor is corrected. For example if flooding is controlled on a Class IVw soil that is frequently flooded, the capability could change to Class IIIw, Class IIw, or even Class I, depending upon the degree of flood control and other factors.

The land capability classes and subclasses of the soils in the flood plain are as follows:

Class & Subclass	Acres	Percent
IIw	2,559	22
IIIw	6,010	53
IVw	850	7
Vw	2,007	18
Total	11,426	100

The upland part of the watershed is in the Texas Blackland Prairie Land Resource Area (9). Geologic formations underlying the watershed are marl, marly sand, and chalk of Upper Cretaceous age (3). The cuesta and valley topography is the result of a slight dip of the bedrock toward the southeast and variations in erosional resistance. Terraces of Pleistocene sand and gravel are in the Southern Coastal Plain Land Resource Area and cover the bedrock in some places in the northern part of the watershed. The southern part of the watershed has 250 acres of critically eroding soils developed from the Marlbrook Marl and Saratoga Chalk Formations.

The topography of the watershed varies from relatively flat flood plains to rolling hills. Elevations range from 280 to 490 feet above mean sea level. The terrain includes east-northeast trending cuestas and the parallel valleys of South Fork and Middle Fork Creeks.

The average annual rainfall at Hope is 51.68 inches. A maximum annual recorded rainfall of 72.58 inches occurred in 1945. Average monthly rainfall is as follows:

Month	Inches	Month	Inches
January	5.21	July	4.09
February	4.46	August	3.26
March	5.01	September	2.93
April	5.60	October	3.17
May	5.16	November	4.57
June	3.76	December	4.46

Mean temperatures range from 43.7 degrees Fahrenheit in January to 82.0 degrees Fahrenheit in August. The minimum and maximum temperatures have been minus 10 degrees Fahrenheit and 115 degrees Fahrenheit. The normal frost-free period of 231 days is from March 21 to November 7 (10).

Mineral resources in the watershed include clay, shale, chalk, marl, greensand, sand and gravel, and ilmenite (6).

Clay deposits, associated with shale in the northwest part of the watershed, are suitable for making brick and tile. Shale in the same vicinity is suitable for haydite, a bloated lightweight aggregate suitable for construction. Chalk and marl are abundant in the thick beds of Cretaceous formations throughout the watershed and have potential values for use in cement and agriculture. The southeast corner of the watershed has large amounts of noncommercial (2.21 to 4.53 percent potash) glauconite-bearing greensand in the Nacatoch Sand. Sand and gravel from the northeast part of the watershed are used for roadstone, concrete aggregate, and cement silica. Sparse, noncommercial amounts of ilmenite, the principal titanium ore, have been found in the northwest corner of the watershed. No significant mining of minerals has occurred in the watershed.

Ground water is one of the most important natural resources in the watershed. The most productive water-bearing aquifers in the watershed are the Tokio Formation and the Nacatoch Sand. Both yield moderate supplies of water for domestic use. Quaternary alluvium and terrace deposits supply moderate yields of hard water (2).

About 57 percent of the watershed and 78 percent of the flood plain are used for agricultural production.

The present land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	9,013	14
Pasture and Hayland	27,200	43
Forest Land	25,953	41
Other Land	1,452	2
Total	63,618	100

The present land use in the flood plain is as follows:

Land Use	Acres	Percent
Cropland	6,800	60
Pasture and Hayland	2,007	18
Forest Land	2,319	20
Other Land	300	2
Total	11,426	100

Except for 5,000 acres owned by International Paper Company and several other large privately owned areas, the forest occurs as small scattered ownerships in the rolling upland portion of the watershed. Species composition of the upland forests on the Southern Coastal Plain and Texas Blackland Prairie soils are primarily loblolly pine, southern red oak, post oak, eastern red cedar, and hickory. The 2,319 acres of forest in the flood plain are mainly in Reaches I and IV and consist of willow oak, water oak, white oak, red oak, blackgum, hickory, red maple, and bald cypress. The forest land in the upper reaches of the flood plain along drainage channels is mainly sweetgum, willow, and cottonwood.

Over two-thirds of the forest land is in small farm holdings and few of these tracts have any forest management; however, International Paper Company has proper timber management on 5,000 acres in the northeastern part of the watershed. These commercial woodlands are managed primarily for softwood cellulose production. No state or national forest lands are in the watershed.

On the small privately owned woodland tracts, the hydrologic conditions of the forest soils are generally poor to very poor; the silvicultural conditions are only fair. These deteriorated woodlands are the result of past destructive logging practices, indiscriminate burning, grazing, and neglect. Site capabilities are greater than the present forest land conditions indicate. Accelerated forest management efforts in the watershed should change the hydrologic condition from very poor to fair and increase the annual production of merchantable forest products.

While the hydrologic condition of the forest floor of the commercial forest land is poor, silvicultural aspects are generally good. The present rate of improvement on these forest lands should continue.

South Fork of Ozan Creek, Middle Fork of Ozan Creek, and Ozan Creek are the major watercourses in the watershed. South Fork and Middle Fork originate in the western part of the watershed and flow eastward about 10 miles to where they combine with North Fork and form Ozan Creek. About 8 miles farther east, Ozan Creek flows into the Little Missouri River at the watershed outlet. North Fork of Ozan Creek is an authorized

Public Law 566 watershed currently under construction and was considered to be in place when this project was formulated and evaluated. About 87 percent of the South Fork and 50 percent of the Middle Fork were replaced with manmade ditches between 1920 and 1930 by local interests. Ozan Creek was realigned at 20 locations in 1965 by excavating between sharp meanders of the natural channel by the U. S. Army Corps of Engineers. This increased the capacity of the creek to carry floodwater.

The present types of channel and types of flow of all streams (in reaches beginning at outlet) downstream from the structures in the watershed are as follows:

Stream	Type of Channel	Type of Flow	Miles
Ozan Creek	Natural	Perennial	.69
Ozan Creek	Manmade (1965)	Perennial	.05
Ozan Creek	Natural	Perennial	.11
Ozan Creek	Manmade (1965)	Perennial	.09
Ozan Creek	Natural	Perennial	.15
Ozan Creek	Manmade (1965)	Perennial	.06
Ozan Creek	Natural	Perennial	.05
Ozan Creek	Manmade (1965)	Perennial	.04
Ozan Creek	Natural	Perennial	.14
Ozan Creek	Manmade (1965)	Perennial	.09
Ozan Creek	Natural	Perennial	.14
Ozan Creek	Manmade (1965)	Perennial	.06
Ozan Creek	Natural	Perennial	.23
Ozan Creek	Manmade (1965)	Perennial	.04
Ozan Creek	Natural	Perennial	1.12
Ozan Creek	Manmade (1965)	Perennial	.09
Ozan Creek	Natural	Perennial	.45
Ozan Creek	Manmade (1965)	Perennial	.07
Ozan Creek	Natural	Perennial	.42
Ozan Creek	Natural	Intermittent	.38
Ozan Creek	Manmade (1965)	Intermittent	.11
Ozan Creek	Natural	Intermittent	.65
Ozan Creek	Manmade (1965)	Intermittent	.33
Ozan Creek	Natural	Intermittent	.23
Ozan Creek	Manmade (1965)	Intermittent	.11
Ozan Creek	Natural	Intermittent	.93
Ozan Creek	Manmade (1965)	Intermittent	.10
Ozan Creek	Natural	Intermittent	.29
Ozan Creek	Manmade (1965)	Intermittent	.18
Ozan Creek	Natural	Intermittent	.48

Stream	Type of Channel	Type of Flow	Miles
Ozan Creek	Manmade (1965)	Intermittent	.07
Ozan Creek	Natural	Intermittent	.28
Ozan Creek	Manmade (1965)	Intermittent	.17
Ozan Creek	Natural	Intermittent	.42
Ozan Creek	Manmade (1965)	Intermittent	.02
Ozan Creek	Natural	Intermittent	.14
Ozan Creek	Manmade (1965)	Intermittent	.13
Ozan Creek	Natural	Intermittent	.09
Ozan Creek	Manmade (1965)	Intermittent	.14
Ozan Creek	Natural	Intermittent	.22
Ozan Creek	Manmade (1965)	Intermittent	.13
Ozan Creek	Natural	Intermittent	.49
Middle Fork	Natural	Intermittent	.80
Middle Fork	Manmade (1925)	Intermittent	6.00
Middle Fork	Natural	Intermittent	2.50
Middle Fork	Natural	Ephemeral	2.60
Middle Fork Tributaries	Natural	Ephemeral	11.80
South Fork	Manmade (1925)	Intermittent	9.10
South Fork	Natural	Ephemeral	1.40
South Fork Tributaries	Natural	Ephemeral	11.80
Summary	Natural	Perennial	3.50
	Natural	Intermittent	7.90
	Natural	Ephemeral	27.60
	Manmade (1965)	Perennial	.59
	Manmade (1925, 1965)	Intermittent	16.59

This tabulation indicates the locations and lengths of the 20 meander cutoffs (2.1 miles total) on Ozan Creek. The cutoffs shortened the length of Ozan Creek from 14.3 to 9.9 miles. The cutoffs averaged about 10 feet in depth with 15 and 20 foot bottom widths. The velocities in Ozan Creek were increased and the capacity was increased from about 800 to 1,000 cfs. About 31 percent of Ozan Creek is manmade ditches. About 69 percent of the streams have natural channels and 49 percent have ephemeral flow.

The Arkansas Department of Pollution Control and Ecology put Ozan Creek in Use Class B and Fishing Class W in the Water Quality Standards for Surface Waters. These classes indicate Ozan Creek is "suitable for desirable warm water species of fish, wildlife and other aquatic and semi-aquatic life, secondary contact recreation and other uses."

Water samples were collected for analyses on South Fork Ozan Creek and Ozan Creek, August 27, 1974. Flow on both creeks was very low. The sample point on South Fork Ozan Creek was at a county road crossing in the south corner of Section 23, T10S, R25W. The sample point on Ozan Creek was at a county road crossing near its outlet into Little Missouri River in Section 25, T9S, R24W. Water quality information on Little Missouri River near Murfreesboro was obtained from analyses made by the U.S. Geological Survey from October 1967 to September 1968. Sample results are listed in the following table.

Tests	South Fork Ozan Creek	Ozan Creek at Outlet	Little Missouri River Near Murfreesboro	Arkansas Water Quality Standards (16)
Iron Fe - mg/l	0.05	0.55	0.13	0.30 1/
Manganese Mn - mg/l	0.2	0.3	0.1	0.05 1/
Calcium Ca - mg/l	56	35	4.6	-
Magnesium Mg - mg/l	1	1	1	-
Alkalinity $CaCO_3$ - mg/l	102	96	14	-
Sulfate SO_4 - mg/l	58	6	5	10
Chloride Cl - mg/l	11	7	3	10
Nitrate N - mg/l	0.5	0.8	0.2	-
Phosphate PO_4 - mg/l	1.55	0.90	0.15	-
Total Hardness $CaCO_3$ - mg/l	145	94	15	-
Conductivity Micromhos/cm	360	194	45	-
pH	7.5	7.2	7.1	6.0 - 9.0
Water Temperature °C	26	26	15	34
Color - Apparent PT - CO Units	30	40	12	-
Turbidity JTU	15	17	14	50
Dissolved Oxygen DO - mg/l	6.0	5.0	7.7	5.0
Percent Oxygen Saturation	73	61	75	-

1/ From Rules and Regulations Pertaining to Public Water Supplies by the Arkansas State Department of Health (17).

Ozan Creeks Watershed yields about 68,300 tons of sediment yearly which would be equivalent to an average annual sediment concentration of 660 milligrams per liter. Water chemical analyses indicate that the innate productivity of the water is good for fishery. Waters with low total alkalinity values are generally biologically less productive than those with high values (15). Water quality analyses from Ozan Creek revealed that $CaCO_3$ total hardness ranged from 94 milligrams per liter to 145 milligrams per liter and alkalinities from 96 milligrams per liter to 102 milligrams per liter. These are considered average values.

Water temperatures in the streams are mostly dependent on the air and soil temperatures during and following rainfall periods because most of the flow is ephemeral or intermittent.

There are 75 acres in 150 small farm ponds, 24 acres of natural lakes as Little Missouri River remnants, and 113 acres in 10 ponds larger than 5 acres within the watershed.

The watershed has 228 acres of Type 5 wetlands (5) which are inland open fresh water and occur in the old channels of the creeks, and 24 acres of Type 6 wetlands, which are shrub swamps and occur along the lower flat reach of Ozan Creek.

Channels that traverse the Marlbrook Marl Formation tend to be deep with steep sides. The channel bed and lower one to two feet of the channel banks are in marl. Most of the banks are in residual clay. The channel beds in the marl tend to fluff and crack when dry and become highly susceptible to erosion during flows. This has resulted in about two feet of channel degradation and voiding of adjacent land.

Present and Projected Population

The 1970 population of Hempstead County was 19,308 (8). Projected population for the year 2000 is 25,000. Of the projected population 13,000 is rural and 12,000 is urban.

Population of the watershed is presently 2,160. Projected population for the watershed is 3,200 in the year 2000.

Changes in the area's population are functions of changes in the area's unemployment. Social conditions tend to improve as the resources of an area are developed and more employment opportunities become available. There are indications that the population in this area is beginning to stabilize. The future trend is expected to be that of an increasing population.

Economic Resources

The Southwest Proving Ground was established in Hempstead County as a part of the national defense effort during World War II. The portion of the defense installation occupying part of the watershed is shown on the Project Map. In 1947, the federally owned land was cleared of unexploded surface ordnance and returned to private ownership; however, a portion of the area was conveyed to private ownership for surface use only. This area is designated on the Project Map as the "hot area."

Currently, land in the watershed is privately owned. The major source of income is from the sale of poultry, livestock, and timber products. Major farm enterprises are poultry, cattle, soybeans, small grains, and livestock supporting crops. Poultry production is a major enterprise in Hempstead County. In 1969, broiler sales amounted to about 40 percent of the value of all agricultural products sold in the county (7).

The 240 farms in the watershed average 265 acres per farm. About 75 of the farms are in the flood plain.

Agricultural yields per acre in the flood plain consist of hay, 3.5 tons; pasture, 8 animal unit months; soybeans, 35 bushels; and small grain, 50 bushels. Yields in the upland areas of the watershed are hay, 2 tons and pasture, 5 animal unit months.

From 1965 to 1970, the average value of land and buildings in Hempstead County increased from $21,764 to $41,881 per farm unit (7). The flood plain land is valued at about $400 per acre. The value of the upland varies according to the location and its intended use. The upland suitable for agricultural use is valued at about $300 per acre.

A system of paved highways and county roads provides access to most of the watershed except during floods. The highway system consists of State Highways Numbers 4, 24, 29, and 195.

The City of Hope (1970 population 8,830) (8) is 12 miles south of the watershed and is the major trade center for most of the watershed residents. There are ample loading facilities for agricultural products at Hope. Rail transportation needs are met by the St. Louis and San Francisco, Missouri-Pacific, and the Louisiana and Arkansas Railroads. Four major trucklines serve the City of Hope and freight service is adequate. The industrial activity of Hope centers around lumber and woodworking industries. Sawmills, both pine and hardwood, represent a chief source of employment. Allied plants produce handles, lumber, pulpwood, crossties, and synthetic plywood or building boards. The poultry industry in the county is supported by various types of industries located in Hope.

Several wood-using outlets for sawlogs and pulpwood exist near the watershed. However, farm forests are understocked and have only a small impact on the economy of the watershed. Proper management can correct this situation because forest sites are potentially productive. This is substantiated by production achieved on industrial lands (sawtimber volumes over 3,500 board feet per acre and pulpwood volumes over 450 cubic feet per acre).

The occurrence of fires and grazing pressure is diminishing. This should accelerate the beneficial effect of any forest management practice implemented during the program period.

The urban population of Hempstead County increased from 8,399 in 1960 to 8,830 in 1970. The rural population decreased from 11,262 to 10,498 during this same period (8). Outmigration from the county is attributed to lack of employment opportunities. Underemployment is prevalent throughout this general area because of the seasonal aspects of the labor pattern. Logging contractors generally lay off many woods workers during inclement weather. This results in about 300 workers being unemployed for varying periods of time.

From 1965 to 1970, the number of farms in Hempstead County decreased from 1,395 to 944; however, the average size of farms increased from 190 acres to 225 acres. In 1970, about 282 or 30 percent of the farms in Hempstead County had agricultural sales under $1,000. Farms with sales under $2,000 constituted 45 percent of the total (7).

Of the total number of farms in the county, 735 were fully owner-operated, 155 were part-owner-operated, and 54 were tenant-operated in 1970 (7).

Per capita income for Hempstead County in 1972 was $2,691. This was below the national average of $3,687 and nearly equal to the average for the State of Arkansas of $2,791. The unemployment rate for the county was 4.3 percent (1 and 4).

Hempstead County is located in the Southwest Arkansas Planning and Development District. The county is eligible for public works grants and business loans under Title IV of the Economic Development Act of 1965. The primary purpose of this act is to improve economic and social conditions in economically depressed areas.

The Overall Economic Development Plan which has been developed for the county stresses the need for watershed protection programs to improve the social and economic well-being of the inhabitants of the area. The proposals outlined in the work plan will complement other programs for economic development of the area by providing greater employment opportunities for the unemployed and underemployed.

Hempstead County is also included in the Southwest Arkansas Resource Conservation and Development Project. This project encompasses a twelve-county area and was established under the provisions of Title I of the Food and Agriculture Act of 1962. The project provides federal assistance for projects in the multi-county area that will conserve, improve, develop, or more efficiently utilize land, water, and other natural resources.

Plant and Animal Resources

Most of the watershed consists of scattered fields interspersed with tracts of woodland. Some of the best deer habitat in Arkansas occurs in this area. Squirrels, turkeys, rabbits, bobwhites, and doves are common upland game species. Only a few waterfowl use this area, with most use confined to existing farm ponds.

Fish resources are limited to numerous farm ponds and the stream fishery in the lower reaches of the creeks. Farm ponds are stocked with bass, bluegills, redears, and channel catfish. Many of these fish escape to streams during periods of excessive rainfall and furnish an important part of the catchable population. Native fish, such as green sunfish, longear sunfish, bluegills, warmouth bass, largemouth bass, channel catfish, and bullheads, form an important part of the stream fishery.

All but 4.1 miles of the creeks cease to flow during the summer. The stream fishery is confined to small pools, mostly in the lower parts of the creeks, while much of the upper parts of the creeks are dry.

Furbearers, such as muskrat, beaver, raccoon, and oppossum, are common along the creeks. Mink, otter, and weasels are rare.

Principal watershed streams are Ozan Creek, Middle Fork of Ozan Creek, and South Fork of Ozan Creek. About 4.1 miles of Ozan Creek in Reach IV has permanent flow. The typical permanent pool in Reach IV has a depth of six feet and a width of 30 feet. The stream water registered 70 milligrams per liter total hardness in October 1972.

There are 212 surface acres of standing water fishery in the watershed. Small farm ponds comprise 75 acres, natural lakes cover 24 acres, and ponds larger than 5 acres inundate 113 acres.

The Arkansas Game and Fish Commission conducted a statewide fishery survey in the 1950's. The sport fishery value of Ozan Creek, South Fork of Ozan Creek, and Middle Fork of Ozan Creek was determined. One mile of Ozan Creek, at its mouth, was rated as a poor sport fishery. All other streams in the watershed were rated as "in need of water or fundamental improvement." Streams outside the watershed in Hempstead County consisted of 19 miles of sport fishery, 22 miles of fair

sport fishery, and 14 miles of poor sport fishery. Sport fishery values in 1972 appeared to be the same as at the time of the survey.

