FINAL WORK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION
AND
RECREATIONAL DEVELOPMENT

LOWER LITTLE BLACK WATERSHED

Butler and Ripley Counties, Missouri
Clay County, Arkansas

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OUR SOIL ★ OUR STRENGTH

USDA-SCS-LINCOLN, NEBR. 1975

ADDENDUM

LOWER LITTLE BLACK WATERSHED, MISSOURI

This addendum shows project cost based on 1973 price base for construction costs amortized for 100 years at 5-7/8 percent interest.

Benefits for this addendum are based on current normalized prices for agricultural commodities and original values for recreation.

Annual project benefits, costs, and benefit-cost ratio are as follows:

Total benefits	$1,232,952
Total costs	801,887
Benefit-cost ratio	1.5:1.0

August 1974

ADDENDUM

LOWER LITTLE BLACK WATERSHED WORK PLAN

BUTLER AND RIPLEY COUNTIES, MISSOURI

CLAY COUNTY, ARKANSAS

AUGUST 1974

This addendum was prepared to meet interim requirements for implementing principles and standards for planning water and related land resources of the Water Resources Council.

It includes the following three parts:

I. Benefit Cost Relationship - Part I shows the effects of 5-7/8 percent interest on the selected plan for the Lower Little Black Watershed. Costs are those for works of improvements located in the Lower Little Black Watershed area and benefits have been prorated between both the Upper and Lower Little Black Watershed plans.

II. Abbreviated Environmental Quality Plan - The abbreviated EQ plan covers both the Upper and Lower Little Black Watershed areas.

III. Display of Accounts - Part III is a display of the national economic development, environmental quality, regional development, and social well-being accounts of the selected plan for the Lower Little Black Watershed.

PART I

BENEFIT COST RELATIONSHIP

The following data shows the benefit cost relationship using 1973 prices for project costs and 5-7/8 percent interest rates for amortization. Benefits are on a current normalized price base for agricultural commodities. Recreation benefits are represented by values set forth in USDA procedures for planning water and related land resources dated March 1974.

Annual project benefits are	$1,232,952.
Annual project costs are	801,887.
The benefit cost ratio is	1.5:1.0.

UPPER AND LOWER LITTLE BLACK WATERSHEDS
MISSOURI

PART II

Abbreviated Environmental Quality Plan

The environmental quality of this watershed has been degraded, and existing values are in jeopardy. This abbreviated environmental quality plan has been formulated to protect and enhance natural environmental values.

Environmental Problems

Extensive forest stands of the same size, and even ages limit natural beauty and wildlife potential. Clearing of bottom land forest has removed most of the native vegetation. The predominance of forest land in the upland and cropland in the bottom lands, result in a lack of diversity in these areas. Both upland forest and delta croplands need greater diversity of natural and man-induced systems. Unmanaged grazing of forest land and pastureland reduces agricultural production and the value of these areas for wildlife habitat. The presence of livestock detracts from the scenic and esthetic value of the stream system. Uncontrolled forest fires destroy or degrade forest resources, farmsteads, and wildlife habitat.

Flat water resources, such as lakes and ponds, are limited, and are principally located on private land where access is very limited. Many scenic land and water areas are present, but few are accessible.

Junk cars, trash, countryside dumps, and roadside litter degrade the natural beauty of the area, and serve as breeding places for disease vectors.

Poor management of uplands result in accelerated erosion from all land uses. Most upland soils are not suited for use as cropland. Where cropping exists, most fields need management to reduce soil loss. Some cropland is present on sites where soils or slope conditions make the site poorly suited for cultivation. Some sandy delta soils need to be vegetated to reduce wind and runoff erosion. Soil losses, by land uses, are listed as follows:

Land Use	Sheet Erosion - Tons/Acre/Year
Cropland	7.2
Idle Land	4.0
Pastureland	3.0
Forest Land	4.2
Other	4.0

Roadside and other erosion is estimated to yield the equivalent of 1.4 tons of sediment per watershed acre per year. Streambank erosion is estimated to yield the equivalent of 1 ton of sediment per watershed acre per year. Areas denuded for construction activities need vegetative planting and seeding. Land treatment needs to prevent accelerated erosion are estimated as follows: cropland, 45,700 acres; pastureland, 18,000 acres; forest land, 104,400 acres; and other land, 6,200 acres. There are 86 miles of eroding roadbanks (approximately 200 acres), 20 miles of eroding streambank (approximately 80 miles), and 6,800 acres of bottom land subject to scour erosion. Old scour channels get deeper and wider and new scour channels are created with each major flood. Excessive erosion occurs where local field and road drainage enter ditches in the delta. Floods deposit sediment, scour flood plain lands, scatter debris, and endanger humans and animals in flooded areas. Continued overland flows are expected to change the course of the Little Black River from the present course to one along one of the drainage ditches.

Water quality is degraded by nutrients and pesticides due to uncontrolled runoff and flooding. The quantity of flows in tributaries vary from no flow to floods. Neither extreme is good and periods of moderate flow are short. Improper waste disposal will eventually degrade water quality due to soil and bedrock conditions. Water quality of streams and drainage ditches is also decreased by turbidity during high flows, and by low flow or stagnancy during droughts.

Three species of animals considered rare or endangered are native to the area. The present status of these animals is largely due to loss of habitat and development and use of the area by man.

Old military roads and indian trails cross the area. These are not marked or preserved in any way. An artesian well is present but nearly unnoticed near Grandin. King Bee Spring is inaccessible. Local history and sites associated with the world's largest timber producing town in 1870 are being forgotten and are largely unprotected. Archeological sites in the area have not been cataloged and some are being destroyed by land modification. Planning and zoning is needed to guide the future development of the area. The location and importance of old cemeteries have not been determined.

COMPONENT NEEDS

Component needs include the following:

1. Change open and green space relationships.
2. Improve the condition of permanent vegetation.
3. Reduce soil erosion.
4. Establish natural areas.
5. Improve water quality and flow conditions.
6. Collect and remove junk, litter, and trash.
7. Provide, protect, and enhance forest and other natural vegetation.
8. Inventory and protect geological, archeological, and historic resources.

Elements of Environmental Quality Plan

1. Improve diversity by:
   a. Planting adapted tree species on 500 acres of delta land. Estimated cost - $55,000.
   b. Extending the area of shortleaf pines in the upland on 50,000 acres. Estimated cost - $1,650,000.
   c. Building 1,100 one-acre ponds. Estimated cost - $3,025,000.
2. Fence tracts of land to exclude domestic animals. Estimated cost - $1,550,000.
3. Plant vegetation screens around salvage lots and dumps. Collect scattered junk and automobiles. Estimated cost - $20,000.
4. Purchase and preserve 5,800 acres, located in the south half of T25N, R3E, for dedication as a wilderness area. Estimated cost - $718,000.
5. Improve scenic and water qualities of the Little Black River by fencing along the 106 miles of river which contains perennial flow. Estimated cost - $2,382,000.

6. Close scour channels and remove obstructions in the Little Black River. Estimated cost - $52,000.

7. Improve upland food and cover for wildlife by planting selected plant species. One thousand acres, located near proposed ponds. Estimated cost - $55,000.

8. Plant and/or protect approximately 2,000 acres of forest corridors along drainage ditches and along the Little Black River. Estimated cost - $669,000.

9. Dig 80 acres of pits along and connected to the drainage ditches. Estimated cost - $240,000.

10. Conduct an educational campaign, promoting environmental concerns, through local news media. Estimated cost - $50,000.

11. Provide fire protection for 146,400 acres of forest land. Estimated cost - $14,000.

12. Establish historic or nature trails to inform and educate. Subjects include: the Grandin Sawmill; Indian Trails; interesting geologic formations or outcrops; or artesian wells. Estimated cost - $52,000.

13. Extend the attraction of the area by development and preservation of historical and archeological sites. Estimated cost - $694,000.

14. Make comprehensive studies of the archeology of the area to find and determine the importance of all sites used by man. Obtain easements on sites found to be important for preservation. Estimated cost - $547,000.

15. Install pipes to outlet field and road drainage into the river and ditches. Estimated cost - $880,000.

16. Manage and install good land practices on 174,000 acres. Estimated cost - $3,846,000.

17. Plant vegetation on 6,800 acres of bottom land subject to swift flooding. Estimated cost - $340,000.

18. Vegetate or otherwise protect 86 miles of eroding roadbanks containing an area of about 208 acres. Estimated cost - $42,000.

19. Vegetate or otherwise protect approximately 20 miles of eroding streambank comprising approximately 80 acres. Estimated cost - $4,981,000.

20. Plant adapted vegetation on approximately 4,500 acres of sand ridges. Estimated cost - $370,000.

21. Provide solid waste disposal areas near Grandin, Fairdealing, and Naylor. Begin centralized waste collection. Estimated cost - $48,000.

22. Build waste disposal plants and sewer systems for selected areas of concentrated dwellings and commercial operations for Grandin, Naylor, and Fairdealing. Estimated cost - $595,000.

23. Initiate county planning and zoning.

A capital investment of $32,985,000 and an annual operation, maintenance, and management cost of $258,000 will be required for the installation of the Environmental Quality Plan.

Institutional Arrangements Available and Needed for the Implementation of the Environmental Quality Plan

Legal entities of government exist or the necessary authority exists for the organization of government entities to implement the EQ plan. They include township, county, and state government. Conservancy districts, watershed subdistricts, and drainage districts all have the power of eminent domain and taxation.

Several private, state, and federal programs are available providing financial assistance for land acquisition and the establishment of measures to implement the EQ plan. Included in the various programs are:

Private Programs

1. Missouri Chapter of Nature Conservancy - acquires and manages land of high ecological value.

2. Leo A. Dry Foundation - acquires small scenic areas.

3. Missouri Prairie Foundation - acquires native blue stem grass areas.

Federal Programs

1. U.S. Department of Agriculture

   a. Resource Conservation and Development - financial and technical assistance involving human and natural resources.

   b. PL-566 - watershed protection and flood prevention.

   c. Rural Environmental Conservation Program - provides cost sharing assistance to individual landowners for application of conservation practices.

   d. Loans, advances, and grants to sponsoring local organizations.

2. U.S. Department of the Interior

   a. Land and Water Conservation Funds - administered by the state - provides financial assistance for developing fish and wildlife habitat areas.

   b. Pitman-Robinson Funds - provides for wildlife research and financial and technical assistance in developing wildlife habitat areas. Administered by the state.

   c. Dingell-Johnson Funds - provides for fishery research and financial and technical assistance in developing fishery habitat areas. Administered by the state.

3. Environmental Protection Agency - provides grants for waste water treatment facilities.

State Programs

1. Missouri Department of Conservation

   a. Cooperative Forestry Program - provides tree planting stock and technical assistance.

   b. Private land wildlife habitat improvement and pond management and stocking.

2. Department of Natural Resources, Division of Parks & Recreation.

   a. Acquire and develop areas for the preservation of archeological resources.

3. Arkansas Game and Fish Commission

   a. Provides wildlife habitat improvement, pond management and stocking.

4. Arkansas Forestry Commission

    a. Provides tree seedling, at cost, and furnishes technical assistance in forest management and wildlife habitat improvement.

Technical assistance including educational and on-site assistance is available from:

1. Soil Conservation Service through local soil and water conservation districts.

2. Agricultural Extension Service.

3. Missouri Department of Conservation.

4. U.S. Forest Service.

5. U.S. Fish and Wildlife Service.

6. Arkansas Game and Fish Commission.

7. Arkansas Forestry Commission.

Although many programs for financial and technical assistance exist, higher priorities in other areas and limited resources available within the area will require additional funds for implementing the EQ plan.

Environmental Effects of the Plan

The installation of measures proposed by this plan would significantly alter the environmental values within the watershed. Reforestation of corridors along the ditches, streams, and other selected areas would provide green space suitable for hiking, nature study, and camping. Planting and furthering the spread of the native shortleaf pine to areas now predominantly oak-hickory forest would provide diversity and improve esthetics. Selective harvest management of forests would improve natural beauty. Better wildfire control would benefit wildlife and eliminate the unesthetic aftermath of a forest fire. These measures will all increase wildlife habitat value and will generally reduce soil erosion.

Protecting all eroding areas by mechanical measures or vegetation would reduce sediment carried by streams and deposits remaining after floods. Dust produced by wind erosion would be controlled. Flood peaks would be reduced by small amounts and the vegetated areas would add to natural beauty and provide additional wildlife cover. Field outlets in the delta would control erosion and sedimentation. Reducing loss of sediment, nutrients, pesticides, and other pollutants would improve water quality.

Purchase and dedication of the wilderness area would preserve existing environmental values. Such a wilderness area would attract visitors to the area. Access to wild or little used areas would provide recreation. Creation of access, demands that the areas be managed and maintained to preserve the quality for which the access was created.

Exclusion of livestock from perennially flowing parts of the river would stop trailing erosion, would increase wildlife cover within the protected area, and would preserve a natural corridor or green strip along the stream.

Wildlife plantings will provide food and cover to benefit wildlife, stop erosion, and add to the natural beauty.

Collection and provisions for solid waste disposal will beautify the area and will eliminate the possibility of pollution of area waters. The temptation to dispose of waste along county roads or at several uncontrolled sites will be halted. The removal of junk and worn out or wrecked automobiles will make the area a more desirable place to live by improving esthetics and removing breeding places for disease vectors.

Construction of sewage treatment plants and lines in towns where houses and businesses are concentrated will eliminate the possibility that water quality will be impaired.

Interested and important geological, archeological, and historic sites preserved and developed could provide educational experiences. These sites could be developed in conjunction with a park or natural area. Information gathered during development would add to the scientific knowledge of the area.

An ongoing educational campaign would help prevent littering and increase the awareness of the needs for environmental betterment.

Adoption of planning and zoning will identify and protect other environmentally sensitive areas. Guidance would be given to residential, industrial, and agricultural developments so that other environmental conflicts are recognized and properly resolved.

PART III

DISPLAY OF ACCOUNTS

The following system of accounts illustrates a display of beneficial and adverse effects of the selected plan for Lower Little Black Watershed on the components of National Economic Development and Environmental Quality Objectives and on the Regional Development and Social Well-being Accounts. This is consistent with the Water Resource Council's adopted Principles and Standards.

SELECTED PLAN
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI AND ARKANSAS

Dollars 1/

Components	Measures of Effects Average Annual
Beneficial Effects:	
A. The value to users of increased output of goods and services.	
1. Flood Prevention	$ 787,127
2. Drainage	292,145
3. Recreation	4,480
4. Utilization of unemployed and underemployed labor resources in project construction.	53,380
Total Beneficial Effects:	$1,137,132

Components	Measures of Effects Average Annual
Adverse Effects:	
A. The value of resources required for a plan.	
1. Floodwater retarding structures, channels, and recreational development.	
Project Installation (structural measures)	$605,250
Project Administration	84,980
O&M&R	81,950
Total Adverse Effects:	$772,180
Net Beneficial Effects	$364,952

1/ Annual values based on 5-5/8 percent interest for 100 year evaluation period.

August 1974

SELECTED PLAN
ENVIRONMENTAL QUALITY ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI AND ARKANSAS

Components	Measures of Effects
Beneficial and adverse effects:	
A. Areas of natural beauty.	1. Create 315 acres of water in sediment pools of floodwater retarding reservoirs that will reduce to approximately zero acres as sediment accumulates over a 100-year period. These areas are largely in a forested landscape.
	2. Permanently inundate 4 miles of perennial and approximately 1 mile of intermittent natural streams with reservoirs.
	3. Remove 80 miles of ditch bank vegetation along proposed reconstructed channels.
	4. Revegate spoils and ditch banks of above removed vegetation.
	5. Reduce fire hazard on 51,025 acres of forest lands.
	6. Reduce the accelerated sediment and debris deposition on 32,543 acres of flood plain.
	7. Add to the aesthetics of the area with the application of land treatment practices such as tree planting and farm ponds.
B. Quality consideration of water, land, and air resources.	1. Reduce erosion on 63,620 acres of upland by applying needed land treatment.
	2. Change water quality of Little Black River by reducing the annual yield of sediment by 54 percent.
	3. Reduce erosion on 4,414 acres of flood plain by 86 percent.

Components	Measures of Effects
	4. Reestablish or preserve existing vegetation along reconstructed ditches in delta area.
	5. Improve forest condition on 5,840 acres of forested upland by applying forest management practices.
	6. Preserve the Little Black River in its present location.
	7. Increase duration of low flows by the storage and release from floodwater structures.
	8. Increase sediment during construction.
C. Biological resources and selected ecosystems.	1. Provide 315 acres of water in sediment pools of floodwater retarding reservoirs which will increase aquatic habitat for warm water fishery and waterfowl.
	2. Provide 13 miles of shoreline and 51 acres less than 2 feet deep around reservoirs that will approximate a littoral zone of standing water communities.
	3. Permanently inundate 315 acres of terrestrial habitat conditions in reservoir areas.
	4. Remove vegetative cover along one side of 65 miles of channel and on both sides of 15 miles of channel to be constructed.
	5. Reestablish 80 miles of the above removed vegetation.
	6. Wildlife and game habitat will be improved by land treatment practices such as forest management, farm ponds, and some pasture improvements.
	7. Remove 62 acres of fishery habitat in 29 miles of delta ditch system.

Components	Measures of Effects
	8. Preserve 27 acres of 4-10 foot pools in 2.1 miles of the delta ditch system.
	9. Establish 175 acres of pools in 9.5 miles of ditch #3. Average depth is 2 feet with a maximum depth of 4 feet.
	10. Preserve the flow of water from Little Black River through ditch #1, 2, and 3.
	11. Establish alternating 1,000 foot "pool-shoal" areas in ditch #1 and 2 by below-grade excavating 2 feet in reconstructing 10 miles.
	12. Reduce fishery and riparian habitat on 2.7 miles of Little Black River in Arkansas. A total of 1.4 miles will be enlarged, and 1.3 miles will have clearing and snagging operations.
	13. Free flowing status of Little Black River will be changed.
	14. Structural measures in the delta may adversely affect some rare, declining, or endangered species.
D. Irreversible and irretrievable commitments	1. Convert 8 acres of pastureland, 55 acres of cropland, and 307 acres forest land to dams, spillways, and reservoir pools. Permanently inundate 4 miles of perennial and 1 mile of intermittent streams.
	2. Construction of the channels will require 1,666 acres of land that will result in a loss of 543 acres of forest land and 199 acres of cropland.
E. Other environmental effects	1. Increase regional funds available for improving the physical appearance of farmsteads on farms and business places in the region.
	2. Increase problems of traffic and congestion caused by a recreation access area in an otherwise "tranquil" area.

SELECTED PLAN
REGIONAL DEVELOPMENT ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI AND ARKANSAS

Dollars 1/

Components	Measures of Effects Average Annual	
I. Income:	Little Black Region	Rest of Nation
Beneficial Effects:		
A. The value of increased output of goods and services to users residing in the region.		
1. Flood Prevention	$ 787,127	--
2. Drainage	292,145	--
3. Recreation	4,480	--
4. The utilization of regional unemployed or underemployed labor resources.	53,380	--
5. Secondary	108,045	--
Total Beneficial Effects:	$1,245,177	--

Components	Measures of Effects Average Annual	
Income:	Little Black Region	Rest of Nation
Adverse Effects:		
A. The value of resources contributed from within the region to achieve the outputs.		
Project Installation	$ 87,279	$517,971
Project Administration	3,530	81,450
O&M&R	81,950	--
Total Adverse Effects:	$ 172,759	$599,421
Net Beneficial Effects	$1,072,418	-599,421

1/ Annual values based on 5-5/8 percent interest for 100 year evaluation period.

August 1974

SELECTED PLAN
REGIONAL DEVELOPMENT ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI AND ARKANSAS

Components	Measures of Effects	
II. Employment:	Little Black Region	Rest of Nation
Beneficial Effects:		
A. Increase in number and types of jobs.		
1. Employment in recreation service sector.	1 seasonal semi-skilled job.	--
2. Employment for project construction.	26 semi-skilled jobs for 12 yrs.	--
3. Employment for project O&M&R.	2 permanent semi-skilled jobs.	--
Total Beneficial Effects:	2 permanent semi-skilled jobs.	--
	1 seasonal semi-skilled job.	--
	26 semi-skilled jobs for 12 yrs.	--

Components	Measures of Effects	
Employment:	Little Black Region	Rest of Nation
Adverse Effects:		
A. Decrease in number and types of jobs.		
1. Loss in agricultural employment at project take area.	--	--
Total Adverse Effects:	--	--
Net Beneficial Effects	2 semi-skilled jobs.	--
	1 seasonal semi-skilled job.	--
	26 semi-skilled jobs for 12 yrs.	--

SELECTED PLAN
REGIONAL DEVELOPMENT ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI AND ARKANSAS

Components	Measures of Effects	
	Little Black Region	Rest of Nation
III. Population Distribution		
Beneficial Effects:	Create 2 permanent semi-skilled jobs, 1 seasonal semi-skilled job, and 26 semi-skilled jobs for 12 years in an isolated rural area which has experienced an 11% reduction in population in the last 20 years.	--
Adverse Effects:	----------	--
IV. Regional Economic Base and Stability		
Beneficial Effects:	Provide drainage and flood protection on approximately 60,000 acres of delta land where agriculture is very significant in the economy. Create 3 semi-skilled jobs and 26 semi-skilled jobs during installation in an area where 30% of the families have income less than the national poverty level.	--

SELECTED PLAN
SOCIAL WELL BEING ACCOUNT
LOWER LITTLE BLACK WATERSHED, MISSOURI

Components	Measures of Effects
A. Real Income Distribution:	1. Income of the project beneficiaries less than $3,000 - 30 percent, $3,000 to $10,000 - 50 percent, and those with incomes greater than $10,000 - 20 percent. Regional cost will be shared in about the same proportion as the benefits accrue.
B. Recreational Opportunities:	1. Provide for about 4,480 recreation days annually, primarily for local and regional area residents.
C. Life, Health, and Safety:	1. Provide two percent level of flood protection. Reduce the threat of injury or loss of life that is directly associated with the velocity and depth of floodwater.
	2. Reduce the hazards to health caused by contamination of wells and pollution from sewage systems.
	3. Installation of the project will require the displacement of two families involving 10 persons.

August 1974

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WATERSHED WORK PLAN AGREEMENT

between the

SOIL AND WATER CONSERVATION DISTRICT OF BUTLER COUNTY, MISSOURI

SOIL AND WATER CONSERVATION DISTRICT OF RIPLEY COUNTY, MISSOURI

SOIL AND WATER CONSERVATION DISTRICT OF CLAY COUNTY, ARKANSAS

LITTLE BLACK WATERSHED SUBDISTRICT

BUTLER COUNTY COURT

CLAY COUNTY COURT

RIPLEY COUNTY COURT

BUTLER COUNTY DRAINAGE DISTRICT NO. 10

NAYLOR DRAINAGE DISTRICT

WESTERN CLAY DRAINAGE DISTRICT

(hereinafter referred to as the Sponsoring Local Organizations)

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 Organizations for assistance in preparing a plan for works of improvement for the Lower Little Black Watershed, States of Arkansas and Missouri, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83 Congress, 68 Statute 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 Organizations and the Service a mutually satisfactory plan for works of improvement for the Lower Little Black Watershed, States of Arkansas and Missouri, 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 Organizations 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 will be installed in about 12 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 PL-566 funds, such land rights as will be needed in connection with the works of improvement (estimated cost $880,982).

   The Sponsoring Local Organization agrees that all land acquired or improved with PL-566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

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	26.4	73.6	32,100

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 works of improvement.

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

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater retarding structures, levees and floodway.	0	100	2,835,379
Multiple-purpose channels.	10.6	89.4	6,075,686
Recreation water control structure.	50.0	50.0	4,000
Access area, recreation facilities.	50.0	50.0	15,000

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

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Engineering Cost (dollars)
Structural measures for flood prevention and agricultural water management.	0	100	871,557
Access area, recreation facilities.	100	0	1,500

6. The Sponsoring Local Organizations and the Service will each bear the costs of project administration which it incurs estimated to be $62,500 and $1,442,103, respectively.

7. The Sponsoring Local Organizations 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 lands.

8. The Sponsoring Local Organizations 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 Organizations 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 Organizations 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 is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriation for this purpose.

    A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement 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 Organizations have failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organizations in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organizations or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsors having specific responsibilities for the particular structural measure involved.

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. 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 subjected 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.

THE SOIL AND WATER CONSERVATION DISTRICT
OF BUTLER COUNTY, MISSOURI

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Butler County, Missouri, adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

THE SOIL AND WATER CONSERVATION DISTRICT
OF RIPLEY COUNTY, MISSOURI

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Ripley County, Missouri, adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

THE SOIL AND WATER CONSERVATION DISTRICT
OF CLAY COUNTY, ARKANSAS

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Soil and Water Conservation District of Clay County, Arkansas, adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

BUTLER COUNTY COURT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Butler County Court adopted at a meeting held on _____.

_____
(County Clerk)

Address: _____

Date: _____

RIPLEY COUNTY COURT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Ripley County Court adopted at a meeting held on _____.

_____
(County Clerk)

Address: _____

Date: _____

LITTLE BLACK WATERSHED SUBDISTRICT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Little Black Watershed Subdistrict adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

BUTLER COUNTY DRAINAGE DISTRICT NO. 10

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Butler County Drainage District No. 10 adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

NAYLOR DRAINAGE DISTRICT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Naylor Drainage District adopted at a meeting held on _____

_____
(Secretary)

Address: _____

Date: _____

WESTERN CLAY DRAINAGE DISTRICT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Western Clay Drainage District adopted at a meeting held on _____.

_____
(Secretary)

Address: _____

Date: _____

CLAY COUNTY COURT

By: _____

Title: _____

Address: _____

Date: _____

The signing of this agreement was authorized by a resolution of the governing body of the Clay County Court adopted at a meeting held on _____.

_____
(County Clerk)

Address: _____

Date: _____

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

_____
Date

WATERSHED WORK PLAN

LOWER LITTLE BLACK WATERSHED

Butler and Ripley Counties, Missouri

Clay 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: Soil and Water Conservation District of Butler County, Missouri

Soil and Water Conservation District of Clay County, Arkansas

Soil and Water Conservation District of Ripley County, Missouri

Little Black Watershed Subdistrict, Missouri

Butler County Drainage District Number 10, Missouri

Naylor Drainage District, Missouri

Western Clay Drainage District, Arkansas

Butler County Court, Missouri

Clay County Court, Arkansas

Ripley County Court, Missouri

With assistance by:

U.S. Department of Agriculture, Soil Conservation Service

U.S. Department of Agriculture, Forest Service

June 1974

WATERSHED WORK PLAN

LOWER LITTLE BLACK WATERSHED

BUTLER AND RIPLEY COUNTIES, MISSOURI

CLAY COUNTY, ARKANSAS

JUNE 1974

Summary of Plan

This work plan for watershed protection, flood prevention, agricultural water management, and nonagricultural water management (recreation) was prepared by the Soil and Water Conservation Districts of Butler and Ripley Counties, Missouri, and Clay County, Arkansas; Little Black Watershed Subdistrict; Butler County Court; Clay County Court; Ripley County Court; Butler County Drainage District Number 10; Naylor Drainage District; and Western Clay Drainage District as cosponsoring local organizations. Technical assistance was furnished by the Soil Conservation Service and the Forest Service of the United States Department of Agriculture.

This 124,390-acre project is located in western Butler County and eastern Ripley County, Missouri, and northern Clay County, Arkansas. The primary problems in the watershed are floodwater, erosion, and sediment damages; inadequate drainage; and inadequate recreational facilities for the area.

The project formulation of the Lower Little Black Watershed was developed concurrently with the Upper Little Black Watershed Project. The projects were analyzed jointly. Measures identified in both projects must be installed to achieve the effects described in this plan. These measures will reduce flood damages in the Lower Little Black Watershed approximately 86 percent. Drainage outlets for lateral and farm field ditches, and a public access area to the Little Black River is also provided.

Land treatment measures planned include treatment on an additional 30,500 acres of cropland, 10,000 acres of pastureland, and 23,120 acres of forest land plus fire control measures on 51,025 acres of forest land. Additional land treatment will be installed that will partially protect other watershed areas. The total cost of land treatment measures is estimated to be $2,793,600. These costs will be shared $442,900 by PL-566 funds and $2,350,700 by other funds.

Structural measures planned for installation in this plan include five floodwater retarding structures, 1.3 miles of floodway with a diversion structure on the river, approximately 81.5 miles of multiple-purpose flood prevention and drainage ditches, approximately 1.4 miles

of enlargement of the existing Little Black River, approximately 1.3 miles of clearing and snagging in the Little Black River, recreation control structure, one recreation development, and approximately 1 mile of levees. The floodway will carry flows from the uncontrolled drainage areas and structure outflows that are in excess of the capacity of the present Little Black River channel. Most of the multiple-purpose channels (98 percent) will be along existing manmade ditches. The present flow conditions of the ditches are 2 miles of ephemeral flow. The channels will remove floodwater and serve as drainage outlets for the bottom land area. Land use in the area served by the channels is 78 percent cropland, 11 percent pasture land, 6 percent forest land, and 5 percent other uses.

Relocations caused by acquisition of land rights will require displacement of one family in the F-11 floodwater retarding structure site. Two families along the floodway will be displaced. This will cause relocation of one farming operation and a total of 14 occupants.

Twelve years will be required for installation of this project. Total estimated cost is $15,014,407, of which $11,055,898 will be borne by PL-566 funds and $3,958,509 by other funds.

Land treatment measures will be maintained by the landowners. The floodwater retarding structures will be operated and maintained by the Little Black Watershed Subdistrict. The floodway and ditch No. 3 in Missouri will be operated and maintained equally by the Butler County Drainage District No. 10 and the Naylor Drainage District. The Arkansas portion of ditch No. 3 will be operated and maintained by the three drainage districts. The Arkansas portion of ditch No. 1 will be operated and maintained by Naylor Drainage District and Western Clay County Drainage District. All other channel modifications, levees, and mitigation features will be operated and maintained by the drainage districts within whose boundaries they are located. Butler County Drainage District No. 10 will operate and maintain the diversion structure recreational access area. The total average annual cost of operating and maintaining the project is estimated to be $81,950.

The total average annual benefits to the structural works of improvement are $1,245,177 compared to an average annual cost of $772,180, giving a benefit-cost ratio of 1.6:1.0. The project was evaluated for 100-years and amortized at 5-5/8 percent.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Lower Little Black Watershed is located in Butler and Ripley Counties in southeastern Missouri and Clay County in northeastern Arkansas. Little Black River is a left-bank tributary to the Current River in the White River Basin which is a major tributary of the Arkansas-White-Red Water Resource Region. The drainage area contains 124,390 acres; 113,345 acres in Missouri and 11,045 acres in Arkansas. It is approximately 18 miles long and 19 miles wide, and approximately 50 percent is bottom land.

The watershed is primarily a rural area with a population of approximately 5,000. Towns in Missouri within the watershed include Naylor, population 586; Neelyville, population 231; Harviell, population 160; and Fairdealing, population 80. Success, population 266, is the only town in Arkansas within the drainage area. 1/ Several small unincorporated communities are scattered throughout the area.

Doniphan, Missouri, the county seat of Ripley County, is located on Highway 160 near the watershed divide and has a population of 1,850. Fairdealing in the central part of the watershed is approximately 125 air miles south of St. Louis. Poplar Bluff, Missouri, the county seat of Butler County, Missouri, has a population of 16,653 and is located 17 miles northeast of Fairdealing.

The Ozark Escarpment bisects the watershed and trends from the west boundary at the State line to Harviell on the east. All of the Little Black River in the Lower Little Black Watershed is located in the valley alluvium paralleling the escarpment.

The watershed is in Land Resource Area 116, Ozark Highland, and Land Resource Area 131, Southern Mississippi Valley Alluvium. These areas correspond to the Ozarks and Southeastern Lowlands Physiographic Provinces.

All of the area northwest of the Little Black River except a narrow band paralleling the channel ranging from 100 feet to a mile wide at the State line, is located in the Ozarks Physiographic Province. This region consists primarily of rolling hills with approximately 75 percent of the area covered with forest. Local relief in the upland ranges from 40 to 80 feet. Flood plains associated with streams in the upland range in width from 300 to 2,000 feet.

The land southeast of Little Black River is in the Southeastern Lowlands Physiographic Province, locally referred to as the delta. The delta consists of a broad arm of the Gulf Coastal Plain which extends up the valley of the Mississippi River from the Gulf of Mexico to

southeastern Missouri. The delta ranges from level to depressional with scattered gently undulating sandy ridges and hummocks. All of the watershed located in Arkansas, except a few acres near the State line, is in the delta.

Soils in the watershed are divided into two major categories based on the material in which they were developed. The soils in the uplands and foothills along the escarpment were developed from residuum. The soils in the bottom land along the tributaries and the delta area were developed in the alluvium. A description of each of these major areas follows:

The dominant soils [a/] on the narrow to moderately wide ridge tops of the uplands are of the Captina and Wilderness series. The dominant soils on the steep side slopes of the uplands are of the Clarkesville and Doniphan series.

The Captina and Wilderness series consists of moderately well-drained soils with fragipans at a depth of 17 to 24 inches. Captina soils have silt loam surfaces and silty clay loam subsoils above the fragipan. Wilderness soils have cherty silt loam surfaces and very cherty silty clay loam subsoils above the fragipan.

The Clarkesville series consists of deep acid somewhat excessively drained soils with very cherty silt loam surfaces and very cherty silty clay loam subsoils. The Doniphan series consists of deep, well-drained soils with very cherty silt loam surfaces and clayey subsoils.

A band of soils along the foothills at the escarpment, ranging from one-half to five miles or more in width, were developed in coastal plains materials. These soils occupy the area immediately below the Ozark Highlands and above the delta flood plains. The soils on the gentle slopes in this area have properties similar to those of the Captina soils. The strongly sloping and steep soils of this area have properties similar to those of the Clarkesville soils.

The dominant soils of the delta area are of the Calhoun, Falaya, Amazon, Bosket, Tuckerman and Sharkey series. All of these soils are nearly level and are developed in the thick alluvial deposits. The Bosket soils are well-drained and have fine sandy loam surfaces and sandy clay loam subsoils. The Falaya soils are somewhat poorly drained and have silt loam texture throughout. The Tuckerman, Sharkey, Amazon and Calhoun soils are poorly drained. The Tuckerman soils have fine sandy loam surfaces and sandy clay loam subsoils. The Sharkey soils are clayey throughout. The Amazon and Calhoun soils have silt loam surfaces and silty clay loam subsoils.

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a/ The soil names used here are subject to change when the soil mapping and soil correlation is completed for the area. Soil series interpretation sheets are available.

AERIAL VIEW OF FLOODING OF DELTA LAND AROUND NAYLOR, MISSOURI, IN 1969

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

REPRESENTATIVE VIEW OF MANMADE DITCHES CONSTRUCTED BY DRAINAGE DISTRICTS IN EARLY 1900'S. DEBRIS AND SILT HAVE CLOGGED THIS DITCH TO THE EXTENT DRAINAGE IS INADEQUATE. FLOOD FLOWS ARE LIKEWISE HELD UP. THIS DITCH WILL BE RENOVATED IN THE PROJECT BY DEEPENING AND SHAPING THE CHANNEL. CONSTRUCTION WORK WILL BE DONE FROM ONE SIDE TO PRESERVE TREES AND BRUSHY COVER ON OPPOSITE BANK FOR WILDLIFE HABITAT. APPROXIMATELY 20 MILES OF THESE MANMADE DRAINAGE DITCHES ARE IN THIS CONDITION WITH INTERMITTENT POOLS OF WATER WHICH ARE SHALLOW EXCEPT FOR A FEW HOLES.

TYPICAL VIEW OF LITTLE BLACK RIVER LOOKING DOWNSTREAM FROM BALL MILL BRIDGE APPROXIMATELY 1/2 MILE ABOVE DIVERSION STRUCTURE PLANNED IN THE PROJECT.

VIEW OF HABITAT ASSOCIATED WITH THE LITTLE BLACK RIVER BANK AT A LOCAL ACCESS POINT. THIS AREA WILL BE DEVELOPED FOR PUBLIC ACCESS BY THE PROJECT. THE LARGE TREES ARE BEECH TREES.

The general soil map is being revised and will be available in March 1975. A detailed soil survey report is scheduled to be published in 1980. Individual soil survey maps are available for reference in the local field offices for most of the area.

Bedrock of lower Ordovician Age underlies the upland area. The Roubidoux Formation is composed of sandstone, chert, and interbedded fine-grained cherty dolomite. The Jefferson City Formation is a fine-grained silty and cherty dolomite. The residual overburden (residuum) which blankets solid rock varies greatly in composition and depth. Well logs in the watershed and surrounding area show a range from 20 to 160 feet in residuum depth. The residuum is principally a stony clay with chert and some sandstone and limestone. Rock particles range in size from sand and gravel to boulders. The residuum may range from rock-free clays and silts to units largely composed of rock fragments. The delta alluvium ranges to depths of 75 feet or more and is underlain with clays, sands, and gravel of the Tertiary Age. (See Figure 9 - Geology Map).

The highest elevation in the watershed is found in the extreme northern part and is approximately 630 feet above mean sea level. Little Black River enters the delta at an elevation of approximately 307 feet. At the junction of the Little Black and Current Rivers the elevation drops to its lowest point, approximately 280 feet.

The watershed is in the humid region with annual precipitation averaging 47.01 inches. Mean temperature varies from 37.5 degrees in January to 79.9 degrees in July. Maximum annual precipitation of 75.24 inches occurred in 1927. Minimum annual rainfall was 31.83 inches in 1954.

Mean annual temperature	58.8 degrees
Maximum temperature	114 degrees
Minimum temperature	-24 degrees
Last killing frost in spring (avg.)	April 7
First killing frost in fall (avg.)	November 2
Length of growing season (avg.)	209 days

Average distribution of precipitation is as follows:

Seasons	Months	Precipitation (Inches)
Spring	March, April, May	13.81
Summer	June, July, August	11.97
Autumn	September, October, November	10.82
Winter	December, January, February	10.41

The known mineral resources are limited to sand, gravel, stone, clay, manganese and iron. 2/ Manganese generally occurs northward from an east-west line 1 to 2 miles south of Hunter, Missouri. "In spite of the wide spread occurrence of manganese in southeastern Missouri, the very small size and low grade of known deposits, and the poor experience to date with attempts to make acceptable concentrates by mechanical methods, do not encourage optimism for significant future production." 3/ The entire watershed is within the area of occurrence of limonite iron ore. Several small prospect pits are within the watershed, but prospecting has not been done for many years. "The brown ores of the Ozarks are accumulations of limonite, also derived at least in part from sulfides, that have been mined extensively but have only a minor and decreasing importance today." 3/

"Clay is mined in the region by A. D. Willis and Sons, Industries, Poplar Bluff, Butler County for the production of red and buff face bricks. The main clay pit is located at the company's brick plant in the northeast part of Poplar Bluff. The company also mines clay from two other pits; one about two miles southwest of Poplar Bluff and the other in Stoddard County. The Willis Company has been the only continuous producer of clay in the region for many years. A small amount of white burning clay was mined during the period 1959-1962 from a pit 4 miles southwest of Poplar Bluff by the Ozark Development Company. The clay was shipped to Ohio for the manufacture of chinaware. Active mining ceased about 1962; however, the company still controls the property. Other small deposits of white burning clay are known in Butler County and several were mined in the late 1800's and early 1900's. Present clay resources are limited and would not support a major brick manufacturing industry." 37/

"Chief sources of sand and gravel in the region are the alluvial deposits on the Black, Current, and St. Francois Rivers and their tributaries. Sand resources and perhaps limited amounts of gravel are present in the southeast lowland area of Butler County, extreme southeastern Ripley County, and northern Clay County, Arkansas. A drawback to these deposits is that they are overlain by appreciable amounts of clay and that they contain lignite." 37/ Only one sand and gravel pit was observed in the Little Black River Watersheds, this abandoned pit being located in the lowlands southwest of Harviell. Present sand and gravel production in the area is from three producers along the Black River in Butler County.

Much of the watershed area is underlain by stone deposits, though stone meeting specifications for high quality aggregate is not normally found. Stone production is not presently occurring in either of the watersheds.

At the present time, there is no oil or natural gas production from the Little Black River Watersheds or any nearby surrounding areas. "In the Mississippi embayment area, very little deep drilling has been attempted and the possibilities of oil and gas occurrences in commercial quantities have not been sufficiently tested."37/

Ground water is of good quality and is present at moderate depths in the upland area. Yields range from 150 to 600 gallons per minute, and dissolved solids are usually less than 1,000 parts per million. Nearly unlimited ground water is available in the delta. The aquifers range from shallow to moderately deep, and water is of good quality.

Irrigation water is readily available from shallow wells in the delta area. The water yields range from 200 to 1,000 g.p.m. The water quality is good with relatively low salts and dissolved solids (300 to 500 parts per million). Pollution of the aquifer by infiltration of salts leached from the irrigated soils will not increase the dissolved solid content to a point where it would be unsuitable for irrigation, municipal, domestic and livestock use.

Although the annual rainfall usually exceeds 40 inches, periods of drought occur most years during the growing seasons. This drought period lasts from 3 to 6 weeks and significantly reduces crop yields.

Irrigation development increased over 300 percent in Butler and Ripley County from 1964 to 1969, 3,296 acres to 10,305 acres. During 1969, over 11,000 acre feet of water were used for irrigation purposes. The existing irrigation systems have minimum development. Land forming has not been practiced because of the scour and sedimentation damages caused by flooding. Much of the water used at present is pumped from the Little Black River and is applied by furrow method to corn and by the flooding method to rice. With adequate flood control and drainage system development, the delta soils could be developed for more intensive irrigation. Because of the high flood frequency and the poor drainage outlets, landowners have not felt justified to make the expenditures necessary for irrigation system developments.

