PLAN for
WATERSHED PROTECTION
FLOOD PREVENTION
and
RECREATION

WET WALNUT CREEK
SUBWATERSHED NO. 2

NESS, RUSH, and PAWNEE COUNTIES, KANSAS

ADDENDUM

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

This addendum was developed in accordance with phase-in procedures adopted by the Water Resources Council for level C plans for which field studies, analyses, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97, as supplemented and amended. This plan was developed using 1974 prices and a 6 1/8 percent discount rate.

Section I of this addendum shows the benefit-cost ratio with and without secondary benefits using the price base and discount rate used in the plan.

Section II of this addendum displays an abbreviated alternative plan for Wet Walnut Creek Basin as a whole and was developed to emphasize environmental quality. This is a hypothetical plan, not to be installed, which presents information for comparison with the selected plan.

Section III of this addendum displays the effects of the selected plan for Wet Walnut Creek as evaluated for each of the separate accounts--national economic development, environmental quality, regional development, and social well-being.

SECTION I

of

ADDENDUM

for

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

This section shows the project costs, benefits, and benefit-cost ratio based on 6 1/8 percent interest rate.

1.	Average annual project costs are	$382,000
2.	Average annual project benefits without secondary benefits are	$398,100
3.	Average annual project benefits with secondary benefits are	$571,100
4.	The project benefit-cost ratio without secondary benefits is	1.04 to 1.0
5.	The project benefit-cost ratio with secondary benefits is	1.50 to 1.0

December 1975

SECTION II

of

ADDENDUM

for

WET WALNUT CREEK WATERSHED, KANSAS

Abbreviated Environmental Quality Plan

This Environmental Quality Plan must consider the Wet Walnut Creek basin as a whole. This plan is not restricted by limitations of any existing authority such as PL-566. Elements to be installed in certain portions of the basin are interrelated to elements and effects in other portions of the basin therefore necessitating basin-wide planning.

Environmental Problems

A. Natural Beauty and Human Enjoyment Area Problems

Shade tree population and quality in small towns within the basin have deteriorated in recent years due to Dutch Elm disease and improper management.

Open spaces for public use within the basin are non-existent. Recreational facilities within reasonable distance from the area are limited.

B. Biological Resource Problems

The existence and needs of rare and endangered species within the basin is little known.

Educational facilities focusing on the environment and preservation of natural resources are lacking in the basin.

The lack of diversity in large tract farming practices has adversely affected wildlife species.

Many acres of Type 1 and 2 wetlands in the western part of the basin are not utilized to their fullest potential for enhancement of wildlife.

The lack of ground water management within the basin has adversely affected stream aquatic habitat and riparian habitat.

C. Archeological and Historical Sites Problems

Archeological, historical, and unique architectural sites are unrecorded or destroyed because of the lack of information and communication between the local public and interested authorities.

D. Land, Water and Air Quality Problems

Unprotected sloping cropland and rangeland within the basin are subject to moderate or severe sheet erosion. The mainstem of Wet Walnut Creek is subject to heavy sedimentation. The average sediment yield for the basin is 108 acre-feet/year.

E. Need for Minimizing Conflicts in Land Use

Increased competition for land and water resources within the area make it important that resource problems be anticipated and that people have the authorities to deal with them. Short and long range comprehensive planning is needed to identify, protect, and enhance important values.

Component Needs

A. Areas of Natural Beauty and Human Enjoyment

A small town shade tree restoration program

Creation of open space public-use areas

B. Biological Resources

Full utilization of certain wetlands within the watershed should be accomplished.

Improve ground water management.

Improvement of fish and wildlife habitat.

Preserve existing riparian habitat.

C. Historical and Archeological Sites

Preservation of historical sites.

Preservation or notation of archeological sites that may be involved with future development areas.

D. Land, Water and Air Quality

Establish proper management systems on lands within the watershed.

E. Conflicts in Land Use

Establish a comprehensive land use plan.

Environmental Quality Plan Elements

A. Management, protection, enhancement, and creation of areas of natural beauty and human enjoyment.

1. Establish a shade tree development program for 13 rural towns.

   Installation by: Towns

   Technical Assistance by: Department of State and Extension Forestry

   Cost: $25,000; $2,000 OM&R

2. Establish 700 farmstead windbreaks and 160 acres of shelterbelts.

   Installation by: Landowners, Department of State and Extension Forestry, Agricultural Stabilization and Conservation Service

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($45,000)

3. Rehabilitate 30 farmstead windbreaks.

   Installation by: Landowners (cost sharing program needed)

   Technical Assistance by: Department of State and Extension Forestry

   Cost: Included in land treatment ($2,000)

4. Establish 4 open space public use areas by purchasing and developing 1,737 acres. Establish within these areas 4 separate developments including a total of 322 acres in resevoirs, 644 acres of public use area, and 771 acres in buffer zones.

   Installation by: Kansas Forestry, Fish and Game Commission, Bureau of Outdoor Recreation, State Park and Resources Authority

   Technical Assistance by: Same as above

   Cost: $1,996,600 $40,100 OM&R

B. Management, preservation, and enhancement of especially valuable or outstanding biological resources or ecosystems.

1. Survey the occurrence of endangered and threatened species and their habitat needs.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $9,000

2. Establish 3 outdoor classroom educational facilities encompassing a total of 60 acres.

   Installation by: School districts

   Technical Assistance by: Soil Conservation Service, Extension Forestry, Educational Institutions, Kansas Forestry, Fish and Game Commission, and Kansas Advisory Council on Environmental Education

   Cost: $18,000; $1,000 OM&R

3. Obtain easements on 3,150 acres of Type 1 and 2 wetlands in Subwatershed Nos. 4 and 5.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Same as above

   Cost: $157,500

4. Increase land use diversity on 70,000 acres of cropland by using variable cropping patterns to provide increased edge effect and habitat diversity.

   Installation: Landowners

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $35,000; $1,800 OM&R

5. Establish an extensive ground water management program including regulated withdrawl and a system of 44 recharge structures and 4 multipurpose (recharge - public use) strucutres to improve 265 miles of stream aquatic habitat.

   Installation by: Watershed district, Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission, (Ground Water Management District needed)

   Technical Assistance by: Kansas Water Resources Board, Kansas Forestry, Fish and Game Commission USGS, Soil Conservation Service

   Cost: (48 sites) $11,872,100; $42,000 OM&R

6. Obtain easements on 11,000 acres of existing riparian habitat.

   Installation by: Kansas Forestry, Fish and Game Commission, Landowners (Cost sharing program needed)

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $600,000

7. Protect 20 miles of existing stream aquatic habitat from sedimentation by removal of major obstructing log jams.

   Installation by: Landowners, Watershed district

   Technical Assistance by: Department of State and Extension Forestry, Kansas Forestry, Fish and Game Commission, Soil Conservation Service

   Cost: $15,000; $500 OM&R

C. Management, preservation, and enhancement of archeological and historical resources.

1. Survey construction and development sites to determine location, significance, and salvage requirements of archeological sites.

Installation by: National Park Service

Technical Assistance by: State Archeologist, National Park Service

Cost: $10,000

2. Identify and encourage preservation of unique architectural and historical sites.

Installation by: State and local historical societies

Technical Assistance by: State Historical Society

Cost: (not determined)

D. Quality considerations of water, land, and air resources.

1. Install land treatment measures and establish proper management systems to accomplish 100 percent watershed protection. Remaining needs include treatment of 257,000 acres of cropland, 124,500 acres of rangeland, 1700 acres of woodland, and 5000 acres other land.

Installation by: Landowners, Agricultural Conservation Program

Technical Assistance by: Soil Conservation Service, Department of State and Extension Forestry

Cost: $5,773,900; $863,000 OM&R

E. Avoid irreversible and irretrievable commitments of resources.

1. Establish a comprehensive plan including land and water use for each county within the basin.

Installation by: Cities and counties

Technical Assistance by: KDED

Cost: $60,000

Effects of Environmental Quality Plan

A. Areas of Natural Beauty and Human Enjoyment

The beauty of small towns within the watershed will be enhanced due to a shade tree restoration program. Rural area beauty and aesthetics will be improved through application of land treatment practices and windbreak and shelterbelt restoration or establishment. Flood plain area natural beauty will be maintained through preservation of the riparian habitat.

The creation of four public use areas will provide needed facilities for water-based recreation. The public developments will provide facilities for 53,100 sightseers, 19,200 picnickers, 41,900 fishermen, 1,800 boaters, and 14,000 campers, totalling 130,000 recreation days annually. Acquisition of areas associated with the developments will provide 966 acres for dams, reservoirs, and facilities and 771 acres of open space for public use. Creation of the developments will cause disruption in the tranquility of the rural environment by 130,000 recreation days annually.

B. Biological Resources

Terrestrial wildlife habitat in 40 acres of windbreaks will be improved due to rehabilitation. An additional 860 acres will be created through establishment of new windbreaks and shelterbelts.

Conservation land treatment on 388,200 acres of agriculture land and land use diversity on 70,000 acres of cropland will improve terrestrial wildlife habitat.

The existence and habitat needs of endangered and threatened species within the watershed will be identified.

The creation of 48 reservoirs will inundate 2,030 acres of terrestrial wildlife habitat and 51, 9, and 7 miles of ephemeral, intermittent, and perennial stream aquatic habitat respectively. The structures will create 2,030 acres of impounded aquatic habitat. Maintenance of flow will improve 142 and 123 miles of intermittent and perennial stream aquatic habitat respectively. Associated riparian habitat will also be improved.

Eleven thousand acres of riparian habitat and 3150 acres of Type 1 and 2 wetlands will be preserved.

The environmental education of young people within the area will be enhanced through use of outdoor classrooms.

C. Historical and Archeological Sites

Significant historical and archeological sites within the watershed would be identified.

D. Land, Water, and Air Quality

The application of land conserving practices on 257,000 acres of cropland, 124,500 acres of rangeland, 1,700 acres of woodland, and 5,000 acres of other land would bring 100 percent of the watershed under conservation treatment. Land treatment measures will reduce sediment yield from 108 acre feet per year to 78 acre feet per year. Land treatment plus 48 reservoirs will reduce sediment yield to 52 acre feet per year.

E. Irreversible and Irretrievable Commitments

Reservoirs will convert 1,419 acres of cropland; 2,766 acres of rangeland; and 51, 9, and 7 miles of ephermeral, intermittent, and perennial stream aquatic habitat respectively to reservoir pools, dams, spillways, and public use areas.

F. Conflicts in Land Use

Implemented land and water use planning for the watershed area will provide the authority to deal with conflicts in the use of the resources. Important environmental values will be recognized and protected through implementation of the plan.

SECTION III

of

ADDENDUM

for

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Display of Selected Plan

in

National Economic Development Account

Regional Development Account

Social Well-Being Account

Environmental Quality Account

SELECTED PLAN

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects (average annual dollars)	Components	Measure of Effects (average annual dollars)
Beneficial effects		Adverse effects	
A. The value to users of increased outputs of goods and services		A. The value of resources required for a plan	
1. Flood prevention	268,500	1. Multipurpose reservoir and 23 single-purpose flood prevention reservoirs	
2. More intensive use	69,600	Project Installation[a/]	269,700
3. Recreation	60,000	Project Administration[a/]	90,900
		OM&R	21,400
Total Beneficial Effects	398,100	Total Adverse Effects	382,000
		Net Beneficial Effects	16,100

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects (average annual dollars)	
	Region	Rest of Nation
A. Income		
Beneficial effects		
1. The value of increased output of goods and services to users residing in the region		
a. Flood damage reduction	268,500	
b. More intensive use	69,600	
c. Recreation	30,000	30,000
d. Secondary	173,000	
Total Beneficial Effects	541,100	30,000

Components	Measure of Effects (average annual dollars)	
	Region	Rest of Nation
A. Income		
Adverse effects		
1. The value of resources contributed from within the region to achieve the output		
a. Multipurpose reservoir and 23 single-purpose flood prevention reservoirs		
Project Installation[a/]	32,800	236,900
Project Administration[a/]	11,500	79,400
OM&R	11,600	9,800
Total Adverse Effects	55,900	326,100
Net Beneficial Effects	485,200	

a/ Amortized for 100 years at 6 1/8 percent interest

December 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects	
	Region	Rest of Nation
B. Employment		
Beneficial effects		
1. Increase in the number and type of jobs		
a. Employment for project construction	88 man years semiskilled	
	29 man years unskilled	
b. Employment for project OM&R	1.8 man years unskilled annually	
Total Beneficial Effects	1.8 permanent unskilled jobs	
	88 semiskilled jobs for 1 year	
	29 unskilled jobs for 1 year	

Components	Measure of Effects	
	Region	Rest of Nation
B. Employment		
Adverse effects		
1. Decrease in the number and type of jobs		
Total Adverse Effects	0	
Net Beneficial Effects	1.8 permanent semiskilled jobs	
	88 semiskilled jobs for 1 year	
	29 unskilled jobs for 1 year	

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects	
	Region	Rest of Nation
C. Population Distribution		
Beneficial effects	Creates 88 semiskilled jobs for 1 year	
	Creates 29 unskilled jobs for 1 year	
	Creates 1.8 man years permanent employment annually	-
Adverse effects	-	-
D. Regional Economic Base and Stability		
Beneficial effects	Provides floodwater damage reduction for 48,697 acres	
	Creates 1.8 man years of unskilled employment annually.	
	Creates 88 short-term semiskilled and 29 short-term unskilled jobs	

SELECTED PLAN

SOCIAL WELL-BEING ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
A. Real income distribution	1. Create 117 man years low to medium income jobs for area residents during construction.
	2. Create 1.8 man years low to medium income employment annually in association with operation and maintenance of the works of improvement.
	3. Create regional income benefit distribution of $541,100. Family incomes are distributed: Under $3,000 — 18% $3,000 to $10,000 — 58% Over $10,000 — 24% It is assumed that benefits will be distributed at about the same percentages.
	4. Local costs to be borne by the watershed region total $55,900. Costs to be distributed by about the same ratio as benefits.
B. Life, health, and safety	1. Provide a sense of economic security, and the psychological security associated with the abatement of a fear of flooding.
C. Recreation opportunities	1. Create 30,000 recreation visits. Fifty percent of these will be utilized by visitors from outside the watershed.

September 1975

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
A. Open and green space, lakes, and other areas of natural beauty	1. Create lake with 100 surface acres for water-based recreation open to the public.
	2. Create 23 floodwater retarding structures and 14 detention dams with a total of 959 surface acres on private land.
	3. Create 470 acres for multipurpose use including public recreation and open and green space.
	4. Improve rural area beauty on 74,580 acres of agricultural land by the application of land treatment practices.
	5. Increase traffic, litter, and noise in a sparsely populated rural community from 30,000 visitor days annually.
	6. Thirty-eight reservoir structures will increase landscape diversity.

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects
eneficial and adverse effects	
. The quality of water, land and air resources	1. Reduce flooding on 48,697 acres of flood plain land.
	2. Reduce floodwater damage 62 percent.
	3. Reduce delivery of sediment to the Arkansas River 24,200 tons annually.
	4. Reduce average annual erosion rate on cropland from 5.9 tons to 3.5 tons per acre.
	5. Reduce average annual erosion rate on rangeland from 1.8 tons to 1.4 tons per acre.
	6. Prolong stream flow following periods of above normal rainfall.

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
C. Archeological, historical, biological, and geological resources and selected ecological systems	1. Create water areas of 959 acres where waterfowl resting and feeding will occur.
	2. Improve wildlife habitat through establishment of enhancement measures adjacent to structural measures.
	3. Wildlife habitat will be improved through application of land treatment practices on 74,580 acres.
	4. Create 959 acres of reservoir aquatic habitat.
	5. Inundate 959 acres of terrestrial wildlife habitat.
	6. Reduced use of 3,461 acres of terrestrial wildlife habitat during periodic inundation of reservoir flood pools.
	7. The use of 488 acres of terrestrial wildlife habitat to be occupied by dams and spillways would be temporarily interrupted.
	8. Inundate 14 miles ephemeral and 3 miles of intermittent stream channel habitat.
	9. Convert 15 miles of ephemeral to intermittent stream and 65 miles of intermittent to perennial stream through increased base flows.

September 1975

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

WET WALNUT CREEK SUBWATERSHED NO. 2, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
D. Irreversible or irretrievalbe commitments	1. Commit 44 acres cropland and 915 acres rangeland to sediment and recreation pools.
	2. Commit 184 acres cropland and 304 acres rangeland to dams and spillways.
	3. Commit 227 acres cropland and 100 acres rangeland to recreation land.
	4. Inundate 14 miles ephemeral and 3 miles of intermittent stream.
	5. Change 15 miles of ephemeral to intermittent stream and 65 miles of intermittent to perennial stream through increased base flows.

WATERSHED PLAN AGREEMENT

between the

Wet Walnut Creek Watershed Joint District No. 58
Local Organization

Rush County Conservation District
Local Organization

Pawnee County Conservation District
Local Organization

Ness County Conservation District
Local Organization

Kansas Forestry, Fish and Game Commission
Local Organization

(Hereinafter referred to as the
Sponsoring Local Organizations)

State of Kansas

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 or works of improvement for the Wet Walnut Creek Subwatershed No. 2, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Congress; 68 Stat. 666), as amended; and

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

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Wet Walnut Creek Subwatershed No. 2, State of Kansas, herein-

after referred to as the watershed 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 plan, and further agree that the works of improvement as set forth in said plan can be installed in about 10 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 plan:

1. The Sponsoring Local Organizations will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Land Rights Cost (dollars)
Multipurpose Str. No. 32 and Recreational Facilities			
Payment to landowners for about 470 acres	50	50	94,000
Legal fees, survey costs, flowage easements, and other	100	0	11,000
23 Floodwater Retarding Structures	100	0	437,000

The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 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 Organizations (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	37.5	62.5	10,500

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

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

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Construction Cost (dollars)
23 Floodwater Retarding Structures	0	100	3,040,000
Multipurpose Structure No. 32	6.4	93.6	284,700
Recreational Facilities	50a/	50b/	31,800

a/ The Sponsoring Local Organizations will provide the equipment and labor necessary for installation of the recreational facilities.

b/ The Service will provide materials necessary for installation of the recreational facilities.

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

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Engineering Costs (dollars)
23 Floodwater Retarding Structures	0	100	439,700
Multipurpose Structure No. 32	0	100	40,700
Recreational Facilities			
Layout and design	100	0	2,400
On-Site planning and standard designs	0	100	800

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be $188,000 and $1,292,900 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 land.

8. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed 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. Detention dams will be operated and maintained by landowners at their own expense through agreements with the watershed district.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually perform-

ing 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 plan is contingent on the availability of appropriations 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 plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement.

    The Service shall promptly notify the Sponsoring Local 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 incorproate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor(s) 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, as amended, 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 otherwise 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.

