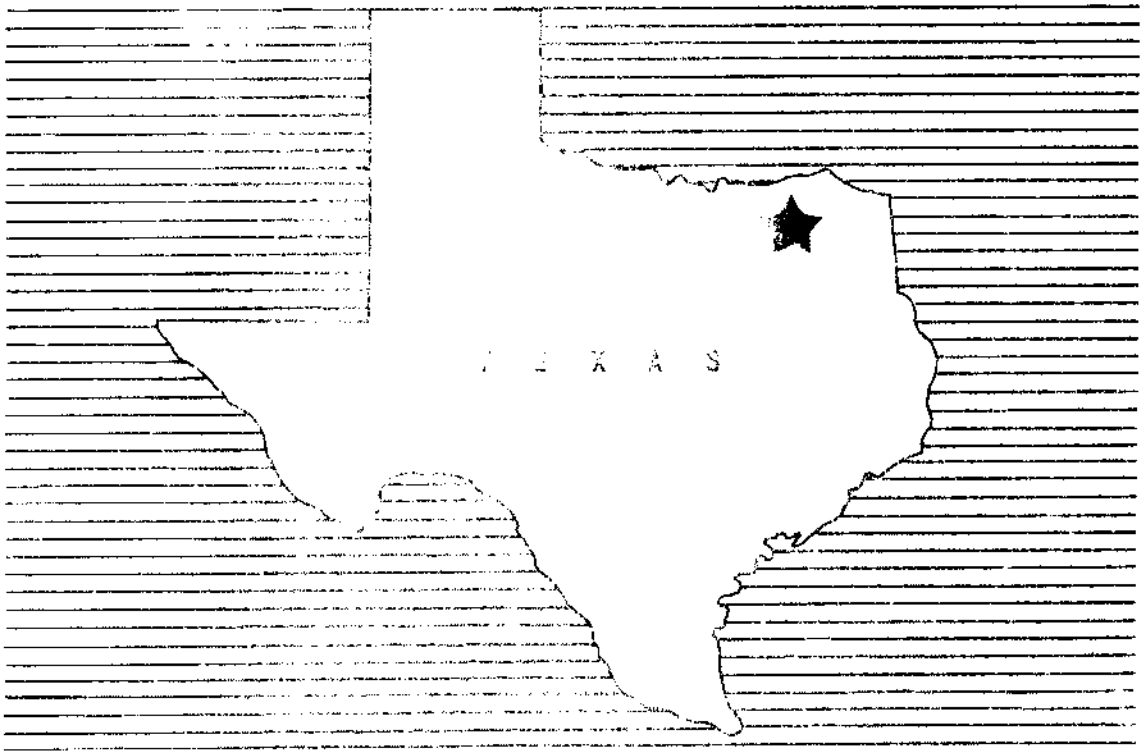
WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

AUDS CREEK WATERSHED

LAMAR COUNTY, TEXAS



September 1957

USDA-SCS FORT WORTH, TEX. 1958

Rev. 1-57

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WATERSHED WORK PLAN AGREEMENT

between the

North Texas Soil Conservation District
Local Organization

Lamar County Water Control and Improvement District No. 1
Local Organization

Lamar County Commissioners Court
Local Organization

State of Texas
(Hereinafter referred to as the Sponsoring Local Organization)

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

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Auds Creek Watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended by the Act of August 7, 1956 (Public Law 1018, 84th Congress; 70 Stat. 1088); and

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

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

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan will be installed, within 3 years, and operated and maintained substantially in accordance with the terms, conditions, and stipulations provided for therein.

It is mutually agreed that in installing and operating and maintaining the works of improvement described in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 49,988 .)

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

3. The percentages of construction costs of the works of improvement to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	% Sponsoring Local Organization Will Pay	% Service Will Pay	Estimated Construction Cost
14 Floodwater Retarding Structures	0	100%	$326,955

The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The Service will bear the cost of all engineering services applicable to works of improvement for flood prevention, and irrigation, drainge, and other agricultural water management. (Estimated cost $ 65,391 .)

The Sponsoring Local Organization will bear the cost of all engineering services applicable to works of improvement for all purposes other than flood prevention, and irrigation, drainage, and other agricultural water management. (Estimated cost $ **None** .)