The soils are generally well suited to irrigation providing adequate drainage systems are developed. Those crops most suitable; such as, corn, sorghums, soybeans, rice and cotton, are readily adaptable to the delta area.

Since towns in the watershed are small (200-600 population) with no large water-using industries and the population is relatively stable, the demand for additional water supply is not great. Most small towns and rural residents rely on shallow wells for water supplies. Several of the water systems in the small towns are not approved by the State Health Department, and plans are presently being made to organize a rural water district to serve rural residents and small towns.

Land use in the upland is primarily forest land and the bottom lands and delta are predominantly cropland. A breakdown of land use is shown in the following table:

	Upland		Bottom Land [a/]		Total Watershed	
Land Use	Acres	Percent	Acres	Percent	Acres	Percent
Cropland	4,044	6	47,578	78	51,622	42
Pastureland	6,917	11	6,765	11	13,682	11
Forest Land	49,434	78	3,431	6	52,865	42
Other Land	3,178	5	3,043	5	6,221	5
TOTAL	63,573	51	60,817	49	124,390	100

a/ This area includes 1,623 acres of bottom land associated with tributaries in the upland, and the remainder is located in the delta.

Clearing of the bottom land hardwood forest areas in the delta began in the early 1900's. Construction of county court drainage ditches took place between 1910 to 1930 and was followed by additional clearing. Approximately 75 percent of the forest land in the delta was cleared prior to World War II, and an additional 10 percent has been cleared since that time.

The forested land in the delta, except for narrow strips along the drainage ditches and Little Black River, consists of tracts ranging from two to 320 acres with the majority less than 40 acres in size. The following table identifying only tracts larger than 40 acres was prepared from an analysis of aerial photos dated 1966 in Butler County, Missouri; 1968 in Ripley County, Missouri; and 1971 in Clay County, Arkansas.

CROPS GROWN ON DELTA LAND

TYPICAL SOYBEAN FIELD. THE PREDOMINANT ROW CROP.

ANOTHER MAJOR CROP. CORN WHICH IS BEING IRRIGATED. IRRIGATION LIMITED BUT INCREASING.

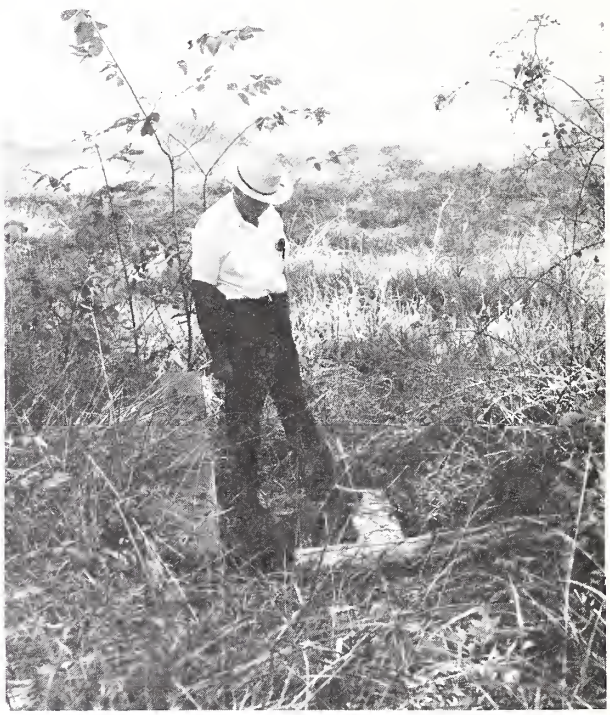
HARVESTING A TYPICAL RICE FIELD. A HIGH VALUE CROP.

A COTTON FIELD. READY FOR HARVEST.

THIS STAND OF HARDWOOD SHOWS TYPICAL GROWTH ON MUCH OF THE UPLAND AREA.

CYPRESS TREES STILL REMAIN IN SCATTERED AREAS THROUGHOUT THE DELTA.

TYPICAL PASTURE SCENE REPRESENTING THE LAND USE FOR APPROXIMATELY 11 PERCENT OF THE WATERSHED. PASTURE IS AN IMPORTANT USE ON BOTTOM LAND ASSOCIATED WITH THE UPLAND.



SCATTERED PINE STANDS ARE LOCATED THROUGHOUT THE WATERSHED.

Forested Tracts	Butler County	Ripley County	Clay County
40 to 80 acres	29 tracts	19 tracts	2 tracts
80 to 160 acres	0 tracts	5 tracts	5 tracts
160 to 320 acres	1 tract	1 tract	2 tracts
320+	0 tracts	0 tracts	0 tracts

Forest stands cover 52,865 acres of the watershed area. Oak and hickory hardwoods make up 79 percent of this total and bottom land hardwoods make up 12 percent. Mixed oak-pine stands total 6 percent, and the remaining 3 percent consists of shortleaf pine. About 12 percent of the forest stands are in saw timber size, 58 percent are in pole size and 30 percent are in seedlings and saplings.

About 25 percent (16,000 acres) of the upland area is open land ranging from managed croplands and pastures to old field vegetation. The delta area is largely cropland, and natural vegetation occurs along drainage ditches and in scattered woodland tracts. Sweet gum, water oak, cottonwood, sycamore, and hackberry are the dominant trees in such areas. Cypress trees occur in many of the drainage ditches or in depressions that occur among sandy knolls.

The drainage pattern of the upland is dendritic; major streams flow to the southwest. Little Black River follows the trend of the Ozark Escarpment. It enters the lower watershed approximately 2 miles northeast of Naylor and follows a strongly meandering southwest course to its confluence with the Current River near Success, Arkansas. Principal tributaries are Harris, Logan, Cypress and Caldwell Creeks, and Buzzard Run. These are unmodified, well-defined natural streams that have perennial flow in lower reaches. Other intermittent unnamed streams have a combined length of 30 miles.

The Little Black River heads in the Upper Ozark Highlands in the Upper Little Black Watershed where it is a high gradient spring-fed stream. In the Lower Little Black Watershed it is an unmodified, low gradient, well-defined natural stream approximately 24 miles long.

The delta is served by a system of manmade ditches which were built by drainage districts between 1910 and 1930. Ditch No. 1 (11.2 miles) has 7.1 miles of intermittent flow and serves only landowner-constructed private ditches. It was built between 1910 and 1912.

Ditch No. 2 (9.7 miles) has 5.6 miles of intermittent flow. The rest of ditch No. 2 and Birdslash lateral (2.7 miles) are ephemeral-flow ditches. An additional 1.4 miles of intermittent flow occur in lateral No. 2 which in turn carries overbank flows of Little Black River into ditch No. 2. Ditch No. 2 was built during the period 1910 and 1915. It joins the Little Black River approximately 1/2 mile above the State line. The two laterals were built in 1920.

Ditch #3 (11.7 miles) is an intermittent-flow ditch built in 1915 to serve as an outlet for several laterals in Butler County. Laterals which outlet into ditch No. 3 are Brown Taft (4.5 miles), Harviell (9.3 miles), Neelyville (7.2 miles) and the Eaton ditch (3.0 miles). These laterals sustain about 9 miles of intermittent flow with the remainder being ephemeral. They were built during the 1920's. Other ephemeral-flow lateral ditches that discharge into these laterals were built in the late 1920's and early 1930's. These include the Hart (0.8 miles), Epps (2.4 miles), Sappington (2.4 miles), W.P.A. (2.2 miles) and the Suder ditch (6.0 miles). Ditch No. 3 extends southward to the Arkansas State line; then west (on the state line) where it joins ditch No. 1. These two ditches after joining are known as the State-Line ditch. It continues approximately 2.5 miles to its junction with the Little Black River. Approximately 1.5 miles south of the State line, State-Line ditch is joined by the Indian Creek ditch (3.8 miles) which is an ephemeral-flow ditch built in 1920. The lower 2-mile portion of State-Line ditch, starting .5 miles below the State line, is considered a perennial-flow ditch.

Indian Creek ditch is in the Western Clay Drainage District in Clay County, Arkansas. The county court drainage districts in Ripley County remained inactive with no regular maintenance programs since this construction until the recent organization of a new circuit court drainage district, known as Naylor Drainage District. This district covers all Ripley County ditches, including the existing Little Black River. Ditches in Butler County, except for Eaton ditch, have been organized into circuit court drainage district, Butler County No. 10. Some maintenance has been carried out on these ditches on an intermittent basis.

The following table summarizes drainage ditches and area drained by each in the delta area:

Ditch	Ripley	Butler	Clay	Total
	Sq. Mi.	Sq. Mi.	Sq. Mi.	Sq. Mi.
Brown Taft	-	5.75 a/	-	5.75
Harviell	-	12.30 b/	-	12.30
Neelyville	0.94	10.94	-	11.88
Eaton	2.99	1.10	-	4.09
Indian Creek	1.38	-	3.84	5.22
Ditch No. 1	11.03	0.08	1.33	12.44
Ditch No. 2	11.59	0.33	-	11.92
Ditch No. 3 (excluding all laterals)	6.95	3.39 c/	4.30	14.64
Little Black River (draining into river from East side)	3.01	0.75	2.63	6.39
Little Black River (draining into river from West side)	2.58	0.38	4.90	7.86
TOTAL (Sq. Mi.)	40.47	35.02	17.00	92.49
(Acres)	25,901	22,413	10,880	59,194

a/ Does not include 1.39 square miles of foothill drainage.
b/ Does not include 2.78 square miles of foothill drainage.
c/ Does not include 0.29 square miles of foothill drainage.

Water quality information for the Lower Little Black Watershed was obtained from two sources. A water quality and stream gaging station is maintained near Naylor on Little Black River. During the spring of 1974 the Midwest Research Institute (M.R.I.) generated additional data at five stations in the project area. 1/ Samples were taken during three periods; January 29, March 12 and 13, and May 1, 1974.

The water quality data from the Naylor station has been compared to a similar station at Doniphan on the Current River. 4/ Current River is a larger stream of which Little Black is a tributary. The Doniphan station is located only a few miles above the Current River's confluence with Little Black. The following parameters were compared: maximum temperature, fecal coliform, maximum dissolved oxygen, PH, dissolved nitrates and ammonia, maximum phosphates, dissolved solids, total hardness and maximum color. It is concluded from the comparison of these parameters that water of the Current is superior to that of Little Black at these reporting stations. Values of all of the above parameters were in favor of better water quality for the Current River.

A more complete discussion of water quality in Little Black drainage is provided by the M.R.I. Report. Eighteen water quality parameters were assessed on samples from each of the three trips. Some of the parameters examined were: dissolved oxygen, ammonia and organic

nitrogen, total phosphate, total alkalinity, total hardness, total dissolved and suspended solids, turbidity, temperature, pH, BOD, total and fecal coliform and pesticides. All of the above parameters met existing state and federal water quality standards except: (1) total phosphates exceeded federal standards of 0.1 mg/liter in all stations, (2) turbidity was higher in some instances than the Arkansas standards of 50 Formazin Units, and (3) exceeded the Arkansas standards for fecal coliform (200/100 ml) at the one station in Arkansas. All stations in Missouri had fecal coliform counts below Missouri standards of 2,000/100 ml. Analysis of three sediment and water samples was made for detection of pesticide accumulation or occurrence. Chlorinated compounds appear to be in acceptable concentrations and organo-phosphorus compounds were not detected at any of the three stations sampled in late April 1974.

No areas of wetland type I, as defined in "Wetlands of the United States," U.S. Department of Interior, Circular C-39, are found in the watershed. The Wetlands Inventory of Missouri classes seasonally, flooded agricultural land as I-A and does not include this group in the inventory. A large part of the delta area is in the I-A classification. The areas are not delineated because they are dispersed throughout the flood plain. There are no areas in the watershed classed as wetland type II or higher.

Cane Creek, a 218,000-acre watershed, borders Little Black Watershed on the east. The two watersheds are separated by a low topographic divide in the delta area. Floodwaters of approximately 2-year frequency or larger from Cane Creek cross the divide on the north edge of Harviell, Missouri. When floodwater enters the Little Black delta area from Cane Creek, it continues as overland flow or drainage ditch flow to the Little Black River.

Economic Data

The economy of the watershed is based largely on agriculture. Most farm operations are diversified livestock and grain farms. Land use changes abruptly between the bottom land (60,817 acres) and the upland (63,573 acres). The primary land use in the upland is forest and pasture, and cropland in the bottom land.

There are approximately 1,100 landowners in the watershed. About 773 are farm units, and the remainder are small acreages used for rural residences, hunting cabins, etc. The forest fire lookout tower, located on 160 acres and managed by the Missouri Department of Conservation, is the only publicly owned land within the watershed. Farms by size are as follows:

SIZE OF FARMS	NUMBER OF FARMS
Less than 40 acres	248
41 - 80 acres	188
81 - 120 acres	99
121 - 160 acres	79
161 - 320 acres	109
320 acres plus	50
TOTAL	773

In the 5-year period between 1964 and 1969, the trend has been toward fewer farm owners with larger farms. 4/ Most of these farms are family-oriented units and 90 percent are owner-operated. Very little outside help is used with less than 6 percent of the farms using more than 150 man-days of hired labor each year. In fact, a 1969 Ripley County census showed that 63 percent of the farmers worked off the farm for some portion of the year and 34 percent worked at least 200 days off the farm. 5/

The bottom land is used for agricultural crops in the following proportions: soybeans, 44 percent; corn, 15 percent; cotton, 10 percent; alfalfa, 6 percent; and wheat, 3 percent. The remaining 22 percent is in pasture, forest and miscellaneous uses. Typical per acre yields are 25 bushels soybeans, 60 bushels corn, 400-500 pounds cotton, 4 to 5 tons alfalfa and 35-40 bushels wheat. Since a large part of the bottom land is affected by the water problem, yields vary widely from year to year. Most of the feed grain produced in the area is marketed through livestock, and the cotton and soybeans are sold as cash crops.

Double cropping is used on some fields by following wheat with soybeans. This practice is not extensively used at present but will probably increase in the future. Flood protection will enhance the possibilities for this cropping system.

Because most of the bottom land is affected by floods, yields vary widely from year to year. Since most croplands are located within the problem area, farm income is severely affected.

The market value of all agricultural crops sold as shown on a per farm basis is $4,000 to $7,000 below the state average for Missouri counties, and $5,000 below the state average for Clay County, Arkansas. 4/ Fifty-two percent of all farms had sales of less than $2,500 annually.

Most feed grains and hay produced in the area are marketed in the form of livestock, while soybeans is the major cash crop. Market outlets are available through farmer-owned cooperatives, local livestock auctions, slaughter facilities and regional outlets outside the watershed. These facilities are adequate for the limited marketing needs of the agricultural sector of the watershed.

Local markets are good for saw logs, stave bolts, pine post, pole, decking, flooring, railroad ties, walnut veneer and wood chips. Charcoal wood, pulpwood, pallet and handle blank material are also marketable.

The forest land in Arkansas and Missouri is controlled by an estimated 275 private owners. The average-size private forest ownership is approximately 190 acres. Forest fire protection is provided by the Arkansas Forestry Commission and the Missouri Department of Conservation, Division of Forestry, in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program.

Land values range from $100-$200 per acre in the upland and $300-$600 per acre in the bottom land. The increased demand for small tracts of land in the upland to be used for home sites and hunting areas is exerting an upward influence on land values, and they are expected to increase.

The watershed is served by a network of county and state roads. Major highways are U.S. 160 and U.S. 67. Several interstate truck lines serve the area via these routes. Rail facilities are furnished by the Missouri Pacific Railroad.

The watershed is economically depressed. 4/ It had a relatively smaller working age population, a lower labor force participation rate and a higher unemployment rate than the U.S. as a whole. Most people employed were working for manufacturing or retail trade industries. This region has a higher percentage of workers engaged in retail trade than the nation as a whole, and the proportion of agricultural employment in the area was about three times as high as the U.S. average.

Median income in the counties was well below the U.S. average of $9,950. 4/ In 1969, Carter County had the lowest median income, only $3,858. Mean income in all counties was higher than the median income, yet still far below the national average. The mean family income in Ripley County was only $5,131 which was 46.6 percent of the U.S. average. Carter County had the highest mean family income among the four counties, $7,482 or 68 percent of the U.S. value of $10,999.

The poverty level for a family of four was set at $3,745 by the Department of Commerce. 4/ The percent of families with income less than the poverty level in the Little Black River counties was two to three times higher than the nation as a whole. Carter County, the best of the four counties, still has 24.2 percent of its families living under the poverty level. In contrast, more than one of every three (or 36.4 percent) families in Ripley County was suffering from poverty.

Local governments provide public goods and services such as education, police and fire services, street and road maintenance, etc. The quality and quantity of these public goods and services are represented by the expenditures per capita in any particular year. A static one-time analysis of revenues and expenditures per capita, which have been frequently employed to measure the output of local governments, may be considered informative and serve as a useful indicator. The latest official document available is the Census of Governments, 1967. 6/ A comparison using 1967 data was made of three counties in the Little Black River region to the U.S. average; statistics for Butler County are not available.

While per capita general revenues for all county governments in the U.S. in 1967 totaled $72, Carter County had only $17, about 23.6 percent of the U.S. average. 4/ Ripley County was the highest among the three, yet still 37.5 percent below the national level. Revenues from taxes were about $10 per capita for the counties in the region, as compared to $33 in the nation. The low tax revenues resulted primarily from a low tax base as reflected by the productivity and income comparisons described previously. As a consequence, expenditures per capita were also very low since balanced budget has traditionally been stressed by county governments.

The watershed is located in the Ozarks Development Region (OZARKA). The Missouri portion is located in the Ozark Foothills Regional Planning Commission. A resource conservation and development (RC&D) project application is being prepared which will include all of the watershed area in Missouri. The Ozark Foothills Regional Planning Commission has endorsed this application and taken the lead in providing information to sponsors of the project. It is also coordinating collection of information and helping organize the RC&D Steering Committee.

Fish and Wildlife Resources

Differences in the physiographic nature of the watershed are reflected in the distributional relationships of the aquatic fauna. 7/ That portion of the watershed lying north of U.S. Highway 160 lies within the Ozark Uplands physiographic region. This portion is largely in the upper watershed project but is a part of the aquatic system

affecting Lower Little Black. This area includes all the higher gradient, cooler, headwater reaches. The aquatic habitat in this area is typified by rapidly flowing water with many short pools and well-defined riffles. The stream bottom is composed mainly of fine to coarse chert fragments. During times of flooding, the fragments are washed up into piles forming an unstable pool-riffle pattern. Sand and silt are found on the bottom only in the quieter, deeper pools and backwater areas. Aquatic vegetation in this part of the stream is limited to water cress (Nasturtium officinale) in areas strongly influenced by springs, water willow (Dianthera americana) along the margins of the larger pools and riffles, coontail (Ceratophyllus sp.) and water milfoil (Myriophyllum sp.) along the margins of the larger pools. Species of fish found in this part of the stream typically prefer cool (maximum 83°F) 8/, silt-free water and include the small-mouth bass, rockbass, northern hogsucker, and several species of darters and minnows. However, warmer microhabitats exist in this portion of the watershed which provide niches for species such as the blackspotted topminnow and green sunfish.

A transition zone exists between the two major physiographic regions which includes Logan and Harris Creeks and a portion of the Little Black River from the confluence with these creeks, upstream to U.S. Highway 160. This portion is within the Lower Little Black Project and includes 25 miles of perennial flowing stream. The aquatic habitat in this zone is more variable; intergrading from fast flowing, rubble bottom areas in the upper reaches to more sluggish, sand bottom areas in the lower reaches. Aquatic vegetation in this area includes those species previously listed for the Ozark Uplands with pond lilies (Nuphar sp.) present in the shallow riffle and pool areas. Additionally, scattered stands of baldcypress (Taxodium distichium) and sycamore (Platanus occidentalis) overhang the stream banks and in some cases produce some very excellent fish cover. The overall stream environment in this zone gives the appearance of being a little more stable than that found in the Ozark Uplands. The pools and riffles seem to be stable, with the exception of the upper reaches of Logan and Harris Creeks. Additionally, the water temperature in this zone is warmer and inorganic turbidity and siltation are more prevalent. Fishes found in this area include both warm and cool water species, as well as silt tolerant and intolerant species. The smallmouth bass - rockbass species association, typical of the Ozark Uplands, is found in the cooler, clearer areas influenced by springs and seasonally in other areas of the stream as their temperature tolerances permit. A second species association, including the spotted bass, longear sunfish, and grass pickerel, are more typically found in the lower reaches of this zone. Their tolerances of higher temperatures and increased turbidity are the apparent permitting factors.

The second major physiographic region included in the Little Black River Watershed is the Southeastern Lowlands. 7/ This region includes all of the lowland ditches and that portion of the main river channel (24 miles of Little Black River) excluded from the two regions previously discussed. Stream flow in this area is more sluggish due to the low gradient, and in some cases (i.e., the oxbows and sloughs) flow is nonexistant.

Aquatic habitats in this area vary considerably in turbidity, bottom type, aquatic vegetation, and shading by riparian vegetation. Cover in these ditches is often sparse and confined to the ditch margins where flow has undercut roots of shoreline vegetation. Principal bottom type is fine shifting sand with a few localized deposits of small gravel or silt. 7/ Bottom types vary from silt in the slower flowing pool areas to sand and small gravel in the swiftly flowing areas. The more open areas, not recently dredged or shaded by trees and shrubs, are generally choked with submergent aquatic vegetation of various types, especially coontail, water milfoil and various pondweeds (Potamogeton sp.). 7/ The oxbows and slough areas are characterized by clear water with seasonal dense growths of aquatic vegetation similar to that found in the quiet pool areas of the ditches.

This entire physiographic region is well supplied with ground water and, even after a 6-week drought, the deeper areas of the ditches have water depths of 4-6 feet and maintain rather large fish populations. 9/ The typical fish species association in this physiographic region includes largemouth bass, bluegill, bowfin, and European carp.

This region is subject to heavy cultivation which gives rise to high stream nutrient loads. However, due to the low relief, erosion is minimal and the waters remain clear most of the year, except during flooding periods.

The fish fauna of the Little Black River is extremely varied due to the diversity of aquatic habitats. A total of 75 species has been collected from the watershed. A total of 117 species known to occur regionally in adjacent watersheds has also been listed as possibly occurring in the Little Black River. 4/

Of concern is the presence of seven species designated rare or endangered by Missouri. 4/ 38/ Two of the seven species listed were included in early Department of Conservation collections on the Little Black Watershed. 7/ These are the harlequin darter and the pugnose minnow. None of the seven were found in recent MRI collections. However, their presence in the watershed is certainly possible.

Data provided by the Missouri Department of Conservation gives a good estimate of standing crops of fishes in the ditches during mid-summer low water levels. 9/ These estimates state that on the average the old heavily vegetated ditches will support approximately 48 pounds per acre of catchable sportfish and 453 pounds per acre of catchable roughfish. Estimates of standing crop for a recently dredged ditch indicate that it supported only 10 pounds per acre of catchable sportfish and 169 pounds per acre of catchable roughfish. Thus, the habitat, enhanced through time provided by the old deeper ditches is influential in nearly tripling the standing crop of catchable fish in proportion to new ditches. Indeed, when adequate depth is available, the old ditches are quite viable in terms of biological production. On the other hand, when mid-summer depths are shallow as shown for the stations on the Harviell ditch 4/ standing crops of fish drop off quite drastically. In terms of sportfish production, most of the ditches leave something to be desired, at least during the time of the Department of Conservation survey. However, conservation agents and residents of the area report catching many bass and crappie during high water in the spring of the year. 7/

There are no perennially flowing ditches except in the lower 2.1 miles of ditch No. 1. Estimates of permanent pools in drainage ditches (midsummer) include 51.6 acres of water greater than 3 feet deep and 36.9 acres of pools less than 3 feet deep. The deeper pools include a half-mile section of ditch No. 3 which is greater than 6 feet deep, and a hole more than a mile long on this ditch that is about 4 feet deep. Additionally, slough area totaling more than 5 acres in size is located at the upper end of ditch No. 3. Another significant pool exists in a lateral of ditch No. 2 which carries overflow from the Little Black River below its confluence with Logan Creek. A large pool in the Brown-Taft ditch system occurs as a slough or scour channel in a lateral just east of where ditch No. 3 begins. These large pools total 29 surface acres.

Several of the deeper pool areas are created by beaver dams. One large dam on ditch No. 1 was estimated to be up to 5 feet deep. 4/ A total of 18 acres of pools was attributed to beaver activity. Another source of pool creation was related to sporadic channel cleaning. A portion of the channel would be cleaned and a lower part not cleaned, thus creating a pool in the dredged area. Beaver activity also seemed to increase in these areas where plant succession was set back to a lower order of growth such as willow and American sycamore.

The smaller pools (less than 3 feet deep) will not be discussed in detail since they are scattered throughout the drainage system. However, their importance should not be underestimated as they provide excellent nursery areas for young-of-the-year sunfish, suckers, and minnows. 7/ See Figure 10 of schematic section for display of channel conditions.

Plankton samples were collected from each of the nine sampling stations 4/ during April 15-18, 1974. Mean number of net plankton for the Upper Little Black River and its tributaries ranged from 27-130 per liter. These counts are so low as to be a negligible consideration in this study. No true or distinctive plankton community exists in the streams because of the limiting factor of current. Those few organisms encountered were derived from headwater ponds, springs, quiet backwaters of streams, or had been dislodged from the bottom or submersed objects. 10/ Samples from the lower reaches of the Little Black main stem were not taken. The two stations sampling the stream transition areas would be largely representative of the lower main stem reaches. Mean number of net plankton per liter for the two transition sections was 127 and 130 respectively, compared to 27-34 range in the 5 stations of the upper reaches. This would be indicative of a more distinctive plankton situation, as expected.

Mean numbers of net plankton for the ditches (Stations Nos. 8-9) ranged from 556-706 per liter. This shows a drastic increase over that found in the upper part of the watershed and reflects the greater productivity of ditch habitats. Organisms identified from the samples, however, did not show the diversity found in the uplands.

The ditches, as compared to the uplands, provide a more stable habitat; however, the number of aquatic niches in the form of springs, ponds, etc., is much reduced. This leads to intense interspecific competition which tends to reduce species diversity. 11/ In simple ecosystems, basic productivity is frequently high but species diversity is low.

Intensive agricultural fertilization in the lowlands is one of the primary causative factors of high production. This undoubtedly leads to occasional nuisance "algal blooms" in the more stagnant areas, and may be partially responsible for the taste problem, expressed by area fishermen, in their midsummer catches.

Samples of stream benthos were collected at each of the nine sampling stations. 4/ A total of 40 taxa of benthic macroinvertebrates were identified from the watershed. 4/ Clifford identified a total of 57 taxa for six Ozark streams. 12/ Considering the larger area involved in Clifford's study, the results shown on the Little Black compare favorably. This is largely due to the diversity of habitats available in this watershed.

The upper portion of the Little Black Watershed lies within the Ozark Plateau zoogeographic region. 13/ The delta area differs from the uplands, not only in physiography, but also in the native wildlife species which inhabit the area.

The Little Black Watershed is within geographic range of 11 species of salamanders and 13 species of frogs and toads. 4/ 14/ The delta area produces a higher standing crop of these animals and should have a greater species diversity than the upland areas. Bullfrogs are abundant in the roadside ditches and sloughs, and are the only species of this group utilized for food and sport by man.

There are no known amphibians which are considered rare or endangered either nationally or by the States of Arkansas or Missouri which occur in this watershed.

The reptiles of this geographical area consist of 6 species of lizards, 15 species of turtles, and 29 species of snakes. 4/ 14/ The large tracts of undeveloped land, the abundance of diverse habitat, and the numerous water areas contribute to high reptilian populations.

In the delta, the populations of turtles would be considerably higher than those found in the uplands. Conversely, lizards would probably be more abundant in the forested uplands. Populations and species diversity of snakes will probably be highest in the areas adjacent to the ditches of the delta and the Little Black River channel.

There are 270 species of birds which possibly occur in the Little Black Watershed. 4/ Of these, 111 are migrants, 37 are winter residents, 68 are summer residents, and 54 are permanent residents. 15/ 16/ Although the watershed is within the Mississippi Flyway, waterfowl use of the watershed is limited. Wood ducks, however, do nest in the area, making use of standing timber adjacent to water courses.

There are 58 species of mammals which possibly occur in the watershed. 4/ 17/ Of these, 13 species are considered furbearers and 5 species are classes as game amimals in Missouri. Those classed as furbearers include the oppossum, raccoon, badger, longtailed weasel, mink, spotted skunk, striped-skunk, coyote, red and gray fox, bobcat, beaver, and muskrat. The game animals are whitetailed deer, swamp rabbit, eastern cottontail, fox and gray squirrel.

Deer, rabbit, quail, and squirrel populations in the uplands are low when compared to state averages. 18/ Quail and rabbit populations in the foothills are considerably higher. Cropland is mixed with woodlands and provides plentiful food and edge areas. The bottom land populations of most wildlife species are highest adjacent to areas of good cover, namely ditch banks. Quail and rabbits are abundant along these banks.

Within the Lower Little Black Watershed gray fox, gray squirrel, turkey, and deer are found in the heavily forested uplands, while

deer, red fox, cottontail rabbit, and quail are found in the areas more interspersed with crop, pasture, and forest land. Swamp rabbits, would be found in the bottom land areas subject to frequent flooding.

Three species of animals considered rare or endangered nationally which may occur in the watershed are the southern bald eagle, Indiana bat, and eastern cougar. a/ 19/

There are several other species considered rare or endangered by Missouri which may occur in the watershed. These are listed, along with their status and other remarks. 4/ It should be understood that some species listed as rare or endangered in Missouri or Arkansas may not necessarily be considered so elsewhere, because Missouri or Arkansas may be a peripheral part of their native range. And, since geographical range is controlled by various limits of tolerance, minor changes in habitat may drastically affect species populations.

Recreational Resources

In 1970, the Missouri Inter-Agency Council for Outdoor Recreation developed a revised Outdoor Recreation Plan. This plan consisted of an inventory of recreational resources and prediction of recreational needs through the year 1990. The plan divides the state into multi-county regions.

The Little Black River Watershed lies near the center of the south half of the Ozark Foothills Region, comprised of Butler, Ripley, Carter, Wayne, and Reynolds Counties. This region contains more recreational land per resident than any other region. Approximately 88 percent of the recreational land in the Ozark Foothills Region is owned or managed by the federal government. Approximately 11 percent is controlled by state agencies. The remainder is in private ownership. This region comprises part of the Ozarks which are major recreational areas. A large part of the recreational resources are used by nonresidents. Access and facilities for outdoor activities on private land are becoming more difficult to obtain. The richness of the soil and high land values in the delta have discouraged large-scale recreational developments in that area.

The Department of Interior, through the National Park Service, is developing a National Scenic Riverway along part of the Current River. This strip-like park includes local points of interest; such as Big Spring near Van Buren, Missouri. Preservation of nature and public use are goals of the riverway.

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a/ The Eastern Cougar (Felis Concolor Cougar) subspecies probably did not occur as a distinct race in Missouri. This part of the state historically is believed to have been an integral area among four races - Cougar, Coryi, hippolestes, and stanleyana.

PRINCIPAL RECREATIONAL AREAS IN OR NEAR

LITTLE BLACK WATERSHED

	Acreage		Primary Uses	Managing Agency
	Land	Water[a/]		
Within a 25-Mile Radius of Grandin, Mo.				
Ripley Community Lake	90	90	Fishing	Missouri Department of Conservation
Ozark National Scenic Riverway	55,000	Current River access	Fishing, Canoeing, Scenery	National Park Service
Lake Wappapello State Park	41,850	400	Picnicking, Camping, Fishing, Waterfowl Hunting and Observation	Missouri State Park Board & Missouri Department of Conservation
Wappapello Reservoir and Wildlife Area	36,196	7,800	Picnicking, Camping, Fishing, Waterfowl Hunting and Observation	Corps of Engineers
Buffalo Creek Recreational Area	(Mark Twain National Forest)		Camping, Swimming, Picnicking	U.S. Forest Service
Hawes Memorial Recreational Area	(Mark Twain National Forest)		Camping, Picnicking, Swimming, Fishing, Boating	U.S. Forest Service
Doniphan Country Club	NA	NA	Golf, Swimming	Private Club
Poplar Bluff Country Club	NA	NA	Golf, Swimming	Private Club
Within a 50-Mile Radius of Grandin, Mo.				
Missouri				
Duck Creek Wildlife Area	4,195	1,773	Fishing, Hunting	Missouri Department of Conservation
Sam A. Baker State Forest	17,782	-	Hunting	Missouri Department of Conservation
Sam A. Baker State Park	4,858	40	Fishing, Boating, Camping, Cabins	Missouri State Park Board
Deer Run State Forest	102,602	-	Hunting	Missouri Department of Conservation
Peck Ranch Wildlife Refuge	22,565	-	Hunting, Wildlife Production	Missouri Department of Conservation
Eleven Point River Trout Management Area	-	5.5 miles of stream	Fishing	Missouri Department of Conservation
Bradyville Wildlife Area	268	-	Waterfowl Hunting	Missouri Department of Conservation
Mingo Wildlife Management Refuge	21,663	NA	Fishing, Hunting, Nature Observation	U.S. Bureau of Sport Fisheries and Wildlife
Clearwater Reservoir	16,992	1,650	Camping, Fishing, Boating	U.S. Corps of Engineers
Fremont Tower Picnic Ground	3	NA	Picnicking	Private
McCormick Lake Recreational Area (part of Mark Twain National Forest)	15	11	Picnicking, Fishing Swimming, Boating	U.S. Forest Service

PRINCIPAL RECREATIONAL AREAS IN OR NEAR

LITTLE BLACK WATERSHED

(Cont'd)

	Acreage			
	Land	Water[a/]	Primary Uses	Managing Agency
Within a 50-Mile Radius of Grandin, Mo.				
Missouri (Concluded)				
Clark National Forest, Butler County [b/]	46,723	15	Picnicking, Camping, Fishing, Hiking	U.S. Forest Service
Mark Twain National Forest [b/]	68,783	96	Picnicking, Camping Fishing, Hiking	U.S. Forest Service
Carter County				
Ripley County	88,405	363	Picnicking, Camping Fishing, Hiking	U.S. Forest Service
Ben Cash Wildlife Area	982	3 miles river access	Hunting, Fishing	Missouri Department of Conservation
Coon Island Access	5	438 ft. of stream	Fishing, Canoeing	Missouri Department of Conservation
Doniphan Towersite	10	-	Picnicking, Fire Control, Hunting	Missouri Department of Conservation
Fish Access	4	stream, 560 ft.	Fishing, Canoeing	Missouri Department of Conservation
Grandin Towersite	160	-	Picnicking, Fire Control, Hunting	Missouri Department of Conservation
Greenville Ford Access	3	stream, 200 ft.	Fishing, Canoeing	Missouri Department of Conservation
Hilliard Access	1	stream, 200 ft.	Fishing, Canoeing	Missouri Department of Conservation
Turkey Pen Tract	160	-	Hunting	Missouri Department of Conservation
Little Black State Forest	2,322	1-1/4 mile of river	Camping, Picnicking, Fishing, Hunting	Missouri Department of Conservation
Lone Hill Towersite	13	-	Picnicking, Fire Control	Missouri Department of Conservation
Poplar Bluff State Forest	950	1/4 mile of river	Camping, Picnicking	Missouri Department of Conservation
Arkansas				
Black River State Wildlife Area	20,000	shallow water	Waterfowl and small Game Hunting	Arkansas Game and Fish Commission
Mammoth Spring State Park	NA	NA	Camping, Picnicking	Arkansas State Park Dept.

a/ Acres unless otherwise given.
NA - Not available.
b/ Clark National Forest and Mark Twain National Forest are now designated as National Forests of Missouri.

The Upper Little Black Watershed is a remote scenic area containing qualities valued for outdoor recreation. Large hills, steeply sloping into valleys, provide many panoramic scenes. The river and its tributaries form a scenic and quaint natural Ozark stream. The Little Black River is one of the watershed's major recreational resources. It is a scenic, spring-fed, free-flowing stream which flows rapidly down through the uplands then slows and meanders through the flood plain between tree-lined banks. Similarly, the tributary streams are exceptionally scenic; opportunities exist for fishing, nature study, swimming and wading in the deeper holes, and aesthetic enjoyment, and canoeing during the high flows. Spring flowerings, summer greenery, and fall foilage all contribute to the type of natural setting sought for recreational experiences.

Canoe floating provides important access to the streams and has potential to more fully use the fishery, recreational, and scenic resources. The river and its tributaries are largely bordered by private lands and the limited number of access sites is important. In addition to fishing on the Little Black River and hunting on private lands in the watershed 4/, the recreational resources on pages 24 and 25 exist.

Pollution is present in the Little Black River, but not of sufficient magnitude to create serious problems. Water quality in the Little Black River is good during normal flows, but pesticides and sediment reduce water quality during runoff periods.

State forests, the National Forests of Missouri, and facilities operated by the Missouri Department of Conservation are accessible to the public. On private areas, permission of the owner or operator is required. Water-based recreation is available on streams, some drainage ditches, Missouri Department of Conservation community lakes, and Clearwater and Wappapello Reservoirs.

Archeological and Historic Values and Unique Scenic Areas: The director of the Missouri Archeological Survey, the staff of the State Historic Preservation Officer, and the state archeologist for the Arkansas Archeological Survey have been consulted regarding archeological sites within the Little Black Watershed. The area covered by the Lower Little Black River Watershed has been intensively surveyed for archeological sites. This work was accomplished over a period of ten years by the Powers Phase Project of the University of Michigan Museum of Anthropology in cooperation with the American Archeology Division of the University of Missouri. Several hundred sites have been located and some extensively excavated. Findings from this research indicate habitation by Mississippian and Archaic cultures. The Mississippian occupation is normally found on the sand ridges of this area, while the Archaic and woodland culture remains occur primarily on the first terrace above the Little Black River channel. Artifacts may be expected to occur from surface level to as deep as 2 meters

below the surface. As a result of this research, a district encompassing over 200 archeological and historical sites (the Little Black River Archeological District) has been nominated by Mr. James L. Wilson, Director of the Department of Natural Resources and Missouri's State Historic Preservation Officer, to the National Register of Historic Places. This district includes two sites previously enrolled on the National Register of Historic Places (Koehler Fortified Archeological Site located about one mile northeast of Naylor and the Wilborn-Steinberg Site, near the west edge of Neelyville).

Research has revealed that for the past 10,000 years the Little Black River area has been a locus of human activity, but little information is available on the Upper Little Black River Watershed due to lack of intensive survey in that area. Based on knowledge concerning human occupation of the Lower Little Black Watershed, it can be assumed that the cultural resources are as extensive, perhaps more extensive, in the Upper Little Black River Valley.

Two Archaic culture sites have been identified in the area of project operations. Site 23BU97 is located near the planned diversion structure and Site 23RI102 is located on the east side of the floodway. One Mississippian Site, 23BU10 is located on the east side of the floodway. These are the only sites which have been identified as near or within the planned project operation areas. From historical documents it is known that there are several historic grist mill sites, a military cemetery, early homesteads, and a historic road located within the Little Black River Watershed. Early French trappers and traders used the road, called the Nachitoches Path, as early as the first quarter of the 18th century. It subsequently became the route of pioneers settling the Red River area and served as a route for movement of the Cherokee Indians during the Jackson Administration. It became an official military road in 1834 and was the major route of invasion for General Price's army during the Missouri Campaign of the Civil War.

Sources of information for the historical survey include: "The National Register of Historic Places," 21/ and more recent announcements of designated historic places that have been reported in the Federal Register. 22/ Other sources include county histories, 23/ 24/ 25/ town histories, 26/ and the "Historic Sites Catalogue." 27/ In addition, the Federal Register, 22/ reviewed for more recent information, provided no listings.

Soil, Water, and Plant Management Status

The flora of the watershed is diverse. 4/ In the delta, in association with the hydric environment along the Little Black River and the ditches, plant communities are probably representative of the original vegetation, if not in age, at least in species composition. Here there is often an overstory of oaks, gums, and bald cypress which form a canopy over a diverse and lush subordinate shrub and forb community.

The overstory of the foothills and the Ozark uplands, for the most part, are typically oak-hickory climax. 4/ In the higher portion of the drainage, which is typically the more arid portion of this area, shortleaf pine becomes a prominent species in the present timber stands. Undoubtedly, this is a consequence of past fire history and the effects of secondary succession.

Timber harvest throughout the drainage, at least on the privately-owned lands, appears to have been essentially unregulated. Probably, through a system of harvesting the most desirable trees over a relatively long-time span, the species composition of many of the stands has shifted to a preponderance of the less desirable varieties, such as blackjack oak, and others which have either a slow growth rate or poor form which makes them less desirable for commercial purposes.

Areas of the uplands, and to a degree in the delta, which have been cleared, now have a vegetative composition of predominately broomsedge (Andropogon virginicus), and shrub and tree regeneration. This circumstance is often the result of overgrazing or from the abandonment of "worn out" agricultural land. Other areas which have been cleared of native vegetation are now in improved pasture, and where conservation practices have been observed, appear productive. 4/

Proper treatment of much of the land is not being practiced. Many farm units are uneconomical, and committed factors of production are employed inefficiently. The land on which soil, water, and related plant resources are adequately protected in the watershed as of June 30, 1973, was reported as 41,211 acres. 30/ The acreages of land adequately protected by land use are as follows:

Land Use	Land Adequately Protected (acres)
Forest Land	21,182
Pastureland	3,682
Cropland	13,677
Other (including wildlife land)	2,670

The uplands are inherently low in fertility and require proper management to fully utilize their potential. Some minor changes in land use are also needed. Although the percent of cropland in the uplands is low, most of it is better suited to other uses.