Wet Walnut Creek Watershed
Joint District No. 58
Local Organization

By s/Lloyd E. West

Title President

Box 207, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Wet Walnut Creek Watershed Joint District No. 58
Local Organization

adopted at a meeting held on March 18, 1976

s/Lawrance Richards
Secretary, Local Organization

Box 207, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

Ness County Conservation District

By s/Keith E. Rider

Title Chairman

Box 439, Ness City, Ks. 67560
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Ness County Conservation District
Local Organization

adopted at a meeting held on May 4, 1976

s/Kay Wasinger
Secretary, Local Organization

Box 439, Ness City, Ks. 67560
Address Zip Code

Date May 13, 1976

Pawnee County Conservation District

By s/Alfons A. Stiebe

Title Chairman

Box B, Larned, Ks. 67550
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Pawnee County Conservation District
Local Organization

adopted at a meeting held on May 5, 1976

s/Rubena Harms
Secretary, Local Organization

Box B, Larned, Ks. 67550
Address Zip Code

Date May 13, 1976

Rush County Conservation District

By s/Robert D. Hanhardt

Title Chairman

Box A, LaCrosse Ks. 67548
Address Zip Code

Date May 13, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Rush County Conservation District
Local Organization

adopted at a meeting held on May 3, 1976

s/Velmer Wilhelm
Secretary, Local Organization

Box A, LaCrosse, Ks. 67548
Address Zip Code

Date May 13, 1976

Kansas Forestry, Fish and Game Commission

By s/Richard D. Wettersten

Title Director

Box 1028, Pratt, Ks. 67124
Address Zip Code

Date May, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Kansas Forestry, Fish and Game Commission
Local Organization

adopted at a meeting held on May, 1976

s/Jerome Salyer
Secretary, Local Organization

Box 1028, Pratt, Ks. 67124
Address Zip Code

Date May, 1976

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:

s/Robert K. Griffin
State Conservationist

May 13, 1976
Date

WATERSHED PLAN

Wet Walnut Creek Subwatershed No. 2

Ness, Rush, and Pawnee Counties, Kansas

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

Prepared by

Ness County Conservation District
Rush County Conservation District
Pawnee County Conservation District
Wet Walnut Creek Watershed Joint District No. 58
Kansas Forestry, Fish and Game Commission

With Assistance by

U.S. Department of Agriculture
Soil Conservation Service
Forest Service

State of Kansas
Conservation Commission
Water Resources Board
Office of the Kansas State and Extension Forester

April 1976

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WATERSHED PLAN
WET WALNUT CREEK SUBWATERSHED NO. 2
NESS, RUSH, AND PAWNEE COUNTIES, KANSAS
December 1975

SUMMARY OF PLAN

Subwatershed No. 2 covers 363 square miles in central Kansas in Ness, Rush, and Pawnee Counties. It is one of five watersheds which were planned jointly. It is sponsored by the Wet Walnut Creek Watershed Joint District No. 58; Ness, Rush, and Pawnee County Conservation Districts; and the Kansas Forestry, Fish and Game Commission.

The major problem in the watershed is flood damage along the entire reach of Wet Walnut Creek. Average annual direct floodwater damages in the watershed are estimated to be $225,400 of which 67 percent is crop and pasture damage. Other problems are erosion, sedimentation, shortage of water-based public recreational areas, and a potential ground water decline.

The proposed watershed project will consist of land treatment and structural measures. Adequate land treatment will be accomplished on 54,200 acres of cropland, 19,700 acres of rangeland, and 680 acres of forestland. Land treatment measures include 14 detention dams. Twenty-three floodwater retarding structures and one multipurpose structure for floodwater retardation and public recreation will be constructed. The Kansas Forestry, Fish and Game Commission will develop recreational facilities at the multipurpose reservoir.

Average annual flood damage will be reduced 62 percent. The average annual soil loss in the watershed will be reduced from 4.6 to 2.8 tons per acre. Average annual sediment yield to Wet Walnut Creek will be reduced by 32,000 tons. Average annual recharge will be increased 6,300 acre feet.

The major impact on the quality of water in Wet Walnut Creek will be the reduction of sediment load. Other impacts of the watershed project on the quality of streamflow will be minimal and localized. Increased base flows, decreased sediment concentration, and reduced erosion will increase fish habitat and food and water for all wildlife in the watershed. Aquatic habitat will generally be improved by the impoundment and management of water in sediment pools and the multipurpose pool. Initially there will be a loss of terres-

trial wildlife habitat. Impoundments will increase both the fishery potential and the amount of suitable habitat for migratory waterfowl. Land treatment measures will increase wildlife cover and habitat diversity. The multipurpose structure will increase public recreation opportunities. In addition, the impounded areas will increase landscape diversity.

A ten year period will be required for project installation. Installation costs will be $8,462,300 of which $5,284,500 will be P.L. 566 funds.

Land treatment measures will be maintained by individual landowners and operators through agreement with conservation districts. Wet Walnut Creek Watershed Joint District No. 58 will be responsible for the operation and maintenance of all floodwater retarding structures and the structural maintenance of the dam and spillway of the multipurpose structure. The Kansas Forestry, Fish and Game Commission will be responsible for operation and maintenance of the reservoir and recreational facility areas at the multipurpose structure. Estimated average annual costs of operation and maintenance of structural measures are $21,400. Average annual benefits attributable to structural measures are expected to be $571,100, average annual costs for the measures are estimated at $382,000. Average annual flood damage reduction benefits from land treatment measures are estimated at $57,500.

WATERSHED RESOURCES--ENVIRONMENTAL SETTING

Physical Data

Subwatershed No. 2 of Wet Walnut Creek Watershed Joint District No. 58 covers an area of 363 square miles in Rush, Ness, and Pawnee Counties in west central Kansas.1/* Incorporated cities in the watershed are Bazine, Rush Center, Alexander, Nekoma, and Brownell. The watershed population in 1970 was 2,759 of which 900 live in cities.2/

The watershed is in the Arkansas-White-Red water resources region and the Arkansas River in Kansas subregion.3/ It is on the northern border of these regions. The watershed experiences periods of too little or too much water which typifies these regions.

The major problem in the watershed is flood damage along the mainstem of Wet Walnut Creek. The cities are all located

* See list of selected references

near the edge of the flood plain. While there is damage to streets, yards, and some homes, there is little danger of loss of life. Upland drainage areas and flood plains are erosion problem areas. Ponds, reservoirs, and stream channels are additional problem areas due to sedimentation. Ground water recharge is insufficient to meet the demand for increased irrigation in some areas. Rapid expansion of irrigation has occurred on the flood plain, but a limited water supply will restrict future expansion. Recreational opportunities related to water are limited.

The watershed lies in the Smoky Hills section of the Dissected High Plains portion of the Great Plains physiographic province.4/ The altitude of land surface ranges from 2,440 feet in the northwest corner to 1,943 feet at the watershed outlet. Maximum relief is 497 feet, the local relief seldom exceeds 100 feet.

The watershed is in the Harney-Uly-Wakeen soil association as shown on the general soil map of Kansas.30/ Soils on the nearly level and gently sloping uplands are mostly of the Harney and Uly series. These are deep, well-drained soils formed in calcareous loess. The Harney soil has a silt loam surface layer over a silty clay loam subsoil that has moderately slow permeability. Uly has a silt loam surface layer over a moderately permeable silt loam subsoil. Soils on steeper slopes are classified as Penden and Wakeen series with a small but significant component of Bogue and Heizer soils. The deep, well-drained Penden soil has formed in calcareous loamy outwash sediments. It has a clay loam surface layer and moderately permeable clay loam subsoils with a high lime content. The well-drained Wakeen soil is about three feet deep over chalky limestone. It is calcareous silty clay loam throughout. Subsoil permeability is moderate. The Heizer soil is like Wakeen but less than twenty inches deep over chalky limestone. The Bogue soil is a very slowly permeable clay throughout and is underlain by dark gray clay shale at about thirty inches depth.

Soils formed in alluvial sediments of the stream valleys throughout the watershed are classified as Roxbury and Bridgeport series on the lower flood plains and as Hord and Detroit series on higher areas. Roxbury and Bridgeport soils are similar but Roxbury has dark colors extending to a much greater depth than Bridgeport. They are deep, well-drained calcareous soils with silt loam surface layers and moderately permeable silt loam subsoils. The deep, well-drained Hord soil has a silt loam surface layer and moderately permeable silt loam surface layer and moderately permeable silt loam

subsoil. Free lime occurs in the soil below depths of forty inches. The deep, well-drained Detroit soil has a silty clay loam surface layer over slowly permeable silty clay subsoil. Free lime occurs below depths of about twenty inches.

Ness and Pawnee Counties has completed surveys and unpublished manuscripts are available. The survey of Rush County is about fifty percent complete and is scheduled for completion early in 1977. More information about the soils, their use and management, and other interpretations are in the published surveys, in the unpublished manuscripts and in the soils handbook for those surveys not completed. These materials are available at the Soil Conservation Service field office in the county of reference.

Mineral resources of the watershed include oil, gas, helium, sand and gravel, limestone, and ground water. Small sand and gravel deposits along streams in the watershed are available for road surfacing material. The fence post (Greenhorn LS.) limestone bed at the top of the Pfeifer shale member has been quarried extensively along the line of outcrop. No quarries are presently operating.

Most of the watershed surface materials are clay, silt, sand and gravel of Pleistocene age. These Pleistocene materials are separable into fluvial deposits on divides and in stream valleys, thick eolian silt or loess mantles on upland surface, and slope (alluvial and colluvial) deposits in headland areas of streams and on slopes along stream courses.

Erosional remnants of the Ogallala Formation, a composite of fluvial deposits of Pliecene age, cap the southern divides The Ogallala Formation unconformably overlies the following Cretaceous formations, listed in descending order of age: Niobrara Chalk (represented by the Fort Hays limestone member), Carlile Shale, and Greenhorn Limestone. No exposures of Fort Hays Limestone are known in the watershed. Carlile Shale is the bedrock formation throughout most of the upland. Greenhorn Limestone is the prominent rock exposed along some of the tributary valleys. The Graneros Shale and Dakota Formation of lower Cretaceous age underlie Wet Walnut Creek.

Alluvial fill in Wet Walnut Creek valley is the principal source of ground water in the watershed. Rainfall and snowmelt are the principal recharge sources. The volume of water, as of 1973, estimated to be available for pumpage was 200,000 acre feet.5/ The alluvial fill is principally of fluvial origin and can be divided into (1) an upper alluviam of lenticular silt, clay, and sand; and (2) a lower alluvium of coarse sand and gravel. Fine-grained colluvial deposits

are present along the edges of the valley. Ground water in the Alluvium is uncontained, or semicontained in areas where the water table is in the fine-grained materials of the upper alluvium. The general movement of ground water is eastward down the valley. Owing to heavy pumping for irrigation and water moving from the stream to the aquifer, the gradient normal to the valley is generally away from the creek.

Normal annual precipitation is 22.33 inches at Bison which is typical for the lower portion of Subwatershed No. 2 and 20.24 inches at Ness City which is more typical of the extreme upper portion of Subwatershed No. 2. The minimum annual precipitation recorded at Bison was 12.07 inches in 1956 and 10.06 inches at Ness City in 1966. The Maximum year at Bison was 1973 with 38.57 inches and 32.40 inches at Ness City in 1951. Most of the rain (75 percent) comes during the growing season which averages 174 days from April through September.6/ High intensity thunderstorms usually occur during spring and summer months and often result in damaging floods. Normal annual temperature is 55.6 degrees at Bison and 53.2 degrees at Ness City. The high temperature of record at Bison is 116 degrees, and the low, -25 degrees.

Land use in the watershed is as follows: cropland, 158,536 acres (68.3 percent); rangeland, 67,419 acres (29.1 percent); forestland, 2,100 acres (0.9 percent); and miscellaneous, 4,164 acres (1.7 percent).

In the flood plain, 60 percent of the 15,437 acres of cropland is irrigated. There are also 771 acres of rangeland, 985 acres of forestland, and 421 acres miscellaneous in the flood plain.

Irrigated cropland in the upland accounts for 1,638 acres of the 143,099 of cropland. There are also 66,648 acres of rangeland, 1,115 acres of forestland, and 3,743 acres miscellaneous upland.

In its original or virgin condition, the major portion of the watershed was natural prairie. This original vegetative community consisted primarily of big bluestem, little bluestem, blue grama, western wheatgrass, buffalograss, and sideoats grama on the uplands. In prairie drainways and bottomland areas, the original vegetation was primarily big bluestem, indiangrass, switchgrass, and western wheatgrass.

Following settlement much of the native rangeland was plowed and converted to cropland. Many small pastures were fenced and grazed by livestock. Pastures were often heavily grazed yearlong, which altered the vegetative composition. On many pastures the taller grasses were largely

replaced by less palatible plants or low growing vegetation which could tolerate heavy grazing.

Now principal upland grasses are blue grama, sideoats grama, buffalograss, western wheatgrass, tall dropseed, annual brome, annual threeawn, windmillgrass, silver bluestem, big bluestem, little bluestem, indiangrass, and switchgrass. Forbs and legumes include Louisiana sagewort, western ragweed, heathaster, falseboneset, dotted gayfeather, Missouri goldenrod, prairie coneflower, wavyleaf thistle, blue wildindigo, leadplant, Illinois bundleflower, and slimflower scurfpea. Woody plants consist primarily of skunk brush, plum, smooth sumac, and buckbrush.

Major grasses occurring on the lowlands are western wheatgrass, switchgrass, meadow dropseed, silver bluestem, big bluestem, indiangrass, vine mesquite, Kentucky bluegrass, blue grama, sideoats grama, buffalograss, Canada wildrye, and several species of sedge. Major forbs and legumes are Baldwin ironweed, tall goldenrod, western ragweed, snow-on-the-mountain, maximilian sunflower, heathaster, and Illinois bundleflower. Woody plants include osageorange, American elm, black willow, cottonwood, hackberry, indigobush amorpha and buckbrush.

The flat, pothole-marked tableland of eastern Scott County is the headwaters of the north, middle and south forks of Wet Walnut Creek. The mainstem of Wet Walnut Creek is formed south of Ness City, Kansas. The stream continues eastward and is joined by Dry Walnut Creek just before entering the Arkansas River about four miles east of Great Bend. The tributaries to Wet Walnut include a large number of small ephemeral streams and four intermittent streams. Ephemeral streams flow only during periods of general runoff. Intermittent streams have periods of continuous flow but little or no flow during other times. Wet Walnut Creek has an unmodified, well defined natural channel. It is underlit, that is, the stream appears too small to have eroded the valley in which it flows. Wet Walnut is an intermittent stream.

There are no Types 3 through 20 wetlands in the watershed extensive enough to be included in the U.S. Fish and Wildlife Service inventory for Kansas.8/

The Kansas Department of Health and Environment has developed surface water quality criteria.7/ The Department states that the high incidence of low flows in Wet Walnut Creek inhibit detailed water quality analyses and the application of water quality criteria.

Limited water quality data has been collected by the Kansas State Board of Health and Environment from Wet Walnut Creek near Rush Center. This data is on the following table. This data is within the range of longer term records downstream at Albert. All the measured factors with the exception of bacteria are within the limits of current acceptable surface water quality standards.

Chemical Analyses of Streamflow

on Wet Walnut Creek West of Rush Center[30/]

Date	Time	Gage	Flow	Temp. °C	Tu.	Milligrams per liter												Sp. Cond.	pH	Counts per 100 ml		
						Ca^{++}	Mg^{++}	HCO_3^-	$CO_3^=$	$SO_4^=$	Cl^-	NO_3^-	Total $PO_4^{\equiv}$	Total Hard.	Total Alk.	BOD_5	DO			Total Coli.	Fecal Coli.	Fecal Strep.
6/21/72	0945	3.63		21.0	150	58	8	188	0	19	11	1.3	0.94	176	154	4.5	2.8	330	7.60	27,000	800	4,100
6/22/72	1000	3.59		18.0	150	54	11	190	0	19	20	1.5	1.00	184	156	2.5	3.7	330	7.70	17,000	100	2,300
6/23/72		3.58			130	75	12	188	0	15	19	1.8	1.00	236	154	3.5	3.1	340	7.65	6,500	200	600
6/24/72	1005	3.58		22.0	150	64	5	198	0	23	11	2.0	0.94	180	162	1.0	3.4	360	7.60	4,900	L+100	900
6/25/72	0930	3.57		22.0	130	70	8	210	0	21	17	1.8	0.90	208	172	2.8	2.4	370	7.60	2,200	300	1,400
6/26/72	0910	3.58		21.0	130	67	12	207	0	17	25	0.7	0.82	216	170	2.5	3.2	300	7.80	8,400	600	1,900
6/27/72	0945	3.58		22.0	75	59	13	205	0	21	18	1.5	0.78	200	168	5.0	2.7	380	7.75	5,000	L+100	2,600
10/ 3/72	1800		0.20	18.0																		
11/15/72	1240		5.70	3.0																		
12/11/72	1320		0.95	0																		
1/15/73	1250		1.70	1.0																		
2/ 6/73	1245		6.30	1.0																		
3/19/73	1250		23.00	7.0																		
4/19/73	1140		63.00	15.0																		
5/22/73	1130		32.00	21.5																		
6/18/73	1040		5.90	21.5																		
7/17/73	1120		20.00	22.0																		
8/16/73	1120		23.00	22.0																		
9/21/73	1030		8.70	17.5																		

Economic Data

All land within the watershed is privately owned except for a small amount used for roads, public buildings and similar purposes. There is no significant tract of publicly owned land. The 638 farm operating units in the watershed average 406 acres in size.

Farming operations in the watershed are primarily centered around wheat, grain sorghums, and corn. Some corn and sorghums are used for livestock production. Alfalfa is grown under irrigation or on thezflat bottomland near Wet Walnut Creek without irrigation.

Principal Crops and Current Yields

		Flood Plain (Flood Free)		Upland
	Unit	Dryland	Irrigated	
Wheat	bu	27	45	21
Sorghum				
Grain	bu	42	133	40
Silage	tn	13.0	20.0	10.0
Corn	bu	-	115	-
Soybeans	bu	20	35	-
Alfalfa	tn	3.5	5.0	3.5

The number of farms in the watershed is decreasing at a rate of about one percent per year or less, as the trend toward larger farms continued.

Selected data for 1969 includes:29/

	Watershed	State of Kansas
Median Family Income	$6,409	$8,693
Families With Incomes Below Poverty Level	16.0%	9.7%
Unemployment Level	2.1%	3.9%
Family Income Distribution		
Less than $3,000	18.0%	11.0%
$3,000 to $10,000	58.0%	49.0%
Over $10,000	24.0%	40.0%

The source of income is generally sale of agricultural products. There are 96 family farms in the flood plain.

Land values in the watershed range from $750 per acre for leveled and irrigated flood plain cropland to $300 per acre for unirrigated upland cropland and $200 per acre for rangeland.

A good transportation grid provides access to market for produce from the area. Kansas Highway 96 parallels the Wet Walnut Creek flood plain throughout the watershed and U.S. 183 is a north-south highway that crosses the watershed. State Highway 4, an east-west road, crosses the northern portion of the watershed. The Atchison, Topeka, and Santa Fe and the Missouri Pacific railroads serve the watershed.

The watershed population in 1970 was 2,759. This total included 900 small town residents and 1,859 rural farm residents. By the year 2000 the watershed population is projected to be 2,939 with small town residents totaling 968 persons and 1971 rural farm residents.

Fish and Wildlife Resources

Fish habitat is scarce and limited to warm water species within the watershed. Portions of the mainstem of Wet Walnut Creek contain channel catfish, bullhead catfish, and carp. Privately owned and stocked farm ponds provide fishing for largemouth bass, black crappie, white crappie, bluegill, carp, drum, channel catfish, and black bullhead catfish.10/ The quality of these resources ranges from poor to excellent.

Woody wildlife cover, provided by cottonwood, honey locust, red cedar, willow, elm, ash, Russian olive, mulberry, and osageorange is limited to riparian sites and shelterbelts.9/ These wooded areas, along with the varied understory of shrubs, forbs, grasses, and adjacent crops provide critical habitat for upland game, deer, and other wildlife.

The effect of water quality on fish and wildlife, due to high sediment concentrations, has generally been damaging.

There are at present 83 miles of intermittent streams and 401 miles of ephemeral streams in the watershed.

Access is a primary factor limiting use of these resources. Most ponds and the lands bordering streams are privately owned. Only sportsmen with landowner permission have access.

Deer hunting, based on permit drawings, occurs in the watershed. Upland game in the watershed includes bobwhite quail, mourning dove, ring-necked pheasant, fox squirrel, cottontail rabbit, and black-tailed jackrabbit.10/ Upland game hunting, particularly for ring-necked pheasants, is important throughout the project area. During wet fall seasons, waterfowl use of marshy areas and potholes is extensive, providing excellent hunting and birdwatching.

