WATERSHED WORK PLAN

for

WATERSHED PROTECTION

FLOOD PREVENTION

and

RECREATION

SAND CREEK WATERSHED

HARVEY and MARION COUNTIES, KANSAS

MAY 1975

ADDENDUM

SAND CREEK WATERSHED, KANSAS

This is a three-section addendum for the purposes of:

Section I - To show the project costs, benefits, and benefit-cost ratio at 5 7/8 percent interest rate (page A.2).

Section II - To present an abbreviated environmental quality plan consistent with part C.2 of the WRC "Schedule and Application of Principles and Standards to Implementation Studies in Process" published in the Federal Register of July 24, 1974.

Section III - To present abbreviated displays of the selected plan consistent with part C.3 of the WRC "Schedule and Application of Principles and Standards to Implementation Studies in Process" published in the Federal Register of July 24, 1974.

SECTION I

of

ADDENDUM

for

SAND CREEK WATERSHED, KANSAS

This section shows the project costs, benefits, and benefit-cost ratio based on 5 7/8 percent interest rate and recreation benefits at $2.25 per recreation visit.

1.	Average annual project costs are	$112,800
2.	Average annual project benefits without secondary are	$178,100
3.	Average annual project benefits are	$233,200
4.	The project benefit-cost ratio without secondary is	1.6 to 1.0
5.	The project benefit-cost ratio is	2.0 to 1.0

May 1975

SECTION II

of

ADDENDUM

for

SAND CREEK WATERSHED, KANSAS

Abbreviated Environmental Quality Plan

Environmental Problems

A. Areas of Natural Beauty and Human Enjoyment

Shade tree population and quality in the city of Newton has deteriorated due to Dutch Elm disease and improper management.

Areas for public and private water-based recreation are lacking in the watershed. The population projection by the year 1980 is an increase of 10-15 percent for the watershed area and adjacent rural area. The demand for recreation facilities will increase in the area. Lakes are also needed to add open space and diversity to the landscape.

B. Biological Resources

Competition for land uses has resulted in wildlife habitat losses. The continuing development of residential areas contributes to this problem. Hunting access and landowner-sportsman relationship problems will become more acute as competition for lands increase. The intermittent nature of the watershed's natural streams does not lend itself to significant fish production. There exists only a limited number of artificial impoundments for public and private fishing. Existing riparian habitat is in danger of eradication due to agricultural and urban encroachment.

C. Historical and Archeological Sites

The Warkentin home historical site in Newton may be destroyed because of increasing competition for urban development lands and the ensuing increase in real estate value. Archeological sites are destroyed or unrecorded because of the lack of communication between the local public and the interested archeologists.

D. Land, Water, and Air Quality

Rehabilitation of old and establishment of new windbreaks and shelterbelts within the watershed are needed to reduce wind erosion. Installation of land treatment measures and establishment of proper management systems are needed on an additional 22,910 acres of cropland and 3,722 acres of grassland to reduce wind and water erosion. The deposition of sediment in the main Sand Creek channel is presently reducing the channel capacity and adversely affecting stream water quality. Due to present land use competition the 7,500 acres of existing native rangeland acreage should be preserved. Approximately 850 acres of Class VI cropland should be converted to native rangeland and wildlife land.

E. Conflicts in Land Use

Projected population increases, potentials for increased industrial development, and continuing land and space competition 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 shaded tree restoration program in Newton

Creation of recreation and open space areas

B. Biological Resources

Improvement of fish and wildlife habitat within the watershed.

Preservation of existing riparian habitat.

C. Historical and Archeological Sites

Preservation of existing 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. Rehabilitate and enhance shade and landscape plants in Newton by removing and disposing of dead trees, planting a wide variety of replacements, and developing a planned maintenance program.

Installation by: City of Newton

Technical Assistance by: Kansas State and Extension Forestry

Cost: $30,000; $3,000 OM&R

2. Establish public open spaces by purchasing and developing 1,195 acres. Establish within the open space a 195 surface acre reservoir, 200 acre recreational facilities area, and 800 acre buffer zone. A bicycle trail will be provided from Newton to the recreation area.

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

Technical Assistance by: Kansas Forestry, Fish and Game Commission; State Park and Resources Authority

Cost: $1,226,500; $23,200 OM&R

3. Establish seven private commercial recreation ponds totaling 136 surface acres.

Installation by: Private

Technical Assistance by: Kansas Forestry, Fish and Game Commission; Soil Conservation Service; Extension Service; private engineer

Cost $126,100; $2,500 OM&R

4. Rehabilitation of an existing 60 windbreaks and 12 miles of shelterbelts.

   Installation by: Landowners (cost sharing program needed)

   Technical Assistance by: Kansas State and Extension Forestry; Soil Conservation Service

   Cost: $8,100; $500 OM&R

5. Establish an additional 65 windbreaks and 20 miles of shelterbelts.

   Installation by: Landowners, Kansas State and Extension Forestry, RECP

   Technical Assistance by: Kansas State and Extension Forestry; Soil Conservation Service

   Cost: $19,100; $700 OM&R

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

1. Improve stream aquatic habitat downstream from Newton by installing two water supply reservoirs.

   Installation by: Kansas Forestry, Fish and Game Commission; other State agencies

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $53,400; $300 OM&R

2. Improve terrestrial wildlife habitat by:

   a. Increasing the amount of permanent cover and diversity through conversion of 850 acres of Class VI cropland to woody and herbaceous cover.

      Installation by: Landowners; RECP

      Technical Assistance by: Kansas Forestry, Fish and Game Commission; Soil Conservation Service

      Cost: $34,000; $500 OM&R

b. Establishing 400 miles of woody and herbaceous cover on farm and field boundaries.

Installation by: Landowners (cost sharing program needed)

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

Cost: $74,000; $500 OM&R

c. Proper management of existing grassland and woodland.

Installation by: Landowners; RECP

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

Cost: $12,800; $1,500 OM&R

d. Conversion of 400 acres of flood plain cropland scour channels to perennial cover

Installation by: Kansas Forestry, Fish and Game Commission; landowners (cost sharing program needed)

Technical Assistance by: Kansas Forestry, Fish and Game Commission; Soil Conservation Service

Cost: $220,000; $1,000 OM&R

3. Protect existing riparian habitat by obtaining easements on 510 acres for the purpose of eliminating land use conversion adjacent to the channel.

Installation by: Kansas Forestry, Fish and Game Commission; landowners (cost sharing program needed)

Technical Assistance by: Kansas Forestry, Fish and Game Commission

Cost: $15,300; $700 OM&R

4. Survey the occurrence of rare and endangered species and their habitat needs.

   Installation by: Kansas Forestry, Fish and Game Commission

   Technical Assistance by: Kansas Forestry, Fish and Game Commission

   Cost: $3,000

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

1. Purchase Warkentin home in Newton

   Installation by: State Historical Society (cost sharing program needed)

   Technical Assistance by: State Historical Society

   Cost: $80,000; $600 OM&R

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

   Installation by: National Park Service

   Technical Assistance by: State Archeologist, NPS

   Cost: $5,100

D. Improve quality of land, water, and air

1. Install land treatment measures and establish proper management systems on 22,910 acres of cropland and 3,722 acres of grassland.

   Installation by: RECP; landowners

   Technical Assistance by: Soil Conservation Service

   Cost: $950,700; $44,000 OM&R

E. Avoid irreversible and irretrievable commitments of resources.

1. Establish a comprehensive plan including land and water use.

Installation by: Cities and counties

Technical Assistance by: KDED

Cost: $30,000

Total Environmental Quality Plan Installation Cost = $2,888,100

Annual Operation, Maintenance, and Replacement = $ 79,000

Effects of Environmental Quality Plan

A. Areas of Natural Beauty and Human Enjoyment

The natural beauty of the city of Newton will be enhanced due to a shade and landscape plant restoration program. Rural area beauty and aesthetics will be improved through the 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 one public and seven private recreation reservoirs will provide part of the needed facilities for water-based recreation. The public recreation development will provide facilities for 18,600 sightseers, 4,800 boaters, 7,200 picnickers, 6,000 campers, 18,000 fishermen, 6,000 swimmers, and 1,800 other users annually, totaling 60,000 visitor use days annually. Acquisition of areas associated with the development will provide 395 acres for dam, reservoirs, and facilities and 800 acres of open space and buffer zone. A bicycle trail from Newton to the reservoir will be provided. The seven private recreation reservoirs will provide recreation opportunities for 4,200 annual visitor users. Creation of the recreation developments will cause disruption in the tranquility of the rural environment by 64,200 recreational visitor days annually.

B. Biological Resources

The creation of eight recreation reservoirs will inundate 331 acres of terrestrial wildlife habitat of which 68 acres are good, 136 acres are fair, and 127 acres are marginal, and inundate 8.0 miles of intermittent stream aquatic habitat. The reservoir developments will create 331 acres of impounded aquatic habitat.

The creation of two water supply reservoirs will improve the environmental condition of 12.5 miles of Sand Creek channel downstream from Newton through maintenance of stream flow. The creation of these two reservoirs will periodically inundate 82 acres of terrestrial wildlife habitat of which 17

acres are good, 34 acres are fair, and 17 acres are marginal; and inundate 1.5 miles of intermittent stream aquatic habitat. The temporary impoundments will provide impounded aquatic habitat varying between zero and 82 surface acres depending upon rainfall quantity and seasonal distribution.

Terrestrial wildlife habitat in 150 acres of shelterbelts and windbreaks will be improved due to rehabilitation. An additional 210 acres will be created through establishment of new windbreaks and shelterbelts.

Conservation land treatment on 26,632 acres of agricultural land plus conversion of 400 acres of flood plain land to wildlife land will improve terrestrial wildlife habitat within the watershed. Creating 400 miles of herbaceous cover on farm and field boundaries will provide essential edge cover needed for terrestrial wildlife habitat improvement.

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

Plan action will maintain the environmental condition of 21.1 miles of Sand Creek stream channel through preservation and management of an existing 510 acres of riparian habitat that includes 80 acres of woodland, 366 acres of grassland, and 64 acres of channel.

C. Historical and Archeological Sites

Plan action would purchase and preserve the Warkentin home historical site.

Archeological sites known or discovered would be recorded and noted or preserved as needed by the State Archeologist.

D. Land, Water, and Air Quality

The application of land conserving practices on 46 percent of the untreated cropland and grassland in the watershed will improve the quality of land, air, and water

on 22,910 acres of cropland and 3,722 acres of grassland. This action will bring 99 percent or 57,800 acres of the total cropland and grassland in the watershed under conservation treatment. Land treatment measures will reduce sediment yield from 100 acre feet per year to 67 acre feet per year. Land treatment plus the installation of 10 reservoirs will reduce sediment yields to 49 acre feet per year.

E. Irreversible and Irretrievable Commitments

Reservoirs will convert 351 acres of cropland, 189 acres of grassland, 11 acres of woodland, 6 acres of other land, and 9.5 miles of intermittent stream to reservoir pools, dams, and spillways.

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 these resources. Growth is inevitable in the watershed and a comprehensive plan will assist it to proceed in an orderly manner. Important environmental values will be recognized and protected through development and implementation of the plan.

SECTION III

of

ADDENDUM

for

SAND CREEK WATERSHED, 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

SAND CREEK WATERSHED, 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	$ 56,100	1. Multi-purpose Reservoir and two single-purpose flood prevention reservoirs	
2. Recreation	79,100	Project Installation[1/]	$ 87,300
Total Beneficial Effects	$135,200	Project Administration[1/]	13,800
		OM&R	25,600
		Total Adverse Effects	$126,700
		Net Beneficial Effects	$ 8,500

1/ Amortized for 100 years at 6 7/8 percent interest

May 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of effects (average annual dollars)	
A. Income	Watershed	Rest of Nation
Beneficial effects		
1. The value of increased output of goods and services to users residing in the region		
a. Flood Prevention	56,100	
b. Recreation	39,600	39,500
c. Secondary	25,400	
Total Beneficial Effects	121,100	39,500

Components	Measure of effects (average annual dollars)	
A. Income	Watershed	Rest of Nation
Adverse effects		
1. The value of resources contributed from within the region to achieve the output		
a. Multi-purpose reservoir and two single-purpose flood prevention structures		
Project Installation[1/]	28,800	58,500
Project Administration[1/]	200	13,600
OM&R	14,100	11,500
Total Adverse Effects	43,100	83,600
Net Beneficial Effects	78,000	

1/ Amortized for 100 years at 6 7/8 percent interest

May 1975

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of effects: Watershed	Measure of effects: Rest of Nation
B. Employment		
Beneficial effects		
1. Increase in the number and type of jobs		
a. Employment for project construction	14 man years semiskilled	
	5 man years unskilled	
b. Employment for project OM&R	1.2 man years semiskilled annually	
Total Beneficial Effects	1.2 permanent semiskilled jobs	
	14 semiskilled jobs for 1 year	
	5 unskilled jobs for 1 year	

Components	Measure of effects: Watershed	Measure of effects: Rest of Nation
B. Employment		
Adverse effects		
1. Decrease in the number and type of jobs		
Total Adverse Effects	0	
Net Beneficial Effects	1.2 permanent semiskilled jobs	
	14 semiskilled jobs for 1 year	
	5 unskilled jobs for 1 year	

A.18

SELECTED PLAN

REGIONAL DEVELOPMENT ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of effects	
	Watershed	Rest of Nation
C. Population Distribution		
Beneficial effects	Creates 14 semiskilled jobs for 1 year	
	Creates 5 unskilled jobs for 1 year	
	Creates 1.2 man years permanent employment annually	-
Adverse effects	-	-
D. Regional Economic Base and Stability		
Beneficial effects	Provides floodwater damage reduction for 4,619 acres	
	Creates annually 1.2 man years of semi-skilled employment	
	Creates 14 short-term semiskilled and 5 short-term unskilled jobs	

A.19

SELECTED PLAN

SOCIAL WELL-BEING ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of Effects
Beneficial and adverse effects	
A. Real income distribution	1. Create 19 man years low to medium income jobs for area residents during construction.
	2. Create 1.2 man years low to medium income employment in association with operation and maintenance of the works of improvement
	3. Create regional income benefit distribution of $121,100. Family incomes are distributed: Under $3,000 — 15% $3,000 to $10,000 — 45% Over $10,000 — 40% It is assumed that benefits will be distributed at about the same percentages
	4. Local costs to be borne by the watershed region total $43,100. Costs to be distributed by about the same ratio as benefits.
B. Life, health, and safety	1. Provide one percent level of protection for the towns of North Newton and Newton
C. Recreation opportunities	1. Create 60,000 recreation visits. Half of the these will be utilized by residents of the Wichita urban area.

May 1975

A.20

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

SAND CREEK WATERSHED, 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 195 surface acres for water-based recreation open to the public
	2. Create two lakes with a total of 55 surface acres on private land.
	3. Create 1,195 acres for multi-purpose use including public recreation and open and green space.
	4. Improve rural area beauty on 26,932 acres of agricultural land by the application of land treatment practices.
	5. Increase traffic, litter, and noise in a sparsely populated rural community by 60,000 visitor days annually.
	6. Twenty-two reservoir structures wil increase landscape diversity.

May 1975

A.21

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of effects
Beneficial and adverse effects	
B. The quality of water, land and air resources	1. Reduce flooding on 4,619 acres of flood plain land.
	2. Reduce floodwater damage 59 percent
	3. Reduce delivery of sediment to the Little Arkansas River from 22 to 10 acre feet annually.
	4. Reduce average annual erosion rate on cropland from 8.3 tons to 2.3 tons per acre.
	5. Reduce average annual erosion rate on rangeland from 3 tons to 2 tons per acre.
	6. Increase flood protection in the city of Newton to above the 100-year frequency level.
	7. Prolong stream flow following periods of above normal rainfall.

May 1975

A.22

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

SAND CREEK WATERSHED, 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 483 acres where water-fowl resting and feeding will occur.
	2. Improve wildlife habitat through establishment of enhancement measures adjacent to structural measures.
	3. Improve wildlife habitat on 26,932 acres of agricultural land by application of land treatment practices.
	4. Create 483 acres of reservoir aquatic habitat.
	5. Inundate 478 acres of terrestrial wildlife habitat.
	6. Reduced use of 1,403 acres of terrestrial wildlife habitat during periodic inundation of reservoir flood pools.
	7. The use of 203 acres of terrestrial wildlife habitat to be occupied by dams and spillways would be temporarily interrupted.
	8. Inundate 10.1 miles of intermittent stream channel habitat.

May 1975

A.23

SELECTED PLAN

ENVIRONMENTAL QUALITY ACCOUNT

SAND CREEK WATERSHED, KANSAS

Components	Measure of effects
Beneficial and adverse effects	
D. Irreversible or irretrievable commitments	1. Commit 95 acres cropland, 374 acres rangeland, 8 acres woodland, and 6 acres miscellaneous to sediment and recreation pools.
	2. Commit 113 acres cropland, 88 acres rangeland, 1 acre woodland, and 1 acre miscellaneous to dams and spillways.
	3. Commit 640 acres cropland, 393 acres rangeland, 28 acres woodland, and 18 acres other land to wildlife and recreation land.
	4. Inundate 10.1 miles of intermittent stream.

May 1975

WATERSHED WORK PLAN AGREEMENT

between the

SAND CREEK WATERSHED JOINT DISTRICT NO. 68
Local Organization

HARVEY COUNTY CONSERVATION DISTRICT
Local Organization

MARION COUNTY CONSERVATION DISTRICT
Local Organization

CITY OF NEWTON
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 for works of improvement for the SAND CREEK WATERSHED, State of Kansas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

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

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the SAND CREEK WATERSHED, State of Kansas, hereinafter referred to as the

watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about seven (7) years.

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

1. The Sponsoring Local 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 Costs (dollars)
2 Floodwater retarding structures	100	0	27,500
Multiple-purpose Structure No. 1 (floodwater retarding and recreational water supply)			
Payment to landowners for about 810 acres	50	50	344,200
Legal fees, survey costs, flowage easements, and other (includes easement area-50 acres)	100	0	14,500
Recreational facilities (payment to landowners - 385 acres)	50	50	163,600

The Sponsoring Local Organizations agree that all land acquired or improved with P. L. 566 financial 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 Organizations will provide relocation assistance advisory services, 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 Organizations and the Service as follows:

	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Relocation Payment Costs (dollars)
Relocation Payments	63.0	37.0	15,000

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 Organization (percent)	Service (percent)	Estimated Construction Costs (dollars)
2 Floodwater retarding structures	0	100	151,900
Multiple-purpose Structure No. 1 (floodwater retarding and recreational water supply)	3.5	96.5	275,400
Recreational facilities	50	50	179,400

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

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Engineering Costs (dollars)
2 Floodwater retarding structures	0	100	24,300
Multiple-purpose Structure No. 1 (floodwater retarding and recreational water supply)	0	100	44,100
Recreational facilities	50	50	28,600

6. The Sponsoring Local Organizations and the Service will each bear the costs of Project Administration which it incurs, estimated to be $2,100 and $197,800, respectively.

7. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50% 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 Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed. The Watershed District is responsible for operation and maintenance of the 19 detention dams. The District will enter into agreements with the landowners who will perform maintenance as needed.

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

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

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

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

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local 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 incorporate 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. Sec. 15.1 - 15.12), which provide that no person in the U.S. 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 program or activity receiving federal financial assistance from the Department of Agriculture or any agency thereof.

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

Sand Creek Watershed
Joint District No. 68
Local Organization

By Audith Lauerman

Title Pres.

500 Meridian Road 67114
Address Zip Code

Date May 8-1975

The signing of this agreement was authorized by a resolution of the governing body of the Sand Creek Watershed Joint District No. 68
Local Organization

adopted at a meeting held on May 8-1975

A. M. Cox
Secretary, Local Organization

500 Meridian Road 67114
Address Newton Ks. Zip Code

Date May 8-1975

Harvey County Conservation
District

By Howard H Beck

Title Chairman

500 Meridian Road 67114
Address Zip Code

Date May 8 1975

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

adopted at a meeting held on May 8 1975

Fred Schlender
Secretary, Local Organization

Burton, Ks. 67020
Address Zip Code

Date 5-8-75

Marion County Conservation District
Local Organization

By Glenna York

Title Chairman

Box 177 Marion Ks 66861
Address Zip Code

Date May 8 - 75

The signing of this agreement was authorized by a resolution of the governing body of the Marion County Conservation District
Local Organization
adopted at a meeting held on May 8 - 75

Janice Peters
Secretary, Local Organization

Marion, Kan. 66861
Address Zip Code

Date May 8 - 1975

City of Newton
Local Organization

By Bradford Wells

Title MAYOR

PO Box 426 67114
Address Zip Code

Date May 8, 1975

The signing of this agreement was authorized by a resolution of the governing body of the City of Newton
Local Organization
adopted at a meeting held on May 7, 1975

Aeesen Schroeder
Secretary, Local Organization

PO Box 426 67114
Address Zip Code

Date May 8, 1975

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:

Robert H. Gustafson
State Conservationist

May 8, 1975
Date

WATERSHED WORK PLAN

Sand Creek Watershed

Harvey and Marion Counties, Kansas

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

Prepared by

Harvey County Conservation District
Marion County Conservation District
City of Newton
Sand Creek Watershed Joint District No. 68

With Assistance by

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

State of Kansas
State Conservation Commission
Forestry, Fish and Game Commission
Office of the Kansas State and Extension Forester

May 1975

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WATERSHED WORK PLAN

SAND CREEK WATERSHED

Harvey and Marion Counties, Kansas

May 1975

SUMMARY OF PLAN

This project is sponsored by the Harvey and Marion County Conservation Districts, Sand Creek Watershed Joint District No. 68, and the City of Newton.

Sand Creek Watershed is located in Harvey and Marion counties in central Kansas and contains 64,134 acres. Municipalities within the watershed include Sedgwick, located at the mouth of Sand Creek at the confluence with the Little Arkansas River, and Newton, North Newton and Walton, in the central portions of the watershed.

Watershed problems are primarily lowland flooding, upland erosion, sedimentation, flood plain scour, and lack of water-based public recreation. Flood damages occur primarily to growing crops and croplands, agricultural and urban properties, and transportation facilities such as roads and bridges. Average annual floodwater damages in the watershed are estimated to be $106,600.

The proposed watershed project will consist of both structural and land treatment measures. Two floodwater retarding reservoirs and a multiple-purpose reservoir for both floodwater retardation and recreation will be constructed. Recreation facilities will also be installed at the multiple-purpose reservoir.