Land use is the most important factor that affects wildlife populations. A tabulation of the land use in the flood plain and upland parts of the watershed is as follows:

Use	Flood Plain		Upland	
	Acres	Percent	Acres	Percent
Cropland	6,800	60	2,213	4
Pasture and Hayland	2,007	18	25,193	49
Forest Land	2,319	20	23,634	45
Other	300	2	1,152	2
Total	11,426	100	52,192	100

Within these land uses, there are 8,800 acres of "edge" habitat (interspersion between woodland and other land uses), 228 acres of Type 5 wetlands (inland open fresh water), and 24 acres of Type 6 wetlands (shrub swamps). About 3,300 acres of flood plain are inundated for short durations in the spring. However, the duration is too short to classify the acreage as Type 1 wetland (seasonally flooded flats).

The flood plain land use favors farm game such as bobwhite, cottontail, and mourning dove. This applies especially to Reaches II and III where the flood plain is narrow and the interspersion of cropland, woodland, odd areas, and ditchbanks is more frequent. In Reach IV, where woodland is a major land use, whitetail deer habitat is excellent. According to the Arkansas Game and Fish Commission a wild turkey flock, approximately 25 birds, is found near Reach IV.

Land use in the upland supports principally deer and small forest game species. Croplands (4 percent upland land use) support local populations of bobwhite and cottontail. The grassland-woodland interspersion in the Texas Blackland Prairie supports smaller wildlife populations than the grassland-woodland interspersion in the forested Southern Coastal Plain.

No federal or state owned lands exist in the watershed to assure free public access to the fish and wildlife resources. Hunters have access to 5,000 acres of woodland owned by International Paper Company. Much of the privately owned land is posted, but watershed residents and others who ask permission are usually permitted access to the fish and wildlife resources.

About 56 species of fish have been collected from the Little Missouri River near the outlet of Ozan Creek. These same species are possibly in the Ozan system. The physical qualities that reduce the probability of all 56 species inhabiting the system for significant periods are only 5 percent permanent flow, maximum pool depths of 6 feet and widths of 30 feet, and limited riffle areas.

Adult longnose gar will move into the Ozan Creek stream system to spawn and the young gar will spend their first summer there, then migrate into the Little Missouri River as adults. Other species following the same pattern are buffalo fish, black bass, crappie, bullheads, and bowfin. In the spring, these adult species are found in the Ozan system. In other seasons, they are found in Reach IV where backwater from the Little Missouri River enters the Ozan Creek channel.

Resident species of the Ozan Creek system are forage fish and smaller sunfish. Prevalent forage species are grass pickerel, golden shiner, emerald shiner, bigeye shiner, redfin shiner, blacktail shiner, blackspotted topminnow, mosquitofish, tadpole madtom, brindled madtom, creole darter, harlequin darter, and logperch. Longear sunfish, green sunfish, and bluegill are the dominant sunfish and any sample will reveal different size classes.

The Ozan Creek stream system will provide an estimated 75 annual man-days of fishing in Reach IV during the spring and early summer.

Watershed streams support no commercial fishery. The Arkansas Game and Fish Commission reported that in 1970 no residents of the watershed purchased commercial fishing licenses, regular or casual. This indicates that residents do not use the watershed fishery resource commercially.

The 40 acres of catfish-producing ponds in the lower end of the watershed comprise about 50 percent of the intensive fish culture in Hempstead County.

The average number of deer legally killed per county in Arkansas in 1971-72 was 312. Hempstead County reported 419 legal kills which ranked 19th statewide. This indicates an above average deer population in the area.

Hempstead County reported three turkeys killed in the northern two-thirds of the county in 1972. Small turkey harvests have occurred for the past 10 years.

No data exist for waterfowl populations, but the scarcity of wetland habitat indicates that waterfowl populations are low.

In 1970, the relative density of resident mourning dove populations in the West Gulf Coastal Plain physiographic region, of which this watershed is a part, was below average. Density estimates of fall populations of other small game species, based on present land use, indicate one rabbit (cottontail and swamp) per 8 acres (total area), 1 bobwhite per 15 acres (total area), and 1 squirrel (gray and fox) per 7 acres (woodland only).

Nongame mammals found in the watershed during some portion of their life history are the least shrew, short-tailed shrew, eastern mole, 10 species of bats, nine-banded armadillo, and 15 species of rodents, including 3 old-world species (house mouse, black rat, and Norway rat).

Because of the mobility and migratory nature of birds, as many as 250 species may be seen in one day. Wetland species are less likely to be seen in this watershed than openland or woodland species.

Major groups and number of species of amphibians and reptiles that may be found within the watershed during all or a part of their life cycle are presented in the following list:

Toads - 2 species
Frogs - 10 species
Salamanders - 9 species
Lizards - 8 species
Turtles - 11 species
Snakes - 31 species, including the Texas Coral Snake, Southern Copperhead, Western Cottonmouth, Canebrake Rattlesnake, Western Pygmy Rattlesnake, and Western Diamondback Rattlesnake.

Rare or endangered species that may be permanent residents or casual visitors to the watershed are the red-cockaded woodpecker, bald eagle, and red wolf (14).

Recreational Resources

The watershed has limited recreational resources. These consist primarily of scattered open fields, tracts of forested land, and Ozan Creek. The resources provide sightseeing, hiking, birdwatching, and pleasure driving.

Access to the resources is usually permitted by the landowners.

The intermittent and ephemeral streamflows and streambank erosion cause the streams to have low values as recreational resources. No recreational facilities are available in the watershed.

Archeological and Historical Values and Unique Scenic Areas

The Arkansas Centennial Commission erected a marker, Henry's Chapel Monument, in the southwest corner, SE 1/4, SE 1/4, Sec 12, T11S, R26W, in 1936. The marker is at the reputed location of the first Methodist Church erected in Arkansas. The church, Mount Moriah, was erected in 1816 under the direction of the first Methodist preacher in south Arkansas, The Reverend John Henry. Mount Moriah Home Church is presently 1/4 mile south of Henry's Chapel Monument. No historical place is listed in, pending inclusion to, nor under consideration for nomination to the National Register of Historic Places in the watershed.

The Arkansas Archeological Survey, under a cooperative agreement with the Soil Conservation Service, prepared a preliminary report on the archeological resources of the watershed. The report covers only the reservoir areas of the proposed floodwater retarding structures.

A gross chronological cultural sequence can be determined for this area (13). Prehistoric cultures including Paleo-Indian (Circa 10,000 to 6,000 B.C.), Archaic (Circa 6,000 to 2,000 B.C.), Fourche Maline (Circa 1,000 B.C. to 500 A.D.), and pre-Caddoan and Caddoan (Circa 500 A.D. to 1,600 A.D.) are well represented in artifact surface collections. Early Historic artifacts represented in surface collections brings this gross chronological cultural sequence up to the present.

Based upon the work of M. R. Harrington (1920), the archives, and the Ozan Creeks Watershed archeological survey, this area of southwest Arkansas is extremely important archeologically, from both a prehistoric and a historic perspective. Not one of the aforementioned prehistoric cultures or the historic culture has been examined adequately in the Ozan Creeks Watershed portion of Arkansas. Before the prehistoric and historic cultural picture of Arkansas can be completed, this portion of southwestern Arkansas must be investigated archeologically.

Paleo-Indian and Archaic cultures of this area are relatively unrecorded. The Fourche Maline culture is known to exist in this area; however, its cultural attributes have not been investigated adequately. The Caddoan culture has been investigated to some degree, but cultural reconstruction for the Ozan Creeks area is not possible based upon the existing data. The early historic period of this area has been preserved to a certain extent by Washington State Park. Nevertheless, the outlying areas, the areas around Ozan Creeks, must have provided water and farm land for subsistence for the early inhabitants of Washington, Arkansas.

Certain specific sites near the Ozan Creeks area have, however, been archeologically investigated. The Mineral Springs site (Bohannon 1973) and selected sites on the Little River prior to the construction of Millwood Reservoir (Hoffman 1967a and 1968) have contributed to a much better scientific understanding of the Caddoan culture in southwest Arkansas. Schambach (1973) has provided a general sequence of diachronic cultural history for the Mid-Ouachita region in south-central Arkansas based predominately on two pre-Caddoan sites, Cooper and Means. All of these sites produced valuable archeological data; therefore sites in the Ozan Creeks area should also contain significant archeological information badly needed for socio-cultural reconstruction of the indigenous populations of southwest Arkansas.

Many more archeological questions need to be answered before this adequate reconstruction of past life-ways can be obtained. Sites located in the Ozan Creeks drainage can answer several of these questions. Cultural relationships between sites of the same time period can be determined. Relationships between ceremonial centers and outlying hamlets, and between similar ecological niches as well as different ecological niches can be understood in much more depth than presently known.

The following table is an inventory of archeological sites located during the archeological survey.

Archeological Site Number	Cultural Association
3HE40	Caddoan
3HE41	Caddoan
3HE115	Fourche Maline
3HE116	Unknown
3HE117	Unknown
3HE118	Archaic & Caddoan
3HE119	Archaic
3HE120	Archaic & Fourche Maline
3HE121	Possibly Archaic
3HE122	Fourche Maline, Caddoan, Historic
3HE123	Possibly Paleo-Indian & Caddoan
3HE124	Possibly Fourche Maline & Caddoan
3HE125	Possibly Caddoan
3HE126	Archaic
3HE127	Possibly Archaic & Caddoan
3HE128	Caddoan
3HE129	Possibly Fourche Maline
3HE130	Possibly Archaic
3HE131	Possibly Caddoan
3HE132	Caddoan
3HE133	Fourche Maline & Caddoan
3HE134	Possibly Caddoan
3HE135	Caddoan
3HE136	Possibly Caddoan
3HE137	Caddoan
3HE138	Caddoan
3HE139	Caddoan
3HE140	Caddoan
3HE141	Caddoan
3HE142	Caddoan
3HE143	Caddoan
3HE144	Unknown

Soil, Water, and Plant Management Status

Trends in land use changes in the flood plain have been from intensive cropping to grassland operations because of increased hazard of flooding. This trend is most pronounced in the areas of frequent flooding.

The future trend in the entire watershed is expected to include further conversions among the various land uses. The following conversions are expected in the woodland of the watershed; 4,000 acres to pasture and hayland, 300 acres to cropland, and 800 acres for use as wildlife habitat. Other expected conversions include about 800 acres of rangeland to pasture and hayland, 500 acres of pasture and hayland to cropland, and 300 acres of idle land to cropland.

Completed land treatment measures include brush management, 18,000 acres; conservation cropping system, 7,000 acres; contour farming, 400 acres; crop residue management, 7,000 acres; deferred grazing, 500 acres; diversions, 50,000 feet; drainage mains and laterals, 50,000 feet; drainage field ditches, 50,000 feet; farm ponds, 150; grade stabilization structures, 10; grassed waterways, 2 acres; pasture and hayland planting, 19,449 acres; pasture and hayland management 14,000 acres; proper grazing use, 1,000 acres; terrace gradient, 150,000 feet; and wildlife habitat management, 300 acres.

The watershed is served by the Hempstead County Soil and Water Conservation District. Technical assistance is provided to the district by the Soil Conservation Service field office at Hope, Arkansas. About 72 landowners cooperate with the district. Conservation plans covering 70 percent of the watershed have been developed with these cooperators and about 70 percent of the planned measures have been installed. These measures have proven beneficial in retarding rainfall runoff and reducing soil erosion.

Soil surveys within the watershed are in progress. The lack of completed standard soil surveys is not expected to hinder the application of needed land treatment measures. About 47,384 acres will require mapping during the project installation. About 4,000 acres will be mapped with funds from the present program and 43,384 acres with funds from Public Law 566. The needed surveys can be made during project installation.

The only major forest management has been on the 5,000 acres of industrial forests.

Effective fire protection is provided by the Arkansas Forestry Commission in cooperation with the U. S. Forest Service through the Clarke-McNary Cooperative Fire Control Program. Other available federal-state forestry programs include Cooperative Forest Management, Cooperative Reforestation, General Forestry Assistance, and Cooperative Insect and Disease Control.

WATER AND RELATED LAND RESOURCE PROBLEMS

The major problem in the watershed is flood damage to crops on 11,426 acres of the flood plain. Secondary problems are improper land use and management, critical erosion on 250 acres, and channel erosion.

Land and Water Management

The conversion of cropland to permanent vegetation in the upland part of the watershed has resulted in the need for different types of land treatment measures. The major problem is the installation of land treatment measures on the small scattered actively eroding areas that have resulted from cultivation or overgrazing. Most of these areas are on chalk or marl and should be deferred from use until vegetative covers are established; however, the barren eroding areas are too small to treat as management units by the landowners and the management units cannot be treated as critically eroding areas for economic reasons. Proper grazing practices are especially important in the upland because of the highly erosive soils and the difficulty of revegetating eroded areas.

Proper land treatment practices such as conservation cropping systems, crop residue management, and onfarm drainage cannot be practiced on the areas of the flood plain that are frequently flooded nor can these areas be used to their greatest capability. About 18 percent of the flood plain is in pasture and hayland that could be used for cropland if flooding were controlled.

Floodwater Damage

About 11,426 acres of bottom land in the watershed are subject to floodwater damages by a 100-year frequency flood.

The flood plain was divided into four reaches to evaluate flood damages. These reaches were located to group areas that have similar flood problems and that are expected to be affected similarly by structural measures. The location, total flood plain, and average annual area flooded in each reach are as follows:

Reach	Location	Total Flood Plain (acres)	Average Annual Area Flooded (acres)
I	East Patrol Road to Common Flood Plain	4,866	14,017
II	South Fork Ozan Creek	1,881	2,075
III	Middle Fork Ozan Creek	3,013	3,247
IV	Common Flood Plain	1,666	6,019
Total		11,426	25,358

The preceding table reveals that the average annual area flooded in all reaches is greater than the total flood plain. This indicates that severe flooding occurs several times annually. The average annual area flooded is the cumulative acres of land flooded by each expected flood in a 100-year period divided by 100.

Flooding in Reach I is severe and restricts land use. Projected land use (without project) on the 4,866 acres of flood plain in Reach I is forest land, 1,460 acres; cropland, 2,189 acres; grassland, 1,119 acres; and miscellaneous, 98 acres. About six damaging floods occur each year and a major flood inundating more than half of the flood plain can be expected annually. Average annual flood damages in Reach I are estimated to be $275,570. North Fork Ozan Creek contributes to flooding in this reach and Reach IV.

Flooding in Reach II is less severe than in Reach I. About four damaging floods occur each year, and a major flood inundating more than half the flood plain can be expected twice in three years. The use of the flood plain for crop production is hampered by the flood hazard. Projected land use (without project) on the 1,881 acres of flood plain in Reach II is cropland, 1,222 acres; grassland, 564 acres; and miscellaneous, 95 acres. The average annual flood damages in Reach II are estimated to be $63,330.

Flooding in Reach III is similar to that in the lower part of Reach II. Reach III has about four damaging floods per year with a major flood occurring once every two years. The land in Reach III is the most highly developed in the watershed, consisting of about 70 percent cropland. Further development is hampered by continued flooding. Projected land use (without project) of the 3,013 acres of flood plain is cropland, 2,129 acres; grassland, 794 acres; and miscellaneous, 90 acres. Average annual flood damages in Reach III are estimated to be $115,410.

Flooding in Reach IV occurs from two sources, the Little Missouri River and Ozan Creek. Floods from the Little Missouri River have been partially controlled by measures implemented by the Corps of Engineers. Projected land use (without project) on the 1,666 acres of flood plain in Reach IV is forest land, 666 acres; cropland, 500 acres; grassland, 417 acres; and miscellaneous, 83 acres. About six damaging floods occur per year and a major flood that inundates more than half the flood plain is expected annually. Average annual flood damages in Reach IV are estimated to be $44,990.

Variations in land use and intensity of production are reflected by comparing damageable values and floodwater damages. The following tabulation presents, by reaches, the estimated per-acre value of production, the average annual crop and pasture damage per acre, and the average percent damage to the value of production annually.

Reach	Location	Damageable Value Per Acre (dollars)	Annual Crop and Pasture Damage Per Acre (dollars)	Gross Production Damaged Annually (percent)
I	East Patrol Road to Common Flood Plain	95.16	37.53	39
II	South Fork Ozan Creek	122.94	19.13	16
III	Middle Fork Ozan Creek	128.16	20.31	16
IV	Common Flood Plain	86.36	27.00	31

About 45 miles of fence are annually damaged by floods, with an estimated loss of $25,700.

Damage to roads and bridges in the flood plain of the watershed constitutes nonagricultural damage. About 5.5 miles of county roads are subject to overflow by a 100-year frequency flood. Three roads are damaged annually, and two are damaged about once every two years. Average annual road damages are estimated to be $60,110.

Indirect damages result from threatened or actual flooding and include interruption of travel; loss of income by workers who commute or are unable to work in the fields; loss or delay in sales by local merchants; and additional time, distance, costs, and general inconvenience associated with marketing of farm products, delivering mail, and transporting children to school. Indirect damages of $45,390 per year are about 10 percent of the direct damages.

A typical major spring flood occurred in May 1969. The flood approached the 2-year frequency event and inundated approximately 8,026 acres of the flood plain. Damages caused by this flood were estimated to be $266,490. Damages included crop and pasture, $187,000; nonagricultural, $35,860; other agricultural, $19,400; and indirect, $24,230.

Erosion Damage

Total erosion in the watershed results from sheet erosion, 72 percent; streambank erosion, 17 percent; roadside erosion, 5 percent; gully erosion, 3 percent; and flood plain scour, 3 percent. Sheet erosion averages about 2.2 tons per acre per year, ranging from 14 tons per acre per year on a few remaining cropped acres in the upland down to 0.1 ton per acre in the nearly level, infrequently flooded portion of the flood plain.

About 250 acres of watershed land are eroding critically. Active gullies constitute 173 acres of this total, occurring at scattered locations throughout the upland along the southern portion of the watershed. Gullies in this area have eroded into the underlying chalk and marl with erosion rates averaging 29 tons per acre per year. The remaining 77 acres of critically eroding areas consist of streambank erosion immediately downstream from Structures Numbers 17, 19, and 20 (see Figure 3). Erosion from this source occurs in connection with side water entry into the existing channels. Erosion rates range from 6 to 62 tons per acre per year depending on streambank soil materials and the amount of side water entering.

Degradation of the streambed is a problem on about a two mile segment of channel immediately downstream from Structures Numbers 7, 8, and 9 in Reach III and on about 11 miles of channel in Reach II. Most of the channels in these areas have bottoms in marl which is highly susceptible to erosion when dry. Ephemeral flow conditions in the streams lead to periodic drying of the streambed with associated cracking and fluffing of the marl. Subsequent stream flows flush the loose material from the channel bed. Degradation of the streambed is occurring at an estimated rate of one-half inch per year, and currently is incised approximately two feet into the underlying marl.

Approximately 2.6 acres per year of flood plain land is being lost by channel enlargement. Essentially all of the streams in Reaches II and III are affected to some degree by channel enlargement. Lateral erosion rates of the channel banks vary between 0.1 and 0.4 feet per year. About 21 miles of channel banks in Reach II and 27 miles in Reach III are affected. This land voiding, which is reducing the flood plain acreage in Reaches II and III by 0.05 percent per year, causes an annual loss of $2,740.

Flood plain scour occurs on about 285 acres. Of this, 11 acres are damaged 10 percent, 138 acres are damaged 20 percent, and 136 acres are damaged 30 percent. Flood plain scour causes an annual loss of $7,840.

Sediment Damage

Sedimentation by overbank flooding damages crops on 1,116 acres of the flood plain. Most of the damage occurs as a continuous widespread deposit of relatively infertile clay. Deposition has been slow and the sediment texture is similar to that of the original flood plain soils. Of the area damaged 895 acres are damaged 10 percent, 206 acres are damaged 20 percent, and 15 acres are damaged 30 percent. The damages occur on agricultural land and are equal to an annual loss of $15,070 of agricultural production.

The average annual sediment yield at the outlet of the watershed is about 68,300 tons. This yield is from Ozan Creeks Watershed only. Although sediment is not a major problem at the watershed outlet, sediment pollution of the Little Missouri River is increased by Ozan Creek. The 68,300 tons of sediment would be equivalent to an average annual sediment concentration of 660 milligrams per liter in Ozan Creek.