5. The Sponsoring Local Organization will employ or provide the following engineering and other services in connection with the installation of the works of improvement:

The Contracting Officer will be Mr. J. W. Abels Jr. Secretary of the Lamar County Water Control and Improvement District No. 1. The District will also take care of the necessary clerical work.
Necessary legal assistance will be furnished by the Lamar County Water Control and Improvement District No. 1. Mr. J. Richard Hutchinson, Liberty National Bank Bldg., Paris, Texas will be the legal council for the District.

The Sponsoring Local Organization will bear all costs of administering contracts except the cost of engineering services applicable to works of improvement for flood prevention, and irrigation, drainage, and other agricultural water management.

6. The Service will provide the following engineering and other services in connection with the installation of the works of improvement: **Necessary engineering services for surveys, site investigations, layout, design, preparation of specifications, supervision of construction and related forms of assistance.**

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

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

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

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

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

12. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose. Where there is a Federal contribution to the construction costs of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service, the Sponsoring Local Organization and the Contracting Local Organization prior to the issuance of the invitation to bid. 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.

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.

North Texas Soil Conservation District
Local Organization

By Jno C Canada

Title Chairman

Date **March 20, 1958**

The signing of this agreement was authorized by a resolution of the governing body of the **North Texas Soil Conservation District**
Local Organization

adopted at a meeting held on **March 20, 1958**

Albert Roach
(Secretary, Local Organization)

Date **March 20, 1958**

Lamar County Water Control and Improvement District No. 1
Local Organization

By A. Louis Williams

Title President

Date March 20, 1958

The signing of this agreement was authorized by a resolution of the governing body of the Lamar County Water Control and Improvement District No. 1
Local Organization
adopted at a meeting held on March 20, 1958.

(Secretary, Local Organization)

Date March 20, 1958

Lamar County Commissioners Court
Local Organization

By Jerry G. Braswell

Title County Judge, Lamar County

Date March 20, 1958

The signing of this agreement was authorized by a resolution of the governing body of the Lamar County Commissioners Court.

Johnny M. Hare County Clerk
(Secretary, Local Organization)

Date March 20, 1958

Soil Conservation Service
United States Department of Agriculture

By _____
Administrator

Date _____

WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

AUDS CREEK WATERSHED
Lamar County, Texas

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act. (Public Law 566, 83rd Congress; 68 Stat. 666 as amended by Public Law 1018, 84th Congress; 70 Stat. 1088)

Prepared by: North Texas Soil Conservation District
(Cosponsor)

Lamar County Water Control and Improvement District No. 1
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service

September 1957

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SECTION 1

WATERSHED WORK PLAN

AUDS CREEK WATERSHED
Lamar County, Texas
September 1957

SUMMARY OF PLAN

General Summary

The watershed work plan for watershed protection and flood prevention for Auds Creek watershed, Texas, was prepared by the North Texas Soil Conservation District and Lamar County Water Control and Improvement District No. 1, as the local cosponsoring organizations. Technical assistance was provided by the Soil Conservation Service of the United States Department of Agriculture.

The watershed work plan covers an area of approximately 49.48 square miles, or 31,670 acres, in Lamar County, Texas. Approximately 51.6 percent of the watershed is cropland, 43.9 percent is grassland and 4.5 percent is in miscellaneous uses such as stream channels, towns, roads, etc.

There is no Federally owned land in the watershed.

The work plan proposes installing in a five year period, a project for the protection and development of the watershed at a total estimated installation cost of $865,946. The local share of this cost, to be borne by other than Public Law 566 funds, will be $404,616. In addition, local interests will bear the entire cost of operation and maintenance with a capitalized value of $42,458. Of the total project cost of $908,404, P. L. 566 funds will bear $461,330 and local and other funds will bear $447,074.

No water management developments are proposed.

Land Treatment Measures

The cost for land treatment measures is estimated to be $377,378, of which the local share to be borne by other than P. L. 566 funds is $347,628. The share to be borne by P. L. 566 funds, consisting entirely of technical assistance, is $29,750. The land treatment measures will be installed over a five year period.

Structural Measures

The structural measures included in the plan consist of 14 floodwater retarding structures. The 14 structures will have a total capacity of 7,352 acre-feet of floodwater detention and sediment storage. The total cost of these

measures, including the capitalized value of operation and maintenance, is $531,026, of which the local share is $99,446 and the Federal (P.L. 566 funds) share $431,580. The local share of the cost of structural measures includes: land, easements, and rights-of-way, 50.3 percent; operation and maintenance, 42.7 percent; and administering contracts, 7.0 percent. The 14 floodwater retarding structures will be installed during a three-year period.