The bottom land is moderate to high in fertility. Land use is mostly cropland except in areas where severe flood problems exist. These lands need flood protection and drainage. Approximately 84 percent of the bottom land area has a seasonal high water table with some temporary surface ponding in the winter and spring. Land treatment practices needed include drainage mains and laterals, surface field ditches, land smoothing, crop residue management, and an adequate fertility program.

The watershed lies within the Soil and Water Conservation Districts of Butler and Ripley Counties, Missouri, and Clay County, Arkansas. These districts have been actively promoting land treatment measures. Landowners in the watershed have signed 608 cooperative agreements with the three soil and water conservation districts. The agreements cover approximately 60 percent of the area. Conservation plans have been developed with 428 cooperators, and approximately 20 percent of the planned practices have been applied. These measures are generally accepted by landowners; however, the land treatment programs need to be accelerated throughout the watershed.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

Upland land use is primarily pastureland and forest land. The upland is inherently low in fertility; however, with proper treatment and management good pasture can be produced. Progress has been made, but much of the pastureland still needs renovation and proper management plans.

Frequent flooding, inadequate outlets, and economic conditions have limited the application of needed land treatment in the delta area. In addition to flood protection, on-farm drainage ditches, land grading, and adequate fertility and management programs are needed. The low returns from the frequently flooded lands have made landowners reluctant to invest in conservation practices for long-term gains.

Approximately 42 percent (52,865 acres) of the watershed is in forest cover. Hydrologic condition is adequate on 34 percent of the area. More intensive management is needed on the remaining forest land. This existing condition is due primarily to the lack of management, wildfires and intentional burning. Individual fires often destroy large areas due to the lack of fire suppression equipment. Public acceptance of the need for fire prevention continues to be a problem as evidenced by the amount of intentional burning that occurs each year.

Much of the existing forest land is poorly managed. The result is a low stocking of poor quality material and undesirable species. This has lead to the landowners placing a low economic value on such areas. Productivity and economic yield should be restored through sound multiple use management practices such as more intensive fire control, approved harvesting techniques, reinforcement and open land tree plantings, and more equitable forest land tax laws.

The clearing of forest land in bottom land sites for production of farm crops has been a common practice. This practice depletes the forest resource when there is a need for lumber and related forest products. The forest resource also has considerable value for environmental corridors, aesthetic appeal, wildlife habitat, watershed protection, air and water pollution abatement, recreation, hunting and fishing. This is particularly applicable in the delta portion of the project where the remaining scattered blocks of forest land and tree areas along the drainage ditches are the principal areas remaining for wildlife habitat and control of wind erosion.

Floodwater Damage

Flooding is a major problem in the bottom land along the tributaries and most of the delta area. Floods occur an average of three to four

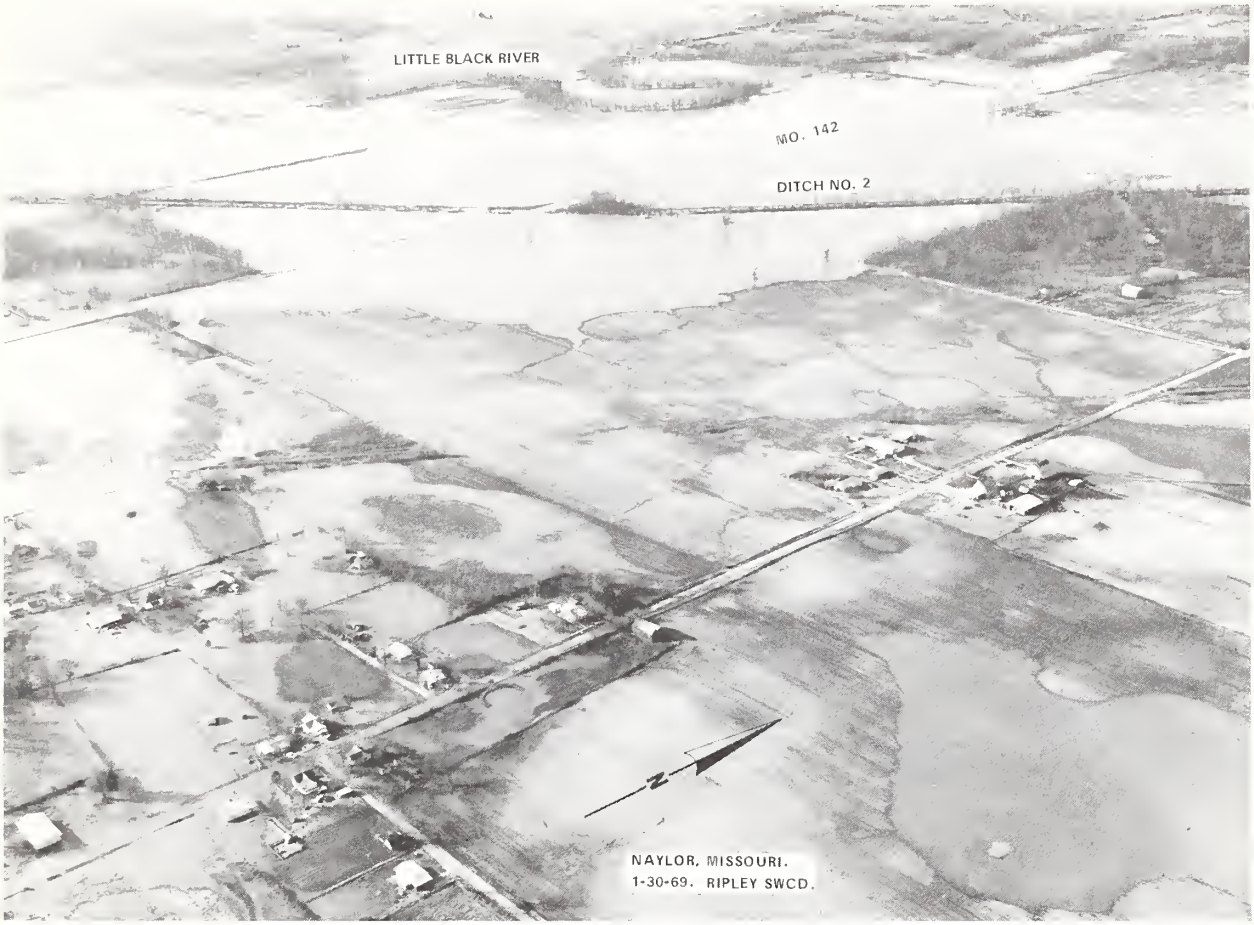

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

JANUARY 1969 FLOODING NORTH OF NAYLOR, MISSOURI.

STATE HIGHWAY 142 IS UNDER WATER. DITCH NO. 2 CROSSES HIGHWAY IN CENTER OF PHOTO AND LITTLE BLACK RIVER IS IN TOP PART WITH UPLAND AREAS IN THE BACKGROUND.

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

FLOOD DAMAGE TO CROPLAND IS SHOWN HERE. IN THE CENTER IS A SCOUR HOLE WHICH REDUCES CROP YIELDS. INFERTILE DEPOSITION OF SAND ON CROPLAND IS SHOWN IN LOWER RIGHT CORNER. THESE DAMAGES OCCUR WHEN FLOODS EXCEED CHANNEL CAPACITY AND FLOW ACROSS CROPLAND. SCOUR AREA AND DEPOSITION OF INFERTILE OUTWASH BY FLOODING WHICH EXCEEDED CAPACITY OF CHANNEL.

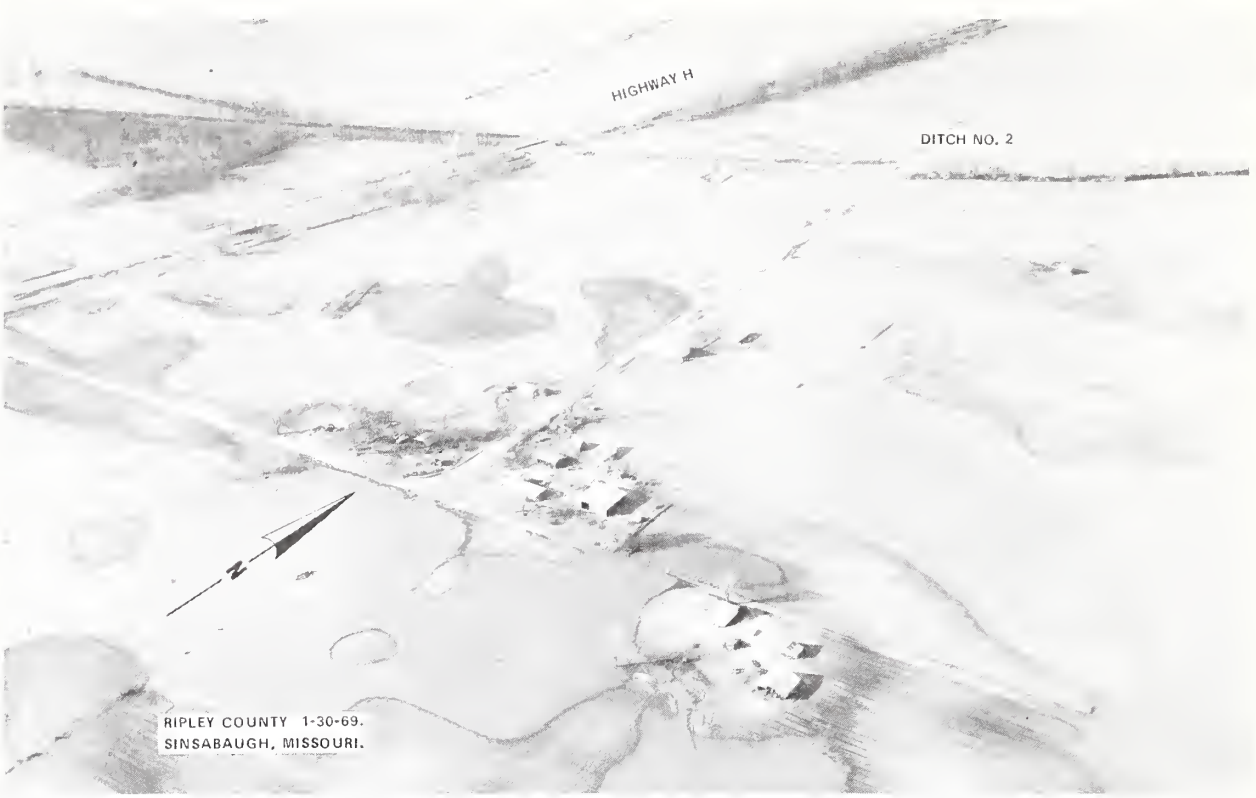

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

FLOODING JANUARY 1969 ON DITCH 2 NEAR SINSABAUGH COMMUNITY. HIGHWAY H UNDER WATER.

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

NEELYVILLE DITCH - BUTLER COUNTY.

DITCH IS SILTED IN AND FLOW IS RESTRICTED BY BRUSH AND DEBRIS. APPROXIMATELY 20 MILES OF DITCH ARE IN THIS CONDITION. WATER IS MOSTLY INTERMITTENT SHALLOW POOLS WITH SOME DEEPER AREAS. CONSTRUCTION TO IMPROVE THIS DITCH FOR FLOODWATER AND DRAINAGE FLOW WILL BE FROM ONE SIDE TO PRESERVE EXISTING TREES, BRUSH, AND OTHER WILDLIFE HABITAT ON THE OTHER SIDE.

times each year, with 70 percent occurring during the growing season. Major floods have occurred in 16 of the past 20 years.

Flooding of the delta land is caused by runoff originating in the delta and upland areas. The magnitude of flooding by runoff from the uplands is increased by two physical conditions: (1) the Little Black River channel capacity decreases as it traverses the delta and (2) natural levees have developed along the main channel.

The Little Black River channel as it leaves the upland through the foothills is a stable incised channel with a capacity of approximately 1,800 c.f.s. The rapidly decreasing grade as the river enters the delta reduces this capacity over 50 percent and causes a spilling of flood flows onto the delta area.

The frequent flooding has caused a natural levee to be developed along the main channel. The velocity of the floodwaters in the main channel is capable of carrying a large sediment load. When the floodwater is spilled out onto the broad delta with an immediate decrease in velocity, most of the sediment load is dropped. Over many years it has developed a natural barrier which prevents the floodwater from returning to the natural channel. The river channel has become ineffective in carrying floodwaters because of meandering, deposition, and frequent root wads.

Floodwater travels overland paralleling the Little Black River and inundating much of the delta area. Most of the floodwater, originating from the 195 square mile drainage area north of Missouri Highway V, flows across the flat delta land. The depth of flooding varies with the undulation of land surface. Most of the homes and farmsteads are developed on the higher ridges or knolls and are not subject to serious flooding. Major floods do isolate many of the farmsteads and cause flooding under houses and, in some cases, a few inches of water inside houses built at lower elevations.

The 100-year flood plain inundated by the Little Black River and upland tributaries is estimated to be 24,187 acres in Missouri and 8,356 acres in Arkansas, making a total of 32,543 acres.

In addition to the 32,543-acre flood plain inundated by the Little Black River and its tributaries, 28,274 acres in the delta which depend on drainage ditches for removal of floodwater, are damaged by local runoff and overflow when their outlets are restricted by floodwaters. This makes a total of 60,817 acres with a water problem in the Lower Little Black Watershed.

Most floodwater damage occurs in reaches VI, VIII, IX and X (designated on project map) where floodwater overtops the bank of the Little Black River and flows over the delta land to the east and south following the natural slope of the land. The grade of the Little Black River; approximately 4 miles northeast of Naylor where it begins

leaving the upland, is 1.7 feet per mile. This changes to almost flat about 3 miles northeast of Naylor to below Highway 142, approximately 1 mile northwest of Naylor.

The left bank of the Little Black River has been breached by floodwater at seven or more locations. Three of these breaks are large and are located along the reach of channel with a low gradient. One of the large breaks is located in the northwest quarter of Sec. 36, T23N, R4E, locally known as Gaines Slough. These eroded channels release floodwater through the natural levees along the river banks and cause flooding. Floodwaters flow south through low areas and are intercepted by drainage ditches No. 1,2, and 3. At two locations the eroded channels are deep enough to carry part of the low flow of the Little Black River. Since these channels are shorter and steeper than the natural Little Black channel, they are likely to become a new channel for the Little Black River unless future flooding through these openings is prevented.

Capacity of the Little Black River where it enters the delta area is approximately 1,800 c.f.s., and flood flows for a 2-year storm frequency are estimated to be 7,125 c.f.s. At several points within the reach with low gradient north and northeast of Naylor the capacity of the Little Black River is 600 c.f.s. or less. As a result of these flood overflows, scour channels have eroded across the bottom land to the main drainage ditches. These ditches carry the water back into the river at the southern end of the watershed in Arkansas.

Cane Creek in the eastern part of the watershed at the north edge of Harviell, frequently overflows its banks causing flooding south and west of town. This inundates approximately 3,000 acres.

The most damaging flood of recent years occurred in March 1964 when 10.10 inches of precipitation were recorded at Doniphan, Missouri, over a 3-day period. During the same period Poplar Bluff, Missouri, recorded 7.95 inches. Approximately 31,000 acres were flooded, and highways to Naylor were closed for 4 days. This flood resulted from a storm in excess of 50-year frequency. Other recent storms of major significance occurred in 1965, 1966, and 1969.

A typical 2-year frequency flood took place in May of 1961. Approximately 18,000 acres were flooded causing an estimated $430,200 in damages.

Damage from flooding occurs primarily in the spring, but also occurs during the growing season and at harvest time. Excessive soil moisture increases cultivation and harvesting costs, decreases crop yields due to delays in planting, and adversely affects the quality of crops.

Value of the flood plain varies from $300 to $600 per acre. Reduction of floodwater damages would result in an increase in the value of these lands.

Flood plain reaches (designated on project map) within the watershed used in these studies and their locations are as follows:

REACH	LOCATION
VIa	Buzzard Run Tributary
VI & VIII	Little Black River from New Channel Improvement Junction to Near Arkansas State Line
VII	Harris and Logan Creek Tributaries
IX & X	Little Black River Between Reach VIII and Current River

Total direct agricultural and nonagricultural floodwater damages were studied for floods up to and including 100-year frequency. Average annual damages by category are as follows:

	AVERAGE ANNUAL DOLLAR DAMAGE			
Reach	Crop and Pasture	Sediment & Erosion	Other Agricultural	Non-Agricultural
VIa	$ 5,949	$-------	$ 52	$ 39
VI	501,679	84,442	5,470	3,353
VII	20,764	7,136	8,346	2,692
VIII	180,283	23,476	593	1,245
IX	41,651	5,993	142	-----
X	76,366	13,663	1,690	1,664

Nonagricultural damage includes damage to roads and bridges. Indirect damages; such as interruption of travel, rerouting mail and school buses, losses sustained by businessmen in the trade area, and similar losses, are estimated to be $98,669 annually. These damages are summarized in Table 5. The average annual area flooded totals 29,616 acres.

Floodwater damage to railroads and highways has been quite severe. Several miles of the St. Louis-San Francisco Railroad were washed out in the March 1964 flood, and this railroad was abandoned following the flood. A total of 10.3 miles of highways (includes 0.4 miles of U.S. Highway 67) are subject to inundation by floodwater when the Little Black River reaches flood stage. In addition to the damage to the roads and bridges, the depth of the floodwater impedes travel on Highway 142 into and out of the town of Naylor and causes damage to the vehicles which must travel through water during these periods. It has been necessary to employ emergency procedures; such as, the use of boats or aircraft, to provide medical aid during flooding periods.

Highway locations and lengths of road damaged by flooding are as follows:

HIGHWAY	LOCATION	MILES
Highway 142	Logans Creek West of Oxley	0.4
Highway 142	Caldwell Creek East of Oxley	0.2
Highway 142	L. Black River & Ditch #2 North of Naylor	1.5
Highway 142	Between Naylor & Neelyville: Ditch #1	0.7
	Ditch #3	0.6
	Suder Ditch	0.4
Highway W	(South of Naylor) Ditch #1	0.7
Highway W	(South of Naylor) Ditch #3	1.2
Highway AA	East from Highway W. Eaton Ditch	0.3
Highway H	North of Naylor & Above Highway 142	0.2
Highway H	Southwest of Naylor Ditch #2	1.0
Highway H	West of Glenn & South	1.7
County Road	West of "H" & Glenn	0.4
Highway N	South of 142 @ Harris Creek	0.4
Federal Highway 67	North of Neelyville & Harviell Ditch	0.4
State Highway 15	West of Harviell	0.2
TOTAL		10.30

Flooding is a direct threat to lives of people living or traveling in the flood plain. Depth, velocity, and lack of warning contributes to this hazardous condition.

Floodwater and inadequate drainage contribute substantially to pollution problems and create a hazard to the health and well-being of the people. Domestic wells are contaminated, and sewage systems are flooded, contributing harmful effluent that spreads with the flood flow. Mosquito and other insect pests are provided ideal breeding conditions and increase tremendously.

Outlets for the Butler County ditches are in Ripley County. Ripley County ditches, in turn, outlet in Clay County, Arkansas. The existing outlets do not have the capacity to carry flood and drainage water. Although some maintenance has been carried out on an intermittent basis, the drainage districts have not carried out an active maintenance program because of the inadequate outlets. The maintenance work performed has resulted in a hit-and-miss pattern of clearing some reaches and leaving other reaches. The reaches cleaned out have pools of water which are held back by the sections not cleaned out. In recent years Emergency Conservation Measure Program funds have been used to clean out short reaches. Other sections of the ditches are choked with sediment and brush and trees growing in the ditch bottoms.

Flooding in lower reaches of Lower Little Black River also occurs from the Current River even without flooding from the Little Black River. This occurs in reaches VIII, IX, and X of Lower Little Black River approximately every third year and inundates about 9,000 acres. Approximately 2,000 acres are flooded by a 2-year frequency storm on the Current River. The Current River breaks out of its banks at two or three places along a section from approximately 1 to 3 miles below the State line. It flows across country in a southeasterly direction where it joins the Little Black River near the Highway 211 bridge at the north side of Success, Arkansas. The Current River has a drainage area of about 2,100 square miles compared to 389 square miles in the combined Little Black Watersheds; therefore, flood peaks on the two streams generally do not coincide.

Erosion Damage

Erosion rates for various land uses in the upland area are as follows:

LAND USE	SHEET EROSION (TONS PER ACRE PER YEAR)
Cropland	7.2
Idle Land	4.0
Pastureland	3.0
Forest Land	4.2
Other	4.0
Average Sheet Erosion	4.3

The average yield from streambank erosion is estimated to be one ton per watershed acre per year and about the same amount of roadside erosion and flood plain scour occurs during a similar period. The average gross erosion including stream bank erosion is 4.6 tons per acre per year. Approximately 1,474 acres of upland flood plain have been damaged by scour, and an estimated 5 percent of the delta soils are damaged by scour. Ten percent of the affected delta areas can be smoothed for higher production. Damage to production in the upland flood plain is estimated at 19 to 54 percent. Sheet erosion of the relatively flat delta land is low. Runoff, however, is considerable and is responsible for the ditch bank erosion which is common throughout the area. Floodwater entering the ditches during a floodwater rise or recession also erodes the ditch banks and yields sediment to the ditches. The average annual erosion damage is estimated at $19,558.

Sediment Damage

Sediment damage is confined principally to agricultural land and drainage channels. Some minor deposition is present on highway surfaces and in road ditches. Deposits on the flood plain along streams above the delta area consist of natural levees and flood plain splays.

The typical deposit ranges in size from cobbles to fine sand. On the flat plain of the delta, deposition consists of fine sand, silt, and clay with the principal damage due to flood plain splays and vertical accretion. Swamping damage is in limited areas. This damage is present where water is trapped by formation of natural levees and in some places in scoured areas of the flood plain. Sediment is a problem in drainage ditches. It contributes to shoaling and losses of capacity and induces growth of vegetation because of fertility.

Sediment deposition damages 13,598 acres of the flood plain. Damage to production ranges up to 30 percent. Accelerated sedimentation reduces the effective capacity of channels, damages uplands, and increases flooding damages. The present yield of sediment from the upper watershed is estimated to be 76,048 for a total yield at the mouth of the Little Black River of 172,905 tons annually. The average annual sediment damage is estimated to be $115,152.

Drainage

Approximately 49,440 acres, or 84 percent of the 59,194 acres of the delta soils, have restricted internal drainage. Proper management of this land dictates limited use due to (1) restricted internal drainage, (2) low areas where surface runoff water temporarily collects, and (3) higher sand ridges formed by flood overflows. High water tables in the spring inhibits root development, leaving plants with inadequate root systems during the summer growing season. The restricted internal drainage and flooding affects the tillage operations, planting, choice of crops, harvesting, and the efficient use of labor, equipment, and capital. Crop yields are low due to uneven stands and the reluctance or inability of the individual to develop adequate drainage systems because of frequency of flooding and the unavailability of adequate drainage outlets. Stream gradient in this part of the watershed is very gradual, generally less than 1 foot per mile.

Most of the early delta area drainage projects were constructed during the period 1900 to 1930. Many of these enterprises became insolvent during the 1930's, and the drainage works have lost their effectiveness as a result of lack of extension and maintenance. In recent years there have been attempts by local interests to construct drainage systems. Generally, these local efforts have not been fully coordinated to insure that the system installed provided maximum benefits for the funds expended. These uncoordinated efforts by individuals tend to partially alleviate the problems in one area while increasing the problems on adjacent farmlands.

One of the major drainage problems is that drainage systems, particularly the major outlets such as ditches 1, 2 and 3, do not have adequate capacities to carry the flow from farm drainage systems. Major drainage ditches which serve as outlets for the lateral systems are characterized by heavy undergrowth and frequent trees in the channel section, accumulations of debris and sediment, and insufficient channel capacity.

The watershed receives an average annual rainfall of about 47 inches with heavy rains occurring at any time of the year. In addition to heavy local rainfall, large volumes of water from the uplands flow into the delta and flood extension areas. Because of the inadequacy of the existing drainage systems, this water inundates low-lying areas behind stream and drainage ditch banks and remains for long periods of time after the parent streams have returned to their banks.

Soils in the delta area have medium to high fertility. Soils with good internal drainage are generally in land capability class I, or class II because of erosion or droughtiness problem. Soils with restricted internal drainage (84 percent) are generally in land capability subclass IIw or IIIw.

Recreation

Many of the recreational areas in the outlying region are managed for the public, but within the watershed boundaries nearly all the forest, water, and open space areas are in private ownership. Access to these areas is generally by permission. In particular, public access to streams is limited to a few points where roads cross the streams; even at these locations access is restricted and inconvenient. No public facilities are available on the lower part of the river, and even private recreational developments are lacking due, in part, to the high agricultural value of the delta land. The lack of adequate access and facilities reduces the use of land and water-based recreational resources in the watershed.

The 1970 Missouri Outdoor Recreation Plan shows a need for additional fishing, hiking, picnicking, and playfield areas for users from Butler, Ripley, and Carter Counties. Population within a 50-mile radius is 75,000.

By 1980, demand is expected to exceed supply for several recreation activities in Butler, Carter, and Ripley Counties. Much of this demand will emanate from Poplar Bluff in Butler County, the largest trade and population center in the region. 4/

While there were no available data on recreation demand for Clay County, Arkansas, in the seven-county region which includes Clay County (designated Northeast Region) demand is estimated to exceed supply for several major recreational activities by 1980. 32/

There are three general observations that can be drawn from data concerning recreational resource problems. The primary need in both the watershed area and the region is for water-based recreation, particularly fishing and swimming opportunities. Two major lakes (Clearwater and Wappapello) are located within 45 minutes to 2 hours driving time. Use of these facilities regularly exceeds capacity, and consideration has been given to limiting the number of recreation users. The National Scenic Riverway on the Current River is also experiencing

use-pressures that exceed capacities. Second, hunting (small game, big game, and waterfowl) opportunities are in great demand by area residents. It has been estimated that by 1980, nearly 300,000 acres will be needed for hunting in Butler, Carter, and Ripley Counties alone. An important recreational resource problem is the preservation and enhancement of hunting lands. Finally, the need is increasing for open, scenic areas with facilities for playfields, picnicking, and bicycling.

National Forest Service lands within a 50-mile area of the watershed is approximately 204,000 acres. Expansion of existing facilities and further development of new facilities will be needed to satisfy some of the needs especially for lower developed recreation activities. These will be quite important in satisfying needs for state and national recreation activities. These resources will not fulfill local and regional needs, because of increasing state and national demands. National Forest Service facilities also will not be distributed to meet needs of local areas influencing the Little Black area.

Natural streams, forest lands, open access, and scenic landscapes are abundant resources in the project area. Local citizens have identified a need for recognition of these resources and making some of them available for public use.

Fish and Wildlife

Wildlife-carrying capacities of the upland region are limited for some species. Much of the upland region has dense stands of pole-size timber, and interspersion of different vegetative types is not extensive. Overgrazing by domestic livestock detrimentally affects wildlife vegetation. Inherent low soil fertility affects plant diversity and nutritional qualities of forest and mast. There appears to be adequate cover resources for deer and turkey, however populations are apparently low. It would appear that food requirements are limiting population growth in this area rather than cover.

The foothill region supports a good population of upland wildlife which is not fully utilized. Road systems make the region geographically accessible, but a higher density of resident human population limits public usage.

The conversion of forested land in the delta to cropland has greatly reduced the importance of this area's many native species of wildlife. This changed land use has been continuing since the early 1900's, and all but about 3,000 acres have been cleared. It is not likely that trends will reverse so that the forested area in the delta portion of the watershed will be increased.

The aquatic resources of the Little Black River watershed are generally very diverse. 4/ However, land clearing and poor agricultural

practices which followed settlement have led to increased stream turbidity and siltation. This in turn has led to a decrease in species diversity through the smothering of spawning beds and by reducing the habitat available to those species whose tolerance of silt and turbidity is limited. These include the pugnose minnow, a lowland species, which is listed as endangered on Missouri's list of rare and endangered species. According to Trautman 33/ the pugnose minnow declines in abundance with increases in turbidity and siltation and decreases in aquatic vegatation. Other species in the watershed which might be affected adversely by sediment pollution are the smallmouth bass, rockbass, hornyhead chub, bigeye chub, and orangethroat darter.

Problems strictly associated with the lowlands involve drainage of the swamplands and removal of vegetation. For all practical purposes, no natural sloughs and swamps remain in this area. The remaining aquatic habitat is generally associated with manmade drainage ditches. These are very rich in aquatic production, but are periodically cleaned and reworked causing disruption of the conditions developed. Generally, no measures are taken to reduce impact of these disruptions.

Availability of stream fishing access is a problem over the entire watershed. Fishermen tend to congregate at all access points. There are approximately 49 miles of perennially flowing stream and 71 miles of ditches recognized in the watershed. No public access site is present on these streams. Access to most of the larger pools on the ditches is available at the will of private land-owners.

Biota of Missouri's delta region is a unique contrast to the rest of the state. Natural conditions have greatly disappeared through reclamation. For this reason, much of the original biota in the area is in a declining status. Several plant or animal species whose habitation is a marsh, swamp, or lowland hardwood have been lost or are in some danger of being lost. There are 9 mammals, 15 birds, 1 amphibian, 3 reptiles, 7 fish, and 18 plant species considered rare or endangered by Missouri. 4/ In most instances, the reduction in populations of these species is due to reduction of habitat. For instance, the swamp rabbit, water turkey, king rail, Swamison's warbler, and Bachman's warbler have been adversely affected by swamp drainage and removal of the original delta forest. The raptorial species which are considered rare or endangered have probably been reduced through the action of cumulative, persistent insecticides rather than through reduction of habitat. Three of the state listed species are considered threatened nationally-- the southern bald eagle, Indiana bat, and eastern cougar.

Seven species of fish included on Missouri's list of rare and endangered species are thought to occur in this watershed. 4/ Collections have been made by the Missouri Department of Conservation of the harlequin darter and the pugnose minnow. 7/ Little is known of the goldstripe darter, except that it is known to occur in Missouri from only one small spring in Butler County. The other listed species have been collected in this general region of the state and may likely occur within this watershed. None of the species listed as possibly

occurring in this watershed are included on the U.S. list of threatened wildlife. 19/ Any further degradation of aquatic habitat in the watershed could adversely affect these species in Missouri.

Water Quality Problems

The water quality of upland streams is high. Pollutant levels increase downstream. Visual comparisons of flow in the Current River, Little Black River, and from the drainage ditches show that turbidity is highest in the ditches, followed by the Little Black River, and lowest in the Current River. A comparison of water quality parameters for the Current River at Doniphan and Little Black River at Naylor show that water quality in the Current River is superior to that of the Little Black River. 4/

River	Max. Temp.	Maximum Fecal Coliform Count/100 Milliliters	DO	Phosphate Milligrams/Liter
Little Black	82.4°	14,000	4.8	0.200
Current	68.0°	620	6.7	0.047

The pH is somewhat higher in the Current River and dissolved nitrates and ammonia nitrogen are much lower. The maximum dissolved solids are about equal, as is total hardness. These data show that water from the Little Black River degrades the quality of the Current River. Dilution by the much larger flow of the Current River significantly reduces the effect of these pollutants.

The only present problem related to water quality is the high concentration of phosphorus in the watershed streams. Samples taken April 30, 1974, contained concentrations of this nutrient which exceeded the maximum recommended limit of 0.1 mg/liter. Arkansas water quality standards include the 0.1 mg/liter for phosphorus although Missouri does not. Regardless of standards, the phosphorus level is high, and may add to the rate of eutrophication. Observations of accelerated algal growth have not been made except for eutrophic conditions sometimes existing in drainage ditches.

Economic and Social

There are 1,100 landowners in the watershed. Of these, 773 have holdings classified as farms which average 190 acres in size. The estimated market value of all agricultural crops sold on a per farm basis averages $4,000 to $7,000 below the state average for the Missouri counties, and $5,000 below the state average for Clay County, Arkansas. The trend for the period 1964 to 1969 was to fewer farm owners with larger farms. This trend has probably not changed in more recent years.

Most of the farms are family-oriented units and 90 percent owner-operated. Less than 6 percent of the farms use more than 150 man-days of hired labor each year. In fact, up to 63 percent of the farmers work off the farm on part-time jobs during a portion of the year.

In 1970 the region's unemployment rate was as high as 7.8 percent compared to the U.S. rate of 4.4 percent. 4/ It also has a relatively smaller working age population, a lower labor force participation rate, and a lower payroll per employee in all sectors than the U.S. as a whole. The percent of families with income less than the poverty level in the Little Black River counties was two to three times higher than the nation as a whole.

During 1970 the manufacturing sector accounted for 21.1 percent of the total employment, while retail trade, personal and business services and agriculture made up 20.1, 19.8 and 11.4 percent, respectively. Comparing these to national averages, manufacturing is 4.8 percent lower, retail trade is 4.1 percent higher, personal and business services are 0.8 percent lower and agricultural-based employment is 7.7 percent higher than the national averages. These data thus suggest that the lack of jobs in the manufacturing trades is the primary factor depressing the employment opportunities in the area. 4/

The financial support for fire and police protection by local government is significantly smaller in the Little Black River region than is provided by the average of local governments in the States of Arkansas or Missouri. The average dollars spent per capita annually by local governments for police protection varies from $4.29 per capita in Butler County to $1.40 in Carter County, compared to $12.59 for the average of all local governments in Missouri and $5.08 in Arkansas. 4/

Similarly, local government finances for fire protection is substantially below the state averages. In Butler County, local governments spend about $2.22 per capita annually for fire protection, while in Ripley County only $0.13 per capita is provided. These figures are considerably lower than the average for all communities in Missouri and Arkansas, $6.43 and $3.04, respectively. 4/

In summary, this area is economically depressed due to the low income from farming activities, lack of industrial-related employment opportunities, and below average governmental expenditures on public goods and services.

PROJECTS OF OTHER AGENCIES

Lower Little Black Watershed is located in the White River Basin. The works of improvement for Lower Little Black are included as a part of the comprehensive Type II study of needed improvements for this river basin. The drainage area controlled and acre feet of flood storage provided by the Upper and Lower Little Black Watershed Work Plans are approximately the same as that used in the evaluations for the White River Type II Study.

The Corps of Engineers have proposed tie back levees along the Current and Little Black Rivers in the Type II study which would complement this project. No activities are under way to implement authorization of the levees.

In the development of the comprehensive basin study for the White River Basin a major tributary reservoir was considered at Fairdealing, Missouri. This reservoir would inundate agricultural areas, provide no protection for areas upstream, and be in conflict with an upstream watershed project. After detailed analysis and meetings with the local interests, this reservoir was eliminated from the 10-15 year plan. The reservoir was retained in the long range plan as an alternate in the event that a watershed project was not developed. This arrangement resulted from joint studies by the Corps of Engineers and the Soil Conservation Service.

No other proposed projects of state or federal agencies will be affected by the works of improvement proposed in the Little Black Work Plans.

PROJECT FORMULATION

From 1961 to 1964 the Soil and Water Conservation District of Ripley County, Missouri, promoted a series of interest meetings to discuss the potential of a PL-566 project on the Little Black River. These were held at the following schools within the watershed: Grandin, Missouri; Pine Valley, Missouri; Fairview, Missouri; Spell, Missouri; Naylor, Missouri; and Success, Arkansas. The district also sponsored two public tours into Arkansas to inspect watersheds under construction.

Early in 1964, the PL-566 application was submitted to the Governor of Missouri. Sponsors included the Carter County Court; Ripley County Court; Butler County Court; Butler County Drainage District No. 10; and Soil and Water District Boards of Ripley County, Carter County, and Butler County, Missouri. The Governor approved the application on June 30, 1964.

The following groups also endorsed the project: Van Buren Lions Club, Van Buren Chamber of Commerce, East Carter County Chamber of Commerce, Doniphan Lions Club, Van Buren Rotary Club, City of Grandin, Ripley County Chamber of Commerce, Doniphan Kiwanis Club, City of Doniphan, Ripley County Farm Bureau, City of Naylor, Clay County Soil and Water Conservation District, Butler County Farm Bureau, Naylor Special Road District, and Poplar Bluff Chamber of Commerce.

A watershed subdistrict was organized for the Missouri portion of the Little Black drainage area in 1964 and has provided leadership in the development of the watershed work plan. The delta area in Ripley County organized a Circuit Court Drainage District in 1968. Clay County Soil and Water Conservation District and Western Clay Drainage District submitted a separate application in August 1964, on the portion of Little Black in Arkansas. The sponsors requested that applications be combined and planned concurrently.

A preliminary investigation was prepared in 1965 and presented to the sponsors on July 26, 1965. The sponsors showed strong interest and requested the Soil Conservation Service to proceed with developing a watershed work plan. Planning authorization was granted in February 1966 by the Administrator of the Soil Conservation Service.

The watershed planning staff gathered field data on various alternatives to meet the goals and objectives of the sponsors. A series of meetings were held with the sponsors and interested public to discuss the field data and various alternatives for formulating land treatment and structural programs to solve their soil and water problems. Some of these meetings were held as follows:

April 20, 1966	Poplar Bluff, Mo., with steering committee
October 18, 1967	Doniphan, Mo., with steering committee

February 28, 1968	Neelyville, Mo., public meeting with sponsors, farmers, landowners
August 12, 1968	Toured watershed with Missouri Department of Conservation
September 10, 1968	Poplar Bluff, Mo., with steering committee
September 12, 1968	Corning, Arkansas, with steering committee
October 25, 1968	Poplar Bluff, Mo., with Corps of Engineers Memphis District representatives, Arkansas River Basin Staff, and Area Conservationist.
October 25, 1968	Naylor, Mo., Soil and Water Conservation Districts of Butler, Carter, and Ripley Counties, Corps of Engineers
March 17, 1969	Doniphan, Mo., with steering committee
September 8, 1969	Neelyville, Mo., with steering committee
September 9, 1969	Meeting with Butler Drainage District No. 10
September 10, 1969	Meeting with Western Clay Drainage District
September 11, 1969	Meeting with Naylor Drainage District
November 14, 1969	Jefferson City, Mo., with Missouri Department of Conservation
March 6, 1970	Jefferson City, Mo., with Missouri Department of Conservation
March 18, 1970	Meeting with steering committee at Doniphan to review mitigation alternatives.
July 8, 1970	Harviell, Mo., meeting with Butler County Soil and Water Conservation Board members and Butler Drainage District No. 10 Board members to review levee location.
October 5-7, 1970	Poplar Bluff and Doniphan, Mo., meeting with sponsors
January 25, 1971	Jefferson City, Mo., with Missouri Department of Conservation
January 26, 1971	Field trip and conference with S&WCD Board at Corning, Ark.

March 2, 1971	Neelyville, Mo., with steering committee
March 2-5, 1971	Field trip and conference with Missouri Department of Conservation.
March 3, 1971	Tour of structure sites with Butler County Soil and Water Conservation District and watershed trustees.
March 4, 1971	Field trip and conference with sponsors and landowners, Ripley County, Missouri and Clay County, Arkansas.
March 22-23, 1972	Naylor, Mo., field trip and conference with Naylor Drainage District Board.
March 19, 1973	Naylor, Mo., public meetings to discuss proposed projects and impacts.
March 20, 1973	Success, Ark., public meetings to discuss proposed projects and impacts.
March 21, 1973	Neelyville, Mo., public meetings to discuss proposed projects and impacts.
January 15, 1974	Meeting with watershed sponsors, Missouri Department of Conservation, Missouri State Park Board (Missouri Department of Natural Resources) at Poplar Bluff, Mo.

The project formulation of the Lower Little Black Watershed was developed concurrently with the Upper Little Black Watershed Work Plan. Flood routings, evaluations, and effects were all developed and formulated to determine the effects on the total Little Black Watershed. Since project formulation for both projects were done jointly, the following writeup with discussion of the decisions regarding flood prevention, as developed, will apply for both projects. Formulation decisions regarding drainage and recreation are discussed as applicable in individual project plans.

Objectives

Specific objectives which have been agreed upon by the sponsoring local organizations and the Soil Conservation Service are as follows:

1. To install needed land treatment as the first increment of the project. The goal for the 12-year project period is 50 percent of that needed in the watershed.

2. To shift marginal or submarginal farmlands to more profitable or socially beneficial uses.

3. To reduce average soil loss in the upland from 4.3 to 3.1 tons per acre per year.

4. To reduce sediment and scour damage to flood plain soils.

5. To reduce flow of upland runoff and provide an approximate 2-year or greater level of protection for areas now in agricultural production.

6. To improve hydrologic conditions, particularly on forested lands in the watershed.

7. To improve the existing system of multiple-purpose (flood prevention and drainage) channels in the delta area to reduce flood damage and provide improved agricultural drainage.

8. To provide protection to multiple-purpose channels and laterals from excessive streambank erosion, channel aggradation, or degradation in the delta area.

9. To provide public access areas to the Little Black River and to develop water base recreation.

In formulating the watershed project, the first increment was considered to be the installation of land treatment measures on private lands by the landowners. The next increment of development included identifying potential floodwater retarding sites. This involved studying many possible sites in the watershed project with various combinations of structures. Close coordination between the watershed planning staff and local leadership resulted in the selection of 25 structures for combined watersheds, controlling 52 percent of the total Little Black drainage. In many cases, this involved studying several alternate locations for each site and also included discussion with the landowners involved. A more detailed discussion on various alternatives follows later in this section.