Recreation Problems

Ozan Creek is a limited recreational resource because the water flows intermittently and the banks are highly susceptible to erosion. During the summer months, the stream fishery is normally confined to small pools in the lower reach of the creek. Sediment deposits and intermittent flows in the stream are detrimental to its recreational potential.

State, county, and private roads provide access to the recreational resources in the watershed, but permission to use the resources should first be obtained from the landowners.

The 1970 population of the urban communities within 50 miles of the watershed was about 40,000. This was a 5-percent increase over the population in 1960. If this trend continues during the life of the project, the urban population would increase to about 65,000.

Millwood Reservoir and Narrows Dam-Lake Greeson, which are Corps of Engineers projects, are within one hour's drive of the watershed.

Plant and Animal Problems

Over a period of years land use changes have occurred that have had an overall detrimental effect on wildlife. Upland cotton fields have been converted to pasture or pine plantations. Upland woodland is being converted to pasture and bottomland woodland is being converted to soybeans. Native pasture is becoming improved pasture and, through timber stand improvement practices, hardwood-pine is becoming pine-hardwood. Deer, squirrel, and turkey are all adversely affected by these land use changes, while bobwhite and rabbit would tend to benefit from the changes. Although not enumerated, many nongame species do not benefit from these practices.

Flooding has a minor effect on populations of ground-dwelling and ground-nesting species because flooding is temporary (48 hours or less in Reaches I, II, and III) and coverts exist above the flooded area. Reach IV is subject to flooding from the Little Missouri River as well as from Ozan Creek. Spring floods have the greatest effect. The renesting of birds and immigration of other species repopulate areas affected by flooding.

The watershed can supply its residents with sufficient deer and small game hunting. Waterfowl hunters and turkey hunters have to use other areas to fulfill their hunting pleasures. Virtually all of the fishing

demand has to be satisfied outside the watershed. This demand can be met by the standing water habitat within 60 miles of the watershed which includes Lake Ouachita, Lake Hamilton, Lake Catherine, Lake Erling, DeGray Reservoir, First Old River Lake, White Oak Lake, Bois d'Arc Lake, Lake June, Narrows Dam-Lake Greeson, and Millwood Reservoir in Arkansas and Lake Texarkana in Texas. DeQueen Reservoir, Dierks Reservoir, and Gillham Reservoir are under construction. These lakes provide 127,000 surface acres of permanent standing water fishery.

Accessible running water fishery habitat is provided by the Ouachita River, Little River, Little Missouri River, Cossatot River, Rolling Fork River, Caddo River, Saline River, Red River, Sulphur River, Bodcaw Creek, Antoine River, Terre Noire Creek, Terre Rouge Creek, and numerous smaller streams.

Public hunting areas within 60 miles of the watershed are the Ouachita National Forest administered by the U. S. Forest Service and 35,000 acres owned and managed by the Arkansas Game and Fish Commission. Hunters have unrestricted access to areas owned by International Paper Company, Georgia-Pacific Corporation, Potlatch Industries, and Weyerhaeuser Company.

Economic and Social

In 1970, about 282 or 30 percent of the farms in Hempstead County had sales under $1,000. Farms with sales under $2,000 were 45 percent of the total (7).

The watershed is in an area which is eligible for aid under the Public Works and Economic Development Act of 1965.

Additional employment opportunities are needed in the area. The unemployment rate is 4.3 percent for Hempstead County and the per capita income is $2,691 (1 and 4). This low income reduces the individual purchasing power and the tax base. General promotion of rural community development is needed in the watershed.

PROJECTS OF OTHER AGENCIES

Ozan Creeks Watershed is located in the Little Missouri River Basin and is affected by flood control works constructed in the basin (12).

The Corps of Engineers, in 1950, completed the construction of Narrows Dam-Lake Greeson near Murfreesboro in Pike County, Arkansas. This project regulates flood flows in the Little Missouri River and Ouachita River Basins.

In 1965, the Corps of Engineers completed the construction of channel work projects which are parts of the Little Missouri River Flood Control Plan. This work consisted of channel clearing and snagging and the excavation of 31 cutoffs in the lower 94 miles of Little Missouri River and 20 cutoffs in the lower 14 miles of Ozan Creek. The channel work is maintained by local interests.

An additional flood control reservoir authorized for construction in the Little Missouri River Basin is located on Muddy Fork, a tributary of the Little Missouri River, about four miles west of Murfreesboro. This project has been placed in the "deferred for restudy" category.

Installation of the Ozan Creeks Watershed will be compatible with these efforts to control flooding in the Little Missouri River Basin since the project will reduce flood flows from a major tributary in the Basin.

PROJECT FORMULATION

The sponsors of the watershed project recognized the need for a comprehensive approach to the watershed problems. They made an application to the Arkansas Soil and Water Conservation Commission on January 31, 1963, for assistance under the provisions of Public Law 566. The Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District was formed under Act 424 of 1965, Arkansas Statute 9-919.

Preliminary field inspections were made by the Soil Conservation Service and the Forest Service during 1963. A preliminary investigation report was made by the Arkansas Soil and Water Conservation Commission on September 19, 1967. The state set the planning priority for upland watersheds as number 5 for Ozan Creeks and a request for planning authorization was made on May 16, 1969. Planning authorization was obtained July 22, 1969.

Preliminary cost estimates were furnished to the City of Blevins for the inclusion of water storage for a municipal and industrial water supply in Site 10. The city was informed of the Water Development Fund of the State of Arkansas which is used to finance local costs of multiple purpose structures for water supplies or recreation lakes. The city indicated that they did not wish to sponsor a water supply at this time.

The possibilities of developing water-based recreational resources in the watershed were discussed with local residents. They were not interested because the topography of the watershed is not suitable for large water-related recreational developments.

Additional technical information was obtained during planning from the Corps of Engineers, Vicksburg District, and the U. S. Geological Survey, Little Rock District.

The U. S. Fish and Wildlife Service submitted a report on the watershed March 11, 1970, with recommendations concerning the project. The Arkansas Game and Fish Commission concurred in these recommendations in a letter dated February 26, 1970. The recommendations included the following:

1. Adequate flows in the stream channels downstream from the project impoundments be maintained;

2. Additional storage be provided in the impoundments and released at a constant rate to reduce channel erosion;

3. Mid-level gates be incorporated in the reservoir outlet works to facilitate fishery management.

The State Conservationist for the Soil Conservation Service, in a letter dated April 29, 1970, indicated that the recommendations of the Fish and Wildlife Service would be incorporated into the work plan.

A meeting of landowners was held on March 22, 1971, as a result of the Fish and Wildlife recommendations and studies of ditch stability. This meeting resulted in the deletion of all channel work in the project and acceptance of the proposed structure sizes and locations by the sponsors.

A cooperative agreement between the Arkansas Archeological Survey and the Soil Conservation Service provided for the state to furnish qualified archeologists, supervision, equipment, and material to perform archeological surveys. The Soil Conservation Service furnished maps, drawings, sketches, and technical specifications of the area to be surveyed and reimbursed the state for performing the archeological survey. The Survey: (1) determined if archeological resources exist within the area committed to the project; (2) recorded, identified, and appraised any located resources; (3) evaluated the impact of project installation on each resource; and (4) provided recommendations for mitigation of anticipated adverse impacts. The final report by the Survey was furnished to the Soil Conservation Service in August 1974. Estimates of costs required by salvage or protection were not included in the report.

No historical place in the watershed is listed in or pending inclusion to the National Register of Historic Places. Consultation with the State Historical Preservation Officer and the Arkansas Archeological Survey indicated that the archeological sites might be eligible for inclusion in the Register. The Soil Conservation Service requested a determination of eligibility on these sites from the Department of the Interior on March 11, 1975, in compliance with Section 800.4(a)(2) of the "Procedures for the Protection of Historic and Cultural Properties" (36 C.F.R. Part 800). The Soil Conservation Service has also complied with Section 106 of Public Law 89-665 and Executive Order 11593.

A public information meeting to review the project was held September 25, 1974. Approximately 45 people were in attendance, including landowners and representatives of the Soil Conservation Service, Arkansas Division of Soil and Water Resources, Arkansas Game and Fish Commission, and the Arkansas Highway Department.

North Fork of Ozan Creek, a Public Law 566 watershed, is currently under construction. This tributary contributes to flooding in Reaches I and IV of Ozan Creeks Watershed. The North Fork Ozan Creek Watershed was assumed to be in place during the evaluation of Ozan Creeks Watershed.

The Ozan Creeks Watershed Project is located in the Ouachita River Basin. A Type IV Comprehensive Multipurpose Plan is currently being developed for this Basin. The Ozan Creeks Watershed Project is a feasible project which will help meet projected needs for this area within the next 10 to 15 years.

Objectives

After consideration of the needs of the watershed and the physical capabilities of the area, the following objectives were agreed upon by the sponsoring local organization and the Soil Conservation Service:

1. To install needed land treatment measures which will:

   a. Increase the efficiency of land use and obtain maximum benefits from the proposed improvements.

   b. Reduce the soil loss in the watershed to an average of less than 3.0 tons per acre per year.

2. To install structural measures which will provide protection for the area which is now subject to frequent damaging floods and reduce damages from the floods as follows:

   a. The maximum feasible amount in Reach I.

   b. Sixty percent in Reach II.

   c. Sixty percent in Reach III.

   d. The maximum feasible amount in Reach IV.

3. To install structural measures and land treatment measures which will provide maximum feasible protection to fish and wildlife resources.

4. To provide an acceptable level of protection from flooding at the lowest cost considering installation, operation, maintenance, and replacement costs.

5. To make the watershed an outstanding example of soil and water conservation.

An analysis of the land treatment data in the conservation district's records indicated that the land treatment goals which had been agreed upon were realistic and could be accomplished during the 5-year project installation period if additional technical assistance were provided.

The forest land treatment program was developed from information acquired during a field survey of the watershed, subsequent consultation by the Arkansas Forestry Commission and the U. S. Forest Service, and from land use recommendations by the Soil Conservation Service. This program is based on the needs beyond those met by the existing cooperative federal-state forestry programs. The goals are realistic and can be accomplished during the 5-year installation period. Public Law 566 funds for accelerated technical assistance are provided as part of this project.

The Arkansas watershed fire protection goal is 0.20 percent. The average percent burn in this watershed for the years 1965 through 1969 was 0.14.

During project formulation, six systems of structural measures were analyzed. They included various numbers and locations of floodwater retarding structures without channel work and floodwater retarding structures with channel work. The systems containing channel work resulted in an increased level of flood protection, but because of the high velocities, it would be difficult to design a stable channel that could be installed and maintained at a reasonable cost and their inclusion in the plan might have resulted in the stimulation of clearing of some of the bottom land hardwoods in the flood plain.

Environmental Considerations

Some incidental recreational use could occur at the floodwater retarding structures. Providing public access to the structures is the responsibility of the local sponsors. After due consideration the sponsors decided that they would not provide public access to any of the floodwater retarding structures.

Low-flows will be released through ungated ports in the principal spillway risers. The water will help maintain streamflow throughout the year and will operate continuously except during extreme droughts. Additional amounts of water will be released from selected structures to maintain wet-bottom channels. The continuous wetting of the channels is expected to reduce the channel degradation caused by an unstable soil condition. The fishery habitat should be improved throughout the watershed by the continuous flow in the channels.

Alternatives

The following alternatives were considered in formulating the proposed project:

1. Land treatment measures only.

2. Land treatment with land stabilization measures.

3. Land treatment with land stabilization measures and alternate systems of floodwater retarding structures.

4. Land treatment with land stabilization measures, floodwater retarding structures, and a floodway.

5. Land treatment with land stabilization measures, floodwater retarding structures, and channel work.

6. No project action.

The installation of land treatment measures would reduce erosion rates about 17 percent. Floodwater damages would be reduced about 3 percent. The cost for land treatment measures would be about $654,300 and would provide annual flood protection benefits of $4,670. This alternative alone would not have significant effects on streamflow patterns, flood plain land use, or upland wildlife habitat. This alternative would not stabilize critically eroding areas.

The alternative of land treatment with stabilization measures on 250 acres of critically eroding areas would produce about the same reduction in floodwater damages; however, a significant source of sediment would be subjected to treatment, and erosion on these areas would be reduced about 92 percent. The cost of this alternative is about $803,000.

In order to reduce the damages from large volumes of floodwater, alternate systems of floodwater retarding structures were considered.

Four floodwater retarding structures were considered within the areas restricted for surface use where the Southwestern Proving Grounds were formerly located but were eliminated because of the excessive costs and danger involved in construction.

Six combinations of structural measures were evaluated, in conjunction with land treatment measures and stabilization measures on critically eroding areas. If the critically eroding areas were not treated, up to 43 percent of the sediment yield at the structures would come from these areas. With treatment on these areas, a maximum of 6 percent of the sediment yield at the structures would come from this source. Without treatment, these areas would continue to erode and enlarge and increase downstream damages. The omission or inclusion of the land stabilization measures would not significantly change the benefits derived from protection afforded by the floodwater retarding structures.

An additional alternative would include a floodway in the lower reach of the flood plain on Ozan Creek to contain flood flows. This alternative would be in addition to the system of land treatment measures, land stabilization measures, and floodwater retarding structures. This alternative would considerably alter the ecosystem in the floodway and most of the bottom land hardwood in the watershed would probably be cleared for constructing the floodway or for agricultural production. New channels would be required outside the floodway to prevent flooding on tributary streams and flooding upstream from the floodway would be increased in some areas. This alternative would cost an estimated $4,648,600.

The substitution of channel work in place of a floodway, in combination with the other measures, would reduce floodwater damages but the higher level of protection afforded by channel work would induce clearing of bottom land hardwoods for agricultural production and reduce the amount of wildlife habitat available. A general deterioration of the environmental quality along the channel and in the flood plain would result from channel work. This alternative would cost about $4,409,600.

If no project action is taken, flood damages will continue to occur and critical areas will continue to erode. Land treatment measures will continue to be installed at about the present rate but the improvement and protection of the land at an accelerated rate will not be possible. Wildlife habitat will remain in its present state or change at a normal rate for improvement or deterioration in quality for individual species. The fishery resource will probably remain in its present state. No land will be required for construction purposes and no production will be lost in construction sites.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Hempstead County Soil and Water Conservation District has been conducting a conservation program on the farms within the watershed for several years. This program, based upon the use of each acre of land within its capabilities and treatment in accordance with its needs, is an essential part of watershed protection. The extent of land treatment measures that have previously been applied within the watershed represents an expenditure by landowners and operators of about $969,935 (Table 1A).

Accelerated application and continued maintenance of conservation land treatment measures is particularly important for protection of 14,560 acres of land which comprise the total drainage area above the planned floodwater retarding structures. Conservation land treatment measures will reduce the capacity which must be provided for sediment accumulation

in the floodwater retarding structures. About 37,632 acres of upland below the structures contribute to the sediment damage occurring on the flood plain. Land treatment measures on this land will reduce the sediment damages on the 11,426 acres of flood plain. The entire watershed will be subject to accelerated land treatment measures.

Table 1 includes estimates of the acreage in each major land use which will be adequately treated during the 5-year project installation period. The measures will be established and maintained by the landowners and operators in the watershed in cooperation with the going district program. Public Law 566 funds will provide $53,300 for technical assistance to accelerate the installation of needed land treatment measures. An additional $4,450 will be provided to hasten the completion of standard soil surveys in the watershed.

Land is presently being cultivated throughout the watershed; however, in the upland areas, the trend has been toward planting grass or trees on the land subject to excessive erosion. This trend is expected to continue with the steeper land presently in cultivation being converted to a permanent vegetative cover. In the flood plain, the trend will be to convert to cropland some of the land presently used for grassland.

Conservation land treatment measures will be applied on all the cropland in the watershed and 9,000 acres will be adequately treated during project installation. The use of sound land management will be encouraged through the use of conservation cropping systems, fertilization, liming, proper tillage, and crop residue management. Conservation cropping systems include the use of cover and green manure crops or rotations with grasses and legumes to insure adequate residue to provide a vegetative cover for erosion control and to maintain a good physical condition of the soil. Upland areas remaining in cultivation will be contour cultivated. Existing terrace systems will be maintained or reworked and new systems will be constructed where needed.

Some bottom land soils will require drainage systems, including drainage mains and laterals, drainage field ditches, grade stabilization structures, and structures for water control. These drainage systems will be installed on individual farms or by a group of landowners. These drainage systems will remove excess surface water and help improve the efficiency of crop production on the bottom land soils.

Approximately 22,000 acres of pasture and hayland will be adequately treated during project installation with proper management which will include brush management, weed control, fertilization, liming, proper grazing use, renovation, and seeding additional grasses and legumes. All pasture and hayland in the watershed will be subject to the accelerated application of land treatment measures. About 4,800 acres of native pasture, low-grade hardwoods, and cropland will be seeded to pasture or hayland. The principal grasses to be planted are bermudagrass, bahiagrass, and tall fescue.

Vegetative cover on 6,900 acres of native grassland will be improved for increased forage production by proper grazing use and brush management and weed control. Present cover includes areas of brush and weeds which will be suppressed. Grass species will be benefited. Among those are fescue and bahiagrass. These grasses provide winter food for several species of wildlife both from forage and seed production.

About 45 farm ponds will be constructed to provide additional water for livestock and to encourage better distribution of grazing. This will result in the improvement of the vegetative cover adjacent to the present watering facilities. Most of these farm ponds will be stocked with fish. Production in all ponds in the watershed can be improved by controlling aquatic weeds, fertilizing, and feeding the fish.

Landowners will be encouraged to manage odd areas and wetland areas as wildlife habitat. These areas will be protected from fire and harmful grazing. Specific wildlife species will be favored, depending on the type of habitat. Trees and other herbaceous species especially valuable to wildlife will be favored. Other areas will be planted to herbaceous and woody plants that are specifically selected for their value to wildlife.

The forest land treatment measures are designed and proposed to reduce runoff and erosion. Proper forest management and protection will accelerate the development of humus, which will increase infiltration and storage of water. Humus-building tree species, game food species, and den trees favored during cutting operations and interplanting will develop well-aggregated soils and accelerate the development of a varied and productive wildlife habitat. Landowners having forest land will be encouraged to apply and maintain forestry measures on their forested lands. The U. S. Forest Service, by and through the Arkansas Forestry Commission, will provide technical assistance in the planning and application of forest land treatment measures on the watershed under the going Cooperative Forest Management Program. They will provide additional technical assistance for accelerating the installation of forestry measures. A forester trained in watershed management will be assigned to this project to guide and assist the landowners in the installation of planned forestry measures.

Accelerated technical assistance to the landowners will result in more effective forestry practices on more forest lands. These forest lands will be developed in harmony with sound watershed management to fulfill wildlife, recreation, timber, and other environmental requirements.

The Hempstead County Soil and Water Conservation District, the Arkansas Forestry Commission, and the International Paper Company will work together in developing a forest land treatment program that will most effectively establish and maintain optimal forest productivity and diversity.

The planned forest land treatment measures include about 1,900 acres of tree planting, about 4,200 acres of stand improvement treatment, and continued fire prevention measures on all forested lands.

1. Tree Planting - Watershed Protection (1,900 acres) - Reforestation of 1,900 acres of understocked stands is required not only to adjust land use up to its capability but also to reduce runoff and erosion by improving a protective forest canopy and an absorbent forest floor. Tree planting will not be performed unless the tract is protected from grazing.

2. Stand Improvement Measures (4,200 acres) - These are silvicultural measures designed to improve the hydrologic capabilities of the forests by adjusting the stand composition which will produce the optimum development and protection of forest cover, litter, and humus. The practices include improvement cuttings, tree release, and cull removal.

Structural Measures

Structural measures consist of 22 floodwater retarding structures and approximately 250 acres of land stabilization measures. The total estimated installation cost of the structural measures is $3,550,300.

Total drainage area above the proposed floodwater retarding structures is 22.75 square miles, representing 23 percent of the entire watershed.