There are no known endangered or threatened plant species in the watershed.11/

The Kansas Academy of Science lists the endangered whooping crane (Grus americana) as a possible transient in the watershed.12/ The American peregrin falcon (Falco peregrinus), another endangered species, may be a transient or winter resident. The bald eagle (Halaeetus leucocephalus), the prairie falcon (Falco mexicanus), and the burrowing owl (Speotyto cunicularia) are listed as threatened species that might be found within the watershed. Although no recent sightings have been made, the endangered black-footed ferret may also be a resident within the watershed.

The Kansas Academy of Science's endangered or threatened species list contains no known fish, amphibians, or reptiles that might be found within the boundaries of Wet Walnut Creek Watershed.

Recreational Resources

There are no federal or state recreational developments in this watershed and water related recreational opportunities are scarce. The Cheyenne Bottoms Waterfowl Management Area is about 30 miles east of the watershed. The Cheyenne Bottoms area provides mostly public hunting and some fishing. Cedar Bluff Reservoir, 20 miles northwest, provides water-based recreation. Water related recreation within the watershed is

restricted to farm ponds. During drought periods most farm ponds and streams dry up providing very few waters that will sustain a permanent fish population.

Archeological and Historical Areas

The National Register of Historic Places lists the Rush County Courthouse at LaCrosse as the only historical site in the watershed.13/

The archeology of this region has received little systematic investigation in the past. There are 12 reported archeological sites within the region.

Data for the locations of previously known archeological sites along Wet Walnut Creek are primarily from the activities of amateurs and collectors reporting their work to the Kansas State Historical Society. The cultural time range known to be represented along Wet Walnut Creek is from the Paleo-Indian period to those of historic Indian tribes of the middle 19th century.

The Kansas State Historical Society reports that no historic buildings or previously known archeological sites will be affected by the proposed structures.12/ An inventory of archeological resources of the proposed structures recommended:28/ (1) Testing to provide assessment and priority of archeological investigations for Structure Nos. 13 and 28 and (2) A revisit when collecting and subsurface conditions are more favorable for Structure Nos. 32 and 33. All other structures lack potential for prehistoric materials and no archeological evidence was found.

An assessment of archeological sites recommended by the inventory of December 1974 was made in July and August of 1975 by a private archeologist in conjunction with the State Archeologist.32/ The assessment report recommended the presence of an archeologist when the humus zone is stripped during construction of Structure No. 13. This recommendation has been adopted. Testing at other structures did not reveal sufficient cultural material to warrant further formal archeological investigation.

Soil, Water, and Plant Management Status

There are no major changes in land use trends.

Conservation districts are active in the watershed. There are 445 cooperators, and 432 basic plans have been developed covering 63 percent of the watershed. An estimated 30 to 75 percent of the needed conservation practices have been applied. Fifty-one percent of the cropland and 48 percent of the rangeland are adequately treated.

Conservation districts receive technical assistance from the Soil Conservation Service. Other agencies with programs affecting land use and treatment in the watershed are the Cooperative Extension Service and the Forest Service, Farmers Home Administration, and Agricultural Stabilization and Conservation Service. The Extension Service, through country agricultural extension agents, assists with informational and educational programs to carry out conservation objectives.

There is presently a total of 11,000 acres under irrigation. The potential for further development is limited by available water supply. The present source of irrigation water is wells rather than surface water. The ground water supply is sufficient for current water demands including irrigation, but will not support increased irrigation.

The withdrawal of ground water for irrigation is increasing rapidly. In recognition of the problem of declining water tables in some areas in western Kansas, the Kansas Water Resources Board and the U.S. Geological Survey undertook a cooperative study of ground water recharge, using as the first study area Wet Walnut Creek in Rush County.16/ The study indicated the pumpage in Rush County is increasing with an average of 11 wells drilled each year. The report said the aquifer depends almost entirely on the stream for its recharge and that the system is in balance at present. However, a long extended drought could seriously deplete the aquifer.

The main valley alluvium is the principal aquifer. In Rush County the aquifer is recharged by subsurface inflow from the west and the tributary valleys on the north and south, and by seepage losses from Wet Walnut Creek and its tributaries during periods of high flow.5/ The maximum potential for storage of recoverable water in the aquifer is 220,000 acre feet. As of January 1973, the aquifer contined 200,000 acre feet of recoverable water.

As of 1974 the average annual flood plain irrigation withdrawals were 10,500 acre feet. The identified average annual recharge from stream flow was 10,000 acre feet. Subsurface inflow to the aquifer in Rush County has been estimated as 320 acre feet per year.5/

The months of July and August are the peak demand months for irrigation. Leaching is not a problem due to the good quality of alluvial aquifer waters used for irrigation and the characteristics of the irrigated soils.

The municipalities of Alexander, Nekoma, and Rush Center have a combined average annual ground water withdrawal of 56 acre feet. The depth of wells supplying this demand range from 50 to 80 feet. The municipal water needs are met by the present wells.

This is not a major industrial area. Any industrial development will probably continue to emphasize local services and agricultural product processing. It appears that there will be no demand for additional water supplies in the watershed for municipal and industrial use in the near future.

Through cooperative agreements with the Forest Service and the Kansas State and Extension Forester, all grassland and woodland in the watershed are within rural fire district protection.14/ The Forest Service and the Kansas State and Extension Forester have also assisted in 900 acres of tree and shrub plantings.

The Agricultural Stabilization and Conservation Service shares the cost of installing certain permanent practices through its ACP or other programs. The Farmers Home Administration will make loans for the installation of conservation practices when other funds are not available to the farm operator.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

Rangeland was first exposed to the plow in the middle 1800's. A gradual increase in cropland has occurred since the first plowing, reaching a maximum around 1938. In 1974, 168 acres of rangeland were converted to cropland. An active land treatment program began in 1941. However, in 1974, conservation cropping systems were needed on 54,036 acres of cropland; rangeland and woodland conservation practices were needed on 36,119 acres.

Erosion is a problem on cultivated uplands where needed land treatment has not been installed. The average cropland soil loss is 5.9 tons per acre per year. Soil loss results in depletion of soil resources, reduction of crop yields and income, sedimentation in farm ponds and on the flood plain, deterioration of stream quality, and increases in road maintenance costs.

Soil fertility is not generally a problem, however low fertility becomes a problem on eroded lands. Available soil moisture is a limiting factor in crop production in most years. Moisture conserving practices such as stubble mulching, terracing and contour farming are needed on cropland. Excessive tillage operations on many farms reduces ground cover; increases compaction, crusting and runoff; and uses more fuel than necessary. Land use adjustments needed are mostly cropland to grassed waterways.

Most landowners are economically able to install needed land treatment with the help of federal cost-sharing programs.

Floodwater Damage

Damage resulting from flooding (2.8 year frequency or greater event) is the principal watershed problem. Two recent floods stand out in the memories of watershed residents: the floods of 1959 and 1973. Both floods caused major damage to most bottomland in the watershed.

The evaluated flood plain covers 17,614 acres and includes 15,437 acres of cropland. Crop and pasture damage due to flooding averages $151,200 annually and accounts for 67 percent of the total direct floodwater damage. Flood durations are usually greater than 48 hours; one of the major causes of damage.

Damages occur throughout the flood plain of the watershed. A total of 65 farm units are subject to damage. In the urban areas 167 residential units are affected. There are also 33 nonresidential units in the urban areas subject to damage. The 1974 value of property subject to damage is $3,084,200. Average annual urban damage is $26,200: Rush Center ($6,400), Nekoma ($3,800), Bazine ($15,300), and Alexander ($700). While there are urban damages to streets, yards, and some homes there is little danger of loss of life.

Flood damages occur on 15,300 acres off project immediately downstream from Subwatershed No. 1 on Wet Walnut Creek flood plain. Part of this area is comprised of: urban and suburban,

320 acres; cropland, 9,910 acres; and pasture and miscellaneous lands, 2,870 acres. The remainder occurs on flood plain common with the Arkansas River and is comprised of: urban and suburban, 680 acres; cropland, 1,290 acres; and pasture and other land, 230 acres. Flood damages also occur on 14,853 acres in Subwatershed No. 1.

Flooding damages building, fences, machinery, cattle and hog pens, feed bunks, and stock tanks. Considerable expense is incurred for cleanup of debris after flooding. Agricultural damages of this type average $34,000 annually.

Floodwater damages to roads, railroads, and bridges average $14,000 annually. Floods wash away road surfacing, scour road shoulders, fill road ditches with mud on 32.9 miles of road and damage 17 bridges. County and township budgets are not usually sufficient to make timely repairs following a flood. This work is necessarily spread over a number of years, hence these essential facilities remain in poor condition. At the 100 year flood frequency, 5.3 miles of railroad are subject to damage.

Small, localized floods frequently cause considerable damage and inconvience to farmers in the watershed. A major flood, such as the one experienced in 1959, affects everyone in the area, due to damaged roads, bridges, utilities, and loss of business to those serving the agricultural community. Such indirect losses are estimated at $28,500 annually.

The 1959 flood was the largest of record in this watershed. A discharge of 12,700 cubic feet per second was recorded at the Albert gauge on September 22 of that year. This flood was the result of a very heavy rain and hail storm which started during the evening of the 20th and continued into the 21st. This storm was preceded by showers for several days, so the runoff was excessive. Precipitation stations in the basin reported rainfall amounts ranging from zero at Great Bend to 6.45 inches at Alexander. A bucket survey indicated an 11-inch rainfall just west of Bazine and a 9-inch rainfall between Alexander and Rush Center. Wet Walnut Creek was out of its banks throughout the watershed. This flood caused damages, based on current prices, of about $2,110,300 within the watershed. Nearly all of Nekoma and Alexander were inundated. The estimated frequency of this flood at Albert is 40 years.

In summary, total average annual direct floodwater damages are estimated at $225,400 as shown in Table 5. There are also

unevaluated damages to wildlife in the flood plain. Ground-nesting birds are especially hard hit by floods occurring between April and August; the period of occurrence of 75 percent of the floods. Flooding destroys protective habitat, nests, and young birds. Terrestrial species in the flood plain may be displaced or killed by floods. Displacement may result in increased predation, starvation, and disease.

Erosion and Sediment Damage

The highest soil losses occur on cropland. Average annual soil loss from cultivated upland fields ranges from 2 to 15 tons per acre, with an overall average of 5.9 tons per acre per year. Some steeply rolling rangeland is gullied. However, average annual soil loss from rangeland is 0.5 tons per acre.

Large floods cause considerable flood plain scour damage. The average annual erosion damage due to scour is $39,700.

Average suspended sediment is 2,100 mg/l at Bazine.

High concentrations of sediment limit development of desirable stream flora and fauna. Murky waters are common in Wet Walnut Creek.

Large sediment deposits were noted following recession of floodwater in September of 1959. As a result of this storm, road ditches, culverts, channels and bridge openings were clogged with sediment and debris. In addition, some roads and bridges were covered with sediment.

Annual sediment yield per square mile ranges from 200 to 500 tons in the watershed. An estimated 170,000 tons of sediment are delivered to the Arkansas River annually from the Wet Walnut Creek Basin. This watershed contributes an estimated 36,000 tons of sediment annually to the Arkansas River. Sediment yield from this watershed is 43,000 tons per year.

In the interval 1932-1968, 640,000 tons of sediment were deposited in Wet Walnut Creek in this watershed. These deposits have decreased the channel capacity. The native grasses that grew in and along the channel have long since been smothered by sediment. Elevated stream banks have formed and weeds and trees now grow in the outer channel. Streamflow is retarded by this recent vegetative growth.

The channel fill deposits are primarily silt and clay sized particles. These fine grained deposits decrease infiltration through the channel floor and walls. As a result, channel recharge to the main valley aquifer is diminishing. The continued loss of channel capacity will result in average annual flooding damages of $3,200.

Recreation

The Kansas State Outdoor Recreation Plan 15/ indicates that the single most important outdoor recreation need in this area is water.

Fishing in the Wet Walnut Creek is poor because of sediment pollution and low water quantity. Fishing in watershed farm ponds ranges from poor to excellent depending on water quality, permanence, and management. Most fishing is restricted to family and close friends of landowners. The need exists for a stable fishery available to the public. There are no public lands within the watershed which may be used for fishing or hunting.

In 1970, the five county area had a population of 48,884. Within a 50 mile radius, about 128,200 people lack sufficient recreation facilities to satisfy needs. By the year 2000, the area's population will be about 137,400.

Fish and Wildlife

There is a need for more wildlife habitat, particularly cover, throughout the watershed. A substantial increase in cover would tend to be in competition with agricultural production, although some compatible increases are possible.

Economic and Social

The watershed is not an economically depressed area. It is composed of family farms. None of the farms in the district use one and one-half man years or more of hired labor at present. There is a need to provide additional employment opportunities in order to give young people options other than migration to an urban area. There is a general need to establish rural community development in the watershed.

PROJECTS OF OTHER AGENCIES

While there are no major projects proposed by other agencies within the watershed, the Corps of Engineers has an authorized local flood protection project at Great Bend. This project and the watershed projects are complementary. The watershed projects would supplement the protection offered at Great Bend. One effect of the watershed projects will be to reduce the Corps of Engineers standard project storm peak discharge by 35 percent. The local flood protection project would protect Great Bend from floods on both the Arkansas River and Wet Walnut Creek. The current estimated cost is 18.4 million dollars, of which 3.7 million dollars would be nonfederal. Construction of the local flood protection project is pending passage of a bond issue by local voters.

PROJECT FORMULATION

Subwatershed No. 2 is one of five watersheds in the Wet Walnut Creek Watershed Joint District No. 58 which covers the entire Wet Walnut Creek basin, except the lower few miles. The five watersheds were planned concurrently. One of the watersheds proved economically unfeasible for a P.L. 566 program. The watershed district has complied with applicable Kansas laws while organizing and carrying out their activities.

Shortly after the flood of September 1959, the first steering committee was selected. Interested citizens held their first public meeting May 8, 1961. The 18 banks of the area provided funds for organizing the watershed. Petitions calling for a formal vote were submitted to the Secretary of State May 16, 1963. The first board of directors was elected July 11, 1963. A favorable vote was taken October 29, 1963. A Certificate of Incorporation was issued by the Secretary of State November 22, 1963.

An application for federal assistance under P.L. 566 was submitted to the State Soil Conservation Committee September 30, 1964. Approval by the State Soil Conservation Committee was granted December 18, 1964. A joint study of Wet Walnut Creek as a part of the Upper Arkansas Basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. The State Soil Conservation Committee assigned a priority for planning July 31, 1967. A ground-water recharge study was started in the Wet Walnut Creek Basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Watershed District during the summer of 1968.

Preliminary planning led to project formulation meetings in October 1968, where 54 P.L. 566 sites and 45 additional sites were selected to be built with other federal assistance programs over the five watersheds. Most of these sites remain in the plans. Planning was authorized by the Soil Conservation Service Administrator January 13, 1969.

The watershed board of directors maintains an active and continuing interest in promoting conservation of all kinds within the district. They employ a full-time watershed manager and have held public meetings monthly throughout the history of the district. In the course of these activities, many alternatives have been considered. The public has had ample opportunity and repeated encouragement to provide inputs into the development of the objectives and project formulation. The local press has given extensive coverage to the activities of the district and the general level of public awareness of the plans is very high.

The General Plan for Wet Walnut Creek Watershed Joint District No. 58 was approved by the board of directors and the Kansas Division of Water Resources of the State Board of Agriculture on March 30, 1972.27/ Modifications were made and approved in February 1973 and January 1974. Well publicized public hearings were held at each of these steps.

Objectives

Original goals of sponsors were expressed in the applications dated September 30, 1964. The goals were stated in general terms by types of benefits expected through project action. As planning progressed the goals became more specific and better defined. The redefined goals, including those of the Soil Conservation Service are summarized herein according to project purpose.

Watershed Protection (Conservation Land Treatment): Reduce soil loss on 54,200 acres of cropland and 19,700 acres of rangeland to allowable levels. The allowable soil loss for a typical upland soil is 5 tons/acre/year.1/

Manage land within its capability. Manage croplands through implementation of conservation practices: conservation cropping systems, stubble mulching, minimum tillage, contour farming, and the installation of terraces, diversions, grassed waterways, and drainage systems. Convert cropland to rangeland where appropriate and improve management practices on existing

rangeland. Manage rangelands through proper grazing use, planned grazing systems, brush management, and the strategic placement of stock ponds.

Reduce sediment load to a point that no new deposition occurs in the main Wet Walnut Creek channel. The objective is to maintain or improve present capacity and ground water recharge capability of the channel.

Flood Prevention: Reduce average annual flood damages to crops, agricultural properties, roads, bridges, and public utilities by 60 percent of 38,500 acres of flood plain within the watershed district. Reduce flooding in urban areas to confine damage to streets, lawns, and parks.

Recreation: Develop one reservoir with the best physical potential for multipurpose use including recreation. Design facilities for maximum potential use for fishing, boating, sightseeing, picnicking, hunting, and camping.

Fish and Wildlife: Enhance fish and wildlife resources within the watershed through land treatment measures, land use conversions, and establishment of impounded water. Where habitat losses unavoidably occur due to installation of structural measures, they are to be mitigated.

Alternatives

Eight alternatives considered in formulation of the project plan are displayed in the table on the next page. These alternatives were analyzed for physical feasibility, sources of authority, availability of local sponsors, effect on adverse environmental impacts, viability, and cost. A viable alternative is defined as one which is physically feasible and could be carried out under an existing authority. Cost estimates are included only for viable alternatives that reduce or eliminate adverse impacts of the proposed project.

Alternative No. 2-1 is the same as the proposed project except that sediment pools in floodwater retarding structures would be dry. These dry impoundments would convert 6 miles

WET WALNUT CREEK SUBWATERSHED NO. 2

MATRIX ANALYSIS OF ALTERNATIVES (X=yes, 0=no)

Alternative No.	Description	Alternative Components						Physical Feasibility	Authority		Local Sponsorship	Effect on Adverse Impact	Viable	Installation Cost ($)
		ACC LT	MP-REC	CW	Z	I	FRS No.		PL 566	Other				
2-1	As planned, but with dry pools	X	X				24	X	X	0	X	Reduce	X	8,169,300
2-2	No project							X		X	X	Eliminate	X	1,838,000
2-3	Acc. L.T.	X						X	X	X	X	Eliminate	X	2,588,800
2-4	Acc. L. T. and Non-Structural Measures	X			X	X		X	0	0	0	Eliminate	0	
2-5	Acc. L.T. and sites 20, 21, 22, 31, 32, and 33	X	X				6	X	X	0	X	Reduce	X	4,392,700
2-6	Acc. L.T. and Channel Work	X		X				X	X	X	X	Increase	X	
2-7	Recharge Structures and Acc. L.T.	X						X	0	X	X	Reduce	X	4,250,700
2-8	As planned, with recharge structures	X	X				24	X	X	X	X	Increase	X	

ACC LT - Accelerated Land Treatment (all alternatives include on-going land treatment)
MP-REC - Multipurpose Floodwater Retarding and Recreation Structure
CW - Channel Work
Z - Flood Plain Zoning
I - Flood Plain Insurance
FRS - Floodwater Retarding Structures

of intermittent stream and 15 miles of ephemeral stream flood plain to 819 acres of frequently flooded odd area habitat. This project, on an average annual basis, would add 6,700 acre feet of groundwater and increase evapotranspiration by 3,900 acre feet. The aesthetics and incidental benefits associated with the development of 771 acres of aquatic habitat would be foregone. The cost of this alternative would be $8,169,300.

Alternative No. 2-2 is to allow present trends including the land treatment program to continue. Net benefits of $189,100 would be foregone.