The combination of land treatment measures and floodwater retarding structures would not provide adequate protection to meet the objectives of the sponsors for developing an adequate level of flood damage reduction. Even though a large percentage of the upland area is controlled by floodwater retarding structures, the Little Black would still overflow frequently in the delta area. The level of protection, without improving the Little Black channel or providing other floodway channels through the delta, would be less than a 1-year storm and would probably induce damage, due to the longer period of flooding along the Little Black channel in the delta area. Therefore, several alternatives were studied for providing additional channel capacity across the delta area. In selecting the alternative for

providing channel improvement, the following factors were considered:

1. Cost
2. Effects on fish and wildlife habitat
3. Land ownership patterns
4. Location of present drainage ditches
5. Bridge locations
6. Other physical and social barriers

A number of different locations were studied for a flood prevention channel, and, of these, it was determined that the best location would be along the approximate alignment of drainage ditch No. 3. In locating and designing this channel, which will begin as a diversion for floodwater, care was given to minimize fish and wildlife losses and also to restore the construction areas to a good condition. The diversion channel was planned in order that base and low flows would continue to flow in the present natural Little Black River channel. This was done by planning a water control structure at the junction of the natural channel and the entrance to the diversion channel.

The level of drainage desired by the sponsors is a system that will make possible the production of field crops; such as corn, soybeans, wheat, and cotton. This is accomplished by designing the system to remove approximately 1 inch of runoff in 24 hours.

The drop structures in ditch No. 3 have been planned to hold water at each structure to maintain a stable bottom and provide water for fishery. Each structure will have a port to permit fish to travel from one structure impoundment to another.

A review was made of the recreational potential in the Upper and Lower Little Black Watersheds. Most of the streams are inaccessible, especially in the Upper Little Black Watershed where the road network is limited. In this area, fire and logging trails are used by landowners and residents for access. These trails and county roads cross the streams at approximately 16 points--bank fishermen concentrate at these places. Based on this study, the B-9 site was selected as the one with the greatest potential in Upper Little Black. The diversion structure was selected as the most desirable location to develop public access in the Lower Little Black Watershed.

The Missouri Department of Conservation was contacted concerning a fish and wildlife development in the Lower Little Black Watershed. The Department was not interested in sponsoring a joint development at a structure site but stated there was a need for access to the Little Black River for fishing and canoeing. Meetings were then held with the Missouri Department of Conservation and the Butler County Drainage District No. 10 which resulted in a plan for a recreational development at the diversion structure.

The Arkansas State Fish and Game Commission was contacted regarding a fish and wildlife development in Arkansas. The Commission was not interested in sponsoring a development but stated there was a need for preservation of the river loop that would be cut off by the project. The Western Clay Drainage District decided to preserve this loop as a mitigation measure.

Because of the limited land to be acquired at the Lower Little Black recreation development, the facilities planned are for low intensity use. The planned capacity is for 10 parking spaces at each of two access points at the diversion structure. The development is designed to accommodate about 80 people at one time for fishing, picnicking, and canoeing.

Water supply was not a purpose in this project since existing towns are able to obtain water from wells.

Although irrigation is not an objective of the project, the opportunity for expanding irrigation in the area will be enhanced by reducing the damages from flooding and poor drainage.

Environmental Considerations

In formulating both projects, structure locations and designs were selected to minimize the displacement of people, the closing of roads and other disruption in the lives of local residents.

Considerations were given to maintaining base flow in the natural Little Black channel so as to preserve this stream in its present state. When studying the alternatives, the erodability of the soils and other physical limitations were considered in determining the need of erosion control structures, both in the channel and as erosion control devices for local inlets. Consideration was also given to modify the structural features for flood prevention to minimize damage to fish and wildlife resources and, if possible, to enhance fish and wildlife habitat. Several alternatives to replace upland wildlife habitat and fisheries involved were developed and thoroughly discussed with the local sponsors and the Missouri Department of Conservation.

The following alternatives were developed for discussion with sponsors. Plans were to list one or a combination of these in the work plan and carry them out in the operational stage.

Ditch No. 3

1. Spread spoil. Seed ditch side slopes, berm and side slope of spoil. Leave 30-feet top bare for native vegetation.

2. Stack spoil. No spreading. Leave bare for native vegetation.

3. Same as 1, except plantings in place of bare area. Fence areas where ditch is along pasture.

4. Substitute other areas acre for acre (10 acres per mile, est.)

5. Ten acres per mile turn-over to Missouri Department of Conservation for planting and maintenance.

Other Ditches

1. Work from one side, and that side planted to grass-legume-mixture --no grazing or mowing until after July 15. Berm and ditch side slope not included.

2. Where working both sides of ditch, treat one side same as for Ditch No. 3, alternatives 1, 2, 3, 4 or 5. Other side, plant to grass-legume-mixture. No grazing or mowing until after July 15. Berm and ditch side slope not included.

Alternative 1 for Ditch No. 3 was selected as the method for replacing wildlife habitat in all counties. Drainage districts in Ripley and Clay Counties selected alternative 1 under Other Ditches for minimizing wildlife habitat losses. Drainage District No. 10 in Butler County selected acquiring scattered blocks of land for managing as wildlife areas as mitigation measures for loss of habitat on small ditches in Butler County.

Five large American Beech trees (Fagus grandifolia) located on the left bank (south side) of the Little Black River in Sec. 24, T23N, R4E, are to be preserved. These trees are comparatively rare in Missouri. The diversion structure and channel were relocated approximately 500 feet west of the original alignment to avoid these trees.

To insure that the Little Black River will maintain its approximate low flow characteristics, three of the floodwater retarding structures in Upper Little Black Project (A-3, B-9, C-7) and one in Lower Little Black Project (F-11) are planned with ports to release water and help maintain stream flows during drought periods. To further insure that existing conditions continue on the Little Black River after the project is built, the two major scour openings in the left bank (Gaines Slough, Sec. 36, T23N, R4E, and the opening in Sec. 24, T22N, R3E) will have pipes of 100 c.f.s. capacity installed in the closure levees.

Alternatives

The following paragraphs review the alternative methods considered in project formulation to reduce damages due to flooding. One alternative is the use of the land within its capabilities and treatment

of 65 percent of the land according to its needs. Another is no treatment at all. Any change from the present land use towards a less intensive use would favor public ownership. Some alternatives are wildlife preserves, recreational areas, parks, and tree farms.

The following are alternatives to the proposed plan for the selected objectives:

A. A system of 39 floodwater retarding structures in the uplands along with 4.4 miles of levee on the left side of the Little Black River, 6 levee closures on the Little Black left bank, 61 miles of multiple-purpose channel modification, and 29.4 miles of channel clearing and snagging on the Little Black River.

B. A system of 25 floodwater retarding structures and no channel modification to carry floodwater except in the existing Little Black River.

C. A system of eight large structures in the upland of Little Black along with the 85 miles of multiple-purpose channel modification proposed in the work plan.

D. Install a system of 25 floodwater retarding structures in the uplands and straighten the Little Black River to carry a 5-year frequency flow from the point that it enters the delta flood plain (Sec. 24, T23N, R4E) to the Current River.

E. Twenty-five structures in the upland with a diversion at Gaines Slough (Sec. 36, T23N, R4E) where the Little Black now overflows at a major break to flood lowlands. At this point divert a 5-year frequency flow from the Little Black over to ditch No. 3; enlarge ditch No. 3 along its present alignment to the State line and to its junction with ditch No. 1, then continue on the alignment of ditch No. 1 to Little Black, straighten Little Black from the Current River to the junction of ditch No. 2 just above the State line.

Alternative A.

The first alternative included development of resource conservation plans on 65 percent of the watershed with the needed land treatment, 39 floodwater retarding structures in the uplands, 4.4 miles of levee on the left side of the Little Black River, 6 levee closures on the Little Black left bank, 61 miles of multiple-purpose channel modification, and 29.4 miles of channel clearing and snagging on the Little Black River. Average annual flood damage reduction would be 90 percent. Sediment pools would permanently inundate 1,740 acres of agricultural and wildlife habitat land; retarding areas would periodically flood 4,000 additional acres. Clearing of 2,030 acres of woodlands would be necessary. Reservoirs would inundate 12 miles of perennial stream and 1 mile of intermittent stream. Fish and wildlife habitat would be reduced or eliminated along 29 miles of

the Little Black River. This alternative was selected during preliminary project investigation. However, 15 of the floodwater retarding structures were not feasible because of physical limitations. The levee proposed along the left side of the Little Black River would create ownership problems and would require purchase of 23 acres of land. This alternative could be implemented under PL-566 authority at an initial cost of $33,130,000.

Alternative B.

Alternative B includes land treatment as described in "A," 25 single-purpose floodwater retarding structures, and no channel modification. Prolonged flows from floodwater retarding structures would induce damages which would offset damage reduction in other areas. Permanent inundation of 1,226 acres from sediment pools would result, and periodic flooding of an additional 2,900 acres would occur on retarding pool areas. A total of 12 miles of perennial and one mile of intermittent stream channel would be inundated. Clearing of 1,360 acres of woodlands would be necessary. The cost of this alternative would be $15,241,000.

Alternative C.

This alternative includes land treatment as described in "A," eight large floodwater retarding structures in the uplands on tributaries to the mainstem of the Little Black River, and 85 miles of multiple-purpose channel modification along the manmade ditches in the delta. An 80 percent reduction in average annual flood damages would result. The sediment pools of these structures would inundate 761 acres of agricultural and wildlife habitat land; retarding pools would periodically flood 2,035 additional acres. The reservoirs would also inundate 12 miles of perennial stream and 1 mile of intermittent stream. Clearing of 818 acres of woodlands would be necessary. Purchase of fee title and flowage easements on 1,775 acres and 2,390 acres, respectively, would be required. Cool water stream fish species (e.g., smallmouth bass, rock bass) would be largely replaced by warm water reservoir species (e.g., largemouth bass, bluegill). This alternative could be implemented under PL-566 authority at an initial cost of $18,546,000.

Alternative D.

This alternative would use land treatment as described in "A," 25 single-purpose floodwater retarding structures in the uplands, and straightening the Little Black River to carry a 5-year frequency flow from the point that it enters the delta flood plain (Sec. 24, T23N, R4E) to the Current River. There would be a 90 percent reduction in average annual flood damages. The retarding structures would inundate 1,226 acres of agricultural and wildlife habitat land due to sediment pools; retarding pools would periodically inundate 2,900 additional acres. Approximately 18 miles of new channel would be constructed,

and 24 miles of the Little Black River channel and existing fish and wildlife habitat would be destroyed. This would represent a loss of the aesthetic value of the river as well as approximately 3,840 annual recreation visits, including canoeists and stream fishermen. In addition, 12 miles of perennial stream and one mile of intermittent stream channel would be flooded by the retarding structures. Channel construction would require that nine bridges be either rebuilt or have extensions installed. An estimated 4.6 million cubic yards of excavation would be necessary. This alternative would create numerous ownership problems along the new channel because present land ownerships are to the center of the existing channel in many cases. This alternative could be implemented under PL-566 authority at an initial cost of approximately $22,022,000.

Alternative E.

This includes land treatment as in "A," 25 single-purpose floodwater retarding structures in the uplands with a diversion at Gaines Slough (Sec. 36, T23N, R4E) enlargement of ditch No. 3 along its present alignment to the State line and the junction with ditch No. 1, alignment of ditch No. 1 to the Little Black River, and straightening the Little Black River from the Current River to the junction of ditch No. 2 (just above the State line). This alternative would divert the 5-year frequency flow from the Little Black River to ditch No. 3. Channel modifications would require bottom widths ranging from 80 feet at the lower end to 40 feet at the upper end, and depths ranging from 12 to 18 feet. With this depth, the channel bottoms would be in the sand strata and would have stability problems. Clearing of 2,280 acres of woodland would be necessary. Ten bridges would need to be extended or rebuilt, and 5.3 million cubic yards of excavation would be needed. About 10 miles of the existing Little Black River and its habitat would be destroyed which would be a significant loss of aesthetic value and 1,600 annual recreation visits. In addition, some land rights problems would occur (similar to Alternative D). The initial cost of this alternative (which would be implemented under PL-566 authority) would be approximately $23,680,000.

Selected Plan

The alternative of 25 structures in the uplands (19 floodwater retarding and one multiple-purpose structure in Upper Little Black; and five floodwater retarding structures in Lower Little Black), a by-pass floodway approximately parallel to the Little Black River, and the rebuilding of the manmade ditches in the delta was selected because it met the objectives of the sponsors with consideration to effects on fish and wildlife resources. The Fish and Wildlife Service Reconnaissance Report on this project stated that floodwater retarding structures in the uplands, while destroying some upland game habitat, were not objectionable since they would create open areas with probably some water for watering places in the forested uplands. 18/ By using a diversion structure on the Little Black River to divert the

part of the 2-year frequency flood flow that is in excess of its capacity, the Little Black River will continue on its present course, thus preserving approximately 24 miles of existing prime habitat for fish and wildlife.

Some factors considered in selecting ditch No. 3 as a bypass floodway were: (1) preserve the Little Black River in the delta in its present state, (2) prevent flood flows from leaving the banks which would cause deep scour channels that in time would change the course of the Little Black River, (3) maintain flows in the larger scour channels to maintain present habitat by placing pipes in the levees placed across these channels near the Little Black channel.

Ditch No. 3 was selected for enlargement to carry extra floodwater since (1) it is approximately the same elevation or in some cases lower than ditch No. 1, (2) enlargement of ditch No. 3 was also required to carry the flows from lateral channels which originate in Butler County, (3) five bridges would need to be enlarged on ditch No. 3 whether or not it was selected for the floodway, and (4) five bridges would be enlarged on ditch No. 1 if it were selected. By using ditch No. 3, only five bridges on ditch No. 3 will need to be enlarged or rebuilt, as compared to 10 bridges if both ditches were enlarged.

Numerous conferences were held with the Missouri Department of Conservation to work out a plan for ditch No. 3. The proposal agreed upon involved the use of drop structures to control grade and modification of the structures to hold water for fisheries. These drop structures will reduce channel grade and maintain a velocity which will meet design criteria for a stable channel. Mitigation measures; such as, sheet piling deflectors, holes dug along the side of the channel, and chutes off the drop structures to create holes, were considered. Because of the erosion created by these measures, the drop structures with water impoundments and ports for fish passage through the structures were considered more desirable.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Soil and Water Conservation Districts of Butler, Ripley, and Clay Counties have been conducting a conservation program with cooperators. This program, based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its need for production and improvement in the chosen land use, is an essential part of watershed protection. The extent of needed land treatment measures which have been applied to date within the watershed represents an expenditure by landowners and operators of approximately $1,045,716 (Table 1A).

Land treatment measures will be installed for watershed protection and flood prevention. Generally a combination of land treatment practices are required and must be tailored to fit the land, topography, use, soil properties, and management ability of the land user. To insure the orderly application and maintenance of land treatment measures, resource conservation plans will be developed on at least 65 percent of the watershed.

Cropland is almost entirely concentrated in the delta area and in the flood plain associated with the upland. Approximately 30,500 acres of cropland will be treated during the project period. Other land treatment measures giving partial protection will be installed that are not reflected in acres adequately treated in Table 1. The cost of planning and installing the practices are included in the table. The practices to be applied are described below:

Conservation Cropping System.--This practice is defined as growing crops with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes, as well as rotations in which the desired benefits are achieved without the use of such crops. The purpose is to improve or maintain good physical conditions of the soil; protect the soil during periods when erosion usually occurs; help control weeds, insects, and diseases; and meet the need and desire of farmers for an economic return. This practice is applicable on all cropland and certain recreation and wildlife land.

Crop Residue Use.--This practice is defined as using plant residue to protect cultivated fields during critical erosion periods. The purpose is to conserve moisture, increase infiltration, reduce soil loss and improve tilth. It is applicable on land where adequate crop residues are produced.

Grass Waterways or Outlets.--This practice is defined as a natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose runoff from a field, diversion, terrace, or other structure.

The purpose is to prevent excessive soil loss and formation of gullies. It is applicable where concentrated runoff must be disposed of at safe velocities.

Grade Stabilization Structures.--This practice consists of structures to stabilize the grade or to control head-cutting in natural or artifical channels. It does not include structures used in drainage and irrigation systems primarily for water control. The purpose is to prevent the formation or advance of gullies and reduce environmental and pollution hazards. These structures apply where the concentration and flow velocity of water are such that structures are required to stabilize the grade in channels or to control gully erosion. Special attention will be given to maintaining or improving habitat for fish and wildlife where applicable.

Diversion.--This practice is sometimes referred to as a diversion terrace. It is a channel with a supporting ridge on the lower side constructed across the slope. The purpose is to divert water from areas, where it is in excess, to sites where it can be used or disposed of safely. It is used where: (1) Runoff from higher lying areas is damaging cropland, pastureland, farmsteads, or conservation practices; such as, terraces or strip cropping; (2) Surface and shallow subsurface flow is damaging sloping upland; (3) Runoff is available for diversion and use on nearby sites; and (4) A pollution abatement system or control of erosion and runoff from urban or developing areas and construction sites is needed.

Diversions will not be substituted for terraces on land requiring terraces for erosion control. Usually they are not constructed below high sediment producing areas unless land treatment practices or structural measures designed to prevent damaging accumulation of sediment in the channels are installed concurrently or before the diversion.

Drainage Field Ditch.--This practice is defined as a graded ditch to collect excess water in a field. This does not include drainage main or lateral or grassed waterway or outlet. The purpose is to drain surface depressions; collect or intercept excess surface water, such as sheet flow from natural and graded land surfaces or channel flow from furrows for removal to an outlet; and collect or intercept excess subsurface water for removal to an outlet.

It is used on flat lands that have soils of low permeability or shallowness over barriers such as rock or clay which hold or prevent ready percolation of water to a deep stratum;

areas that have insufficient land slope for ready movement of excess runoff; and areas that require removal of excess irrigation water or control of the ground water table. It is necessary that this practice have adequate outlets available for disposal of drainage water by gravity flow or pumping.

Land Smoothing.--This practice is defined as removing irregularities on the land surface by use of special equipment. Ordinarily, this does not require a complete grid survey. It includes operations ordinarily classed as rough grading. This does not include the "floating" done as a regular maintenance practice on irrigated land or the "planing" done as the final step in irrigation land leveling or drainage land grading. The purpose is to improve surface drainage, provide for more effective use of precipitation, obtain uniform planting depths, provide for more uniform cultivation, improve equipment operation and efficiency, improve terrace alignment, and facilitate contour cultivation. This practice is applicable on lands where depressions, mounds, old terraces, turn rows, and other surface irregularities interfere with the application of needed soil and water conservation and management practices. It is limited to areas having adequate soil depths.

Irrigation Land Leveling.--This is defined as reshaping the surface of land to be irrigated to planned grades. It does not include drainage land grading or land smoothing. Land leveling for irrigation permits uniform and efficient application of irrigation water without erosion, loss of water quality, or damage to land by waterlogging and at the same time provides adequate surface drainage.

All lands to be leveled shall be suitable for use as irrigated land and for the proposed methods of water application. Water supplies and irrigation deliveries to the area to be leveled shall be sufficient to make irrigation practical for the crops to be grown and the irrigation water application methods to be used.

Soils shall have adequate depths to assure that an adequate, usable root zone remains after leveling which will permit satisfactory crop production with proper conservation measures. The finished leveling work must not result in exposed areas of highly permeable materials that would inhibit proper distribution of water over the field.

Pastureland treatment will include brush and weed control, pasture and hayland planting, pasture and hayland management, ponds for livestock water, and an adequate fertility program. Pasture and hayland management will be used to bring forage production for each season in balance with livestock needs. Approximately 10,000 acres of pastureland will be adequately treated during the project period. Some of

these practices will be applied on additional pastureland. The practices to be applied are described as follows:

Pasture and Hayland Management.--This practice is defined as proper treatment and use of pastureland or hayland. The purpose is to prolong the life of desirable forage species; maintain or improve the quality and quantity of forage; protect the soil; and reduce water loss.

Pasture and Hayland Planting.--This practice is establishing and reestablishing long-term stands of adapted species of perennial, biennial, or reseeding forage plants. It includes pasture and hayland renovation but does not include grass waterway or outlet on cropland. It reduces erosion, produces high quality forage, and adjusts land use. It is applicable on existing pasture and hayland or on land that is converted from other uses.

Ponds.--This is defined as a water impoundment made by constructing a dam or embankment or by excavating a pit or dugout. Ponds are constructed to provide water for livestock, fish and wildlife, recreation, fire control, crop and orchard spraying, and other related uses. In this project the ponds constructed will be located in predominantly rural or agricultural areas where failure of the structures would not result in the loss of lives; damage to homes, commercial or industrial buildings, main highways, or railroads; or interruption of the use of service of public utilities. Generally, the distance between the lowest point of the natural ground along the centerline of the dam and the crest of the emergency spillway will not exceed 20 feet. Technical assistance by Soil Conservation Service personnel will be furnished to landowners to assure that: (1) Site conditions, drainage area, topography, or soil of the site will permit storage of water at a depth and volume that will insure a dependable water supply; (2) The foundation for the dam is adequate; and (3) In the reservoir area the soil is impervious enough to prevent excessive seepage losses or is a type that sealing is practicable.

Forest land management plans will be prepared for approximately 90 landowners, involving 17,280 acres, to provide for the proper installation and maintenance of forestry measures on private land.

A land treatment program has been developed for private lands from a statement of land treatment needs prepared by the Division of Forestry of the Missouri Department of Conservation and the Arkansas Forestry Commission, in cooperation with the U.S. Forest Service. Land treatment measures will be installed in the Arkansas portion of the watershed as the need develops. The following program is planned for installation in Missouri:

Tree Planting (90 acres).--Reforestation of appropriate open lands in private ownership is necessary to adjust planned use with capability and to reduce runoff and erosion by developing a protective cover and absorbent forest floor of litter and humus.

Hydrologic Cultural Operations (5,750 acres).--These silvicultural operations are aimed at improving hydrologic conditions of private forest lands by manipulation of stand composition to create conditions favorable for the maximum production and protection of litter, humus, and forest cover. They include thinnings, weedings, improvement, salvage, intermediate harvest and harvest cuttings; and supplemental plantings.

Fire Control Intensification (51,025 acres).--Adequate fire protection is necessary to derive maximum benefits from other watershed works of improvement. In order to meet and provide for minimum watershed requirements, it will be necessary to purchase additional fire suppression equipment for use on the watershed. This equipment includes a crawler tractor, fire plow, truck, radios and handtools. This set of equipment will serve both the Upper and Lower Little Black Projects.

During development of resource conservation plans landowners will be encouraged to plan and apply forage, forestry, and cropland management practices that are important in maintaining or developing favorable wildlife conditions. Forest cutting patterns, differing age classes in forest stands, native grass establishment, crop residue use, and crop rotation are important considerations that can benefit wildlife. Protecting existing stands of fruit-producing shrubs and making new plantings of these on eroding areas, gullies, and steep banks will benefit wildlife. Native warm season grasses and legumes established around floodwater retarding pools will reduce wind erosion, sediment accumulation, and increase wildlife values. Some establishment of tall grasses and trees around farmsteads and on sandy soils will provide windbreaks and beautify the landscape.

Some individual farms, which will be developed for private and income-producing recreation, will plan and install recreation practices. Recreation area stabilization, recreation area improvement, recreation trails and walkways, and ponds are included in the practices to be applied.

A work plan has been developed for completing and publishing a soil survey in Butler and Ripley Counties. There are about 211,000 acres of the Little Black Watersheds in the soil survey area. Approximately 101,280 acres are in Lower Little Black. It is estimated that 1.75 man years of technical assistance will be needed to complete that portion of the survey. Farmers cooperating with the soil and water conservation districts will use this information in developing

resource conservation plans that will help achieve proper land use and meet the conservation needs of the land.

Application and continued maintenance of land treatment are important; without them, installation of the other work plan features would not produce the expected benefits. The amounts and estimated costs of land treatment to be applied during the project period are shown in Table 1.

Structural Measures

The structural measures will consist of the following:

1. Five floodwater retarding structures - single purpose.

2. One diversion structure on the Little Black River to pass normal flow on down the channel and to divert floodwater into the floodway.

3. New channel work to construct a floodway for flood prevention. (Approximately 1.3 miles)

4. Multiple-purpose channel work. (Approximately 84.2 miles)

   a. Channel work on existing manmade ditches to construct multiple-purpose channels for flood prevention and drainage. (Approximately 79.8 miles)

   b. Five drop structures to reduce channel grade in the floodway and ditch No. 3. One structure at the end of the floodway where ditch No. 3 begins and four structures on ditch No. 3.

   c. One drop structure at outlet end of ditch No. 1.

   d. Approximately 1.7 miles of new channel work to construct a multiple-purpose channel for flood prevention and drainage. This includes three sections for improving alignment of existing manmade ditches--two 0.6 mile segments and one 0.5 mile segment.

   e. Channel work on the existing Little Black River in Arkansas along its present alignment to enlarge the cross section for flood prevention and drainage. (Approximately 1.4 miles)

   f. Approximately 1.3 miles of clearing and snagging on the existing Little Black River in Arkansas to improve flow conditions and increase capacity for flood control and drainage.

5. Approximately 1.0 mile of levees for flood prevention consisting of 0.2 mile above Harviell, 0.3 mile on road at diversion structure, 0.1 mile on lateral #2, 0.4 mile in short segments at washout areas along the Little Black River.

6. Water control structure for the river loop cutoff at the diversion structure and recreation development facilities. These facilities will include access road, parking lots, sanitary facilities, and boat launching ramp.

Reservoir-Type Structures

A total of five floodwater retarding structures ranging in height from 24 to 66 feet are planned to be installed. (See Typical Earth Dam with Pipe Drop Inlet - Figure 1). They will control a drainage area of 56.31 square miles, representing 29 percent of the Lower Little Black Watershed. The drainage area controlled by structures in both Upper and Lower Little Black Watersheds is 52 percent of the Little Black River at its confluence with the Current River.

The foundations and abutments on all structure sites are gravelly and range from clayey silts to silty clays. The generally dense residuum in the foundations range from 5 to over 50 feet in depth. All structures are planned with foundation drains to control seepage in the moderately permeable foundation soils.

All structures are to be constructed of a compacted earth fill with concrete conduits or box principal spillways on yielding foundations. All are designed for a 100-year life. The principal spillways are all planned with open top risers. Structures F-2, F-3 and F-11 are planned with two stage inlets to reduce peak flows for storms of less than a 5-year frequency. F-2 and F-11 will have box culvert conduits with S.A.F. outlets as energy dissipaters. Structures E-6 and G-2 are planned with single stage inlets. All structures will have vegetative emergency spillways.

Structure F-11, with a drainage area of 20.49 square miles, will have two water release ports installed in the principal spillway riser. These will release water from the sediment pool to insure more normal stream flows during periods of drought. One release will be located near the bottom of the riser, and one approximately 5 feet below the sediment pool elevation. The combined capacity of the two ports will be 0.02 c.s.m. (Approximately 0.4 c.f.s.)

Sediment storage was determined for 50- and 100-year accumulation periods. The principal spillway inlets will be installed at the elevation of the 100-year sediment accumulation unless the sponsors request the risers to be ported at some lower elevation. The 100-year sediment pool storage for all structures in this plan is 2,940 acre feet. The surface area size of the sediment pools range from 21 to 94 acres. The combined total surface area of these pools will be 315 acres. Clearing will be limited to the main pool areas of the sediment pools and that area required for construction of the earth fill structure and emergency spillway. Narrow reservoir arms will not be cleared. Root wads and brush piles from clearing will be stacked and left in the sediment pools for fishery habitat. The Missouri Department of Conservation will be requested to make recommendations on a site-by-site basis for location of the stacks of material to be left for fishery habitat.

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HARVIELL DITCH - BUTLER COUNTY.

THIS PHOTO REPRESENTS THE CONDITION OF APPROXIMATELY 50 MILES OF EXISTING MANMADE DRAINAGE DITCHES WHERE DRAINAGE FLOW IS NEGLIGIBLE AND FLOODWATERS ARE RETARDED. THESE DITCHES CARRY WATER ONLY DURING PERIODS OF SURFACE RUNOFF. CONSTRUCTION IS PLANNED FROM ONE SIDE AND THE WILDLIFE HABITAT ON THE OPPOSITE SIDE WILL NOT BE DISTURBED.

RECONSTRUCTION OF DITCH SIMILAR TO ABOVE CONDITIONS. NOTE WORK FROM ONE SIDE -- SPOIL DUMP IS BACK FROM DITCH TO ALLOW ACCESS ROAD FOR MAINTENANCE.

A CONSTRUCTED FLOODWATER RETARDING STRUCTURE IN ARKANSAS IN TOPOGRAPHY SIMILAR TO LITTLE BLACK WATERSHED.

CONSTRUCTION SCENE DURING CONSTRUCTION OF FLOODWATER RETARDING STRUCTURE. NOTE INLET RISER ON UPLAND SIDE.

Emergency spillways are planned to operate on a 2 percent chance (once in 50 years), except structure E-6 which is on a 4 percent chance (one time in 25 years). These structures will have a total floodwater detention capacity of 15,285 acre feet. The temporary flood storage pools will contain from 3.30 to 5.89 inches of runoff from the contributing area as shown by dam sites in Table 3.

Borrow areas for all structures are to be located within the reservoir area, except for that portion which is excavated from the emergency spillway and usable as earth fill material. The fill material will be sand, silt, and clays obtained from the valley flood plain alluvium and upland residuum.

A total of 1,281 acres will be needed for the five dams. Land use on the 315 acres requested for sediment pools and 911 acres for floodwater retarding pools to an elevation 2 feet above the crest of the emergency spillway is 17 percent cropland, 81 percent forest land, and 2 percent pastureland. The area needed for fills and spillways is 55 acres. The land use on this area is 6 percent cropland, 89 percent forest land and 5 percent pasture.

Existing facilities affected by structures are roads, bridges, power lines and buildings. Flooding of existing county roads in structures F-2, F-3 and F-11 will require an easement for temporary flooding. State Highway 142 will have temporary floodwater on the right-of-way above structure F-3. This section of road will require modification.

An easement for a power line will be needed in the flood pool of structure F-2. Land rights will involve the removal of two hunting cabins in the flood pool of structure F-2 and a residence in the F-11 flood pool. The residence in F-11 involves the displacement of four occupants.

Sediment pools in the single purpose flood retarding structures will have potential for limited recreational use by owners, operators and their friends by permission. Access by the general public will be prohibited unless or until adequate sanitary facilities are approved which meet state and local health requirements. Sponsors have indicated that they do not intend to provide public access to sediment pools under their control at any of these sites.

Channels

All proposed channel work in this plan is located in the delta area. It is divided into categories as follows:

1. Floodway (approximately 1.3 miles).

2. Multiple-purpose channel work for flood prevention and drainage. This work is divided as follows: (approximately 84.2 miles)

a. Multiple-purpose flood prevention drainage ditches (approximately 81.5 miles).

b. Enlargement of the existing Little Black River along present alignment with riprap at bends (approximately 1.4 miles).

c. Clearing and snagging in Little Black River (approximately 1.3 miles).

The floodway will be approximately 1.3 miles long starting at the diversion structure to be located on the Little Black River in the SE 1/4 , Sec. 24, T23N, R4E and ending with the drop structure at Station 154+56. The diversion structure is planned as an earth fill structure (Figure No. 2) with four 48-inch reinforced concrete conduits to carry the flow of Little Black at bank-full condition. This structure will maintain normal flow in the Little Black River downstream. Storm flows will be diverted into the floodway through a control section with a bottom elevation approximately 4.5 feet above the Little Black River bottom. The diversion structure and control section, including the Little Black River at the entrance to the diversion structure and the wing levees, will be protected by riprap to control erosion.

The floodway will be a new channel constructed in an ML material (silts with clays - low plasticity) in an area whose land use is presently 42 percent cropland and 58 percent forest land. The floodway bottom width will be approximately 60 feet. Side slopes planned are 2:1. The floodway will have a 16-feet wide berm on each side. The berms and ditch will be seeded to grass. The inside slope of the spoil is planned for 3:1 to a height of 10 feet above the natural ground level. This area will be approximately 30 feet wide and will be planted to grass, legumes and woody vegetation adapted for wildlife as a mitigation feature. The top of the spoil will be leveled off and sloped toward the field side with the outside slope approximately 6:1. The berm between the spoil bank and the side slope will be used as an access road for maintenance. (See Typical Cross Section Main Ditch - Figure 3.)

Channel stability was checked with regard to materials which were most restrictive, and velocities planned are stable based on present design criteria.

The lower part of the floodway will have continuous spoil banks on each side from the structure at Station 154+56 upstream to the point the hydraulic grade line and the natural ground level coincide to carry ditch flows in the section where the hydraulic grade line is above ground level. Each spoil bank will have an opening at this point which will act as an emergency spillway when storm flows exceed a 2-year frequency.

The drop structure will be installed on the county road at Station 154+56 (SW corner, Sec. 30, T23N, R5E) as part of the new floodway to

reduce the slope to a nonerosive grade. The structure will be a 6.1 feet drop with a weir 20 feet wide by 11.2 feet deep. Water storage is not planned above this structure. A bridge will be constructed over the structure.

Land rights for the floodway will be obtained by easement. The area outside the crown of the spoil bank will be shaped to a flat slope to be used by landowners for cropping or pasture after construction is completed. When cleanout is required, this area will be used to waste spoil material. All channel area inside the top of the spoil bank will be restricted from grazing by fencing where needed to control livestock. Fence construction will be the responsibility of and the expense of the landowner as provided for in the easement. The total area required for construction of the floodway and one structure is approximately 46 acres. Approximately 13 acres will be outside the spoil bank crown. This area will be available for agricultural uses.

The floodway will require the removal of one dwelling near the drop structure, and one set of farm buildings including a dwelling near the diversion structure. Two families, involving 10 persons, will be displaced.

One loop of the Little Black River (approximately 0.2 miles long) will be cut off by construction of the floodway. This loop will be blocked at both ends, and a tube will be installed to maintain water level flow. This cut off is located in Sec. 24, T23N, R4E.

The works of improvement proposed in the vicinity of Archaic Culture Sites No. 23BU97 and No. 23RI102 and Mississippian Site No. 23BU10 are planned to avoid excavation in the area. 4/ 20/ The installation of the levee and parking lot in this area will involve placing of fill, and no excavation will be required that would disturb the site. A preliminary field review did not identify any other archeological site involved with the proposed structural measures. If other archeological sites are discovered during construction, the Missouri Archaeological Survey and the National Park Service will be immediately notified.

Approximately 80 miles of manmade ditches will be rebuilt as multiple-purpose ditches for flood prevention and drainage. Existing flow conditions in these ditches are: 2 miles perennial flow; 37 miles intermittent; and 41 miles ephemeral. Refer to Table 3A for a detailed description of ditches. Ditches No. 1, 2 and 3 are nearly parallel to the Little Black River. The other named ditches--Brown-Taft, Neelyville, Harviell and Indian Creek ditch--are laterals draining that area from the north and east into ditch No. 3. Other ditches are collector laterals draining into the named and numbered ditches. These include a WPA ditch, Epps and Sappington, all laterals to Harviell; Suder, a lateral to Neelyville ditch; and Birdslash, a lateral to ditch No. 2. All planned multiple-purpose ditch alignments will follow the existing ditches except for about 1/2 mile on ditch No. 3 just below the State line to its junction with Indian Creek ditch.

Ditch No. 3 which begins at the end of the Little Black floodway will be designed to carry the 2-year frequency flow diverted from Little Black River and a 2-year frequency flow from the contributing delta area. This capacity will provide an outlet for all other multiple-purpose ditches in the delta area which are designed to remove approximately 1 inch of runoff in 24 hours. The ditch will be constructed to bottom widths ranging from 60 feet at the upper end to 117 feet below the State line. Side slopes planned are 2:1. Also planned for each side is a 16-feet wide berm to provide access for maintenance equipment. This berm and ditch side slopes will be seeded to grass. The inside slope of the spoil will be shaped to a 3:1 slope and leveled off 10 feet above the berm to provide a 30-feet wide strip between the access road and the top of the spoil. Vegetation adapted for wildlife will be established on this strip. The top will be sloped towards the field, and the outside slope will be approximately 6:1.

Four spoil bank openings per mile on each side, not less than 100 feet wide, will be provided to allow for overflow of floodwaters in excess of design ditch capacity.

Channel modifications will have corrugated metal pipe inlet structures installed as needed to provide outlets for all local field and road drainage into the channels. There will be approximately eight per mile, an average of four on each side. These will serve as grade control outlets from the end of field drainage systems. Drainage collection basins will be installed on each inlet as a project measure. The basins will be approximately 2 feet deep.

The upper 6 to 8 feet of soil materials in the Missouri portion of ditch No. 3 are silty clays or clayey silts (CL-ML), overlying sandy (SM-SC-SP) material. Enlargement of ditch No. 3 will deepen the existing ditch from 2 to 7 feet, placing the ditch bottom in this sandy zone. The water level in these ditches will be maintained at approximately the contact zone of the sandy and silty or clayey materials by the drop structures (See Ditch Profile, Figure 4).

Ditch No. 3 will have four drop structures for stabilization purposes. All will be modified to retain permanent water upstream from the structures. The water depth will be 4 feet at each structure, and these structures will create water impoundments totaling approximately 175 acres. The weir notch of each drop structure will be designed to maintain channel capacity at design depth of flow. The approximate location of the drop structures and sizes of weir notches are as follows:

Structure No.	Location [a/]	Weir Notch
3	Sta. 260+26	66 feet wide x 7.2 feet deep
4	Sta. 388+12	66 feet wide x 7.4 feet deep
5	Sta. 674+71 (state line)	90 feet wide x 7.4 feet deep
6	Sta. 860+04	90 feet wide x 7.6 feet deep

a/ See Ditch Profile, Figure 4.

Three drop structures will be located on county roads--one in Missouri (between Sec. 23, T22N, R4E), and one in Arkansas (Sec. 11 & 12, T21N, R3E), and the third will be located on the State line. (See Main Ditch - Modified Drop Structure and Road Crossing, Figure 5.) The remaining structures will be upstream from the junction of ditch No. 3 and Harviell ditch in Missouri, Sec. 1, T22N, R4E. Each weir will have a port opening (in the bottom), approximately 1 foot square, to permit flow of water and allow passage of fish from one pool to the other. All drop structures will be diked as island-type drops to prevent overtopping from large storms.

A drop structure will be installed at the lower end of ditch No. 1 (station 717+80) at its junction with ditch No. 3. This structure will also be designed as an island-type structure.

All other ditches will be rebuilt and their depth increased to provide more capacity and drainage outlets for other main and lateral ditches. These ditches will be constructed in predominantly CL-ML soils. Field investigations and laboratory analysis have identified soil dispersion values ranging from a trace to 95 percent on some of the multiple-purpose ditches. It is estimated that this may occur on approximately 62 miles of proposed channel work which may require additional measures to cope with the dispersion problem. A lime application treatment has been considered as a basis for providing additional cost. The final choice of treatment will be made at the time final plans are prepared. These ditches are designed to remove approximately 1 inch of runoff in 24 hours. These ditches, except ditch No. 3, will be constructed from one side to save existing wildlife habitat on the opposite side.

Fishery mitigation in ditches No. 1 and 2 will involve an extra 2 feet of excavation of alternate 1,000-feet long sections of ditch bottom which will result in approximately a "V" bottom ditch and would create impoundments for fish habitat. Ditch No. 1 will have approximately 6 miles constructed in this manner beginning at the bridge on the north line of Sec. 28, T22N, R4E, and extending to the junction with ditch No. 3 in Arkansas. Ditch No. 2 will be constructed in the same manner and will be approximately 4 miles long beginning at

the bridge on Highway H, Sec. 19, T22N, R4E, and extending to its junction with the Little Black River. Mitigation on ditch No. 2 will also include a 100 c.f.s. capacity conduit in a levee at the break in the river bank in Sec. 24, T22N, R3E, to provide water for lateral No. 2 and the lower reach of ditch No. 2. The lower end of lateral No. 2 will be blocked at its junction with ditch No. 2 with a fill containing a pipe of 100 c.f.s. capacity set at the level needed to maintain the existing water level in lateral No. 2. These measures will maintain approximately 6 acres of water in ditches No. 1 and 2 and approximately 11 acres of water in lateral No. 2.

A 10-acre pool of water 1.2 miles long will be maintained in the Hart ditch beginning approximately one-fourth mile above its junction with the Brown-Taft ditch. The ditch below this pool will be graded from its junction with Brown-Taft upstream to the high point about one-fourth mile north of Brown-Taft. This high point in the ditch bottom will serve as a dam to preserve the upstream water area.

One loop of the Little Black River in Arkansas (approximately 0.5 mile long) will be cut off by construction of the outlet for ditch No. 3 into Little Black River. This loop will be blocked at both ends, and pipe culverts will be installed to maintain existing water levels. This cutoff is located in Sec. 14, T21N, R3E.

Approximately 1.4 miles of the Little Black River in Arkansas from the confluence of ditch No. 3 at Sta. 936+00 to Sta. 1010+50 approximately 1 mile below the county highway bridge at Success, Arkansas, will be enlarged along the existing alignment to carry 2-year frequency flood flows from Little Black above its confluence with ditch No. 3 and the design flows from ditch No. 3 (see figure 4). Bottom widths will range from 116 to 97 feet. Riprap will be installed at the junction of the Little Black and ditch No. 3 and on the curves of Little Black to control erosion.

Clearing and snagging to remove fallen trees, gravel bars, and other channel obstructions are planned for approximately 1.3 miles of the Little Black River from Sta. 1010+50 to the end of the project at Sta. 1077+00. Bottom widths vary from 97 to 85 feet in this section. Clearing and snagging operations will be performed from the north side of the river and will be confined to restricted sections. Riprap will be used to control erosion as needed. The ditch modifications will end approximately 3 miles from the Little Black River's confluence with the Current River. The hydraulic grade line for ditch design was set using the capacity of a downstream natural cross section. This elevation was 280.5 for the ditches. The 1.1-year elevation on the Current River is 279.5, and the 2-year elevation is 285.5. The backwater effects on design flow in the ditches under normal conditions are insignificant due to the difference in sizes of the respective drainage areas and the probability of a 2-year frequency storm occurring on both at the same time. For storms exceeding the 2-year frequency on the Current River, the backwater effects are significant and flooding will occur on several thousand acres of common flood plain.