Damages and Benefits

The estimated average annual floodwater, sediment, and flood plain erosion damage without the project is $57,264 at long term price levels. The estimated average annual floodwater, sediment, and flood plain erosion damage with the project installed, including reductions accruing to both land treatment and structural measures, is $16,067, a reduction of 72 percent. The average annual primary benefits accruing to structural measures are $34,496, which are distributed as follows:

Floodwater damage reduction	$24,222
Sediment damage reduction	3,497
Erosion damage reduction (flood plain)	998
Indirect damage reduction	4,307
Benefits from changed use of land	791
Identifiable downstream benefits	681

The ratio of the average annual benefits ($34,496) to the average annual costs of structural measures ($18,723) is 1.84 to 1.

The total benefits of land treatment measures were not evaluated in monetary terms since experience has shown these soil and water conservation measures produce benefits in excess of their costs.

Provisions for Financing Construction

The Lamar County Water Control and Improvement District No. 1 has powers of taxation and eminent domain under applicable State laws. The district will let the contracts for the structural measures listed in the plan. Funds for financing the local share of the project will be raised by a tax on flood plain land benefitted.

Operation and Maintenance

Land treatment measures will be installed, operated and maintained by the landowners or operators of the farms under agreements with the North Texas Soil Conservation District. Under terms of an operation and maintenance agreement to be executed, the 14 floodwater retarding structures will be operated and maintained by the Lamar County Water Control and Improvement District No. 1. The Lamar County Commissioners Court has offered and pledged its assistance in maintaining the floodwater retarding structures to the end of protecting and correcting the structures from erosion and other water damage.

DESCRIPTION OF THE WATERSHED

Physical Data

Auds Creek watershed heads approximately six miles west of the city of Paris, Texas, and enters the North Sulphur River approximately 12 miles south of Paris, in Lamar County, Texas. The principal tributaries are Cottonwood and Baker Branches which enter Auds Creek about four miles south of the city of Paris. The area of the watershed is estimated to be 49.48 square miles (31,670 acres).

The topography of the watershed ranges from nearly level along the alluvial valley to gently rolling in the upland areas. Elevations range from 395 feet to 600 feet above mean sea level. The main alluvial valley of Auds Creek is well defined and consists of 3,108 acres.

The watershed lies entirely within the Blackland Prairies Land Resource Area. The soils consist of dark-gray to light-gray clays and sandy clay loams of the Wilson, Crockett and Hunt series. They are slowly to very slowly permeable and are usually deep. Generally the soils are in poor to fair physical condition.

Grassland occupies approximately 44 percent of the watershed, with the major portion of this area being formerly cultivated land that has been changed to pasture use.

The overall land use for the watershed is as follows:

Land Use	Acres	Percents
Cultivation	16,354	51.6
Grassland	13,891	43.9
Miscellaneous 1/	1,425	4.5
Total	31,670	100.0

1/ Includes roads, highways, railroad rights-of-way, urban areas, etc.

The principal floodwater and sediment damages occur upstream from mile 2.5 of Auds Creek. Land use in the flood plain is as follows: 58 percent in cultivation; 39 percent in pasture; and 3 percent in miscellaneous areas.

The mean annual rainfall is 40.30 inches as recorded at U. S. Weather Bureau gage at Paris, Texas over a period of 60 years. The monthly average ranges from 2.56 inches in February to 4.98 inches in May.

Average temperatures range from 83 degrees Fahrenheit in the summer to 44 degrees in the winter. The normal frost-free season of 241 days extends from March 19 to November 15.

Water for livestock and rural domestic use is obtained from surface ponds and wells. The city of Paris obtains its water from a surface reservoir on Pine Creek. The high annual rainfall provides water for streams to flow most of the time. Water for these uses is not generally considered to be a problem.

Economic Data

This watershed is in a county which has been outstanding in crop production for many years. Settlement began in 1825 and county government was organized in 1841. Corn was the principal crop until about 1850, and wheat from 1850 to 1860. Following this period cotton was the principal source of farm income and held this position until about 1920. Much of the farm income is now obtained from livestock, poultry, and dairy products.