Land treatment measures will consist of: conservation cropping systems; stubble mulching; contour farming; minimum tillage; stock water pond development; proper grazing use; brush

management; woodland improvement; windbreak and shelterbelt renovation; hedgerow replacement; special purpose plantings; fire protection; and installation of diversions, gradient terraces, grass waterways, concrete structures for terrace outlets, and 19 detention dams.

The proposed project will reduce average annual floodwater damage by 59%, and the urban area of Newton will be protected up to the 100-year flood frequency level. The average annual soil loss from croplands will be reduced from 8.3 to 2.3 tons/acre and from 3 to 2 tons/acre on rangelands. The overall reduction in soil loss is expected to be 69%. Average sediment yield from Sand Creek into the Little Arkansas River will decrease from 22 acre-ft to 10 acre-ft, a 55% reduction. Future flood plain scour will be reduced by 31%.

The structural measures will inundate about 250 acres of terrestrial habitat and create an equal amount of aquatic habitat. Periodic flooding of an additional 572 acres from detention pools will interrupt or reduce agricultural and terrestrial wildlife uses. Due to land acquisition, an estimated 15 persons on five farm operations either will have to live on the farms reduced in size or relocate. Most of the land treatment measures, with the exception of the 19 detention reservoirs, will be advantageous to several species of terrestrial wildlife. In the early stages of the project there will be reduced terrestrial mammal and bird habitat and little benefit to fisheries. With time, however, the impoundments will increase both the fishery potential and the amount of suitable habitat for migratory waterfowl, and the land treatment measures will eventually increase wildlife cover and habitat diversity. The multiple-purpose reservoir will increase the recreation opportunities and provide public water-based recreation. In addition, the impounded areas will increase landscape diversity.

Seven years will be required for project implementation. The installation cost will be $2,943,800, of which $1,090,100 will be P. L. 566 funds and the remainder will be from other sources.

Land treatment measures will be maintained by individual landowners and operators through agreement with the conservation districts. The operation and maintenance of structural measures will be provided by the sponsoring organizations. Sand Creek Watershed Joint District No. 68 will provide land rights, contract for construction, operate, and maintain the floodwater retarding Structures Nos. 2 and 3. The City of Newton will provide similar

services for the multiple-purpose Structure No. 1. Dam and reservoir construction costs for Site No. 1 allocated to flood prevention will be paid by the Soil Conservation Service; land rights and construction costs allocated to recreation will be shared equally by the Service and the City of Newton. Inspections of these sites will be made annually by local sponsors.

The estimated average annual cost of operation and maintenance of structural measures is $25,600. The average annual benefits attributable to structural measures are expected to be $160,900; average annual costs for these measures are estimated to be $126,700. Average annual flood damage reduction benefits from land treatment measures will be $31,700; costs for land treatment measures were not computed on an annual basis.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

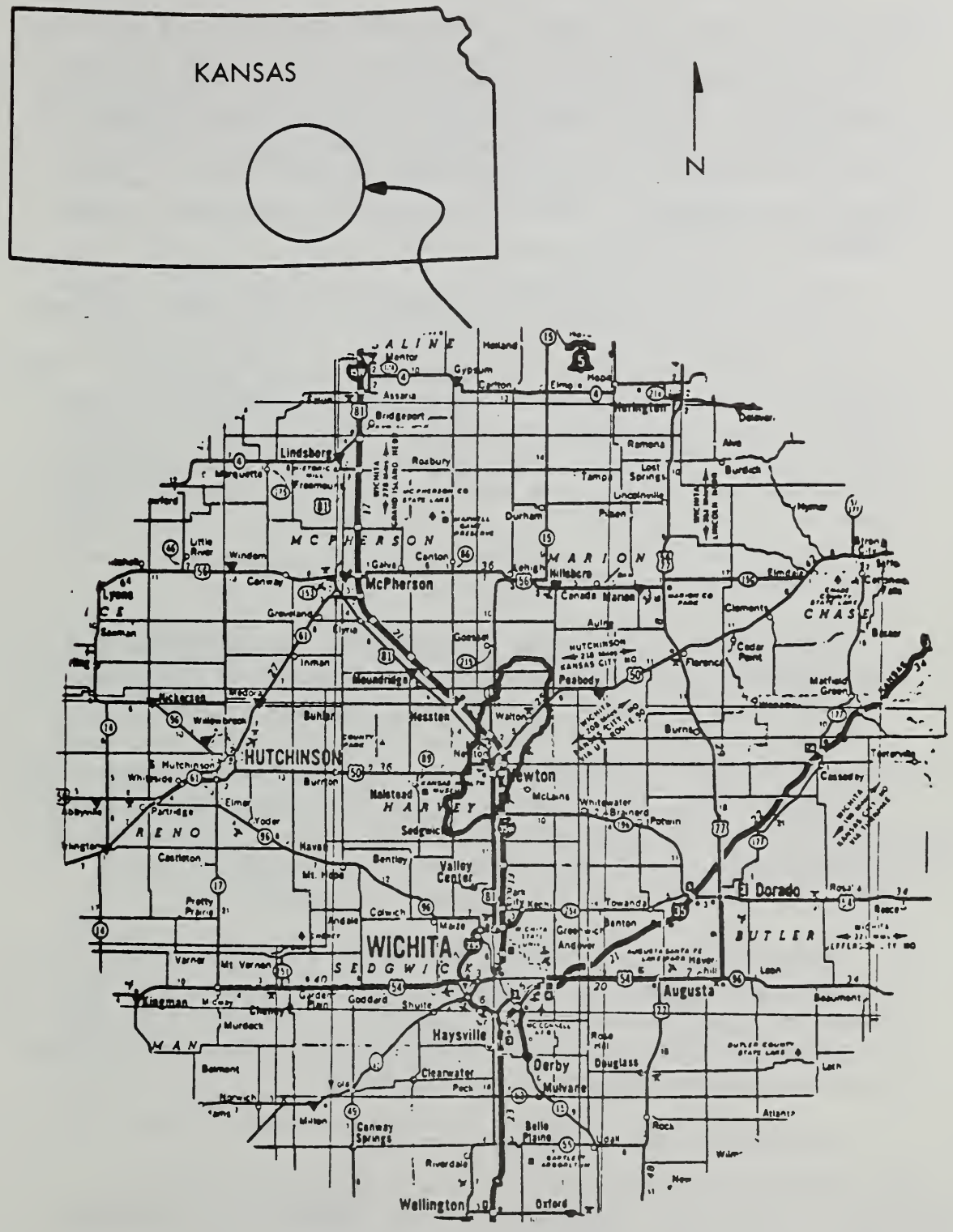
Physical Data

Sand Creek Watershed occupies 64,134 acres or 100.2 sq miles in south-central Kansas. The upper part of the watershed, 9,186 acres, is in Marion County; the remainder, 54,948 acres, is in Harvey County[1] (see list of references, p. 107). There are four municipalities within the watershed: Sedgwick, at the mouth of Sand Creek, and Newton, North Newton and Walton, all in the central portion of the drainage. Newton is located 26 miles north of Wichita, a major population center of Kansas (see Vicinity Map). The watershed has a population of 19,119; of this total, 18,109 persons (95%) live in urban areas, and the remaining 1,010 persons (5%) reside in rural areas.

The watershed is located in the Arkansas River Basin in the Kansas subregion of the Arkansas-White-Red-Water Resources Region.[2] The soil and water resource problems in Sand Creek Watershed are typical of those throughout the region. Uncontrolled or unimpeded runoff contribute to erosion in the uplands and a subsequent concentration of runoff and heavy flooding throughout the flood plain.

Sand Creek Watershed lies entirely within the Central Loess Plains Land of the Central Great Plains Winter Wheat and Range Land Resource Region.[3] Also, it lies in the extreme eastern part of the Great Bend Prairie physiographic province. The topography ranges from flat to gently sloping, with a total relief of 185 ft from the headlands to the outfall. The land slope equals about 8 ft/mile.

The watershed is underlain by the Wellington Formation, which was deposited during the Cimmeronian Stage of the Permian Period.[4] This formation is 150 to 200 ft thick in this area and consists of soft gray and bluish gray calcareous shale containing several thin beds of shaly limestone and gypsum.[5] The fossil species of plant and animal remains found in this formation are indicative of both marine and freshwater origins. Although no salt is known to underlie this area, it is present in the subsurface of western Harvey County.



SAND CREEK WATERSHED AND VICINITY

The McPherson Formation overlies the Wellington Formation in the uplands of the western and southern portions of the area. It consists of interbedded silt, clay, and fine sand, and was deposited during the Kansan Stage of the Pleistocene Epoch. It ranges from 0 to 60 ft thick in this area. Recent alluvium in the valley is similar in character to the deposits of the McPherson Formation and no subsurface division can be made between these deposits. The alluvium occurs extensively between Sedgwick and Newton.[5/]

Soils of the watershed are varied.[6/] Deep, dark, clay and semiclaypan soils of old alluvial origin occupy most of the upland. Moderately deep, friable, silty to clayey soils of loess origin are interspersed in narrow bands on either side of Sand Creek. Flood plain soils are deep, friable, silty to clayey alluvium with streaks of sandy loam deposits. They are mostly Geary, Farnum, Detroit, and Hobbs series, which are deep with moderate to slow permeability and high available water storage capacity (9 to 12 in. in a 60-in. profile). These soils would be suitable for irrigation.

The climate of the area is considered "Humid Continental Warm Summer" by Koppen[7/] and "Moist Sub-Humid" by Thorntwaite classification.[8/] Normal annual precipitation at Newton is 30.50 in. and has varied from a low of 13.39 in/year to a high of 51.50 in/year. Seventy percent of the rainfall occurs during the summer months as the result of high intensity thunderstorms. The normal annual temperature at Newton is 56.5°F. The average growing season is 185 days; however, this season has varied from 172 to 203 days during the past 12 years.[9/]

Mineral deposits in Harvey and Marion counties currently yield petroleum and natural gas. However, within the watershed there are presently no known economically recoverable minerals, although sand and gravel have been extracted in the past. Several oil and gas pipelines extend through the watershed area.

Land use in the watershed is as follows:

Land Use	Percent	Acres
Cropland	78	50,025
Grassland	13	8,337
Woodland	--	300
Other	9	5,472
Total	100	64,134

Land use in the flood plain is similar to that in the watershed as a whole. The percentage of cropland is slightly lower and grassland, woodland, and other uses are somewhat higher. Croplands primarily produce wheat, grain sorghums, soybeans, and alfalfa. Grasslands are primarily used for dairy and beef cattle.

In the vicinity of cities there is a trend toward increased urban expansion, suburban housing developments, and individual nonfarm, rural residences. If economic and population growth continue, this trend will probably also continue.

Woodlands in the watershed consist mostly of elm, ash, cottonwood, hackberry, and osage orange trees. Their commercial quality is low and they commonly serve as pasture for livestock. Woodlands are often erosion problem areas because of heavy livestock use.

Sand Creek with its tributaries is the major surface water resource of the watershed. It originates about 3 miles southeast of the town of Goessel, Kansas, in Marion County and flows south-southwest to its confluence with the Little Arkansas River, a distance of about 24 air-miles. The stream system contains about 90 miles of channel, including major tributaries.

During the watershed planning investigations, Sand Creek was divided into eight study reaches as shown on the Project Map, p. 114. Reaches 1 through 4, from the mouth of the stream upstream to the south edge of Newton, are considered intermittent. During drought periods the only flow in these reaches comes from the effluent of Newton's sewage treatment plant. Reaches 5 through 8, upstream from the Newton sewage treatment plant, are also considered intermittent because although the stream continues to flow after each period of surface runoff, it ceases to flow during moderate drought periods. In spite of the lack of natural, permanent base flow, most of the eight reaches of Sand Creek exhibit a well-defined natural channel.

Portions of reaches 4 and 5 through the City of Newton have been modified for flood control by the U.S. Army Corps of Engineers. Three miles of Sand Creek in these reaches have been straightened, shaped, and riprapped. In addition to the channel modification, channel cleanout and snag removal was carried out for 1 mile above and 2 miles below the modified section.[10/]

Ground water is the principal source for farmstead, municipal, and industrial water supplies. A summary of ground water supplies for municipalities in the watershed, reported by the Kansas State Department of Agriculture, Division of Water Resources[11,12] and the Kansas State Department of Health, Division of Environmental Health Services,[13] is given as follows:

Municipality	Number of Wells	Depth (ft)	Geological Source	Source Capacity (acre-ft)	Plant Capacity (MGD)
Newton	10	150[a]	Equus Beds	3,600	6.5
Sedgwick	3	49,57,102	Alluvium	46	1.296
Walton	2	30[a]	Alluvium	23	0.05

a/ Average depth.

Ground water supplies in the watershed are considered adequate for present and future municipal populations and industrial applications until 1990.

Water quality is covered by various parameters such as mineral content, total solids, hardness, etc. Generally speaking, ground water quality in the Sand Creek Watershed meets federal standards for drinking water.[14] The exceptions are around Sedgwick and in the southern end of the watershed, where some wells have high manganese, iron, and hardness concentrations.

The State of Kansas has adopted water quality criteria[15] which give a Class B designation to Sand Creek under the following interpretation of the standards.

> "All watercourses which reach zero natural flow annually are exempted from water use classification and the application of water quality criteria, except: (1) those waters specifically listed in the document table, and (2) those waters that can be reasonably expected to support aquatic wildlife because of pooling during periods of no flow."

"Unlisted tributary watercourses which are perennial or which can be reasonably expected to support aquatic wildlife because of pooling during periods of no flow shall be classified as Class B waters."

The latter designation includes Sand Creek. Specific criteria for water quality of Class B streams (State of Kansas) include the following:

1. Fecal coliform content shall not exceed 2,000 per 100 ml, although it is expected that surface runoff during heavy precipitation will exceed this level.

2. Dissolved oxygen content shall be maintained above 5 mg/liter (except for 4 mg/liter for short periods of time within a 24-hr period). Dissolved oxygen concentrations less than the above levels shall not be due to man-made point source waste discharges.

3. Temperature of receiving water shall not be raised above 90°F by man-made point discharges. Heat of artificial origin shall not be added to a stream that will raise the stream temperature more than 5°F.

4. Point source waste discharges shall not cause the pH of waters of the state to vary below pH 6.5 and above 8.5.

5. Point source waste discharges shall not cause the undissociated ammonium hydroxide concentration of waters of the state to exceed 0.15 mg/liter as N.

Data on the water quality of Sand Creek 7 miles downstream from Newton show that fecal coliform counts made in April 1970 ranged between <100 and 1,900 per 100-ml sample.[13] Data reported for analyses made in September 1973, show fecal coliform populations ranged between 700 and 10,000/100 ml sample.[13] Fecal streptococcal counts are also indicative of human fecal contamination. During the limited sampling periods covered (7 days each), the fecal coliform and total coliform counts were consistently higher in 1973 samples (gage height 1 to 2 ft) than in 1970 samples (gage height approximately 19 ft). The difference reflects the sewage dilution factor introduced during the higher stream flow rate. Dissolved oxygen for the same analyses ranged between 4.3 and 7.1 mg/liter. Stream temperatures ranged between 55° and 64°F; pH measurements ranged between 7.9 and 8.5.

Water quality samples for Sand Creek at various locations in and near Newton and Sedgwick[16,17] show acceptable levels of dissolved oxygen, pH and temperature for compliance with the State of Kansas, Class B waters.

Based upon these data, the water quality of Sand Creek meets the State of Kansas Class B water quality criteria except for fecal coliform counts. Sewage effluent from Newton probably contributes greatly to the fluctuations in fecal coliform populations in the stream.

The natural runoff from farmsteads throughout the watershed influences the water quality of the streams. The most dominant factors which contribute to poor water quality from agricultural runoff are: (1) sediment from sheet erosion, (2) microorganisms from soil and barnyard accumulations, (3) dissolved and suspended solids, and (4) nutrients (nitrogen, potassium, and phosphorus) from organic and inorganic materials. Sediment yields are reported to be 0.50 to 1.00 acre-ft/sq mile/year.[18] Many of the stream pollutants are carried by soil particles.

Streams normally low in bacterial counts receive high bacterial populations through runoff from agricultural lands even with no influence from municipal, industrial or feedlot waste sources. Both fecal coliforms and fecal streptococci contribute to the bacteriological load under such conditions. With high populations of microorganisms and increased dissolved and suspended solids as nutrients from farmstead runoff during heavy rainfall, the biochemical oxygen demand (BOD) may increase appreciably from biological oxidation of nutrients and lower the dissolved oxygen content of the stream. Extreme conditions would produce fish kills and reduce the populations of other aquatic life.

Economic Data

Population of the watershed area is 19,119. The cities of Newton and North Newton, centrally located with a combined population of 16,829, are the largest incorporated areas in the watershed. Other communities are Walton, located in the northeast, and Sedgwick, located at the very south end of the watershed. Ninety-five percent of the population reside in urban

areas. The watershed population is projected to reach 25,000 by the year 2000, and 31,500 by the year 2020.[19/] It is expected that most of the increased population will locate in existing towns; thus, there will be no significant change in land use from rural to urban. Present and projected populations are as follows:

POPULATION IN SAND CREEK WATERSHED

Area	Population 1972	2000	2020
Watershed	19,119	25,000	31,500
Newton and North Newton	16,829	NA	NA
Walton	214	NA	NA
Sedgwick	1,066	NA	NA
Rural areas	1,010	NA	NA

NA = Not Available

Most of the land in the Sand Creek Watershed is privately owned. Of the 64,134 total watershed acres, only 3.5% (2,240 acres) are state and local government controlled land. This land is in the form of schools, rights-of-way, or parks. The largest contiguous tract of publicly owned land is the 120-acre Newton airport.

Farms in the watershed average 310 acres, which is somewhat smaller than the Harvey County average of 337 acres. Most of the 196 farms are typical diversified family operations and only five farms employ 1-1/2 or more man-years of labor. About 23% of the agricultural land is owned by the operator; 24% is tenant operated; and over half, 53%, is farmed by operators who own one or more units and rent one or more additional farms.

Agricultural operations are based primarily on dry-land crop production, livestock feeding, and dairy operations. There are five dairy herds numbering over 100 head and numerous smaller herds. Nine of the largest dairies in Harvey County milk about 670 animals. There is also some hog production.

The major crops produced in the area include wheat, grain, sorghums, soybeans and alfalfa. Wheat and soybeans are the major cash crops with most of the other feed grains and hay marketed through livestock production. In 1971, wheat and cattle production totaled $4.5 million and $5.8 million, respectively.

In a representative flood-free year, crop yields per acre in the flood plain are almost double those of Harvey County average yields, as shown below:[20]

HARVEY COUNTY AVERAGE YIELDS
1966[a]

Crop	Average Yield	Flood Plain Yield
Wheat	28 bu/acre	50 bu/acre
Grain sorghum	45 bu/acre	90 bu/acre
Silage sorghum	12 tons/acre	20 tons/acre
Alfalfa	2.3 tons/acre	4.5 tons/acre
Soybeans	17 bu/acre	40 bu/acre
Silage corn	NA[b]	16 tons/acre dry land 24 tons/acre irrigated

a/ Based on 18-year trend line for county yields; flood-free yield based on interviews.
b/ Not Available.

The natural woodlands contain only small amounts of currently marketable timber; however, several small Christmas tree plantations represent high per-acre values. The greatest woodland value now is soil protection, stream bank stabilization, wildlife habitat, and esthetics. Trees planted in the urban areas represent a large investment in providing pleasant surroundings.

Sand Creek Watershed is located in one of the most prosperous farming areas in the state. Economic conditions are represented by Harvey County averages. The average market value of all agricultural products sold in Harvey County (before taxes and expenses) averaged $17,351 per farm in 1969, which was a 25% increase ($3,447) since 1964.

In 1969, the median family income for Harvey County residents was $8,745, slightly above the state median income figure of $8,693. Only 7.1% of the families had incomes below the poverty level compared to 9.7% for the state.[19/]

Most family farms in the area generate incomes above the poverty level. More than 80% of the farms in Harvey County had sales of farm products totaling over $2,500 in 1969. Forty-four percent of the farms in the county had sales of farm products over $10,000. Less than 3% of the farms, operating on a full-time basis, had sales of farm products less than $2,500. In addition, nearly 17% of the farms which did have sales less than $2,500 were operating on a part-time or on a retirement basis. However, it should be noted that many of these farmers worked more than 100 days off their farms to supplement their incomes.[21/]

The current value of land adjacent to urban centers in the watershed is $1,000/acre. Current nonurban market land values are roughly $300/acre for upland cropland, $150/acre of upland pasture, $300/acre for tributary bottomland and $350/acre for mainstem bottomland. The gross value of the composite flood plain acre* is projected to range from $110 to $132 in the year 2000.

Highway, rail and air transportation all provide access to major grain marketing terminals such as Wichita and Hutchinson. The watershed is served by a system of secondary roads. Major highways to markets in and outside of the watershed are: K-15, I-35, US 81, and US 50. The Atchison, Topeka and Santa Fe and the Missouri Pacific railroads both provide service to the watershed. In Newton there are Amtrak and air transportation services.

Unemployment has been increasing in Harvey County but is still below the state level. In 1969, there was 2% unemployment compared to 3.9% for the state. By December 1970, the county unemployment had increased to 2.4% and by December 1971, it had risen to 4%.[22/] State unemployment rates continued to be greater, going from 4.9% in 1970 to 5.7% in 1971.[23/]

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* Gross value of a composite flood plain acre is defined as the value of production, without flooding, from 1 acre of representative flood plain land use.

Despite the agricultural orientation of the county, manufacturing and trade play an important part in the overall area economy. Out of a total employment force of 11,642, 22% are employed in manufacturing and 21% are employed in wholesale and retail trade. The principal manufacturing industry within the watershed is the construction of mobile homes and mobile home components. Thirteen percent of the Harvey County labor force is employed outside the county.[19/]

The total value of all land in the watershed is nearly $22 million. About $5.5 million of this is attributed to urban areas, and the remaining $16.5 million represents the value of rural lands. Thus, the average land value of a farm unit is about $84,000. The values of improvements and farm equipment would increase this capitalization. It appears that the value of real and personal property in the watershed is substantial and provides an adequate base for generating tax revenues to local and county governments. The tax revenues in the area seem to be adequate to support the maintenance of many rural roads and highways.