Design velocity was established based upon a stability analysis of the most restricted materials in the cross section profile. Table 3A indicates velocities by channel reach. Outlets of lateral ditches which enter another ditch will be stabilized with the planned installation of the four drop structures.

Land rights for all channel work and the oxbow loop on the portion of the Little Black River that is in Arkansas will be by easement.

The total area required for construction of all multiple-purpose ditches is approximately 1,666 acres. The present land use of this area is 33 percent cropland, 52 percent forest land, and 15 percent ditches. Part of this area (351 acres) will be outside the crown (field side) of the spoil bank on ditch No. 3, the floodway, and Little Black River. This area will be available for agricultural uses. An additional 100 acres of delta land will be acquired in Butler County for managing as wildlife areas as a mitigation feature for loss of terrestrial habitat. Approximately 50 acres of this area will be associated with the diversion structure and the remainder will be one or more blocks of primarily forested land presently existing in the delta. This makes a total of 1,766 acres of land easements or fee simple required for the multiple-purpose ditches.

Features included in channel design for replacement of upland habitat damaged by the project are as follows:

1. Establish and maintain planting for wildlife on the 30 feet wide inside-spoil-slope on each side of ditch No. 3 and the floodway. Grazing will not be permitted inside the crown of the spoil bank slopes. Planting plans for these areas will be developed in cooperation with the Missouri Department of Conservation.

   A special clause in the easements which would prevent grazing of inside slopes or berms along ditch No. 3 and the floodway will be required.

2. Require a special easement clause that would preserve present habitat 30 feet wide along one side of all other multiple-purpose flood control drainage ditches in Ripley County, Missouri, and Clay County, Arkansas. Construction will be from the opposite side, and a 12 feet wide grassed berm will be established for maintenance access. (See Typical Channel Cross Section - Figure 6.)

3. Mitigation of wildlife habitat for the multiple-purpose ditches in Butler County, except ditch No. 3, will be a trade-off for 50 acres of delta land to be acquired by fee title, and 50 acres under a long-term easement. The 50 acres acquired by fee title, except for the portion used for construction of the diversion structure

and a public recreation access to the Little Black River, will be used for wildlife management by Butler County Drainage District No. 10 under an agreement with the Missouri Department of Conservation. The 50 acres under long-term easement will likewise be used for wildlife management under an agreement with the Missouri Department of Conservation. This area will be identified prior to construction of the Butler County ditches.

4. As an additional mitigation measure, the river loop cutoff in Clay County, Arkansas, will be preserved by acquiring six acres of land and the installation of a water control structure at each end of the loop. The area within the loop will be allowed to develop as wildlife habitat. This will be managed and maintained by the Western Clay Drainage District in accordance with the recommendations of the Arkansas Game and Fish Commission.

Levees

Approximately 1.0 mile of levee is planned. A levee is planned immediately upstream from the diversion structure to prevent high river flows from breaking across to the east. This levee amounts to raising approximately 0.30 mile of existing road to an elevation of 312.0. The levee will have a corrugated metal culvert pipe, approximately 18 inches, installed through the fill to drain low areas from the east through an old scour channel. Approximately 0.20 mile of levee is planned above the town of Harviell, adjacent to Cane Creek. The planned levee will be earth fill, approximately 8 feet high, between the railroad fill and the foothills, to keep the Cane Creek overflow out of the Little Black Watershed.

Approximately 0.40 mile of levee is planned across washed out areas along the Little Black River in sections 25, 35 and 36, T23N, R4E. There are approximately three of these areas where the river has scoured a channel and washed across cropland fields during high flows. These levees will be low height fills with the top of the levee built approximately 2 feet above the natural river bank. One of these levees which will be at Gaines Slough in the NW 1/4, Sec. 36, and will have a pipe of approximately 25 c.f.s. capacity installed to maintain flow in the Gaines Slough scour channel.

The levee previously mentioned under fishery mitigation is planned with a 100 c.f.s. capacity pipe at the break in the river bank in Sec. 24, T22N, R3E. This will be a low height earth fill structure to prevent the overflow of the Little Black River through a scour channel connected with Ditch No. 2. The fill height will be slightly higher than the existing river bank and approximately 400 feet long. When flood flow occurs in the Little Black River, excess water will flow around this structure.

Public Recreation

The river loop cutoff at the diversion structure in Missouri will be developed as a public access area. A recreation water control structure consisting of a concrete pipe (approximately 16 inches in diameter) will be installed through the dike at the upper end to maintain water for recreation. All facilities in which cost sharing is involved will be designed and constructed to assure accessibility and usability by physically handicapped people in accordance with PL-90-480.

A public recreation access area will be developed at the junction of the Little Black River and the floodway diversion. Access to the Little Black River will be provided both above and below the diversion structure (see Figure 2). Measures to be installed include access roads, parking lots, and toilets. Sanitary facilities will meet state and local health standards. The development of the access area is compatible with the statewide outdoor recreation plan, and approximately 50 acres are included in the area. Of the 50 acres associated with the diversion structure, 45 acres will be purchased for recreation purposes and 5 acres for wildlife management area. On the 45 acre area, 14 acres will be used for construction of the diversion structure, floodway and dikes, and 2 acres will be used for recreation facilities. The balance of this area will be allowed to develop as a mitigation area. In addition to this, 5 acres in the vicinity of the structure and floodway area will be available for planting and wildlife as a mitigation feature. Necessary erosion control measures, including limited land shaping with grass and tree plantings, will be installed. The 50 acre area will be acquired by Butler County Drainage District No. 10. An access road will be constructed across the riprap section near the diversion structure to serve farmlands, the public access area located between the new channel and Little Black River and the 5-acre wildlife management area.

Environmental Considerations

Construction operations will be performed in a manner that will provide the greatest protection to environmental values. This will include minimizing water pollution and protecting fish and wildlife habitat, forest resources, and the natural beauty of the area. Weather conditions will normally permit construction to proceed without a winter shutdown. This will allow a more rapid completion of the construction and a more timely seeding of the disturbed areas. A construction operation plan for minimizing the effects of construction on the environment will be a part of each contract.

Some items that will receive careful attention in planning and constructing are: (1) Size and duration of exposure of denuded areas

will be minimized. (2) Runoff from the construction site will be controlled to prevent erosion. (3) Where needed, sediment traps and debris basins will be installed. (4) Temporary bridges or culverts will be used where fording stream is objectionable. (5) Diversion above all cut slopes will be required to prevent concentration of runoff across the exposed areas. (6) The embankment surface will be maintained in a manner that will minimize stream pollution should the embankment overtop. (7) Soil will be protected by use of vegetation. (8) Segments of work will be completed and protected as rapidly as possible consistent with construction schedules. (9) Ditches are to be constructed in a manner that will not cause significant aggradation or degradation of the channel bed or erosion of the channel bank. (10) Ditch banks will be protected during construction by making a temporary seeding at the end of each day of construction. (11) Ditch No. 3 will be constructed and appropriate protection applied before permitting the diversion of outside water from Little Black. (12) The drop structures on ditch No. 3 will be installed in advance of, or concurrently with, the ditch excavation. (13) Each reach of ditch will be completed prior to initiating work on subsequent reaches. (14) Side inlet structures and vegetative measures will be applied as excavation progresses. (15) On all ditches except ditch No. 3, the excavation will be limited to one side only. (16) Dust will be kept within tolerable limits. (17) Burning will comply with regulations of Missouri and Arkansas.

Archeological, Historic and Scientific

The Arkansas Archeological Survey has provided some information and the Missouri Archeological Survey is cooperating closely to help define the location and importance of prehistoric remains in areas to be disturbed by construction. Project measures will not affect those properties listed in the National Register of Historic Places. The consulting agencies state that the project measures can be installed without damaging archeological values. The only archeological site identified in proposed construction areas will be protected as discussed on page of this plan. Remains discovered during construction will be reported to the responsible state agency. It is anticipated that through the cooperation existing between local groups and the concerned state and federal agencies, significant archeological remains can be protected. Information which may become available during construction could also add to the prehistoric knowledge of the area.

EXPLANATION OF INSTALLATION COSTS

The total cost of installing land treatment measures is $2,793,600 as shown in Table 1. This includes $702,700 for technical assistance, $4,300 for fire suppression equipment and $2,086,600 for application of individual measures. A total of $440,400 of PL-566 funds will be used for accelerated treatment assistance; $406,000 of this will be provided by the Soil Conservation Service, and $34,400 will be provided by the Forest Service. Technical assistance for the on-going program is estimated to cost $262,300, of which $224,000 will be provided by the Soil Conservation Service under the PL-46 program. The estimated cost of technical assistance for installing forestry measures under the going program is $38,300. The $38,300 consists of $6,500 from the Missouri Department of Conservation, Division of Forestry; and $31,800 from the Forest Service under the going cooperative forest management program. The proportional project share in the cost of additional fire suppression equipment will be provided by PL-566 in the amount of $2,500 and $1,800 by the Missouri Department of Conservation, Division of Forestry.

Costs of installation of the forest land treatment measures are based on current costs of supervision, labor, equipment and materials needed to install the planned measures. Costs of technical assistance for the installation of the forest land treatment measures on private land are based on actual expenditures and accomplishments by the Missouri Department of Conservation. An analysis of the costs against the accomplishments was made of each measure to determine unit costs for technical assistance. Fire suppression equipment costs are also based on current costs of standard equipment. Costs of this equipment are prorated between the Upper and the Lower Little Black Watershed Work Plans.

The total estimated cost of establishing structural measures is $12,220,807, of which $1,607,809 will be borne by local funds and $10,612,998 by PL-566 funds. Public Law 566 funds include $8,275,713 for construction, $871,557 for engineering services, $23,625 for relocation costs and $1,442,103 for project administration. Local costs include $654,352 for construction, $1,500 for engineering services on recreational facilities, $880,982 for land rights, $8,475 for relocation costs and $62,500 for project administration.

Construction costs include the contract cost for constructing the floodwater retarding structures; floodway channel, diversion structure; recreation water control structures; floodway channel drop structure; multiple-purpose channel modification, including the drop structures and appurtenances; the levees, and the recreational developments in this plan. Construction costs were based on current contract costs plus a 12 percent contingency. A special 10 percent contingency was added to the construction cost of multiple-purpose channels other than ditch No. 3 to cover additional costs of establishing bank stability. All construction costs for the floodwater retarding structures; the floodway channel, including the diversion structure and drop

structure; and the levees will be borne by PL-566 funds. Construction costs for the recreation water control structures will be shared 50 percent by PL-566 and 50 percent by local funds. Construction cost for the multiple-purpose channel modification and drop structures will be shared 89.4 percent by PL-566 and 10.6 percent by local funds.

Construction costs include $5,000 for modifying or reconstructing existing railroad and public bridge piers and abutments necessitated by channel enlargement. Construction costs also include $402,300 for treating dispersed soils.

The construction costs of multiple-purpose channels were allocated to flood prevention and drainage according to the second method described in paragraph 103.0221 of the Watershed Protection Handbook. This method is based on a relationship of wet and nonwetland in the drainage area of the channel. The portion of the cost of the channel modification is allocated to flood prevention which is equal to the ratio of the area of nonwetland to the uncontrolled drainage area of the channel. The remainder of the cost is allocated equally to flood prevention and drainage.

Three of the five drop structures will be located at existing bridges. A new bridge is planned at the drop structure to be located on the State line and will be built at local cost.

Engineering services include the cost of engineers and technicians for surveys, investigations, and design and preparation of plans and specifications for the structural measures. All engineering costs will be borne by PL-566 funds, except $1,500 for engineering services on recreational facilities which will be borne by local funds. In the event the local sponsors do not have an engineering staff to develop plans and specifications for recreation facilities, engineering and architectural services should be secured from other sources if possible. Such engineering and architectural services eligible for PL-566 cost sharing will not exceed 50 percent of the total engineering services cost for facilities.

The total estimated cost for relocation payments at structure F-11 and the floodway channel, including diversion structure and drop structure, is $32,100. This cost will be shared, based on the ratio of PL-566 funds and other funds minus relocation payments, to the total project installation costs. The relocation costs will be shared 73.6 percent, or $23,625 by PL-566 funds, and 26.4 percent, or $8,475 by other funds.

The estimated land rights costs are $880,982. Included in the land rights cost is $28,600 for mitigation land; $22,500 for river access area; $8,810 for legal fees and appraisals, etc.; $14,500 for moving buildings and utility easements, and $267,852 for bridges across structures and the deck portion of all bridges to be modified. All land rights costs will be borne by the local sponsors.

Project administration costs include the cost of inspection service during construction and other Soil Conservation Service administration costs incurred with the installation of this plan. These costs will be borne by PL-566 funds. Contract administration and other costs required by state drainage district statutes are administration costs that will be borne by local funds. Relocation assistance advisory services are likewise a project administration cost which will be borne by local funds without PL-566 cost sharing.

In addition to the specific services defined as relocation assistance advisory services, the sponsors and the Soil Conservation Service will be involved in administrative functions associated with making relocation payments. These are also included in project administration costs. The drainage districts and the Little Black Watershed Subdistrict will provide, without PL-566 cost sharing, the costs they incur in serving notices of displacement, providing appropriate application forms, assisting in filing applications, hearing and resolving grievances, and making relocation payments. The Soil Conservation Service will bear the costs it incurs and will assist the subdistrict in providing these services.

The estimated schedule of obligations for the 12-year installation period covering installation of both land treatment and structural measures is as follows:

SCHEDULE OF OBLIGATIONS

Lower Little Black Watershed, Missouri

(Dollars)

Year	Measures	PL-566 Funds	Other Funds	Total
1	Land Treatment	37,000	145,000	182,000
	Structural Measures	124,100	73,400	197,500
2	Land Treatment	37,000	210,000	247,000
	Structural Measures	1,223,700	124,900	1,348,600
3	Land Treatment	37,000	210,000	247,000
	Structural Measures	537,300	148,700	686,000
4	Land Treatment	37,000	210,000	247,000
	Structural Measures	1,097,500	184,400	1,281,900
5	Land Treatment	37,000	220,000	257,000
	Structural Measures	1,321,600	164,000	1,485,600
6	Land Treatment	37,000	220,000	257,000
	Structural Measures	563,500	162,600	726,100
7	Land Treatment	37,000	220,000	257,000
	Structural Measures	1,063,400	156,700	1,220,100
8	Land Treatment	37,000	210,000	247,000
	Structural Measures	813,500	180,500	994,000
9	Land Treatment	37,000	210,000	247,000
	Structural Measures	1,042,000	154,000	1,196,000
10	Land Treatment	37,000	210,000	247,000
	Structural Measures	911,800	109,600	1,021,400
11	Land Treatment	37,000	145,000	182,000
	Structural Measures	999,500	56,600	1,056,100
12	Land Treatment	35,900	140,700	176,600
	Structural Measures	915,098	92,409	1,007,507
Total Land Treatment		442,900	2,350,700	2,793,600
Total Structural Measures		10,612,998	1,607,809	12,220,807
GRAND TOTAL		11,055,898	3,958,509	15,014,407

EFFECTS OF WORKS OF IMPROVEMENT

The combined effects of the Upper and Lower Little Black Watershed Projects will have a major impact on this rural area. Damage from flooding will be significantly reduced. The planned improvements will increase farm profits, provide agricultural and nonagricultural jobs, stabilize incomes, and improve living conditions in the watershed. These effects, along with other beneficial and adverse effects, are discussed in this section.

Flood Prevention, Erosion and Sediment

Land treatment on cropland will reduce the rate of runoff, erosion and sedimentation. In the delta area, drainage practices will improve agricultural efficiency. Where this reduces the seasonally inundated basins and flats, there will be a loss of habitat for waterfowl during spring and fall migration. In both areas land treatment will conserve the soil and aid in maintaining optimum moisture conditions. Cropland treatment which is concentrated in the upland flood plain and delta will result in less flooding of fields and improve field drainage. Acres of cropland to be adequately treated during the project period are 30,500.

Land treatment measures on pastureland will increase livestock forage production and create a better balance between needed and used livestock forage. This will make livestock operations more stable, thus having a beneficial economic impact on rural land residents engaged in livestock farming. These measures will result in a decrease of competing woody vegetation and weeds which will reduce the value of the area for production of wildlife food and cover plants. Installation of ponds will provide more water for livestock, wildlife and fish habitat. Water quality will be improved by the reduction of sediment. Pastureland to be adequately treated during the project period is 10,000 acres.

The forest land treatment program will develop a protective and absorbent cover of litter and humus to reduce runoff erosion, as well as improve other hydrologic conditions. Proper management and added fire protection will increase the productivity of forest land. Forest land to be adequately treated during the project period is 23,120 acres.

Land treatment expected to be completed during the project installation period will reduce watershed sheet erosion on the upland as follows:

Upland Land Use	Without Project	With Project
	tons/acre/year	tons/acre/year
Cropland	7.2	4.0
Idle Land	4.0	a/
Pastureland	3.0	3.0
Forest Land	4.2	3.0
Other	4.0	4.0
Average Sheet Erosion	4.3	3.1

a/ This land use is expected to change to pastureland or forest land.

The Lower Little Black Watershed Project is closely related to the Upper Little Black Watershed Project. Measures identified in both projects must be installed to achieve the effects described in this plan. Dams in the Upper and Lower Little Black Projects will control 72 percent of the total upland area, or 52 percent of the combined watershed areas.

The combined projects of Upper and Lower Little Black Projects will have a major effect on the flood plain of this watershed. Flood peaks, area inundated and duration of flooding will be reduced substantially after installation of the projects. The combined projects consisting of structures and channel will provide approximately a 2-year level of protection in the vicinity of the improved channel. Low frequency flooding will continue along the Little Black River in reaches VI, VIII, and IX because of the present restriction in the river channel. The area benefited, the percent reduction in damages, and the average degree of protection that will be obtained from the combined Upper and Lower Little Black Projects from land treatment, floodwater retarding structures, and channel work are listed as follows:

Reach	Area Benefited Acres	Percent Reduction in Damages	Average Degree of Protection Recurrence Interval (Yr.)
VIa (upland)	158	21	Less than 1
VI	16,479	90	3
VII (upland)	1,465	85	3
VIII	7,151	83	2
IX	1,800	88	3
X	5,490	75	2
TOTAL a/	32,543	84	

a/ Fifty-two percent of the combined Upper and Lower Little Black Watersheds will be controlled by structures.

Peak flows and depth of flow will be reduced at the lower end of reaches VII and VIII by the project as follows:

Reach	Recurrence Interval	Reduction In Peak Discharges (percent)	Reduction In Stage (feet)
VII	100-year	78	3.9
	5-year	70	2.2
	2-year	64	1.9
VIII	100-year	25	3.5
	5-year	18	5.9
	2-year	13	4.8

Area flooded will be reduced as follows:

Recurrence Interval	Reduction in Area Flooded	
	Without Project (acres)	With Project (acres)
100-year	32,543	24,107
5-year	25,674	7,367
2-year	18,224	760

The effects of the Upper and Lower Little Black Watershed Projects at four locations are illustrated on the following page. The peak flows for present conditions without project and future conditions with project are shown for 2-year, 5-year, 25-year and 100-year storms based upon a 24-hour storm analysis. The combined capacity of Little Black River and Ditches 1, 2 and 3 are also shown for two locations.

The effects on damages resulting from floodwater originating from outside the watershed will be as follows: (1) Flood damages in reaches VIII, IX and X caused by floods overflowing from the Current River will not be reduced by installation of the Upper and Lower Little Black Projects and (2) The levee at Harviell will substantially eliminate overland flooding in this watershed by Cane Creek.

Flood plain area flooded by a storm similar to the 1961 flood would be reduced from 18,244 to 760 acres with installation of the projects, a reduction of 96 percent. The combined projects will reduce flooding from 31,000 to 20,000 acres for a storm similar to that of March 1964. The 100-year peak discharge at the outlet end of the watershed will be reduced by 28 percent, and the 2-year peak discharge will be reduced 13 percent.

The installation of lateral multiple-purpose channels will result in a reduction in floodwater damages and provide agricultural drainage for land in the remaining portion of the delta area. The construction of these channels will make it possible for landowners to install improved land treatment practices.

Flood plain use with the project installed will be limited primarily to agriculture. The 2-year level of protection planned in Ditch No. 3 for flood flows and the design capacity of the multiple-purpose ditches will not provide adequate protection for specialty crops or urban use. Farmsteads and other permanent improvements should not be installed in previously flooded areas as major storms will still inundate these areas with the projects installed.

Flood plain lands are used, and will continue to be used, for production of corn, soybeans, rice, cotton, wheat and hay. Double cropping of wheat and soybeans is expected to increase with installation of the projects. Crop yields will increase as a result of reduction of floodwater.

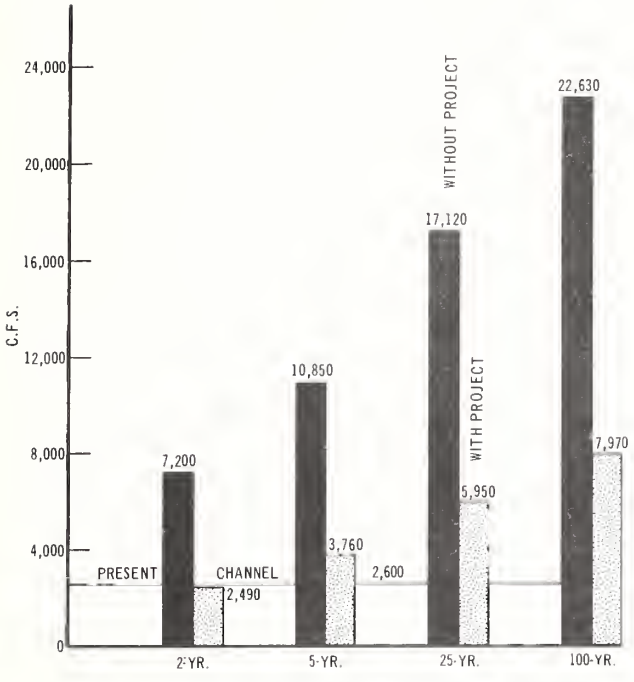
More intensive land use and drainage benefits result from reduced production costs, improved crop quality and increased yields. Timeliness of field work will permit the selection of higher yielding crop varieties and a more efficient weed control program.

Restoration of former productivity or changed land use is not expected to occur in the bottom land area since 89 percent is presently used for production of crops and pasture. Benefits derived from increased production of surplus crops on new lands were not used for economic justification of the project.

In addition to the effects in this watershed, the Upper and Lower Little Black Projects will also reduce flood losses downstream. The Comprehensive Basin Study on the White River Basin, Arkansas and Missouri, was published by the White River Coordination Committee in June 1968. This study identifies reduction in damages accruing to the Little Black Projects. These benefits consist of reductions in damages to crops and pasture, fences, roads, bridges, livestock, farm buildings, and indirect losses. They will accrue in the Black Rock, Lockheart Ferry, Newport, Augusta, and Success reaches included in the White River Study.

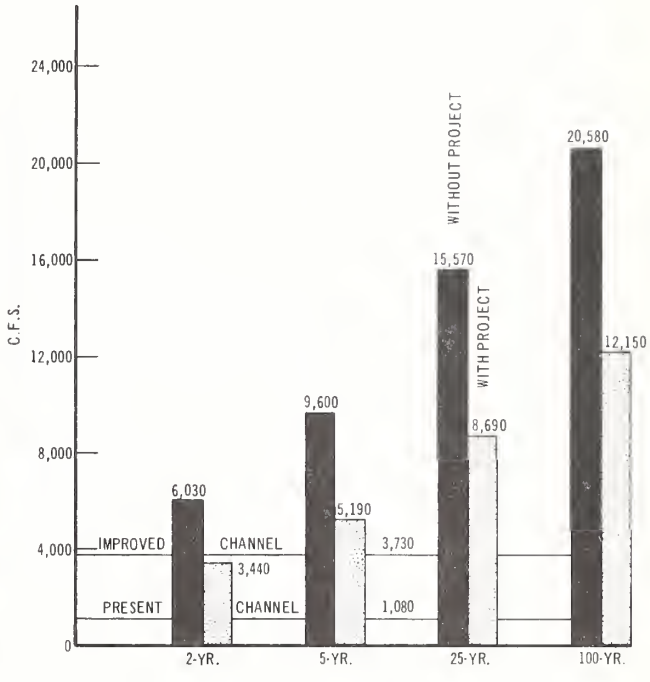
Construction of the five planned floodwater retarding structures will require 370 acres for dams, emergency spillways and sediment pools. Present land use is 307 acres of forest land, 55 acres of cropland, and 8 acres of pastureland. Four miles of perennial stream channel and 1 mile of intermittent channel will be permanently inundated by sediment pools. Pool sizes range from 21 to 94 acres, averaging 63 acres. The structures are all more than 1 mile apart.

THE PEAK FLOWS FOR PRESENT CONDITIONS (WITHOUT PROJECT) AND FUTURE CONDITIONS (WITH PROJECT) ARE SHOWN FOR 2-YEAR, 5-YEAR, 25-YEAR, AND 100-YEAR STORMS BASED ON A 24-HOUR STORM ANALYSIS. TWO LOCATIONS - CROSS SECTIONS 46 AND 78 - ARE FOR LITTLE BLACK RIVER ALONE, AND TWO - 52 AND 72 - INCLUDE LITTLE BLACK RIVER AND DITCHES 1, 2, AND 3.



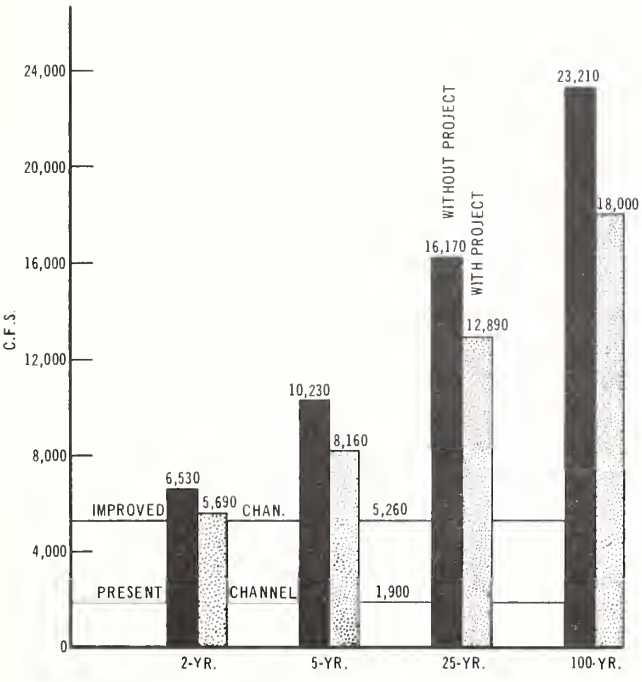
CROSS SECTION NO. 46 - BALL MILL BRIDGE

LOCATION IS APPROXIMATELY 2 MILES BELOW HIGHWAY 160.



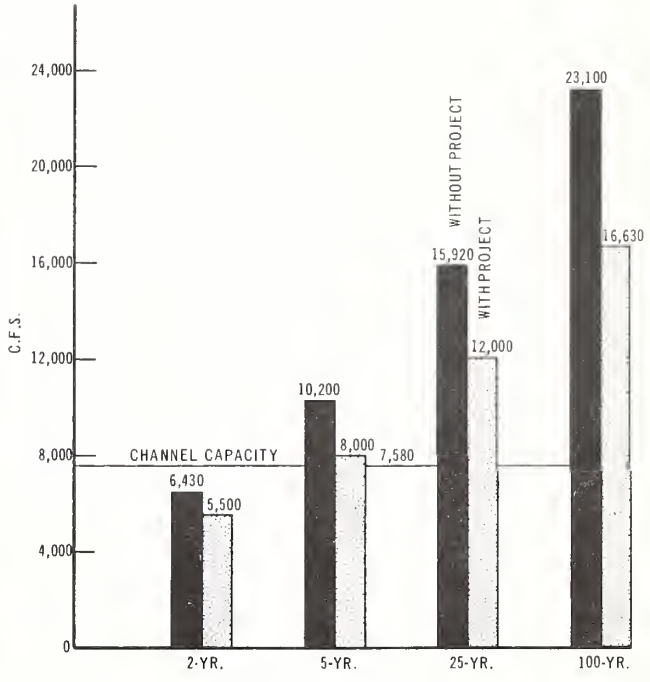
CROSS SECTION NO. 52

NEAR NAYLOR. INCLUDES LITTLE BLACK RIVER APPROXIMATELY 3/4 MILES BELOW HIGHWAY 142 BRIDGE; DITCH NO. 2, 1/4 MILE WEST OF HIGHWAY 142 NORTH OF NAYLOR; DITCH NO. 1, 1/2 MILE NORTH OF HIGHWAY 142, AND DITCH NO. 3, 1/4 MILE NDRTH OF HIGHWAY 142.



CROSS SECTION NO. 72 AT STATE LINE

INCLUDES LITTLE BLACK RIVER, DITCHES 1, 2, AND 3 NEAR STATE LINE.



CROSS SECTION NO. 78

TWO MILES SOUTHWEST OF SUCCESS, ARKANSAS. LITTLE BLACK RIVER CHANNEL ONLY AT CONFLUENCE OF LITTLE BLACK RIVER AND BLACK CREEK APPROXIMATELY 2 MILES ABOVE CONFLUENCE OF LITTLE BLACK RIVER WITH CURRENT RIVER.

FIGURE 8

USDA SCS-LINCOLN, NEBR 1974

Construction of the floodway will involve 46 acres of land. Present land use of the area is 27 acres of forest land and 19 acres of cropland. After project installation, all of the forest land and 6 acres of cropland will be lost. Thirteen acres of cropland and 33 acres of channel will remain after construction. The 33 acres of channel will be seeded to grass and legume and will provide wildlife habitat as well as serving as a floodway.

Proposed modification of multiple-purpose ditches will involve 1,666 acres in channels, spoil banks, and adjoining land. Land use of this area is 555 acres cropland, 866 acres forest land, and 241 acres in channels-- 130 acres of which is water. After project installation, land use of the 1,666 acres will be 356 acres cropland, 718 acres pastureland, 323 acres of forest land, and 269 acres channels--260 acres of which will be water.

Construction of ditch No. 3 will involve approximately 720 acres of land now in channel, old spoil banks, and adjoining land in Butler, Ripley, and Clay Counties. Present land use of this area is approximately 314 acres cropland, 368 acres forest, and 38 acres channel. Thirty-two acres of this is water. After project installation, land use of the ditch No. 3 area is expected to be 280 acres cropland, 157 acres pastureland, 100 acres forest land (woody shrubs planted for wildlife cover), and 183 acres channel. The water area will be 175 acres.

The remaining 810 acres not involved with ditch No. 3 occurs on the rest of the manmade ditches of the project. The following tabulation shows a breakdown of the remaining ditches for each county under present conditions and with project installed.

Land Use	Butler County		Ripley County		Clay County		Totals	
	Present	After Proj.	Present	After Proj.	Present	After Proj.	Pres.	After
Cropland	89	--	60	--	20	--	169	--
Pastureland	---	279	--	228	--	54	--	561
Forest Land	210	100	212	91	42	17	464	208
Ditch Channel[a/]	90	10	76	29	11	2	177	41
TOTAL	389	389	348	348	73	73	810	810

a/ Ditch channel after project includes only the channel bottom. The ditch channel under present conditions included a wider area than just channel bottom.

THIS PICTURE SHOWS THE CONDITION OF THE DRAINAGE DITCHES WHICH SERVE AS OUTLETS FOR LATERAL DITCHES AND ON-FARM DITCHES. RENOVATING OF THESE DITCHES BY THE PROJECT WILL IMPROVE DRAINAGE AND REDUCE FLOODING. CONSTRUCTION WILL BE FROM ONE SIDE TO PRESERVE TREES AND BRUSHY COVER ON THE OPPOSITE BANK FOR WILDLIFE HABITAT.

IMPROVED DRAINAGE AND REDUCED FLOODING WILL IMPROVE THE RELIABILITY OF CROPS AT LESS COST, SUCH AS THE CROP SHOWN ABOVE.

Photo credit: Daily American Republic
Poplar Bluff Printing Co. Inc., Poplar Bluff, Mo.

LITTLE BLACK RIVER. BUTLER-RIPLEY COUNTY LINE. SEC. 35 & 36, T-23-N, R-4-E.

NOTE IRREGULAR COURSE OF THE RIVER WITH TREES AND BRUSH ALONG THE BANKS; ALSO NOTE THE BREAK IN THE RIVER BANK WITH RESULTING SCOUR CHANNEL CAUSED BY FLOOD FLOWS. THIS BREAK IS KNOWN LOCALLY AS GAINES SLOUGH. THE PROJECT WILL CLOSE THIS BREAK WITH A LEVEE AND PIPE TO CONTROL FLOW THROUGH THIS SCOUR CHANNEL. A BY-PASS FLOODWAY IS PLANNED FOR FLOOD FLOWS TO REDUCE FLOODING WITHOUT MODIFYING THE LITTLE BLACK RIVER. THE FLOODWAY WILL HELP PRESERVE APPROXIMATELY 24 MILES OF LITTLE BLACK RIVER AND HABITAT ALONG THE BANKS.

LITTLE BLACK RIVER IN ARKANSAS BELOW JUNCTION OF STATE LINE DITCH. NOTE BRUSH AND SAND DEPOSITED DURING FLOOD FLOWS. THIS DAMAGE WILL BE SIGNIFICANTLY REDUCED BY FLOODWATER RETARDING STRUCTURES AND INLET STRUCTURES ASSOCIATED WITH DRAINAGE DITCHES.

The existing manmade ditches in Naylor Drainage District and Western Clay Drainage District, except ditch No. 3, will be constructed from one side to preserve existing wildlife habitat on the opposite side. This area, amounting to approximately 200 acres, is now mostly forest land. Its preservation will be assured by a special easement clause to preserve a 30-feet wide strip of existing vegetation along these ditches on the side opposite from the construction.

The ditches in Butler County, except for ditch No. 3, will be worked from one side. Existing vegetation on the opposite side will not be cleared for construction. In lieu of a special easement clause to preserve a 30-feet strip of existing vegetation on the opposite side, Butler County Drainage District No. 10 will acquire by fee simple title or by 100-year easement 100 acres of delta land which will be maintained for wildlife use. Approximately 50 acres will be at the diversion structure on Little Black River, and 50 acres will be located in the delta area.

In Arkansas, 1.4 miles of Little Black River channel enlargement and 1.3 miles of channel clearing and snagging measures will decrease fish and wildlife habitat conditions for several years. Stream bank vegetation, instream cover, and deeper holes will be removed. Revegetation of these channel banks will provide erosion protection and redevelop the removed stream bank vegetation.

Installation of land treatment measures and retarding structures will reduce the amount of sediment and other pollutants flowing into the Little Black River. Over a 100-year period, reservoirs in Lower Little Black are designed to trap 2,940 acre feet of sediment. These reservoirs control 56 percent of the upland area and will trap an estimated 95 percent of the sediment carried into them. The dams will trap an estimated 38,433 tons of sediment annually. Sedimentation of drainage and highway ditches will be reduced. Sediment discharged into the Current River orginating in this project area will be reduced from 76,048 to 38,370 tons, a reduction of 50 percent annually.

The dams planned in the Upper Little Black Watershed Project are designed to trap 7,780 acre feet of sediment. The combined sediment storage in both plans is 10,720 acre feet. The dams in both projects will trap an estimated 138,106 tons of sediment annually. Sediment from both Upper and Lower Little Black Watersheds will be reduced from 172,955 to 79,730 tons, a reduction of 54 percent.

Flood plain scour in this watershed will be reduced by 86 percent on 1,474 acres along the upland streams and 2,940 acres in the delta. Ten percent of these affected areas will be reclaimed. Average annual sediment damage (overbank deposition) will be reduced 88 percent. The hazard caused by sediment pollution of floodwaters will be reduced by the trapping effect of the floodwater retarding reservoirs.

The inlet structures planned along the multiple-purpose ditches will control degrading of field drains and waterways entering into these channels. Installation of the structures will also prevent much of the surface scouring occurring around the entrances of the field drains.

The reduction of the sediment in the drainage ditches will reduce ditch maintenance costs and improve the water quality. Improvement in water quality will be primarily from the reduction of suspended sediment. Other pollutants of the stream will be reduced in approximately the proportion that they are associated with the sediment fraction. Because no major pollution problems presently exist, little effect is anticipated on existing or possible pollutants. The relatively high phosphate concentrations found may become more associated with trapped sediment and thus be reduced, but this is not expected to substantially reduce phosphate concentrations below structures. Installation of basins at the field side of the inlet structure will supplement the structures in trapping additional sediment by slowing the velocity of the water through the excavated basins.

Installation of the project will reduce damages on approximately 60,817 acres of bottom land. This includes 1,623 acres on upland tributaries, 30,920 acres of delta land subject to overflow from upland and delta runoff, and 28,274 acres of delta land which have an excess water problem. For benefit evaluation purposes, 16 percent (4,524 acres) of the latter area was excluded to reflect the small ridges of sandy soil groups interspersed throughout the area.

During and immediately following construction of flood retarding structures and multiple-purpose channels, a hazard of increased erosion and sediment production will exist. The reduction of crop and pasture flood damage will be 86 percent. Fence damage, debris cleanup, and loss of farm equipment and livestock will be reduced 90 percent. Nonagricultural damages will be reduced 88 percent. This reduction of damages is primarily to highways and bridges.

Agricultural Water Management

The combined program of land treatment and structural measures will afford benefits on 59,194 acres of land with an excess water problem which includes approximately 300 operating units. This includes 30,920 acres identified as having flood reduction benefits. For benefit evaluation purposes, approximately 4,524 acres of the remaining 28,274 acres were excluded to reflect the small ridges of sandy soil groups. The multiple-purpose channels will provide improved outlets for lateral and field ditches associated with farm drainage systems. Landowners and operators can construct and maintain measures for land treatment with the assurance that excess water will flow off their land. The land treatment measures will be more effective and result in an increase in net farm income.

Inputs of capital, labor, and management can be more intensively utilized when drainage is improved. More profitable cropping patterns can also be used. Crops; such as alfalfa which requires well-drained land, can be included in the cropping system. Production costs will decrease through less frequent replanting, fewer trips over the land in seed bed preparation, less expense in weed and grass control, and use of fewer chemicals.

Fish - Wildlife - Recreation

Approximately 24 miles of Little Black River is within the project area. Alteration planned includes a floodway diversion structure at the beginning of the delta area in Missouri and channel work in Arkansas consisting of enlargement on 1.4 miles along the present alignment and clearing and snagging on approximately 1.3 miles. The floodway diversion channel will not affect the stream channel except in the immediate area of construction. Changes caused by the 1.4 miles of enlargement and 1.3 miles of clearing and snagging will remove streambank cover, instream cover, and holes along this part of the stream. Streambank cover will be replaced. Reduced peak storm flows, reduced sediment loads, and prolonged stream flow will be the major effects on stream system of the project area.

The floodway diversion structure and associated levees along the Little Black River will preserve the normal stream flow and natural, scenic, and fishery conditions along 24 miles of natural stream. Without the project, continued breakout of the river during flood stage could in time change the location of the Little Black River from its present course and create a new flow regime down Ditch No. 3. The social and geologic adjustments necessitated by this occurrence will be avoided by installation of the project. The preservation of habitat along drainage ditches by project action will also prevent the clearing of these areas by individuals as is the general trend throughout the delta area.

Twenty-five miles of perennial flow are identified in the tributaries of Logan, Cypress, and Harris Creeks. Four miles of the upper stream in the tributaries will be inundated with floodwater retarding structures. The proposed reservoir structures will change the status of the Little Black River and its tributaries--Harris, Logan and Cypress Creeks, from a "free flowing" stream to a partially controlled stream. 4/ Flows will become less sporadic and of longer duration, providing a more stable stream environment for all aquatic organisms. These stable conditions may influence stream ecology in several complex ways. Species unable to tolerate sporadic flows and occasional droughts may increase in numbers as suggested by Paloumpis. 33/

If spawning seasons of these species overlay with those of species currently dominating the ecosystem (e.g., smallmouth bass and rockbass), increased interspecific competition for food may result among the

young immediately following dispersal from the nest. Pflieger suggests that this may be a potential factor in the mortality of smallmouth bass fry. 34/ Under these conditions natural recruitment of smallmouth bass could be reduced.

Approximately 80 miles of manmade drainage ditches in the delta area containing 89 acres of water will be altered. Channel work will affect 2.1 miles of perennial flow and 35 miles of intermittent flow channel. Sixty-two acres of existing water areas in 29 miles of channel will be removed. Streambank vegetation will be removed from both sides of the channel for 15 miles and from one side of the channel for 65 miles.

Twenty-seven acres of water in scour or slough channels will be preserved in its present condition. These scour areas currently receive heavy fishing pressure and should continue to provide good fishing habitat. In 9.5 miles of ditch No. 3, 175 acres of water will be impounded as a result of the project. The 2-feet deep, 1,000-feet holes excavated in ditch No. 1 and No. 2 will provide 10 miles of alternating pool-shoal areas in these ditches. The lower part of ditch No. 2 and all of ditch No. 3 will receive water flow from Little Black River by the conduits installed in the blocking levees at the river breaks. Fishery losses in the ditches will be primarily attributed to destruction of habitat. Instream cover and snags removed from the ditches will not be replaced, and ditches will not be allowed to return completely to their present state. Carrying capacity in pounds per surface-acre of water will thus be lessened. The primary impact on fisheries will occur in the first several years following channel construction and decrease as limited fishery cover develops, provided by holes and allowed regrowth of some aquatic vegetation.