All floodwater retarding structures provide for 100-year sediment storage. Because of physical limitations, the principal spillway crests of Structures Numbers 1 through 6 and 21 were set at the 100-year submerged sediment elevation with ungated ports at the 50-year sediment elevations. The principal spillway crests of the remaining structures were raised to provide additional storage to be released through ungated ports at the 100-year sediment elevations. The augmentation flow will mitigate the adverse effect on downstream fishery. In addition, the augmentation flow will help control channel degradation by maintaining a wet-bottom channel where the channels traverse the Marlbrook Marl Formation.

The floodwater retarding structures will provide for storage of 2,164 acre-feet of submerged sediment and 94 acre-feet of aerated sediment expected to accumulate during the life of the project, 1,000 acre-feet of storage to augment low flow downstream, and 8,032 acre-feet of floodwater detention storage. The pools at the crests of the principal spillways will inundate 664 acres, of which 227 acres between the spillway crests and the ungated ports will be subject to fluctuation during periods of drought. An additional 835 acres will be subject to temporary inundation in the floodwater detention pools. Floodwater detention storage capacities included in the structures vary from 4.95 to 8.33 inches of runoff from the contributing drainage areas.

Principal spillways will be reinforced concrete pipe with reinforced concrete risers. These structures will be built on yielding foundations consisting of marl, shale, and chalk bedrock at moderate depths overlain by residual clay soils. Structures Numbers 1, 4, 10, 20, and 21 will have single-stage inlets and all other structures will have two-stage inlets. The two-stage inlets will provide storage for runoff from the 5-year, 1-day storm between the high-stage and low-stage inlets.

Each principal spillway will include a drain valve to facilitate installation of the dam by disposing of runoff during construction and to drain the impoundment as needed for repairs. A mid-level gate will be provided for fish management, exposure of shallow edges for waterfowl plantings, and manipulation of water levels for aquatic weed control.

All dams will be earthfill structures with vegetated emergency spillways to convey runoff exceeding reservoir storage safely past the embankments. These emergency spillways have been planned for a chance of operation in any one year of 4 percent or less. Earthfills will be essentially homogeneous consisting of moderately to highly plastic clay material. All borrow materials will be obtained from the sediment pools which consist of residual clay weathered in place from marl, chalk, and shale bedrock of Cretaceous age. All dams and emergency spillways will be fenced to provide for control of grazing. Figure 1 shows a section of a typical floodwater retarding structure. Plans for a typical structure are illustrated by Figures 2 and 2A.

Selective clearing will be utilized to preserve trees and shrubs useful for erosion control, wildlife habitat, screening objectionable views, and blending structural measures with the surroundings. Approximately 105 acres of forest land will be retained in the upper one-third of permanent pools and at points where feeder streams enter the pools. This measures will provide shelter and increase fish food production.

Present land uses in the embankment and emergency spillway area for each floodwater retarding structure are tabulated as follows:

Structure Number	Land Use			Embankments and Emergency Spillways
	Grassland (acres)	Woodland (acres)	Cropland (acres)	(acres)
1	1	8	-	9
2	2	5	-	7
3	2	3	-	5
4	9	-	-	9
5	7	1	-	8
6	8	3	-	11
7	8	1	-	9
8	1	3	-	4
9	4	-	-	4
10	6	2	1	9
11	3	3	-	6
12	0	8	-	8
13	4	2	-	6
14	3	2	-	5
15	1	5	-	6
16	7	3	-	10
17	9	1	-	10
18	9	1	-	10
19	8	2	-	10
20	15	-	-	15
21	15	-	-	15
22	16	-	-	16
Total	138	53	1	192

After the project is completed, the embankment and spillway areas will be revegetated and classified as grassland. Landscaping will be performed on Structures Numbers 4, 6, 10, 11, 12, 13, and 16 to improve the appearance of the areas adjacent to roads.

Land in the submerged sediment and low-flow augmentation pools will be inundated. Construction measures will have a slight effect on the overall land use pattern of the watershed. So that the impact of these changes can be determined, the land uses affected by the pool of each reservoir are tabulated as follows:

Structure Number	Land Use			Submerged Sediment and Augmentation Pool
	Grassland (acres)	Woodland (acres)	Cropland (acres)	(acres)
1	17	24	-	41
2	4	8	-	12
3	11	2	-	13
4	19	30	-	49
5	7	23	-	30
6	22	-	-	22
7	28	1	-	29
8	3	10	-	13
9	12	-	-	12
10	32	-	18	50
11	12	17	-	29
12	-	20	-	20
13	15	-	-	15
14	4	13	-	17
15	4	8	-	12
16	23	11	-	34
17	17	11	-	28
18	29	-	-	29
19	16	12	-	28
20	42	35	-	77
21	22	16	-	38
22	59	7	-	66
Total	398	248	18	664

Of this area, 515 acres will be reserved for sediment accumulation during the life of the project and will contain water during the period of sediment accumulation. An additional 149 acres of pools will be used to augment streamflow by low-flow releases through the principal spillways.

Flood pools of the 22 structures total 835 acres. This area will remain in grassland or woodland and will be subject to fluctuating water levels as the structures operate as planned. These 835 acres can be used for grazing purposes or for use by wildlife adapted to this type of habitat. The development of permanent improvements in this area would be discouraged because of the periodic inundation during structure operation.

During project installation, all federal, state, and local health, safety, and air and water pollution regulations will be followed. Cleared material will be piled and burned, and any unburned material will be buried. Burning and disposal of debris will be in accordance with all applicable regulations.

The following actions will be taken to control erosion and pollution:

1. Sprinkling will be used to keep dust within acceptable limits.

2. Sanitary facilities will not be located over, or adjacent to, live streams or springs.

3. Measures will be provided at equipment storage and repair areas to prevent contaminants from reaching streams and ground water.

4. The following erosion and sediment control measures will be applied, as needed, to minimize stream turbidity at and below structures.

    a. Diversions, waterways, and terraces will be used to retard the rate of runoff and control erosion from the construction site.

    b. Debris basins will be used to minimize sediment resulting from construction and dewatering operations.

    c. Clearing and grubbing of construction sites and borrow areas will occur in stages as construction progresses.

    d. Temporary vegetation and/or mulching will be used to protect the soils. Segments of work will be completed and protected as rapidly as is consistent with construction schedules.

    e. Conduits or bridges will be installed where construction activities cross flowing streams.

5. Prior to construction, areas will be designated for the disposal of waste material.

Noise from the equipment used during construction cannot be avoided; however, the contractor will keep his equipment in a state of good repair to insure that noise will be held to a minimum. The structures are located in remote areas away from any concentrations of population and the noise problem will be minimal.

Dust is not expected to be a problem but it will be kept within tolerable limits by sprinkling, application of dust suppressors, or by other appropriate means.

Vectors should not be a problem because of the remoteness of the structure sites. However, practices to prevent and reduce mosquito and other aquatic insect breeding sites include the following:

1. All borrow pits and other potential ponding areas associated with construction of the dam and relocation of roads that are located above the maximum pool level will be made self-draining.

2. Prior to impoundage, borrow pits and depressions that will be flooded by the reservoirs at maximum pool levels and would retain water at lower pool levels will be provided with drains to insure complete drainage of water within them.

Floodwater Retarding Structures Numbers 1, 3, 4, 6, 10, 11, 12, and 13 are located near existing public roads and have potential for incidental recreation. Floodwater Retarding Structures Numbers 2, 5, 7, 8, 9, 14, 15, 16, 17, 18, 19, 20, 21, and 22 have little potential for incidental recreation because of their remote location or size. The sponsor will not provide public access to any of the structures.

A total of 24 sites were located in the reservoir areas during the archeological survey (13). These sites are located at Floodwater Retarding Structures Numbers 1, 6, 7, 9, 10, 11, 12, 14, 16, and 21. Structure Number 22 was not surveyed because survey access was denied by the landowner. The following table lists the archeological sites located at each floodwater retarding structure.

Floodwater Retarding Structure Number	Archeological Site Number	Located in Sediment Pool	Located in Flood Pool
1	3HE 132		X
6	3HE 129	X	
	3HE 130	X	
	3HE 131	X	
7	3HE 124	X	
	3HE 125	X	
9	3HE 127	X	
10	3HE 119	X	
	3HE 120	X	
	3HE 121		X
11	3HE 133	X	
	3HE 134	X	
	3HE 135	X	
	3HE 136	X	
12	3HE 122	X	
14	3HE 137	X	
	3HE 138	X	
	3HE 139	X	
	3HE 140	X	
16	3HE 115	X	
	3HE 116	X	
	3HE 117	X	
	3HE 128		X
21	3HE 126	X	
22	(not surveyed)		
TOTAL		21	3

The 24 archeological sites listed above will be affected by installation of the project, according to the report of the Arkansas Archeological Survey. The Arkansas Archeological Survey will be requested to make an additional investigation after clearing operations have been completed. Recovery, protection, or preservation of the sites will be performed in accordance with the Archeological and Historical Preservation Act (PL 93-291). The National Park Service will be notified if any previously unidentified evidence of cultural values are discovered during detailed investigations or construction and the procedures in PL 93-291 will be followed. Since this is a federally assisted local project, there is no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archeological and historical resources.

Land stabilization measures will be installed on about 250 acres of critically eroded land. Areas associated with waterways (77 acres) will be shaped to stabilize slopes and grade stabilization structures will be installed. In most cases, the chalky upland areas (173 acres) will require shaping, but some areas will require only seedbed preparation.

Critically eroded land and areas disturbed during construction will be planted to grasses, legumes, and other plants, fertilized with poultry litter, and mulched. These plants will control erosion, provide wildlife food and habitat, and increase aesthetic values. Areas now subject to intensive grazing will be fenced to control grazing.

Installation of structural measures will require relocations of 1-1/2 miles of county roads, 1/2 mile of telephone line, and 1/2 mile of powerline.

Structure locations and reaches are shown on Figure 3, Project Map. More detailed information on quantities, costs, and design features is given in Tables 2 and 3.

EXPLANATION OF INSTALLATION COSTS

The total installation cost of the project is estimated to be $4,204,600 of which $3,141,350 will be paid from Public Law 566 funds and $1,063,250 will be borne by other funds. Included in the total cost are $654,300 for land treatment measures and $3,550,300 for structural measures.

Land treatment costs will be shared $57,750 by Public Law 566 funds and $596,550 by other funds. Public Law 566 funds will provide $34,000 for technical assistance to accelerate installation of the land treatment program administered by the Soil Conservation Service through the going conservation program and $4,450 for soil surveys. Other funds will provide $26,000 for technical assistance and $400 for soil surveys through the regular program of Public Law 46.

Installation costs of the forestry phases of the private land treatment program were developed by the U. S. Forest Service and the Arkansas Forestry Commission. Costs for technical assistance were based on present costs of the going Cooperative Forest Management Program. Installation costs were based on present prices paid by landowners and operators to establish similar measures on their land. Forest land treatment measures needed to meet the sponsor's goals were developed from field surveys of the watershed and were adjusted for expected landowner participation during the installation period.

The estimated cost of the forest land treatment program is $174,000. Of this amount, $19,300 will be from Public Law 566 funds and $154,700 will be from other sources. The Public Law 566 funds are to be used for accelerated technical assistance. The Arkansas Forestry Commission will provide $4,800 for accelerated technical assistance. The going Cooperative Forest Management Program will provide additional technical assistance valued at $500. The going Cooperative Forest Fire Control Program will provide additional assistance for the protection of the watershed through capital outlay valued at $2,500 during the installation period. Landowners and operators will furnish $135,800 for the installation of forest land treatment measures on their lands.

The estimated cost of the 22 floodwater retarding structures and land stabilization measures was allocated to flood prevention. The cost of the additional storage to mitigate unavoidable losses and to minimize adverse impacts downstream was allocated in the same manner as the floodwater retarding structures. The estimated installation cost of structural measures is $3,550,300, of which Public Law 566 funds will pay $3,083,600 and other funds will pay $466,700.

Public Law 566 funds will pay all construction costs estimated to be $2,444,800. This includes $2,296,500 for floodwater retarding structures and $148,300 for land stabilization measures. Construction costs of the floodwater retarding structures include clearing, excavation, fills,

principal and emergency spillways, and revegetation of disturbed areas. The cost of land stabilization measures includes vegetative measures, sloping and seeding of channel banks, and grade stabilization structures.

Public Law 566 funds will provide all engineering services estimated to be $218,300 which includes the direct cost of engineers and other technicians for survey, investigation, design, and preparation of plans and specifications for structural measures.

Investigation has disclosed that, under present conditions, the project measures will not result in the displacement of any person, business, or farm operation; however, if relocations become necessary, relocation payments will be cost-shared 74.7 percent by Public Law 566 funds and 25.3 percent by other funds.

Project administration costs were estimated to be $430,800. These are Public Law 566 and other administrative costs associated with the installation of structural measures, including the cost of contract administration, government representatives, and necessary inspection services during construction to insure that structural measures are installed in accordance with the plans and specifications. These costs were treated as project costs but were not considered applicable to individual purposes served by the project nor are they a part of the cost of individual measures. Public Law 566 funds will provide an estimated $205,100 for construction inspection, $205,100 for administrative cost, and $10,300 for administration of contracts. The Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District will pay an estimated $10,300 for administrative cost.

The sponsors will provide land rights costs estimated to be $456,400. Included in land rights costs are $9,000 for moving 1.5 miles of county road and $3,200 for moving or modifying 1.0 miles of utility lines.

The engineer's cost estimate and contingency allowance of 12 percent is considered realistic and provides a reasonable allowance for unexpected cost.

The estimated schedule of obligations for the 5-year project installation period covering the installation of both land treatment and structural measures is as follows:

Fiscal Year	Measures	P. L. 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
First	Land Treatment	11,600	119,300	130,900
	Engineering Services	60,830	-	60,830
	Land Rights Cost	-	151,150	151,150
	Construction Cost: Land Stabilization Measures	37,100	-	37,100
Second	Land Treatment	11,600	119,300	130,900
	Engineering Services	42,270	-	42,270
	Land Rights Cost	-	107,750	107,750
	Construction Cost: Structures Numbers 17, 18, 19, 20, and 21 and Land Stabilization Measures	681,400	-	681,400
Third	Land Treatment	11,600	119,300	130,900
	Engineering Services	70,050	-	70,050
	Land Rights Cost	-	115,450	115,450
	Construction Cost: Structures Numbers 1, 2, 3, 4, and 5 and Land Stabilization Measures	473,500	-	473,500
Fourth	Land Treatment	11,600	119,300	130,900
	Engineering Services	45,150	-	45,150
	Land Rights Cost	-	82,050	82,050
	Construction Cost: Structures Numbers 10, 11, 12, 13, 14, 15, and 16 and Land Stabilization Measures	784,600	-	784,600
Fifth	Land Treatment	11,350	119,350	130,700
	Construction Cost: Structures Numbers 6, 7, 8, 9, and 22	468,200	-	468,200
Subtotal		2,720,850	1,052,950	3,773,800
Project Administration		420,500	10,300	430,800
TOTAL		3,141,350	1,063,250	4,204,600

This schedule may be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desirable and in the light of appropriations and accomplishments actually made.

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion, and Sediment

The proposed project will reduce flood damages on the 11,426 acres of flood plain. Average annual area flooded will be reduced 25 percent, from 25,358 acres to 19,124 acres. Reduction in the average annual area flooded, by reaches, is as follows:

Reach Number	Location	Average Annual Acres Flooded: Without Project	Average Annual Acres Flooded: With Project	Percent Reduction
I	East Patrol Road to Common Flood Plain	14,017	11,783	16
II	South Fork Ozan	2,075	906	56
III	Middle Fork Ozan	3,247	1,336	59
IV	Common Flood Plain	6,019	5,099	15
Total		25,358	19,124	25

Flood reductions in Reaches I and IV will not be sufficient to cause major land use changes or agricultural production increases.

The conservation land treatment measures will reduce erosion by 17 percent, reduce surface water runoff, and increase rainfall infiltration.

Reach locations are shown on the Project Map, Figure 3.

The May 1969 flood, about a 2-year frequency flood, would have been reduced 21 percent (from 8,026 acres flooded to 6,380 acres flooded) if proposed measures had been installed.

The following table lists the reduction in acres flooded by reaches for the one-half year, the two-year (May 1969) and the ten-year frequency floods:

Reach Number	One-half Year		
	Without Project (acres)	With Project (acres)	Percent Reduction
I	3,425	3,215	6
II	412	150	64
III	643	209	67
IV	1,500	1,405	6
TOTAL	5,980	4,979	17

Reach Number	Two-year (May 1969)		
	Without Project (acres)	With Project (acres)	Percent Reduction
I	3,832	3,650	5
II	1,078	461	57
III	1,468	654	55
IV	1,648	1,615	2
TOTAL	8,026	6,380	21

Reach Number	Ten-year		
	Without Project (acres)	With Project (acres)	Percent Reduction
I	4,402	4,205	4
II	1,623	1,276	21
III	2,562	2,033	21
IV	1,666	1,666	0
TOTAL	10,253	9,180	10

The project will not provide a large reduction in flooding in Reaches I and IV but damages are high in these reaches ($320,560 average annual). No measures in addition to those included in the Ozan Creeks Watershed Work Plan are planned to reduce future flood losses in Reaches I and IV. In Reaches II and III, flood reductions will be significant and can be expected to provide a high level of protection.

Flooding disrupts long-range planning and orderly conservation crop rotations in the flood plain. Farmers in the flood plain have indicated that, with adequate flood protection, they can improve the efficiency of their farming operations and increase their income by intensified use of the flood plain.

Land use and crop yields, as projected by the Economic Research Service, were used as guides in determining future conditions. Projected land use in the flood plain is shown in the following table for "without project" and "with project" conditions for major land uses.

Projected Flood Plain Land Use	Without Project (acres)	With Project (acres)
Forest Land	2,126	2,126
Cropland	6,040	6,648
Grassland	2,894	2,286
Miscellaneous	366	366
TOTAL	11,426	11,426

It is anticipated that the low level of protection from flooding in Reaches I and IV will keep the project from stimulating the clearing of forest land in the reaches. Most of the land use changes will occur in Reaches II and III with grassland being converted to cropland. The land has been in cultivation in the past but, because of the flood hazard, it was converted to grassland. The reduction of the flood threat will allow 1,300 acres to be restored to its former productivity. More intensive land use will occur on 4,800 acres of land in the flood plain as a result of the reduction of damaging floods. This will be a result of more production inputs, such as seed and fertilizer, and the use of more profitable crops. These changes can be expected in Reaches II and III only. Benefits derived from increased production from surplus crops on new lands were not used for economic justification of the project. Bringing new land into production or increasing agricultural production on new land is not a primary purpose of the project.

Production losses as a result of inundation by sediment pools are estimated to be about $8,000 which includes cropland ($1,500), grassland ($4,000), and woodland ($2,500). This will be permanent loss as this area is reserved for sediment storage during the life of the project.

Production losses on land required for the embankments and emergency spillways are estimated to be about $2,000, which includes cropland ($90), grassland ($1,380), and woodland ($530). This area will be revegetated and fenced for controlled grazing and production gains under this land use may equal or exceed losses resulting from construction of the structures.

Wildlife habitat in the sediment pools will be permanently lost as a result of the project. This area will create a lake fishery. Habitat in the embankments and emergency spillways will be changed. About 28 percent of the land required for the structures is currently in woodland. This area will be converted to grassland.

The provisions made for low-flow releases from the system of retarding structures will keep the channel beds wet and partially control channel degradation.

Sediment yield from the watershed uplands will be reduced about 43 percent by land treatment and structural measures. Project measures are expected to reduce the annual erosion rate of 39 tons per acre by about 92 percent on 250 acres of critically eroding land.

Stream pollution caused by sediment will be reduced about 44 percent by the project. The average annual sediment concentration will be reduced by about 290 milligrams per liter in Ozan Creek at the watershed outlet.