Harvey County recorded a 5.3% increase in population during 1960-1970 and the population of Newton increased by 3.8%.

The population of both Harvey County and the watershed area is predominantly urban. Over 56% of the county's 27,236 residents live in urban communities. The presence of a city the size of Newton (population 16,829) accounts for a large portion of the urban population. The inclusion of the city in the watershed area results in 95% of the area's 19,119 residents being classified as urban. The nonwhite population in Harvey County accounts for only 2% of the total population.[19/]

Harvey County residents have a median age 2 years older than state residents as a whole--30.6 years compared to 28.7 years. A greater proportion of people in the retirement ages accounts for part of this difference. Nearly 14% of the county population is 65 years or older compared to 11.8% of the state population.[19/]

Median school years completed by county residents age 25 years and over is 12.3 years--the same as the state average. This indicates many residents have gone past the high school level. In 1970, 7,886 persons between the ages of 3 and 34 years were enrolled in school.[19/]

The average farm operator is considerably older than the average county or state resident. The average age of the farm operator is 50.3 years. This compares to a median age for all county residents of 30.6 years--some 20 years greater than the average for county residents and nearly 22 years greater than the average for state residents.[21]

Marion County is included in the Flint Hills Resource Conservation and Development Project which also includes Chase, Lyon, and Morris Counties.

Fish and Wildlife Resources

Because Sand Creek is intermittent and therefore cannot support stable aquatic populations, fishery potential is marginal at best.[25] The number of species found in this stream would probably be considerably less than that found in adjacent streams of the general area which have perennial flows. Permanent pools in some of the Sand Creek tributaries offer limited fishing, but most of the fishery potential in the watershed is found in farm ponds on private land. There are no known fish inventories of Sand Creek watershed; however, there are about 24 species of fish which occur in this general area.[26] Among these are nine species of Centrarchids, which include the largemouth bass, bluegill, crappie, etc., and two species of catfish which are found in the streams and farm ponds.

There is no known survey of amphibians or reptiles for the watershed. Data from various sources[27-31] report 1 species of salamander, 8 species of frogs and toads, 9 species of lizards, 9 species of turtles, and 23 species of snakes are found in this general vicinity.

In general, it appears that those species adapted to more arid conditions are found in this area. For instance, there are fewer salamander species found in the project area than in eastern Kansas. Snake species, on the other hand, are well represented in the area fauna.

The bird life of the watershed is varied, and a mixture of eastern and western North American birds inhabit this area. Some of these species are permanent residents, others are seasonal,

and yet others are transient during their northern or southern migrations. Of the bird species in this general vicinity, 34 would be considered permanent residents, 61 are summer residents, 28 are winter residents, and 116 are transients.[32] Not all these species would necessarily be present in the watershed.

There are 47 species of mammals which have a geographical range that includes the Sand Creek Watershed.[33] Of these species, there are 12 which would be considered fur bearers or game animals.

Habitat for upland game is considered marginal to good.[25] In general, however, there is little permanent cover available for many species. About 300 acres, or 0.5% of the project area, is woodland. Lack of permanent cover is a major limiting factor for wildlife populations in this area.[25]

Species of small game hunted in the watershed include bob-white quail, mourning dove, ring-necked pheasant, fox squirrel, and cottontail rabbit. In addition, the project area is within the western portion of the Central Flyway for migratory waterfowl, but there is presently little waterfowl hunting or habitat within the watershed. Deer hunting potential is increasing, and hunting is presently allowed on a permit system.

There are three bird species observed in Kansas which are on the national endangered wildlife list;[34] these species are the whooping crane (Grus americana), peregrine falcon (Falco peregrinus), and the bald eagle (Haliaeetus leucocephalus). The Kansas Academy of Science[35] lists these and four additional species as endangered in Kansas; these are the prairie falcon (Falco mexicanus), the burrowing owl (Speotyto cunicularia), the black-capped vireo (Vireo atricapilla), and the Eskimo curlew (Numenius borealis), which is probably extinct.

Birds listed as rare in Kansas but not nationally are the whistling swan (Olor columbianus), the osprey (Pandion haliaetus), the merlin (Falco columbarius), the long-billed curlew (Numenius americanus), and the bobolink (Dolichonyx oryzivorus).

Several of these species are birds of prey and are limited through reduced reproduction caused by insecticide ingestion, not through lack of habitat.[36,37] An exception to this is the

whooping crane, whose decline is more related to land use changes and the depredations of man than to the use of insecticides.

The southern lemming-mouse (Synaptomys cooperi), the spotted skunk (Spilogale putorius) and the bobcat (Lynx rufus) are mammals listed by the Kansas Academy of Science as rare in Kansas but not nationally, and may be present within the watershed.

The Botany Department at Kansas University lists Oklahoma phlox (Phlox oklahomensis) as rare, uncommon, or at least of limited distribution in North America. This plant may be present within the Sand Creek Watershed. Records indicate it has been recorded in an adjoining county (Butler).

Some other plants that may occur within the watershed are listed as rare or at least uncommon within Kansas, although they may occur more abundantly in other parts of North America. They are: milkweed (Asclepias meadii) and Rock elm (Ulmus thomasi).

Recreational Resources

In assessing the recreational resources of the watershed, particularly that portion within Harvey County, it is necessary to distinguish between public and private, large and small, and land or water-based recreation areas. As of 1966, there were 12 public and nine private recreation areas in Harvey County. All of the private recreation areas had 10 or more acres, but only two of the public areas were that large. The total area of all recreation areas in the county was 1,090 acres, of which 25% or 235 acres were water acres. Only 40 of these 235 acres were publicly owned. This means that 4% of the total recreation area of the county was available for general public, water-based recreation.[38/]

There are no lakes suitable for water sports in the Sand Creek Watershed. The nearest large impoundments are Cheney Reservoir and Marion Lake. Cheney Reservoir, built by the Bureau of Reclamation, is located about 45 miles southwest of Newton and is heavily used by Wichita and Hutchinson residents. Marion Lake, built by the U.S. Army Corps of Engineers, is approximately 40 miles northeast of Newton. During 1972, about 820,400 persons used the recreational

facilities at this lake.[39] Within the city of Newton, a Fabridam (nylon reinforced neoprene dam) has been installed on the Sand Creek channel. The Fabridam is inflated by water pressure during normal flow periods and automatically deflates during periods of high flow. There is some fishing, canoeing, and rowboating on this 26-acre impoundment, but it is primarily for water storage and aesthetic value. Multiple-purpose Structure No. 14 in the recently authorized West Sector Whitewater River Watershed will be located about 6 miles east of Newton. When completed, this 231-acre lake will offer public recreation for 50,000 recreation visits annually.

Archeological and Historical Values and Unique Scenic Areas

A preliminary archeological field reconnaissance was conducted for Sites Nos. 1, 2, and 3 in the summer of 1974. Preparation for the field studies involved a review of literature from previous archeological investigations of sites from nearby areas. These adjacent sites represent cultures of the nomadic Paleo-Indian, ca. 8000-5000 B.C.; the Archaic period, ca. 5000 B.C.-0 A.D.; the Middle Woodland period, ca. 0-1000 A.D.; and the Protohistoric period, ca. 1500 A.D.

The proposed construction sites were extensively surveyed on foot during a 3-day period. Conditions were good for surface collecting and surveying. All areas were randomly probed to a depth of at least 2 ft. No surface evidence of habitational sites was observed in the recreational area of Site No. 1 or in the projected structural areas of Sites Nos. 1, 2, or 3. There still remains, of course, the possibility of more deeply buried sites. In addition, at Site No. 3 a small area of pioneer graves was found; the headstones had been removed to expedite farming. According to local residents, this small cemetery is located somewhere in the NE 1/4, SW 1/4, NW 1/4, Sec. 11, T22S, R1E.[40]

The National Register of Historic Places lists the Carnegie Library, Warkentin House, and Warkentin Mill, all located in Newton, and the Bethel College Administration Building on the campus in North Newton, as historical sites.[58] These sites do not lie within any proposed construction area of the project.

There are no widely recognized unique scenic areas within the watershed.

Soil, Water and Plant Management Status

With the exception of residential development in the vicinity of Newton, the following land use pattern has been essentially constant within the watershed:

Land Use	Percent	Acres
Cropland	78	50,025
Grassland	13	8,337
Woodland	-	300
Other	9	5,472
Total	100	64,134

Before 1961 only a few scattered farms were applying land treatment measures. Through an extensive educational program by the watershed steering committee, 49% of the watershed was under cooperative agreement with the Harvey and Marion County Conservation Districts by 1965.

Efficient use of capital and labor on easily eroded or marginal uplands has continued to increase, and presently approximately 60% of the watershed farmers are cooperators with the two conservation districts. Plans are being implemented to control erosion and improve cropland, hayland, pastureland, woodland and wildlife habitat.

At present, about 54% of the land under cooperative agreements is adequately treated. This includes the construction of approximately 36% of the waterways, 28% of the gradient terraces, and 75% of the needed farm ponds. Good conservation cropping systems are in use on 50% of the cropland. However, pasture management is poor and only 15% of the treatment needed on rangeland has been applied. The practices that have been applied are as follows:

Land Treatment Measure	Unit	Amount Applied as of January 1972
Conservation cropping system	Acre	25,000
Farm pond	Number	16
Grade stabilization structure	Number	177
Grass waterway	Acre	525
Range proper use	Acre	4,554
Range seeding	Acre	100
Terraces, gradient	Mile	217

About 6% of the flood plain cropland is being irrigated using treated effluent from the Newton sewage treatment plant. This water and available flows in Sand Creek comprise the only source for irrigation water in the watershed. Since the flow in Sand Creek is intermittent, the sewage treatment plant effluent is the only dependable source. Furthermore, water in Sand Creek is exceptionally hard, with up to 424 mg/liter total hardness. Surprisingly, the total hardness increases with increased flow because of the greater solution of calcium sulfate deposits along the channel during wet periods. Inadequate water supplies and poor quality indicate that few additional areas of cropland can be brought under irrigation.

Other agencies with programs affecting land use and treatment in the watershed are the Cooperative Extension Service and the Forest Service. The Extension Service, through county agricultural extension agents, assists with informational and educational programs to carry out conservation objectives. Through cooperative agreements with the Forest Service and the Kansas State Forester, all the grassland and woodland areas in the watershed are within rural fire district protection. The Forest Service and the Kansas State Forester have also assisted in installing 900 acres of tree and shrub plantings on woodlands and other lands.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

Loss of soil through sheet and rill erosion is a major problem on untreated cropland. Soil losses* of 13 tons/acre/year are not uncommon. The average soil loss is 7 tons/acre/year. This results in a reduction in crop yields and farm income. Excessive erosion results in sediment deposition in road ditches, farm ponds, streams and on the flood plain.

Resource management systems are needed on 50,025 acres of cropland, 8,337 acres of rangeland, and 300 acres of woodland. Resource management systems include those conservation practices needed to accomplish soil and water conservation objectives for each land use. Cropland management systems include waterway development, terracing, conservation crop rotations, contour farming, and crop residue use. Pastureland management systems include pasture planting and pasture management. Range seeding, proper grazing use, brush management and planned grazing systems are important components of range management systems.

More emphasis needs to be placed on contour farming. Some conservation farmers have discontinued farming their terraced land on the contour. This trend needs to be reversed. Improved residue management practices, such as minimum tillage and stubble mulching, are also needed.

Rangeland pastures are relatively small in acreage. The number of livestock in the project area far exceeds the carrying capacity of the rangeland resource. Overgrazing is common. Most of the pastures are accessible to livestock yearlong. Even when cropland is being utilized as the primary source of forage, livestock are given access to rangeland pastures due to permanent sources of livestock water located in these pastures. This results in trampling and repeated overgrazing of the more desirable plants. Gradually the pasture vegetation is reduced in vigor and production declines. As the more desirable plants are weakened, weeds invade and increase in abundance. Runoff becomes excessive, causing erosion and subsequent sedimentation. Lowered rates of moisture infiltration also reduce the productivity of rangeland vegetation.

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* Soil loss is the gross quantity of material removed from a site of erosion.

Adequate treatment of rangeland is needed to reduce erosion and sediment deposition in reservoirs and stream channels. Sediment surveys have indicated that well-managed rangeland with conditions similar to those in the project area yielded only 0.4 ton sediment per acre annually, whereas poorly managed rangeland produced 1.6 to 2.0 tons/acre each year.*

Many pastures have rows of osage orange trees as borders. These trees have invaded the pastures and compete with forage plants for light and moisture. Mechanical and chemical brush control methods will be used to control invading brush and trees.

The watershed contains 300 acres of woodland, mostly adjacent to Sand Creek and its major tributaries. These stands are generally of poor commercial quality. There is frequently overgrazing in woodland areas resulting in increased erosion. There is also a need for tree plantings for windbreaks, shelterbelts, wildlife and recreation uses.

Many of the farms in the headwater region have not established soil conservation practices. This area of the watershed is divided into small, separately owned tracts. It will take considerable time and very careful handling to secure the application of needed conservation practices in this critical region.

Twenty-three percent of the farms are operated by full owners, 53% by part-owners and 24% are rented. Farms operated by part-owners must produce income for both the tenant and the owner, and therefore these owners have fewer financial resources to install needed land treatment measures. Many landowners, however, can take advantage of assistance offered by federal cost-sharing programs.

Floodwater Damage

Floodwater damage has been extensive on rural and agricultural lands. The major flood damage occurs to growing crops. Most flooding occurs during the growing season, but floods occur throughout the year. Flooding which comes before or shortly after fields have been planted causes extra tillage and reseeding operations. Other agricultural facilities damaged are fences, machinery,

* Sediment yield is the net quantity of material delivered to a point of measurement from a site of erosion.

and farm building. Floodwater damage also occurs in North Newton, Newton, and Sedgwick; property destruction and even loss of life have been direct or indirect consequences of floods in urban areas.

Approximately 7% of the watershed land, or 4,619 acres, are subject to flooding. The flood plain includes 4,353 acres of rural land and 266 acres of nonrural land in Newton, North Newton, and Sedgwick. Agricultural flood plain land includes 3,403 acres of cropland, with values up to $350/acre. There are 47 farming operations affected by flood damages.

Land use of the flood hazard area on the evaluated reaches of the flood plain is as follows:

Land Use	Acres	Percent
Cropland	3,403	73
Rangeland	688	15
Woodland	88	2
Other	440	10
Total	4,619	100

Annual average flood damage by reaches (see Project Map, p. 114) is as follows:

Reach No.	Flood Plain (acres)	Damage Estimation (dollars)
1	620	8,300
2	1,285	26,200
3	861	35,200
4	380	10,900
5	145	100
6	292	4,400
7	477	10,200
8	392	11,300
Tributaries	167	a/
Total	4,619	106,600

a/ Included in reaches above.

Since 1900, there have been 12 major floods in Sand Creek Watershed. Until the relatively recent flood of June 9, 1965, the most severe flood occurred in 1923. The 1965 flood crested 2 ft higher than any of previous record.[10/] The flood of 1923 had an estimated discharge of 10,000 cfs with a frequency of once in 29 years. The flood of 1965 had an estimated discharge of 20,000 cfs and a frequency of once in about 350 years.

The 1965 flood damaged or destroyed 360 houses, 30 commercial establishments, parks, water and sewer lines, streets and bridges, and private utilities in the urban area of Newton. Two lives were lost as a direct or indirect consequence of the flood. The total damage to Newton was estimated to be $1,201,000.

Damages to the city of Sedgwick from the 1965 flood were estimated to be $113,500. Of this total, $12,000 damage was suffered by the Southwestern Bell Telephone Company alone. Sedgwick was damaged by floodwater from the local drainage area located immediately northeast of town in addition to the flooding caused by Sand Creek mainstem.

In addition to urban areas, the 1965 flood was devastating to rural areas. For example, six farms sustained losses totaling $86,556. Although the total rural loss was not estimated, it was extremely high.

In addition to the other losses, damage to roads and bridges was estimated to have been $53,000. Further, the damage to the railroad south of Newton was $19,445.

In 1967 the U.S. Army Corps of Engineers installed a local protection project in Newton and North Newton. The project consisted of channel modification through Newton and channel clean-out and snag removal, both above and below Newton. That vicinity is now protected up to a 50-year flood frequency level. Even so, a flood of the severity of that of 1965 would still cause considerable damage.

It is estimated that the average annual damage to crops and pasture due to flooding is $37,300 (see Table 5, p. 94), and accounts for 35% of the total average annual flood damage. Other agricultural expenses, such as debris removal after flooding, average $10,300 annually. The total average annual floodwater damage on agricultural lands is evaluated at $47,600.

Floodwater damage to roads and bridges averages $26,800 annually. Flood flows wash away road surfacing, scour road shoulders, silt in roadside ditches, and damage bridges. County and township road budgets are not usually sufficient to make immediate replacements and repairs following floods. Repair work to these facilities is spread over a number of years which necessitates extended use of subnormal improvements. An estimated 15.6 miles of road and 31 bridges are subject to flood damage within the project area.

Railroad transportation services suffer during Sand Creek floods. The average annual damage on an estimated 5-1/2 mile stretch of Atchison, Topeka, and Santa Fe track located in the flood plain south of Newton is $900.

The average annual urban flood damage in Newton and Sedgwick (attributable to Sand Creek) is estimated to be $100 and $2,100, respectively.

Flooding affects everyone in the area due to damage to roads, bridges, transportation, utilities, and loss of business to those serving the agricultural community. Such indirect losses under future conditions without the project are estimated to average $11,100 annually.

There are also significant nonmonetary damages to wildlife species residing within the flood plain area. Seventy-five percent of the storms causing out-of-bank flows occur between April and August. Ground-nesting species of birds are vulnerable to flooding during this period. Flooding destroys protective habitat, nests, and young birds. Terrestrial species residing in the flood plain may be displaced or destroyed by floods. This displacement may result in increased predation.

In summary, the total average annual direct monetary floodwater damages are estimated to be $77,500 as shown in Table 5, p. 94.

Erosion Damage

The average annual upland soil loss for the watershed is 7 tons/acre. On approximately 23,000 acres of untreated cropland,

however, the average annual soil loss is 13 tons/acre and may range as high as 20 tons/acre.

In most instances of moderate to light flooding, little scour damage is done to the deep productive flood plain soils because water velocities are low. In severe floods such as that of June 1965, extensive damage occurs. At that time, fields without vegetative cover along the flood plain had soil removed to plow depth or deeper. Scour channels exist on 587 acres, where productive capacity has been reduced by 15 to 29%.

Average annual scour damage to the flood plain is estimated to be $18,000. Continual high soil losses ultimately diminish agricultural yields and result in the irretrievable loss of a natural resource.

Sediment Damage

Sediment, resulting from erosion, is being deposited in farm ponds, stream channels, roadside ditches, along field borders, and on the flood plain. The average annual sediment yield for this region is estimated to be 1.0 acre-ft/sq mile/year. The average sediment yield at the mouth of Sand Creek is 22 acre-ft/year. An additional 78 acre-ft are annually deposited throughout the drainage area.

While the monetary damages of sediment deposition have not been fully evaluated, some of the physical effects are obvious. Farm ponds are disrupted as sedimentation following runoff affects turbidity, dissolved oxygen, and temperature of the water as well as spawning beds in the ponds.[41,42] Following heavy runoff, stream channels are often plastered with mud which smothers vegetation and is esthetically unpleasing. Sedimentation on flood plains alters soil structure, nutrient content, and water regimes. It causes deterioration of grain crops by stimulating sprouting and fungus growth; it also increases the cost of cleaning and separating the grain, and contributes to harvesting equipment attrition (included in crop and pasture damage evaluation). Sediment deposits are subject to wind action and can add to dust storms. Further, sedimentation of natural field drains inhibits surface water runoff from cultivated areas.

Municipal and Industrial Water

The quality of ground water for municipalities in some areas of the watershed does not meet recommended federal standards for drinking water. The Report of the National Advisory Committee on Water Quality Criteria[14] gives the following pertinent standards for both domestic and municipal supplies:

Constituent	Maximum Recommended Concentration (mg/ℓ)
Iron (Fe)	0.30
Manganese (Mn)	0.05
Sulfate (SO_4)	250.00
Chloride (Cl)	250.00
Fluoride (F)	1.00[a]
Dissolved solids	500.00

a/ Varies with temperature (0.8 to 1.7).

The wells for municipal water supply at Sedgwick show manganese contents of 0.36, 0.23, and 0.91 mg/liter when the maximum recommended level is 0.05 mg/liter.[14] Iron for those wells is reported to be 2.0, 0.15, and 0.79 mg/liter with a recommended maximum iron concentration of 0.30 mg/liter.[14] Hardness for those wells at Sedgwick is reported to be 406, 448 and 378 mg/liter where 300-500 mg/liter is considered excessive for public water supply.[14] Some wells in the southern end of the watershed show amounts of iron and manganese in excess of recommended standards and two of the wells in townships 23 and 24 South, range 1 East are reported to have hardnesses of 2,000 and 700 mg/liter, respectively. Such hard water is unsuitable for human consumption.

Recreation

Water-based public recreational facilities in the watershed are extremely limited as there are no lakes or streams suitable for water sports. The City of Newton has installed a Fabridam on

Sand Creek within the city, but recreational use of this pool is limited to some canoeing, fishing, and esthetic enjoyment.

Recreational facilities described in the section entitled "Recreational Resources" do not fully meet the demand for such resources. It is estimated that by 1980 demand will exceed supply for several recreational activities in Harvey County. Specifically, the need will exist for an additional 139,938 annual activity days of boating and 51,222 annual activity days of camping. By 2020 demand for picnicking and fishing, as well as boating and camping, will exceed supply. Demands for boating, camping, picnicking, and fishing in 2020 are estimated to exceed supply by 467,264; 239,848; 111,328 and 93,696 annual activity days, respectively.[38]*

The area consisting of Harvey County and any point within 20 miles of the county is defined as the "local area of influence," or the land area for which day-use recreation in the watershed is considered important. This local area of influence has a present population of 66,000 and a projected population for 1980 of 76,000 persons. In addition, the urban areas of Wichita and Hutchinson, with a present combined population of 443,000, are close to this region. Their projected combined population of 510,000 in 1980 may signal additional pressure on recreational facilities which watershed residents use or are intending to use in the future.