The loop of the Little Black channel in Arkansas cut off by construction will be preserved. Pipe culverts at each end will maintain existing water levels. The installation of the pipe culverts and preservation of the loop area of approximately 6 acres will help offset the losses of fish and wildlife caused by construction of the Arkansas channel.

Protection of the soil resource is a long-term necessity for all life systems in the watershed. Control of accelerated soil erosion will protect this basic resource. Sediment effects on fish in the Little Black River are not a major limitation. Favorable populations exist in spite of the accelerated sediment load. Nevertheless, visual evidence of sediment turbidity is present after large flows and at the confluence of drainage ditches with Little Black River and the Little Black with the Current River. A considerable improvement in water quality and, therefore, conditions for many fish species will result with the sediment reduction. Water quality improvement by reduced sediment turbidity is expected in the drainage ditches of

the delta. Where water quantity and cover conditions are preserved and restored, fish conditions will improve.

The release ports on structure F-11 will discharge 0.4 c.f.s. In addition, appurtenances of all structures with watersheds larger than 3.0 square miles will be installed with a bottom-water discharge principal spillway. They will help insure that outflow water from these structures does not increase stream temperatures of the Little Black River, and will replace evaporating losses. These outlets will be designed to function similarly to those described by Dillon, et al. 35/ In this way, reservoirs on all major intermittently flowing streams (i.e., those flowing in excess of 6 months out of the year) will not contribute warm surface water to the Little Black River. The above design features should prevent abnormal stream temperature rises and low flows on the Upper Little Black River.

Numbers of plankton organisms in the upper watershed are expected to increase considerably due to the water impoundments, resulting in overall increased aquatic productivity. The greatly increased volume of water will also produce much larger standing crops of fishes in the impoundments than are now found in the streams. However, the species composition of the fishery will change, and the productive level considered optimum for fish production in Missouri will not be reached due to the large watershed ratios involved. 34/

Species composition of benthic populations within impoundments are expected to change. Those typically found on depositing substrata will predominate. 36/ Total numbers of benthic organisms are also expected to increase, which will result in an increase of fish food production.

Reservoirs and standing waters will collect phosphates from influent streams and store a portion of these in consolidated sediments. Algal blooms and aquatic plant problems may occur in the impoundments in response to the relatively high phosphate levels.

The impact of the proposed project will be of more consequence to terrestrial species in the delta than to those in the uplands. The most severe damage will result from a significant loss of terrestrial habitat along the ditch banks. Approximately 543 acres of forest land will be lost in the modification of multiple-purpose channels. This is a loss of over 60 percent of the ditch bank vegetation in the construction areas. The preservation of 306 acres of existing forest land will not replace habitat losses associated with the project. Revegetated areas could, over the life of the project, regain their full productivity if properly managed and allowed to revegetate with some large woody species. No nationally endangered wildlife are expected to be affected by this project.

The rebuilt manmade ditches will be greatly changed in appearance; the scenic value afforded by the bottom land hardwoods and brushy growth

that has grown up along the ditch banks will be greatly reduced, particularly along ditch No. 3, where both sides will be cleared. The waterways will be more accessible to the public, however, and with revegetation may eventually regain some aesthetic value. However, short-term effects will be a reduction of aesthetic values.

The sediment pools of five floodwater retarding structures will provide opportunities for developing fisheries and acquatic wildlife areas. The pools will create 315 acres of water, ranging in size from 21 to 94 acres. Depth will average 7.7 feet, ranging from the 4.5 average in site E-6 to the 9.8 average in site F-11. Water fluctuation in flood pools and the water exchange will lower carrying conditions and management options of the fishery resource. Maintaining balanced populations of desirable fish species will be the major management problem. The pool areas will function as sediment storage through the life of the project. This water resource will, therefore, not be available for the entire 100-year life of the project. If public access is provided later around these sites, the sponsors will require landowners to provide facilities meeting the minimum state and local health requirements. Shallow water areas will be created by 51 acres of the sediment pools which will be less than 2 feet deep. Surrounding this shallow water area will be approximately 13 miles of shoreline. This aquatic "edge" will increase the various species associated with this environs. Creation of the above sediment pools will increase the availability of water resources to area residents. Management and utilization of sediment pool resources will be under the control of involved landowners.

Land use changes in the past have resulted in clearing of 89 percent of the delta area for cropland and pasture. These changes to more intensive agriculture in the delta lowlands have decreased the habitat for many species. Unless this trend is changed, or critical habitat areas are preserved, little improvement can be assured for many of the affected species.

Land treatment within the foothill area is expected to have an effect on the existing habitat conditions. Improved pastures are expected to increase, and land use changes of cropland to permanent pasture can be expected. A combination of "old field" vegetation, low grade pastures, and marginal cropping attempts, have created the present habitat conditions. The present status is temporary with or without the project. Well-planned wildlife considerations while developing forage and woodland potentials can lessen adverse wildlife effects.

Application of planned treatment measures in the 52,865 acres of forest land is expected to benefit most native wildlife. Livestock overgrazing presently affects wildlife carrying capacity. Planned woodland grazing systems or livestock exclusion on forest land will improve wildlife conditions.

Frequent flooding within temporary pool areas of floodwater retarding structures will limit the use of these areas for agricultural production. Some of these areas can be expected to develop into wildlife habitat, and optimum conditions will exist for natural establishment of native plant species. Since most of the flood plain land suitable for farming is presently cropped, loss of habitat from changed land use will not be significant. More intensive use of the flood plain will result in a decrease of habitat for some species of wildlife.

Several state-listed rare, endangered, or declining species of plants and animals occur or may occur in the project. In areas where structural works are to be installed, adverse effects to some of these species can be anticipated. Planned land treatment measures will not adversely affect listed species and improved management of woodlands and native pasturelands could enhance habitat. No project effects are anticipated on the species considered nationally threatened--the Southern Bald Eagle, Indiana Bat, and Eastern Cougar. The Southern Bald Eagle is considered extirpated from the state, and the primary habitat of the Indiana Bat is in caves. No occurrence of cougar in the state has been verified for many years.

The recreational development at the diversion structure will provide access to the Little Black River. These facilities will provide some of the recreation needs of the area. Access for canoeing and fishing on Little Black River are planned recreational activities. A total of 4,480 annual recreation visits is estimated. Sixty percent of the annual (recreation) usage is during the period from Memorial Day to Labor Day. Maximum attendance on any single day is estimated to be 80 persons. Because of the limited facilities, a value of $1.00 per recreation day was used in estimating benefits.

Economic and Social

Information from the community profile for Ripley County states that the farm-operator family level of living index in 1959 was lower than 81 percent of the 3,135 United States counties. Unemployment and underemployment are persistent problems. The unemployed civilian labor force in Ripley County in 1960 was 7.3 percent, a somewhat higher proportion than the national rate of 5.6 percent. Ranked against the other counties, Ripley County had a higher rate of unemployment than 85 percent of the 3,135 counties in the United States. Eighty percent of all counties in the United States had a higher per capita disposable income than Ripley County in 1966. Since a large part of the watershed is in Ripley County and conditions are similar throughout the area, the census data for the county is considered representative.

Installation of the project will expand the economic base of the rural area. New jobs will be created as a result of the increased

production and processing of agricultural products. Improved agricultural efficiency will allow more family farms to stay in business thereby reducing migration to the cities. As a result of stabilizing agriculture and increasing farm profits, the quality of living will be improved and progress will be made toward overall rural development.

The small number of people displaced by the project will not have a major effect on schools, churches, and other neighborhood groups.

There will be some interrupted traffic where flood pools inundate unimproved county roads. In flood plain areas, however, interruption of travel, mail deliveries, and work delays will be much less a problem with the installation of the project. The project will allow about $8,000 annually, now spent on roads and bridges, to be used for other priority improvements.

Effects not evaluated in monetary values include: (1) the reduced threat of injury or loss of life that is directly associated with the velocity and depth of floodwaters, (2) hazards to health caused by contamination of wells and pollution from sewage systems, (3) reduced costs of activities that are necessary to control disease-carrying insects and organisms after major floods, and (4) enhanced water quality as a result of land treatment and trapping effect of reservoirs.

The proposed works of improvement will have little effect upon the mineral resources of the watershed. The large regional sand and gravel resource makes it unlikely that it would be necessary to utilize any sand and gravel present near the proposed structure sites. Because of deep overburden and large nearby supplies, it is doubtful that the stone near the proposed structures will become of economic importance. Clay, iron, and manganese deposits have been noted in Butler County. However, no such deposits were observed around any of the proposed works of improvement.

It has been noted that the delta area, or Mississippi Embayment, is a potential area for oil and gas exploration. However, the Lower Little Black Watershed is located on shallow sediments at the northern edge of the Embayment, while the oil and gas potential is expected to be farther south in the deeper sediments of the southern portions of the Embayment. For this reason, no oil and gas exploration is anticipated in the Lower Little Black Watershed.

PROJECT BENEFITS

Benefits accruing to the structural measures included in this plan amount to $1,245,177 annually at current normalized prices. Benefits derived from flood prevention $787,127; drainage, $292,145; redevelopment, $53,380; recreation, $4,480; and local secondary, $108,045. Since secondary benefits from a national viewpoint were not considered pertinent, none were evaluated.

Included in the flood prevention benefits are $67,980 in annual benefits accruing downstream in the White River Basin. These benefits consist of a reduction in damages to crops, pastures, fences, roads, bridges, and farm buildings and a reduction in indirect losses. Installation of planned land treatment measures will provide additional flood damage reduction benefits of $52,065 annually. Flood prevention benefits consist of $575,306 in reduction of damages and $211,821 in benefits from more intensive land use.

Redevelopment benefits, resulting from employment of locally unemployed or underemployed labor during project installation and operation, are estimated to be $53,380 annually.

Benefits accruing from the use of the recreation access areas and associated facilities are estimated to be $4,480 annually.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of structural measures is estimated to be $772,180. These measures are expected to produce annual benefits, excluding secondary benefits, of $1,137,132 or $1.47 for each dollar cost.

The ratio of the total average annual benefits, $1,245,177, to the average annual cost of structural measures, $772,180, is 1.6:1.

PROJECT INSTALLATION

Sponsoring local organizations, with the assistance of interested local, state, and federal agencies and groups, will develop an educational program regarding watershed development. This program will help achieve understanding and stimulate participation in the project.

Land treatment itemized in Table 1 will be established (during the project installation period) by landowners and operators in cooperation with the soil and water conservation districts of their counties. The governing bodies of the soil and water conservation districts will arrange for meetings according to a definite schedule. They will set priorities on completed practices and otherwise assist and encourage landowners and operators to establish complete resource conservation plans. Technical assistance for planning and applying land treatment measures will be provided by the Soil Conservation Service, the Arkansas Game and Fish Commission, the Missouri Department of Conservation - Division of Forestry, and the Arkansas Forestry Commission in cooperation with the U.S. Forest Service. The assistance will be accelerated to assure satisfactory planning progress and application of the planned measures within the project period.

Seed, shrubs, and trees in limited quantities which are not a part of wildlife mitigation measures will be provided by the Missouri Department of Conservation to establish food and cover for wildlife management areas within the limitations of existing agreements. Plantings of these materials will be on the basis of recommendations and guidance by the Missouri Conservation Department personnel. Protection from livestock must be assured.

The Soil Conservation Service will be responsible for all engineering costs except those pertaining to recreational facilities. The Butler County Drainage District No. 10 will be responsible for the engineering costs on recreational facilities at the Little Black River access areas at the diversion structure. The Soil Conservation Service will provide assistance in the design of recreational facilities, however the primary responsibility for both the engineering and design will be with the Butler County Drainage District No. 10. Drainage District No. 10 will arrange for assistance in the engineering and design of recreation facilities with the Missouri Department of Conservation.

Little Black Watershed Subdistrict, Butler County Drainage District No. 10, Naylor Drainage District and Western Clay Drainage District are all eligible under Missouri or Arkansas statutes to administer and contract for construction of all works of improvement in this plan. All agencies have the power of eminent domain. Construction will not begin on any structural measures until: (1) All land rights have been

obtained for structural measures or (2) A substantial part of the land rights have been obtained and a written statement furnished by the sponsors that all powers granted them by the state will be used, if necessary, to clear the remaining land rights within the project period and that funds are available for this purpose. All items will be installed by contract or force accounts. Appropriate project agreements will be executed prior to construction.

The three drainage districts--Butler County Drainage District No. 10 and Naylor Drainage District of Ripley County, Missouri, and Western Clay Drainage District of Clay County, Arkansas, have entered into agreements for construction, operation, and maintenance of the channel work. These agreements refer to ditch names used in the watershed work plan, except for Main Ditch which is identified as Ditch No. 3 in the work plan. The sponsors, as designated below, will be responsible for contracting construction of all works of improvement unless they, at a later date, request the Soil Conservation Service to administer the contracts.

Structural Measures	Sponsor or Sponsors Responsible For Contracting
Floodwater Retarding Structures	Little Black Watershed Subdistrict
Little Black River Channel and Ditch No. 3 in Arkansas	Joint Boards of Butler County Drainage District No. 10, Naylor Drainage District, and Western Clay Drainage District.
Ditch No. 3 in Missouri, Water Control Structure at Diversion Access, Diversion Structure, and Floodway Channel.	Joint Boards of Butler County Drainage District No. 10, and Naylor Drainage District.
Ditch No. 1 in Arkansas	Joint Boards of Naylor Drainage District, Ripley County, Missouri, and Western Clay Drainage District, Clay County, Arkansas.
All other ditches and levees located in Butler County, Missouri, and the portion of Neelyville Ditch located in Ripley County, Missouri. Recreational facilities at diversion access point in Butler County, Missouri.	Butler County Drainage District No. 10
All other ditches and levees located in Ripley County, Missouri.	Naylor Drainage District
Indian Creek ditch	Western Clay Drainage District

If the sponsors perform the contracting, they will be responsible for establishing and maintaining a financial management system, including financial reporting requirements adequate to meet Federal procurement regulations. This system shall provide for accurate, current and complete disclosure of the financial results of each segment of the project in which Soil Conservation Service has a financial interest in accordance with Soil Conservation Service reporting requirements. Their records must identify adequately the source and application of funds for the project. The sponsors must maintain effective control over and accountability for all funds, property and other assets. The sponsors procurement procedures shall be in writing and conform to Federal procurement regulations, Soil Conservation Service policies and procedures and applicable state and local laws. All accounting records must be supported by source documentation. The sponsor must schedule audits of the financial management system at reasonable frequency, usually annually, but not less than biannually, and assure timely and appropriate resolution of audit findings and recommendations.

The sponsor shall develop, maintain and enforce a written code or standards of conduct which shall govern the performance of its officers, employees, or agents in contracting with and expending PL-566 funds. As a minimum the standards shall provide that the sponsor officers, employees or agents, shall neither solicit nor accept gratuities, favors, or anything of monetary value from contractors or potential contractors. The contract or other procurement action shall not be awarded to a sponsor, or firms in which any official of such organizations or any member of such official's immediate family, has direct or indirect interest in the recurring profits or contracts of such firms. To the extent permissible by state or local law, rules or regulations, such standards shall provide for penalties, sanctions, or other disciplinary actions to be applied for violations of such standards by either the CLO officers, employees, or agents, or by contractors or their agents.

Little Black Watershed Subdistrict will be responsible for acquiring land rights for the floodwater retarding structures. These land rights include land needed for structure sites and impoundments, an easement and modification on State Highway 142 in Site F-3, county roads in Sites F-2 and F-11, an easement on a powerline, and the removal of two hunting cabins in the F-2 site.

Western Clay Drainage District will be responsible for the land rights on those portions of ditch No. 3, Little Black River, ditch No. 1, and Indian Creek which are in Arkansas.

Butler County Drainage District No. 10 will be responsible for the land rights for the diversion structure and the area needed for recreation access and mitigation lands surrounding the structure; ditch No. 3 from the diversion structure to cross section 148, station 283+36 (station 283+36 is approximately 236 feet south of the railroad bridge); the levees; and all other ditches in Butler County.

Naylor Drainage District will be responsible for the land rights on ditch No. 3 from cross section 148 (station 283+36) to the State line, the levees, and all other ditches in Ripley County.

Butler County Drainage District No. 10 will be responsible for bridge replacements or modifications of the bridges on the channels located in Butler County. Naylor Drainage District will be responsible for bridge replacement or modifications of the bridges on the channels located in Ripley County. Butler County Drainage District No. 10 and Naylor Drainage District will be jointly responsible for the new bridge on ditch No. 3 at the State Line.

The Western Clay Drainage District will be responsible for bridge replacements or modifications located within the Clay County portion of the watershed.

Sponsors responsible for land rights will comply with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (PL91-646) and regulations issued by the U.S. Department of Agriculture. The sponsors may contact the landowners to determine the availability of lands for easements. If it is necessary to negotiate for easements or acquisitions, sponsors must obtain an appraisal from a qualified land appraiser before making an offer to the landowner. After the appraisal is accepted, the sponsors must offer the landowner, in writing, no less than the established appraisal value.

Acquisition of land rights will also require removal of one residence in the F-11 site, one residence at the lower end of the floodway channel near Sta. 154+56, and a residence near the floodway diversion structure. These residences will involve relocation costs and relocation assistance advisory services. As a part of project administration, the responsible sponsors will: (1) provide personally or by first class mail written notice of displacement and appropriate application forms to each displaced person, business, or farm operation; (2) assist in filing applications; (3) review and take action on applications for relocation assistance; (4) review and process grievances in connection with displacements; and (5) make relocation payments.

The Service will assist the subdistrict in fulfilling their responsibilities.

As a part of project administration, the subdistrict and the drainage districts will provide, without PL-566 cost sharing, relocation advisory assistance services as may be needed in connection with the relocation of displaced persons, businesses, or farming operations. These services include:

1. Determining the need, if any, of displaced persons for relocation assistance.

2. Providing current and continuing information on the availability, prices, and rentals of decent, safe and sanitary sale and rental housing and of comparable commercial properties and locations for displaced businessmen and farm operations.

3. Assuring that replacement dwellings will be available within a reasonable period of time prior to displacement.

4. Assisting a person displaced from his business or farm operation in obtaining and becoming established in a suitable replacement location.

5. Supplying information concerning housing programs, disaster loan programs, and other federal or state programs, and offering assistance to displaced persons.

6. Providing other advisory services to displaced persons in order to minimize hardships to such persons in adjusting to relocation.

7. Advising displaced persons that they should notify the displacing agency before they move.

8. Providing persons from whom it is planned to acquire land a brochure or pamphlet outlining the benefits to which they may be entitled prior to initiation of acquisition.

The sponsors have determined that decent, safe, and sanitary replacement housing will be available for all persons subject to displacement by the project. All displaced persons will be given notice to vacate at least 90 days before they have to move.

Little Black River and channel work on ditch No. 3 will have priority for construction ahead of all other ditches. The construction will begin on the Little Black River in Arkansas and proceed upstream. Drop structures in ditch No. 3 will be built in advance of, or concurrently with the ditch.

Dams having release flows of 1,000 to 1,200 c.f.s. from low and single stage inlets will be built in the Upper Little Black project before the diversion structure and floodway channel are constructed. Dams in this project will be built concurrently with the channel work. The levee at Harviell will be constructed early in the installation period. A lateral ditch may be built any time after construction is completed on its outlet.

The following other pertinent provisions of the law, regulations, and policies shall be met before issuance of invitations to bid on any portion of the installation of works of improvement:

1. Mutual agreement on schedules of construction, plans, and specifications shall be reached. Terms of contracts and all matters pertaining to contracts of works of improvement shall be mutually satisfactory in accordance with Service technical and administrative specifications.

2. Land rights shall be secured at no cost to PL-566 Funds, and valid ownership therefore presented to the mutual satisfaction of all parties.

3. Full conformance with State laws and regulations shall be the responsibility of the sponsors and shall be secured at no cost to the federal government. Reasonable evidence of conformity shall be presented to the mutual satisfaction of all parties.

4. Needed land treatment must be applied prior to construction or concurrently with construction of the proposed structural measures.

5. Agreements for operation and maintenance of works of improvement to be installed shall be secured.

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 Statute 666), as amended. This assistance is subject to appropriation of funds.

Estimated installation costs for land treatment measures are $2,086,600 ($1,830,000 for cropland, $200,000 for pastureland and $56,600 for forest land) which will be financed by landowners with assistance from federal and/or state programs. The total cost of installing land treatment measures, including forest land treatment measures, is estimated to be $2,793,600. The Service will provide $630,000 in technical assistance for applying land treatment other than forestry measures, $224,000 of which will be funded by the going program and $406,000 by PL-566 funds. Technical assistance to private landowners for installation of forest measures will be provided as follows: PL-566 funds, $34,400; the Missouri Department of Conservation - Division of Forestry, $6,500; and the Cooperative Forest Management Program, $31,800.

The proportional project share of the cost of additional fire suppression equipment for intensification of fire protection will be $2,500 from PL-566 funds and $1,800 from the State of Missouri.

Table 1 shows the extent of land treatment programmed for this project and the amount of accelerated technical assistance.

The Soil and Water Conservation Districts of Butler, Carter, and Ripley Counties organized a watershed subdistrict in Missouri that includes the entire drainage area of the Upper Little Black and Lower Little Black Watersheds in Missouri. This subdistrict has the legal authority to levy taxes for its expenses in connection with these two watershed projects. Little Black Watershed Subdistrict anticipates that loans will be necessary to finance land rights for the floodwater retarding structures in Lower Little Black Watershed. A letter of intent has been filed with the Farmers Home Administration for a loan of approximately $15,000 to purchase land rights for floodwater retarding structures.

In addition to the Little Black Watershed Subdistrict in Carter, Butler and Ripley Counties, Missouri, the delta portion of the watershed is divided into three drainage districts--Butler County Drainage District No. 10; Naylor Drainage District in Ripley County, Missouri; and Western Clay Drainage District in Clay County, Arkansas. Each of these drainage districts have the power to levy taxes to operate, maintain and repay its costs incurred in this plan. Each drainage district anticipates that loans will be necessary to carry out its responsibility in this watershed project. A letter of intent (from each of the drainage districts) has been filed with the Farmers Home Administration for construction and land rights cost for channel improvement. The approximate amounts requested are $563,000 for

Butler Drainage District No. 10, $609,000 for Naylor Drainage District and $242,000 for Western Clay Drainage District. The amount for Butler Drainage District No. 10 includes funds for acquiring in fee simple 50 acres at the diversion structure, and approximately 50 acres of delta land by easement for additional mitigation areas.

The construction cost of the floodwater retarding structures ($2,150,200); the levees ($41,836); and the diversion structure, floodway and drop structure ($643,343) will be borne by PL-566 funds. The construction cost ($4,000) of the recreation water control structure will be shared 50 percent by PL-566 funds and 50 percent by other funds. Other funds will be provided by Butler County Drainage District No. 10. The cost of the multiple-purpose channels ($6,075,686) will be shared 89.4 percent by PL-566 funds and 10.6 percent by other funds. The sponsoring local organizations will share their portion of construction cost on multiple-purpose ditches as follows:

Measure	Percent of Construction Cost (Other Funds) to be Borne by Sponsoring Local Organizations		
	Butler County Drainage District No. 10	Naylor Drainage District	Western Clay Drainage District
Ditch No. 3 in Missouri (Sta. 154+56 to State Line Sta. 674+71)	50	50	
Ditch No. 3 State Line to End Construction (Sta. 674+71 to 1077+00)	50	50	
Ditch No. 1 Ripley County		100	
Ditch No. 1 Clay County		100	
All other ditches in Butler County	100		
All other ditches in Ripley County		100	
Indian Creek Ditch in Clay County			100

Construction costs of recreation facilities at the access area ($15,000) will be shared equally by the Soil Conservation Service and the Butler County Drainage District No. 10. Engineering for design and installation of recreation facilities ($1,500) will be financed by the Butler County Drainage District No. 10. Drainage District No. 10 intends to arrange for reimbursement of their share of the construction and engineering costs associated with the recreation facilities through an agreement with the Missouri Department of Conservation. All land rights will be acquired by the local sponsors at no cost to the Soil Conservation Service. Approximately 50 acres will be acquired by the Butler County Drainage District No. 10. This area will be used for the public access area and for mitigating part of the wildlife losses incurred in Butler County Drainage District No. 10 as a result of installing the Lower Little Black project.

The local share of relocation payments and the total cost of relocation advisory services will be financed by the Little Black Watershed Subdistrict from tax levies made against real property in the subdistrict.

Construction cost ($6,500) for the water control structure at the river loop cutoff in Arkansas will be shared 89.4 percent by the Soil Conservation Service and 10.6 percent by other funds.

All land rights will be acquired by the local sponsors at no cost to the Soil Conservation Service. Easements on approximately 6 acres will be acquired by Western Clay Drainage District. This area will be used for mitigating part of the wildlife losses in Clay County, Arkansas, incurred as a result of installing the project.

Sponsors must account to Soil Conservation Service for certain income earned by them during the "grant period". The grant period for this purpose is from the effective date of the Soil Conservation Service fund obligating agreement with the date on which Soil Conservation Service formally notifies the sponsors that the undertaking has been completed to the satisfaction of Soil Conservation Service. Program income may include, but will not be limited to, income from service fees, usage or rental fees, and sale of assets purchased with Federal funds under a Soil Conservation Service-fund obligating agreement. This does not include fees collected for operating and maintaining recreational facilities that are a part of the Works of Improvement.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators cooperating with the soil and water conservation districts, as described in their resource conservation plans. Representatives of the soil and water conservation districts and the Soil Conservation Service will periodically inspect land treatment measures, and the districts will encourage farmers to perform needed maintenance.

The forest land treatment measures installed on private land will be maintained by the landowners with technical assistance furnished by the Missouri Department of Conservation - Division of Forestry and the Arkansas Forestry Commission, in cooperation with the U.S. Forest Service under the going Cooperative Forestry Program.

Current federal-state forestry programs include Cooperative Forest Management, Cooperative Forestation, Cooperative Forest Pest Management and Cooperative Forest Fire Control.

Floodwater retarding structures will be operated and maintained at an estimated annual cost of $8,600 by the Little Black Watershed Subdistrict. Funds for operation and maintenance costs will be obtained from taxes levied in the watershed area.

The Missouri portion of ditch No. 3, the floodway, and related mitigation features will be operated and maintained at an estimated annual cost of $21,531 ($20,316 for operation and maintenance and $1,215 replacement costs). It will be operated and maintained equally by the Joint Boards of Butler County Drainage District No. 10 and the Naylor Drainage District. The Arkansas portion of this channel, including the Little Black River and the mitigation features, will be operated and maintained at an estimated annual cost of $17,608 ($16,770 operation and maintenance and $838 replacement) by the joint boards of the three drainage districts. These costs will be divided 38.1 percent to Butler County Drainage District No. 10, 44 percent to Naylor Drainage District, and 17.9 percent to Western Clay Drainage District.

The Missouri portion of ditch No. 1 will be operated and maintained by the Naylor Drainage District. Estimated annual cost, including replacement, is $4,921 ($3,927 operation and maintenance and $994 replacement). The portion of ditch No. 1 in Arkansas will be operated and maintained jointly by the Western Clay Drainage District and the Naylor Drainage District. Estimated annual cost is $985 ($776 operation and maintenance and $209 replacement). The costs of operation and maintenance of this section of ditch will be divided 13 percent to Western Clay Drainage District and 87 percent to Naylor Drainage District.

All other channel modification, levees and mitigation features will be operated and maintained at an estimated annual cost of $26,472

($20,326 operation and maintenance and $6,146 replacement) by the drainage district within whose boundaries they are located. These costs will be borne by the responsible drainage district.

The annual operation, maintenance and replacement cost for all channel work including the floodway as summarized above is $71,517, including $9,401 for replacement. This includes provision for higher maintenance cost in dispersed soil areas and in maintaining the alternate 1,000 feet long 2-feet deep sections on ditch No. 1 and 2. It is also necessary that designed channel capacity above each drop structure be maintained to achieve the expected benefits.

Operation and maintenance costs for the diversion structure, Gaines Slough Levee and the Harviell Levee will be shared by the Joint Boards of Butler County Drainage District No. 10 and the Naylor Drainage District. Estimated annual cost is $273 ($183 operation and maintenance and $90 replacement). This cost will be shared on the basis of Butler County Drainage District No. 10, 46.4 percent and Naylor Drainage District, 53.6 percent.

The works of improvement installed on the 50-acre recreation access area includes the diversion structure, pipes installed at the oxbow, that portion of the floodway on the 50-acre area, dikes and appurtenances associated with the diversion structure, mitigation measures and the recreational facilities. The responsibility for operation and maintenance of these works of improvement will be with the Butler County Drainage District No. 10 and the Naylor Drainage District, except for recreational facilities. Butler County Drainage District No. 10 will be responsible for operation and maintenance of the recreational facilities. They intend to enter into an agreement with the Missouri Department of Conservation for operation and maintenance of the recreational facilities and the wildlife management area.

Costs of operation and maintenance, including replacement, for diversion recreational access facilities are estimated to be $1,560 annually. Operation and maintenance items for the recreational facilities will include labor, utilities and maintenance (estimated $900). The replacement items are estimated to cost $660 annually. Items requiring replacement include: trash can supports, road and parking lot spaces, and toilets.

Operation, maintenance and replacement costs for all structural measures including recreational development are $81,950, including $10,152 for replacement.

Operation and maintenance costs will include, but not be limited to, those costs of removing sediment deposits from the channel improvements; replacing and repairing riprap around the concrete drop structures; mowing side slopes and berms along the channels for control of undesirable species; repairing channel bank erosion; maintaining drop structures, floodwater retarding structures and the diversion structure;

controlling woody vegetation in the channels; maintaining the levees; and maintaining all mitigation features. Mowing and/or spraying of ditch side slopes and berms to control weeds and brush will be delayed until after July 15 to reduce wildlife losses. Herbicides used for spraying will be those approved by the Missouri Department of Conservation as least detrimental to wildlife.

Where latent defects become apparent during the establishment period, the Soil Conservation Service will share the cost of repair at the same rate as original cost of construction. For structural measures the establishment period shall extend 3 years from the date of acceptance of the structural works of improvement. The establishment period for vegetative work associated with a structural measure is a period from date of acceptance of the initial vegetative work to midnight of the date on which the Soil Conservation Service writes the sponsor advising that adequate vegetative cover has been obtained. This period shall not, however, exceed two growing seasons or the end of the establishment period for the associated structural measure whichever is greater in time.

The Soil Conservation Service and the local sponsors have agreed to accept some minor deviation in the design criteria of lateral channels recognizing a degree of risk was involved in establishing their stability. Additional work may be necessary during the establishment period to achieve the desired stability.

The Soil Conservation Service and the sponsors will make joint inspections annually after each severe flood and after the occurrence of any other unusual condition which might adversely affect the structural and mitigation measures. These inspections will continue for 3 years following the installation of each structural work of improvement. Such inspections will also be made by the sponsors after the 3-year period and a report furnished to the Soil Conservation Service.

Inspection of the floodwater retarding structures will include the condition of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetation, riprap and other items installed as a part of the structure. The inspection of the channel modifications will include the condition of the drop structures, embankments, channel side slopes, vegetation, side inlet structures, and other installed features. Levee inspections will include the condition of the earth fill, pipe conduit, vegetation, and other installed features. A map will be prepared showing the location and nature of all mitigation lands and other mitigation items to be inspected. Inspection of the mitigation items will include the wildlife habitat plantings, the fishery pools in the channels and management of other wildlife areas. Missouri Department of Conservation representatives will be asked to participate in the inspection of project mitigation measures.

Provisions for Operation and Maintenance

An operation and maintenance agreement will be developed by the Soil Conservation Service for all structural measures in the watershed prior to the issuance of an invitation to bid on the first contract. A separate operation and maintenance plan will be prepared for each similar group of structural measures. The operation and maintenance agreements will refer to the Missouri Soil Conservation Service Watershed Operation and Maintenance Handbook.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Lower Little Black Watershed, Missouri
Dollars a/

Installation Cost Item	Unit	Number			Estimated Cost (Dollars) a/							
					P. L. 566 Funds				Other Funds			
		Fed. Land	Non-Fed. Land	Total	Federal Land SCS c/ FS c/	Non-Federal Land SCS c/	Non-Federal Land FS c/	Total	Federal Land SCS c/ FS c/	Non-Federal Land SCS c/	Non-Federal Land FS c/	Total	Total
LAND TREATMENT													
Land Areas b/													
Cropland	Acre		30,500	30,500						1,830,000		1,830,000	1,830,000
Pastureland	Acre		10,000	10,000						200,000		200,000	200,000
Forest Land	Acre		23,120	23,120							56,600	56,600	56,600
Individual Practices													
Fire Control	Acre		51,025	51,025			2,500	2,500			1,800	1,800	4,300
Technical Assistance						406,000	34,400	440,400		224,000	38,300	262,300	702,700
TOTAL LAND TREATMENT						406,000	36,900	442,900		2,254,000	96,700	2,350,700	2,793,600
STRUCTURAL MEASURES													
Construction													
Flood Ret. Structures	No.		5	5		2,150,200		2,150,200					2,150,200
Levees	Mile		1	1		41,836		41,836					41,836
Floodway (O) d/	Mile		1.3	1.3		643,343		643,343					643,343
Multiple-Purpose Chan.d/													
(M)	Mile		79.8	79.8		4,553,950		4,553,950		540,881		540,881	5,094,831
(N)	Mile		2.7	2.7		548,736		548,736		65,063		65,063	613,799
(O)	Mile		1.7	1.7		328,148		328,148		38,908		38,908	367,056
Recreation Facilities	No.		1	1		7,500		7,500		7,500		7,500	15,000
Rec. Water Control Str.	No.		1	1		2,000		2,000		2,000		2,000	4,000
Subtotal Construction						8,275,713		8,275,713		654,352		654,352	8,930,065
Engineering Services						871,557		871,557		1,500		1,500	873,057
Relocation Payments						23,625		23,625		8,475		8,475	32,100
Project Administration													
Construction Inspection						1,311,145		1,311,145					1,311,145
Other						130,958		130,958		61,000		61,000	191,958
Rel. Assist. Adv. Serv.										1,500		1,500	1,500
Subtotal Project Administration						1,442,103		1,442,103		62,500		62,500	1,504,603
Other Cost													
Land Rights										880,982		880,982	880,982
Subtotal Other Costs										880,982		880,982	880,982
TOTAL STRUCTURAL MEASURES						10,612,998		10,612,998		1,607,809		1,607,809	12,220,807
TOTAL PROJECT						11,018,998	36,900	11,055,898		3,861,809	96,700	3,958,509	15,014,407

a/ Price base 1973.

b/ Includes only areas estimated to be adequately treated during project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.

c/ Federal agency responsible for assisting in installation of works of improvement.

d/ Type of channel before project: (N) - an unmodified, well defined natural channel or stream; (M) - manmade ditch or previously modified channel; (O) - none or practically no defined channel.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Lower Little Black Watershed, Missouri

Measures	Unit	Applied to Date	Total Cost (Dollars)[a/]
LAND TREATMENT			
Brush Control	Acres	1,990	26,865
Conservation Cropping System	Acres	17,148	102,888
Crop Residue Management	Acres	22,172	310,408
Ponds	No.	61	48,800
Drainage Mains and Laterals	Feet	300,960	142,500
Pasture and Hayland Management	Acres	1,859	46,475
Pasture and Hayland Planting	Acres	2,063	123,780
Drainage Field Ditches	Feet	200,640	30,400
Irrigation Field Ditches	Feet	15,840	2,400
Sprinkler Irrigation	No.	2	20,000
Surface Irrigation	No.	8	16,000
Forest Management Plans	Acres	2,995	4,100
Tree Planting	Acres	60	2,600
Hydrologic Cultural Operations	Acres	3,050	76,000
Fire Control	Acres	52,865	92,500
TOTAL			1,045,716

a/ Price base 1973.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Lower Little Black Watershed, Missouri
Dollars a/

ITEM			INSTALLATION COST - P. L. 566 FUNDS					INSTALLATION COST - OTHER FUNDS					Total Installation Costs
			Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land Rights	Relocation Payments	Total Other	
Multiple-Purpose Channels													
Ditch #3	154+56-674+71	(M)	1,597,450	171,394		9,715	1,778,559	189,477		331,752	3,485	524,714	2,303,273
	708+00-869+92	(M)	701,462	75,521			776,983	83,253		99,710		182,963	959,946
	900+00-907+40	(M)	18,138	2,029			20,167	2,151		2,240		4,391	24,558
Ditch #1	126+08-717+80	(M)	420,500	47,000			467,500	49,900		23,750		73,650	541,150
Ditch #2	11+28-524+14	(M)	353,700	39,600			393,300	42,000		18,250		60,250	453,550
Neelyville	79+99-461+39	(M)	291,400	32,600			324,000	34,600		19,300 b/		53,900	377,900
Harviell	33+68-525+70	(M)	354,100	39,600			393,700	42,000		21,450 b/		63,450	457,150
Indian Creek	137+12-340+10	(M)	143,000	16,000			159,000	17,000		33,450		50,450	209,450
Brown-Taft	9+07-245+86	(M)	131,800	14,800			146,600	15,700		10,550 b/		26,250	172,850
Eaton Ditch		(M)	85,100	9,500			94,600	10,100		6,500		16,600	111,200
Suder Ditch		(M)	170,800	19,100			189,900	20,300		18,000 b/		38,300	228,200
W.P.A. Ditch		(M)	52,500	5,900			58,400	6,300		6,530 b/		12,830	71,230
Lateral Ditch #2		(M)	35,800	4,000			39,800	4,300		2,750		7,050	46,850
Hart Ditch		(M)	19,200	2,200			21,400	2,300		1,470		3,770	25,170
Epps Ditch		(M)	57,300	6,400			63,700	6,900		6,900 b/		13,800	77,500
Sappington Ditch		(M)	57,300	6,400			63,700	6,900		6,900 b/		13,800	77,500
Birdslash Ditch		(M)	64,400	7,200			71,600	7,700		4,950		12,650	84,250
Subtotal (M) Ditches i/			4,553,950	499,244		9,715	5,062,909	540,881		614,452	3,485	1,158,818	6,221,727
L. B. River	936+00-1010+50	(N)	324,738	36,324			361,062	38,504		24,130		62,634	423,696
L. B. River	1010+50-1077+00	(N)	223,998	25,056			249,054	26,559		20,760		47,319	296,373
Subtotal (N) Ditches i/			548,736	61,380			610,116	65,063		44,890		109,953	720,069
Ditch #3	674+71-708+00	(O)	112,704	12,607			125,311	13,363		11,160		24,523	149,834
	869+92-900+00	(O)	102,566	11,473			114,039	12,161		9,900		22,061	136,100
	907+40-936+00	(O)	112,878	11,976			124,854	13,384		11,040 f/		24,424	149,278 h/
Subtotal (O) Ditches i/			328,148	36,056			364,204	38,908		32,100		71,008	435,212
Subtotal MP Ditches			5,430,834	596,680		9,715	6,037,229	644,852		691,442	3,485	1,339,779	7,377,008
Floodway i/	85+78-154+56	(O)	643,343	55,674		10,977	709,994			44,670 g/	3,938	48,608	758,602
Total All Ditches			6,074,177	652,354		20,692	6,747,223	644,852		736,112	7,423	1,388,387	8,135,610 d/

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Lower Little Black Watershed, Missouri
Dollars a/

ITEM	INSTALLATION COST - P. L. 566 FUNDS					INSTALLATION COST - OTHER FUNDS					Total Installation Costs
	Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land Rights	Relocation Payments	Total Other	
Floodwater Retarding Structures											
E-6	95,200	9,520			104,720			6,700		6,700	111,420
F-2	659,400	65,940			725,340			20,200		20,200	745,540
F-3	361,800	36,180			397,980			16,000		16,000	413,980
F-11	693,400	69,340		2,355	765,095			52,500	845	53,345	818,440
G-2	340,400	34,040			374,440			22,500		22,500	396,940
Subtotal F. R. Structures	2,150,200	215,020		2,355	2,367,575			117,900	845	118,745	2,486,320
Levees	41,836	4,183			46,019			4,470		4,470	50,489
Recreational Facilities Diversion Structure Area	7,500			578	8,078	7,500	1,500	22,500 c/	207	31,707	39,785
Recreation Water Control Str. Diversion Structure Area	2,000				2,000	2,000				2,000	4,000
Subtotal Structural Measures	8,275,713	871,557		23,625	9,170,895	654,352	1,500	880,982	8,475	1,545,309	10,716,204
Project Administration					1,442,103					62,500 e/	1,504,603
GRAND TOTAL	8,275,713	871,557		23,625	10,612,998	654,352	1,500	880,982	8,475	1,607,809	12,220,807

a/ Price base 1973.

b/ Includes $25,000 for mitigation land (50 acres) for Butler County Ditches; $5,000 each on Neelyville, Harviell & Suder Ditches; and $2,500 each on Brown-Taft, Epps, Sappington, & W.P.A. Ditches.

c/ Includes $22,500 for 45 acres of land for the river access area.

d/ Includes $28,600 ($25,568.40, PL-566 funds; $3,031.60, Other funds) for mitigation plantings on Ditch No. 3 and the floodway.

e/ Includes $1,500 for relocation advisory assistance.

f/ Includes $1,200 for Arkansas River Loop.

g/ Includes $2,400 for mitigation land at the diversion structure.

h/ Includes $6,500 ($5,811, PL-566 funds; $689, Other funds) for pipe at Arkansas River Loop.

i/ Type of channel before project: (N) - an unmodified, well-defined natural channel or stream; (M) - manmade ditch or previously modified channel; (O) - none or practically no defined channel.