Approximately 51.6 percent of the watershed is in cultivated crops. Principal crops are cotton, grain sorghums, and oats. The average farm is approximately 140 acres in size. The number of farms in the watershed and nearby area is decreasing with a definite trend toward larger operating units. Cattle and hogs are usually hauled by truck to Fort Worth markets, a distance of 136 miles. Cotton is usually sold to local buyers and compressed before shipment to terminal markets. Most of the corn, grain sorghum, and hay is sold locally and fed to livestock.

There is no production of oil or natural gas in the watershed. Some building stone has been quarried from the Gober Chalk formation which outcrops at several points.

Paris, with a population estimated at 23,200 in 1955, is at the head of the watershed. It is the county seat of Lamar County and is the banking, commercial and industrial center for a considerable portion of northeast Texas and southeast Oklahoma. The small villages of Broadway, Glory and Slabtown are located in the watershed.

The Auds Creek watershed is served by the Soil Conservation Service work unit at Paris, through the North Texas Soil Conservation District. The work unit has assisted farmers in preparing 103 soil and water conservation plans on 17,730 acres (56 percent of the agricultural land) within the watershed and giving guidance in establishing and maintaining planned measures.

The watershed is served by 64 miles of roads, of which 23 are paved (State Highway 24 and Farm to Market Roads Nos. 137, 1184, 1497, 1498 and 1506). One state highway and two farm to market roads cross Auds Creek and its tributaries. All other road crossings have been abandoned because of frequent flood damage, the last one in 1941 when a school bus fell through a bridge damaged by floodwater. Thus, extra travel distance is required to and from markets and for school bus and mail routes.

Adequate loading facilities and rail transportation are available in Paris over the Texas and Pacific, Santa Fe, Frisco and Southern Pacific Railroads.

WATERSHED PROBLEMS

Floodwater Damage

The flood plain of Auds Creek was placed in cultivation during the early days of settlement in Lamar County. Frequent flooding has caused about 60 percent of the flood plain to be used for temporary pasture and meadow rather than for row crops. Row crops are now generally grown on only the less frequently flooded portions of the flood plain (figure 1).

Floods occur very frequently on Auds Creek and cause severe damage. During the 30-year period studied, 1923-1952, there were 30 floods which covered more than half of the flood plain and 90 smaller floods. Ninety-three of the floods occurred during the growing season and caused severe damage to crops and pasture. For the floods experienced during the period studied, the total direct floodwater damages were estimated to average $37,546 annually under present conditions, of which $23,346 is crop and pasture damage, $11,338 is other agricultural damage, and $2,862 is nonagricultural such as damages to roads, railroads and bridges. Indirect damages, such as interruption of travel, extra travel for school bus and mail routes, losses sustained by dealers and industries in the area and similar losses are estimated to average $7,469 per year.

Sediment Damage

Damage from overbank deposition in the watershed has been severe in past years. The area cultivated in the watershed reached its peak in 1920. Since that time the area in cultivation has decreased. As a result there has been a decline in erosion and runoff and less material is being deposited overbank than was formerly the case.

Overbank deposits consist chiefly of silts, silty clays, and clays produced by erosion of upland soils. The deposits are low in organic matter, and crust and puddle readily. The majority of the deposition is located below the planned floodwater retarding structures. It is estimated that approximately 1,892 acres of agricultural land have been damaged by sediment. This damage is estimated to have reduced crop production on 97 acres by 10 percent, on 946 acres by 20 percent, and on 849 acres by 30 percent, with an average annual monetary damage of $10,583 at long-term price levels.

Gordon Lake, which is a privately owned recreational facility, is the only large lake in the watershed. It has suffered moderate sediment damage. The numerous farm ponds (locally known as pools) in the watershed have suffered moderate to severe damage due to sedimentation.

Erosion Damage

The rates of erosion in the watershed are moderate. Sheet erosion on upland areas accounts for 65 percent of the total annual gross erosion, scour erosion on the flood plain for 26 percent, gully erosion for 7 percent,

Auds Creek on April 23, 1957 near F.M. Highway 1184. (Crop and Pasture damage). Paris News Photo.

Auds Creak on April 26, 1957 west of State Highway 24 - (Cropland and county road inundated).