The results of a population sample of Harvey County for recreation preferences showed that 38% chose sports (either spectator or participant), 29% chose picnicking, and 14% chose warmwater fishing as their first choice.[39] Because the acreage for water-based recreation areas in the county is extremely limited, and since sports, picnicking and fishing are high priorities among county residents, there is a definite interest in recreation facilities that provide a combination of these activities.

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* Demand and supply projections of this study may be affected by the increased travel costs since 1966.

Fish and Wildlife

In general, the diversity of wildlife in this area is decreasing. The U.S. Fish and Wildlife Service in concurrence with the Kansas Forestry, Fish and Game Commission stated:

> "Generally, clean farming practices of the project area have left little wildlife cover--Woodlands in these areas total 300 acres and include cottonwood, honey locust, red cedar, willow, American elm, ash, Russian olive, mulberry and osage orange. These trees, together with their understory of shrubs, forbs and grasses, lying adjacent to cropland, provide habitat needs for wildlife. Lack of vegetative cover of this type is a major limiting factor for game populations in this area. Loss of a few acres of cover reduces game populations over a greater acreage of surrounding lands."25/

It is evident that there is a need for the development of wildlife habitat, particularly cover, throughout the watershed. It must further be recognized that a substantial increase in cover would be in competition with agricultural production, at least in the short run. However, the possibility exists of encouraging landowners to enhance wildlife cover around the edges of fields; to practice proper grazing use; and to convert areas of high erosion hazard presently in agricultural production to vegetation suitable for wildlife cover.

Since there are no public lands within the watershed which may be utilized for hunting, this activity is restricted to private lands.

The fisheries potential of Sand Creek is low due to the intermittent nature of this stream. Under present conditions, maintenance of streamflow and fishery habitat is not feasible. The major fishery of the watershed is in small farm pond impoundments; a limited amount occurs in Sand Creek and its major tributaries. Except for the Fabridam impoundment in the City of Newton, access to these fishing areas is privately controlled. The quality of aquatic habitat is further diminished by sediment and low flow in dry years. Below the Newton sewage treatment plant streamflow at times is entirely treatment plant effluent. The need exists for a stable fishery habitat available to the public.

Economic and Social Problems

In 1969 the county median family income was $8,745, slightly above the state median income level of $8,693.[19] Among farm operators that year, 20% produced annual gross sales of farm products under $2,500. Most of these low-income farms were operated on a part-time or retirement basis; however, many were farms whose operators worked more than 100 days off their farms to supplement their incomes.[21] Flood damage to growing crops and personal property is relatively more costly to low-income farmers.

Flood plain farmers are presently not realizing the full economic potential of their lands. While their lands are nearly 100% more productive than upland farms, their land value is only 17% higher. The threat of flood damages depresses land values, yields lower tax revenue to the area economy, and reduces appreciation to the landowner when he sells his land.

Unemployment in Harvey County is below the 1971 state level.[23] However, there is a trend of increasing unemployment in Kansas. As population and unemployment rates in Harvey County rise, there is a steady increase in the number of unemployed persons in the watershed. Present farming operations do not provide significant employment opportunities, as only five of the 196 farming units employed 1-1/2 or more man-years of labor in 1969. The need for additional employment opportunities will probably increase in the future.

While the general economy of Harvey County and the watershed is slightly above the state average, the rural community does not exhibit the same degree of economic welfare. There is a need to increase production on low-income farms and increase land value of flood plain farms. By stimulating rural community development, the economy and the tax base of the watershed will also benefit.

Other

The City of Newton owns and operates a sewage treatment plant with primary settling, digester, and trickling filter systems. This plant has the capacity to handle the waste from an average

community of 20,000. Its present loading is from about 16,400 persons. The effluent BOD_5 is generally 10 mg/liter, and the effluent discharge is 1.64 mgd. Several industries are connected to this system. Projections of population growth indicate that the facilities will soon be inadequate. Because the effluent, during drought periods, is the only flow in the stream below Newton, it is important for the plant to be enlarged and efficiently maintained and operated in anticipation of the population growth. The Kansas Department of Health, Division of Environmental Health Services, notified the City of Newton that action to enlarge the plant was needed. Plans and specifications were developed and a construction grant application was filed with the U.S. Environmental Protection Agency. The grant was approved by EPA and the plans and specifications are currently being reviewed by the Division of Environmental Services.

PROJECTS OR PLANS OF OTHER AGENCIES

The U.S. Army Corps of Engineers has provided flood protection to Newton by modifying Sand Creek through the city. The channel was straightened, shaped to a trapezoidal cross section, and protected from erosion by rock riprap and grass. The channel is now capable of handling 50-year frequency floods.[10/] Works of improvement being prepared in this plan are complimentary to the Corps' channel work.

A comprehensive plan for Harvey County is in the development stage. The land use element considers works of improvement included in the general plan of Sand Creek Watershed Joint District No. 68. This assures compatibility between the work plan and the comprehensive plan. It is also a first step to avoid conflicts between future development and the reservoir sites. Harvey County Commissioners have expressed the intent to include flood plain regulations in future zoning ordinances.

PROJECT FORMULATION

In 1962 the Sand Creek Watershed Steering Committee made a request to the State Division of Water Resources for assistance in establishing definitive watershed boundaries. The following year, this committee requested a preliminary feasibility study prior to proceeding with the formal organization of a watershed district.

Petitions calling for the formation of a district carried 171 signatures. On April 6, 1965, watershed residents voted 2,618 to 909 in favor of district formation. A certificate of incorporation for Sand Creek Watershed Joint District No. 68 was granted by the Secretary of State on April 26, 1965.

An application for assistance under the P. L. 566 Watershed Protection and Flood Prevention Act was filed with the Governor's Watershed Review Committee on October 4, 1965. The application was sponsored by the Harvey County Conservation District, Marion County Conservation District, and Sand Creek Watershed Joint District No. 68.

The Governor's Watershed Review Committee requested a field examination, which was conducted on November 16, 1965. A published notice announced the examination and invited public attendance.

The examination consisted of a tour of the watershed followed by a meeting with the sponsors and other community leaders. The Governor's Watershed Review Committee Field Inspection Team, the Soil Conservation Service, the Forest Service, the Extension Service, the Watershed District, and interested individuals were all represented in this study. The field examination showed that a flood prevention and watershed treatment program with some recreational development was needed. Consequently, the application for assistance in planning and carrying out works of improvement under the P. L. 566 Act was approved by the Governor's Watershed Review Committee on January 3, 1966. The application was then filed with the Soil Conservation Service.

On July 28, 1967, the Governor's Watershed Review Committee recommended Sand Creek Watershed for planning and assigned priority No. 52.

Pursuant to the application for assistance, representatives of the Watershed Planning Staff from the Soil Conservation Service, Salina, Kansas, made a reconnaissance of the watershed on January 24, 1968. These representatives included planning specialists in hydrology, geology, engineering, and economics. A preliminary investigation report was subsequently prepared for the sponsors. Sponsors agreed to proceed with planning based upon this preliminary information. A news item in the Newton local newspaper, The Kansan, informed the public of preliminary project objectives and the probable scope of planned works of improvement.

A request to the administrator of the Soil Conservation Service for authorization to provide planning assistance to Sand Creek Watershed District was made on April 25, 1968. This authorization was granted on July 15, 1968, under the authority of the Watershed Protection and Flood Prevention Act.

On March 10, 1970, the Soil Conservation Service Watershed Planning Staff met with sponsors to report the planning progress. This meeting was the last of a series of meetings beginning July 15, 1968, designed to prepare the District Board of Directors for their responsibilities in formulating a project. Presentations were given by each staff specialist to acquaint district board members with procedures used in developing planning data. Average annual flood damages and potential benefits of the flood protection program were presented with visual aids. Procedures for developing structure designs and cost estimations were explained. As in earlier meetings, information useful to district board members in selecting structure sites was discussed.

On March 11, 1970, the Watershed District Board formulated a program of land treatment and flood control measures. The board further decided to expand objectives to include public recreation in a multiple-purpose structure at Site No. 1.

Since submitting their application for assistance through the P. L. 566 Watershed Act in October 1965, the Watershed District Board has carried out a continuing information exchange program with the general public. Some of these activities are listed below:

1. Ninety-two regular monthly meetings open to the public have been held. Specialists have usually been available to discuss specific planning problems.

2. Seven annual meetings, advertised in advance in the principal county newspapers, have been conducted.

3. Several meetings have occurred between board representatives and officials of the townships, state and county highway departments, and the City of Newton.

4. Frequent person-to-person contacts have been made between watershed directors and individual farmers in order to explain the program and encourage the application of land treatment measures. Most of the farmers within the watershed have been contacted in this manner.

5. A part-time field representative has been employed by the district to help farmers apply land treatment measures.

6. Seven tours to other watersheds have been sponsored by the district board.

7. Seven public informational meetings have been conducted, and a public hearing on the general plan was held November 8, 1973.

8. A booth to promote watershed management has been displayed each year for 8 years at the Harvey County Fair.

The sponsoring conservation districts are in full support of the proposed watershed program. News media, business people, and others, such as a local flood control association and a Mennonite church relief group, are giving substantial backing to the project objectives. There has been considerable opportunity for residents and landowners in the watershed to participate

in formulating the project objectives. As a result, most have an understanding of the proposed program and support it fully.

During project formulation, considerable attention was given to the relationship of this plan to the comprehensive plan for the Arkansas River Basin. The "Arkansas River Basin in Kansas"[43/] report shows 81 feasible P. L. 566 projects. The total area for these projects is 15,674 sq miles, or 37% of the Kansas portion of the Arkansas River Basin. Applications for P. L. 566 assistance have been received for 51 of these projects, which would cover 10,820 sq miles. Eleven projects have been completed; 14 are authorized for construction; and 11 (including this project) are authorized for planning.

Installation of the works of improvement on all 81 feasible watershed projects would benefit 668,000 acres of flood plain land. In the proposed reservoirs, the combined storage capacities would be 224,900 acre-ft for sediment, 1,070,500 acre-ft for floodwater detention, and 65,300 acre-ft for multiple use.

At present, land use in the Kansas portion of the Arkansas River Basin is 57% cropland, 35% rangeland, 2% woodland, and 6% other uses. Cumulative effects from the 81 feasible watershed projects would convert a total of 32,600 acres to water storage, and thus increase the amount of land in the category of "other use" by 0.1%.

Objectives

The primary objectives of the project sponsors are to provide watershed protection, to reduce flood damage in both rural and urban areas, and to provide water-based recreational facilities for watershed residents.

Pursuant to the objective of watershed protection, a major goal is to obtain 100% cooperation of the landowners and operators with the county conservation districts' land treatment program. It is essential to have land treatment measures applied to the drainage areas prior to the installation of retarding and detention structures to reduce sedimentation.

With proper land treatment, soil losses on croplands will be reduced to allowable limits.* On upland soils, which are generally heavy to moderately heavy claypan types, this loss limit will be generally 4 tons/acre/year.

Sponsors desire to bring watershed woodlands under management so that they will be vigorous stands, fully stocked with native species, and with undisturbed ground cover. Another goal is to improve existing windbreaks and shelterbelts and to develop more such plantings. Hedgerow renovation and special plantings to add to the woody cover in the watershed are desirable. Plantings of species which stabilize soil and provide wildlife habitat will serve dual objectives. Some cropland needs to be converted to rangeland. Improved management practices on existing rangeland and the control of bushy volunteer growth are desirable. In general, proper management of desirable plant communities throughout the watershed is an objective for watershed protection.

A major objective of project sponsors is to raise the level of flood protection for the land, crops, and properties on the flood plain as much as is economically possible. Sponsors desire to raise the level of protection through Newton and North Newton to a 100-year flood frequency level by supplementing the Corps of Engineers' local protection project with floodwater retarding structures. Sponsors also wish to reduce flooding in Sedgwick to a frequency equal to or less than that occurring due to overflows of the Little Arkansas River. Sponsors wish to accomplish these goals with the least possible further encroachment on flood plain land.

The objective for recreation is to maximize recreation potential at the multiple-purpose reservoir as much as is physically and economically possible. Specific design capacity for this development was not established initially because it was obvious that recreation demand throughout the local area of influence would far exceed possible recreation supply provided by this one reservoir.

An additional objective of the sponsors is to preserve, improve, and develop fish and wildlife habitat throughout the watershed. Where losses to fish and wildlife habitat occur due to implementation of other project measures, these losses are to be mitigated.

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* Allowable soil loss limits are set for sustained agricultural production.

Environmental Considerations

Project sponsors recognize the potential water quality and health-related problems associated with recreational use of the multiple-purpose reservoir. Information provided by the Kansas State Department of Health, Division of Environmental Health,[13] indicates that water quality in Sand Creek above Newton is generally good. The following information was submitted by the Kansas State Department of Health, Division of Environmental Health, regarding the Sand Creek Watershed project.

> "We know of no water quality problems that should develop at site 1 as a result of the proposed impoundment, provided that the two proposed waste stabilization pond facilities are operated properly with respect to discharge. This Division will require that the two facilities be designed with sufficient retention capacity to store wastewaters during the recreation season, and discharge will be allowed only between November 1 and March 31 of each year. Also, by state statute, discharge into the lake is not allowed from any watercraft which has sanitary facilities. If watercraft of this type are allowed on the lake, on-shore pumping and disposal installations must be provided for receipt of wastes from boat toilets. Permits for the water supply and wastewater facilities must be obtained from this Division prior to use.
>
> The proposed project will have no effect on the operation of the Newton wastewater treatment plant. The design flow of 1 cfs for discharge of wastewater into Sand Creek will not change as a result of low-flow alteration by the proposed impoundment.
>
> Presently, there are no sampling requirements for recreational lakes unless the Kansas State Board of Health officially designates the lake a "body contact area" which will be protected for body contact sports. This determination is made on the basis of intensity and frequency of recreational use, and thus far has been applied to 30 federal and state

> lakes in Kansas. If the proposed impoundment at site 1 is designated a body contact recreation lake in the future, the minimum requirement will be five samples for fecal coliform analysis taken during separate 24-hour periods over each 30-day period. There presently are no other operational requirements for recreational lakes.44/

When the multiple-purpose reservoir is officially designated a "body contact area," the City of Newton will have to meet a minimum sampling requirement for five samples for fecal coliform analysis taken during separate 24-hr periods over each 30-day period. Samples must not exceed a geometric mean of 200/100 ml sample, nor shall more than 10% of total samples during any 30-day period exceed 400/100 ml sample. This requirement does not prohibit use of the lake for body contact water sports prior to such designation. Sites Nos. 2 and 3 have no likelihood of public recreational use.

The potential for using flood control to improve the environment of people who reside and derive their incomes from the flood plain was a major consideration of sponsors throughout the project planning. Attention was given to possible impacts of alternative flood control measures on people and farm operations both in the areas that would be protected and in the areas that would be inundated by reservoir impoundments. This perspective aided sponsors in arriving at an acceptable level of flood protection.

Planning was carried out with the intent to minimize fish and wildlife habitat losses as much as possible. Losses will be lessened by leaving part of the multiple-purpose reservoir site in its natural state. This portion will be used only for nature trails and wildlife habitat. In addition, some habitat downstream from the reservoirs will be improved by reduced flooding. Sediment pools will provide resting and feeding areas for waterfowl. Finally, some land treatment measures and planned land use conversions will provide wildlife habitat at locations where it did not exist before the project.

Sponsors desire to minimize the displacement of people, businesses, or farms due to the project installations. Necessary relocations will be provided for by local sponsors under the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

Alternatives

A matrix (pp. 41, 42) was designed to display alternatives which were considered during the formulation of the project plan. A total of 21 alternatives were devised from various combinations of land treatment, flood plain management, and structural measures. These alternatives were then analyzed for the following factors: physical and economic feasibility, source of authority, availability of local sponsorship, effect on adverse environmental impacts, viability, and cost. A viable alternative was defined as one which was physically feasible and could be carried out under some existing authority, though not necessarily P. L. 566. Cost estimates were included for only those alternatives which were viable and which would have reduced or eliminated adverse impacts of the proposed project. Thus, only those alternatives which received cost estimates were considered further and are discussed in the following narrative.

Alternative No. 3 proposed accelerated land treatment, the multiple-purpose reservoir, and two floodwater retarding structures with dry pool storage instead of water storage. A 59% reduction in average annual flood damages would occur. Flood protection in Newton would be equal to the 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. There would be 1,195 acres for public recreation and open space, including a 195-acre public reservoir providing warm-water fishing and water-based recreation. An estimated 60,000 annual recreation visits would be available. Inundation would occur on 4.5 miles of stream channel and 1,886 acres of agricultural and wildlife habitat land (236 acres from sediment pools, 1,455 acres from retarding pools, and 195 acres from the multiple-purpose reservoir). Total land conversions would result in the loss of 2,252 acres of cropland, 809 acres of rangeland, and 27 acres of woodland; added would be 950 acres of hayland, 80 acres of pastureland, 1,773 acres for wildlife and recreation, and 285 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 55%. Floodwaters would contain suspended sediments which would be deposited and exposed following discharge of floodwaters. This alternative would cost $2,904,600.

Alternative No. 4 proposed extensive land treatment measures, including the 19 small detention dams, with no additional structural measures. A 30% reduction in average annual flood damages would result. The level of flood protection in Newton would be

MATRIX ANALYSIS TO IDENTIFY VIABLE[a/] ALTERNATIVES WHICH REDUCE OR ELIMINATE ADVERSE IMPACTS OF PLANNED PROJECT
(X = yes, 0 = no)

Alternative No.	Components of Alternative to Planned Project								Feasibility		Authority		Local Sponsorship Available	Effect on Adverse Impacts			Viable	Cost ($)
	LT	FRS	MP-REC	CW	FP-MGT Z	FP-MGT P	FP-MGT I	Other Description	Physical	Financial	P. L. 566	Other		Eliminate	Reduce	Increase		
1.	X	X	X					Additional small FRS	X	0	0	X	X	0	0	X	X	[b/]
2.	X		X					One large multiple-purpose site on main-stream of Sand Creek	X	X	X	X	0	0	0	X	X	[b/]
3.	X	X	X					Dry-pool storage in FRS	X	X	X	X	X	0	X	0	X	2,904,600
4.	X							Only LT including 19 detention dams	X	X	X	X	X	X	X	0	X	1,475,400
5.	X	X	X					Develop Sites 2 and 3 for recreation instead of Site 1	0	0	0	0	0	0	X	0	0	[b/]
6.	X			X				LT and channel work extending from Newton into rural areas	X	X	0	X	X	0	0	X	X	[b/]
7.	X	X	X	X				Planned project plus channel work into rural areas	X	0	0	X	X	0	0	X	X	[b/]
8.	X				X			Zoning to restrict agricultural use of flood plain	X	0	0	0	0	X	X	0	0	[b/]
9.	X				X			Zoning to restrict urban buildup in flood plain	X	X	X	X	X	X	X	0	X	≥1,475,400[c/]
10.	X		X					Planned project less Sites 2 and 3	X	X	X	X	X	0	X	0	X	2,680,300
11.	X	X						Eliminate recreation purpose from Site 1	X	X	X	X	X	0	X	0	X	2,296,300
12.	X		X	X				Channel work into rural areas	X	X	X	X	X	0	0	X	X	[b/]
13.				X				Only channel work	X	X	0	X	X	0	0	X	X	[b/]

MATRIX ANALYSIS TO IDENTIFY VIABLE[a/] ALTERNATIVES WHICH REDUCE OR ELIMINATE ADVERSE IMPACTS OF PLANNED PROJECT (Concluded)
(X = yes, O = no)

Alternative No.	Components of Alternative to Planned Project								Feasibility		Authority		Local Sponsorship Available	Effect on Adverse Impacts			Viable	Cost ($)
	LT	FRS	MP-REC	CW	FP-MGT Z	FP-MGT P	FP-MGT I	Other Description	Physical	Financial	P. L. 566	Other		Eliminate	Reduce	Increase		
14.			X					Planned project less LT and FRS	X	X	O	X	X	O	X	O	X	1,204,900
15.								Single-purpose recreation site	X	X	O	X	X	O	X	O	X	1,159,000
16.	X	X	X		X			Zoning to restrict urban buildup in flood plain	X	X	X	X	X	O	O	O	X	[b/]
17.	X		X		X			Zoning to restrict urban buildup in flood plain	X	X	X	X	X	O	X	O	X	≥2,680,300[c/]
18.	X					X		Single-purpose recreation site: purchase flood plain to restrict agricultural use	X	O	O	X	O	X	X	O	X	5,204,400
19.	X					X		Purchase easement and convert 400 acres of flood plain scour channels to perennial cover	X	O	X	X	O	X	X	O	X	1,686,200
20.	X						X	Single-purpose recreation site; flood plain insurance	X	X	X	X	X	X	X	O	X	≥2,634,400[c/]
21.								No action. Continuing land treatment program would not be accelerated	-	-	-	-	-	X	X	O	-	-

a/ A viable alternative is defined as one which is physically feasible and can be carried out under some existing authority (not necessarily P. L. 566).

b/ Cost estimates are included only for viable alternatives which reduce or eliminate adverse impacts of the proposed project.

c/ Cost estimates for flood plain management programs are unknown. Costs are shown as equal to or greater than costs for the nonmanagement components of the alternative.

LT - Land treatment (includes ongoing program plus accelerated program and 19 small detention dams)
FRS - Floodwater retarding structure
MP-REC - Multiple-purpose floodwater retarding - recreation water supply structure including recrestion facilities
CW - Channel work
I - Insurance
FP-MGT - Flood plain management
Z - Zoning
P - Purchase

slightly less than the 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. Inundation would occur on 233 acres from sediment pools and 831 acres from periodic flooding of retarding areas. Total land conversions would result in the loss of 1,422 acres of cropland and 245 acres of rangeland; added would be 950 acres of hayland, 80 acres of pastureland, 317 acres for wildlife and recreation, 10 acres of woodland, and 310 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 47%. This alternative would cost $1,475,400.