Alternative No. 2-3 consists of accelerated land treatment only. Resource management systems would be installed in 10 years on 74,580 acres of agricultural land. The average annual soil loss from upland soils would be reduced from 4.6 to 2.8 tons per acre. Average annual sediment deposition in existing ponds would be reduced 38 percent and average annual sediment yield to the watershed outlet would be reduced from 43,000 to 27,000 tons. The cost of this alternative would be $2,588,800.

Alternative No. 2-4 is the same as Alternative No. 2-3 with the addition of flood plain management including zoning to those uses best adapted to flooding. Agricultural use of flood plain land would be controlled. State law prohibits restriction of agricultural use of land. Flood insurance would be made available to all communities. This alternative would require additional studies for evaluation.

Alternative 2-5 consists of accelerated land treatment and six floodwater retarding structures. Floodwater retarding dams and spillways would occupy 42 acres now in crops and 93 acres now in grass. The pools would convert 3 miles of intermittent stream and 5 miles of ephemeral stream flood plain to 306 acres of aquatic habitat. Temporary flooding and sediment deposition would occur above the proposed structures on 221 acres of cropland and 745 acres of rangeland and pastureland. Identified flood damages within the watershed would be reduced 39 percent on 17,614 acres of flood plain below the proposed structures. Accelerated land treatment would improve the soil, water, and plant management on 74,580 acres. Average annual soil loss from upland soils would be reduced from 4.6 to 2.8 tons per acre. Average annual sediment deposition

in existing ponds would be reduced 38 percent; and average annual sediment yield to the watershed outlet would be reduced from 43,000 to 24,000 tons. The project would add 2,700 acre feet of ground water and increase evapotranspiration by 4,100 acre feet annually. The cost of this alternative would be $4,392,700.

Alternative No. 2-6 consists of accelerated land treatment and channel work to achieve the flood benefits provided by the project. Channel work would be the enlargement and realignment or confinement by dikes of approximately 31 miles of intermittent stream. While flood benefits as large as the planned project could be obtained, flooding would be increased downstream. The achievement of damage reductions comparable to the planned project would cause loss of riparian and aquatic stream habitat.

Alternative No. 2-7 consists of 20 low head dams, on the mainstem channel for groundwater recharge, annual clean out of the pools created by the dams, and accelerated land treatment. Pools would inundate 31 miles of intermittent stream. In 10 years, resource management systems would be installed on 74,580 acres of agricultural land. Average annual upland soil loss would be reduced from 4.6 to 2.8 tons per acre. Average annual sediment deposition in existing ponds would be reduced 38 percent; and average sediment yield to the watershed outlet would be reduced from 43,000 to 10,000 tons. The project would add 500 acre feet of groundwater and increase evapotranspiration by 100 acre feet annually. Average annual discharge would be reduced 450 acre feet. The project would result in $8,900 average annual increase in flood damages. Average annual costs of clean out and maintenance of the pools and maintenance of the dams would be $75,700. The installation cost of the project would be $4,250,700.

Alternative No. 2-8 is the planned project plus low-head dams on the mainstem channel for additional groundwater recharge. The pools created by the low-head dams would inundate an additional 31 miles of intermittent stream. This alternative would not reduce flood damages as much as the planned project. This alternative would add 8,000 acre feet of groundwater and increase evapotranspiration 5,100 acre feet annually. The average annual costs of clean out and maintenance of the pools and maintenance of the dams would be $51,700.

All viable alternatives were evaluated in terms of their effects on watershed problems and planning objectives. Alternatives which provided the maximum reduction in average annual flood damages for the watershed were considered most desirable for the following reasons:

The flood plain is already extensively used, mostly for agricultural enterprise. Any reduction in present or future agricultural use of the flood plain would be undesirable as an alternative because of the importance of agricultural production to the area's economy.

Additionally, sponsors felt that the reductions in adverse effects (see effects section) that would be achieved by eliminating recreational use were not sufficient to justify the loss of benefits.

After consideration of all viable alternatives that could reduce or eliminate adverse project effects, the proposed project, which includes conservation land treatment, 2 multipurpose structures and all economically justifiable floodwater retarding structures, was selected.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Resource management is essential to a sound watershed protection and flood prevention program. Farmers and ranchers, in cooperation with the conservation districts, will develop conservation plans to achieve proper land use and conservation.

Adequate land treatment will be implemented on 54,200 acres of cropland, 19,700 acres of rangeland, and 680 acres of forestland. Conservation agreements must be obtained from operators of at least 50 percent of the land in drainage areas above reservoirs before construction of the structure is started. Additionally, 75 percent of the effective land treatment measures must be applied to sediment source areas which, if uncontrolled, would require a material increase in the cost of construction, operation, or maintenance of the structural measure. Provisions for installation of these measures before or concurrent with construction must be made in each project agreement. The resource management systems will include all practices needed for desired and compatible use of a particular area. Land use conversions needed to establish proper conservation of the watershed

resources include 5,474 acres of cropland to: hayland (560 acres), rangeland (4,578 acres), wildlife and recreation land (148 acres), forestland (136 acres), and other uses (52 acres); and 476 acres of rangeland to wildlife and recreation land.

Alternative conservation practices for cropland resource management systems include:

Conservation Cropping System: Using needed cultural and management measures for crops. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without these crops.

Stubble Mulching: Managing plant residue on a year-round basis so harvesting, tilling, planting, and cultivating are done to keep protective amounts of vegetation on the soil surface.

Minimum Tillage: Limitation of cultivation to that essential to crop production and prevention of soil loss.

Gradient Terraces: A system of earth embankments, ridges, and channels, constructed along a slope at a suitable spacing and with an acceptable grade.

Level Terrace: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing with no grade.

Diversion: A channel with a supporting ridge on the lower side constructed across a slope. Diversions are constructed to divert water from areas where it is in excess to sites where it can be used or disposed of safety.

Contour Farming: Cultivation of sloping land at right angles to the slope. This includes following established grades of terraces, diversions, or contour strips.

Grassed Waterway or Outlet: A natural or constructed passageway for water with vegetation established that is suitable for safe disposal of runoff from a field, diversion, terrace, or other structure.

Drainage: Disposal of excess water in a field by grading to reshape the land surface or by construction of a graded ditch.

Artificial Groundwater Recharge System: A conservation practice system for temporary surface storage of excess runoff to be infiltrated into the soil and percolated to the groundwater table.

Rangeland is used for grazing livestock and big game animals. The natural plant community is dominated by grasses, grass-like plants, forbs, legumes, and shrubs. The primary practices among alternatives for rangeland are:

Proper Grazing Use: Grazing at an intensity which will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation. This can be accomplished by stocking at rates compatible with forage production where summer-long grazing is practical or by rotating grazing use between two or more pastures. Cropland forage to produce seasonal pasture, hay, or silage can be planned to supplement rangeland pastures.

Planned Grazing Systems: A system in which two or more grazing units are alternately rested from grazing in a planned sequence over a period of years. The rest period may be throughout the year or during part of the growing season of the desirable plants. Many pastures in the watershed contain sufficient amounts of desirable plants to recover rapidly through periodic deferments.

Brush Management: Manipulation of stands of brush by mechanical, chemical, or biological means, or by controlled burning. This includes reducing excess brush and weeds to restore natural plant community balance and manipulation of brush stands through selective and patterned control methods to meet specific needs of the land and objectives of the land user.

Range Seeding: Establishing adapted plants by seeding on rangeland.

Pond: A watering source for livestock made by constructing a dam or embankment or by excavating a pit.

Detention Dam: A dam or embankment which temporarily detains floodwater to regulate the rate of flow in a watercourse.

Woodland is used primarily to produce adapted woody plants, to provide cover to protect fields and farmsteads from inclement weather, and to supply watershed protection, wildlife

habitat, and landscape diversity. For optimum maintenance or improvement of hydrologic conditions, woodland must support vigorous, fully stocked stands of trees with undisturbed ground cover. Benefits from woodland management will be sustained by realizing the maximum economic returns consistent with site capabilities. To obtain these objectives, the following will be employed:

Woodland Improvement: This may include harvesting mature trees, removing poor quality or less desirable trees, and pruning the managed species.

Windbreak and Shelterbelt Planting and Renovation: Planting tree and shrub seedlings to establish new, or renovate existing shelterbelts and windbreaks. Renovation may also include the removal or pruning of existing plants or the adoption of improved management practices.

Hedgerow Replacement or Renovation: Hedge seedlings may be planted to establish permanent field borders and add to wildlife habitat and landscape beautification.

Grazing Control: Livestock can damage young trees and cause soil erosion and compaction. All new plantings and cultural operations should be protected from grazing livestock. Some good quality young native timber also need protective fencing.

Tree and Shrub Plantings: Special shelterbelt plantings are planned at each flood control structure to breakup summer winds and thereby reduce evaporation. These plantings will be planned to maximize their value for wildlife habitat, recreation shelter, and site beautification. Plantings in other areas will serve similar purposes.

An educational program is planned to inform rural residents of the economic and wildlife benefits that can be gained from excluding livestock from woodland and shelterbelts.

A forestry work plan was developed for the watershed by the Kansas State and Extension Forester, in cooperation with the U.S. Department of Agriculture, Forest Service.14/ Forestry technical assistance provided through the existing Cooperative Forest Management Program and P. L. 566 program will adequately serve the needs of the watershed woodlands throughout the life of the project.

Although the watershed area is protected by rural fire districts, new districts need to be organized in response to additional documented fire protection needs. Fire prevention education programs will be developed. Technical assistance for fire control measures will be provided by the Kansas State and Extension Forester. The cost of improved fire control equipment and facilities is to be borne by rural fire districts. Technical fire control assistance will be provided from going programs.

As part of the land treatment measures to be installed, the watershed district, in cooperation with the conservation districts, will work with landowners to install approximately 14 detention dams. These dams will control drainage areas ranging in size from 0.25 to 6.06 square miles for a total of 22.56 square miles or 6.5 percent of the watershed. These dams will provide detention of runoff averaging 2 inches per square mile. The total estimated flood storage for the 10 detention dams is 2,410 acre feet. Sediment pools will store 480 acre feet.

Watershed director and conservation district supervisors are furnishing part-time technical assistance to accelerate the installation of soil and water conservation treatment. Provisions have been made for personal contact with landowners and operators to urge them to establish conservation practices on their farms. During this contact, people will be informed about the watershed program and its progress. Underlying these efforts is the importance of landowner-operator understanding that these treatment measures not only benefit them individually but also are necessary prior to building floodwater retarding structures in the watershed.

Non-Structural Measures

Data will be provided to the communities of Rush Center, Nekoma, Alexander and Bazine during detailed flood insurance or special flood hazard studies to avoid increased future urban and rural residence flood damages. Such precautions as selective location, elevating, or flood proofing will prevent future damages to rural and urban facilities. Flood warning systems are effective for reduction of flood damages from flood generated by storms in the upper portion of the Wet Walnut Basin. The 1967 flood peak generated by a storm northwest of Ness City took one-half day to reach Bazine and two and one-half days to reach Timken from Ness City.

Structural Measures

A system of 23 floodwater retarding structures and 1 multipurpose structure with recreational facilities will be installed at locations shown on the project map.

All structures will be earth dams with vegetated emergency spillways to release runoff exceeding reservoir storage capacity safely past the dam. All foundations are classified as yielding and consist mostly of silty clay. Emergency spillways have been planned so that their chance of operation in any one year is four percent or less. A cross section of the typical structure is shown in Figure 1 (page 76).

At all sites, the predominant emergency spillway material to be excavated is silty clay. The remaining materials to be excavated will be shale and limestone.

The predominant borrow material at all sites will be silty clay. The intended borrow area for all sites is the sediment pool and emergency spillway excavation. Clearing will be necessary in the borrow areas; however, any opportunity to retain trees and brush will be given special consideration.

All structures will have drop inlet type principal spillways with single stage inlets near the estimated 100 year accumulation of sediment. Principal spillways will be reinforced concrete or a material of comparable strength and quality. Average uncontrolled release rates of 3.5 cubic feet per second per square mile of drainage area above the structures will not exceed downstream channel capacities.

Natural streamflow is to be passed through the dams to meet downstream water rights as provided by the Kansas Water Appropriation Act. Principal spillways will include 8 inch minimum diameter drawdown pipes with control valves to permit low flow releases regardless of reservoir storage elevation.

The floodwater retarding structures will have a total of 32,616 acre feet of floodwater storage. Retarding storage will vary from 2.07 to 3.80 inches of runoff from the drainage area. Drainage area controlled by the structures will range from 1.80 to 27.91 square miles. A total of 57.1 percent of the drainage area in the watershed will be controlled. Sediment storage will be provided for the expected 100 year accumulation of 3,569 acre feet. Sediment storage volumes range from 0.24 to 0.51 inches from the drainage areas.

All structural measures are designed for 100 year life.

The multipurpose reservoir is planned to store 2,649 acre feet for floodwater retarding storage, 431 acre feet of recreational water, and 279 acre feet of sediment. The recreational pool will have a full pool surface area of 100 acres 30 percent of the time. A 56 acre pool will be available for recreational use 80 percent of the time. Forty-four acres below the full pool will be exposed around shoreline 20 percent of the time. The pool will have a maximum initial depth of 19 feet and an average initial depth of 7.1 feet. The average depth at the end of 100 years is estimated to be 4.3 feet. The estimated time for initial filling of the recreational pool is two years.

Four hundred and seventy acres of land will be purchased in association with the multipurpose structure. This land includes 270 acres for recreational use and floodwater detention, and 200 acres to insure full use of the recreational facilities. Flowage easements will be obtained on an additional 65 acres.

All borrow areas for the multipurpose structure will be located on purchased land.

Sponsors will provide public access to recreational facilities at the multipurpose reservoirs. All recreational facilities will be installed, operated, and maintained to meet or exceed the requirements of state and local public health agencies. In addition, HEW standards will be used as guidelines.26/ Facilities will be designed and constructed to be usable for the physically handicapped.

Sediment pools in all the floodwater retarding structures will have some potential for limited recreational use. Access to these structure sites will be controlled by landowners. Access by the general public will be prohibited unless or until adequate sanitary facilities are provided to meet State and local health requirements. The Watershed District will notify the State Department of Health and Environment if adequate sanitary facilities are not provided.

If the multipurpose reservoir is eventually officially designated a "body contact area" by the Kansas State Department of Health, the Kansas Forestry, Fish and Game Commission will be responsible for regular monitoring of water quality

in the lake in accordance with the state code for Class A waters. This requirement does not prohibit use of the lake for body contact water sports prior to such designation.

Facilities for full use of the multipurpose structure will be installed during the project period as described in Table 2B. These will include fencing, signs, access roads, parking, drinking water, picnic areas, sanitation facilities, and facilities for boating. Random or primitive camping areas will be available.

The following modifications to physical features will be a result of project installation: raise a road and relocate a powerline at Structure No. 10; relocate a powerline and telephone line at Structure No. 13, raise a road at Structure No. 18; raise a road and bridge at Structure No. 21; relocate a powerline at Structure No. 12; relocate a powerline and dike around farm buildings at Structure No. 25; raise a water well and relocate a powerline and telephone line at Structure No. 26; raise a road and bridge and dike around farm buildings at Structure No. 28; relocate a powerline and dike around farm buildings at Structure No. 29; raise a road at Structure No. 31; and raise a road at Structure No. 32. See Table 2 for estimated costs.

Record search and field examinations confirm abandoned oil or gas wells in the reservoir areas to be adequately plugged. No producing gas or oil wells will be affected by structural measures.

As a result of the acquisition of land for multipurpose Structure No. 32 and the installation of structure No. 13, it is estimated that six persons on two farm operations associated with Structure No. 32 and two persons on one farm operation associated with Structure No. 13 will be eligible for relocation payments. Relocation payments of $8,000 and $2,500 for Structure Nos. 32 and 13 respectively are included in the estimated structural cost distribution as shown in Table 2.

Specific measures to offset wildlife losses and enhance habitat have been recommended for each structure site. Maps and descriptions of these measures are in a report by the U.S. Fish and Wildlife Service.27/

The dams and spillways of the 23 floodwater retarding structures will be fenced and seeded to a grass-legume mixture suitable for wildlife. Compensating measures have been adopted as design features for each structure. The fee title area for the multipurpose structure will be fenced and the dam and spillway seeded to a grass-legume mixutre suitable for wildlife. Specific odd areas adjacent to structure Nos. 11, 13, 14, 16, 18, 20, 27, 29, 31, and 33 as designated in the Fish and Wildlife Service Report are to be within the permanently fenced and seeded area. Tree and shrub plantings are to be made in the designated areas for Structure No. 13. The location of the tree and shrub plantings for multipurpose Structure No. 32 will be preserved where possible.

Enhancement measures recommended in the Fish and Wildlife Service report for installation at the floodwater retarding structures include: additional odd areas and tree and shrub plantings within the permanently fenced area; seeding cropland within a one foot vertical elevation of the sediment pool to switchgrass; leaving as much woody vegetation within the sediment pools as possible; constructing brush piles suitable for wildlife using trees cleared for construction; and planting borrow areas within the sediment pools to a quick cover. The need for water and air pollution abatement during construction will be determined on a site-by-site basis. Abatement measures may include dry stream crossings, temporary vegetative establishment, watering for dust control, controlled burning, and sediment control basins None of the enhancement measures have been adopted as a part of this plan.

The State Archeologist will be notified in advance of stripping operations at Structure 13 so that an archeologist may be present.

The Soil Conservation Service will in consultation with the State Historic Preservation Officer maintain close communication with the State Archeologist during project construction so that any finds may be investigated to determine the need for emergency salvage. The National Park Service will also be notified of any discoveries. If necessary, the Secretary of the Interior will be asked to determine the site's eligibility for inclusion on the National Register. The Advisory Council on Historic Preservation will be requested to comment on any site affected by project activities which have the qualities to make it eligible for inclusion in the National Register of Historic Places. This is in accordance with section 106 of the

National Historic Preservation Act, PL-89-665, 16 USC 470(f). Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Exeuctive Order 11593 with respect to archeological and historical resources.

EXPLANATION OF INSTALLATION COSTS

Needed land treatment measures and their estimated costs are shown in Table 1. The estimated total planning and installation cost for land treatment is $2,588,800. Public Law 566 funds will provide $134,400 of this total for technical assistance to accelerate the current program. Other sources will provide the remaining $2,454,400 for installing these measures. Land treatment installation costs include 14 detention dams. All land treatment cost estimates are based on present costs under current programs.

Structural measures and their estimated costs are also shown in Table 1. These costs are separated by individual structure sites in Table 2. The total estimated cost for all structural measures in $5,873,500. The following discussion of structural measures costs deals first with major elements listed in Table 1 (construction, engineering services, relocation payments, project administration, and land rights). Next is an explanation of estimated structural cost distributions found in Table 2.

Construction cost estimates are based on topographic survey data and unit costs of similar work on other projects. A contingency allowance of 12 percent was used; however, no unusual construction problems are anticipated.

Engineering services include all direct and related costs of surveys, geologic site investigations, soil mechanics, structure design, construction plans, and specifications.

Relocation payments are made to those landowners and farm operators who are displaced from their farm operations. These costs include moving and expenses of searching for a replacement farm location or payments for direct loss of personal property if the farm operation is not relocated. The estimated total relocation payments are $10,500. Public Law 566 funds will pay 62.5 percent or $6,600, and other sources will pay 37.5 percent or $3,900. The cost-sharing percentages are based on the ratio of P.L. 566 funds and other funds to total project costs, not including relocation

payments. The sponsors and the Service will be involved in administrative functions in connection with relocation payments. Each will bear the costs they incur.