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TABLE 2A - COST ALLOCATION AND COST SHARING

Lower Little Black Watershed, Missouri

(Dollars) [a/]

ITEM	COST ALLOCATION				COST SHARING							
	Purpose				PL-566				Other			
	Flood Prevention	Other Drainage	Recre-ation	Total	Flood Prevention	Other Drainage	Recre-ation	Total	Flood Prevention	Other Drainage	Recre-ation	Total
Flood retarding structures	2,486,320	-	-	2,486,320	2,367,575	-	-	2,367,575	118,745	-	-	118,745
Multi-purpose channels	5,244,011	1,412,928	-	6,656,939	4,731,782	695,331	-	5,427,113	512,229	717,597	-	1,229,826
Little Black River	567,413	152,656	-	720,069	532,040	78,076	-	610,116	35,373	74,580	-	109,953
Floodway	758,602	-	-	758,602	709,994	-	-	709,994	48,608	-	-	48,608
Levees	50,489	-	-	50,489	46,019	-	-	46,019	4,470	-	-	4,470
Recreation facilities	-	-	39,785	39,785	-	-	8,078	8,078	-	-	31,707	31,707
Recreation water control structures	-	-	4,000	4,000	-	-	2,000	2,000	-	-	2,000	2,000
GRAND TOTAL	9,106,835	1,565,584	43,785	10,716,204	8,387,410	773,407	10,078	9,170,895	719,425	792,177	33,707	1,545,309

[a/] Price base 1973.

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TABLE 2B - RECREATION FACILITIES
ESTIMATED CONSTRUCTION COSTS
Lower Little Black Watershed, Missouri

Dollars a/

Diversion Structure	Units	Quantity b/	Estimated Unit Cost	Total
Access Road - 20' gravel	Feet	1,400	5.00	7,000
Parking - 10' x 20' gravel	No.	20	60.00	1,200
Toilet - vault double unit	Each	2	2,500.00	5,000
Trash can units	Each	4	75.00	300
Boat launch ramp - gravel	Feet	200	7.50	1,500
TOTAL				15,000

a/ Price base 1973.

b/ Estimated quantities, subject to minor variation at time of detailed planning.

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TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY

Lower Little Black Watershed, Missouri

ITEM	Unit	Structure Number					Totals
		E-6	F-2	F-3	F-11	G-2	
Class of Structure	-	"a"	"b"	"b"	"b"	"b"	
Drainage Area (total)	Sq.Mi.	1.50	13.53	5.80	20.49	14.99	56.31
Controlled	Sq.Mi.	-	-	-	-	-	
Curve No. (1-day) (AMC II)	-	74	80	80	80	74	
Elevation Top of Dam	Feet	347.1	374.3	365.8	408.8	372.9	
Elevation Crest Emerg. Spillway	Feet	344.1	364.3	358.1	399.3	361.2	
Elevation Crest High Stage Inlet	Feet	336.3	353.4	351.1	380.7	340.4	
Elevation Crest Low Stage Inlet	Feet	-	340.2	341.9	368.6	-	
Maximum Height of Dam	Feet	24.1	57.3	46.2	65.9	56.8	
Volume of Fill[a/]	Cu.Yds.	38,400	362,900	259,400	427,900	190,500	1,279,100
Total Capacity[a/]	Ac.Ft.	368	4,263	1,593	7,451	4,550	18,225
Sediment Submerged	Ac.Ft.	94	640	301	923	709	2,667
Sediment Aerated	Ac.Ft.	10	66	30	94	73	273
Retarding	Ac.Ft.	264	3,557	1,262	6,434	3,768	15,285
Between High and Low Stage	Ac.Ft.	-	1,438	508	1,509	-	3,455
Surface Area							
Sediment Pool[b/]	Acres	21.0	81.0	39.0	94.0	80.0	315.0
Retarding Pool[a/]	Acres	50.0	241.0	134.0	365.0	307.0	1,097.0
Principal Spillway Design							
Rainfall Volume (areal) (1 day)	Inches	6.20	7.20	6.80	7.51	7.10	
Rainfall Volume (areal) (10 day)	Inches	12.00	14.00	13.20	14.83	13.90	
Runoff Volume (10 day)	Inches	6.10	9.12	8.39	9.88	7.70	
Capacity of Low Stage (Max.)	c.f.s.	-	269	152	224	-	
Capacity of High Stage (Max.)	c.f.s.	29	731	316	770	354	
Frequency Operation - Emer. Splwy.	% chance	4	2	2	2	2	
Dimensions of Conduit	Ft.or In.	18	5x5	48	5x5	48	
Emergency Spillway Design							
Rainfall Volume (ESH) (areal)	Inches	5.42	8.03	8.19	7.72	7.91	
Runoff Volume (ESH)	Inches	2.71	5.65	5.80	5.36	4.85	
Storm Duration	Hours	6	6	6	6	6	
Type	-	Veg.	Veg.	Veg.	Veg.	Veg.	
Bottom Width	Feet	30	200	200	400	150	
Velocity of Flow (V_e)	Ft/Sec.	-	1.65	5.40	-	-	
Slope of Exit Channel	Ft/Ft.	0.035	0.045	0.035	0.080	0.020	
Max. Reservoir Water Surface Elev.	Feet	342.9	364.7	359.9	396.6	360.8	
Freeboard Design							
Rainfall Volume (FH)(areal)(-hrs)	Inches	8.20	14.36	14.65	13.80	14.15	
Runoff Volume (FH)	Inches	5.11	11.75	12.03	11.19	10.67	
Storm Duration	Hours	6	6	6	6	6	
Max. Reservoir Water Surface Elev.	Feet	346.1	371.5	363.6	405.6	370.2	
Capacity Equivalents							
Sediment Volume	Inches	1.30	0.98	1.07	0.93	0.98	
Retarding Volume	Inches	3.30	4.93	4.08	5.89	4.71	
Beneficial Volume	Inches	-	-	-	-	-	

a/ Crest of emergency spillway.

b/ Area to be shown in ( ) if reservoir contains beneficial storage or if sediment capacity will not store water.

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TABLE 3A - STRUCTURE DATA CHANNELS
Lower Little Black Watershed, Missouri

Channel Number or Name Reach Stations	Drainage Area	Capacity		Water Surface Elevation	Hydraulic Gradient	Channel Dimensions [a]				"n" Value		Velocities		Excavation	Type of Work	Before Project	
						Bottom		Depth of Flow	Side Slope	Aged	As Built	Aged	As Built			Type of Channel	Flow Conditions
	Sq.Mi.	Required c.f.s.	Design c.f.s.	-	Feet/Feet	Width Feet	Grade %	Feet	-	-	-	f.p.s.	f.p.s.	Cu. Yds.	[b]	[c]	[d]
Floodway																	
85+78-154+56	51.0[e]	1950	1954	305.68	0.00015	60	0.015	10.21	2:1	0.030	0.025	2.38	2.85	240,134	I	0	-
Ditch No. 3																	
154+56-174+86	51.0	1950	1954	299.25	0.00015	60	0.015	10.21	2:1	0.030	0.025	2.38	2.85	67,657	II	M(1915)	i
174+86-260+26	60.3	2200	2218	297.91	0.00015	70	0.015	10.15	2:1	0.030	0.025	2.42	2.90	184,232	II	M(1915)	i
260+26-316+40	78.3	2775	2788	295.32	0.00015	86	0.015	10.40	2:1	0.030	0.025	2.51	3.00	199,673	II	M(1915)	i
316+40-428+40	80.8	2850	2864	292.14	0.00015	89	0.015	10.40	2:1	0.030	0.025	2.52	3.02	385,362	II	M(1915)	i
428+40-546+32	99.1	3400	3429	290.37	0.00015	108	0.015	10.40	2:1	0.030	0.025	2.56	3.07	506,688	II	M(1915)	i
546+32-674+71	99.1	3675	3697	288.44	0.00015	117	0.015	10.40	2:1	0.030	0.025	2.58	3.09	553,759	II	M(1915)	i
674+71-708+00	99.1	3675	3697	286.64	0.00015	112	0.015	10.60	2:1	0.030	0.025	2.60	3.11	190,885	I	0	-
708+00-860+04	108.3	3800	3824	284.36	0.00015	117	0.015	10.60	2:1	0.030	0.025	2.61	3.13	855,830	II	M(1920)	E
860+04-869+92	108.3	3800	3840	282.77	0.00010	98	0.036	13.10	2:1	0.030	0.025	2.36	2.83	59,399	II	M(1920)	E
869+92-900+00	121.0	3900	3910	282.47	0.00010	89	0.036	13.89	2:1	0.030	0.025	2.41	2.89	166,944	I	0	-
900+00-907+40	121.0	3900	3924	282.40	0.00010	87	0.035	14.08	2:1	0.030	0.025	2.42	2.90	27,565	II	M(1920)	i
907+40-922+00	121.0	3900	3914	282.12	0.00010	84	0.034	14.30	2:1	0.030	0.025	2.43	2.92	96,345	I	0	-
Little Black R.																	
922+00-936+00	185.7	5500	5507	282.07	0.00010	116	0.031	14.75	2:1	0.030	0.025	2.57	3.08	83,440	I	0	-
936+00-1010+50	186.7	5500	5543	281.27	0.00010	97	0.031	16.17	2:1	0.030	0.025	2.65	3.18	238,569	II	N	PR
1032+00-	187.7	5500	-	281.05	0.00010	1270.4[a]	0.031	-	145.9[a]	-	-	-	-	-	III	N	PR
1057+00-	187.7	5500	-	280.90	0.00010	1390.9[a]	0.031	-	128.3[a]	-	-	-	-	-	III	N	PR
1077+00-	187.7	5500	-	280.70	0.00010	1516.6[a]	0.031	-	104.0[a]	-	-	-	-	-	III	N	PR
Ditch No. 1																	
126+08-230+90	5.8	88	89	295.40	0.00023	6	0.023	4.96	2:1	0.040	0.025	1.11	1.78	16,840	II	M(1912)	i
230+90-362+70	5.8	163	164	293.00	0.00023	8	0.023	6.16	2:1	0.040	0.025	1.30	2.08	26,020	II	M(1912)	i
362+70-464+20	8.1	214	216	290.00	0.00023	8	0.023	6.58	2:1	0.035	0.025	1.54	2.16	28,560	II	M(1912)	i
464+20-615+70	10.9	274	274	288.00	0.00023	8	0.023	7.35	2:1	0.035	0.025	1.64	2.30	48,635	II	M(1912)	i
615+70-717+80	12.7	308	308	285.00	0.00023	8	0.023	7.75	2:1	0.035	0.025	1.69	2.37	18,345	II	M(1912)	PR
Ditch No. 2																	
11+28-241+95	4.1	96	96	300.20	0.00030	4	0.030	5.24	2:1	0.040	0.025	1.27	2.03	52,690	II	M(1915)	E
241+95-360+81	5.1	142	143	293.30	0.00030	8	0.030	5.40	2:1	0.040	0.025	1.40	2.24	32,820	II	M(1915)	i
360+81-524+14	11.9	390	392	289.70	0.00030	16	0.030	6.79	2:1	0.035	0.025	1.95	2.73	87,260	II	M(1915)	i
Brown Taft																	
9+07-100+00	5.0	154	154	303.70	0.00018	8	0.018	6.20	2:1	0.040	0.025	1.22	1.95	31,280	II	M(1920)	E
100+00-245+86	7.1	228	228	302.00	0.00018	10	0.018	6.60	2:1	0.035	0.025	1.48	2.07	50,050	II	M(1920)	i
Harviell																	
33+68-268+20	4.0	164	164	310.20	0.00040	6	0.040	5.80	2:1	0.040	0.025	1.61	2.58	103,540	II	M(1920)	E
268+20-435+82	12.3	367	367	300.90	0.00020	12	0.025	7.50	2:1	0.035	0.025	1.81	2.53	74,020	II	M(1920)	i
435+82-525+70	14.5	413	414	297.50	0.00025	14	0.025	7.50	2:1	0.035	0.025	1.90	2.66	39,690	II	M(1920)	i
Neelyville																	
79+99-273+70	3.4	100	101	302.20	0.00045	4	0.050	4.78	2:1	0.040	0.025	1.55	2.48	69,215	II	M(1920)	E
273+70-326+50	3.9	109	109	293.60	0.00030	6	0.050	5.10	2:1	0.040	0.025	1.32	2.11	18,870	II	M(1920)	i
326+50-461+39	11.9	286	286	292.20	0.00015	12	0.022	7.50	2:1	0.035	0.025	1.41	1.97	66,650	II	M(1920)	i
Indian Creek Ditch																	
137+12-180+68	2.2	72	72	287.10	0.000075	6	0.020	3.20	2:1	0.040	0.025	0.69	1.10	21,910	II	M(1920)	E
180+68-275+00	5.3	144	144	286.80	0.000075	12	0.020	4.15	2:1	0.040	0.025	0.81	1.30	47,450	II	M(1920)	E
275+00-340+10	5.3	156	164	286.20	0.000075	10	0.020	4.36	2:1	0.040	0.025	0.86	1.38	32,750	II	M(1920)	E
Other Ditches[g]																	
Eaton 3.0 [h]	4.1	80							2:1	0.040	0.025			76,500	II	M(1930)	E
Suder 6.0 [h]	5.0	95[f]							2:1	0.040	0.025			153,000	II	M(1920)	E
Lateral #2 1.5 [h]	1.1	145[f]							2:1	0.040	0.025			31,900	II	M(1920)	i
Hart 0.8 [h]	1.0	43							2:1	0.040	0.025			17,000	II	M(1930)	E
Epps 2.4 [h]	2.2	51							2:1	0.040	0.025			51,000	II	M(1930)	E
Sappington 2.4 [h]	3.0	63							2:1	0.040	0.025			51,000	II	M(1930)	E
Birdslash 2.7 [h]	3.6	72							2:1	0.040	0.025			57,400	II	M(1930)	E
W.P.A. 2.2 [h]	1.4	52							2:1	0.040	0.025			46,700	II	M(1930)	E

TABLE 3A - STRUCTURE DATA CHANNELS
Lower Little Black Watershed, Missouri

FOOTNOTES:

a/ Cross sectional area and wetted perimeter below hydraulic grade line shown on Little Black River where excavation is not planned.

b/ Type of Work: (I) Establishment of new channel.
(II) Enlargement of existing channel.
(III) Cleaning out natural channel.

c/ Type of Channel: (N) An unmodified, well-defined natural channel or stream.
(M) Manmade ditch or previously modified channel. (date of original construction)
(O) None or practically no defined channel.

d/ Flow conditions: (PR) Perennial - Flows at all times, except during extreme drought.
(i) Intermittent - Continuous flow through some seasons of year with little or no flow during other seasons.
(E) Ephemeral - Flows only during periods of surface runoff, otherwise dry.

e/ Includes 2.78 square miles of upland drainage. (Converted from B to C drainage curve.)

f/ Includes 100 c.f.s. flow from pipe outlet in levee at head end of Lateral Ditch No. 2 from Little Black River.

g/ Other ditches were not surveyed or designed. Costs and quantity estimates were made based on ditches of similar drainage areas.

h/ Ditch length in miles.

TABLE 3B - STRUCTURE DATA
GRADE STABILIZATION STRUCTURES
Lower Little Black Watershed, Missouri

Station	Drainage Area Sq.Mi. a/	Drop Ft.	Concrete Cu.Yds.	Type Structure
Floodway				
154+56	51.0	6.12	214	Drop
Ditch No. 3				
260+26	60.3	2.00	271	Drop
388+12	78.3	1.50	292	Drop
674+71	99.1	1.50	363	Drop
860+04	108.3	3.74	377	Drop
Ditch No. 1				
717+80	12.7	6.00	91	Drop

a/ Uncontrolled drainage area.

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TABLE 4 - ANNUAL COST
Lower Little Black Watershed, Missouri

Dollars [a/]

Evaluation Unit	Amortization of Installation Cost [b/]	Operation and Maintenance Cost	Total
Structural measures	605,250	81,950[c/ d/]	687,200
Project administration	84,980	-	84,980
GRAND TOTAL	690,230	81,950 [e/]	772,180

a/ Price base 1973.

b/ 100 years @ 5-5/8 percent interest.

c/ Includes $9,491 for replacement of CMP pipes.

d/ Includes $660 for replacement of recreation facilities.

e/ Includes $1,560 for O&M and replacement for the recreational development.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Lower Little Black Watershed, Missouri
Dollars [a/]

Item	Estimated Average Annual Damage Without Project	Estimated Average Annual Damage With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	826,692	114,609	712,083
Other Agricultural	16,293	1,664	14,629
Road and Bridge	8,993	1,093	7,900
Subtotal	851,978	117,366	734,612
Sediment			
Overbank deposition	115,152	14,147	101,005
Subtotal	115,152	14,147	101,005
Erosion			
Flood Plain Scour	19,558	2,660	16,898
Subtotal	19,558	2,660	16,898
Indirect	98,669	13,417	85,252
TOTAL	1,085,357	147,590	937,767

a/ Price base current normalized prices for agricultural damages and benefits and 1973 price base for all others.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Lower Little Black Watershed, Missouri
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS a/						Total	Avg. c/ Annual Cost	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Drainage	Redevel-opment	Recrea-tion	Secon-dary			
All structural measures	575,306 b/ d/	201,519	276,553	60,500	5,040	103,950	1,222,868	769,216	1.6:1.0
Project administration								98,849	
GRAND TOTAL	575,306 b/	201,519	276,553	60,500	5,040	103,950	1,222,868	868,065	1.4:1.0

a/ Price base current normalized for agricultural benefits and 1973 prices for all others.

b/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $52,065 annually and $378,376 annual damage reduction benefits will accrue to the structural measures in the Upper Little Black Watershed.

c/ From Table 4.

d/ Includes $67,980 annual damage reduction benefits in the Black Rock, Lockheart-Ferry, Newport, Augusta, and Success reaches of the White River Basin accruing to measures in this watershed.

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INVESTIGATIONS AND ANALYSES

The purpose of this section is to present information pertinent in supporting conclusions on which this plan is based. Sufficient information is included to explain the technical aspects of the plan. Items of a routine nature, as set forth in Soil Conservation Service Handbooks of Watershed Protection, Hydrology, Hydraulics, Geology and Economics, are not included. Supporting data developed for this study are on file at the Soil Conservation Service state office in Columbia, Missouri.

Work plan development was started in February 1966. Studies have been coordinated with the Corps of Engineers, Little Rock District, Little Rock, Arkansas, and the Missouri Department of Conservation. Since planning of Little Black Watershed was authorized in 1966, new legislation has been passed which has increased the needed detail and extent of the evaluation studies. Additional studies and evaluations have gone into preparation of the Little Black Watershed work plans in an effort to comply with the Environmental Protection Act of 1969 and the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The Soil Conservation Service contracted for an Environmental Assessment of the Little Black Watershed with the Midwest Research Institute of Kansas City, Missouri. The scope of this study was to supplement Soil Conservation Service investigations and evaluations made during watershed planning and to develop an environmental assessment for use in the environmental impact statement. Evaluation factors include: environmental setting - current and future without project; environmental impact; future environmental setting with project, alternative objectives; alternative measures; relationship between local short-term uses of man's environment and maintenance and enhancement of long-term productivity; irreversible and irretrievable commitment of resources; discussion of controversial issues; conclusions; and recommendations.

Land Use and Treatment

The Conservation Needs Inventory and Work Unit Technical Guides provided information on land capabilities and conservation needs for the watershed. Land treatment measures already applied and cost per unit of application for each measure were obtained from records of Soil Conservation Service field offices, the Missouri Department of Conservation, and farm operators. This information was used in preparing Table 1A.

Forest fire protection is provided by the Missouri Department of Conservation - Division of Forestry and Arkansas Forestry Commission in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program. Average annual fire loss of 0.4 percent in Missouri exceeds the established fire loss index goal of 0.2 percent. Presuppression activities and detection facilities are adequate, but additional suppression equipment is needed in Missouri to provide necessary protection to private land.

All land treatment measures to be applied during the project installation period were determined on the basis of treatment needs for watershed protection and flood prevention and on the level of participation expected from local landowners and operators. Consideration was given to personnel available for planning, funds available for federal cost sharing, and resources of farm operators for providing their share of funds to install land treatment measures.

Hydrologic and Hydraulic Studies

Lower Little Black Watershed and Upper Little Black Watershed were studied as one hydrologic unit constituting the entire Little Black Watershed. Six evaluation reaches in Lower Little Black Watershed and seven evaluation reaches in Upper Little Black Watershed were selected to divide the flood plain for proper hydrologic and economic evaluation. These reaches are shown on the project map.

Little Black Watershed was divided into eight subwatershed areas because of different hydrologic and soil conditions. Soil-cover complex numbers were developed for each subarea under present and future conditions. Future conditions will exist when land treatment outlined in the plan is established.

A series of systematically selected field plots provided information on the hydrologic condition of the forest land in the watershed and the reasons for the present hydrologic condition. The data obtained included measurements of litter and humus layers, determination of soil type and other hydrologic factors. The presence or absence of disturbance factors; such as fire, grazing, cutting, logging and the abnormal infestation of insects or diseases which might adversely affect hydrologic condition or increase fire hazard, was also recorded. This information served as the basis for developing precipitation-runoff curve numbers and land treatment needs for forest land.

Point rainfall quantities were obtained from United States Weather Bureau Technical Papers 40 and 49 for use in structure design and hydrologic evaluation. Basic rainfall amounts used are as follows:

Frequency	Duration	Inches
Probable maximum precipitation	6-hour	28.60
100-year	24-hour	7.45
50-year	24-hour	6.80
25-year	24-hour	6.20
10-year	24-hour	5.40
5-year	24-hour	4.65
2-year	24-hour	3.70
1-year	24-hour	3.00
.55-year	24-hour	2.20

Eighty-two valley and bridge cross sections were surveyed on the main stem and upland tributaries. An additional 75 cross sections for multiple-purpose channels were surveyed in the delta area. The flood

plain in the upland section was outlined on photographs and checked by field inspection and interview. It was also checked in relation to the 100-year peak discharge elevation.

The flood plain in the delta portion directly affected by flows from the Little Black River is that area of land lying between the upland along the western side of the river and the western edge of a series of sand ridges adjacent to ditch No. 3. Stream flows are generally in a southwesterly direction, but some cross flow also occurs overland because of a natural surface slope to the southeast.

Water surface profiles for floodwater damage evaluation in the upland area were processed by a computer. Water surface profiles and rating curves for the delta portion and improved channel section were computed manually.

Channel flood routing was obtained by computers and by the manual convex method. Computer routings were used for the upland tributaries and the main stem above reach VI. Printed hydrographs were obtained for the lower end of each section routed. Flood routing was then extended across the delta portion by manual computation.

For present conditions, hydrographs at the lower end of reach V were divided with approximately 4,000 c.f.s. maximum discharge for a 2-year storm and 8,500 c.f.s. for a 25-year storm remaining in the river flood plain. The balance was routed along the alignment of the improved channel until it rejoined Little Black River in reach X where the hydrographs were added. The separate hydrographs were added at each intervening cross section to make a composite hydrograph that was used to determine flood damage. The manually routed frequencies were expanded to the other four storms studied, making it possible to complete the evaluation. The same process was followed for future conditions assuring a minimum of 500 c.f.s. for a 2-year storm and 1,000 c.f.s. for a 25-year storm through the river channel. These future conditions were used to determine the final designed channel capacity.

Flood routed volumes were checked against those of actual measurements at various stream gages in the surrounding area. As a result of this comparison, volumes used for economic evaluation were adjusted upward by 10 percent for all frequencies.

Floodwater retarding structure release rates were established in consideration of downstream channel capacities. Two-stage releases are planned in seven of the large structures (three in lower and four in upper). Individual structure release rates are shown in Table 3.

Monthly flood distribution used in this work plan was developed from a weighted average of 11 stream gages located in southeast Missouri.

Twelve alternative formulations in addition to present conditions were flood routed by computers and manual computations. Six storm frequencies were used in the flood routing of each alternate. Four of these alternates, in addition to present conditions, were processed by an Economics II computer program to represent formulations in both watersheds for benefit evaluation. Two additional formulations, without improved channel, were computed by manual methods to assist in allocation of the evaluated benefits between the two watersheds.

Engineering Studies

Field surveys for all floodwater retarding structures are in sufficient detail to determine storage available and to make final land rights maps. All surveys are based on sea level data and are adequate for construction with minor amounts of additional work needed around the fill and borrow areas. Topographic maps were made by Kelsh plotting and plotted at 4-feet contour intervals in the reservoir area and 2-feet contour intervals in the fill and emergency spillway areas.

Special care was given the large sites in this watershed. The runoff was increased over minimum as specified in Engineering Memorandum SCS-27 on all sites over 10 square miles of drainage area by a factor ranging from 1.1 to 1.3. Duration and velocity of flow of the freeboard storm were also reduced to the level of smaller structure sites by increasing temporary storage and/or using high c.s.m. second-stage inlets. Emergency spillways on the large sites were planned away from the dam where possible and with bulk lengths to meet the requirements of Technical Release 52.

Special counter measures were incorporated in the design of the floodwater retarding structures because of location in the earthquake intensity zone. Structures F-2, F-3, F-11 and G-2 are class b structures. The design features incorporated were additional freeboard (0.05 fill height), additional top width (0.25 normal top width) and flatter slopes (3.5:1). The other structure is a class a structure, and the top width was increased (0.25 normal top width).

Field surveys for channel improvement were obtained by taking cross sections along the proposed channel. These surveys were based on sea level data. Additional cross sections will be needed in the design stage.

Peak discharges of drainage channels were based on the "C" drainage curve with conversion of upland drainage areas to bottom land drainage area equivalents by the procedure in National Engineering Handbook 16.

Design of the floodway and multiple-purpose ditch No. 3 was based on a 2-year storm runoff from the installed Upper Little Black Watershed and the delta area east of the Little Black River in the Lower Little Black Watershed. The Upper Little Black peak discharge was reduced

by 30 percent at the diversion structure by using two-stage inlets and storing a 5-year storm runoff in four of the larger structures. These larger structures were designed with an open port and a gated port on the low stage inlet. By reducing peak discharge at the diversion structure by 850 c.f.s., the size of the floodway was reduced by 40 percent and the multiple-purpose ditch No. 3 was reduced by approximately 25 percent. The floodway multiple-purpose ditch No. 3 and other channels were designed for stability by criteria in Technical Release 25.

Model studies will be made on the floodway and multiple-purpose ditch No. 3 before final design is made. Additional money was provided in the cost estimates of the drop structures to cover additional design requirements revealed in the model studies. Stability requirements of multiple-purpose laterals for the aged conditions have been met in all cases. Some minor deviation in the "as-built" criteria was accepted recognizing a degree of risk was involved in establishing the initial stability. Additional work may be necessary during the establishment period to achieve the desired stability of the channels. This should be accomplished at a cost not exceeding 10 percent of construction costs.

Geologic Studies

Sediment investigations were made concurrently with those for the Upper Little Black Watershed. Present land use was mapped on a 40 percent sample of the upland area.

Aerial photographs were used for the field study. Data concerning crop rotations, conservation practices and changed land use for present and future conditions were obtained from the Ripley and Butler Counties, Missouri, district conservationists and staffs. Four areas were studied in Upper Little Black Watershed. A weighted average was drawn from the detailed studies of these watersheds and was used for reservoir areas not studied in detail.

The universal soil loss equation was used to determine soil loss by sheet erosion. Estimated sediment from other sources was based on field examinations and studies in similar watersheds. Sediment delivery ratios, adjusted to the respective drainage areas, range from 18 to 70 percent. Trap efficiency, as determined by the capacity-inflow ratio, is 95 percent.

The average volume weight for upland soils is estimated to be 95 pounds per cubic foot. Submerged sediment in the reservoir is estimated to average 55 pounds per cubic foot. Aerated sediment is estimated to average 95 pounds per cubic foot.

Reservoir sedimentation design summaries (SCS-309) were completed for each site. Total sediment storage requirements used in planning are presented in Table 3.

Preliminary borings at three sites, backhoe pits at one site and seismic data were used to sample bedrock and soil conditions. A detailed study was not made at any site. Abutments are usually composed of deep residuum over Ordovician Age bedrock. All calcareous rocks have solution openings. This development generally follows fractures or bedding planes. The influence of bedrock solution openings has been assessed and adjustments to structure designs and/or construction costs have been made where necessary (see geology and engineering supporting data for details). A few deposits of Tertiary Age sand and gravel are present on abutments. The residuum consists of gravelly clays and weathered bedrock which are moderately dense, permeable, and subject to moderate consolidation. Foundations are recent alluvial valley fill over residuum or bedrock. The alluvium consists of various combinations of sand, silt and clay. Emergency spillway excavations will be from residuum. Boring at sites F-2 and F-11 were made to determine soil materials and depths and to obtain samples. Index tests were made to determine values for the Technical Release 52 analysis.

Borrow is available from the valley fill alluvium, terrace deposits, and residuum, and sufficient quantities are available for construction. General site conditions encountered were projected to sites which were not investigated. No samples of foundation or embankment materials were tested. Boring logs, profiles, and investigation reports were prepared for each site.

Borings were made at approximately 1-mile intervals along the proposed route of the multiple-purpose channel. Standard penetration tests were made, and soil samples obtained at each location. Selected samples were tested at the Service Soil Mechanics Laboratory. Soils tested along the route of the proposed channel consist of clayey silts, silty clays and sandy strata. Boring logs and investigation reports were prepared, and sample analysis reports were obtained for the channel study.

Detailed site investigations will be conducted prior to design and construction.

Economic Studies

The Economics II computer program was used to calculate crop, pasture, other agricultural and nonagricultural damages at present and with the project installed. Input data for the computer program was based on data obtained from landowners, agricultural agency leaders, and other knowledgeable persons in the area. Information collected included present land use, crop yields, probable shifts in crop distribution, expected land use after project installation, and historical

information on flooding and flood damages. Basic data for estimates of projected yields were obtained from interviews, Missouri Soil Conservation Service field office Technical Guide, and local Soil Conservation Service personnel. Fences and roads in the flood plain were mapped in the field and measured for damage calculation.

More intensive land use and drainage benefits were calculated for the flood plain area in reaches VI, VIII, IX, and X and drainage benefits for the remaining wetland part of the delta area. Associated costs were deducted from gross benefits to obtain the net benefits. Benefits were discounted to allow for a 10-year lag in accrual. An adjustment of 80 percent was used as the degree of participation by landowners. Operation and maintenance costs of on-farm land treatment, necessary to realize the benefits, were treated as associated costs in determining net benefits.

Damage reduction resulting from land treatment was calculated as a percentage of the total damage reduction. A study of routings in other projects, having land treatment, was used to arrive at the percentage factor.

Economic and hydrologic studies were made concurrently for the Upper and Lower Little Black work plans. To facilitate the analysis and for planning efficiency, the 82 valley sections were combined into 13 evaluation reaches. Reaches were combined when it was determined that cropping patterns, damageable values, and flooding hazard were similar. This resulted in seven evaluation reaches in Upper Little Black and six in Lower Little Black.

Both projects consist of one hydrologic unit and some benefits in the project accrue to measures installed in the Upper Little Black project. Allocation of the benefits in this project accruing to the measures in Upper Little Black was based on an incremental analysis. Floodwater retarding structures were treated as the first increment in the analysis.

The White River Basin Study was used for a source of benefits and damages in the downstream section. Damage reduction in the downstream reaches was determined by the use of the holdout hydrograph method. All benefits are distributed between the Corps of Engineers and Soil Conservation Service projects so that each share equitably on a first-added basis. All benefits are adjusted for a 15-year lag in installation. The area controlled in the two Little Black work plans is the same as that used in the White River Study, and no adjustment was necessary in the benefits attributable to the Little Black projects. Downstream benefits were allocated between the Upper and Lower Little Black projects based on the area controlled by floodwater retarding structures in each project. Benefits in reaches VIII, IX, and X were based on a reduced composite acre value to account for the effects of flooding from the Current River.

Estimate of damages to land by flood plain scour and sedimentation was derived from data gathered in the field by the geologist. These data included acres damaged, severity of damage, and period and degree of recovery attributed to the installed project. Damages were evaluated according to procedures set forth in chapter 5 of the Soil Conservation Service Economics Guide.

Indirect damages considered were depreciation of property in the flood areas; loss of time; additional expenses of operators used in repair and cleanup which would normally be used in productive operation; and additional distances driven by mail carriers, school buses, and farmers because of flooded roads. The indirect damages were computed as 10 percent of the direct damage.

Secondary benefits were computed on two conditions using procedures outlined in chapter 11 of the Economics Guide. One condition was the value of local secondary benefits stemming from the project. These values were determined as 10 percent of the direct primary benefits. Indirect benefits were excluded from consideration in computing secon dary benefits. The second condition was the value of local secondary benefits induced by the project. These values were determined as 10 percent of the increased costs that primary producers will incur in connection with increased production. These benefits were not needed for project justification but were included in the overall benefit cost ratio of the project.

Project installation will provide opportunities for employment of local labor presently unemployed or underemployed. Data from similar projects indicate that labor cost is equal to approximately 50 percent of construction costs. Unemployed or underemployed local labor used in project installation is estimated to be 20 percent. This value was amortized and converted to a redevelopment benefit. The value of local labor employed in project operation and maintenance was treated as a decreasing annuity for 20 years, converted to an annual equivalent for the project life, and used as a redevelopment benefit.

Value of easements was determined by local appraisal, taking into consideration the current market value of real estate. Area inundated by sediment and flood pools was excluded from damage calculations. An estimate was made of the value of production lost in sediment and flood pools and channel areas after installation of the project. The average annual loss in value of production within the pool areas plus secondary costs was compared with the amortized value of easements. The larger amount, the value of the easements, was used in the economic evaluation.

Current normalized prices were used in this plan for all agricultural damage and benefit calculations. All monetary values have been converted to an average annual basis. All costs were amortized at 5-5/8

percent except associated costs which were amortized at 8 percent. Amortization of the project is for a 100-year period.

Fish, Wildlife and Recreation

In 1967 fish and wildlife investigations were conducted by the Bureau of Sport Fisheries and Wildlife in cooperation with the Missouri Department of Conservation and the Soil Conservation Service.

A formal investigation of the fishery resource contained in this project's ditch channels was conducted by the Missouri Department of Conservation in the summer of 1969. Observations were made for standing crop of fish, cover, and channel conditions to provide fish habitat.

In the summer of 1973 the Soil Conservation Service made formal observations of the ditch channels obtaining water length, depth, type of flow, and associated streambank vegetation.

In January 1971 Soil Conservation Service technicians made a field trip by canoe on the Little Black River main stem through the project. This survey identified the areas of critical overbank breaks where the river may change its course. Observations of wildlife, streambank vegetation, and stream flow were made. The observations emphasized the scenic and aesthetic properties of the stream.

Numerous meetings, coordination, and correspondence have taken place among the sponsors, Soil Conservation Service, Missouri Department of Conservation, and the Arkansas Fish and Game Commission to deal with fish, wildlife, and recreation aspects of this project.

From their formal investigations and discussion of the project, the areas of fish and wildlife concern were loss of riparian habitat on the ditch channel, fishery of the ditch channel, and need for public access points along the main stem of the Little Black River. Mitigation and preservation measures will be planned to reduce adverse fish and wildlife effects of the channel modification. Opportunities to provide recreational facilities on the main stem of the Little Black River were incorporated into other aspects of the project.

The staff of the Missouri State Park Board made a recreational analysis and developed a proposal for a water-based recreational development. The analysis included proposed facilities and day-use capacities. The proposed recreational development in the Upper Little Black Watershed Project is based on the proposal from the Missouri State Park Board.