Alternative No. 9 was to use land treatment measures, including the 19 detention dams, in combination with zoning to restrict urban encroachment on the flood plain. A 30% reduction in average annual flood damage would occur. The level of flood protection in Newton would be slightly less than the 100-year flood frequency level. Unwise development and future increases in urban flood damages would be prevented through restrictive zoning. Requirements of Public Laws 90-448 and 93-234 will help serve to prevent further development of flood prone areas in urban communities, and these communities will be required to apply for flood insurance and adopt flood plain management programs. Under this alternative, soil, water, and plant management status would be improved by land treatment on 26,990 acres. Inundation would occur on 233 acres from sediment pools and 831 acres from periodic flooding of retarding areas. Total land conversions would result in the loss of 1,422 acres of cropland and 245 acres of rangeland; added would be 950 acres of hayland, 80 acres of pastureland, 317 acres for wildlife and recreation, 10 acres of woodland, and 310 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 47%. The cost of this alternative would be $1,475,400 for the land treatment measures, plus an undetermined amount for flood plain management implementation.

Alternative No. 10 proposed the land treatment measures and the multiple-purpose structure without floodwater retarding Structures Nos. 2 and 3. A 50% reduction in average annual flood damages would be achieved; protection in Newton would be slightly less than the 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. There would be 1,195 acres for public recreation and open space, including a 195-acre public reservoir providing

warm-water fishing and water-based recreation. Estimated annual recreation visits would be 60,000. Inundation would occur on 4.5 miles of stream channel and 1,694 acres of agricultural and wildlife habitat land (233 acres from sediment pools, 195 acres from the multiple-purpose reservoir, and 1,266 acres from periodic flooding of retarding areas). Total land conversions would result in the loss of 2,169 acres of cropland, 690 acres of rangeland, and 23 acres of woodland; added would be 950 acres of hayland, 80 acres of pastureland, 1,562 acres for wildlife and recreation, and 290 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 53%. This alternative would cost $2,680,300.

Alternative No. 11 consisted of the planned project without recreation development at Site No. 1. There would be a 59% reduction in average annual flood damages. Flood protection in Newton would be equal to the 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. Inundated would be 6.3 miles of stream channel, 418 acres from sediment pools, and 1,403 acres from periodic flooding of retarding areas. Total land conversions would result in the loss of 2,228 acres of cropland, 773 acres of rangeland, and 24 acres of woodland; added would be 950 acres of hayland, 80 acres of pastureland, 1,708 acres for wildlife and recreation, and 287 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 55%. This alternative would cost $1,991,900.

Alternative No. 14 was to install only the multiple-purpose reservoir, without accelerated land treatment and the two floodwater retarding structures. The current land treatment program would continue, however, including the eventual installation of 11 detention dams. This alternative would produce a 38% reduction in average annual flood damages. The level of flood protection in Newton would be slightly less than the 100-year flood frequency level. There would be 1,195 acres for public recreation and open space, including a 195-acre public reservoir providing warm-water fishing and water-based recreation. Estimated annual recreation visits would be 60,000. Inundation would occur on 4.5 miles of stream channel and 1,201 acres of agricultural and wildlife habitat land (90 acres from sediment pools of the 11 detention dams, 195 acres from the multiple-purpose reservoir, and 916 acres from periodic flooding and retarding areas). Total land conversions would result in the loss of 1,007 acres of cropland, 504 acres of rangeland, 33 acres of woodland, and 20 acres of other land uses; added would

be 2,060 acres for wildlife and recreation. The average annual sediment yield to the mouth of Sand Creek would be reduced 5%. This alternative would cost $1,204,900.

Alternative No. 15 was to install only a single-purpose recreation site. Average annual flood damage reduction would be 36%, a result of the continuing (but not accelerated) land treatment program and incidental floodwater protection at the single-purpose reservoir. There would be 1,195 acres for public recreation and open space, including a 195-acre public reservoir providing warm-water fishing and water-based recreation. Estimated annual recreation visits would be 60,000. Inundation would occur on 4.5 miles of stream channel and 1,176 acres of agricultural and wildlife habitat land (90 acres from sediment pools of the 11 detention dams, 195 acres from the recreation reservoir, and 891 acres from periodic flooding of retarding areas). Total land conversions would result in the loss of 991 acres of cropland, 496 acres of rangeland, 32 acres of woodland, and 20 acres of other land use; added would be 1,439 acres for wildlife and recreation. The average annual sediment yield to the mouth of Sand Creek would be reduced 34%. This alternative would cost $1,159,000.

Alternative No. 17 proposed land treatment measures, the multiple-purpose structure, and zoning to restrict urban use of the flood plain. Average annual flood damages would be reduced by 50%. Flood protection for Newton would be slightly less than the 100-year flood frequency level. Unwise flood plain development and future increases in urban flood damages would be prevented, as construction on flood-prone areas would be restricted or limited to flood-proof types of construction. As stated previously, requirements of Public Laws 90-448 and 93-234 will help prevent further development of flood-prone areas in urban communities by requiring these communities to apply for flood insurance and adopt flood plain management programs. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. There would be 1,195 acres for public recreation and open space, including a 195-acre public recreation reservoir. Estimated annual recreation visits would be 60,000. Inundation would occur on 4.5 miles of stream channel and 1,694 acres of agricultural and wildlife habitat land (233 acres from sediment pools, 195 acres from the multiple-purpose reservoir, and 1,266 acres from periodic flooding of retarding areas). Total land conversions would result

in the loss of 2,169 acres of cropland, 690 acres of rangeland, and 23 acres of woodland; added would be 950 acres of hayland, 80 acres of pastureland, 1,562 acres for wildlife and recreation, and 290 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 53%. This alternative would cost $2,680,300 plus an undetermined amount for flood plain management implementation.

Alternative No. 18 was to use land treatment measures, a single-purpose recreation site, and purchase of the agricultural flood plain lands. A 90% reduction in average annual flood damages would be achieved; increased damages on agricultural flood plain lands would be prevented. The level of flood protection in Newton would be slightly less than the 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. Wildlife habitat would be improved by reestablishing native vegetation and installing wildlife management on 4,300 acres of purchased flood plain land, and by including a wildlife management area within the 1,195-acre single-purpose recreation area. A total of 5,495 acres would be available for public recreation and open space, including a 195-acre reservoir for warm-water fishing and water-based recreation. The recreation site would provide 60,000 annual recreation visits; public access along 21.1 miles of Sand Creek would provide 25,000 additional annual recreation visits. Use of the flood plain area for recreation would change the small town environment and decrease the tranquility of the rural area. The quality of 128 acres of riparian habitat would deteriorate due to unrestricted public access. Inundation would occur on 4.5 miles of stream channel and 1,669 acres of agricultural and wildlife habitat land (233 acres from sediment pools, 195 acres from the recreation reservoir, and 1,241 acres from periodic flooding of the retarding areas). The flood plain purchase would convert 3,403 acres of cropland, 688 acres of rangeland, 88 acres of woodland, and 121 acres of other land to public recreation, open space, and wildlife habitat. The land treatment measures and the single-purpose recreation site would result in the loss of 2,153 acres of cropland, 682 acres of rangeland, and 22 acres of woodland. There would be a gain of 950 acres of hayland, 80 acres of pastureland, 1,537 acres for wildlife and recreation, and 290 acres of other land. The average annual sediment yield to the mouth of Sand Creek would be reduced 47%. The cost of this alternative would be $5,204,400.

Alternative No. 19 suggested using land treatment measures plus the purchase of flowage easements on the flood plain to convert 400 acres of flood plain scour channel to perennial cover. Flood plain damage would be reduced by 39%. The level of flood protection in Newton would be slightly less than 100-year flood frequency level. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. Wildlife habitat would be improved by purchasing easements on 400 acres and reestablishing native vegetation on this land. Inundation would occur on 233 acres from sediment pools and 831 acres from retarding areas. Land treatment measures would result in the loss of 1,422 acres of cropland and 245 acres of rangeland; added would be 950 acres of hayland, 80 acres of pastureland, 317 acres for wildlife and recreation, 10 acres of woodland, and 310 acres of other uses. Agricultural production would be foregone on the 400 acres purchased for flowage easements. This alternative would cost $1,686,200.

Alternative No. 20 was to use land treatment measures, a single-purpose recreation site, and flood plain insurance. Average annual flood damages would be reduced by 48%. The City of Newton would be protected to slightly less than the 100-year flood frequency level. Owners of existing structures would be able to buy flood damage protection at reduced rates; insurance payments for losses would assist the landowners in repairing flood damages. Requirements of Public Laws 90-448 and 93-234, previously described, will require landowners in flood-prone areas to apply for flood insurance. Soil, water, and plant management status would be improved by land treatment on 26,990 acres. There would be 1,195 acres for public recreation and open space, including a 195-acre public reservoir providing warm-water fishing and water-based recreation. Estimated annual recreation visits would be 60,000. Inundation would occur on 4.5 miles of stream channel and 1,669 acres of agricultural and wildlife habitat land (233 acres from sediment pools, 195 acres from the recreation reservoir, and 1,241 acres from periodic flooding of retarding areas). Total land conversions would result in the loss of 2,153 acres of cropland, 682 acres of rangeland and 22 acres of woodland; added would be 950 acres of hayland, 80 acres of pastureland, 1,537 acres for wildlife and recreation, and 290 acres of other land uses. The average annual sediment yield to the mouth of Sand Creek would be reduced 53%. This alternative would cost $2,634,400.

Alternative No. 21 was to take no action. The land treatment program would continue without acceleration; 11 of the 19 detention dams would be built under the ongoing program. There would be a 19% reduction in average annual flood damages. Sediment pools of detention dams would inundate 90 acres of agricultural and wildlife habitat; retarding areas would periodically flood 481 acres. Average net project benefits of $72,200 from flood damage reduction, land use intensification, off-project benefits, water storage, recreation, and secondary benefits would be foregone.

All viable alternatives were evaluated in terms of their effects on watershed problems and planning objectives. Alternatives which provided the maximum (59%) reduction in average annual flood damages for the watershed were considered most desirable for the following reasons:

First, the flood plain is already extensively used, both for agricultural enterprise and urban development. It was assumed that the 50-year flood frequency protection afforded to Newton residents by the Army Corps of Engineers' flood protection project will be conducive to further flood plain encroachment. Even if urban use of flood plain lands were restricted and potential flood damages thereby reduced, 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.

In addition, sponsors felt that the reductions in adverse effects that could be achieved by eliminating either recreation use at Site No. 1, or the water storage and incidental recreation opportunities from water storage at Sites Nos. 2 and 3 were not sufficient to justify the loss of benefits.

One water problem not treated by the proposed project or alternatives was that ground water in some municipalities in the watershed does not meet recommended federal standards for drinking water. However, there was no apparent way to improve ground water quality, as it is a direct result of area geologic conditions. Consideration was given to organizing a rural water district, or utilizing impoundments to supplement supplies; however, surface water as well as ground water in Sand Creek Watershed has high hardness concentrations, and the installation

of water treatment plants is not within the scope of P. L. 566 plans. For these reasons, this problem was not included in project objectives.

After consideration of all viable alternatives that could reduce or eliminate adverse project effects, the proposed project, with conservation land treatment and all economically justifiable floodwater retarding structures, was selected. The structure on the most suitable physical site was planned to include multiple-purpose (recreation) development.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Application of resource management systems, including appropriate combinations of land treatment measures, is essential to a sound watershed protection and flood prevention program. Farmers and ranchers cooperating with the conservation districts will develop conservation plans that will achieve proper land use and land conservation needs. Development of these plans will be expedited by consulting county soil surveys which are completed in Harvey County and near completion in Marion County.

Resource management systems will be implemented on 22,970 acres of cropland, 3,720 acres of rangeland, and 300 acres of woodland. The resource management systems will include all practices that are needed for the desired use of a particular land area. Land use conversions will include 1,462 acres of cropland to: hayland (950 acres), pastureland (80 acres), rangeland (80 acres), wildlife and recreation land (32 acres), woodland (10 acres), and other uses (310 acres). In addition, 325 acres of rangeland will be converted to cropland (40 acres), and to wildlife and recreation (285 acres).

Cropland is used primarily for the production of adapted, cultivated, and close-growing crops for harvest, alone or in association with seed crops. The basic conservation practices needed on cropland in Sand Creek Watershed are the following:

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

Stubble Mulching: Managing plant residues on a year-round basis in which harvesting, tilling, planting, and cultivating operations are performed to keep protective amounts of vegetation on the soil surface.

Minimum Tillage: Limitation of cultural operations to those that are properly timed and essential to crop production and soil loss prevention.

Gradient Terrace: An earth embankment or a ridge and channel constructed parallel across a slope at a suitable spacing and with an acceptable grade.

Diversion: A channel with a supporting ridge on the lower side constructed across a slope.

Contour Farming: Farming sloping cultivated land in such a way that plowing, preparing land, planting, and cultivating are done on the contour. This includes following established grades of terraces, diversions, or contour strips.

Grassed Waterway or Outlet: A natural or constructed waterway or outlet, shaped or graded, and established in vegetation suitable to 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.

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

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 within 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 the growing season of the desirable plants. Many pastures contain sufficient amounts of desirable plants to recover rapidly through periodic deferments.

Brush Management: Management and 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 manipulating 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 water impoundment made by constructing a dam or embankment, or by excavating a pit to serve as a watering facility for livestock.

Detention Dam: A water impoundment made by constructing a dam or embankment to regulate the rate of flow in a watercourse.

Woodland is used primarily to produce adapted wood species, to provide tree cover to protect fields and farmsteads from inclement weather, and to supply watershed protection, wildlife habitat, and landscape diversity. In order to maintain or improve hydrologic conditions of woodland sites, areas must support vigorous, fully stocked stands of trees with undisturbed ground cover. Watershed benefits, from woodland management and proper land use of forest sites, will be sustained by realizing the maximum economic returns consistent with site capabilities. To obtain these objectives, the following land treatment measures will be employed on woodlands:

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

Special Purpose Plantings: Plantings of trees and shrubs may serve as special purpose plantings for screens, sound barriers, wildlife habitat, etc.

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

The watershed area is protected by rural fire districts. Equipment procurement, training in fire fighting and control, and fire prevention education will be continued. Technical assistance for fire control measures will be provided by the Kansas State and Extension Forester through the Cooperative Fire Control Program. No additional funds are needed to maintain the desired level of fire protection. The desired level of protection for Sand Creek Watershed is 0.1 of 1% loss per year on woodlands and 0.5 of 1% loss on grasslands.

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 19 detention dams. These dams will control drainage areas ranging in size from 0.29 to 2.62 sq miles. They will help control 25.41 sq miles; of this, 1.37 and 1.24 sq miles will be recontrolled by Structures Nos. 1 and 3, respectively. Water detention storage in these reservoirs will control from 2.40 to 4.00 in. of runoff from the drainage areas. The total estimated flood storage for the 19 detention dams is 3,765 acre-ft. Retarding pools will cover a total of 831 acres. Sediment storage will be provided for yields averaging 0.63 in. from the drainage areas. The total estimated sediment storage for the 19 detention dams will be 854 acre-ft. Sediment pools will cover a total of 228 acres. Dam heights will vary from 13 to 31 ft. Volume of earth fill for these dams will range from 9,700 to 78,300 cu yd.

Watershed directors and conservation district supervisors are furnishing part-time assistance to the Soil Conservation Service in an effort to accelerate the installation of needed soil and water conservation treatment measures. The watershed district has made provisions for a field representative to personally contact individual landowners and operators to urge them to cooperate in establishing conservation practices on their farms. His duties include informing the people about the watershed program and its progress. It is important for landowners and operators to understand that land treatment measures not only benefit them individually but also are necessary prior to establishing the structural phase of the watershed program.

An educational program is planned to inform rural residents of the watershed of the economic and wildlife benefits gained from excluding livestock from woodlands and shelterbelts.

The Mennonite Disaster Units, which have helped generously to clean up Newton and the surrounding area after the more recent floods, have offered to help educate farmers in the headwater region as to the benefits of soil conservation practices. They have offered to hold meetings with farmers of this area to induce them to complete their conservation practices. The members of the Unit feel that it is much wiser to help prevent floods than to clean up afterwards.

The watershed district board of directors estimates that land treatment measures can be completed within 7 years.

Structural Measures

A system composed of two floodwater retarding structures and one multiple-purpose structure with recreation facilities will be installed at locations shown on the Project Map, p. 114.

Principal spillways of the three structures will be made of reinforced concrete or a material of comparable quality and strength. Each spillway will have a single-stage inlet with an uncontrolled release. Release rates will vary from 23 csm (cubic feet per second per sq mile) to 38 csm, which will not exceed present downstream channel capacities. Regulations of the Kansas Division of Water Resources require natural streamflow to be passed

through the dam and reservoir to satisfy downstream water rights. Structure No. 1 will have an 18-in. diameter pipe and Structures Nos. 2 and 3 will have 8-in. diameter pipes with control valves, installed at the bottom of the outlet works. These pipes will permit releases regardless of reservoir storage elevation. Features of a typical dam with a drop inlet conduit (representative of Sites Nos. 2 and 3) are shown on p. 112. Site No. 1 is similar with addition of an impact basin at the principal spillway outlet.

All dams will be earth-fill structures with vegetated emergency spillways provided to release runoff safely past the embankment when reservoir storage capacity and normal release rates have been exceeded. The chance of operation in any 1 year for the emergency spillways is 4% on the two floodwater retarding structures and 1% on the multiple-purpose structure.

Wellington shale occurs as irregular bedrock at the three reservoir sites. Soils in the abutments are 3 ft to 10 ft deep. Soils in the flood plains of Sites Nos. 2 and 3 are 6 ft to 10 ft deep; in the flood plain of Site No.1, soils are 8 ft to 25 ft deep. The principal spillways at Sites Nos. 2 and 3 will be located on approximately 6 ft to 8 ft of yielding soils overlying nonyielding shale. The principal spillway at Site No. 1 will be located on approximately 20 ft of yielding soils overlying nonyielding shale.

The main borrow areas at Site No. 1 will be confined to the sediment and recreation pool area. Within limits of material location and availability, the borrow areas will be shaped to allow optimum development of the fishery resource. The main borrow areas at Sites Nos. 2 and 3 will be confined to the sediment pool areas. The borrow material at all sites is silty clay (CL*).

Floodwater retarding Structures Nos. 2 and 3 will each provide floodwater storage for 3.20 in. of runoff from their drainage areas. The combined surface area of the retarding pools will be 192 acres. Storage will be provided for the expected 100-year accumulations of sediment with sediment storage volume equivalents of 1.05 in. and 0.97 in., respectively. The principal spillway crest of the two structures will be placed at the elevation of the 100-year accumulation of sediment. Total sediment storage volume in the two structures will be 239 acre-ft. The combined surface area of the sediment pools will be 55 acres.

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* Classification of Soils for Engineering Purposes, ASTM D24-87 (Laboratory), D24-88 (Field).

Multiple-purpose Structure No. 1 was also designed for a 100-year life, with 4,209 acre-ft for floodwater retarding storage and 592 acre-ft for sediment storage. The recreation pool will have a full pool surface area of 195 acres 46% of the time. A 145-acre pool will be available for recreational use 80% of the time. Fifty acres will be exposed around the full pool shoreline 20% of the time. The pool will have a maximum initial depth of 24 ft and an average initial depth of 6 ft. The average depth at the end of 100 years is estimated to be 3 ft.

The total capacities of the three structures will be 4,976 acre-ft for floodwater retarding storage, 831 acre-ft for sediment storage, and 368 acre-ft for recreation water storage. They will control runoff from 18.9 sq miles, or 19% of the watershed. All of the sediment storage capacity will initially store water.

A total of 1,195 acres of land will be purchased in association with Site No. 1. This land will include 810 acres for recreation use and floodwater detention, and 385 acres located above this area to insure full utilization of the recreational facilities. Flowage easements will be obtained on an additional 50 acres. All borrow areas will be located on purchased land.

Facilities to be installed for the full recreational use of Site No. 1 will include landscaping, signs, access roads, parking areas, utilities, camping and picnicking sites, boat docks and ramps, sanitary and waste facilities, and a swimming beach. Facilities will be designed and installed to be usable by the physically handicapped. For a complete list of facilities and costs, see Table 2B, p. 90. One area of the reservoir site will be specifically for wildlife habitat management, with the only installations being access roads, parking facilities, erosion control measures and a nature and fisherman trail. The arrangement of recreation facilities and wildlife areas is shown on the Public Recreation Development Map, p. 113. A description of recreation facilities follows:

Access Roads

Two-way - Roads will be constructed on the contour to the extent practical. Surfaces will be gravel and equivalent in quality to all-weather county gravel roads.

One-way - A one-way circulation road is planned for the camping area. This road will be gravel and of a quality consistent with that of the two-way road.

Picnic Tables: Tables will have steel frames and treated wood tops and benches.

Refuse Barrels: Suitable containers will be provided in numbers (generally one per campsite and one per two to three picnic tables) to adequately dispose of garbage and other refuse within the recreation area.

Grills: Metal grills will be waist-high and suitable for use with either wood or charcoal. One or two fireplaces will be provided for use by groups desiring to have a campfire. Fireplaces will be constructed of iron, brick, stone, or concrete.

Comfort Stations: Two comfort stations will be provided. Each will have a wood exterior with a concrete floor. Two showers each for men and women will be in the campground facility only. Three toilets and two lavatories for women; and two toilets, one urinal, and two lavatories for men will be in each sanitary facility. A roof with plastic or fiberglass sky lights will be used on the campground facility. Showers will be exposed to sunlight (no roof).

Bathhouse: The bathhouse will be similar to the facility in the campground area except it will have a center "room" where swimmers' clothing may be checked by bathhouse attendants, and two open-topped areas for changing clothes.

Sand Beach: The beach and swimming area will be graded and shaped prior to impoundment of water in the reservoir. Twelve inches of sand will be provided over 35,000 sq ft of beach and swimming area.

Water Supply: Two to three wells will be used in providing an adequate water supply (estimated at 15,000 gal/day) for recreation use. No standpipes will be required although an adequate storage tank necessary to chlorinate the water will be installed to meet public health requirements. Without a standpipe it is recognized that water will not be available for recreation use when the electrical system is inoperative.

Electrical Utilities: The extension of a nearby power supply to the recreation area by the utility company is anticipated. Buried cable will be used to all outlets. Security lighting will be provided at each sanitary facility, bathhouse, picnic and camping area.

Campground: Trailer spurs and tent pads will be provided. An electric outlet will be available at each trailer spur. Spurs and tent pads will be graveled. Each trailer site will have a picnic table, grill, and refuse barrel in addition to the electric outlet.

Picnic Shelters: A concrete slab floor, approximately 20 ft x 20 ft, will be installed with steel pipe supports for a wood or plastic roof. The roof shall be slightly larger than 20 ft x 20 ft.