Land voiding caused by channel enlargement is causing significant land damage. The present rate of 2.6 acres per year will be reduced to 0.6 acre per year and will save about 200 acres during the life of the project.

Sediment produced at the construction sites will not cause a significant increase in sediment yield. Sediment reduction by land treatment and floodwater retarding structures is expected to offset any temporary increase in sediment from any construction site.

Field investigations indicate that the project will have no effect on mineral resources in the watershed. The sand and gravel, clay, shale, chalk, and marl are found over large areas throughout this portion of the state and deposits are not limited to areas of planned structural measures, which constitute only 2.5 percent of the area of the watershed.

Seventy-five farms in the flood plain will benefit from flood reduction on 11,426 acres.

Fish and Wildlife and Recreation

The 1,000 acre-feet of water that will be stored in the planned structures will provide low-flow releases into the downstream channel. An accumulated 15.16 cubic feet per second (6,804 gallons per minute) will be released into channel sections that now have ephemeral flow conditions. Although this may be insufficient water to make the watershed's streams a sport fishery, it will provide more permanent habitat for forage fishes, young-of-the-year sport and food fishes, amphibians, aquatic reptiles, and aquatic invertebrates. Some of the water will be lost by infiltration, evaporation, and transpiration.

About 687 surface acres of water will be added to the watershed's 252 surface acres of Types 5 and 6 wetland. Some of this acreage is dedicated to storage for downstream release, so the acreage is a maximum estimate.

About 23 acres of farm ponds and 664 acres of reservoirs will be added to the watershed's standing water fishery, an increase of 324 percent. Each reservoir will be stocked with game fish. The drainage area-surface area ratios of the floodwater retarding structures range from 14:1 to 29:1, which are three to six times the ideal ratio of 5:1. Structures Numbers 7, 8, 11, 12, 13, 16, 18, 19 and 20 have some water deeper than 19 feet and will have principal spillways with bottom-water releases. This will insure that infertile, profundal water (below light penetration or low oxygen) will be released rather than the accumulated fertility in the limnetic water (surface water that is too deep for rooted plants). The water to be released from the structures will be aerated as it passes through the principal spillways and stilling basins of the structures. Water quality downstream from the structures should not be greatly altered. About 348 surface acres of littoral water (supports both rooted plants and floating plants) will be created within the sediment pools. About 30 miles of "shoreline edge" will be created by the impoundments. All principal spillways will provide for drawdown as a fishery management tool.

The conversion of 536 acres of grassland, 301 acres of woodland, and 19 acres of cropland to spillways, embankments, and reservoirs will not affect any critical wildlife value. The affected area currently provides upland wildlife habitat for deer, small game species, and various species of birds. The 250 acres of critically eroded areas will be revegetated with King Ranch bluestem, annual lespedeza, sweet clover, tall fescue, weeping lovegrass, and bermudagrass. Each area will be fenced to restrict grazing and improve its value as wildlife habitat.

The low-flow releases from all proposed structures will aid in providing perennial flow in the channels downstream from the structures which are presently classified as 27.6 miles ephemeral, 24.5 miles of intermittent, and 4.1 miles of perennial flow.

Reservoirs and wet channels offer opportunity for ground water recharge. However, onsite conditions in this watershed indicate that the amount of recharge will be minor. The sediment pools will be small (average about 9 acres) and seepage pressures will be low (average depth about 5 feet).

Archeological, Historic, and Scientific

A total of 21 archeological sites located at 9 floodwater retarding structures will be inundated by the sediment pools of the structures. Three additional sites at three structures will be affected by periodic inundation within the flood pools as the structures function. According to the Arkansas Archeological Survey Report the majority of these recorded archeological sites would be destroyed.

Economic and Social

The project will serve as an immediate stimulus to the local economy by providing new employment opportunities during the construction period.

Employment opportunities will also result from the increased agricultural activity and increased income brought about by project installation. This is particularly significant because of the high rate of unemployment and underemployment in the local area. An estimated 92 new jobs will be added to the local economy and 30 jobs will remain after the construction period.

The local economy will receive additional income from laborers employed during construction. Added income to farmers will be generated by an increase in the quantity and quality of crops which can be grown in the watershed.

Increased income will generate additional consumer expenditures for basic necessities, items which improve standards of living, and other goods and services. These expenditures will initiate a chain of spending whereby each successive recipient spends a portion of the amount received. Business activity in other sectors of the local economy will increase as this new income is spent and respent. More employment opportunities will be provided in these sectors.

Protection afforded by the project will give the residents a greater sense of security. Family farms will be strengthened which will help maintain population stability.

The project will contribute to the economic goals of the Southwest Arkansas Planning and Development District and the Southwest Arkansas Resource Conservation and Development Project.

Secondary project benefits are successive rounds of spending made possible by additional income in the general area. These impacts are based on additional income from the sales of more and better farm products. Farm supply dealers, transporters, processors, and others will have increased sales. Income will be generated in other sectors of the local economy by business activity as this new income is cycled through the economy.

PROJECT BENEFITS

The estimated average annual monetary floodwater and indirect damages (Table 5) within the watershed will be reduced from $499,300 to $339,610 by the proposed project. This is a reduction of 32 percent, 97 percent of which will result from the system of structural measures.

Annual flood reduction benefits will accrue as follows:

Crop and Pasture	$102,560
Other Agricultural	9,100
Nonagricultural	15,520
Sediment Reduction	11,160
Land Voiding	2,120
Scour	4,710
Indirect	14,520
TOTAL 1/	$159,690

1/ Of this amount, land treatment measures will provide flood reduction benefits of $8,740 annually.

The general location of damage reduction benefits within the project area is presented in the following tabulation:

Evaluation Reach	Location	Without Project 1/ (dollars)	With Project 1/ (dollars)	Reduction (percent)
I	East Patrol Road to Common Flood Plain	275,570	236,410	16
II	South Fork Ozan Creek	63,330	23,750	62
III	Middle Fork Ozan Creek	115,410	38,170	67
IV	Common Flood Plain	44,990	41,280	8
TOTAL		499,300	339,610	32

1/ Current Normalized Prices.

Reduction in frequency and depth of flooding will permit farmers to increase their net income. Increased farm income of $81,720 annually will result from more intensive use of the flood plain. Restoration of land to its former productivity amounts to $21,710 annually; this amount is included in the crop and pasture benefits.

Since the watershed is located in an area which has been designated under the Public Works and Economic Development Act of 1965 as suffering from serious and chronic unemployment, redevelopment benefits were calculated and used for project justification. Benefits amounting to $29,120 will accrue annually by providing employment for the unemployed and the under-employed during project installation and from operation and maintenance of project measures during a 20-year period.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation of the project. Locally, secondary benefits, including increased business activity and improved economic conditions in the adjoining communities, will result from installation of the project.

Secondary benefits attributable to the project are estimated to be $68,280 annually. These benefits represent the effect of initial and successive rounds of spending made possible by additional income created by the project. These benefits are based on additional income from employment of local laborers during construction and for operation and maintenance; increased agricultural employment in sales of greater quantities of farm products or products having higher values; increased sales by local farm supply dealers, transporters, processors, etc., who provide production inputs or other items or services required to produce and market the increased quantity of goods; and the income generated in other sectors of the local economy by increased business activity as this new income is cycled through the economy.

Secondary benefits are not based on indirect benefits and are adjusted to account for that portion of the new income spent outside the local area.

The evaluated monetary benefits from structural measures are summarized in Table 6.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures (amortized installation cost plus operation and maintenance) is $247,230. Installation of the structural measures is expected to produce average annual benefits, excluding secondary, of $261,790. The ratio of benefits to costs will be 1.06 to 1.

Total benefits, including secondary, from structural measures will be $330,070 and will provide $1.30 in benefits for each dollar of cost (Table 6).

PROJECT INSTALLATION

The watershed project is planned for a 5-year installation period. Land treatment measures will be established throughout the entire period by landowners and operators, in cooperation with the Hempstead County Soil and Water Conservation District. The district, with additional help from the Soil Conservation Service and the Arkansas Forestry Commission, in cooperation with the U. S. Forest Service, will assist with planning and application of these measures. Assistance will be accelerated to assure application of planned measures within the project installation period. The Soil Conservation Service will provide additional technical assistance for conservation planning, land use determination, application assistance for cropland, pastureland, rangeland, and wildlife area practices.

Landowners having forest land will be encouraged to apply and maintain forestry measures on their forested lands. The U. S. Forest Service, by and through the Arkansas Forestry Commission, will provide technical assistance in the planning and application of forest land treatment measures on the watershed under the going Cooperative Forest Management Program. They will provide additional technical assistance for accele-

rating the installation of forestry measures. A forester trained in watershed management will be assigned to this project to guide and assist the landowners in the installation of planned forestry measures.

The Hempstead County Soil and Water Conservation District will assume active leadership in establishing the land treatment program. District directors will schedule meetings and through contacts will encourage landowners and operators to establish a complete soil and water conservation program.

The Cooperative Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings; preparing radio, television, and press releases; and using other methods of conveying information to the watershed landowners and operators.

The sponsor will make a concerted effort to interest local landowners in establishing additional wildlife food and cover plants that will benefit quail, deer, rabbit, and dove.

Structural measures will be installed during the second, third, fourth, and fifth years of the project installation period.

The Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District has all of the necessary authority to discharge local responsibility.

Installation of structural measures will be contingent upon the following conditions:

1. Conservation plans covering 50 percent or more of the land in the drainage area above each detention reservoir have been developed prior to installation of structural measures.

2. All land rights have been obtained for all structural measures, or a substantial part has been obtained and a written statement has been furnished by the Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District that the right of eminent domain will be used, if necessary, to secure the remainder within the project installation period and that sufficient funds are available for this purpose.

3. Installation of land stabilization measures above floodwater retarding structures must be scheduled before or concurrently with the structural measures below.

4. The Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District is prepared to discharge its responsibilities as set forth in this plan for installation of all structural measures.

5. Project agreements have been executed.

6. The operation and maintenance agreement has been executed.

The Soil Conservation Service has been formally requested to be the contracting agency and will provide all other technical assistance in design, construction inspection, preparation of contract payment estimates, final inspections, execution of certificates of completion, and related tasks for the establishment of planned structural measures.

FINANCING PROJECT INSTALLATION

Federal assistance will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended. This assistance is subject to appropriation of funds.

The cost of land treatment measures will be financed by the landowners and operators.

Technical assistance will be provided by the Soil Conservation Service through the Hempstead County Soil and Water Conservation District and the Arkansas Forestry Commission, cooperating with the U. S. Forest Service. The going conservation program and the cooperative forestry programs will be available and additional technical assistance will be provided by Public Law 566 funds to accelerate the installation of land treatment measures.

The Hempstead County Soil and Water Conservation District through the Ozan Creeks Improvement Project Area has the power under state law to secure and repay loans, assess benefits, and levy taxes, and will provide the funds needed to meet their obligations in the installation of the planned structural measures. The district plans to obtain a watershed loan to finance their share of the project installation cost. A letter of intent to borrow has been filed with the Farmers Home Administration. Funds for the repayment of this loan will be obtained from taxes levied on the benefited area.

Public Law 566 funds will provide the construction costs and all installation costs incurred by the Soil Conservation Service in the installation of structural measures.

PROVISIONS FOR OPERATION AND MAINTENANCE

The landowners and operators will maintain the land treatment measures under agreement with the Hempstead County Soil and Water Conservation District.

The Arkansas Forestry Commission, in cooperation with the U. S. Forest Service, will furnish the technical assistance necessary for operating and maintaining the forest land treatment measures under the going

Cooperative Forest Management Program. They will also continue to furnish fire protection under the Cooperative Forest Fire Control Program. Representatives of the Hempstead County Soil and Water Conservation District and the Soil Conservation Service will make periodic inspections of land treatment measures and the district will encourage farmers to perform needed maintenance.

The structural measures will be operated and maintained by the Ozan Creeks Improvement Project Area of the Hempstead County Soil and Water Conservation District at an estimated annual cost of $2,950. Funds for paying maintenance costs on the floodwater retarding structures and land stabilization measures will be obtained from taxes levied on the benefited area. Maintenance will be performed with contributed labor, district-owned equipment, by contract or force account, or a combination of these methods.

Provision will be made for free access for representatives of the sponsoring local organization and federal agencies to inspect and for the sponsor to provide maintenance for the structural measures at any time.

All work will meet the requirements of Act 81 of the Arkansas General Assembly of 1957, as amended, which authorizes the Division of Soil and Water Resources to issue permits for construction of dams, inspect construction, and make annual operation and maintenance inspections after construction. The Sponsor will be required to follow the Division's recommendations on needed maintenance work.

For the first three years after the structural measures are installed, the Soil Conservation Service and the sponsor will make a joint inspection annually, after unusually severe floods, and after the occurrence of any other unusual conditions which might adversely affect the structural measures. Inspections after the third year will be made annually by the sponsor.

Annual maintenance will be needed to maintain an adequate vegetative cover on earthfills, vegetative emergency spillways, and borrow areas. During the life of the structures, it may be necessary to do major repair work to restore concrete that has deteriorated; replace gates, trash racks, or other metal works; remove and/or stabilize slide material; and replace eroded material and revegetate the emergency spillways. Fences will be maintained until there is mutual agreement that they are no longer needed to protect structural works of improvement.

The sponsoring local organization will maintain a record of all maintenance inspections and maintenance performed and have the record available for review by the Soil Conservation Service. The sponsor fully understands its obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitations to bid on the construction of structural measures.

An operation and maintenance agreement will be executed prior to signing a project agreement. This operation and maintenance agreement will con-

tain a reference to the Soil Conservation Service publication, "State of Arkansas Watersheds Operation and Maintenance Handbook", and a plan for operation and maintenance of the structural measures will be prepared.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Ozan Creeks Watershed, Arkansas

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/ P. L. 566 Funds SCS 3/	P. L. 566 Funds FS 3/	P. L. 566 Funds Total	Other SCS 3/	Other FS 3/	Other Total	Total
Land Treatment									
Land Areas 2/									
Cropland	Acre	9,000	-	-	-	95,000	-	95,000	95,000
Grassland	Acre	22,000	-	-	-	320,000	-	320,000	320,000
Forest Land	Acre	6,100	-	-	-	-	135,800	135,800	135,800
Other Land	Acre	450				450	-	450	450
Cooperative Fire Protection Program	Acre	20,900	-	-	-	-	13,600 5/	13,600	13,600
Technical Assistance			34,000	19,300	53,300	26,000	5,300 4/	31,300	84,600
Soil Survey	Acre	47,384	4,450	-	4,450	400	-	400	4,850
TOTAL LAND TREATMENT	-	-	38,450	19,300	57,750	441,850	154,700	596,550	654,300
STRUCTURAL MEASURES									
Construction									
Floodwater Retarding Structures 1 thru 22	No.	22	2,296,500	-	2,296,500	-	-	-	2,296,500
Land Stabilization			148,300	-	148,300	-	-	-	148,300
Subtotal - Construction			2,444,800		2,444,800	-	-	-	2,444,800
Engineering Services			218,300	-	218,300	-	-	-	218,300
Relocation Payments			-	-	-	-	-	-	-
Project Administration									
Construction Inspection			205,100	-	205,100	-	-	-	205,100
Other			215,400	-	215,400	10,300	-	10,300	225,700
Subtotal - Administration			420,500	-	420,500	10,300	-	10,300	430,800
Other Costs									
Land Rights			-	-	-	456,400	-	456,400	456,400
Subtotal - Other			-	-	-	456,400	-	456,400	456,400
TOTAL STRUCTURAL MEASURES			3,083,600	-	3,083,600	466,700	-	466,700	3,550,300
TOTAL PROJECT			3,122,050	19,300	3,141,350	908,550	154,700	1,063,250	4,204,600

1/ Price Base: 1973
2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.
3/ Federal agency responsible for assisting in installation of works of improvement.
4/ Includes $500 from the going Cooperative Forest Management Program.
5/ Includes $2,500 capital outlay acceleration based on 1970 Area and Cost Review.

February 1974

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPPOVEMENT

(at time of work plan preparation)

Ozan Creeks Watershed, Arkansas

Measures	Unit	Applied to Date	Total Cost 1/ (dollars)
Land Treatment Measures			
Brush Management	Acre	18,000	90,000
Conservation Cropping System	Acre	7,000	21,000
Contour Farming	Acre	400	600
Crop Residue Management	Acre	7,000	17,500
Deferred Grazing	Acre	500	750
Diversion	Foot	50,000	5,000
Drainage Mains or Laterals	Foot	50,000	25,000
Drainage Field Ditch	Foot	50,000	5,000
Farm Pond	Number	150	75,000
Grade Stabilization Structure	Number	10	5,000
Grassed Waterway	Acre	2	70
Pasture and Hayland Planting	Acre	19,449	680,715
Pasture and Hayland Management	Acre	14,000	28,000
Proper Grazing Use	Acre	1,000	1,000
Terrace Gradient	Foot	150,000	15,000
Wildlife Habitat Management	Acre	300	300
TOTAL		XXXXXXX	969,935

1/ Price Base: 1973.