Project administration costs are P.L. 566 and other administrative costs associated with installation of structural measures. These costs include contract administration, review of engineering plans prepared by others, and necessary inspection service during construction to insure that structural measures are installed in accordance with plans and specifications. Project administration costs to the district also includes relocation assistance advisory services. These services shall provide (1) measures or facilities necessary to determine relocation assistance needs, (2) information regarding replacement property, (3) informational brochures, (4) assurance of replacement dwellings, and (5) assistance in getting established. In addition to relocation assistance advisory services, the sponsors and the Service will be involved in administrative functions in connection with relocation payments. The sponsors and the Service will each bear the costs they incur. These shall include costs for: (1) serving notice of displacement, (2) providing application forms, (3) assisting in filing applications, (4) hearing and resolving grievances, and (5) making relocation payments. The Service will assist the sponsors in carrying out these administrative functions.

All land values were determined by the Wet Walnut Creek Watershed Joint District Board of Directors and agreed to by the Soil Conservation Service, where the watershed district is to pay the entire cost. Land cost estimates are based on current land values which vary from $200 per acre for grassland to $750 per acre for leveled and irrigated cropland. For structures where land rights are cost-shared, the Service and the Kansas Forestry, Fish and Game Commission determined the values. Land cost estimates also include appraisal fees. Land cost estimates may not coincide with actual out-of-pocket costs to the local sponsoring organization because some easements may be donated. Land cost estimates for the recreational site are based on $200 per acre. Some additional local costs are required in modifying roads and utilities.

Construction and engineering cost for the multipurpose site, excluding recreational facilities, will be allocated on the basis of the "use of facilities" method. Allocations computed in this manner are: flood prevention, 87.2 percent, and public recreation, 12.8 percent. Construction costs will be cost shared as follows:

Item	Sponsoring Local Organization %	Sponsoring Local Organization Cost	P.L. 566 %	P.L. 566 Cost	Total %	Total Cost
Flood Prevention	0	0	100.0	248,300	100	248,300
Public Recreation	50.0	18,200	50.00	18,200	100	36,400
TOTAL	6.4	18,200	93.6	266,500	100	284,700

The engineering cost for the multipurpose structure is estimated at $43,900. All of these costs are paid by P.L. 566 except for $2400 of the $3,200 required for the recreational facilities.

Land rights for the multipurpose reservoir and the recreational facilities and development are to be acquired on 470 acres at an estimated cost of $105,000. These costs will be shared as follows:

Item	Sponsoring Local Organization %	Sponsoring Local Organization Cost	P.L. 566 %	P.L. 566 Cost	Total %	Total Cost
Dam and reservoir fee title--270 acres	50.0	27,000	50.0	27,000	100	54,000
Recreational area--200 acres	50.0	20,000	50.0	20,000	100	40,000
Surveys, legal fees, etc. (includes easement on 65 acres)	100.0	11,000	0	0	100	11,000
TOTAL		58,000		47,000		105,000

Costs paid with P.L. 566 funds for the 23 floodwater retarding structures include all the construction and engineering services costs. Part of the project administration costs will also be paid from P.L. 566 funds. The district will pay the land rights costs including costs for road and bridge modifications, utility modification and other as shown on Table 2.

The total project administration cost is estimated to be $1,480,900. Public Law 566 will bear $1,292,900 of this cost and other funds will pay the remaining $188,000. The Service and the Sponsors will each bear the costs they incur.

The total estimated installation cost of the 23 floodwater retarding structures and 1 multipurpose structure is $4,392,600. These costs, in relation to purpose and cost sharing, are shown in Table 2A.

Estimated total P.L. 566 costs and other obligations by fiscal years during the project installation period are as follows:

LAND TREATMENT

Fiscal Year	P.L. 566 Costs	Other Costs	Total
First	$ 20,200	$ 368,200	$ 388,400
Second	20,200	368,200	388,400
Third	20,200	368,200	388,400
Fourth	20,200	368,200	388,400
Fifth	20,200	368,200	388,400
Sixth	13,400	245,400	258,800
Seventh	6,700	122,700	129,400
Eighth	6,700	122,700	129,400
Ninth	4,000	73,600	77,600
Tenth	2,600	49,000	51,600
Total	134,400	2,454,400	2,588,800

Structural Measures

Fiscal Year	P.L. 566 Costs	Other Costs	Total
First	$ 286,600	$155,900	$ 442,500
Second	531,100	63,500	594,600
Third	525,600	59,200	584,800
Fourth	525,000	54,400	579,400
Fifth	666,600	102,300	768,900
Sixth	538,800	84,400	623,200
Seventh	515,500	42,900	558,400
Eighth	525,400	47,800	573,200
Ninth	508,000	60,300	568,300
Tenth	527,500	52,700	580,200
Total	5,150,100	723,400	5,873,500

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion and Sediment

The planned project will reduce the 100 year flood near Rush Center from 18.0 csm to 9.7 csm and would eliminate flood damage up to the 10 year flood. The effect on the area flooded by the 100 year frequency storm is shown in the following table:

Reach	Area Inundated 100 Year Frequency Storm Without Project (Ac.)	With Project (Ac.)
IV	5,098	1,443
V	4,152	607
VI	4,434	775
VII	3,930	770
TOTAL	17,614	3,595

Average annual flood damages will be reduced by 62 percent in this watershed. A 19 percent reduction will result from land treatment applied in this watershed and upstream watersheds; 13 percent from structure measures in this watershed and 30 percent from structural measures in upstream watersheds. The watershed protection program would benefit all or parts of 65 farms on the evaluated flood plain. In addition, the project will benefit directly or indirectly all of the 2,759 inhabitants of the watershed (including 31 farms with 930 acres of non-evaluated flood plain having significant damage only with floods approaching or exceeding the 100 year frequency storm) and 101 farms (30,153 acres) and 24,764 urban, surburban or small town inhabitants downstream on the Wet Walnut Creek flood plain.

The proposed project would have reduced the damage from the September 1959 flood by 60 percent. The total area flooded would have been reduced from 16,185 acres to 4,420 acres.

The effects of structural works of improvement on a flood equivalent to the 1959 flood are shown in the following table:

	1959 FLOOD		100-YEAR FREQUENCY	
			Elevation Related to 1959 Flood	
	Without Project	With Project	Without Project (ft.)	With Project (ft.)
Rush Center			+ .7	-1.7
Water Depth (Number of Locations)				
Below first floor-				
with basement	10	--		
without basement	17	11		
0 to .5' above first floor -				
with basement	7	--		
without basement	14	--		
.5' to 1.5' above first floor -				
with basement	--	--		
without basement	11	--		
Nekoma			+ .7	- .3
Water Depth (Number of Locations)				
Below first floor -				
with basement	2	2		
without basement	--	--		
0 to 1.0' above first floor -				
with basement	2	2		
without basement	--	5		
1.0' to 3.0' above first floor -				
with basement	2	1		
without basement	6	8		
3.0' plus above first floor -				
with basement	1	--		
without basement	8	1		

	1959 FLOOD		100-YEAR FREQUENCY	
			Elevation Related to 1959 Flood	
	Without Project	With Project	Without Project (ft.)	With Project (ft.)
Alexander			+ .8	- .1
Water Depth (Number of Locations)				
Below first floor -				
with basement	3	1		
without basement	17	6		
0 to 1.0' above first floor -				
with basement	1	1		
without basement	3	--		
Bazine			+ .6	- .3
Water Depth (Number of Locations)				
Below first floor -				
with basement	15	2		
without basement	58	74		
0 to .7' above first floor -				
with basement	--	--		
without basement	16	7		
.7' to 1.5' above first floor -				
with basement	--	--		
without basement	7	--		

The project will increase the level of flood protection of the planned local protection works at Great Bend. The requirements of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 will serve to regulate further development of designated flood prone areas. Flood insurance is available to the residents of Bazine. The communities of Rush Center and Alexander have been officially notified of existing flood hazard areas and will apply for eligibility under the flood insurance program. Rush County will act for rural residents and unincorporated communities including Nekoma in designated flood hazard areas.

Land use and cropping patterns on the flood plain are not expected to change greatly. Decreased flooding will allow more intensive use of 1,323 acres. The land treatment program should result in more efficient use of land and water resources, and thus, increase farm income.

Normal release of retarded floodwater will result in increased ground water recharge. Principal spillways are planned to operate at about bank-full capacity throughout the tributary and mainstem channel reaches. More than one-half of flows that would normally pass a given point over a two to three day period will be detained within the channel banks for 20 to 30 days. This increase in channel flow duration will increase recharge through the channel walls.16/ Reduced flood plain inundation does not reduce the net recharge increase since a negligable amount of natural recharge takes place through flood plain soils and subsoils. Six thousand one hundred acre feet of mainstem recharge and 200 acre feet of tributary recharge will occur annually. These same works will increase evapotranspiration losses 4,700 acre feet annually.

The average annual soil loss in this watershed will be reduced from 4.6 to 2.8 tons/acre. Changes in soil losses by land use will be: cropland 5.9 to 3.5 tons/acre; rangeland 1.8 to 1.4 tons/acre; forestland and miscellaneous no change. The project will reduce severe scour such as resulted from the September 1959 storm.

The combined effects of the four watershed projects will reduce the total average annual sediment yield to the Arkansas River from an estimated 170,000 tons to 86,400 tons. The average annual sediment yield from this watershed to Wet Walnut Creek will be reduced by 32,000 tons. However, the average annual sediment yield from this watershed to the Arkansas River will be reduced by 23,200 tons. At Albert, the combined effects of the four watershed projects will lower the average annual suspended sediment concentration from 1,200 mg/l to 1,000 mg/l. This watershed accounts for 33 percent of the reduction.

The water quality standards for Kansas streams such as Wet Walnut Creek are already being met. They will still be met following completion of the watershed project.17/ The major impact on the quality of water in Wet Walnut Creek and its tributaries will be a reduction in sediment load.

Other effects on the quality of stream flow will be minimal and localized although a lack of data concerning the effects of completed watershed projects on stream flow quality prevents any detailed predictions. It is likely that some reduction will occur in organic wastes and nutrient levels.

Fish and Wildlife

Base flow in mainstreams will be increased as will the flow in all streams below structures. Prolonged releases and seepage from the reservoirs are expected to provide additions to low flows of sufficient magnitude or duration to change some stream classifications: 15 miles of ephemeral stream to intermittent and 65 miles of intermittent stream to perennial. During some periods reservoir levels will be below principal spillway inlets. Natural stream flow will be passed through the dams during drought periods as required to meet downstream water rights.

Some soil erosion and air and water pollution will occur during reservoir construction. These effects will be minimized.

A reduction in mortality to species inhabiting the flood plain below structures will occur due to reduced flooding. Rather than increasing population levels, this will probably tend to stabilize populations in that area.

Forty-four acres of cropland and 915 acres of rangeland in sediment and recreation storage pools will be lost to agricultural and terrestrial wildlife habitat use. Periodic flooding of 3,461 acres of retarding and detention areas will interrupt and reduce agricultural and wildlife uses. In addition, construction of dams and spillways on 184 acres of cropland and 304 acres of rangeland will largely displace these uses; however, revegetation will return most of the land to wildlife habitat. Two hundred and fifteen acres of agricultural land associated with the recreational development areas will be available for use as managed terrestrial wildlife areas.

Measures to enhance fish and wildlife habitat (fencing and seeding areas to grasses and legumes, additional tree and strub plantings, and seeding pool areas to quick cover crops) will increase fish and wildlife habitat. Installation of land treatment measures will improve terrestrial wildlife habitat by increasing habitat diversity.

Project measures will create 959 surface areas of habitat for aquatic species and migratory water fowl. They will improve the Wet Walnut Creek stream fishery.

Impoundments will inundate 14 miles of ephemeral streams and three miles of intermittent stream.

The proposed project should have no impact on endangered or threatened species, other than to increase the possible number of resting places available to the whooping crane, a possible transient resident in the area.12/

Recreation

Construction of the multipurpose reservoir will provide 470 acres for recreational use and is expected to draw visitors from throughout the area of influence. Fifty percent of the visitors will come from outside the watershed. While the lakes and recreational facilities will be used throughout the year, 60 percent of the recreational visits will occur between May 15 and September 15. The daily design capacity for the site will be 90 for sightseeing, 3 for boating, 138 for fishing, 51 for picnicking and 38 for camping. Hunting, fishing, picnicking, random and primitive camping, sightseeing, and other recreational activities will be available. An estimated 30,000 annual recreational visits are expected.

The multipurpose reservoir will provide fishing waters during drought periods and will maintain a stable fish population for use by watershed residents during these periods.

Water quality in the multipurpose reservoir is expected to be adequate for the intended use and to meet state water quality criteria.17/

Archeological, Historic and Scientific

Project measures will have no effect on any known historical or archeological sites. The State Historic Preservation Officer and the National Park Service will be notified immediately of any archeological sites discovered during construction.

Economic and Social

The works of improvement will have a positive effect on the area economy. Construction of the P.L. 566 structures will provide 117 man years of new employment over a 10 year period. Operation, maintenance, and replacement will provide 1.8 man years of employment annually. These employment opportunities will primarily benefit low and moderate income groups of the area.

There will be a positive effect on the quality of living for many watershed residents resulting from increased capital made available by reduced floodwater damages and more intensive use of property used in agricultural production. In addition, the general public, especially watershed residents, will benefit from better roads as a result of the reduced maintenance and repairs of the road system.

Relocation may adversely affect the quality of living for 8 persons on 3 farms that will be eligible for relocation assistance. It is estimated that 398 acres of these farms will be affected. None of the farmsteads and dwellings will be inundated or otherwise involved. Most of the residents are near retirement age and may elect to accept the reduction in sizes of the farms instead of relocating. Decreasing the sizes will decrease agricultural income for farm operators, an adverse effect on the quality of life for these persons.

The project offers a sound basis for rural development. Farm operations in areas where a high degree of flood protection is offered have a better chance of survival. Thus a reversal in the trend of declining numbers of farms could be more likely with the project.

Secondary benefits will result from transporting, processing, and marketing greater amounts of agricultural commodities produced as a result of reduced crop losses. Increased farm incomes will mean increased consumer expenditures for farm equipment and material to local retailers and wholesalers. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation. An increase in job opportunities and the economic benefits associated with additional commercial growth activities, particularly those which service the recreational areas, will accrue to the watershed and region.

In addition to the monetary benefits, there are other substantial intangible benefits which will result from the project. These include better living conditions, a sense of economic security, and the psychological security associated with the abatement of a fear of flooding.

The recreational developments will provide needed public open space areas in addition to serving recreational use needs.

Sediment pools of the floodwater retarding structures and detention dams will be of some benefit to agricultural operations by providing livestock water supply.

Traffic, noise and litter around the recreational developments will increase. For nearby residents, the aesthetic value of the area will change with the addition of reservoirs and recreational facilities.

At the multipurpose structure 44 acres around the full pool shoreline will be exposed 20 percent of the time.

Other

The following land use changes are expected to occur during the installation period of the project.

Land Use	Present Acres	End of Installation Acres	Net Changes Acres
Cropland	158,536	152,668	-5,868
Rangeland	67,419	70,926a/	+3,507
Forestland	2,100	2,236	+ 136
Other	4,164	6,389b/	+2,225
Total	232,219		

a/ Includes 507 acres hayland
b/ Includes 2,216 acres for wildlife and recreation

PROJECT BENEFITS

Average annual project benefits will equal $628,600. Of this, $57,500 will accrue from land treatment measures and $571,100 from structural measures. Individual items are shown in Tables 5 and 6.

Average annual floodwater damage reduction benefits with the project installed will total $147,600. Benefits from reduced floodwater damage to crops and pasture will average $92,100 annually and account for 62 percent of the total floodwater damage reduction benefits. Reduced flooding will achieve benefits of $25,600 to other agricultural

properties such as stored feed, fences, building, and other farm facilities. Annual average benefits of $7,700 to roads and bridges and $2,000 to railroads will result. Urban benefits will average $20,200 annually.

Benefits from reduced flood plain scour and sediment deposition will average $18,700 annually, accounting for about nine percent of the total damage reduction benefits. Indirect average annual benefits, such as less interruption of travel for mail, school buses, and milk routes are $18,100.

The reduction of the flood hazard will make possible annual benefits averaging $69,600 from more intensive use of land through improved crop rotations and use of fertilizer.

Multipurpose Structure No. 32 will produce annual recreation benefits of $60,000 from boating, fishing, sightseeing, camping, hunting, picnicking, and swimming. A value of $2.00 per recreation day is used in the evaluation.

Local net secondary benefits will average $173,000 annually. Secondary benefits from a national viewpoint were not considered in the economic evaluation.

Total off project benefits of $230,400 will occur annually; $112,400 in Subwatershed No. 1 and $118,000 between Subwatershed No. 1 and the Arkansas River.

Incidental benefits from beneficial use of stored water will be $4,400. Incidental groundwater recharge benefits will be $235,400. Incidental benefits were not claimed toward project justification.

COMPARISON OF BENEFITS AND COSTS

Average annual cost of structural measures, including installation, operation, maintenance, and administration is $382,000. When the project is completely installed, the structural measures are expected to produce average annual benefits (excluding local secondary benefits) of $398,100. The benefit-cost ratio without including local secondary benefits is 1.04 to 1. With local secondary benefits of $173,000 included, the project benefit-cost ratio is 1.50 to 1. (see Table 6)

PROJECT INSTALLATION

Works of improvement to be installed by the district are proposed to be completed within a 10 year period following

the adoption of the watershed plan. This schedule is contingent upon availability of federal funds provided under authority of the Watershed Protection and Flood Prevention Act (P.L. 566, 83rd Congress; 68 Stat. 666) as amended.

Land treatment measures will be installed by individual landowners and groups of landowners, cooperating with the Agriculture Stabilization and Conservation Service, Extension Forestry, conservation districts, and the watershed district. Technical assistance for land treatment installation will be provided by Extension Forestry, Soil Conservation Service, and the Kansas Forestry, Fish and Game Commission.

Land treatment measures include 14 detention dams that are also a part of the works of improvement in the General Plan of the watershed district.25/ Approval of the general plans has been obtained in accordance with sections 24-1214 of the Kansas Watershed District Act, as amended, from the Chief Engineer of the Division of Water Resources, State Board of Agriculture. The general plan has been adopted by Wet Walnut Creek Watershed Joint District No. 58. This process, along with requirements of the Chief Engineer, are assurances that the 14 detention dams will be installed essentially as planned. Technical assistance for the detention dams will be provided by the Service and the watershed district.

The Extension Service will assist in carrying out the educational phase of the program through the preparation of general information in cooperation with the conservation districts. The Farmers Home Administration Soil and Water Loan Program will be available to eligible farmers in the area. The County Agricultural Stabilization and Conservation Committees will cooperate with governing bodies of the conservation districts to accelerate assistance for practices which will accomplish the conservation objectives.

The watershed district will obtain all land rights, including legal services, needed for installation of the 23 floodwater retarding structures. P.L. 566 funds will pay 50 percent, the watershed district will pay 25 percent, and the Kansas Forestry, Fish and Game Commission will pay 25 percent of the cost of land acquisition for the multipurpose structure and associated recreational facilities. The watershed district will obtain 100 percent of the remaining land rights required for the multipurpose structure. The district and the Kansas Forestry, Fish and Game Commission will share equally the legal fees associated with land acquisition for the multipurpose structure. The watershed district has the power of eminent domain to obtain land rights for public improvements and has agreed to use such authority when needed.

The watershed district will make arrangements for abandonment, moving, or modification of roads, pipelines, communication lines, or other public utilities.

Land rights will be secured in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

The watershed district, as a part of their project administration, will provide written notice, application forms and advisory services to each displaced person or farm operation; assist in filing applications; review and take action on applications for relocation assistance and displacement grievances; and make relocation payments. The Service will assist the district in carrying out its responsibility.

Decent, safe, and sanitary replacement housing, if needed, will be made available prior to the construction of measures causing such displacements. All displaced persons will be given at least 90 days advance notice to vacate.