Boat Launching Ramps: Three ramps are planned. Ramps are to be constructed of reinforced concrete or asphalt. Graveled parking areas will be provided close to boat ramps to accomodate vehicles with boat trailers.

Boat Docks: These floating docks will be constructed of wood and styrofoam and anchored adjacent to boat launching ramps.

Signs: Entrance and directional signs will be constructed from metal or wood with lettering meeting county highway standards. These will be placed at strategic locations to regulate, direct, or inform users of the area.

Parking Areas: They shall be of the same quality as the roads with vehicles restrained to the parking areas by mechanical barriers.

Landscaping: A landscape plan will be developed to utilize plant materials for shade, utility, and beauty.

Sewage Lagoons: Sewage from two comfort stations, one bathhouse, and a trailer dump station will flow into two two-cell lagoons. Lagoons will be located so that the sewage effluent will be discharged by gravity flow, thus eliminating the need and expense of sewage lift pumps.

Fish and Wildlife Habitat Development Measures: Resting native pastures within the fee title area to assist in reestablishment; placing and maintaining tree and shrub plantings at recommended locations (in addition to those adjacent to the dam and spillway); establishing soil and water conservation measures on all of the cropland within the fee title area; leaving as much vegetation in the sediment and recreation pool as possible; constructing brush piles suitable for wildlife with the trees cleared for construction; planting switchgrass within a 2-ft vertical elevation of the recreation pool; reseeding borrow areas to a quick cover crop; and fencing the entire fee title area.

Sponsors will provide public access to recreation facilities at the multiple-purpose reservoir. Sites Nos. 2 and 3 have no likelihood of public recreational use. Access to the sediment pools of the two floodwater retarding structures will be controlled by landowners. All recreational facilities at Site No. 1 will be installed, operated, and maintained to meet or exceed the requirements of state and local public health agencies. In addition, HEW Standards[45/] will be used as guidelines. The watershed district will notify landowners of the need for sanitation facilities at the two floodwater retarding structures if significant recreation use occurs; they will further notify the State Department of Health and Environment if the landowners do not provide needed sanitation facilities. When sufficient recreational density is demonstrated the State Department of Health and Environment will designate the multiple-purpose reservoir a "body contact area."[44/] Following this designation, the City of Newton 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.

As a result of the acquisiton of land for Structure No. 1, it is estimated that 15 persons on five farm operations will be eligible for relocation payments. Relocation payments totaling $15,000 are included in the estimated structural cost distribution for this site as shown in Table 2, p. 88.

The proposed structures will require clearing 9 acres of woodlands. Sediment pools will inundate 250 acres, 50 acres of which are good wildlife habitat. The remaining acres are largely cropland and rangeland.

Specific measures to mitigate wildlife losses and to enhance habitat have been recommended for each structure site. Maps and descriptions of these measures are included in a report by the U.S. Fish and Wildlife Service.[25/] The recommended mitigation measures have been adopted as design features for each site.

Specific odd areas adjacent to Sites Nos. 2 and 3 as designated in the Fish and Wildlife Service report are to be within the permanently fenced area. The dam, spillway, and wildlife areas are to be fenced and seeded to a grass-legume mixture suitable for wildlife. Two-row tree and shrub plantings are to be made in the wildlife areas. Mature trees are to be preserved in wildlife areas where possible.

The dam, spillway, and adjacent wildlife areas of Site No. 1 are to be seeded to a grass-legume mixture suitable for wildlife. Two-row tree and shrub plantings will be made at designated locations adjacent to the dam and spillway. A sharecropping program will be established on designated areas within the fee title area.

Enhancement measures recommended for adoption at Sites Nos. 2 and 3 include: seeding cropland within a band 0.5 ft below to 2.0 ft above the normal water surface elevation of the sediment pools to Kanlow switchgrass; encouraging landowners to leave portions of food crops adjacent to the sites unharvested; leaving as much woody vegetation within the sediment pools as possible; constructing brush piles suitable for wildlife using the trees that were cleared for construction; planting borrow areas within sediment pools to a quick cover crop; and recommending additional odd areas and shrub plantings within the permanently fenced area.

Roads cross each end of Structure No. 1; these roads will be raised. In the reservoir area one road will be closed and another will be raised. No roads are affected by Structures Nos. 2 and 3. None of the structures affect pipelines, utilities, or mineral deposits. A record search by the State Corporation Commission and field investigations by Soil Conservation Service personnel did not reveal any abandoned oil or gas wells which were improperly plugged and therefore possible sources of pollution, either in the reservoir areas or upstream from these sites.

The guidelines of SCS Engineering Memorandum 66 will be implemented in order to minimize soil erosion and water and air pollution during construction. The need for pollution abatement will be determined on a site-by-site evaluation basis.

Close communication will be maintained with the State Archeologist during project construction so that any finds may be investigated to determine the need for emergency salvage. In accordance with P. L. 86-523, the National Park Service will also be notified of any discoveries.

EXPLANATION OF INSTALLATION COSTS

Needed land treatment measures and their estimated costs are shown in Table 1 (p. 86). The estimated total planning and installation cost for land treatment is $1,475,400. P. L. 566 funds will provide $42,700 of this total for technical assistance to accelerate the current program. Other sources will provide the remaining $1,432,700 for installing these measures. Land treatment installation costs include $449,700 for 19 detention dams. All land treatment cost estimates are based on present costs of applying these measures 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 (p. 88). The total estimated cost for all structural measures is $1,468,400. The following discussion of the structural measures costs will deal first with the major elements listed in Table 1 (construction, engineering services, relocation payments, project administration, and land rights). Following that will be an explanation of the 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% was used; however, unusual construction problems are not anticipated. Mitigation costs are included as construction costs.

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 losses of personal property if the farm operation is not relocated. The estimated total relocation payments are $15,000. Public Law 566 funds will pay 37% or $5,600, and the City of Newton will pay 63% or $9,400. The cost-sharing percentages are based on the ratio of P. L. 566 funds and other funds to the total project costs, not including the relocation payments.

The sponsors will provide relocation assistance advisory services without P. L. 566 cost-sharing. The estimated cost for these services is $500. These services shall provide (1) all measures or facilities necessary to determine relocation assistance needs, (2) information regarding replacement property, and (3) other assistance as set forth in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

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 appropriate 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.

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.

All land values were determined by the Sand Creek Watershed Joint District Board of Directors and agreed to by the Soil Conservation Service. Land cost estimates, except for Site No. 1, were based on current land values which vary from $150/acre for grassland to $350/acre for flood plain cropland. Land costs 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 obtained through donation. Land cost estimates for Site No. 1 are based on $425/acre. Some additional local costs are required in modifying roads.

In allocating costs for multiple-purpose Site No. 1, excluding recreational facilities, costs for construction will be shared by P. L. 566 funds and the sponsoring local organization. Construction costs of the dam are estimated at $275,400.

These costs will be shared on the basis of the "use of facilities" method. Allocations computed in this manner are: flood prevention, 93%, or $256,200, and public recreation, 7%, or $19,200. Allocated costs will be shared as follows:

Item	Sponsoring Local Organization		P. L. 566		Total	
	%	Cost	%	Cost	%	Cost
Public recreation	50.0	$9,600	50.0	$ 9,600	100	$ 19,200
Flood prevention			100.0	256,200	100	256,200
Total	3.5	$9,600	96.5	$265,800	100	$275,400

The engineering cost for the multiple-purpose reservoir, excluding recreational facilities, is estimated at $44,100. This is totally a P. L. 566 cost.

Land rights for both the multiple-purpose reservoir and the recreational facilities and development are to be acquired on 1,195 acres at an estimated cost of $522,300. These costs will be shared as follows:

Item	Sponsoring Local Organization		P. L. 566		Total	
	%	Cost	%	Cost	%	Cost
Dam and reservoir fee title--810 acres	50	$172,100	50	$172,100	100	$344,200
Recreation area 385 acres	50	81,800	50	81,800	100	163,600
Surveys, legal fees, etc. (includes easement on 50 acres)	100	14,500			100	14,500
Total	52	$268,400	48	$253,900	100	$522,300

Construction and engineering costs for the recreation facilities amount to $208,000. These costs will be shared 50% by P. L. 566 and 50% by the sponsoring local organization.

Public Law 566 costs for the two floodwater retarding structures include 100% of the construction and engineering services and part of the project administration costs.

The total project administration cost is estimated to be $199,900. Public Law 566 will bear $197,800 of this cost and other funds will pay the remaining $2,100. These costs will be shared as they accrue to the Service and the sponsors.

The total estimated installation cost of the two floodwater retarding structures, the multiple-purpose structure, and the recreational facilities (excluding project administration) is $1,268,500. This cost in relation to purpose and cost sharing is shown in Table 2A, p. 89.

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	$ 7,300	$ 235,600	$ 242,900
Second	7,300	235,600	242,900
Third	7,300	235,600	242,900
Fourth	7,300	235,600	242,900
Fifth	6,300	211,400	217,700
Sixth	5,400	187,500	192,900
Seventh	1,800	91,400	93,200
Total	$42,700	$1,432,700	$1,475,400

Structural Measures

Fiscal Year	P.L. 566 Costs	Other Costs	Total
First	$ -	$ -	$ -
Second	8,400	16,200	24,600
Third	28,300	18,350	46,650
Fourth	487,350	256,650	744,000
Fifth	383,150	27,650	410,800
Sixth	124,700	101,750	226,450
Seventh	15,500	400	15,900
Total	$1,047,400	$421,000	$1,468,400

EFFECTS OF WORKS OF IMPROVEMENT

Flood Prevention, Erosion and Sediment

The proposed project will reduce the sediment load, depth, velocity and extent of future flood conditions. The following table shows the bank full capacity for each reach in which peak discharges (in csm--cubic feet per second per square mile) were developed, and for selected frequencies without project conditions and with the planned project (excluding detention dams).

Evaluation Reach[a/]	Bank Full	Peak Discharge Frequency (years) Without Project					With Project				
		100	50	10	2	1	100	50	10	2	1
	(csm)	csm					csm				
1	86	216	184	112	49	-	178	154	94	41	26
2	44.5	220	190	118	54	32	187	160	97	43	27
3	34	245	215	133	60	36	193	167	103	46	29
4	34	290	250	157	75	44	219	187	116	54	34
5	240	312	270	-	-	-	229	195	121	-	-
6	148	340	293	180	86	51	240	204	124	56	-
7	47	381	327	200	92	54	254	217	132	57	35
8	56	454	397	252	120	71	133	112	70	40	-

a/ See Project Map, p. 114, for reach details.

The May 1960 flood without the project but with the Corps of Engineers' channel improvement project would have produced the following damages:

Crop and pasture	$ 64,900
Other agricultural	12,952
Road and bridge	29,209
Flood plain scour	21,800
Urban	380
Indirect	14,345
Total	$143,586

With the land treatment (including detention dams) and P. L. 566 structural measures, the damages would be reduced to:

Crop and pasture	$ 19,900
Other agricultural	1,601
Road and bridge	13,270
Flood plain scour	2,600
Urban	--
Indirect	3,737
Total	$ 41,108

This amounts to 71% damage reduction for the May 1960 flood. The total area flooded would have been reduced from 2,235 acres to 856 acres or a reduction of 62%.

The program of land treatment (including detention dams) and structural measures will accomplish a 59% reduction in average annual flood damages. Land treatment other than detention dams accounts for 10% of this reduction, 20% is attributable to detention dams, and 29% to structural measures. Area benefited in each reach along with percent reduction in damages is shown in the following table:

Evaluation Reach	Area Benefited[a/] (acres)	Average Annual Damage Reduction (percent)
1	620	67
2	1,285	50
3	861	48
4	380	54
5	145	100
6	292	70
7	477	71
8	392	98
Tributaries	167	b/
Total	4,619	59

a/ In addition, off-project benefits will accrue to 1,630 acres of flood plain existing in common with the Little Arkansas River.

b/ Included in reaches above.

With the two floodwater retarding structures, one multiple-purpose structure, and the 19 detention dams in place, 33 sq miles or 62% of the drainage area above Newton will be controlled by structural and land treatment measures. The watershed protection and flood prevention program will benefit all or parts of 47 farms located on the flood plain of the project area. In addition, the project will benefit, directly or indirectly, all of the inhabitants of the drainage.

With reduced flood frequency and severity, farmers may use more fertilizer and improved varieties of crop plants and establish soil-building rotations. They will also be able to plan and perform tillage, planting, and harvesting operations on a timely basis for improved crop yield. Crop and pasture damage will be reduced by 62%. This level of protection is not, however, sufficient for economical conversion of permanent cover to cropland.

The removal of soil through flood plain scour will be substantially reduced, making it possible to regain normal productivity on previously damaged lands. Future flood plain scour will be reduced by 31%.

Average annual nonagricultural damages will be reduced by 61%. The reduction of road and bridge damage on the flood plain as a result of this project is estimated to be 57%. Funds previously allocated to repair flood-damaged structures may be used for improving and modernizing local road systems after project installation.

The completion of the project will increase the level of flood protection for the cities of Newton and North Newton to the 100-year frequency level. Floods of greater magnitude, such as the one of 1965, are quite possible. Therefore, Newton residents are warned against developing a feeling of false security and engaging in future flood plain development. Flooding in Sedgwick will be reduced to a frequency equal to or less than that occurring due to overflows of the Little Arkansas River. Residents should be warned against assuming a degree of flood protection that does not exist.

Requirements of the National Flood Insurance Act of 1968 (P. L. 90-448) and the Flood Disaster Protection Act of 1973 (P. L. 93-234) will serve to prevent further development of flood-prone areas in Sedgwick and within the 3-mile extraterritorial limit of Newton.[46,47/] Both of these communities will find it necessary to apply for flood insurance and to adopt programs of flood plain management under terms of these laws. Flood plain development within 3 miles of Newton is currently restricted by zoning ordinances. Both Newton and Sedgwick are taking definite steps toward application for flood insurance.

Land use and cropping patterns on the flood plain are not expected to change greatly as indicated by the following table.

LAND USE AND CROPPING PATTERN OF THE FLOOD PLAIN

	Without Project (percent)	With Project and More Intensive Use (percent)
Wheat	33	31
Grain sorghum	18	17
Sorghum silage	3	3
Corn silage	3	3
Corn silage-irrigated	4	5
Alfalfa	6	8
Soybeans	6	6
Rangeland	15	15
Woodland	2	2
Other	10	10
Total	100	100

The land treatment program should result in more efficient use of land and water resources and thus increased farm income. Land treatment measures will result in adequate management and protection on an additional 22,970 acres of cropland, 3,720 acres of rangeland, and 300 acres of woodland. Direct benefits attributable to land treatment will be reduced erosion and

improved soil tilth and water quality, increased moisture intake by soils, and increased crop and livestock production.

The application of planned land treatment will reduce the average annual soil loss from 8.3 to 2.3 tons/acre on cropland and from 3 to 2 tons/acre on rangeland. The overall reduction in soil loss in the watershed is expected to be 69%, resulting in more productive upland soils. Land treatment will reduce water pollution by reducing the movement of soil particles which often transport pollutants.

Resource management systems including treatment measures in needed combinations will not only contribute to protection of the watershed, but will increase forage production for livestock and food and cover for many wildlife species. When supplemental forage is being utilized, the rangeland acreage can be rested to allow the better native grass a period of regrowth to improve both vigor and productivity. Detention dams, as part of the land treatment measures, will reduce flood damage on the tributary streams and substantially add to the overall flood prevention (20% damage reduction).

Presently, 22 acre-ft of sediment enter the Little Arkansas River annually from Sand Creek. With the completion of the floodwater retarding structures, the detention dams, and adequate treatment of 75% of the cropland, sediments from Sand Creek will be about 10 acre-ft/year, a reduction of 55%.

Agricultural Water Management

Agricultural water management is not a specific objective of the Sand Creek Watershed Project. However, sediment pools should benefit agricultural operations. These impoundments will provide water for livestock, some increase in groundwater recharge through percolation, and some stabilization of stream flow in Sand Creek.

The quality of groundwater will not be changed by impounded water returning as groundwater recharge.

Fish and Wildlife and Recreation

With or without the project, Sand Creek will not support a highly productive stream fishery. The most productive waters in the watershed will continue to be farm ponds.

The construction of the three reservoirs and the detention dams will enhance the warm-water fish habitat of the watershed considerably, even though only the multiple-purpose structure will have public access. Entry to the two floodwater retarding structures and the detention dams will be controlled by landowners, yet it is anticipated that fishing will occur in all these impoundments. The three reservoirs will have a total surface area of about 250 acres, 195 acres on the multiple-purpose reservoir and 55 acres on the floodwater retarding structures. The detention dams will have a total sediment pool area of 228 acres.

The impoundments and the 19 detention dams will increase the available habitat for some of the amphibians, primarily frogs. Frogs such as the bullfrog, western chorus frog, and the cricket frog should become more numerous. Other amphibian species, such as the toads and the tiger salamander, will probably remain at present population levels.

Among reptilian fauna, it may be expected that turtle populations will increase due to the increase in water area, while impoundments will reduce the habitat available to lizards and snakes. However, land treatment measures may compensate for this habitat loss by adding habitat diversity.

The impoundments will increase available resting areas for migratory waterfowl, particularly ducks. To a lesser degree, they will increase available waterfowl food. Initially, there will be a loss of nesting habitat for some species of song birds due to the clearing of woodlands and brush for the reservoirs. In time, project land treatment measures and public land acquisition and development of the multiple-purpose reservoir should lead to increased song bird populations. The land treatment measures, with time, should also lead to increased populations of game birds such as quail and pheasant.

There are several species of birds in this area which are considered endangered. These species are primarily raptoral or piscivoral and their endangered status is a result of insecticide concentrations rather than either changes of land use patterns or loss of habitat. The proposed project should have no adverse impact on any of the endangered bird species.

Mammalian species which are semiaquatic, such as the muskrat, will probably increase in numbers. The only mammalian species on the endangered list for this area is the black-footed ferret, which may no longer be found in Kansas.

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

The construction of the multiple-purpose reservoir will increase opportunities for water-based recreation. This development will convert 1,195 acres to recreational use and is expected to draw visitors from throughout the area of influence. While the lake and recreational facilities will be used throughout the year, it is estimated that 71% of the recreation visits will occur between May 15 and September 15. The daily design capacity will be 300 for sightseeing, 380 for boating and fishing, 120 for picnicking, 100 for swimming, and 100 for camping. The remaining 29% of the total recreation visits will occur between September 15 and May 15. Hunting, fishing, picnicking, camping, sightseeing, and other recreational activities will be available. An estimated 60,000 annual recreation visits are expected. For evaluation purposes, the value assigned per recreation visit was $1.50.

There are presently few public fishing areas within the watershed. The project will provide facilities and a fishery management program for a minimum of 15,000 annual fishing days for the public on the 195-acre multiple-purpose reservoir.

The two floodwater retarding structures will provide 25- and 30-acre water impoundments that will support warm-water fishing. Access will be controlled by landowners. If extensive use of these impoundments occurs, the potential exists for environmental degradation and sanitation problems. The procedures that would be followed in this event were previously discussed in the description of structural measures to be installed.

Archeological, Historic and Scientific

Archeological sites that may be discovered in the proposed reservoirs will be reported promptly to the Archeological Division of the Kansas State Historical Society and to the National Park Service. The Service will request comments from the Advisory Council on Historic Preservation if such properties are determined to be eligible for inclusion in the National Register of Historic Places. Potential destruction of archeological material could occur initially by earthmoving activities or later by wave or wind action after pools have been filled. All efforts will be made to avert such loss.

None of the buildings in the watershed listed in the National Register of Historic Places are in areas directly affected by installation of works of improvement.[48/] No effects are expected to occur on historic buildings or sites which are listed or eligible for listing on the National Register.

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 19 man-years of new employment, and operation and maintenance of the structures and the recreational facilities will provide 1.2 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 living capital made available by reduced floodwater damages to property used in agricultural production. All or parts of 47 farm units, affected in varying degrees by floodwater damages, are subject to possible benefits from the project. 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 the owners of five small farms. These individuals will be eligible for relocation assistance, but may experience indecision, anxiety, or disappointment over their available options. It is

estimated that 775 acres of these five 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 their farms instead of relocating. Decreasing the sizes of the farms will result in a decrease in agricultural income for farm operators, and this would be considered an adverse effect on the quality of life for these persons. However, money paid to owners for the land can be invested to earn income to offset the loss of farm income.

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 occur as a result of the project. The funds made available by floodwater damage reduction and more intensive use of bottomlands could be used for upgrading the standard of living of area residents.

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, due to flood protection and reduced crop losses, will mean increased consumer expenditures for farm equipment and material which will raise net returns for 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 area, 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.

Finally, the recreation development will provide needed public open space areas in addition to serving recreation, fish, and wildlife.

Other

The reservoirs are expected to have minor effect on low flows in Sand Creek. Natural streamflow will be passed through the dams during drought periods as required to meet downstream water rights. Some seepage from the reservoirs is expected to contribute to streamflow. Reductions from or additions to low flows are not expected to be of sufficient magnitude or duration to change the intermittent classification of Sand Creek. The reservoirs are not expected to have an appreciable effect on water quality in Sand Creek other than reduction of sediment concentrations.

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

In the multiple-purpose reservoir, 50 acres of shoreline will be exposed around the full pool 20% of the time.

The following land use changes are expected to occur during the installation period (7 years) of the project:

Land Use	Present (acres)	End of Installation (acres)	Net Change (acres)
Cropland	50,025	47,773	-2,252
Grassland	8,337	8,558	+221
Woodland	300	273	-27
Other	5,472	7,530*	+2,058*

* Includes 1,773 acres of wildlife and recreation area.

PROJECT BENEFITS

Evaluated average annual project benefits will equal $192,600. Of this, $31,700 will accrue from land treatment measures and $160,900 is attributable to structural measures. Individual items of benefit are shown in Table 5, p. 94, and Table 6, p. 95.

Average annual floodwater damage reduction benefits with the project installed will total $63,000. Benefits from reduced floodwater damage to crops and pasture will average $23,300 annually and account for 37% of the total floodwater damage reduction benefits. Reduced flooding will achieve benefits of $9,300 to other agricultural properties such as stored feed, fences, buildings, and other farm facilities. Annual average benefits of $15,300 to roads and bridges and $800 to railroads will result. Urban benefits will average $2,100 annually.