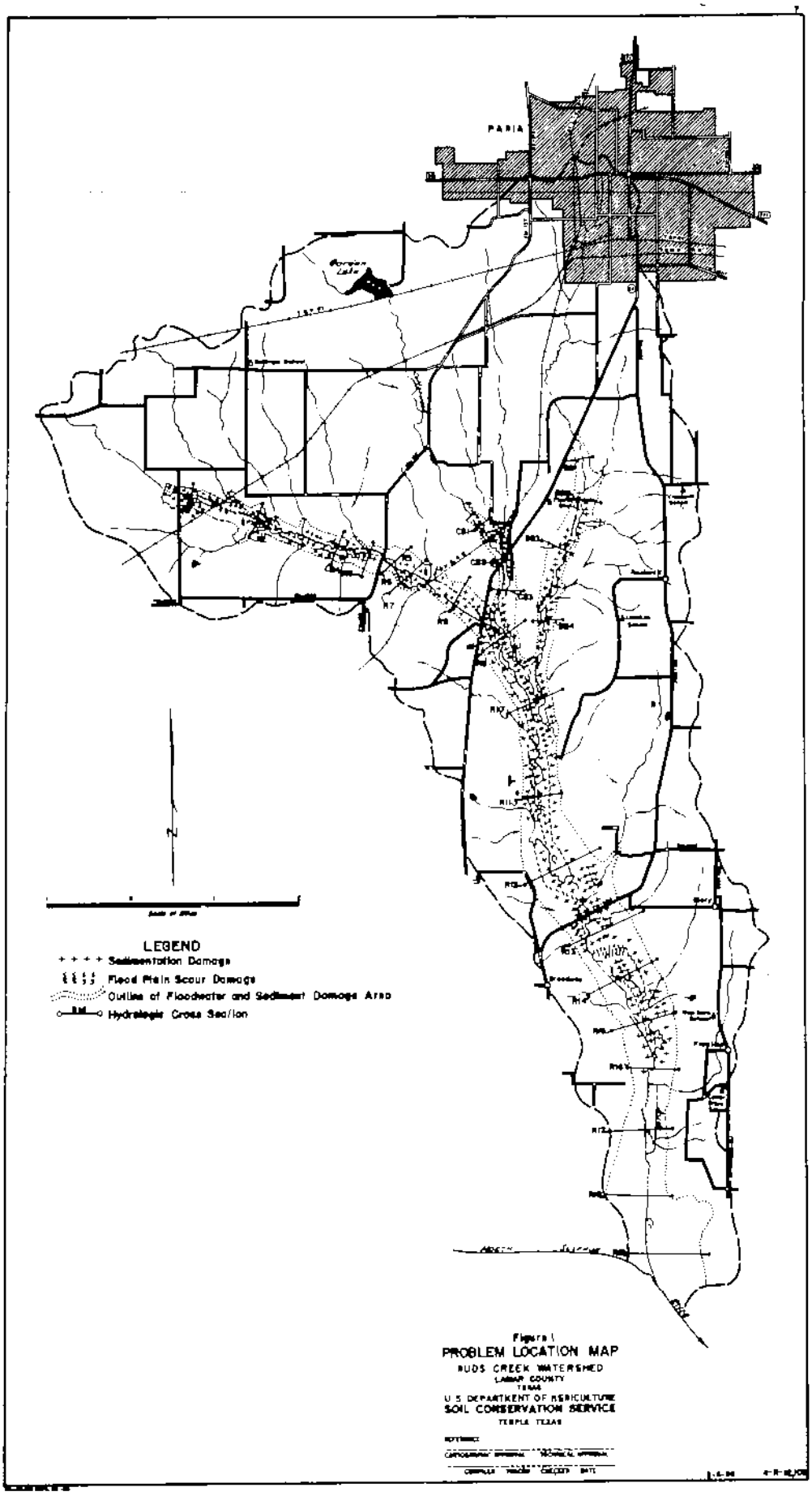


Figure 1

PROBLEM LOCATION MAP

RUDS CREEK WATERSHED

LAMAR COUNTY

TEXAS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

and streambank erosion for 2 percent.

Approximately 396 acres of the flood plain (figure 1) have been scoured by floodwater, with the resulting damages ranging from 5 to 40 percent of the productive capacity. The estimated annual damage is $1,666 at long term price levels.