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Ozan Creeks Watershed, Arkansas
(Dollars) 1/

Item	Installation Cost - P. L. 566 Funds				Installation Cost - Other Funds					Total Installation Cost
	Construction	Engineering Services	Land Rights	Total P. L. 566	Con - struction	Engineering Services	Land Rights	Water Rights	Total Other	
Floodwater Retarding Structure Number										
1	80,500	7,190	-	87,690	-	-	22,800	-	22,800	110,490
2	64,200	5,730	-	69,930	-	-	10,400	-	10,400	80,330
3	55,100	4,920	-	60,020	-	-	11,400	-	11,400	71,420
4	110,500	9,870	-	120,370	-	-	34,000	-	34,000	154,370
5	126,100	11,260	-	137,360	-	-	22,800	-	22,800	160,160
6	81,200	7,250	-	88,450	-	-	18,700	-	18,700	107,150
7	93,600	8,360	-	101,960	-	-	16,400	-	16,400	118,360
8	69,800	6,230	-	76,030	-	-	7,200	-	7,200	83,230
9	70,200	6,270	-	76,470	-	-	7,800	-	7,800	84,270
10	146,500	13,080	-	159,580	-	-	21,600	-	21,600	181,180
11	112,500	10,040	-	122,540	-	-	21,300	-	21,300	143,840
12	102,100	9,120	-	111,220	-	-	10,700	-	10,700	121,920
13	89,700	8,010	-	97,710	-	-	12,500	-	12,500	110,210
14	88,500	7,900	-	96,400	-	-	14,700	-	14,700	111,100
15	84,200	7,520	-	91,720	-	-	10,500	-	10,500	102,220
16	124,100	11,080	-	135,180	-	-	17,800	-	17,800	152,980
17	99,900	8,920	-	108,820	-	-	25,500	-	25,500	134,320
18	144,300	12,880	-	157,180	-	-	24,800	-	24,800	181,980
19	152,200	13,590	-	165,790	-	-	25,800	-	25,800	191,590
20	151,000	13,480	-	164,480	-	-	43,100	-	43,100	207,580
21	96,900	8,650	-	105,550	-	-	25,600	-	25,600	131,150
22	153,400	13,700	-	167,100	-	-	25,600	-	25,600	192,700
Subtotal	2,296,500	205,050	-	2,501,550	-	-	431,000	-	431,000	2,932,550
Land Stabilization Measures	148,300	13,250	-	161,550	-	-	25,400	-	25,400	186,950
Project Administration	-	-	-	420,500	-	-	-	-	10,300	430,800
GRAND TOTAL	2,444,800	218,300	-	3,083,600	-	-	456,400	-	466,700	3,550,300

1/ Price Base: 1973

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 1	2	3
Class of Structure		a 6/	a	a
Drainage Area	Sq. Mi.	1.68	0.41	0.42
Curve No. (1-day) (AMC II)		80	80	80
Elevation Top of Dam	Ft.	410.4	414.0	406.2
Elevation Crest Emergency Spillway	Ft.	407.4	411.0	403.2
Elevation Crest High Stage Inlet	Ft.	400.6	409.0	400.1
Elevation Crest Low Stage Inlet	Ft.	-	404.4	396.0
Elevation Crest Ungated Port	Ft.	398.6	402.7	394.0
Maximum Height of Dam	Ft.	20	22	22
Volume of Fill	Cu. Yds.	38,281	28,433	25,768
Total Capacity 1/	Ac. Ft.	633	168	211
Sediment Submerged	Ac. Ft.	143	35	43
Sediment Aerated	Ac. Ft.	5	1	2
Augmentation	Ac. Ft.	-	-	-
Retarding	Ac. Ft.	485	132	166
Between High and Low Stage	Ac. Ft.	-	77	80
Surface Area				
Sediment Pool 2/	Acres	41	12	13
Augmentation Pool	Acres	-	-	-
Retarding Pool 1/	Acres	102	30	31
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	8.1	7.7	7.7
Rainfall Volume (areal)(10-day)	In.	14.6	13.8	13.8
Runoff Volume (10-day)	In.	9.67	8.94	8.94
Capacity of Low Stage (Maximum)	cfs	-	5	5
Capacity of High Stage (Maximum)	cfs	51	50	51
Frequency Operation - Emergency Spillway	% chance	3	4	2
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	8.1	6.7	6.7
Runoff Volume (ESH)	In.	5.72	4.42	4.42
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	150	50	50
Velocity of Flow (Ve)	Ft./Sec.	1.77	- 3/	- 3/
Slope of Exit Channel	Ft./Ft.	.040	.032	.033
Maximum Water Surface Elevation	Ft.	407.5	-	-
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	17.1	13.8	13.8
Runoff Volume (FH)	In.	14.43	11.20	11.20
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	410.4	414.0	406.2
Capacity Equivalents				
Sediment Volume	In.	1.66	1.66	2.01
Retarding Volume	In.	5.40	6.06	7.43
Augmentation Volume	In.	-	-	-

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 4	5	6
Class of Structure		a 6/	a 6/	a
Drainage Area	Sq. Mi.	2.22	0.94	0.77
Curve No. (1-day)(AMC II)		80	80	80
Elevation Top of Dam	Ft.	405.9	394.4	418.9
Elevation Crest Emergency Spillway	Ft.	403.0	391.7	415.9
Elevation Crest High Stage Inlet	Ft.	394.7	389.3	412.5
Elevation Crest Low Stage Inlet	Ft.	-	385.0	407.8
Elevation Crest Ungated Port	Ft.	392.7	382.5	405.8
Maximum Height of Dam	Ft.	24	26	25
Volume of Fill	Cu. Yds.	67,140	78,434	48,877
Total Capacity 1/	Ac. Ft.	903	456	395
Sediment Submerged	Ac. Ft.	187	130	81
Sediment Aerated	Ac. Ft.	8	6	3
Augmentation	Ac. Ft.	-	-	-
Retarding	Ac. Ft.	708	320	311
Between High and Low Stage	Ac. Ft.	-	182	147
Surface Area				
Sediment Pool 2/	Acres	49	30	22
Augmentation Pool	Acres	-	-	-
Retarding Pool 1/	Acres	120	73	57
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	8.1	8.1	7.7
Rainfall Volume (areal)(10-day)	In.	14.8	14.8	13.8
Runoff Volume (10-day)	In.	9.85	9.85	8.94
Capacity of Low Stage (Maximum)	cfs	-	14	10
Capacity of High Stage (Maximum)	cfs	52	54	53
Frequency Operation - Emergency Spillway	% chance	3	3	3
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	8.1	8.1	6.7
Runoff Volume (ESH)	In.	5.72	5.72	4.42
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	250	100	75
Velocity of Flow (Ve)	Ft./Sec.	- 3/	1.66	- 3/
Slope of Exit Channel	Ft./Ft.	.027	.040	.032
Maximum Water Surface Elevation	Ft.	-	391.8	-
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	17.1	17.1	13.8
Runoff Volume (FH)	In.	14.43	14.43	11.20
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	405.9	394.4	418.9
Capacity Equivalents				
Sediment Volume	In.	1.65	2.70	2.03
Retarding Volume	In.	5.98	6.38	7.53
Augmentation Volume	In.	-	-	-

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 7	8	9
Class of Structure		a	a	a
Drainage Area	Sq. Mi.	0.68	0.24	0.36
Curve No. (1-day)(AMC II)		84	84	84
Elevation Top of Dam	Ft.	404.6	404.0	398.0
Elevation Crest Emergency Spillway	Ft.	401.6	401.0	395.0
Elevation Crest High Stage Inlet	Ft.	398.5	399.0	393.0
Elevation Crest Low Stage Inlet	Ft.	394.5	395.6	388.1
Elevation Crest Ungated Port	Ft.	391.9	391.0	383.8
Maximum Height of Dam	Ft.	35	26	30
Volume of Fill	Cu. Yds.	50,932	33,760	34,899
Total Capacity 1/	Ac. Ft.	451	152	190
Sediment Submerged	Ac. Ft.	79	23	32
Sediment Aerated	Ac. Ft.	4	2	2
Augmentation	Ac. Ft.	66	42	40
Retarding	Ac. Ft.	302	85	116
Between High and Low Stage	Ac. Ft.	146	53	76
Surface Area				
Sediment Pool 2/	Acres	(20)	(6)	(7)
Augmentation Pool	Acres	29	13	12
Retarding Pool 1/	Acres	59	21	24
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	7.7	7.7	7.7
Rainfall Volume (areal)(10-day)	In.	13.8	13.8	13.8
Runoff Volume (10-day)	In.	9.88	9.88	9.88
Capacity of Low Stage (Maximum)	cfs	9	4	5
Capacity of High Stage (Maximum)	cfs	60	53	60
Frequency Operation - Emergency Spillway	% chance	3	3	4
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	6.7	6.7	6.7
Runoff Volume (ESH)	In.	4.86	4.86	4.86
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	75	50	50
Velocity of Flow (Ve)	Ft./Sec.	- 3/	- 3/	- 3/
Slope of Exit Channel	Ft./Ft.	.033	.037	.037
Maximum Water Surface Elevation	Ft.	-	-	-
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	13.8	13.8	13.8
Runoff Volume (FH)	In.	11.75	11.75	11.75
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	404.6	403.7	398.0
Capacity Equivalents				
Sediment Volume	In.	2.28	1.90	1.80
Retarding Volume	In.	8.33	6.65	6.00
Augmentation Volume	In.	1.81	3.20	2.06

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 10	11	12
Class of Structure		b	a 6/	a
Drainage Area	Sq. Mi.	1.93	1.05	0.74
Curve No. (1-day)(AMC II)		74	84	84
Elevation Top of Dam	Ft.	351.8	361.1	346.7
Elevation Crest Emergency Spillway	Ft.	348.2	358.3	343.7
Elevation Crest High Stage Inlet	Ft.	340.7	355.4	341.4
Elevation Crest Low Stage Inlet	Ft.	-	349.4	335.7
Elevation Crest Ungated Port	Ft.	338.5	346.7	332.8
Maximum Height of Dam	Ft.	34	38	33
Volume of Fill	Cu. Yds.	102,733	67,178	55,708
Total Capacity 1/	Ac. Ft.	807	565	387
Sediment Submerged	Ac. Ft.	189	105	81
Sediment Aerated	Ac. Ft.	8	5	3
Augmentation	Ac. Ft.	101	65	54
Retarding	Ac. Ft.	509	390	249
Between High and Low Stage	Ac. Ft.	-	223	157
Surface Area				
Sediment Pool 2/	Acres	(39)	(18)	(15)
Augmentation Pool	Acres	50	29	20
Retarding Pool 1/	Acres	90	61	41
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	8.5	8.1	7.7
Rainfall Volume (areal)(10-day)	In.	15.5	14.8	13.8
Runoff Volume (10-day)	In.	9.09	10.80	9.88
Capacity of Low Stage (Maximum)	cfs	-	17	11
Capacity of High Stage (Maximum)	cfs	61	66	61
Frequency Operation - Emergency Spillway	% chance	2	3	3
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	9.5	8.1	6.7
Runoff Volume (ESH)	In.	6.29	6.20	4.86
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	250	150	50
Velocity of Flow (Ve)	Ft./Sec.	3.96	2.22	- 3/
Slope of Exit Channel	Ft./Ft.	.040	.040	.028
Maximum Water Surface Elevation	Ft.	349.1	358.6	-
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	20.4	17.1	13.8
Runoff Volume (FH)	In.	16.73	15.01	11.75
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	351.8	361.1	346.7
Capacity Equivalents				
Sediment Volume	In.	1.91	1.96	2.13
Retarding Volume	In.	4.95	6.96	6.30
Augmentation Volume	In.	0.98	1.15	1.37

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number T3	T4	T5
Class of Structure		a	a	b
Drainage Area	Sq. Mi.	0.32	0.57	0.24
Curve No. (1-day)(AMC II)		84	84	84
Elevation Top of Dam	Ft.	357.1	375.7	383.8
Elevation Crest Emergency Spillway	Ft.	354.1	372.7	380.8
Elevation Crest High Stage Inlet	Ft.	352.1	370.7	378.8
Elevation Crest Low Stage Inlet	Ft.	348.5	365.3	375.3
Elevation Crest Ungated Port	Ft.	344.8	362.0	370.7
Maximum Height of Dam	Ft.	32	29	32
Volume of Fill	Cu. Yds.	49,285	47,728	44,509
Total Capacity 1/	Ac. Ft.	195	275	145
Sediment Submerged	Ac. Ft.	36	48	18
Sediment Aerated	Ac. Ft.	1	1	1
Augmentation	Ac. Ft.	44	47	42
Retarding	Ac. Ft.	114	179	84
Between High and Low Stage	Ac. Ft.	67	119	50
Surface Area				
Sediment Pool 2/	Acres	(9)	(12)	(6)
Augmentation Pool	Acres	15	17	12
Retarding Pool 1/	Acres	27	35	21
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	7.7	7.7	8.5
Rainfall Volume (areal)(10-day)	In.	13.8	13.8	15.5
Runoff Volume (10-day)	In.	9.88	9.88	11.49
Capacity of Low Stage (Maximum)	cfs	4	16	4
Capacity of High Stage (Maximum)	cfs	60	57	60
Frequency Operation - Emergency Spillway	% chance	3	4	2
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	6.7	6.7	9.5
Runoff Volume (ESH)	In.	4.86	4.86	7.55
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	50	50	50
Velocity of Flow (Ve)	Ft./Sec.	- 3/	- 3/	2.13
Slope of Exit Channel	Ft./Ft.	.034	.030	.040
Maximum Water Surface Elevation	Ft.	-	-	381.0
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	13.8	13.8	20.4
Runoff Volume (FH)	In.	11.75	11.75	18.29
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	357.1	375.7	383.8
Capacity Equivalents				
Sediment Volume	In.	2.27	1.62	1.50
Retarding Volume	In.	6.77	5.90	6.67
Augmentation Volume	In.	2.57	1.55	3.32

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 16	17	18
Class of Structure		b	a	a 6/
Drainage Area	Sq. Mi.	0.82	0.76	0.99
Curve No. (1-day)(AMC II)		84	84	84
Elevation Top of Dam	Ft.	369.6	378.8	387.5
Elevation Crest Emergency Spillway	Ft.	366.5	375.8	384.6
Elevation Crest High Stage Inlet	Ft.	364.0	373.7	382.2
Elevation Crest Low Stage Inlet	Ft.	359.7	369.0	377.3
Elevation Crest Ungated Port	Ft.	357.3	366.0	374.6
Maximum Height of Dam	Ft.	38	30	33
Volume of Fill	Cu. Yds.	74,858	51,519	90,873
Total Capacity 1/	Ac. Ft.	528	389	538
Sediment Submerged	Ac. Ft.	137	57	98
Sediment Aerated	Ac. Ft.	5	2	4
Augmentation	Ac. Ft.	73	63	67
Retarding	Ac. Ft.	313	267	369
Between High and Low Stage	Ac. Ft.	176	160	210
Surface Area				
Sediment Pool 2/	Acres	(26)	(17)	(22)
Augmentation Pool	Acres	34	28	29
Retarding Pool 1/	Acres	61	54	77
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	8.5	7.7	8.1
Rainfall Volume (areal)(10-day)	In.	15.5	13.8	14.8
Runoff Volume (10-day)	In.	11.49	9.88	10.80
Capacity of Low Stage (Maximum)	cfs.	14	10	15
Capacity of High Stage (Maximum)	cfs	64	57	61
Frequency Operation - Emergency Spillway	% chance	2	3	3
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	9.5	6.7	8.1
Runoff Volume (ESH)	In.	7.55	4.86	6.20
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	125	75	75
Velocity of Flow (Ve)	Ft./Sec.	3.06	- 3/	1.92
Slope of Exit Channel	Ft./Ft.	.040	.030	.040
Maximum Water Surface Elevation	Ft.	367.0	-	384.8
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	20.4	13.8	17.1
Runoff Volume (FH)	In.	18.29	11.75	15.01
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	369.6	378.7	387.5
Capacity Equivalents				
Sediment Volume	In.	3.25	1.47	1.92
Retarding Volume	In.	7.15	6.58	6.98
Augmentation Volume	In.	1.67	1.56	1.26

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Items	Unit	Structure Number 19	20	21
Class of Structure		a 6/	b	b
Drainage Area	Sq. Mi.	0.87	3.18	1.35
Curve No. (1-day)(AMC II)		84	84	84
Elevation Top of Dam	Ft.	393.9	396.2	396.0
Elevation Crest Emergency Spillway	Ft.	391.2	393.0	392.8
Elevation Crest High Stage Inlet	Ft.	388.2	383.3	386.2
Elevation Crest Low Stage Inlet	Ft.	383.6	-	-
Elevation Crest Ungated Port	Ft.	380.7	381.3	384.0
Maximum Height of Dam	Ft.	31	35	26
Volume of Fill	Cu. Yds.	93,022	83,848	55,984
Total Capacity 1/	Ac. Ft.	509	1,615	578
Sediment Submerged	Ac. Ft.	78	202	143
Sediment Aerated	Ac. Ft.	3	10	7
Augmentation	Ac. Ft.	57	108	-
Retarding	Ac. Ft.	371	1,295	428
Between High and Low Stage	Ac. Ft.	184	-	-
Surface Area				
Sediment Pool 2/	Acres	(16)	(47)	38
Augmentation Pool	Acres	28	77	-
Retarding Pool 1/	Acres	75	200	93
Principal Spillway Design				
Rainfall Volume (areal)(1-day)	In.	8.1	8.5	8.5
Rainfall Volume (areal)(10-day)	In.	14.8	15.5	15.5
Runoff Volume (10-day)	In.	10.80	11.49	11.49
Capacity of Low Stage (Maximum)	cfs	10	-	-
Capacity of High Stage (Maximum)	cfs	60	63	54
Frequency Operation - Emergency Spillway	% chance	3	2	2
Dimensions of Conduit	In.	24	24	24
Emergency Spillway Design				
Rainfall Volume (ESH)(areal)	In.	8.1	9.5	9.5
Runoff Volume (ESH)	In.	6.20	7.55	7.55
Storm Duration	Hrs.	6.0	6.0	6.0
Type		Veg.	Veg.	Veg.
Bottom Width	Ft.	75	450	175
Velocity of Flow (Ve)	Ft./Sec.	1.20	- 3/	3.60
Slope of Exit Channel	Ft./Ft.	.040	.040	.040
Maximum Water Surface Elevation	Ft.	391.2	394.0	393.5
Freeboard Design				
Rainfall Volume (FH)(areal)	In.	17.1	20.4	20.4
Runoff Volume (FH)	In.	15.01	18.29	18.29
Storm Duration	Hrs.	6.0	6.0	6.0
Maximum Water Surface Elevation	Ft.	393.9	396.2	396.0
Capacity Equivalents				
Sediment Volume	In.	1.74	1.25	2.08
Retarding Volume	In.	7.99	7.64	5.95
Augmentation Volume	In.	1.24	0.63	-

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

Item	Unit	Structure Number 22 5/	Total
Class of Structure		b	-
Drainage Area	Sq. Mi.	2.21	22.75
Curve No. (1-day)(AMC II)		84	-
Elevation Top of Dam	Ft.	409.0	-
Elevation Crest Emergency Spillway	Ft.	405.9	-
Elevation Crest High Stage Inlet	Ft.	402.9	-
Elevation Crest Low Stage Inlet	Ft.	398.1	-
Elevation Crest Ungated Port	Ft.	396.0	-
Maximum Height of Dam	Ft.	23	-
Volume of Fill	Cu. Yds	83,562	1,307,331
Total Capacity 1/	Ac. Ft.	1,200	11,290
Sediment Submerged	Ac. Ft.	219	2,164
Sediment Aerated	Ac. Ft.	11	94
Augmentation	Ac. Ft.	131	1,000
Retarding	Ac. Ft.	839	8,032
Between High and Low Stage	Ac. Ft.	471	-
Surface Area			
Sediment Pool 2/	Acres	(50)	205 4/
Augmentation Pool	Acres	66	459
Retarding Pool 1/	Acres	147	1,499
Principal Spillway Design			
Rainfall Volume (areal)(1-day)	In.	8.5	-
Rainfall Volume (areal)(10-day)	In.	15.5	-
Runoff Volume (10-day)	In.	11.49	-
Capacity of Low Stage (Maximum)	cfs	32	-
Capacity of High Stage (Maximum)	cfs	56	-
Frequency Operation - Emergency Spillway	% chance	2	-
Dimensions of Conduit	In.	24"	-
Emergency Spillway Design			
Rainfall Volume (ESH)(areal)	In.	9.5	-
Runoff Volume (ESH)	In.	7.55	-
Storm Duration	Hrs.	6.0	-
Type		Veg.	-
Bottom Width	Ft.	160	-
Velocity of Flow (Ve)	Ft./Sec.	- 3/	-
Slope of Exit Channel	Ft./Ft.	.040	-
Maximum Water Surface Elevation	Ft.	-	-
Freeboard Design			
Rainfall Volume (FH)(areal)	In.	20.4	-
Runoff Volume (FH)	In.	18.29	-
Storm Duration	Hrs.	6.0	-
Maximum Water Surface Elevation	Ft.	405.9	-
Capacity Equivalents			
Sediment Volume	In.	1.95	-
Retarding Volume	In.	7.12	-
Augmentation Volume	In.	1.11	-

TABLE 3 - STRUCTURE DATA (continued)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Ozan Creeks Watershed, Arkansas

1/ Crest of Emergency Spillway.
2/ Area shown in ( ) for reservoirs with augmentation storage.
3/ No flow during passage of hydrograph.
4/ Total does not include structures with augmentation storage.
5/ Storage data based on 7.5 minute quadrangle sheet.
6/ Criteria exceeds the minimum required for "a" classification.

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TABLE 4 - ANNUAL COST

Ozan Creeks Watershed, Arkansas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structures Numbers 1 through 22 and Land Stabilization Measures	214,740	2,950	217,670
Project Administration	29,560	-	29,560
GRAND TOTAL	244,280	2,950	247,230

1/ Price Base: 1973.
2/ 100 years at 6 7/8 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Ozan Creeks Watershed, Arkansas

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	342,450	239,890	102,560
Other Agricultural	25,700	16,600	9,100
Nonagricultural Road and Bridge	60,110	44,590	15,520
Subtotal	428,260	301,080	127,180
Sediment			
Overbank Deposition	15,070	3,910	11,160
Land Voiding	2,740	620	2,120
Subtotal	17,810	4,530	13,280
Erosion			
Flood plain Scour	7,840	3,130	4,710
Indirect	45,390	30,870	14,520
TOTAL	499,300	339,610	159,690

1/ Price Base: Crop and pasture current normalized prices; all other 1973 prices.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Ozan Creeks Watershed, Arkansas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost 3/	Benefit-Cost Ratio
	Flood Prevention						
	Damage Reduction 2/	More Intensive Land Use	Redevelopment	Secondary	Total		
Floodwater Retarding Structures Numbers 1 through 22 and Land Stabilization Measures	150,950	81,720	29,120	68,280	330,070	217,670	1.5:1
Project Administration	-	-	-	-	-	29,560	-
GRAND TOTAL	150,950	81,720	29,120	68,280	330,070	247,230	1.3:1

1/ Price Base: Crop and pasture benefits current normalized prices; all other benefits 1973 prices.
2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $8,740 annually.
3/ From table 4.