Benefits from reduced damage to flood plain land by scour will average $5,600 annually, accounting for about 9% of the total damage reduction benefits. Indirect average annual benefits, realized from less interruption of travel to mail deliveries, school buses, and milk routes, will amount to $6,600.

The reduction of the flood hazard will make possible annual benefits averaging $22,000 from more intensive use of land through improved crop rotations and use of fertilizer.

Multiple-purpose Structure No. 1 will produce annual recreation benefits of $79,100. These benefits will accrue from boating, fishing, sight-seeing, camping, hunting, picnicking, and swimming opportunities. Incidental recreation benefits were not evaluated.

Local secondary benefits will average $40,600 annually. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

Benefits of $2,800 will occur annually to the off-project Sand Creek flood plain area. Average annual benefits due to beneficial use of stored water will be $300.

COMPARISON OF BENEFITS AND COSTS

Average annual cost of structural measures, including installation, operation, and maintenance, is $126,700. When the project is completely installed, the structural measures are expected to produce average annual benefits (excluding local secondary benefits) of $160,900. The benefit-cost ratio without the inclusion of local secondary benefits is 1.07 to 1.00. With local secondary benefits of $25,400 included, the project will produce benefits of $1.27 for each dollar of cost (100 years at 6-7/8% interest--See Table 6).

PROJECT INSTALLATION

The works of improvement will be installed in a 7-year period following authorization of federal assistance provided under authority of the Watershed Protection and Flood Prevention Act (P. L. 566, 83d Congress; 68 Stat. 666) as amended.

The installation of general land treatment and forestry land treatment measures, including fire control, was discussed in the section "Works of Improvement to be Installed" under "Land Treatment Measures." In addition, the Kansas Forestry, Fish and Game Commission and the sponsors will provide technical assistance for the application of wildlife mitigation and enhancement measures.

The 19 detention dams are part of the works of improvement included in the General Plan of the Watershed District.[49/] In accordance with sections 24-1213 and 24-1214 of the Kansas Watershed District Act, as amended, the General Plan has been approved by the Chief Engineer of the Division of Water Resources, State Board of Agriculture, and has been adopted by the Watershed District. This process, along with requirements of the Chief Engineer, are assurances that the 19 detention dams will be installed essentially as planned. The planned schedule for completion of the 19 detention dams is two each during 1974 and 1975, three during 1976, and two each during years 1977 through 1982. The installation of the multiple-purpose Structure No. 1 and floodwater retarding Structure No. 3 are not dependent upon the installation of detention dams No. 119 and No. 116.

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 those practices which will accomplish the conservation objectives.

After federal assistance is authorized for installation of the project, the Soil Conservation Service will furnish engineering services to prepare construction plans and specifications

for the two floodwater retarding structures and for multiple-purpose Structure No. 1.

Sand Creek Watershed Joint District No. 68 will contract for construction of the two floodwater retarding structures. Construction contracts will be awarded on the basis of competitive bidding. There will be separate contracts for construction and for fencing, vegetative establishment, and wildlife mitigation measures. The watershed district will appoint a contracting officer.

The watershed district will obtain all land rights needed for installation of the two floodwater retarding structures. They have the power of eminent domain to obtain land rights for public improvements and have agreed to use such authority when needed. Land rights that are not donated will be secured in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. The watershed district board will make arrangements with county commissioners for abandonment, moving, or modification of any county roads requiring such action. The watershed district board will likewise arrange for any necessary moving or modification of pipelines, communication lines, or other public utilities.

The City of Newton will contract for construction of Site No. 1 and associated recreational facilities and obtain land rights required for this development, with the exception of flowage easements which will be provided by the watershed district.

Engineering for the recreation facilities will be provided in part by the regularly employed staff of the Newton City Engineer. An equivalent amount will be provided by the Service in the form of on-site planning, standard designs as available, and construction inspection. An A&E contract will be let by the city for the remaining engineering services connected with the recreation facilities.

Legal services involved in acquiring land rights for all structures will be furnished by local sponsors.

Sand Creek Watershed Joint District No. 68 and the City of Newton will be accountable for managing finances associated with installing those measures which involve the expenditure of P. L. 566 funds. This will require development of a financial management system which shall provide for the maintenance of appropriate records, reports, audits, and accounts needed to satisfy the requirements of CMB Circular A-102.

The City of Newton, 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 City 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.

The Soil Conservation Service will inspect construction of all structural measures and recreation facilities, which will be required to meet Service standards.

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.

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.

Sand Creek Watershed Joint District No. 68 and the City of Newton have the necessary authority and power to finance and to 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.

The watershed district has been furnished land rights work maps for the two floodwater retarding structures as a basis for contacting landowners and appraising land rights costs. Land rights which must be purchased for these structures will be financed through a general tax levy. Construction and engineering costs for the floodwater retarding structures will be borne by the Service. The Service and the district will each bear their own contract administration costs.

Land rights work maps for the multiple-purpose structure, showing fee title and flowage easement areas, were furnished to the watershed district and the City of Newton to determine land acquisition costs.

The Service will pay 50% of the cost of all land purchased for the multiple-purpose structure and associated recreation facilities. The City of Newton will pay 50% of the cost of land purchased for recreation. The watershed district will pay for land rights associated with floodwater detention not paid by P. L. 566 cost sharing. This includes the cost of flowage easements. Each sponsor will bear its own cost of legal services involved in land rights acquisition.

Engineering costs for the dam and reservoir of Site No. 1 will be borne by the Service. The Service and the City of Newton will each pay 50% of the cost of an architectural and engineering contract for recreation facilities. Allocation of construction costs for Site No. 1 are discussed in the Section "Explanation of Installation Costs."

The City of Newton will pay 63.0% of the relocation payment costs associated with Site No. 1 and the recreation facilities; the Service will pay the remaining 37.0%.

Each participant will bear its own contract administration costs for installation of Site No. 1 and the associated recreation facilities.

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

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

The 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.

In accordance with CMB Circular A-102, Sand Creek Watershed Joint District No. 68 and the City of Newton will account to the Service certain earned income during the grant period. For this purpose the grant period shall extend from the effective date of the Service's fund obligating agreement until the date on which the Service formally notifies the sponsors that the undertaking has been satisfactorily completed.

Program income may include, but not be limited to: income from service fees, usage, or rental fees; and sales of assets purchased with federal funds under a Service-fund agreement.

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 19 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 regular continuing programs.

Agreements providing for operation and maintenance of structural measures and recreation facilities will be executed by the local sponsoring organizations before federal construction funds are made available. These agreements will contain, in addition to sponsor responsibilities for nonstructural and structural measures, specific provisions of CMB Circular A-102 for retention and disposal of real and personal property acquired in whole or in part with P. L. 566 funds.

The two floodwater retarding structures will be operated and maintained by the watershed district. The estimated average annual costs are $900. Maintenance will be accomplished through hired or contributed labor and equipment, and funds will be obtained from an annual tax levy.

The multiple-purpose reservoir will be operated and maintained, and the associated recreational facilities and fish and wildlife habitat measures will be operated, maintained, and replaced by the City of Newton at an estimated annual cost of $24,700, of which $23,100 is for recreation facilities. Useful life will vary for recreation facilities, but an average period of 20 years has been used to compute replacement costs. Funds will be obtained from user fees and an annual tax levy. User fees will not exceed those required to offset initial costs and annual operation and maintenance expenses.

Regulations of the Kansas Division of Water Resources require natural streamflow to be passed through the dam and reservoir to satisfy downstream water rights. Structure No. 1 will have an 18-in. diameter pipe and Structures Nos. 2 and 3 will have 8-in. diameter pipes, controlled by valves, in their principal spillway outlet works. These pipes will be for the express purposes of complying with the state regulations and providing sediment and beneficial pool drainage for maintenance and repair. The Sand Creek Watershed District will assume the responsibility for passing natural streamflow and managing releases from the two floodwater retarding structures. Responsibility for passing natural streamflow and managing releases from the multiple-purpose reservoir rests with the City of Newton. Releases, other than natural streamflow, are not to be made when they will interfere with operation of the reservoir for recreational purposes. The recreation pool is normally expected to be operated between elevations 1,486.0 and 1,488.5

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

An establishment period, to allow time for latent defects and design deficiencies to become apparent, shall extend 3 years from the date the structural works of improvement are accepted from the contractor as being completed. The establishment period for vegetative work associated with a structural measure is to terminate when any of the following conditions are met:

a. Adequate vegetative cover is obtained.

b. Two growing seasons have elapsed after the initial installation of vegetative work.

c. The establishment period for the associated structural measure has terminated.

Operation and maintenance responsibility rests with the sponsors during the establishment period, as it does during the remainder of the project life, except that the Service will consider sharing in the cost of repairs (on a case-by-case basis) which become necessary as a result of latent defects and design deficiencies. Cost sharing will be at the rate used in project installation.

All structural measures will be inspected annually, after unusually severe floods, 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 for a 3-year period following completion of construction. Thereafter, annual inspections will be made for the life of the structures. Items of inspection will include, but not be limited to: the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and emergency spillway, the fences installed as a part of the structural measures, the wildlife mitigation measures, and all recreational facilities. Records of inspections will be maintained by the watershed district and the City of Newton.

Prescribed tree and shrub plantings should be maintained at a 75% survival rate for the first 5 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 not be permitted unless deemed necessary for wildlife purposes.

Maintenance work will be carried out when needed. Repairs on major construction items, such as dams and spillways, are expected very infrequently. Fences, water and sewer systems, picnic tables, etc., and clearing of trash and debris are expected to be common maintenance items.

Provisions will be made for access to inspect the structural measures at any time.

TABLE 1

ESTIMATED PROJECT INSTALLATION COST

Sand Creek Watershed, Kansas

Installation Cost Item	Unit	Nonfederal 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/]									
Cropland	Acres to be Treated	22,970				880,400		880,400	880,400
Rangeland		3,720				10,600		10,600	10,600
Forest land		300					12,000	12,000	12,000
Urban and build-up		310				10,000		10,000	10,000
Individual practices									
Fire control		8,200					3,000	3,000	3,000
Detention dams	No.	19				449,700		449,700	449,700
Technical assistance			42,700		42,700	63,000	4,000[d/]	67,000	109,700
TOTAL LAND TREATMENT			42,700		42,700	1,413,700	19,000	1,432,700	1,475,400
STRUCTURAL MEASURES									
Construction									
Floodwater retarding structures	No.	2	151,900		151,900				151,900
Multiple-purpose structures	No.	1	265,800		265,800	9,600		9,600	275,400
Recreational facilities			89,700		89,700	89,700		89,700	179,400
Subtotal - construction			507,400		507,400	99,300		99,300	606,700
Engineering services			82,700		82,700	14,300		14,300	97,000
Relocation payments			5,600		5,600	9,400		9,400	15,000
Project administration									
Construction inspection			147,100		147,100				147,100
Other			50,700		50,700	1,600		1,600	52,300
Relocation assistance advisory services						500		500	500
Subtotal - administration			197,800		197,800	2,100		2,100	199,900
Other costs									
Land rights			253,900		253,900	295,900		295,900	549,800
TOTAL STRUCTURAL MEASURES			1,047,400		1,047,400	421,000		421,000	1,468,400
TOTAL PROJECT			1,090,100		1,090,100	1,834,700	19,000	1,853,700	2,943,800

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 $2,500 from CFM Forestry Program and $1,500 from CM-2 Fire Program.

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TABLE 1A

STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at Time of Work Plan Preparation)

Sand Creek Watershed, Kansas

Measures	Unit	Applied to Date	Total Cost (dollars)[a/]
Land treatment			
Soil Conservation Service			
Conservation cropping system	Acre	25,000	930,600
Farm pond	Number	16	17,800
Grade stabilization structure	Number	177	78,600
Grass waterway	Acre	525	81,600
Range proper use	Acre	4,554	5,100
Range seeding	Acre	100	2,200
Terraces, gradient	Mile	217	101,600
Subtotal - SCS			1,217,500
Forest Service			
Tree and shrub planting (on woodland and other land)	Acre	900	20,000
Fire control	Acre	8,200[b/]	22,200
Subtotal - FS			42,200
Total			1,259,700

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/]

Sand Creek Watershed, 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 Structure No. 2	64,900	10,400	-	-	75,300	-	-	12,900	-	12,900	88,200
Floodwater Retarding Structure No. 3	87,000	13,900	-	-	100,900	-	-	14,600	-	14,600	115,500
Subtotal - FRS	151,900	24,300	-	-	176,200	-	-	27,500	-	27,500	203,700
Multiple-purpose Structure No. 1	265,800	44,100	172,100	5,600	487,600	9,600	-	186,600[b/]	9,400	205,600	693,200
Recreational facilities	89,700	14,300	81,800	-	185,800	89,700	14,300	81,800	-	185,800	371,600
Subtotal - MPS	355,500	58,400	253,900	5,600	673,400	99,300	14,300	268,400	9,400	391,400	1,064,800
Project administration	-	-	-	-	197,800	-	-	-	-	2,100[c/]	199,900
Total	507,400	82,700	253,900	5,600	1,047,400	99,300	14,300	295,900	9,400	421,000	1,468,400

a/ Price base 1974.
b/ Includes $2,500 for easements, $2,000 for road modification, and $10,000 for legal fees.
c/ Includes $500 for Relocation Assistance Advisory Service.

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TABLE 2A

COST ALLOCATION AND COST SHARING SUMMARY
(Dollars)[a/]

Sand Creek Watershed, Kansas

Item	Cost Allocation			Cost Sharing					
	Purpose			P. L. 566			Other		
	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Total
Floodwater retarding Structures	203,700	-	203,700	176,200	-	176,200	27,500	-	27,500
Multiple-purpose Structure No. 1	299,700	393,500	693,200	297,200	190,400	487,600	2,500	203,100	205,600
Recreational facilities	-	371,600	371,600	-	185,800	185,800	-	185,800	185,800
Total	503,400	765,100	1,268,500	473,400	376,200	849,600	30,000	388,900	418,900

a/ Price base 1974.

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TABLE 2B

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

Sand Creek Watershed, Kansas

Item	Number	Estimated Unit Cost	Total Construction Cost
Access roads (two-way gravel)	6,900 ft[b]	2.25/linear ft	15,500
Access roads (one-way)	2,500 ft[b]	1.75/linear ft	4,400
Camp sites	25 each	200	5,000
Electric cable (buried)	3,750 ft[b]	2.00/linear ft	7,500
Vault toilet (two unit)	3 each	5,000	15,000
Comfort stations	2 each	15,000	30,000
Sewage lagoons	2 each	5,000	10,000
Water supply (wells)	3 each	3,300	9,900
Picnic shelter	5 each	1,000	5,000
Picnic tables	55 each[b]	70	3,900
Grills or fireplaces	40 each[b]	70	2,800
Parking areas	1,200 ft[b]	2.25/linear ft	2,700
Boat launching ramps	3 each	3,000	9,000
Boat docks	3 each	1,000	3,000
Swimming area (35,000 sq ft)	1 each	5,000	5,000
Bathhouse	1 each	17,500	17,500
Trailer dump stations	1 each	1,000	1,000
Landscaping	Lump Sum	8,000	8,000
Wildlife habitat development	Lump Sum	6,900	6,900
Signs, directional	20 each[b]	50	1,000
Subtotal			163,100
Contingencies (10%)			16,300
Total			$179,400

a/ Price base 1974.
b/ Estimated quantity, subject to minor variation at time of detailed planning.

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TABLE 3

STRUCTURAL DATA - STRUCTURES WITH PLANNED STORAGE CAPACITY

Sand Creek Watershed, Kansas

Item	Unit	Structure Number 1	2	3	Total
Class of structure		c	a	a	
Drainage area (total)	sq miles	14.42	1.48	3.01	18.91
Curve No. (1-day) (AMC II)		84.0	82.0	82.0	
Tc	hr	4.0	1.5	2.0	
Elevation top of dam	ft	1,506.7	1,513.8	1,505.2	
Elevation crest emergency spillway	ft	1,499.2	1,507.8	1,500.2	
Elevation crest high stage inlet	ft	1,488.5	1,502.0	1,492.8	
Maximum height of dam	ft	40.9	25.1	26.4	
Volume of fill	cu yd	276,200	66,300	90,800	433,300
Total capacity[a/]	acre-ft	5,169	336	670	6,175
Sediment submerged	acre-ft	592	75	140	807
Sediment aerated	acre-ft		8	16	24
Beneficial use (identify use)	acre-ft	368(Rec)			368(Rec)
Retarding	acre-ft	4,209	253	514	4,976
Surface area					
Sediment pool[b/]	acres	(130)	20	35	185
Beneficial use pool (identify use)	acres	195(Rec)			195(Rec)
Retarding pool[a/]	acres	630	74	118	822
Principal spillway design					
Rainfall volume (areal) (1 day)	in.	7.53	6.10	6.10	
Rainfall volume (areal) (10 days)	in.	12.09	9.70	9.70	
Runoff volume (10 days)	in.	8.28	5.70	5.70	
Capacity of high stage (maximum)	cfs	332	55	94	
Frequency operation--emergency spillway	% chance	1	4	4	
Dimensions of conduit	in.	48	24	30	
Emergency spillway design					
Rainfall volume (ESH) (areal)	in.	11.06	5.80	5.80	
Runoff volume (ESH)	in.	9.06	3.80	3.80	
Type		Veg.	Veg.	Veg.	
Bottom width	ft	600	40	80	
Velocity of flow (V_e)	ft/sec	5.0	2.4	2.53	
Slope of exit channel	ft/ft	0.034	0.061	0.058	
Maximum reservoir water surface elevation	ft	1,501.8	1,508.2	1,500.7	
Freeboard design					
Rainfall volume (FH) (areal)	in.	26.58	8.40	8.40	
Runoff volume (FH)	in.	24.42	6.24	6.24	
Maximum reservoir water surface elevation	ft	1,506.9	1,509.8	1,502.7	
Capacity equivalents					
Sediment volume	in.	0.77	1.05	0.97	
Retarding volume	in.	5.48	3.20	3.20	
Beneficial volume	in.	0.48			

a/ Crest of emergency spillway.

b/ Area shown in ( ) for reservoir containing beneficial storage.

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TABLE 3A

DATA FOR LAND TREATMENT DETENTION DAMS[a/]

Sand Creek Watershed, Kansas

Dam Number	Drainage Area (sq. mile)	Class	Sediment Volume (acre-ft)	Detention Volume (acre-ft)	Total Volume (acre-ft)	Sediment Pool (acre)	Detention Pool (acre)	Height Dam (ft)	Fill Volume (cu yd)
101	2.59	I-a	87	359	446	30	105	16	29,600
102	0.94	I-b	31	165	196	9	46	26	50,800
103	1.96	I-a	66	272	338	22	90	16	37,000
104	0.68	II-a	23	84	107	5	35	16	29,700
105	2.54	I-a	85	352	437	17	105	24	78,300
106	1.51	I-a	51	209	260	10	74	23	29,300
107	2.62	I-b	88	461	549	23	83	31	61,400
108	0.43	I-c	14	92	106	4	20	22	34,000
109	1.95	I-a	66	270	336	14	64	23	55,700
110	1.37	I-a	46	190	236	13	46	21	40,600
111	1.62	I-a	54	300	354	11	67	27	27,000
112	0.35	II-a	12	44	56	4	70	13	9,700
113	1.58	I-a	53	295	348	13	59	27	30,600
114	0.41	II-a	14	52	66	3	13	16	9,900
115	0.82	II-a	28	100	128	6	28	16	22,800
116	1.24	II-a	42	155	197	16	44	16	31,100
117	0.29	II-a	10	37	47	4	14	19	29,200
118	1.14	II-a	38	138	176	11	39	19	53,200
119	1.37	I-a	46	190	236	13	57	18	31,900
Total	25.41		854	3,765	4,619	228	1,059		691,800

a/ Data based on average conditions for the watershed and is subject to change with refinement of engineering data for individual sites.

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TABLE 4

ANNUAL COST
(Dollars)[a/]

Sand Creek Watershed, Kansas

Evaluation Unit	Amortization of Installation Cost[b/]	Operation and Maintenance Cost	Total
2 Floodwater retarding structures; 1 multiple-purpose structure; and recreational facilities	87,300	25,600	112,900
Project administration	13,800	-	13,800
Total	101,100	25,600[c/]	126,700

a/ Price base: Installation 1974, O&M current prices.
b/ 100 years at 6 7/8% interest.
c/ Includes $23,100 for operation, maintenance, and replacement for the recreational development.

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TABLE 5

ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
(Dollars)[a]

Sand Creek Watershed, Kansas

Item	Estimated Average Annual Damage		Damage[b] Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and pasture	37,300	14,000	23,300
Other agricultural	10,300	1,000	9,300
Road and bridge	26,800	11,500	15,300
Railroad	900	100	800
Urban	2,200	100	2,100
Subtotal	77,500	26,700	50,800
Erosion			
Flood plain scour	18,000	12,400	5,600
Indirect	11,100	4,500	6,600
Total	106,600	43,600	63,000

a/ Price base: Agricultural = current normalized; All other = current prices.
b/ From land treatment and structural measures

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TABLE 6

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
(dollars)

Sand Creek Watershed, Kansas

Evaluation Unit	Average Annual Benefits[a/]							Average Annual Cost[c/]	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Off Project	Beneficial Use of Stored Water	Recreation	Secondary	Total		
2 Floodwater retarding structures and 1 Multiple-purpose structure and Recreational facilities	31,300	22,000	2,800	300	79,100	25,400	160,900	112,900	1.4:1
Project administration	--	--	--	--	--	--	--	13,800	--
Total	31,300[b/]	22,000	2,800	300	79,100	25,400	160,900	126,700	1.3:1

a/ Price base: Agricultural-current normalized; All other - current prices.
b/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $31,700 annually.
c/ From Table 4.

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INVESTIGATION AND ANALYSES

Planning Cooperation

The Kansas State Conservation Commission established engineering contracts with the consulting firms of Wilson and Company, Salina, Kansas; and Delameter, Freund, and Scherer, P. A., Wichita, Kansas. Services under these contracts included preparing watershed maps, cross section surveys, and topographic surveys of reservoirs, spillways, and dam sites; establishing watershed bench marks; computing areas and lengths of roads inundated; and conducting the necessary hydraulic investigations. In addition, these firms were responsible for plotting reservoir stage-storage curves, preparing centerline profiles of structure sites, conducting operation studies for the multiple-purpose reservoir, and drafting and printing the work plan maps.