Engineering for the 23 floodwater retarding structures and the multipurpose structure will be provided by the Service. Engineering for recreational facilities will be provided in part by the Kansas Forestry, Fish and Game Commission through its regularly employed staff and in part by the Service in the form of on-site planning and standard designs. Technical assistance will be provided by the Kansas Forestry, Fish and Game Commission for the installation of wildlife measures.

The watershed district will contract for construction of the 23 floodwater retarding structures and the multipurpose structure. Recreational facilities will be installed by the Kansas Forestry, Fish and Game Commission with materials furnished by the Service.

Construction inspection of the 23 floodwater retarding structures and the multipurpose structure will be provided by the Service. Sponsors will make contributions toward construction inspection in accordance with their needs. The Service and the Kansas Forestry, Fish and Game Commission will share the construction inspection of the recreational facilities as needed.

Construction can be started when necessary land treatment has been completed, necessary land rights have been obtained,

P.L. 566 funds are available, and sponsoring organizations have complied with state laws relating to approval of construction plans.

Kansas Forestry, Fish and Game Commission participation in sponsorship of the multipurpose reservoir is contingent upon funding approval by the State Legislature.

FINANCING PROJECT INSTALLATION

Land treatment measures will be financed by landowners and operators with partial cost sharing through the watershed district and/or state and federal programs in effect at the time of installation. Technical assistance will be provided by the Service using P.L. 46 funds and supplemented by accelerated assistance using P.L. 566 funds. Installation costs of forestry land treatment and fire control measures will be borne by individual landowners, rural fire districts, and other federal programs. The cost of accelerated technical forestry assistance will be borne by P.L. 566 and the Kansas State and Extension Forester. Technical assistance for the fire control measures will be financed by the Kansas State and Extension Forester through the Fire Control Program.

Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission have the necessary authority and power to finance and carry out watershed improvements. These powers include the right to accept contributions, levy taxes, make assessments against land specially benefited, issue bonds, and exercise the right of eminent domain.

Expenses of organizing the watershed district have been paid and current general expenses are being met by an annual ad valorem tax levy.

All local costs to be financed by the sponsors will be paid from funds currently on hand and budgeted for the purpose, funds that will be collected through taxes before construction takes place, or through the issuance of general obligation bonds.

Relocation assistance and advisory services costs will be financed by the watershed district through a general tax levy.

P.L. 566 funds for construction and land rights will be provided to the local sponsoring organizations through project agreements executed with the Soil Conservation Service.

Prior to entering into agreements that obligate funds of the Service, the Wet Walnut Creek Watershed Joint District No. 58 and the Kansas Forestry, Fish and Game Commission will have a financial management system for control, accountability, and disclosure of P.L. 566 funds received, and for control and accountability for property and other assets purchased with P.L. 566 funds.

Program income earned during the grant period will be reported on the sponsor's request for advance or reimbursement from the Service.

Federal technical assistance, engineering services, project administration, and funds for construction are contingent upon appropriations for these purposes.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners and operators of farms on which the measures are installed under agreements with the conservation districts. Conservation district representatives will make periodic inspections of land treatment measures to encourage landowners to perform needed maintenance.

The watershed district is responsible for operation and maintenance of the 14 detention dams. The district will enter into agreements with the landowners who will perform maintenance as needed.

Technical assistance to landowners and rural fire districts for operating and maintaining forestry and fire control measures beyond the installation period will be provided by the Kansas State and Extension Forester in cooperation with the Forest Service under going programs.

Agreements for operation and maintenance of structural measures and recreational facilities will be executed by the local sponsoring organizations before federal construction funds are made available.

The 23 floodwater retarding structures and the dam for the multipurpose structure will be operated and maintained

by the watershed district. The estimated average annual costs are $11,600. Maintenance will be accomplished through hired or contributed labor and equipment, and funds will be obtained from an annual tax levy.

Recreational facilities and fish and wildlife habitat measures for the multipurpose reservoir will be operated, maintained, and replaced by the Kansas Forestry, Fish and Game Commission at an estimated annual cost of $9,800 of which $800 is for recreational facilities replacement. Useful life will vary for recreational facilities, but an average period of 20 years has been used to compute replacement costs. Funds will be obtained from Kansas Forestry, Fish and Game Commission revenues.

The Wet Walnut Creek Watershed District will assume the responsibility for passing natural stream flow and managing low flow releases from the 23 floodwater retarding structures. Making releases and passing natural stream flow through the multipurpose reservoir will be the responsibility of the Kansas Forestry, Fish and Game Commission. The recreational pool is normally expected to be operated between elevations 2,170.9 and 2,173.0.

A vegetative measure (associated with structural measures) establishment period is granted. During this period the State Conservationist may approve P.L. 566 cost sharing for additional work that is required to obtain adequate vegetative cover. This period is to terminate when adequate vegetative cover is obtained or 2 growing seasons have elapsed after initial installation of vegetative work, whichever occurs first.

Operation and maintenance responsibility rests with the sponsors during the establishment period, as it does during the remainder of the project life.

Maintenance work for structures and wildlife mitigation measures will be carried out when needed. Kinds of maintenance expected rather frequently are repairs to fences, clearing of debris, etc. Repairs to major construction items such as dams and spillways are expected very infrequently. Technical assistance available through the Soil Conservation Service will be utilized.

Prescribed tree and shrub plantings should be maintained at a 75 percent survival rate for the first five years, and

thereafter managed to allow for desirable natural growth and reproduction during the life of the project. Mowing, haying, burning, and livestock grazing will be permitted only when deemed compatible with wildlife uses.

All structural measures will be inspected annually, after unusually severe storms, and after any other unusual condition that might adversely affect their operation, maintenance, or safety. The Soil Conservation Service and local representatives responsible for operation and maintenance will make inspections jointly for a three year period following completion of construction. Thereafter, annual inspections will be made for the life of the structures by the sponsors.

Items of inspection will include, but not be limited to: the principal spillway and its appurtenances, emergency spillway, earth fill, vegetative cover of the earth fill and emergency spillway, fences installed as part of the structural measures, wildlife mitigation measures, and recreational facilities. Records of inspection will be maintained by the watershed district. Provisions will be made for access to inspect the structures at any time.

Sediment and beneficial use pools will be checked regularly during spring and summer months and measures taken to control mosquito breeding.

Where public access for recreation is permitted at any site, the sponsoring local organizations will require or provide sanitary facilities necessary to meet State Department of Health and Environment Standards to insure health and safety.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with P.L. 566 financial assistance.

TABLES

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Wet Walnut Creek Subwatershed No. 2, Kansas

Installation Cost Item	Unit	Number Non-Fed. Land	Estimated Cost (dollars)[a] P.L. 566 Funds Nonfederal Land SCS[c]	FS[c]	Total	Other Nonfederal Land SCS[c]	FS[c]	Total	Total
LAND TREATMENT									
Land Areas[b]	Acres					[d]			
Cropland	to be	54,200				1,581,800		1,581,800	1,581,800
Rangeland	treated	19,700				542,500		542,500	542,500
Forestland		680					20,200	20,200	20,200
Individual Practices such as -									
Fire control		69,100					7,500	7,500	7,500
Technical Assistance			120,000	14,400	134,400	291,900	10,500[e]	302,400	436,800
TOTAL LAND TREATMENT			120,000	14,400	134,400	2,416,200	38,200	2,454,400	2,588,800
STRUCTURAL MEASURES									
Construction									
Floodwater Retarding Structures		23	3,040,000		3,040,000				3,040,000
Multipurpose Structure		1	266,500		266,500	18,200		18,200	284,700
Recreational Facilities		1	15,900		15,900	15,900		15,900	31,800
Subtotal - Construction			3,322,400		3,322,400	34,100		34,100	3,356,500
Engineering Services			481,200		481,200	2,400		2,400	483,600
Relocation Payments			6,600		6,600	3,900		3,900	10,500
Project Administration									
Construction Inspection			961,400		961,400	2,500		2,500	963,900
Other			331,500		331,500	185,000		185,000	516,500
Relocation Assistance Advisory Services						500		500	500
Subtotal - Administration			1,292,900		1,292,900	188,000		188,000	1,480,900
Other Costs									
Land Rights			47,000		47,000	495,000		495,000	542,000
TOTAL STRUCTURAL MEASURES			5,150,100		5,150,100	723,400		723,400	5,873,500
TOTAL PROJECT			5,270,100		5,284,500	3,139,600		3,177,800	8,462,300

a/ Price base 1974.
b/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts apply to total land areas, not just to adequately treated areas.
c/ Federal agency responsible for assisting in installation of works of improvement.
d/ Includes $10,600 for shelterbelts.
e/ Includes $4,000 contributed through going programs.

September 1975

TABLE 1A - STATUS OF SUBWATERSHED WORKS OF IMPROVEMENT
(at Time of Work Plan Preparation)

Wet Walnut Creek Subwatershed No. 2, Kansas

Measures	Unit	Applied to Date	Total Cost (dollars)[a/]
Land Treatment			
Soil Conservation Service			
Conservation cropping system	Acre	104,500	732,100
Crop residue management	Acre	99,900	422,000
Contour farming	Acre	55,436	239,500
Proper grazing use	Acre	35,060	26,100
Range seeding	Acre	2,102	41,700
Grassed waterway	Acre	1,087	272,800
Diversion	Feet	100,814	19,600
Terrace	Mile	2,040	997,100
Farm pond	No.	211	239,300
Irrigation systems	Acre	8,511	1,442,700
Grade stabilization structure	No.	5	13,200
Floodwater retarding structure	No.	2	10,600
Subtotal - SCS			4,456,700
Forest Service			
Tree and shrub planting	Acre	900	139,800
Fire control	Acre	49,100[b/]	48,700
Subtotal - FS			188,500
Total			4,645,200

a/ Price base 1974
b/ These acres are included in Table 1 as needing further treatment.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
(Dollars)[a]

Wet Walnut Creek Subwatershed No. 2, Kansas

Item	Installation Cost P.L. 566 Funds					Installation Cost - Other Funds					Total Installation Cost
	Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land Rights	Relocation Payments	Total Other	
Floodwater Retarding Structures											
No. 10	109,500	15,400			124,900			8,300[b]		8,300	133,200
No. 11	94,000	13,400			107,400			10,500		10,500	117,900
No. 12	161,400	23,100			184,500			17,400		17,400	201,900
No. 13	330,500	50,100		1,600	382,200			53,000[c]	900	53,900	436,100
No. 14	163,700	23,600			187,300			18,800		18,800	206,100
No. 15	77,600	11,100			88,700			8,800		8,800	97,500
No. 16	139,800	19,700			159,500			18,700		18,700	178,200
No. 17	105,300	15,400			120,700			21,700		21,700	142,400
No. 18	119,200	17,200			136,400			17,600[d]		17,600	154,000
No. 19	94,800	13,700			108,500			10,100		10,100	118,600
No. 20	111,000	15,900			126,900			11,500		11,500	138,400
No. 21	264,400	37,300			301,700			46,400[e]		46,400	348,100
No. 22	137,700	19,300			157,000			11,300		11,300	168,300
No. 23	95,800	13,600			109,400			9,300[f]		9,300	118,700
No. 24	59,500	8,600			68,100			5,700		5,700	73,800
No. 25	88,300	12,700			101,000			13,300[g]		13,300	114,300
No. 26	116,700	16,900			133,600			11,700[h]		11,700	145,300
No. 27	100,300	14,500			114,800			14,400		14,400	129,200
No. 28	144,200	20,300			164,500			24,100[i]		24,100	188,600
No. 29	180,000	27,600			207,600			29,000[i]		29,000	236,600
No. 30	90,100	13,400			103,500			16,900		16,900	120,400
No. 31	142,100	20,600			162,700			33,900[k]		33,900	196,600
No. 33	114,100	16,300			130,400			24,600		24,600	155,000
Subtotal - FRS	3,040,000	439,700		1,600	3,481,300			437,000	900	437,900	3,919,200
Multipurpose Structure No. 32	266,500	40,700	27,000	5,000	339,200	18,200		38,000[l]	3,000	59,200	398,400
Recreational Facilities No. 32	15,900	800	20,000		36,700	15,900	2,400	20,000		38,300	75,000
Subtotal - MPS	282,400	41,500	47,000	5,000	375,900	34,100	2,400	58,000	3,000	97,500	473,400
Total	3,322,400	481,200	47,000	6,600	3,857,200	34,100	2,400	495,000	3,900	535,400	4,392,600
Project Administration					1,292,900					188,000	1,480,900
GRAND TOTAL	3,322,400	481,200	47,000	6,600	5,150,100	34,100	2,400	495,000	3,900	723,400	5,873,500

* See footnotes on following page.

September 1975

F O O T N O T E S

Table 2 - Estimated Structural Cost Distribution
Wet Walnut Creek Subwatershed No. 2, Kansas

a/ Price base 1974.
b/ Includes $800 for road modification and $1,100 for powerline modification.
c/ Includes $1,200 for powerline and telephone line modification.
d/ Includes $1,300 for road modification.
e/ Includes $8,500 for road modification and $1,000 for bridge modification.
f/ Includes $1,000 for powerline modification.
g/ Includes $200 for powerline modification and $2,300 for dike around buildings.
h/ Includes $100 for well modification and $400 for modification of telephone and powerlines.
i/ Includes $300 for dike around buildings and $5,000 for road and bridge modification.
j/ Includes $500 for dike around buildings and $1,600 for powerline modification.
k/ Includes $9,400 for road modification.
l/ Includes $2,800 for road modification and $3,200 for easements, and $5,000 for legal fees.

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

(Dollars)[a/]

Wet Walnut Creek Subwatershed No. 2, Kansas

Item	Cost Allocation			Cost Sharing					
	Purpose			P.L. 566			Other		
	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total
23 Floodwater Retarding Structures	3,919,200		3,919,200	3,481,300		3,481,300	437,900		437,900
Multipurpose Structure No. 32	297,100	101,300	398,400	288,800	50,400	339,200	8,300	50,900	59,200
Recreational Facilities		75,000	75,000		36,700	36,700		38,300	38,300
Total	4,216,300	176,300	4,392,600	3,770,100	87,100	3,857,200	446,200	89,200	535,400

a/ Price base 1974

September 1975

TABLE 2B - RECREATIONAL FACILITIES
ESTIMATED CONSTRUCTION COSTS
(Dollars)[a]

Wet Walnut Creek Subwatershed No. 2, Kansas

Item	Number	Estimated Unit Cost	Total Construction Cost
Road, gravel, 24' width	1,500 ft	1.85/linear ft	2,800.00
Parking Areas, gravel	20,000 sq ft	0.075/square ft	1,500.00
Fence, barbed, 4 wire, steel posts	4.0 mi	3,000/mile	12,000.00
Corrugated metal pipe - 24"	36 ft	14/ft	500.00
100 ft boat ramp, concrete, 14 ft width	1 each	Lump Sum	2,500.00
Toilet, vault, concrete block block	1 each	Lump Sum	2,500.00
Drinking water well	1 each	Lump Sum	3,000.00
Sun shades, wood	2 each	540	1,100.00
Picnic tables, 7 ft wood	4 each	70	300.00
Grill, metal, waist high	4 each	50	200.00
Refuse barrels, metal	2 each	20	100.00
	20% contingency		5,300.00
Total			31,800.00

a/ Price base 1974

September 1975

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING AND MULTIPURPOSE STRUCTURES

Wet Walnut Creek Subwatershed No. 2, Kansas

ITEM	UNIT	STRUCTURE NO.							
		10	11	12	13	14	15	16	17
Class of Structure		a	a	b	b	b	a	a	b
Drainage Area	Sq. Mi.	4.00	5.00	7.70	27.91	7.55	2.75	11.47	9.00
Controlled	Sq. Mi.	--	--	--	--	--	--	--	--
Curve No. (1-day) (AMC II)		75	76	75	75	76	75	72	72
Tc	Hours	1.9	2.1	2.7	5.4	2.0	1.2	3.4	3.4
Elevation Top of Dam	Feet	2,020.0	2,011.0	2,054.7	2,042.1	2,057.6	2,099.1	2,103.5	2,138.5
Elevation Crest Emergency Spillway	Feet	2,015.0	2,006.0	2,049.4	2,035.4	2,051.7	2,094.1	2,098.5	2,133.0
Elevation Crest Low Stage Inlet	Feet	1,997.0	1,993.2	2,030.4	2,016.0	2,037.3	2,084.1	2,082.7	2,117.7
Maximum Height of Dam	Feet	42.2	33.0	40.0	54.3	34.3	25.4	34.5	35.7
Volume of Fill	Cu. Yds.	119,700	91,200	146,800	337,200	149,100	72,100	149,400	83,400
Total Capacity	Ac. Ft.	698	896	1,495	4,600	1,486	494	1,872	1,531
Sediment Submerged	Ac. Ft.	77	93	136	417	113	53	153	158
Sediment Aerated	Ac. Ft.	2	3	4	15	4	1	6	5
Beneficial Use (Recreation)	Ac. Ft.	--	--	--	--	--	--	--	--
Retarding	Ac. Ft.	619	800	1,355	4,168	1,369	440	1,713	1,368
Surface Area									
Sediment Pool	Acres	13	23	27	58	30	19	39	38
Beneficial Use Pool (Recreation)	Acres	--	--	--	--	--	--	--	--
Retarding Pool	Acres	67	102	136	425	166	76	185	162
Principal Spillway									
Rainfall Volume (areal) (1-day)	Inches	5.9	5.9	6.5	6.3	6.5	5.9	6.3	6.4
Rainfall Volume (areal) (10-day)	Inches	9.3	9.3	10.1	9.9	10.1	9.2	10.0	10.0
Runoff Volume (10-day)	Inches	3.76	3.91	4.14	3.70	4.33	3.77	3.42	3.52
Capacity of Low Stage (Max.)	c.f.s.	17.8	31.4	33.5	127.9	31.6	13.2	62.2	43.1
Frequency Operation - Emerg. Splwy.	% Chance	2	2	1	1	1	2	1	1
Size of Conduit	Dim.	18"	18"	24"	30"	24"	18"	24"	24"
Emergency Spillway									
Rainfall Volume (ESH) (areal)	Inches	5.0	5.0	6.1	6.61	7.6	5.0	6.2	7.6
Runoff Volume (ESH)	Inches	2.45	2.53	4.68	3.80	4.79	2.45	3.14	4.34
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Feet	100	100	400	700	300	80	250	400
Velocity of Flow (V_e) a/	Ft./Sec.	b/	b/	7.6	4.8	6.1	b/	2.4	6.2
Slope of Exit Channel	Ft./Ft.	b/	b/	.032	.038	.032	b/	.040	.032
Maximum Water Surface Elevation	Feet	b/	b/	2,051.9	2,037.8	2,054.2	b/	2,099.2	2,135.6
Freeboard									
Rainfall Volume (FH) (areal)	Inches	7.6	7.6	13.6	11.8	13.6	7.6	9.8	13.6
Runoff Volume (FH)	Inches	4.68	4.79	10.29	8.59	10.43	4.68	6.31	9.84
Maximum Water Surface Elevation	Feet	2,018.4	2,008.9	2,054.7	2,042.1	2,057.6	2,096.6	2,103.1	2,138.5
Capacity Equivalents									
Sediment Volume	Inches	0.37	0.36	0.34	0.29	0.29	0.37	0.26	0.34
Retarding Volume	Inches	2.90	3.00	3.30	2.80	3.40	3.00	2.80	2.85
Other	Inches	--	--	--	--	--	--	--	--

a/ Maximum during passage of hydrograph
b/ Emergency spillway hydrograph is contained below crest of emergency spillway

September 1975

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING AND MULTIPURPOSE STRUCTURES