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INVESTIGATIONS AND ANALYSES

Land Treatment

The Conservation Needs Inventory and technical guide provided interpretative information and needs for the watershed.

Land treatment measures already applied and the cost per unit of application for each measure were obtained from field office records. This information was used in preparing Table 1A.

A systematic field survey revealed ground cover, forest and hydrologic conditions, and treatment needs. The field survey, supporting data, and information from other agencies and forestry officials were used to determine the amount of remedial measures needed. Measures considered will contribute to flood reduction and soil stabilization.

All land treatment measures to be applied during the project installation period were determined on the basis of the need for treatment for watershed protection and flood prevention and the level of participation expected from landowners and operators. Consideration was given to the personnel available for planning assistance and the resources of owners and operators for providing the funds for installing the land treatment measures.

Engineering

A base map of the watershed was prepared to show the watershed boundary, drainage pattern, system of roads, and other pertinent information.

Structure locations were determined from quadrangle maps and field examination. Topographic information for Structure Number 22 was developed for a 7.5 minute quadrangle sheet of the area, plus a profile along the centerline of the proposed dam. All other structures were surveyed by the rangeline method. Topographic maps with 4-foot contour intervals were developed on aerial photographs with a scale of 660 feet = 1 inch. A stereoscope was used in sketching contours between rangelines. Storage curves and stage-surface area curves were developed from these contour maps.

The heights of the dams and pool sizes were determined by storage volumes needed to control runoff from the design storms and to provide sediment storage for Structures Numbers 1 through 6 and 21. Structures Numbers 7 through 20 and 22 include additional storage for streamflow augmentation.

Floodwater detention storage was determined by routing principal spillway hydrographs on the IBM-1130 computer. A minimum of two feet vertically was used between the high stage and the emergency spillway crest.

Emergency spillway and freeboard hydrographs were routed on the IBM-1130 computer. A minimum emergency spillway width of 50 feet was used for the design.

Four sites within the area formerly owned by the Southwestern Proving Grounds were considered. This land is restricted for surface use only and the sites were eliminated because of the excessive cost and danger involved in construction.

A preliminary cost estimate to include additional storage for municipal and industrial water supply at Structure Number 10 was furnished to the City of Blevins. The local cost was more than they could finance at the present time.

Nine proposed locations for grade-control structures were surveyed for cost estimate purposes.

Structure Number 5 combines two drainage areas by utilizing the ridge between the streams for borrow material.

The cost estimate of the floodwater retarding structures was based on recent construction costs of similar projects.

A summary of physical data is shown on Table 3.

Geologic

Preliminary geologic investigations were made on each floodwater retarding structure. These investigations included studies of stratigraphy, structural geology, lithology, borrow materials, and depths of over-burden at the structures.

Bedrock underlying the watershed is of Upper Cretaceous age. Geologic formations exposed from the northwest to southeast are Brownstown Marl, Ozan Formation, Marlbrook Marl, Saratoga Chalk, and Nacatoch Sand. In general, the slight dip of strata toward the southeast and variations in resistance to erosion account for cuesta and valley topography in the watershed. Rock types are primarily marl, marly sand, and chalk. Terraces of Pleistocene sand and gravel cover a portion of the bedrock in the northern part of the watershed and Recent alluvium is abundant in the flood plain of South Fork and Middle Fork Creeks. All of the structures will be located on either the Brownstown or Marlbrook Marls, Saratoga Chalk, or Ozan Formations. Although these formations are not completely indurated, they are preconsolidated and should provide sufficient foundation strength for the proposed embankments.

Borrow material is abundant at all 22 structures. All structures will be constructed primarily with CH materials, with CL and SM soils available in limited quantities. Offsite borrow materials will not be required for any of the proposed structures.

Emergency spillway conditions are favorable on all of the structures and no unusual foundation conditions are anticipated which would appreciably affect costs or stability of proposed structures. Rock excavation will not be encountered in any of the emergency spillways. Firm clay, marl, or sandy marl exists at or very near emergency spillway crest elevations on all of the structures. All of the emergency spillways will be vegetated.

The Marlbrook Marl is a chalky marl (calcareous clay) which when freshly exposed and moist is dark blue but when weathered is nearly white. When dry it looks chalky and is very susceptible to erosion. When wet, it is highly plastic, because of its large content of clay (3), and is more resistant to erosion. Alternate wetting and drying results in the disintegration of the clay particles into smaller fragments. The explanation of the process probably lies in the alternate swelling and shrinking of the colloids. Uneven expansion and contraction, which occur because a portion of the clay is never wet or dried uniformly and simultaneously, result in numerous cracks which separate the soil into smaller pieces. They are drawn apart into units as shrinking of the colloid occurs. Also, reabsorption of water by the particles is very slow, that is once water is lost from the molecular structure of the clay it is not readily regained.

Provisions are made for low-flow release from the system of retarding structures to keep the channel beds wet. This continuous wetting of the channels will reduce channel degradation by an estimated 50 percent. This reduction is based upon the relationship between wet and dry periods of the channelbeds under present and with-project conditions. The channelbeds, including the marl, will be continuously wetted while the marl in the channelbanks above the low-flow elevations will undergo shorter and less frequent periods of drying-out than at present.

Natural resources in Ozan Creeks Watershed include ground water, clay, shale, chalk and marl, greensand, sand and gravel, and ilmenite. Ground water is one of the most important natural resources in the watershed. The most productive water-bearing formations in the watershed are the Tokio Formation and the Nacatoch Sand, both of which yield moderate supplies of good quality water to domestic and public supply wells. Quaternary alluvium and terrace deposits supply moderate yields of hard water to domestic wells.

Clay deposits, associated with shale in the northwestern portion of the watershed, are suitable for brick and tile. Shale in the same vicinity is suitable for haydite, a bloated lightweight aggregate. Chalk, sandy

chalk, and marl, which are abundant and widespread in thick beds of Cretaceous formations in the watershed, have potential value for utilization in cement and as agricultural limestone. Removal of silica from Saratoga Chalk by floatation might open a vast new source of raw material for the cement industry if testing determines economic feasibility. Large quantites of low-grade glauconite-bearing greensand are available in the Nacatoch Sand. The sand occurs in the extreme southeastern corner of the watershed. Samples taken by Midwest Research Institute showed that the glauconite content was too low to be of commercial value. Sands of the Nacatoch contain 2.21 - 4.53 percent potash. Sand and gravel deposits used for roadstone, concrete aggregate, and for silica used in the manufacture of cement are present in the northeastern portion of the watershed. Sparse amounts of ilmenite, the principal ore of titanium, which has been observed in surficial sands in the extreme northwestern corner of the watershed, are not currently commercial. To date, there has been no significant mining of mineral resources with the watershed.

Water quality in the proposed reservoirs is expected to be good. Drainage areas above the structures are sparsely populated, with woodland and grassland the major land use.

Sedimentation

Sediment sources were located and evaluated by field mapping methods. Soil cover complex and erosion studies were conducted on a representative portion of the upland area of the watershed. The basic erosion rate for each land use was determined from detailed investigation. The present and future projected erosion and sedimentation rates were computed for each structure. Delivery ratios of sediment from sheet erosion are estimated to range from 49 percent to 69 percent, depending primarily upon drainage area size. Submerged sediment in the reservoirs will have a density of approximately 40 pounds per cubic foot, and the aerated sediment will be deposited at a density of about 90 pounds per cubic foot. It is expected that sediment yield from the watershed uplands will be reduced by 43 percent by land treatment and structural measures.

The concentration of sediment from Ozan Creeks Watershed is approximately 660 milligrams per liter under present conditions. Computations indicate that the installation of planned land treatment and structural measures will reduce this concentration to approximately 370 milligrams per liter. This would amount to a reduction of 44 percent in the average annual sediment concentration at the point where Ozan Creek flows into the Little Missouri River.

Land damages on the flood plain are not extensive. Flood plain scour which affects 285 acres is causing an annual damage of $7,840. Sediment deposits on the flood plain cause an annual damage of $15,070 on 1,116 acres. These valley damages were mapped by measuring each type of damage by use of aerial photographs and field investigation. The area and intensity of the damages were computed from data collected in the field.

Installation of project measures will reduce valley damages by reducing flooding. An area of 906 acres which is damaged 10 percent by sedimentation and scour will have virtually 100-percent recovery. Once the flooding is alleviated, the tilling action of cultivation and the build-up of soil nutrients will accelerate the recovery.

Land voiding caused by channel enlargement is presently causing significant land damage. At the present rate, approximately 2.6 acres per year is lost to channel enlargement. Installation of project measures is expected to reduce this rate 2.0 acres per year or 200 acres during the life of the project. Approximately 4 percent of the flood plain in Reaches II and III will be saved by the project.

Soils derived from the Marlbrook Marl and Saratoga Chalk Formations are highly erosive. Approximately 250 acres of critically eroding areas exist in the southern portion of the watershed which is occupied by these soils. Approximately 173 acres of land has eroded down to a chalky or marly material, while 77 acres of severely eroding land occurs along stream channel banks. Soil loss is estimated at 39 tons per acre per year. Project measures are expected to reduce the present rate 92 percent. Once structural measures are completed and vegetation is established on these soils, eroding areas should continue to heal.

Hydraulic and Hydrologic

Monthly rainfall records at Hope, Arkansas, are available for the period of 1840 to 1971. A stream gage is located on Ozan Creek near McCaskill, Arkansas. This recording gage has been in place since 1948. Annual peak discharges are available for the period of 1940 to 1971.

Aerial photographs, watershed base maps, and quadrangle maps provided basic topographic information. Valley sections were surveyed at 35 locations to provide information for streamflow computations. These valley sections provided topographic information, land use, and other pertinent information.

Land use and cover conditions were mapped in detail by a thorough reconnaissance of the watershed. Cover conditions were determined on the woodland areas of the watershed by the U. S. Forest Service. Future cover conditions were estimated with the assistance of the district conservationist and the State Conservation Agronomist of the Soil Conservation Service.

A hydrologic soil-cover complex was developed by considering such factors as soil groups, relief, land use, and cover conditions. This soil-cover complex was used to compute runoff curve numbers for present conditions and future conditions with land treatment measures installed.

North Fork of Ozan Creek Watershed, a PL-566 project currently under construction, outlets through Reaches I and IV of Ozan Creeks Watershed into the Little Missouri River. This project was assumed to be completed during the evaluation of Ozan Creeks Watershed.

Stage-discharge and stage-area flooded relationships were computed on the IBM-1130 Computer.

Stream reach routings were made using the convex or coefficient routing method as outlined in Chapter 17 of Section 4 of the SCS National Engineering Handbook. Six structural alternates were routed. Three of the alternates were routed using the Hydrology-2 program as programmed on the IBM-1130 Computer. The remaining three alternates were routed using hold-out hydrographs and routing coefficients as determined on the computer runs.

The standard unit hydrograph used by the computer did not produce routings that matched the recorded data on the McCaskill gage. By comparing the results for a routed 3-year frequency peak discharge with the gage it was necessary to change the constant in the peak discharge formula from 484 to 300. This procedure is discussed in detail in Chapter 16 of Section 4 of the SCS National Engineering Handbook.

Evaluation routings were made by the frequency method. Rainfall volumes of 24-hour duration storms for various frequencies were obtained from the U. S. Weather Bureau Technical Paper 40. Frequencies of the storms routed were checked by comparing the routed peak discharges with the discharge-frequency relationship developed for the Ozan Creek gage near McCaskill. The economist assessed damages on the basis of the acres flooded for each routed storm.

The channel capacity downstream from the structures, flood characteristics, and the anticipated required flood pool drawdown time indicated that the structure release rates should be set as near 20 cubic feet per second per square mile as possible using a standard pipe size. The release rate will allow for less than 10-day emptying time and will not induce downstream flooding.

Floodwater detention storage volumes were determined by routing a principal spillway hydrograph as outlined in Chapter 21 of Section 4 of the Soil Conservation Service National Engineering Handbook, in accordance with the criteria set out in Engineering Memorandum SCS-27.

Emergency spillway and freeboard hydrographs were computed and routed as programmed on the IBM-1130 Computer which uses procedures outlined in Section 4 of the Soil Conservation Service National Engineering Handbook. Rainfall volumes were determined from maps included in Arkansas Hydrology Memorandum 303 and are in excess of those found in Chapter 21 of Section 4 of the Soil Conservation Service National Engineering Handbook.

Two types of low flow releases are planned. Structures Numbers 1 through 6 and 21 include a port at the 50-year sediment pool elevation with the top of the riser at the 100-year sediment pool elevation. This port will discharge approximately 0.2 csm continuously except during extreme drought periods to augment low flows below the structures.

Structures Numbers 7 through 20 and 22 include a port at the 100-year sediment pool elevation with additional storage provided above the 100-year sediment pool elevation. These structures will discharge about 1 cfs each to insure that the channels remain wet below the structures for channel stability as well as to augment low flows.

Economic

Damage schedules were taken in the flood plain. These schedules covered historical information on flooding and flood damages. Land use and crop yield projections were obtained from River Basin Studies made by the Economic Research Service. Land use and crop yield projections, supplemented by the information contained in the schedules, served as a guide for determining damage rates for depth and season of flooding.

A future "without project" and future "with project" approach was taken in this evaluation. Land use and crop yields were used as guides in determining future "without project" conditions. The land use and crop yield projections for the Ozan Creeks Watershed are based on soils in the flood plain, which are comparable to those used in the River Basin Studies.

The frequency method of analysis was used. Floodwater damages were calculated under future "without project" conditions and future "with project" conditions. Crop and pasture damages were adjusted for recurrent flooding. Damages were adjusted for any area having a common flood plain with the Little Missouri River. Damages caused by flooding from the Little Missouri are not included in this work plan.

The difference between average annual damages before project installation and those expected after project installation constitutes the benefits achieved by land treatment and structural measures.

Damage to other agricultural property, such as fences, livestock, and farm equipment, was estimated from analyses of schedules using prevailing costs in the area.

Damages to roads and bridges are items of nonagricultural damage in the watershed. Estimates were obtained from people who knew the damage caused to these items by flooding.

Floodwater damage to crop and pasture, other agricultural property, and nonagricultural property was incorporated as computer input data. This information was generated as output data by the computer which gave average annual damages before and after project installation. Six

systems of structural measures were analyzed. The system which gave the most effective flood prevention program for the costs involved was used for project justification.

The monetary value of physical damage to the flood plain from scour and sediment deposition was based on lost production. Lag in recovering productivity and cost of farm operations to speed recovery was taken into consideration.

Indirect damages consist primarily of extra travel time to market, interrupted travel, later deliveries, loss of business, and loss of employment. It is estimated that indirect damage amounts to at least 10 percent of the direct damages.

Analysis of land use and crop yields in conjunction with other available information, indicates that there will be restoration of former productivity and more intensive use in the flood plain after project installation. The magnitude of these benefits is discussed in the Project Benefits section of this plan.

Project installation will provide opportunities for employment of local labor presently unemployed or underemployed. Data from other projects indicate that local labor costs will be approximately 15 percent of the construction costs. This value for the structures was amortized and converted to a redevelopment benefit. The value of local labor employed in project operation and maintenance over a 20-year period was treated as a decreasing annuity and converted to an average value for the project life and used as a second redevelopment benefit.

Secondary benefits were analyzed to determine the effect of increased income and employment generated by the project. Benefits will be realized by landowners, workers, processors, and business establishments in the trade area. In the analysis, consideration was given to values added to several sectors of the local economy, as measured by economic multipliers.

The investment multiplier was used to measure the effects of: (1) values added to agricultural inputs; (2) values added to transportation, processing, and marketing; (3) values added to local retailers; and (4) the values added by additional employment. Values added to agricultural inputs were the difference in the farmers' cost for additional inputs and the wholesale value of those inputs. Values added to transportation, processing, and marketing were the difference in the value of the product as it leaves the local area and its value at the farm. Values added to local retailers are amounts available for successive rounds of consumption spending.

The employment multiplier was used to measure the total effect of creating additional employment. This multiplier was derived from the occupational classifications of the employed labor force. The ratio of the total employment to those employed in basic occupations was a basis for estimating the multiplier.

The investment multiplier was based on data in the USDA Consumer Expenditure Survey Report Number 3, "Consumer Expenditures and Income, Rural Farm Population, Southern Region, 1961." The multiplier was estimated by summing the effects of successive rounds of spending and respending. The consumption expenditures for each of the successive rounds of spending and respending were based on the farm families' marginal propensity to consume.

The investment multiplier times the various sources of new income yields the total effect of the successive rounds of spending this new income. To estimate the net local effect of the project-induced investments and employment, both multipliers were adjusted to account for leakages. The investment multiplier was adjusted downward by 88 percent to cover non-local effects. The employment multiplier was adjusted for unused capacity. It is assumed for this analysis that labor would function at 90 percent efficiency.

Areas that will be inundated by the sediment and detention pools of the floodwater retarding structures were excluded from the damage appraisal. Lost production in these areas after project installation was compared with the appraised value of the sites. In the analysis, no production would occur in the sediment pools. Land covered by detention pools was assumed to be converted to grassland under project conditions. Since the value of the easement exceeded the value of lost production, the easement value was used in economic justification.

With the exception of the multiplier effect, details of the procedure used in the investigation are described in the Economic Guide for Watershed Protection and Flood Prevention.

Fish and Wildlife

A stream survey was conducted on Ozan Creek and its tributaries on which floodwater retarding structures were planned. Physical parameters measured were pool to riffle ratio, average pool size, average pool depth, bottom type, stream shelter, water temperature, and riparian vegetation. Examples of chemical parameters measures were dissolved oxygen, total hardness, total alkalinity, and pH.

In conjunction with the stream survey the land use within the area of each planned sediment pool was recorded. Observations recorded within forest land were species and diameters. Dominant grasses, herbs and shrubs in other land uses were recorded.

Information from files of the Arkansas Game and Fish Commission was used. Examples are Dingell-Johnson reports, county fish population samples, deer harvest records, and turkey harvest records.

Engineering data from "Table 3 - Structure Data" of this work plan, four-foot contour interval maps of the structures, and stage surface acres curves were used to predict morphometric characteristics of sediment pools. Examples are surface area to drainage area ratio, average depth, acres of littoral water, and acres of limnetic area.

Distribution maps from the following texts were used to determine watershed fauna:

1. A Field Guide to Reptiles and Amphibians by R. Conant.
2. A field Guide to the Birds by R. T. Peterson.
3. The Mammals of North America, Volume I and II by E. R. Hall and K. R. Kelson.

A checklist of fish fauna was compiled with the assistance of Dr. H. W. Robison, Assistant Professor of Biology, Southern State College.

LITERATURE CITED

1. Arkansas Department of Labor, Labor Force Statistics Annual Averages, State, and Areas. Little Rock, Arkansas, 1971.

2. Counts, H. B., et al Ground-water Resources in a Part of Southwestern Arkansas. Univ. of Arkansas Inst. of Sci. and Tech. Water Resources Cir. No. 2. Little Rock, Arkansas, 1955.

3. Dane, Carle A. Upper Cretaceous Formations of Southwestern Arkansas. Bul. 1 AR. Geol. Sur. Little Rock, Arkansas, 1929.

4. Industrial Research and Extension Center, State and County Economic Data for Arkansas. Pub. L-2A. Little Rock, Arkansas, 1973.

5. Shaw, Samuel P. and Gordon C. Fredine, Wetlands of the United States U. S. Dept. Int. Cir. 39. USGPO Wash. D. C., 1971.