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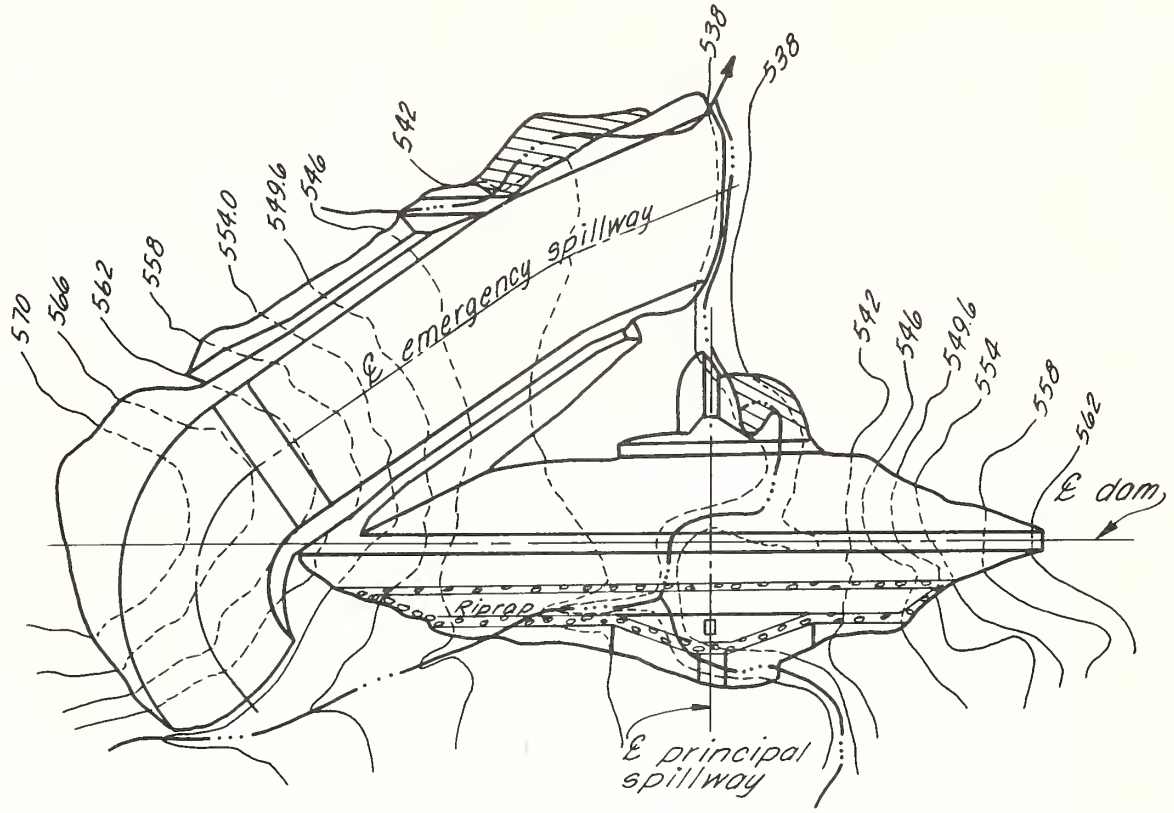
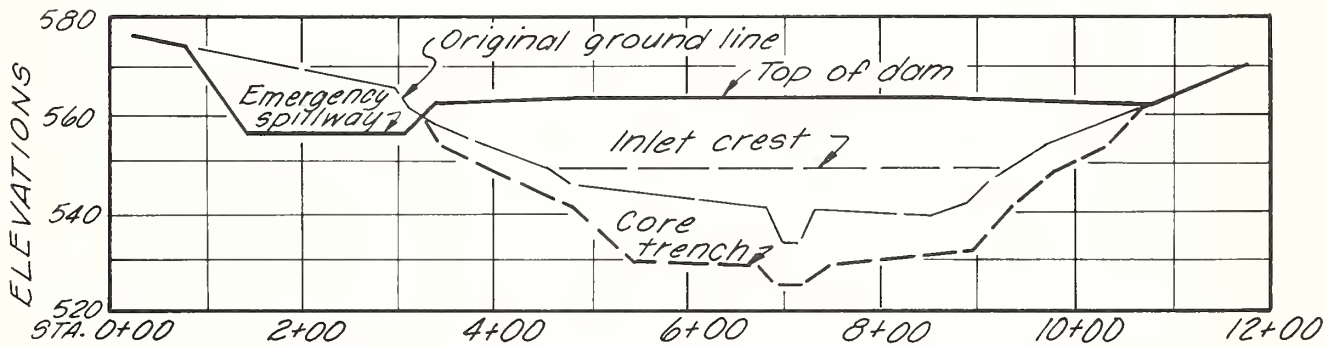
USDA-SCS-LINCOLN, NEBR. 1975

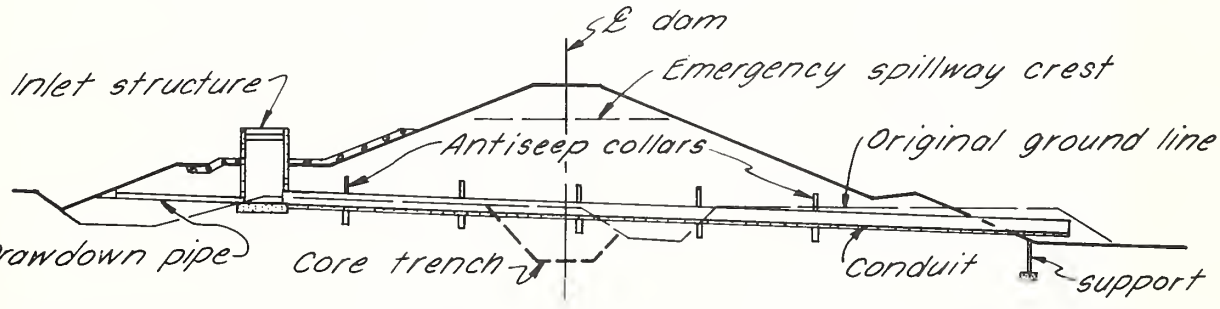
TYPICAL EARTH DAM WITH PIPE DROP INLET



PLAN OF EMBANKMENT AND SPILLWAY



PROFILE ON CENTERLINE OF DAM



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

FIGURE 1

USDA-SCS-LINCOLN, NEBR. 1972

S,L-28,767

U. S. DEPARTMENT OF AGRICULTURE

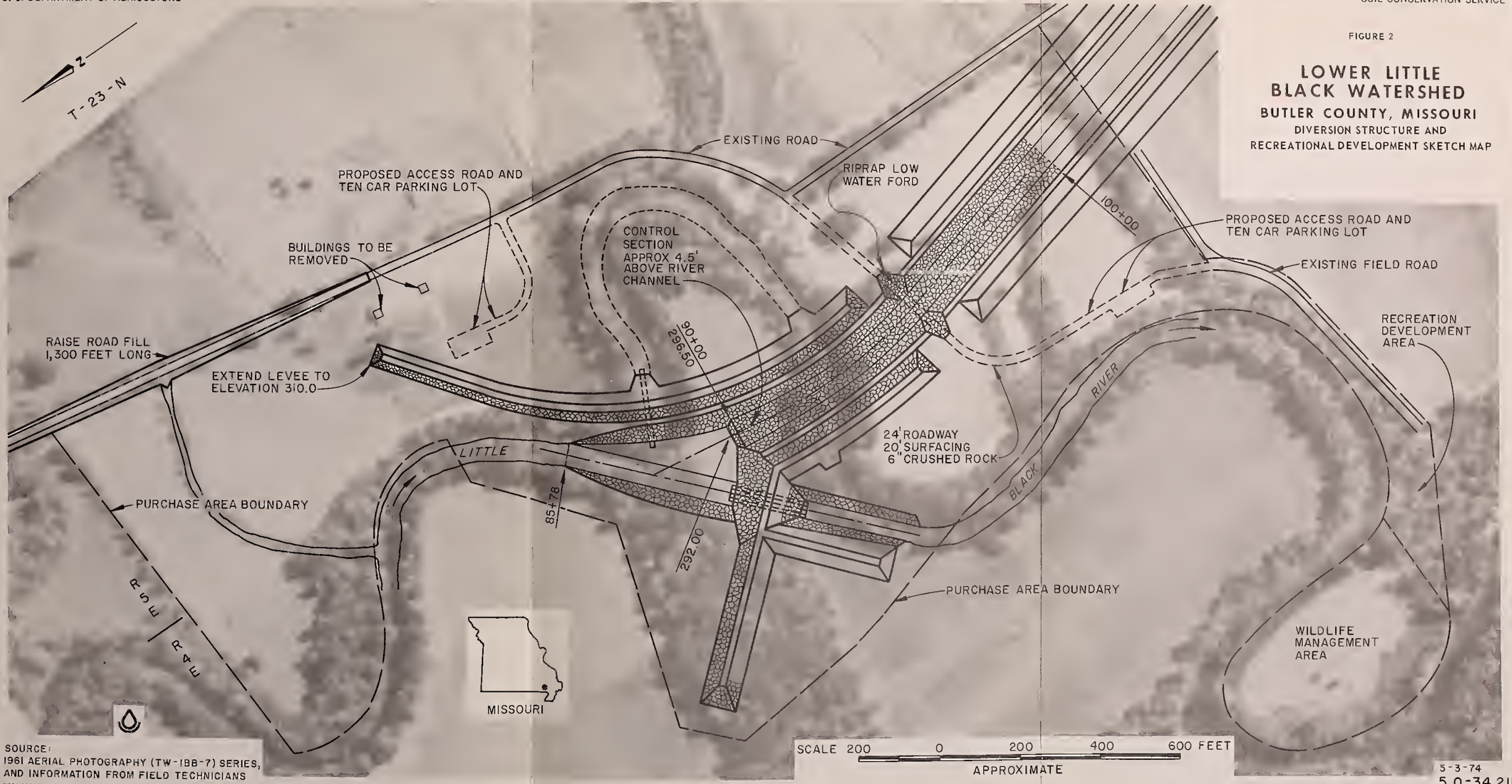
SOIL CONSERVATION SERVICE

FIGURE 2

LOWER LITTLE BLACK WATERSHED

BUTLER COUNTY, MISSOURI

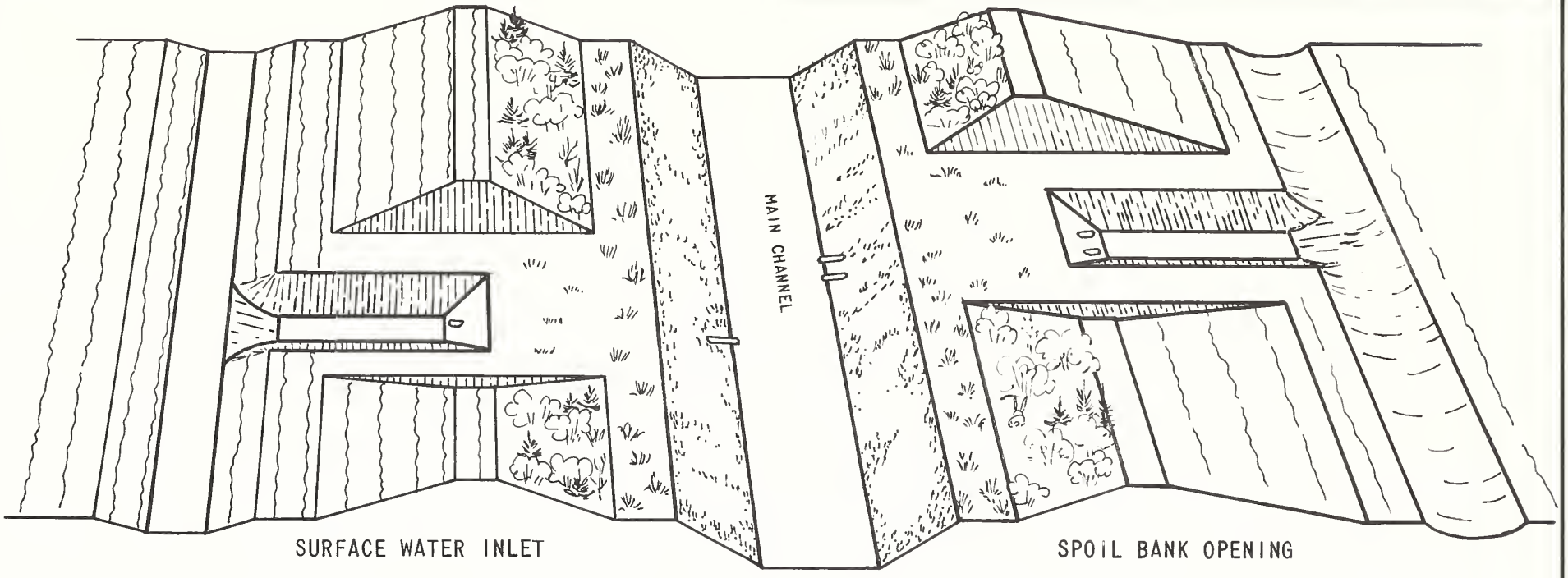
DIVERSION STRUCTURE AND RECREATIONAL DEVELOPMENT SKETCH MAP

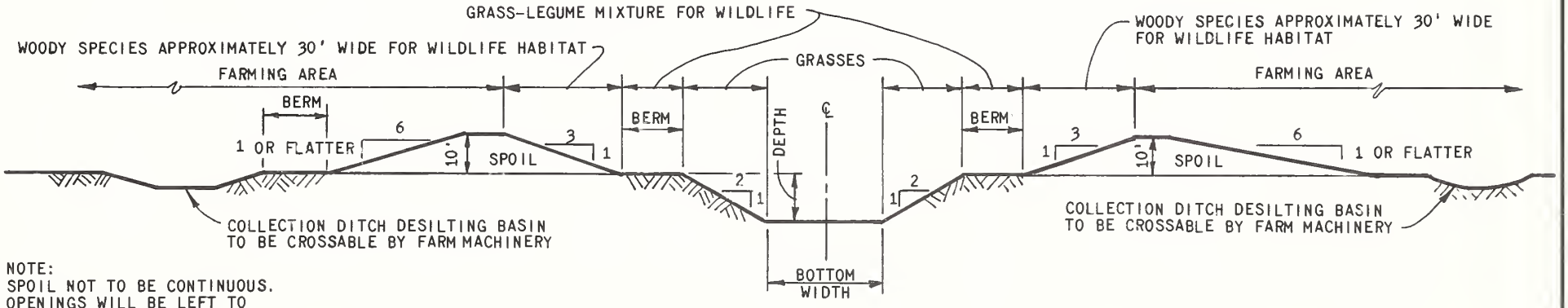


SOURCE:
1961 AERIAL PHOTOGRAPHY (TW-1BB-7) SERIES, AND INFORMATION FROM FIELD TECHNICIANS

USDA-SCS-LINCOLN, NEBR 1974

5-3-74
5,0-34,211





NOTE:
SPOIL NOT TO BE CONTINUOUS.
OPENINGS WILL BE LEFT TO
PERMIT DITCH OVERFLOW AT
HIGH FLOOD STAGES.

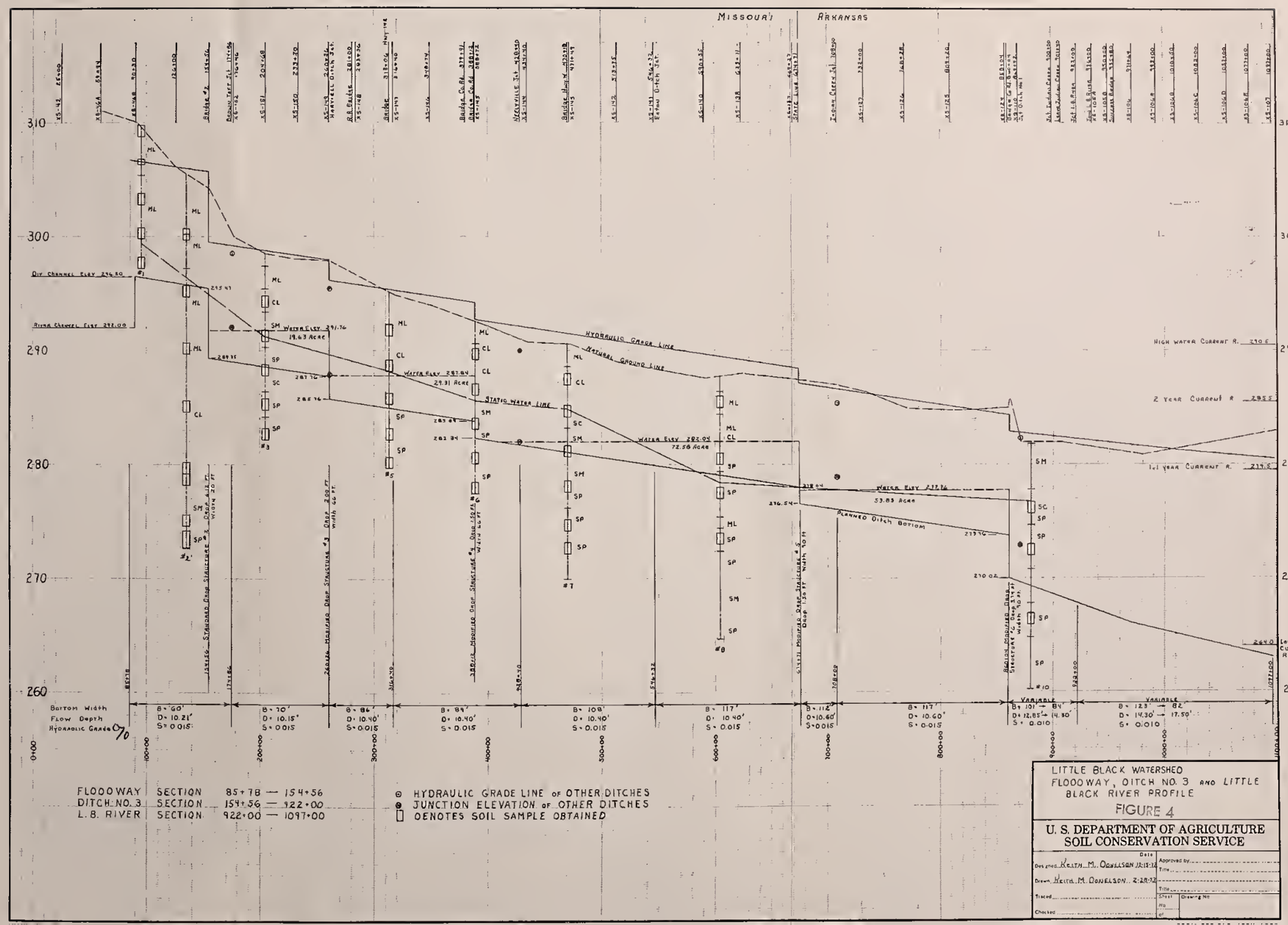
TYPICAL CHANNEL CROSS SECTION – MAIN DITCH

FIGURE 3

SHOWING SURFACE INLETS AND RE-ESTABLISHMENT OF VEGETATIVE COVER ON BOTH SIDES.

USDA-SCS-LINCOLN, NEBR. 1974

5,L-29,659.2



FLOODWAY SECTION 85+78 — 154+56
DITCH NO. 3 SECTION 154+56 — 922+00
L.B. RIVER SECTION 922+00 — 1097+00

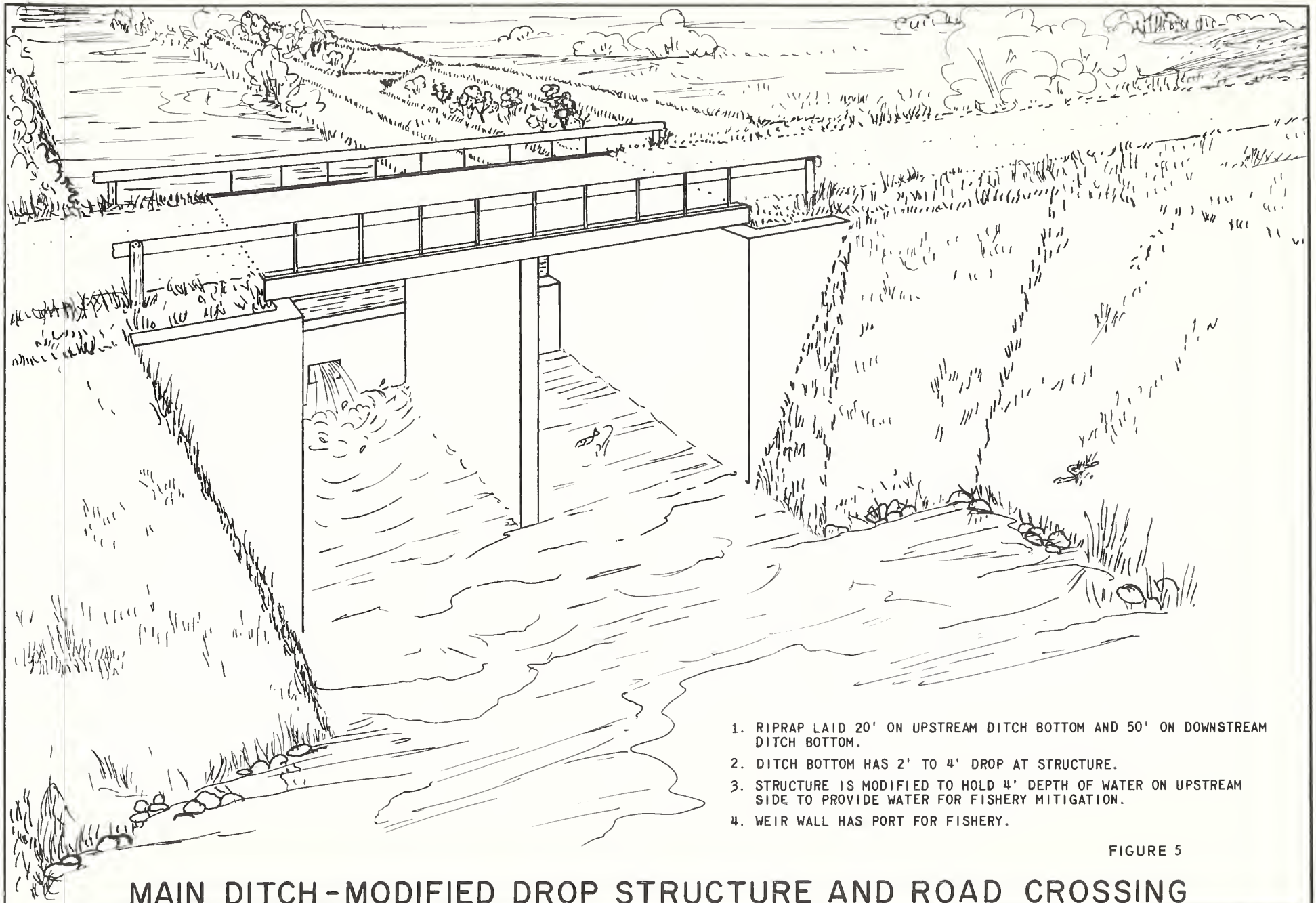
⊙ HYDRAULIC GRADE LINE OF OTHER DITCHES
⊛ JUNCTION ELEVATION OF OTHER DITCHES
□ DENOTES SOIL SAMPLE OBTAINED

LITTLE BLACK WATERSHED
FLOODWAY, DITCH NO. 3 AND LITTLE BLACK RIVER PROFILE

FIGURE 4

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date
Designed KEITH M. DONELSON 12-15-72
Drawn KEITH M. DONELSON 2-28-73
Traced
Checked
Approved by
Title
Sheet No. of
Drawing No.

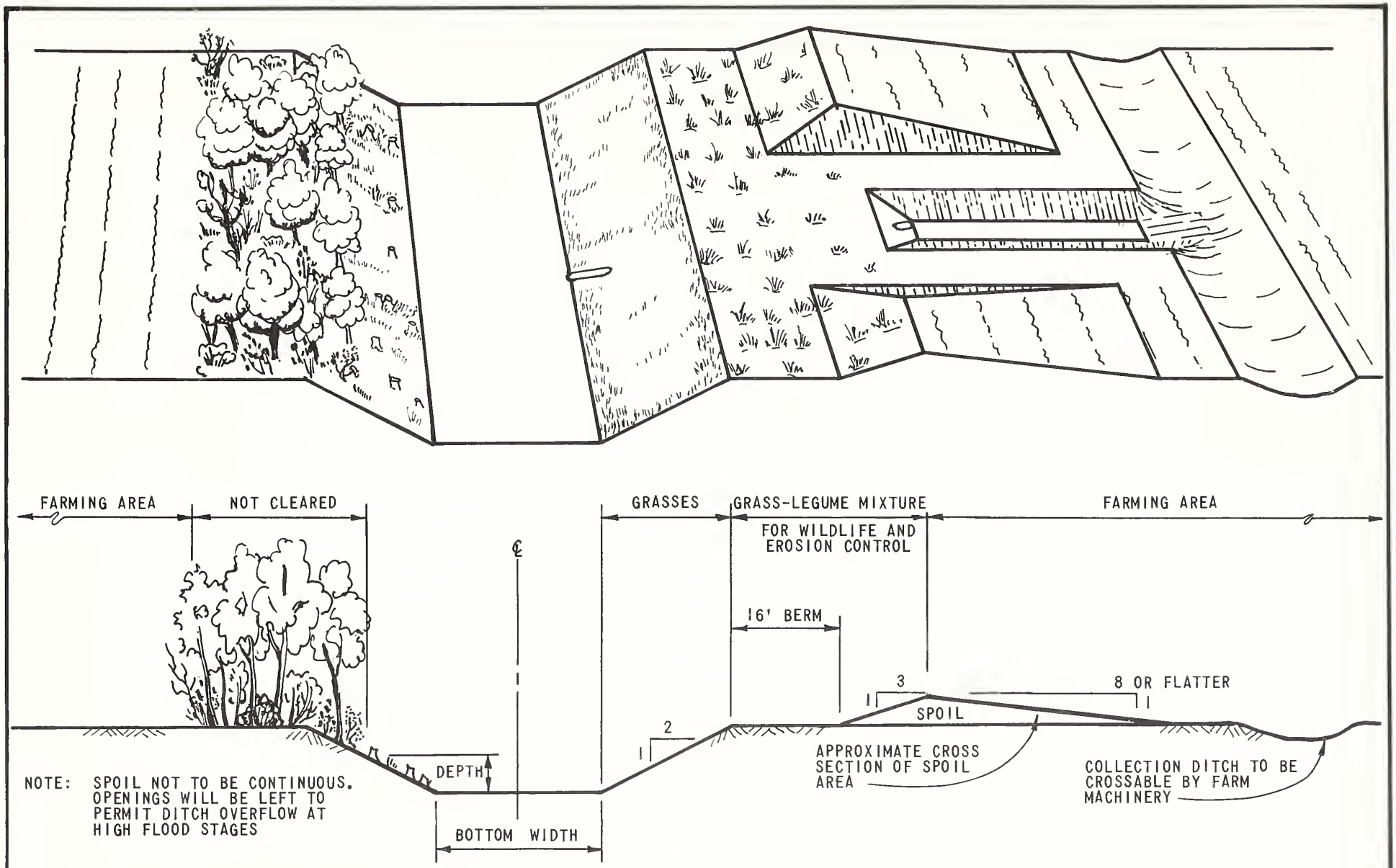


1. RIPRAP LAID 20' ON UPSTREAM DITCH BOTTOM AND 50' ON DOWNSTREAM DITCH BOTTOM.
2. DITCH BOTTOM HAS 2' TO 4' DROP AT STRUCTURE.
3. STRUCTURE IS MODIFIED TO HOLD 4' DEPTH OF WATER ON UPSTREAM SIDE TO PROVIDE WATER FOR FISHERY MITIGATION.
4. WEIR WALL HAS PORT FOR FISHERY.

FIGURE 5

MAIN DITCH - MODIFIED DROP STRUCTURE AND ROAD CROSSING

USDA-SCS-LINCOLN, NEBR. 1974



TYPICAL CHANNEL CROSS SECTION

FIGURE 6

SHOWING CONSTRUCTION WORK FROM ONE SIDE TO SAVE EXISTING WILDLIFE HABITAT ON OPPOSITE SIDE.

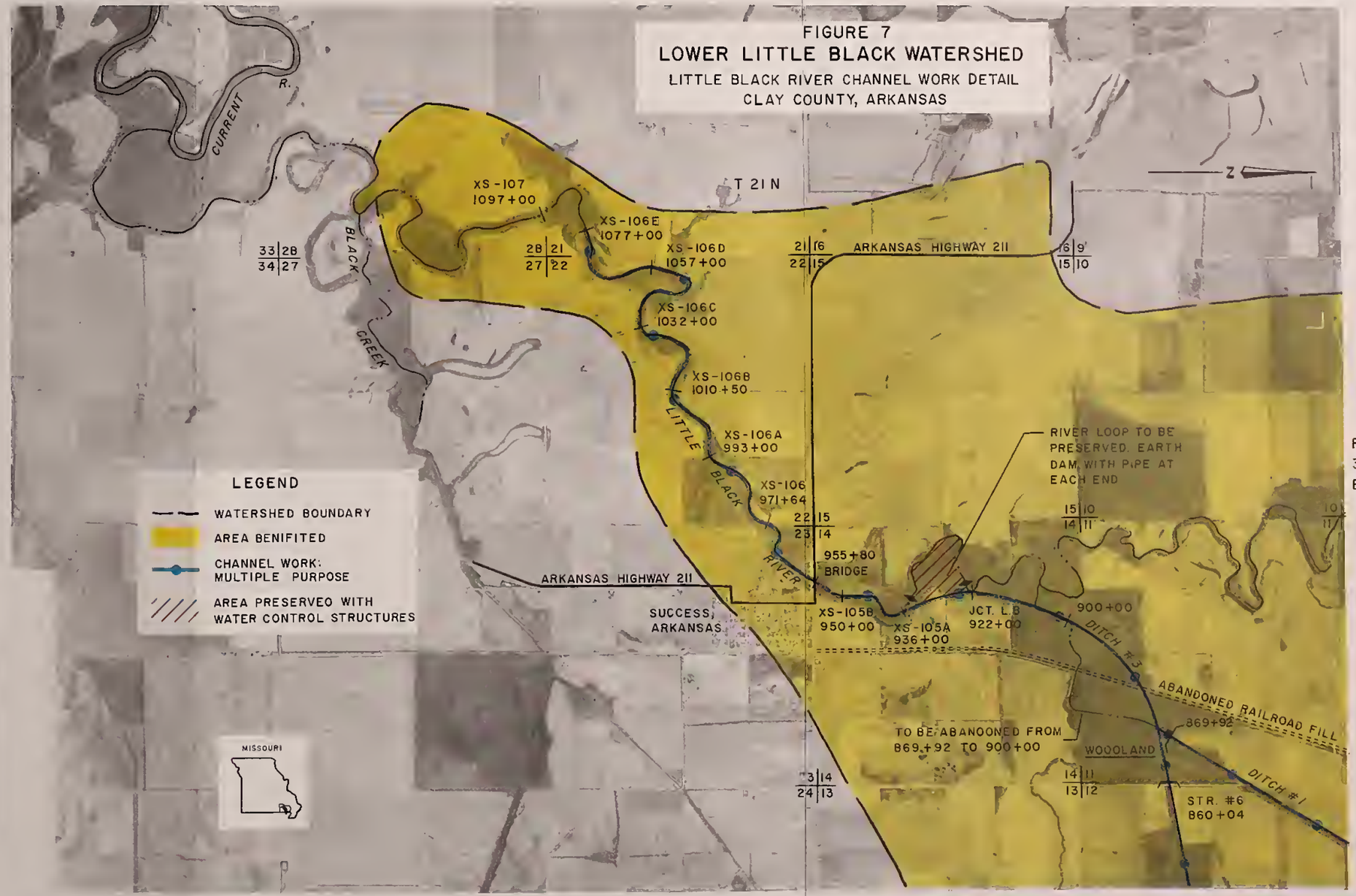
USDA-SCS-LINCOLN, NEBR. 1974

Rev. 4-72 5,L-29,659.4

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

FIGURE 7
LOWER LITTLE BLACK WATERSHED
LITTLE BLACK RIVER CHANNEL WORK DETAIL
CLAY COUNTY, ARKANSAS



SOURCE:
1971 AERIAL PHOTOGRAPHY, SERIES HZ, SCS DRAWING 5,S-30,983, AND INFORMATION FROM FIELD TECHNICIANS.

SCALE 2000 0 2000 4000 FEET
APPROXIMATE

REV. 5-10-74
5,N-34,038

USDA-SCS-LINCOLN, NEBR., 1974

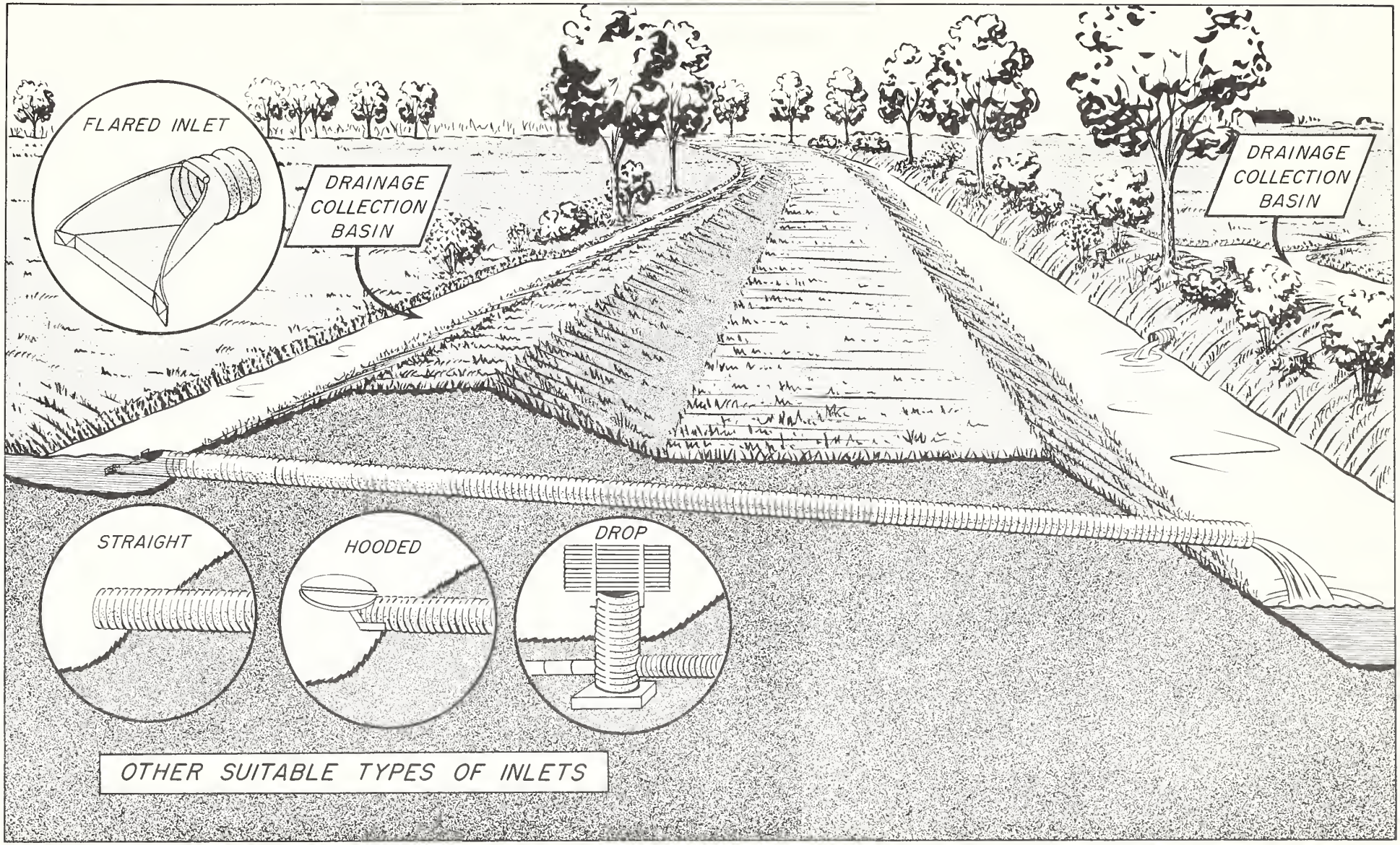


Figure 8
Typical Water Surface Inlet
Associated With All Channels

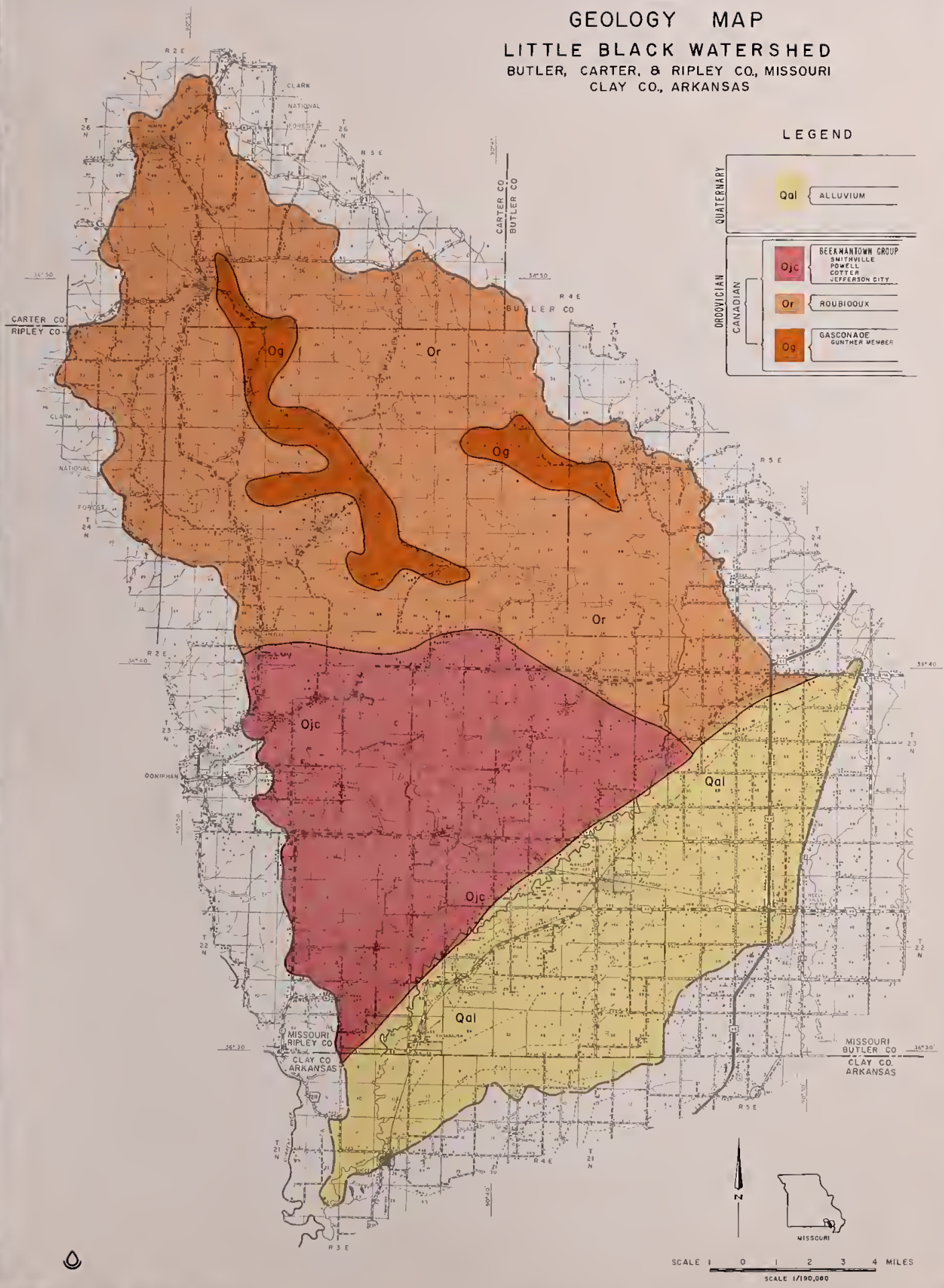
USDA SCS LINCOLN NEBR 1974

FIGURE 9

GEOLOGY MAP

LITTLE BLACK WATERSHED

BUTLER, CARTER, & RIPLEY CO., MISSOURI
CLAY CO., ARKANSAS



SOURCE
S.C.S. Drawing Number 5,S-21405 and
Geological Map of Missouri, 1961 Polyconic Projection

4 - 4 - 74
5, P-34,036

DRAINAGE DITCHES OF LOWER LITTLE BLACK

Ditch Name	Type of Flow Pr[a] (Miles)	I[b] (Miles)	E[c] (Miles)	Total Length (Miles)	Pools Greater Than 3.0 Deep (Acres)	(Miles)	Pools Less Than 3.0 Deep (Acres)	(Miles)
Ditch #3	-	11.7	-	11.7	15.1	3.3	16.8	6.2
Ditch #1 (2.7 miles of perennial flow is in Arkansas)	2.1	7.1	2.8	12.0	7.5	6.0	-	-
Ditch #2 (includes Lateral #2)	-	7.0	4.3	11.3	11.0	1.1	8.4	5.9
Harviell	-	3.7	5.7	9.4	8.2	1.7	6.1	2.0
Brown-Taft	-	1.2	4.1	5.3	9.8	1.0	0.5	0.2
Neelyville-Suder	-	4.0	7.5	11.5	-	-	5.1	4.0
Eaton Ditch	-	-	3.9	3.9	-	-	-	-
Indian Creek Ditch	-	-	6.0	6.0	-	-	-	-
TOTAL	2.1	34.7	34.3	71.1	51.6	13.1	36.9	18.3

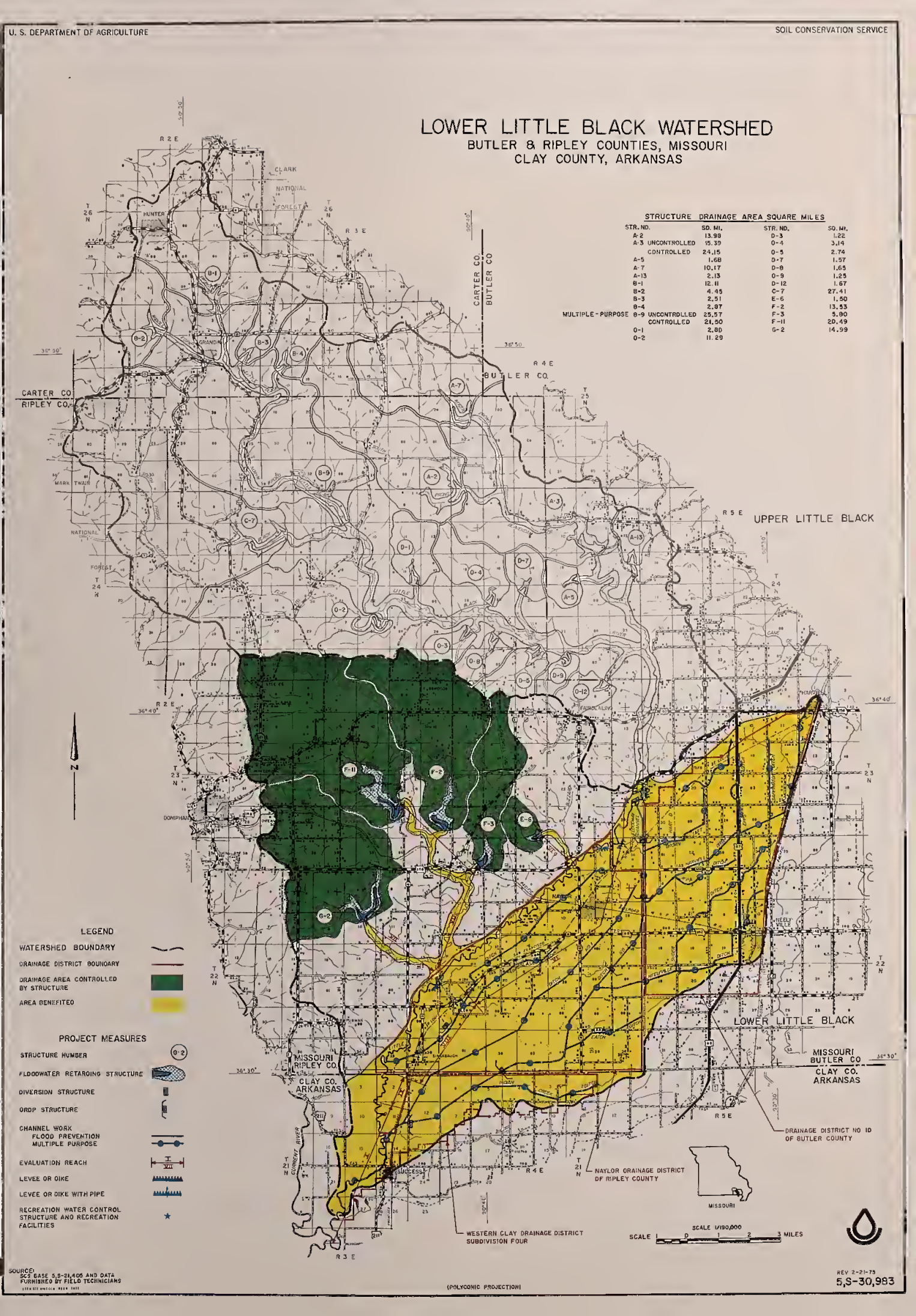
a/ Perennial Flow - continuous flow except during period of extreme drought.
b/ Intermittent Flow - continuous flow through some seasons but little or no flow through other seasons. Sustains permanent pools.
c/ Ephemeral Flow - flows only during periods of surface runoff.

FIGURE 10

LOWER LITTLE BLACK WATERSHED

BUTLER & RIPLEY COUNTIES, MISSOURI
CLAY COUNTY, ARKANSAS

STRUCTURE		DRAINAGE AREA SQUARE MILES		
STR. NO.		SQ. MI.	STR. NO.	SQ. MI.
	A-2	13.98	D-3	1.22
	A-3 UNCONTROLLED	15.39	D-4	3.14
	CONTROLLED	24.15	D-5	2.74
	A-5	1.68	D-7	1.57
	A-7	10.17	D-8	1.65
	A-13	2.13	D-9	1.25
	B-1	12.11	D-12	1.67
	B-2	4.45	C-7	27.41
	B-3	2.51	E-6	1.50
	B-4	2.87	F-2	13.53
MULTIPLE-PURPOSE	B-9 UNCONTROLLED	25.57	F-3	5.80
	CONTROLLED	21.50	F-11	20.49
	D-1	2.80	G-2	14.99
	D-2	11.29		



LEGEND

- WATERSHED BOUNDARY
- DRAINAGE DISTRICT BOUNDARY
- DRAINAGE AREA CONTROLLED BY STRUCTURE
- AREA BENEFITED

PROJECT MEASURES

- STRUCTURE NUMBER (0-2)
- FLOODWATER RETARDING STRUCTURE
- DIVERSION STRUCTURE
- DROP STRUCTURE
- CHANNEL WORK
  - FLOOD PREVENTION
  - MULTIPLE PURPOSE
- EVALUATION REACH
- LEVEE OR DIKE
- LEVEE OR DIKE WITH PIPE
- RECREATION WATER CONTROL STRUCTURE AND RECREATION FACILITIES

SOURCE: SCS BASE 5,S-21,405 AND DATA FURNISHED BY FIELD TECHNICIANS

(POLYCONIC PROJECTION)

REV 2-21-75

5,S-30,983