Wet Walnut Creek Subwatershed No. 2, Kansas

ITEM	UNIT	STRUCTURE NO. 18	19	20	21	22	23	24	25
Class of Structure		b	b	b	b	b	b	c	b
Drainage Area	Sq. Mi.	7.11	4.41	5.78	17.74	6.93	2.62	1.80	4.61
Controlled	Sq. Mi.	--	--	--	--	--	--	--	--
Curve No. (1-day) (AMC II)		72	73	74	74	72	77	76	76
TC	Hours	1.9	1.5	1.8	3.1	1.7	1.3	1.3	1.8
Elevation Top of Dam	Feet	2,164.0	2,103.2	2,110.9	2,134.7	2,172.0	2,032.5	2,053.9	2,053.7
Elevation Crest Emergency Spillway	Feet	2,158.8	2,098.0	2,104.8	2,127.3	2,166.2	2,026.6	2,047.5	2,048.7
Elevation Crest Low Stage Inlet	Feet	2,144.6	2,081.8	2,088.3	2,112.4	2,148.0	2,015.2	2,035.7	2,034.0
Maximum Height of Dam	Feet	29.0	35.7	35.9	40.4	43.5	27.0	26.2	30.5
Volume of Fill	Cu. Yds.	107,100	83,900	103,900	276,100	149,300	98,600	51,200	79,600
Total Capacity	Ac. Ft.	1,229	821	1,184	2,971	1,279	588	413	968
Sediment Submerged	Ac. Ft.	106	78	117	218	111	56	48	106
Sediment Aerated	Ac. Ft.	4	2	3	9	4	1	1	2
Beneficial Use (Recreation)	Ac. Ft.	--	--	--	--	--	--	--	--
Retarding	Ac. Ft.	1,119	741	1,064	2,744	1,164	531	364	860
Surface Area									
Sediment Pool	Acres	25	16	24	57	23	19	13	18
Beneficial Use Pool (Recreation)	Acres	--	--	--	--	--	--	--	--
Retarding Pool	Acres	162	91	118	315	116	80	54	109
Principal Spillway									
Rainfall Volume (areal) (1-day)	Inches	6.3	6.3	6.3	6.0	6.2	6.4	6.4	6.4
Rainfall Volume (areal) (10-day)	Inches	10.0	9.9	9.9	9.8	9.9	10.0	10.0	10.0
Runoff Volume (10-day)	Inches	3.56	3.89	4.29	3.50	4.07	4.73	4.75	4.46
Capacity of Low Stage (Max.)	c.f.s.	29.3	19.0	30.8	110.8	33.4	13.2	11.5	30.5
Frequency Operation - Emerg. Splwy.	% Chance	1	1	1	1	1	1	1	1
Size of Conduit	Dim.	24"	24"	24"	30"	24"	24"	30"	24"
Emergency Spillway									
Rainfall Volume (ESH) (areal)	Inches	7.6	7.6	7.6	6.81	7.40	7.6	10.5	7.6
Runoff Volume (ESH)	Inches	4.34	4.46	4.56	3.88	4.17	4.91	7.47	4.79
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Bottom Width	Feet	400	250	200	200	250	60	200	250
Velocity of Flow (V_e)[a/]	Ft./Sec.	5.6	6.1	6.4	4.8	6.0	6.4	6.7	5.8
Slope of Exit Channel	Ft./Ft.	.034	.032	.031	.036	.031	.031	.030	.033
Maximum Water Surface Elevation	Feet	2,161.2	2,100.5	2,107.3	2,129.3	2,168.7	2,029.1	2,050.0	2,051.0
Freeboard									
Rainfall Volume (FH) (areal)	Inches	13.6	13.6	13.6	12.2	13.3	13.6	26.0	13.6
Runoff Volume (FH)	Inches	9.84	9.99	10.13	8.86	9.55	10.57	22.56	10.43
Maximum Water Surface Elevation	Feet	2,164.0	2,103.2	2,110.9	2,134.9	2,172.0	2,032.5	2,053.9	2,053.7
Capacity Equivalents									
Sediment Volume	Inches	0.29	0.34	0.39	0.24	0.31	0.41	0.51	0.44
Retarding Volume	Inches	2.95	3.15	3.45	2.90	3.15	3.80	3.79	3.50
Other	Inches	---	--	--	--	--	--	--	--

a/ Maximum during passage of hydrograph

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING AND MULTIPURPOSE STRUCTURES

Wet Walnut Creek Subwatershed No. 2, Kansas

ITEM	UNIT	STRUCTURE NO. 26	27	28	29	30	31	32 MP	33	TOTAL
Class of Structure		a	a	a	b	b	b	b	a	xxx[x]
Drainage Area	Sq. Mi.	6.45	6.92	9.57	10.15	7.36	11.06	18.06	11.25	207.20
Controlled	Sq. Mi.	--	--	--	--	--	--	--	--	xxxx
Curve No. (1-day) (AMC II)		75	74	75	74	73	75	73	74	xxxx
Tc	Hours	3.0	2.5	1.8	1.5	3.6	3.8	7.2	1.7	xxxx
Elevation Top of Dam	Feet	2,049.1	2,060.2	2,076.2	2,106.6	2,091.7	2,133.6	2,192.2	2,212.9	xxxx
Elevation Crest Emergency Spillway	Feet	2,043.8	2,055.0	2,071.2	2,100.4	2,086.2	2,128.4	2,187.2	2,207.9	xxxx
Elevation Crest Low Stage Inlet	Feet	2,028.6	2,039.3	2,054.8	2,089.2	2,071.6	2,113.7	2,173.0	2,198.7	xxxx
Maximum Height of Dam	Feet	35.0	40.2	38.2	30.4	33.2	34.9	40.1	26.4	xxxx
Volume of Fill	Cu. Yds	100,500	86,100	157,000	186,600	89,500	118,700	273,100	86,700	3,196,800
Total Capacity	Ac. Ft.	1,122	1,229	1,848	1,905	1,430	1,764	3,359	1,434	36,616
Sediment Submerged	Ac. Ft.	121	155	168	195	130	195	279	186	3,469
Sediment Aerated	Ac. Ft.	3	4	6	5	4	6	--	6	100
Beneficial Use (Recreation)	Ac. Ft.	--	--	--	--	--	--	431	--	431
Retarding	Ac. Ft.	998	1,070	1,674	1,705	1,296	1,563	2,649	1,242	32,616
Surface Area										
Sediment Pool	Acres	24	32	34	58	27	44	52	58	771
Beneficial Use Pool (Recreation)	Acres	--	--	--	--	--	--	100	--	100
Retarding Pool	Acres	113	114	196	260	178	198	300	225	3,948
Principal Spillway										
Rainfall Volume (areal) (1-day)	Inches	5.8	5.8	5.8	6.3	6.2	5.7	5.9	4.9	xxxx
Rainfall Volume (areal) (10-day)	Inches	9.1	9.1	9.1	9.9	9.9	9.0	9.7	8.2	xxxx
Runoff Volume (10-day)	Inches	3.46	3.46	3.46	3.87	3.96	3.26	3.35	2.71	xxxx
Capacity of Low Stage (Max.)	c.f.s.	32.5	34.6	66.5	56.0	30.1	49.7	107.9	54.3	xxxx
Frequency Operation - Emerg. Splwy.	% Chance	2	2	1	1	1	2	1	4	xxxx
Size of Conduit	Dim.	18"	18"	24"	24"	24"	24"	30"	24"	xxxx
Emergency Spillway										
Rainfall Volume (ESH) (areal)	Inches	7.6	7.6	6.3	7.6	7.6	7.4	6.8	4.0	xxxx
Runoff Volume (ESH)	Inches	4.68	4.56	3.53	4.56	4.45	4.51	4.00	2.28	xxxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxxx
Bottom Width	Feet	300	400	150	300	250	500	550	240	xxxx
Velocity of Flow (Ve)[a/]	Ft./Sec.	6.1	6.4	2.4	5.3	5.4	5.7	4.6	2.1	xxxx
Slope of Exit Channel	Ft./Ft.	.032	.032	.040	.035	.034	.034	.039	.040	xxxx
Maximum Water Surface Elevation	Feet	2,046.2	2,057.4	2,071.8	2,103.0	2,088.8	2,130.9	2,188.9	2,208.4	xxxx
Freeboard										
Rainfall Volume (FH) (areal)	Inches	13.6	13.6	10.4	13.6	13.6	13.3	12.2	7.4	xxxx
Runoff Volume (FH)	Inches	10.29	10.13	7.25	10.13	9.98	10.00	9.16	4.39	xxxx
Maximum Water Surface Elevation	Feet	2,049.1	2,060.1	2,076.2	2,106.6	2,091.7	2,133.6	2,192.2	2,211.4	xxxx
Capacity Equivalents										
Sediment Volume	Inches	0.36	0.43	0.34	0.37	0.34	0.34	0.29	0.32	xxxx
Retarding Volume	Inches	2.90	2.90	3.28	3.15	3.30	2.65	2.75	2.07	xxxx
Other	Inches	--	--	--	--	--	--	0.45	--	xxxx

a/ Maximum during passage of hydrograph

September 1975

TABLE 4 - ANNUAL COST

(Dollars)[a/]

Wet Walnut Creek Subwatershed No. 2, Kansas

Evaluation Unit	Amortization of Installation Cost[b/]	Operation and Maintenance Cost	Total
23 Floodwater Retarding Structures; 1 Multipurpose Structure; and Recreational Facilities	269,700	21,400	291,100
Project Administration	90,900		90,900
Total	360,600	21,400[c/]	382,000

a/ Price base 1974.
b/ 100 years at 6 1/8 percent interest.
c/ Includes $9,800 for operation, maintenance, and replacement for the recreational development.

September 1975

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Wet Walnut Creek Subwatershed No. 2, Kansas

(Dollars)a/

Item	Estimated Average Annual Damage		Total Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	151,200	59,100	92,100
Other Agricultural	34,000	8,400	25,600
Non-agricultural			
Road and Bridge	11,300	3,600	7,700
Railroad	2,700	700	2,000
Urban	26,200	6,000	20,200
Subtotal	225,400	77,800	147,600
Sediment			
Channel Deposition	3,200	2,700	500
Erosion			
Flood Plain Scour	39,700	21,500	18,200
Indirect	28,500	10,400	18,100
TOTAL ON PROJECT	296,800	112,400	184,400
Floodwater			
Crop and Pasture	xxx	xxx	80,200
Other Agricultural	xxx	xxx	3,100
Non-agricultural			
Road and Bridge	xxx	xxx	6,000
Railroad	xxx	xxx	1,400
Urban	xxx	xxx	117,600
Subtotal	xxx	xxx	208,300
Sediment			
Channel Deposition	xxx	xxx	200
Erosion			
Flood Plain Scour	xxx	xxx	12,100
Indirect	xxx	xxx	9,800
TOTAL OFF PROJECT	xxx	xxx	230,400
TOTAL			414,800

a/ Price base: Agricultural = current normalized (WRC - October 1974); all other = 1974

December 1975

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Wet Walnut Creek Subwatershed No. 2, Kansas

(Dollars)a/

Evaluation Unit	Average Annual Benefitsa/				Total	Average Annual Costc/	Benefit Cost Ratio
	Damage Reductionb/	More Intensive Land Use	Recreation	Secondary			
23 Floodwater Retarding Structures and 1 Multi-purpose Floodwater Retarding and Recreational Structure	268,500	69,600	60,000	173,000	571,100	291,100	2.0:1
Project Administration						90,900	
GRAND TOTAL	268,500	69,600	60,000	173,000	571,100	382,000	1.5:1

a/ Price base: Agricultural current normalized (WRC - October 1974); all other 1974

b/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $57,500 annually including $32,200 from detention dams; P.L. 566 structures in upper watersheds will provide $88,800 damage reduction.

c/ From Table 4.

December 1975

INVESTIGATIONS AND ANALYSIS

General

A joint study of the Upper Arkansas Basin by the Soil Conservation Service, Forest Service, Economic Research Service, and the Kansas Water Resources Board was started May 4, 1965. Wet Walnut Creek was studied as an example of large watershed potential in western Kansas. Stream and valley cross sections were surveyed by the Kansas Water Resources Board in five mainstem reaches from Heizer to Ness City and on three reaches of the North and South Forks above Ness City. Hydraulic computations were made by Cook, Flatt, and Strobel, Consulting Engineers, Topeka, Kansas.

The Kansas Watershed Review Committee assigned a priority for planning on July 31, 1967. A groundwater recharge study was started in the Wet Walnut Basin as a cooperative venture of the Kansas Water Resources Board, the U.S. Geological Survey, and the Wet Walnut Creek Watershed District during the summer of 1968. The State Conservation Commission negotiated and funded contracts for structure site topographic maps of the P.L. 566 sites. Structures in the eastern half of the watershed district were surveyed by Evans, Bierly, and Hutchinson, Consulting Engineers, Great Bend, Kansas; and structures in the western half of the watershed district were surveyed by George McKee, Jr., Consulting Engineer of Colby, Kansas. All other engineering, geologic, hydrologic, and economic investigations were conducted by the Soil Conservation Service.

A forestry work plan was developed by the State Extension Forester, Kansas State University, Manhattan, Kansas, and the Forest Service, USDA. Information for this plan was gathered from aerial photography of the watershed and a field examination of hydrologic conditions of woodlands. Estimates were made of land treatment measures needed to improve hydrologic conditions; these estimates were included in this work plan.

A letter report 27/ covering fish and wildlife resources and recommending measures to offset losses and enhance wildlife habitat was supplied by the Fish and Wildlife Service, U.S. Department of the Interior. The Kansas Forestry, Fish and Game Commission concurred with this report.

The Kansas Water Resources Board and State Conservation Commission provided assistance in drafting the watershed plans and environmental impact statement.

Hydrology and Hydraulics

The five Wet Walnut watersheds were treated as a hydrologic unit and broken down into 21 reaches. Each reach was evaluated for its present soil cover condition, and for its future condition with planned land treatment and cover measures.

A standard procedure 18/ was used to find the relationship between rainfall and runoff with special consideration given to flat potholed areas and areas treated with level storage type terraces. A factor of 2.3 was used to convert the annual flood plotting positions to partial duration plotting positions. The relationship between rainfall frequency and runoff volume was calculated for the actual range of hydrologic curve numbers.

Field surveys of the valley and road and bridge cross sections were made. Sufficient readings were taken to define the shape of the channel in detail. The types of road surfaces and bridges were indicated on each road cross section.

The step method was used in defining the hydraulics of the flood plain. A range of discharges from below nondamage flow to above 100 year flood frequency was considered. Flood plain profiles were plotted showing the channel bottom, bank line, and at least five discharges. A semi-controlled, screened aerial mosaic map of the flood plain was developed for each reach.

The relationship between discharge and area of flood plain inundation was based on 73 valley and channel cross sections in eight detailed evaluation reaches. These cross sections were vertically related to mean sea level, and horizontally related by using aerial photographs. The width of flooding at each cross section and the distance between cross sections were used to compute the area flooded in each reach by depth increments. These area data were then combined to determine totals for each evaluated reach.

Similarly, road and bridge cross sections were used to compute lengths of roads inundated by various flood depths.

Frequency discharge relationships were developed for each reach using the SCS TR-20 computer program with service provided by the Central Technical Unit, Hyattsville, Maryland. Four uniform storms were routed to define discharge frequency

curves for present conditions, future conditions with land treatment, future conditions with land treatment and various percentages of control by structures, and future conditions with land treatment and the proposed system of structures. These routings gave the discharge frequency relationship for each evaluation reach under present conditions and for various levels of control including that offered by the proposed plan. Routings were developed for historical storms, September 1959 and May-June 1967, and high water marks were plotted on water surface profiles and peaks determined.

Release rates for floodwater retarding structures were selected according to downstream channel capacities, routing losses, and desired reservoir drawdown times. Single stage release rates for all structures are shown in Table 3. (See "Capacity of Low Stage (Max.)") Combined maximum release rates will not exceed channel capacities.

Floodwater storage volumes were determined using mass routing procedures for storm durations of up to 10 days. Storms used in this procedure were taken from U.S. Weather Bureau Technical Paper No. 40.19/ The volumes needed for floodwater storage were computed using 25, 50, or 100 year frequency storms, depending on the structure hazard class. Floodwater storages were selected to fit site conditions, with minimum volumes computed in accordance with the National Engineering Handbook.

Emergency spillway requirements were found by routing the storms according to SCS Engineering Memorandum No. 27. Computer services were provided by SCS at Lincoln, Nebraska, and Fort Worth, Texas. Emergency spillways will exceed minimum criteria set by the State of Kansas.

For the design of the four recreation sites, trial and error solutions of the water budget equation by computer program, using average values over each drought period, gave the expected reservoir level-frequency relationship. Yields used were minimum cfs per square mile for a range of time periods and drought frequency.2/ Net evaporation values2/ were also included in the computations. Evaporation and seepage losses were applied against the average reservoir surface area for each period under consideration. Mean annual runoff at each of the four sites was also computed by relating to channel geometry with assistance from the U.S. Geological Survey.31/

Engineering

Topographic maps of floodwater retarding and multipurpose sites were made using a photogrammetric plotter and field surveys. Aerial photographs were taken from approximately 4,800 feet, and topographic maps were made using a four foot contour interval. Accuracy of plotter work was verified by field surveys of centerline profiles. Using the topographic maps, storage capacities were measured and stage-storage curves were developed. Embankment quantities were calculated from centerline profiles.

An inventory of all man-made features, such as farm buildings, roads, bridges, existing and abandoned oil wells, pipelines, power lines, etc. was made and those affected by structures were located on topographic maps.

Structure Design and Cost Estimates: Structures were planned with single-stage principal spillways and average release rates of 3.5 csm. Elevations of emergency spillway crests were selected to provide at least a 25 year detention storage.

Storage will be provided for a 100 year accumulation of sediment. Elevations of principal spillway crests of floodwater retarding structures will be at the 100 year sediment accumulation levels. The inlet of the multipurpose structure is planned at the elevation that will store the 100 year sediment accumulations and provide water for recreation.

The freeboard hydrograph was routed through all structures with the maximum elevation at or below the tops of the dams.

Drainage areas for all sites were delineated and measured on USGS 7 1/2 minute quadrangle maps and photographs.

Individual structure cost data are shown in Table 2, and the total cost of all proposed structures is shown in Table 1.

Unit costs, reflecting current bid prices for embankment, principal spillways, riprap, fencing, drains, seeding, clearing, etc., were used to determine the total construction cost of each structure. Contingencies were calculated at 12 percent of the engineer's estimate. Installation services' costs were calculated as a percentage of construction costs.

Geology

Structure No. 32 was one of 10 sites in Watershed Nos. 1 through 5 selected by the Kansas Forestry, Fish and Game Commission in 1970 as having a potential for development as fishing lakes. SCS analyzed the water-holding characteristics of these sites. Infiltration tests were run at all sites. Field determinations of seepage losses at sites in Cimarron Watershed were made and compared with the infiltration tests.

A groundwater study was made by SCS from May 25 to July 15, 1967. The results of this study were used in a more intensive study by the USGS for Rush County and summarized in Bulletin No. 17 (1972) of the Kansas Water Resources Board.16/

The preceding two studies were used by SCS to make an algebraic account of the present without and future with project average annual water budget for the Wet Walnut basin. The basin water budget was compiled by subwatershed.

The Greenhorn Limestone underlies the 24 proposed flood water retarding structures. Greenhorn Limestone is chalky limestone alternating with chalky shale. Carlile Shale was identified in abutments of several sites. All 24 sites were surface imspected. Structure Nos. 17, 19, 27, 31, and 32 were drilled. These investigations showed favorable construction conditions at all sites.

Sediment storage was based on existing reservoir sedimentation surveys. A delivery ratio of 5 percent was used for determining sediment yield from Watershed No. 2 to the Arkansas River.