6. Stroud, Raymond B., et al Mineral Resources and Industries of Arkansas. U. S. Dept. Int. Bul. 645 USGPO Wash. D. C., 1969.

7. United States Bureau of Census. Census of Agriculture, 1969. Vol. 1 Area Rpt. 34. AR Sec. 2. Co. Data. USGPO Wash. D. C., 1972.

8. United States Bureau of the Census. United States Census of Population, 1970. No. of Inhabitants Final Rpt. PC (1)-A5 AR USGPO Wash. D. C., 1971.

9. United States Department of Agriculture. Land Resource Regions and Major Land Resource Areas. Agr. Handbook 296. USGPO Wash. D. C., 1965.

10. United States Department of Commerce. Climatological Data USGPO Wash. D.C.

11. Water Resources Council. Water Resources Regions and Subregions for the National Assessment of Water and Related Land Resources. Wash. D. C., 1970.

12. U. S. Army Corps of Engineers. Water Resource Development in Arkansas 1973. Vicksburg, Mississippi.

13. Arkansas Archeological Survey. A Preliminary Field Study of the Ozan Creeks Watershed Project, Hempstead County, Arkansas. Fayetteville, Arkansas, 1974.

14. U. S. Department of the Interior, Fish and Wildlife Service. United States List of Endangered Fauna, May, 1974.

15. Lagler, Karl F. Freshwater Fishery Biology. Dubuque, Iowa, 1956.

16. Arkansas Department of Pollution Control and Ecology, Arkansas Water Quality Standards, Little Rock, Arkansas, 1973.

17. Arkansas State Department of Health, Rules and Regulations Pertaining to Public Water Supplies, Little Rock, Arkansas, 1971.

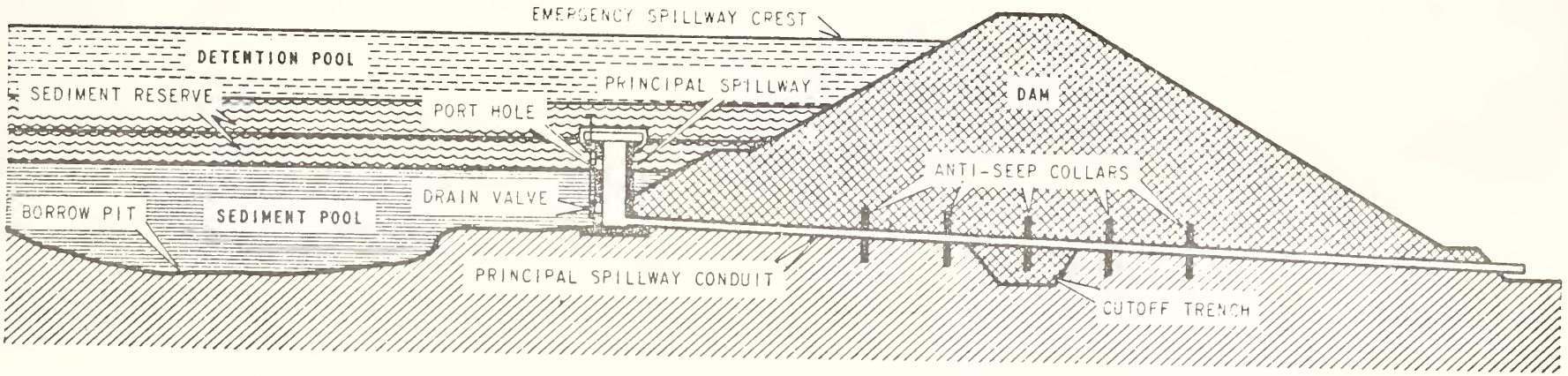
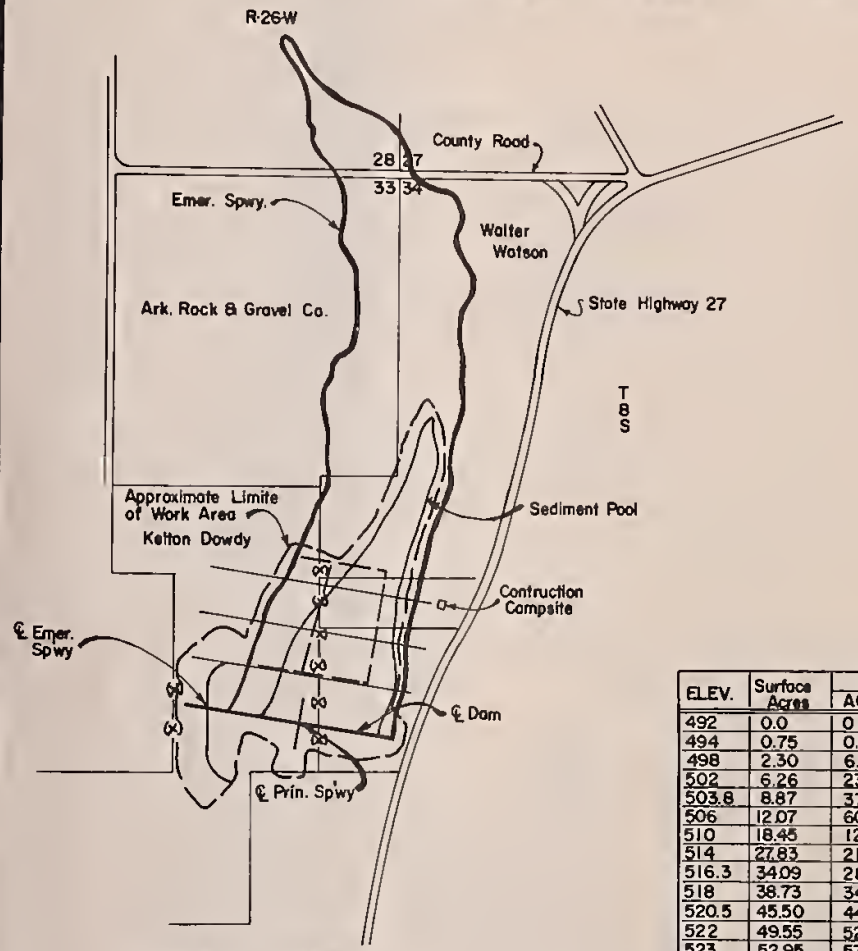


Figure 1

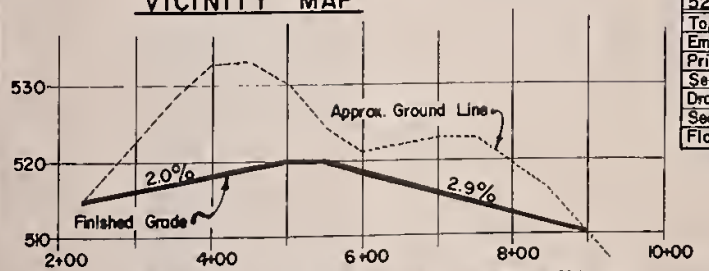
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE



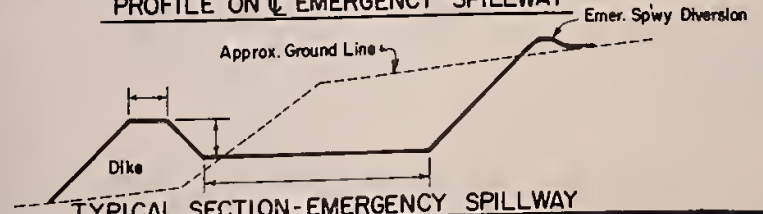
VICINITY MAP

ELEV.	Surface Acres	STORAGE AC.-FT.	STORAGE INCHES
492	0.0	0.0	0.0
494	0.75	0.75	0.01
498	2.30	6.85	0.10
502	6.26	23.97	0.33
503.8	8.87	37.40	0.52
506	12.07	60.57	0.84
510	18.45	121.61	1.69
514	27.83	214.17	2.99
516.3	34.09	285.40	3.97
518	38.73	347.34	4.83
520.5	45.50	447.80	6.22
522	49.55	523.86	7.27
523	52.95	575.11	8.00
524	56.37	629.77	8.74

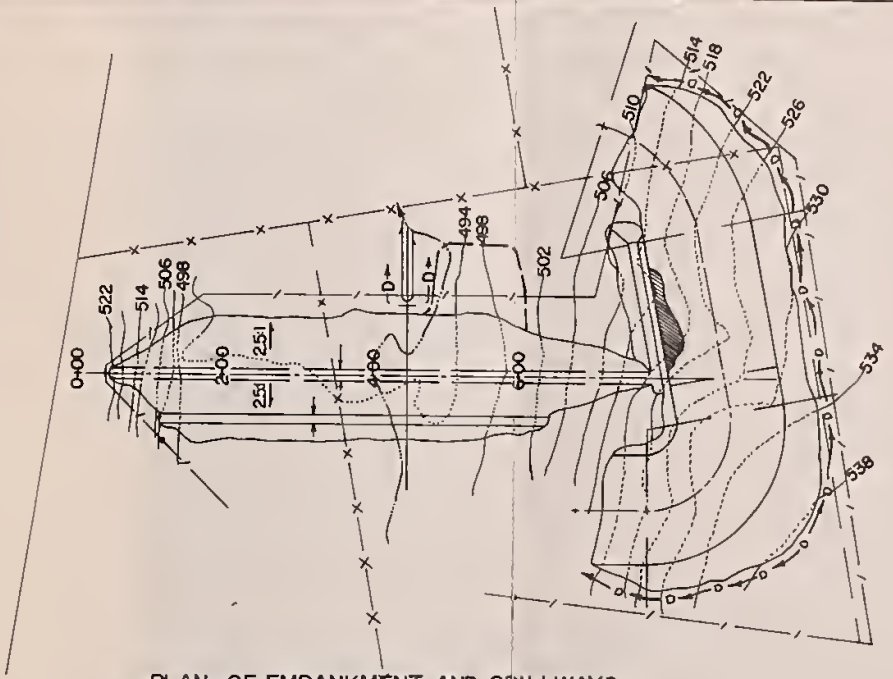
Top of Dam (effective) Elev.	523.5
Emergency Spwy Crest Elev.	520.5
Prin. Spwy Crest Elev.	516.3
Sed. Pool & Port Elev.	503.8
Drainage Area-Acres	864
Sed. Storage-Ac. Ft.	73.40
Floodwater Storage Ac. Ft.	374.4



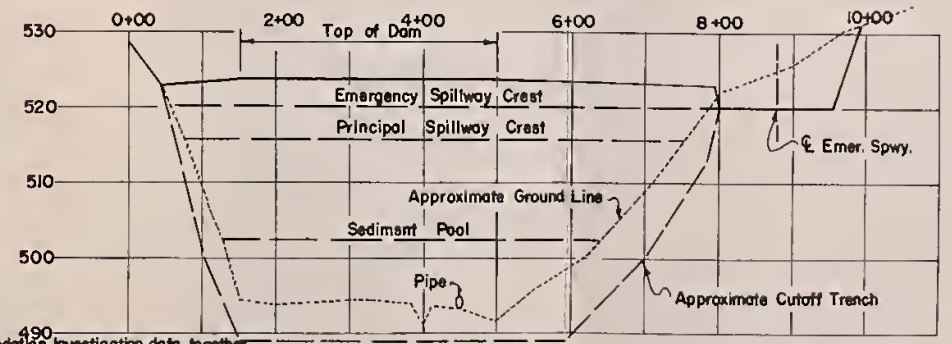
PROFILE ON ℄ EMERGENCY SPILLWAY



TYPICAL SECTION-EMERGENCY SPILLWAY



PLAN OF EMBANKMENT AND SPILLWAYS



PROFILE ON ℄ DAM

Additional soil and foundation investigation data together with laboratory test data are available in S.C.S. field construction office for review by prospective bidders.

Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed ____ Date ____ Approved by State Conservationist
Drawn ____
Traced ____ Title ____
Checked ____ Drawing No. II-L-30711-1

4-30703

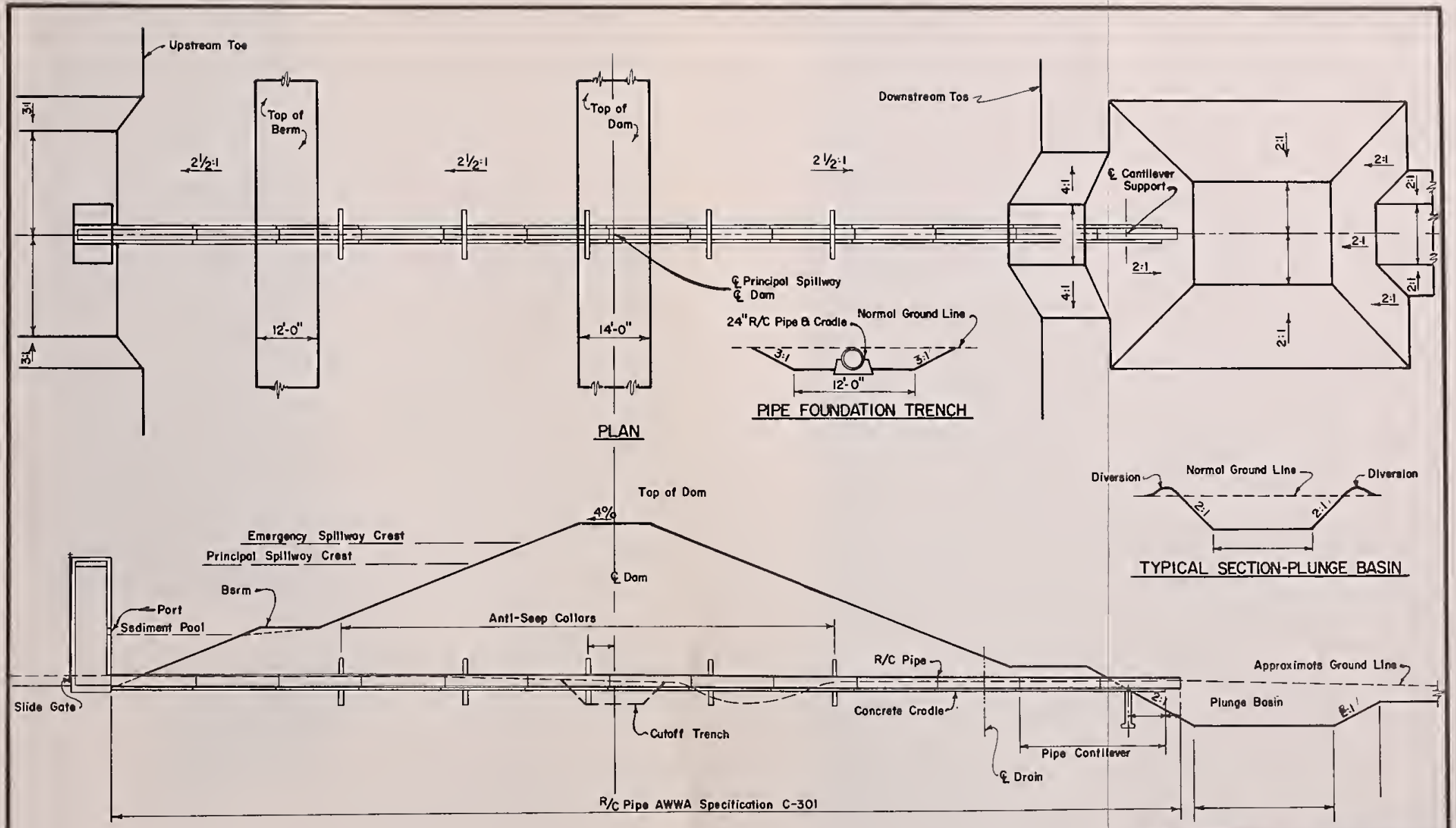


Figure 2a
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date
Drawn	Approved by:
Traced	Title: State Conservation Engr.
Checked	Title
Scale	Drawing No. 4-L-30711-2

4-30703

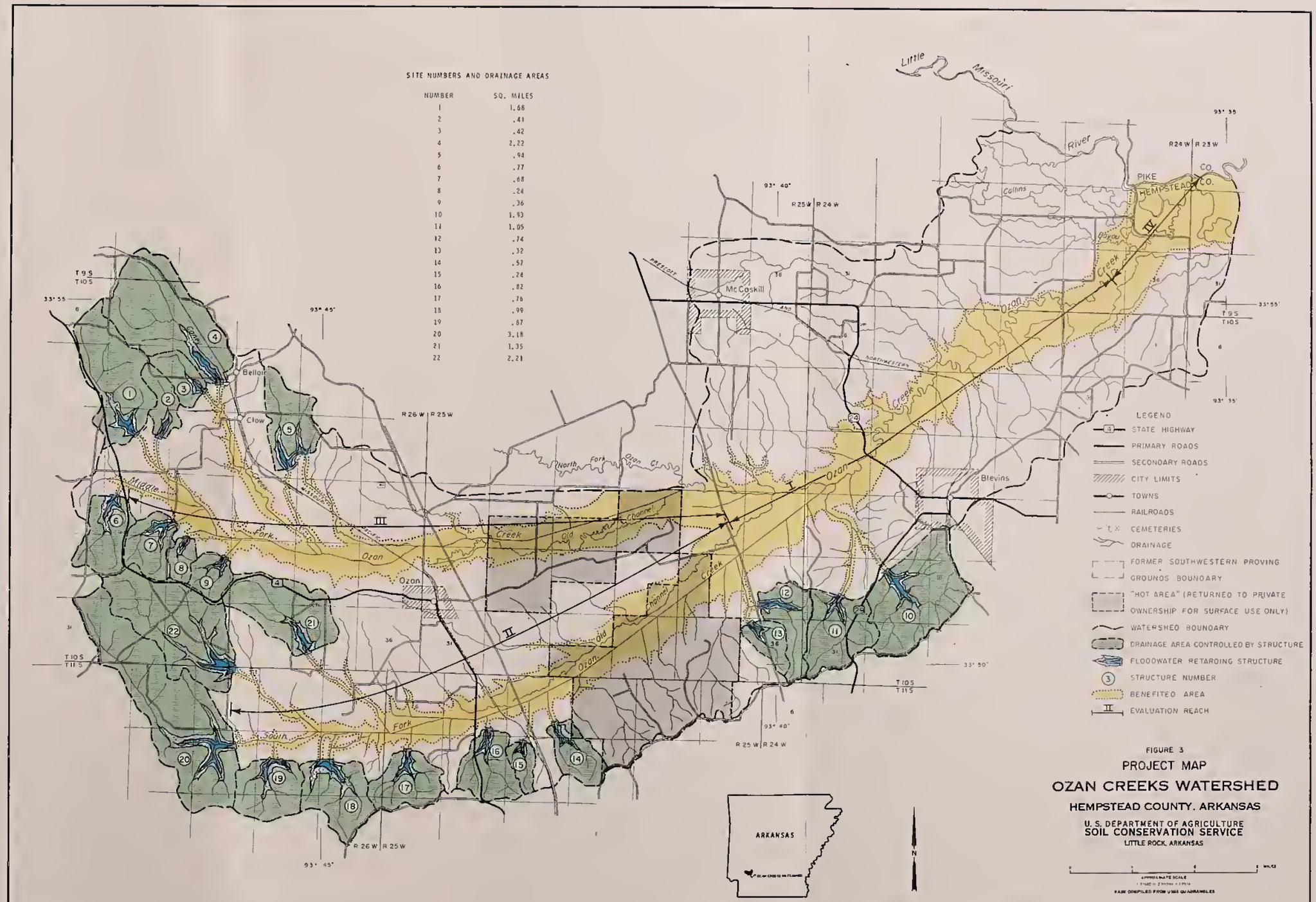


FIGURE 3

PROJECT MAP

OZAN CREEKS WATERSHED

HEMPSTEAD COUNTY, ARKANSAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LITTLE ROCK, ARKANSAS

APPROXIMATE SCALE
BASE COMPILED FROM USGS QUADRANGLES

6-73 4-R-33,144

AUGUST 1967

4-R-24,619