Working drafts of the work plan and the environmental statement were prepared by Delameter, Freund, and Scherer, P. A., Wichita, Kansas, under contract with the Kansas State Conservation Commission. The preliminary draft work plan and environmental impact statement were prepared by Midwest Research Institute, Kansas City, Missouri, under a federal contract.

All other engineering, geology, hydrology, 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 the hydrologic conditions of all woodlands. Estimates were made of the land treatment measures needed to improve hydrologic conditions; these estimates were included in this work plan.

A letter report covering fish and wildlife resources and recommending measures to mitigate losses and enhance wildlife habitat was supplied by the Fish and Wildlife Service, U.S. Department of the Interior.[25/] The Kansas Forestry, Fish and Game Commission concurred with this report.

Hydrology and Hydraulics

The watershed was divided into nine subwatershed areas, which included the eight reaches along the flood plain that are shown on the Project Map. Each subwatershed was evaluated for its present soil cover condition, and for its future condition if land treatment and cover measures proposed in this plan were installed.

A standard procedure[50/] was used in determining the relationship between rainfall and runoff. A factor of 3.5 was used to convert the annual flood plotting positions to partial duration plotting positions. The relationship between rainfall frequency and volume runoff was calculated for the actual range of hydrologic curve numbers.

The Step Method[50/] 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.

The relationship between discharge and area of flood plain inundation was based on 50 valley and channel cross sections. 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 at each area cross section by depth increments. These area data were then combined to determine totals for each flood plain reach.

Similarly, road and bridge cross sections were used to compute lengths of roads inundated by depth increments.

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. This determination was made for present conditions, future conditions with land treatment, future conditions with land treatment and various percentages of control from floodwater retarding structures, and future conditions with land treatment and the

proposed system of structural measures. These routings gave the discharge frequency relationship for each evaluation reach under present conditions and hypothesizing various levels of control by floodwater retarding structures and the level of control offered by the proposed plan. Routings were developed for historical storms of May 1960 and June 1965, and high water marks were also plotted on water surface profiles.

Release rates for floodwater retarding structures were established according to downstream channel capacities and desired reservoir drawdown rates. Single stage release rates for all structures are shown in Table 3, p. 91 (see "Capacity of High Stage"). Combined maximum release rates will not exceed channel capacities.

Floodwater detention storage volume was determined using mass routing procedures for storm durations of up to 10 days. Storms used in connection with this procedure were taken from U.S. Weather Bureau Technical Paper No. 40.[51] The volumes for floodwater storage at the three reservoirs were computed using 25- or 100-year frequency storms, depending on the structure hazard class. Floodwater storage was selected to fit site conditions, with minimum storage volumes computed in accordance with the National Engineering Handbook.[50]

Emergency spillway requirements were determined by routing the storms according to the method indicated in SCS Engineering Memorandum No. 27. Computer programs were provided by the SCS ADP Unit at Lincoln, Nebraska. Emergency spillways will exceed minimum criteria as established by the State of Kansas.

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 frequency droughts.[52] Net evaporation values[53] were also included in the computations. In this manner evaporation and seepage losses were applied against the average reservoir surface area for each period under consideration. With 960 acre-ft of gross storage for sediment and recreation the surface area is expected to vary as follows:

Percent Chance Drought	Percent of Time	Minimum Surface Acres
2	98	48
5	95	78
10	90	117
20	80	145
50	50	190
54	46	195 (full pool)

Engineering

Surveys: Vertical control lines were run throughout the watershed and one permanent bench mark was established within approximately 1 mile of each structure site. Thirty-four temporary bench marks were tied into the level circuit. All surveys were referenced to mean sea level.

Field surveys of 50 valley and 22 road and bridge cross sections were made. Sufficient readings were taken to define the topography along each section, to locate all crop boundaries and changes in roughness, to locate all roads, fences, and other objects along the sections, and to define the shape of the channel in detail. The types of road surfaces and bridges were indicated on each road cross section.

Topographic maps of the sites for the floodwater retarding structures and the multiple-purpose structure were made using a photogrammetric plotter. Aerial photographs were taken from approximately 4,800 ft, and topographic maps were made using a 4-ft contour interval. Accuracy of the plotter work was verified by field surveys of all the centerline profiles. Using the topographic maps, storage capacities were measured and stage-storage curves were developed. The extent of embankment was calculated from centerline profiles.

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

Structure design and cost estimates: The structures were planned with single-stage principal spillways and average release rates varying from 23.02 to 37.16 csm. The 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. The elevation of the principal spillway crests for the floodwater retarding structures will be set at the 100-year sediment accumulation. The inlet of the multiple-purpose structure is planned at the elevation that will store the 100-year sediment accumulation and provide 368 acre-ft for recreational use.

The freeboard hydrograph was routed through all structures with the maximum elevation equal to or less than the elevation of the top of the dams.

Drainage areas for each structure site were delineated and measured from USGS 7-1/2-min quadrangle maps.

Individual structure cost data are presented in Table 2, p. 88, and the total cost of all proposed structures is shown in Table 1, p. 86.

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% of the engineer's estimate. Installation services' costs were calculated as a percentage of construction costs.

Geology

Dam site investigations: A geologic investigation was conducted at each proposed dam site; however, investigations at Site No. 1 were more extensive than at Sites Nos. 2 and 3. Significant geologic features that might influence the design, construction, or operation of each structure were investigated.

Each site investigation included a thorough surface study of geologic formations and a centerline profile. Sufficient test

holes were drilled to bedrock level on these centerlines to determine foundation stability. All tests holes were logged and plotted, and necessary stripping and the depth of core trenches were indicated. Similar investigations were carried out in the emergency spillway and borrow areas at each site.

In addition, at Site No. 1 sufficient samples were analyzed to prepare a report discussing foundation and embankment conditions. Falling head permeability tests were made on two consolidation specimens. The results indicated a permeability rate in the range of 0.015 ft/day to 0.030 ft/day for the CL soils. CL is the predominant material in the flood plain beneath the proposed cut off trench. The upper limit of permeability was used to calculate the seepage loss beneath and around the dam. All seepage losses were totaled and converted to feet per year surface loss from the reservoir. This procedure gave seepage losses less than the estimated figure used in the water budget analysis.

The principal spillway location was determined according to foundation stability, amount of excavation and the length of conduit required, and alignment of the outlet to the stream channel. The quantities of material to be excavated from the emergency spillways were estimated and their potential construction uses were determined.

Sediment yields: The total sediment yield for Sand Creek at its junction with the Little Arkansas River was computed using sediment survey data. Land use throughout the watershed was determined from aerial photographs. Average sediment yields for each land use were computed according to the sediment delivery ratio and the amount of applied land treatment measures.

The future sediment yield was similarly computed using future conservation practices and considering the sediment trapping by floodwater retarding structures. The difference between present and future sediment yield represented the reduced sediment deposition made possible by the planned works of improvement.

Sedimentation in reservoirs: Sediment rates and volumes were determined from surveys of existing area reservoirs. The reservoirs selected for survey had sediment source areas and erosion conditions similar to those above the planned structures.

The range survey method was used to determine the volume of accumulated sediment in each reservoir. The age of the reservoir, the size of the drainage area, and the trap efficiency were used to compute the total sediment yield. Significant sediment-producing factors, such as soil type and cover, slope of the land, land use, and type and degree of erosion were used to classify the rate and source of sediment.

These sediment-producing factors were compared to sediment yields, and sediment rating curves were developed. These curves were plotted to show sediment yield (in acre-feet per square mile per year) versus drainage area size. All sediment-producing factors were then mapped and compiled for the drainage areas above the proposed dam sites. The sediment yield to each proposed reservoir was read opposite the drainage area size, based on the representative curve from the survey site data. Adjustments in readings were made when a drainage area had unusual sediment-producing factors.

Flood plain scour: The extent and severity of sheet and channel scour resulting from floods were determined from field surveys. Scoured areas were mapped on aerial photographs. Damage estimates were based on both the loss of soil depth and the reduced productivity of scoured areas as compared to unaffected areas. Interviews with soil scientists and farmers aided in assembling land damage information. In each of the evaluation reaches, the percentage of acres damaged by sheet and channel scour was tabulated. Only eroded areas affected by upstream runoff were considered.

Future scour damage that would occur without the proposed project was estimated for each reach. Future damage was based on soil type, present soil depth on the eroded areas, and the annual rate of erosion.

The recovery period (in years) for each reach under future conditions with and without flooding was established according to the degree of damage, the soil characteristics, and the length and number of crop rotations required for potential recovery. The potential recovery of soil productivity without floods was based primarily on the capability class of the soil and the present soil depth. Affected areas having 60 in. or more of soil

and at least 15 in. of topsoil and good subsoil drainage were considered capable of full recovery. Other areas with less depth and permeability were considered capable of partial recovery.

Economic Investigations

The Frequency Method[54/] was used to determine the 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 51% of the landowners and operators of the flood plain area in each evaluation reach; the maximum interview coverage in any one reach was 75%. The storms of May 1960 and June 1965 were discussed.

Damages that occurred 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 from floodwater retarding structures, and future land treatment conditions with the proposed plan. Where more intensive use of land would have been made possible, benefits were computed under these same conditions.

A composite acre of flood plain use was constructed by measuring the percent of each land use shown on the 50 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 percentage loss from each crop on the composite acre was estimated according to depth, duration, and month of flooding. The damage to the composite acre was weighted using the lower values of crop yields from the scoured areas. The percentage was used to determine rates of damage on the composite acre, using the percent of the year's excessive storms occurring in each month,[55/] 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 damage estimate for each storm in the 100-year flood series.

Interviews were used to determine other agricultural damages from the May 1960 and June 1965 storms. These included loss of livestock, damage to private roads, dikes, fences, and the removal of debris. From rainfall records and high water marks, the discharge of these storms was 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.

Road and bridge damages were based on repair or replacement costs obtained from county engineers. Damages to various types of road surfaces were computed as the dollar damage per foot by depth increments of inundation. Damages to individual bridges were estimated for a range of discharges. Road and bridge damages were then combined in each evaluation reach and dollar damage versus discharge curves were plotted. These curves were then applied to the 100-year flood frequency series.

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. The economic evaluation was based on the net value of the composite acre. The changes in net income due to scour damage were discounted at an 8% interest rate.

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 though 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 as 10% of the agricultural damages and 15% of the nonagricultural damages.

The off-project benefits (Table 6, p. 95) were the fair share benefits accruing to the project from the benefits on that part of the flood plain shared by Sand Creek and the Little Arkansas River.

Annual sediment storage benefits for sediments leaving the watershed were computed as equal to the cost of storage divided by 100 years. Monetary damages from sediment within the watershed were not computed.

Recreation benefits were determined using procedures outlined in the Economics Guide,[54/] the Lincoln E&WP Technical Letter Recreation No. 5 (April 5, 1965), and Lincoln E&WP Technical Letter Recreation No. 6 (April 5, 1966). The "local area of influence" was computed to have a population of 66,000 people.[56/]

Within a 50-mile radius of the watershed there is a population of more than 500,000 people. Consultation with the staff of the Kansas Forestry, Fish and Game Commission and the Kansas Park Authority indicated that the demand for water-based recreation, such as that which would be offered at Site No. 1, would exceed 60,000 annual recreation visits. It was estimated that 71% of the total use would occur from May 15 to September 15 and that 75% of the visits would occur on a weekend day. Records of recreation use at other reservoirs[57/] indicated that recreation visitor use would be 31% sightseeing, 8% boating, 12% picnicking, 10% camping, 30% fishing, 10% swimming, and 3% miscellaneous. (The percentage total is greater than 100 due to some visitors engaging in more than one activity per visit.) A similar recreation visitor use was assumed for this site. By limiting parking area, recreational facilities were designed to limit use to 1,000 visits per weekend day. Other facilities were designed to adequately provide for visitor needs. A current value was used of $1.50 per each recreation visit. This was discounted for lag in accrual for 5 years at 6-7/8%.

Incidental recreation benefits were not evaluated. Local secondary benefits were computed following procedures in the EWP Technical Note--Watershed LI-7, February 5, 1973. Indirect benefits and benefits resulting from a change in consumptive patterns were excluded from consideration in computing secondary benefits.

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, $350/acre for bottom cropland, and $150/acre for pasture for the floodwater retarding sites. Land costs were based on 100% of value for the sediment pool areas, 75% of value for the structure and spillway areas, and 50% 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 the recreation development.

All monetary benefits were based on current normalized prices approved by the Water Resources Council, effective October 25, 1973. Construction costs were based on 1974 construction costs for Kansas P. L. 566 projects. Operation and maintenance costs were computed at 0.61% of construction costs for floodwater retarding structures; this percentage method was developed by SCS and is based on the principal 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 measures were amortized at 6-7/8% interest rate for a period of 100 years.

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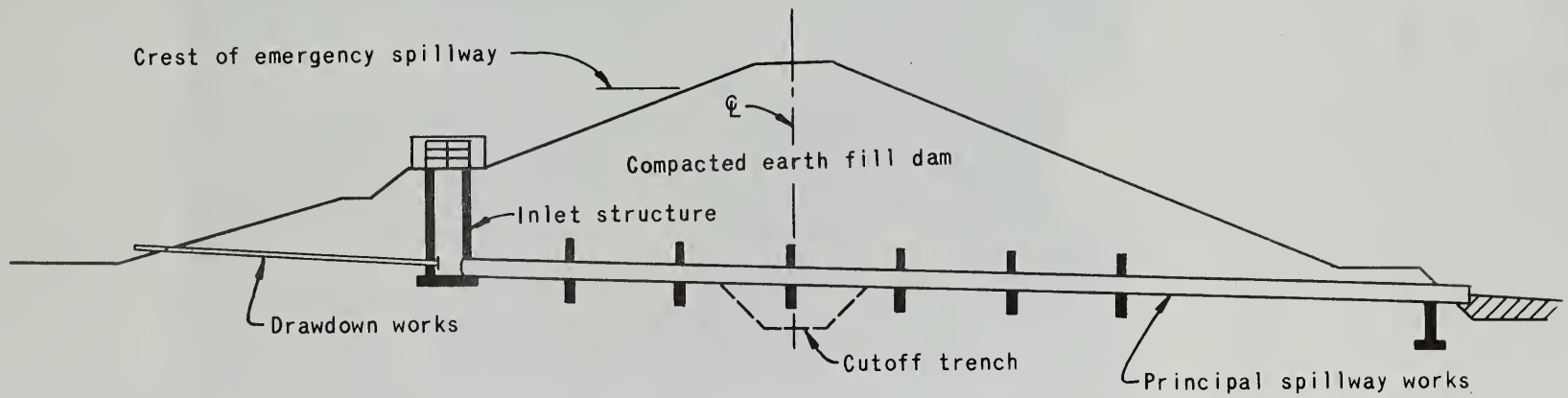
SOIL CONSERVATION SERVICE

TYPICAL EARTH DAM WITH PIPE DROP INLET



CROSS SECTION OF DAM ON CENTERLINE OF PRINCIPAL SPILLWAY

NOTES:

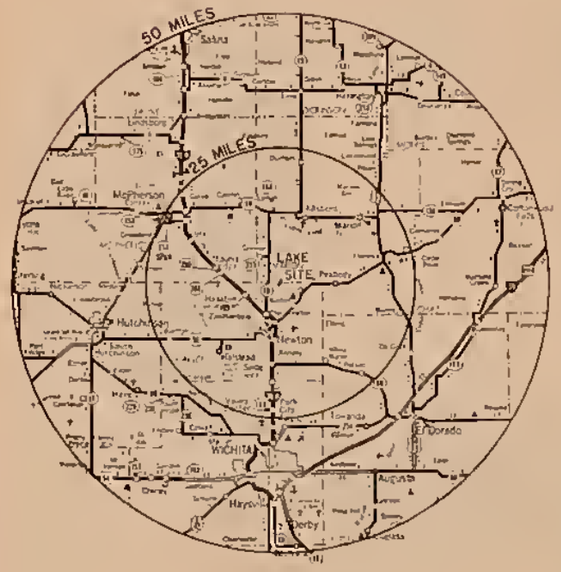
1. FOR INDIVIDUAL STRUCTURE DATA SEE TABLE 3.
2. EMBANKMENT AND FOUNDATION DESIGN FEATURES NOT SHOWN.

SAND CREEK WATERSHED

MARION AND HARVEY COUNTIES

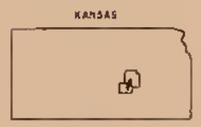
STRUCTURE NO. 1

PUBLIC RECREATION DEVELOPMENT



POPULATION CENTERS AND HIGHWAYS
WITHIN 50 MILE RADIUS

SCALE 10 5 0 10 20 30 40 MILES



LEGEND

(1) CAMPSITES
(2) TOILETS
(3) COMFORT STATIONS
(4) SEWAGE LAGOON
(5) BOAT LAUNCHING RAMP
(6) BOAT DOCKS
(7) SWIMMING AREA
(8) BATHHOUSE
(9) TRAILER DUMP STATION
(10) WILDLIFE MANAGEMENT AREA
(11) PARKING AREAS

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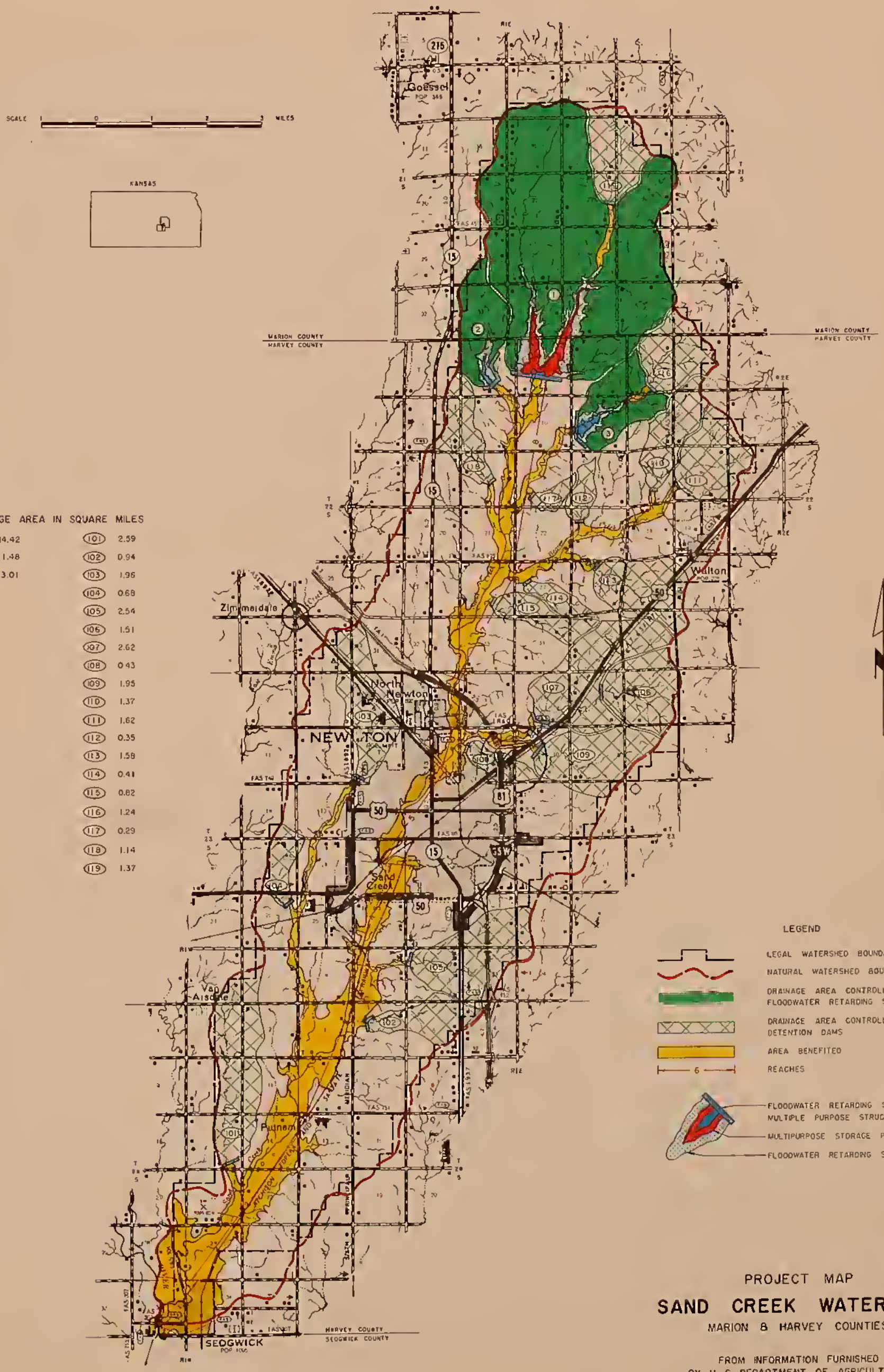

DRAINAGE AREA IN SQUARE MILES

(1)	14.42	(101)	2.59
(2)	1.48	(102)	0.94
(3)	3.01	(103)	1.95
		(104)	0.68
		(105)	2.54
		(106)	1.51
		(107)	2.62
		(108)	0.43
		(109)	1.95
		(110)	1.37
		(111)	1.62
		(112)	0.35
		(113)	1.58
		(114)	0.41
		(115)	0.82
		(116)	1.24
		(117)	0.29
		(118)	1.14
		(119)	1.37

LEGEND

- LEGAL WATERSHED BOUNDARY
- NATURAL WATERSHED BOUNDARY
- DRAINAGE AREA CONTROLLED BY FLOODWATER RETARDING STRUCTURES
- DRAINAGE AREA CONTROLLED BY DETENTION DAMS
- AREA BENEFITED
- 6 REACHES
- FLOODWATER RETARDING STRUCTURE OR MULTIPLE PURPOSE STRUCTURE
- MULTIPURPOSE STORAGE POOL
- FLOODWATER RETARDING STORAGE POOL

PROJECT MAP

SAND CREEK WATERSHED

MARION & HARVEY COUNTIES

FROM INFORMATION FURNISHED
BY U. S DEPARTMENT OF AGRICULTURE,
SOIL CONSERVATION SERVICE

JULY, 1974

DELAWATER, PAYLING & SCHERER, P.A., CONSULTING ENGINEERS
PREPARED FROM STATE HIGHWAY COMMISSION MAPS OF
MARION AND HARVEY COUNTIES.

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