Economic Investigations

Seven reaches representing 57 percent of the flood plain were evaluated in detail. The additional area was evaluated as related to these reaches. Five subwatersheds were evaluated as a unit then divided into individual reaches. Twelve of the 21 reaches had significant flood damages.

The frequency method 22/ was used to find average annual floodwater damages. Data on floodwater damages were collected by personal contacts with farm operators, township and county officials, and local agricultural technicians. Interviews were obtained from at least 46 percent of the landowners and

operators of the flood plain area in each evaluation reach; the maximum interview coverage in any one reach was 65 percent. The storms of September 1959 and July 1958 were discussed.

Damages under present land treatment conditions were computed in each evaluation reach. Damage estimates were made for future land treatment conditions, future land treatment conditions with varying percentages of control by floodwater retarding structures, and future land treatment conditions with the proposed plan. Where more intensive use of land would be possible, benefits were computed under these same conditions. More intensive use was computed on those areas lying within the flood plain delineated by 2.84 year and the 10 year frequency floods.

A composite acre of flood plain use was constructed by measuring the percent of each land use shown on valley cross sections. Average crop yields, adjusted to flood-free conditions by the judgment of farm operators and agricultural technicians, were projected to reflect future conditions without the project. Different composite acres and crop yields, which would be possible under more intensive land use, were similarly obtained.

The percent loss from each crop on the composite acre was estimated according to depth, duration, and month of flooding. Damage to the composite acre was weighted using the lower values to crop yields from the scoured areas. Percentage loss was used to determine rates of damage on the composite acre (adjusted normalized prices), using the percent of the year's excessive storms occurring in each month 23/ and the weighted value of the composite acre multiplied by total acreage inundated by selected discharges. A curve showing monetary damage versus flood discharge was developed to provide a cost estimate for each storm in the 100 year flood series. A weighted value (current normalized value) was developed and damages updated by a factor.

Interviews were used to determine other agricultural damages from the September 1959 and July 1958 storms. These included loss of livestock, damage to private roads, dikes, and fences, and removal of debris. From rainfall records and high-water marks, discharges of these storms were determined for each evaluation reach. From these data a dollar damage versus discharge curve was developed and applied to the 100 year flood frequency series. The values were updated using the Engineering News Record Construction Cost Index.

Flood plain scour damages were derived from geologic field data. The number of acres damaged, the severity of damage, and the estimated period and degree of recovery were considered, with and without the proposed project. Economic evaluation was based on the net value of the cropland composite acre. Changes in net income due to scour damage were discounted at an 8 percent interest rate.

Urban damages were determined by interviews with owners or occupants of all business and homes in the town. The 1959 and 1958 storms were discussed. The percent chance of occurrence was determined for each of these storms, then a curve was drawn to compute the average annual damage. This value was updated to 1974 based on the composite index (U.S. Department of Commerce).

Indirect damages include such items as food spoilage from electric power failure; slower rate of weight gain of livestock and extra expense caused by feeding interruption (even through livestock were not in the flood); and additional distances driven by rural mail carriers, school buses, and farmers because of flooded roads. Indirect damages were computed at 10 percent of the agricultural damages and 15 percent of the nonagricultural damages.

Recharge benefits were computed as the increased net value from dry land cropland to irrigated cropland for that number of acres for which water will become available. This value was reduced for increased floodwater damage and discounted for a 10 year lag in accrual.

The damage reduction benefits occurring downstream from Subwatershed No. 1 are fair share benefits accruing to the project from the Great Bend area. This includes 13,100 acres of Wet Walnut flood plain below the watershed and 2,200 acres of flood plain common with the Arkansas River.

Increased flood damages from reduced channel capacity from sediment deposits were computed.

Recreation benefits were determined using procedures outlined in the Economic Guide 22/, The Lincoln EWP Technical Letter Recreation No. 5 (April 5, 1965), and Lincoln EWP Technical Letter Recreation No. 6 (April 5, 1966). The watershed population was computed at 2,759.24/

Within a 50 mile radius of the watershed there is a population of more than 128,200 people. Consultation with the staff of the Kansas Forestry, Fish and Game Commission and the Kansas Park and Resources Authority indicated that the demand for water-based recreation, such as that offered at Structure No. 32, would exceed 30,000 annual visitor days.

It was estimated that 60 percent of the total use would occur from May 15 to September 15 and that 65 percent of the visits would occur on a weekend day. By limiting parking area, recreational facilities were designed to limit use to 320 visits per weekend day. Some additional parking space is provided to accommodate vehicles on unmarked gravel parking lots. Other facilities were designed to adequately provide for visitor needs. A current value of $2.00 per each visit was used.

Incidental recreational benefits were not evaluated. Regional secondary benefits were computed following procedures in the EWP Technical Note--Watershed LI-7, February 1973. Indirect benefits and benefits resulting from a change in consumptive patterns were excluded in computing secondary benefits. The region is defined as 5 counties: Barton, Rush, Ness, Lane, and Scott.

All structures were individually evaluated. The relative contribution that structural control in each upstream subwatershed made toward reduction of peak discharge was the basis for distribution of evaluation reach benefits.

Costs of land rights were based on the value of cropland and pasture as determined by the watershed directors. These values, slightly higher than the capitalized value of net production, were used for project evaluation. The values agreed on were $300/acre for upland cropland, $750/acre for bottom cropland, and $200/acre for pasture for the floodwater retarding sites. Land costs were based on 100 percent of value for the sediment pool areas, 75 percent of value for the structure and spillway areas, and 50 percent of value for the floodwater retarding areas. The productive capacity retained under future conditions was thereby considered. Full fair market value was used as the basis for the cost of all land purchased for recreational development.

All monetary benefits were based on current normalized prices approved by the Water Resources Council. Construction costs were based on 1974 construction costs for Kansas P.L.

566 projects. Operation and maintenance costs were computed at 0.35 percent of construction costs for floodwater retarding structures; this percentage method was developed by the SCS and is based on the principle that the relative probability of need for major repairs decreases as the number of structures increases. Operation and maintenance costs for the recreational facilities were computed at the current cost of $0.30 per visitor day. Replacement costs of these facilities were computed on the basis of a 20 year life. Federal and local costs for structural measure were amortized at a 6 1/8 percent interest rate for a period of 100 years.

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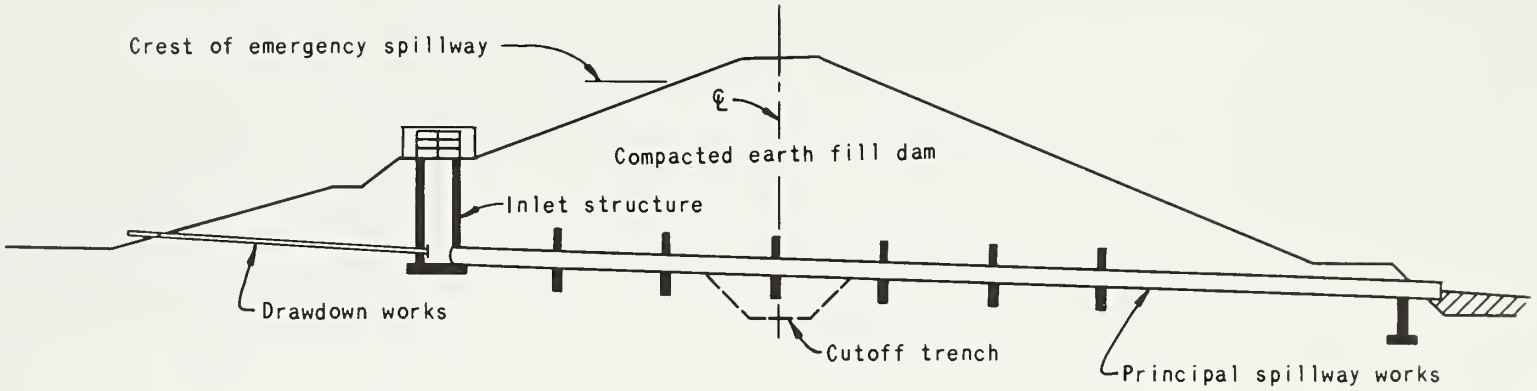
SOIL CONSERVATION SERVICE

FIGURE 1

TYPICAL EARTH DAM WITH PIPE DROP INLET



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

NOTES:

1. FOR INDIVIDUAL STRUCTURE DATA SEE TABLE 3.
2. EMBANKMENT AND FOUNDATION DESIGN FEATURES NOT SHOWN.

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U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

WET WALNUT CREEK WATERSHED NO. 2

RUSH, NESS, AND PAWNEE COUNTIES, KANSAS

STRUCTURE NO. 32

PUBLIC RECREATION DEVELOPMENT.

SCALE 300 0 300 600 900 FEET

150

POPULATION CENTERS AND HIGHWAYS
WITHIN 50 MILE RADIUS

SCALE 10 5 0 10 20 30 40 MILES

LEGEND

① BOAT RAMP
② ORINKING WATER WELL
③ PARKING AREA & ROAD
④ PICNIC TABLE
⑤ PICNIC TABLE WITH SUNSHADE
⑥ TOILET

SOIL CONSERVATION SERVICE

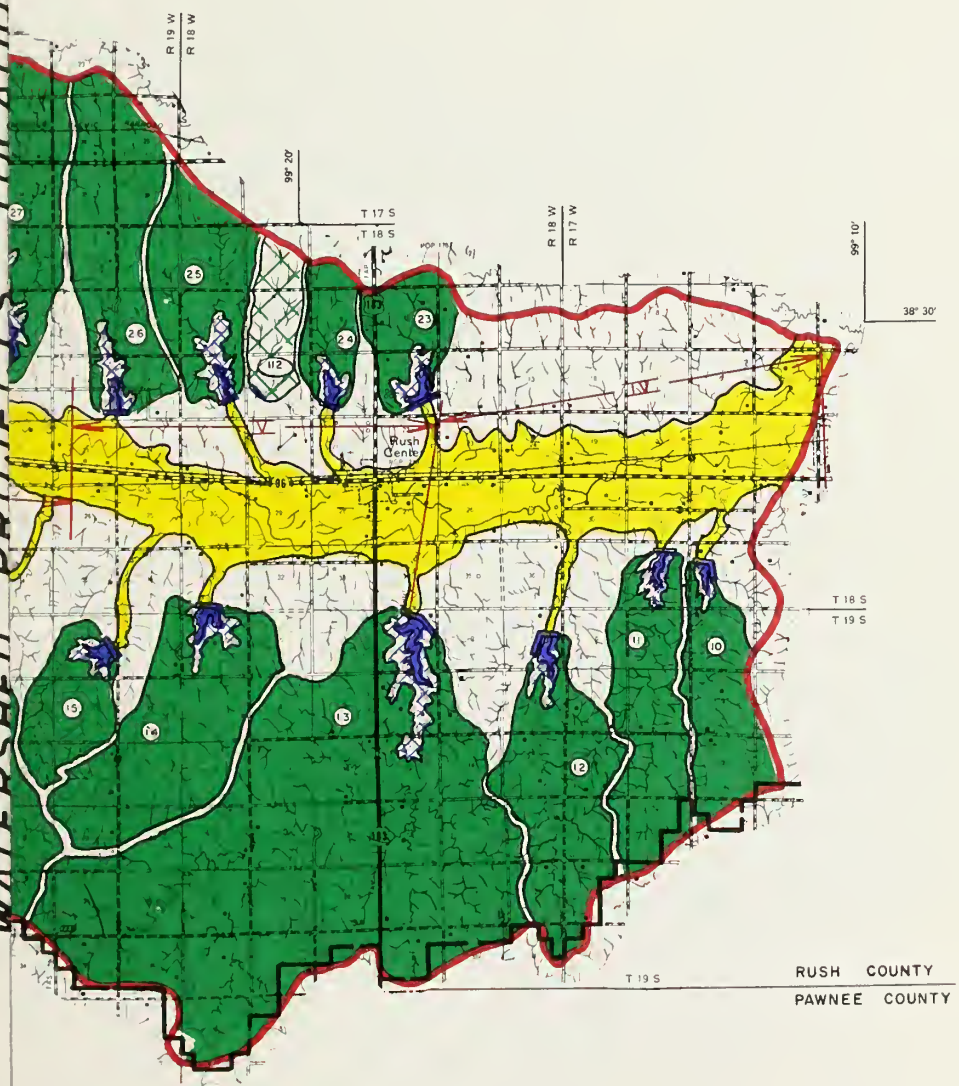
PROJECT MAP

WET WALNUT CREEK WATERSHED

AND PAWNEE COUNTIES

KANSAS

WATERSHED PROJECTS LOCATION



LEGEND

- FLOODWATER RETARDING OR MULTIPLE PURPOSE STRUCTURE
- SEDIMENT STORAGE POOL
- MUTIPURPOSE STORAGE POOL
- FLOODWATER DETENTION POOL
- AREA BENEFITED
- DRAINAGE AREA CONTROLLED BY R. E. A. P. STRUCTURE
- (2) P. L. 566 STRUCTURE NUMBER
- (202) R. E. A. P. STRUCTURE NUMBER

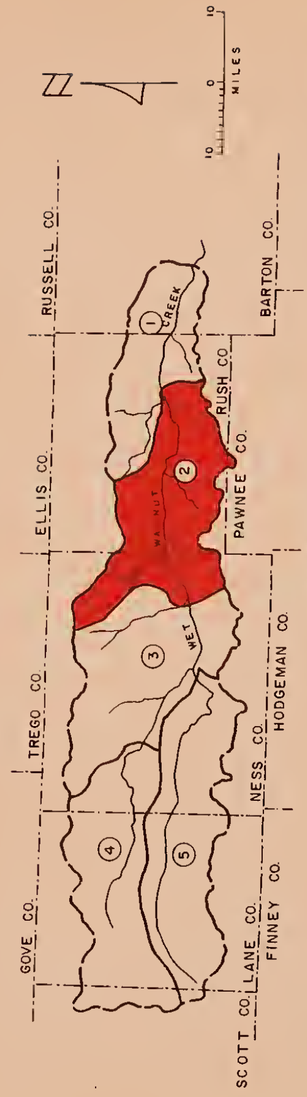
U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PROJECT MAP
SUBWATERSHED NO. ② WET WALNUT CREEK WATERSHED
RUSH, NESS AND PAWNEE COUNTIES
KANSAS

KANSAS

WATERSHED PROJECTS LOCATION
WET WALNUT CREEK

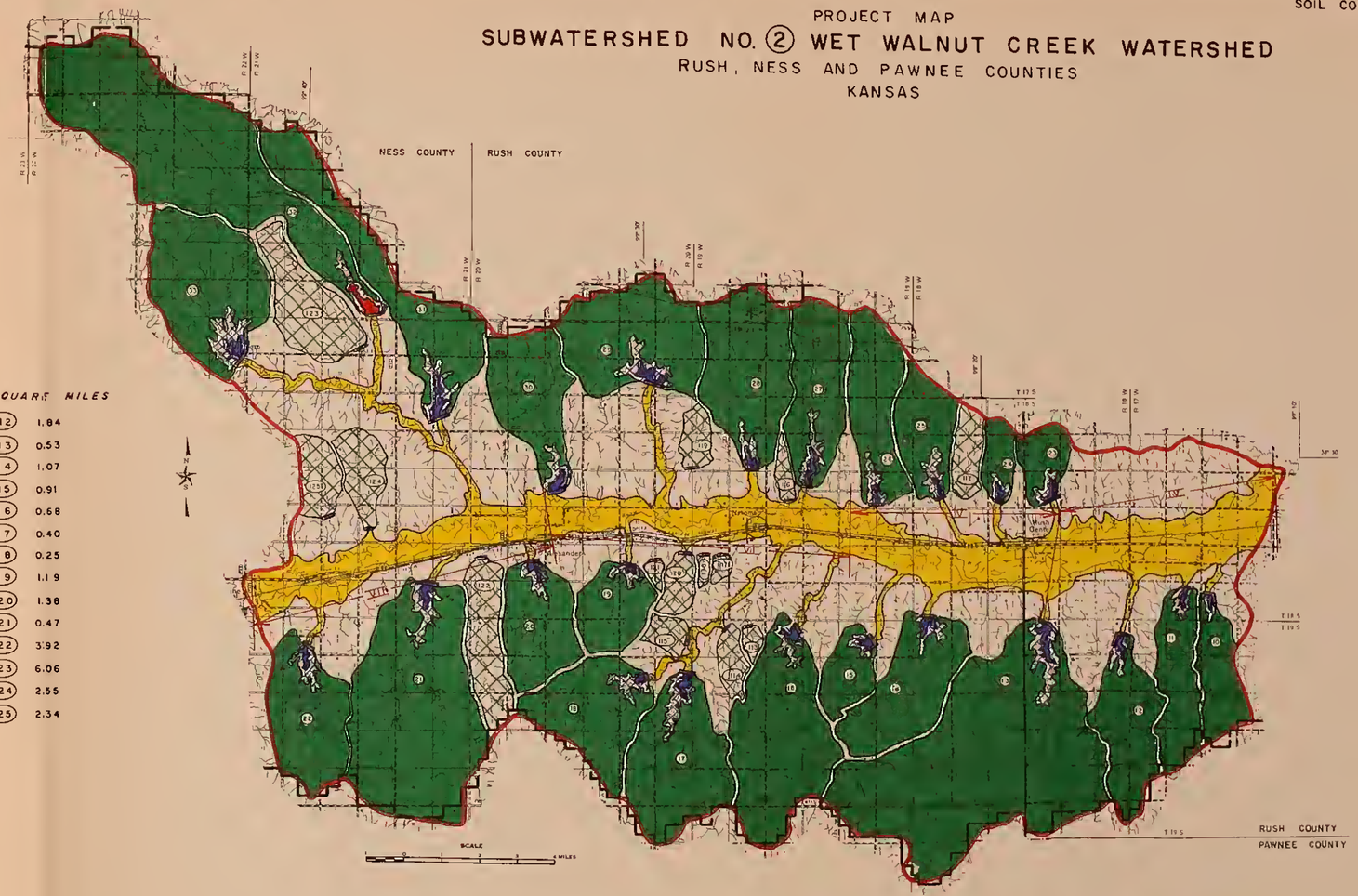


WET WALNUT CREEK WATERSHED BOUNDARY

PROJECT WATERSHED BOUNDARY

LEGEND

② SUB WATERSHED NUMBER



DRAINAGE AREA IN SQUARE MILES

10	4.00	112	1.84
11	5.00	113	0.53
12	7.70	114	1.07
13	27.91	115	0.91
14	7.55	116	0.68
15	2.75	117	0.40
16	11.47	118	0.25
17	9.00	119	1.19
18	7.11	120	1.38
19	4.41	121	0.47
20	5.78	122	3.92
21	17.74	123	6.06
22	6.93	124	2.55
23	2.62	125	2.34
24	1.80		
25	4.61		
26	6.45		
27	6.92		
28	9.57		
29	10.15		
30	7.36		
31	11.06		
32	18.06		
33	11.25		

LEGEND

- LEGAL WATERSHED BOUNDARY
- NATURAL WATERSHED BOUNDARY
- DRAINAGE AREA CONTROLLED BY P.L. 566 STRUCTURE
- EVALUATION REACH
- FLOODWATER RETARDING OR MULTIPLE PURPOSE STRUCTURE
- SEDIMENT STORAGE POOL
- MULTIPURPOSE STORAGE POOL
- FLOODWATER DETENTION POOL
- AREA BENEFITED
- DRAINAGE AREA CONTROLLED BY R.E.A.P. STRUCTURE
- ② P.L. 566 STRUCTURE NUMBER
- (202) R.E.A.P. STRUCTURE NUMBER

SOURCE:
INFORMATION FURNISHED BY FIELD TECHNICIANS, EVANS - BIERLY - HUTCHISON ENGINEERS