Problems Relating to Water Management

Problems relating to methods now used in the conservation, development, utilization and disposal of water are of a minor nature in the Auds Creek watershed and did not warrant a study at this time. The planned works of improvement will have no known detrimental effects on any water supply in the watershed.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

As a part of channel improvement on the North Sulphur River, the Auds Creek Channel was enlarged to a point approximately 1.0 mile above its confluence with this stream. At a later date the channel was improved to mile 3.5 on Auds Creek as a project of the Works Project Administration.

In Part II, Section 2, Volume F of the Arkansas-White-Red Basin Inter-Agency Committee Report, the Corps of Engineers has proposed channel improvement on Auds Creek from the limits of the North Sulphur River backwater, mile 3.5, to mile 14, by enlargement and realignment and/or by clearing and snagging, based on an investigation of preliminary examination scope. It is stated in this report that the effects of land treatment measures and waterflow retardation structures on this project have not been determined.

Recently the Corps of Engineers has indicated that they have no plans for further studies on Auds Creek at the present time. Therefore, the plans for this watershed have been developed on the assumption that the effects of this watershed protection project on any future channel improvement by the Corps of Engineers could be evaluated and the two projects completely coordinated.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures for Watershed Protection

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as is now being carried out by the North Texas Soil Conservation District, is necessary for a sound flood prevention program on the watershed. Basic to reaching this objective is the establishment and maintenance of all applicable soil and water conservation and plant management practices essential to proper land use. Emphasis will be

placed on accelerating the establishment of land treatment practices which have a measurable effect on the reduction of floodwater, sediment and erosion damages.

Approximately 12,128 acres of the total watershed area of 31,670 acres lie above planned floodwater retarding structures. Land treatment is especially important for protection of these watershed lands to support and supplement the structural measures. There are another 16,434 acres of upland in the watershed for which no structural control has been planned and for which establishment of land treatment constitute the only planned measures in this plan. Land treatment measures on the 3,108 acres of flood plain are also important in reducing floodwater and flood plain scour damages.

The amounts and estimated costs of the measures that will be installed by the landowners and operators are shown in table 1. The estimated total cost of planning and installing these measures is $377,378, including $29,750 for the acceleration of technical assistance during the 5-year installation period to help owners and operators to plan and to speed up the application of conservation practices. Landowners and operators will maintain these measures in accordance with provisions of the farmer-district cooperative agreements with the North Texas Soil Conservation District.

Land treatment measures will decrease erosion damage and sediment production from fields and pastures by providing improved soil-cover conditions. These measures include cover cropping, use of rotation hay and pasture, crop residue utilization for cropland, and pasture planting to establish good cover on grassland and formerly cultivated lands. They also include brush control to allow grass stands to improve and replace the poor brushy cover, construction of farm ponds to provide watering places to prevent cover-destroying seasonal concentrations of livestock, and proper use of grasslands to provide improvement, protection and good maintenance of grass stands. These measures also effectively improve soil conditions which allow rainfall to soak into the soil at a more rapid rate.

In addition to the soil improvement and cover measures, land treatment includes contour farming, terracing, diversion construction, and the waterway development and stabilizing measures to serve them, all of which have a measurable effect in reducing peak discharge by slowing runoff water from fields. These measures also help the soil improvement and cover measures to reduce erosion damage and sediment production.

Structural Measures

A system of 14 floodwater retarding structures will be installed in the Auds Creek watershed to afford the needed protection to flood plain land which cannot be provided by land treatment measures alone. An additional site was investigated on Baker Branch, upstream from State Highway 24. This site cannot be utilized at the present time because a branch line of the Southern Pacific (T. & N.O.)Railroad would be

TABLE 1 - ESTIMATED PROJECT INSTALLATION COSTS

Auds Creek Watershed, Texas

Installation Cost Item	Unit	No. to be Applied Non-Federal Land	Estimated Cost 1/ P.L. 566 Funds (dollars)	Other (dollars)	Total (dollars)
LAND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	1,140	-	N.C.	N.C.
Cover Cropping	Acre	8,575	-	113,190	113,190
Crop Residue Utilization	Acre	6,365	-	3,178	3,178
Rotation Hay and Pasture	Acre	3,920	-	56,840	56,840
Pasture Improvement For Watershed Protection					
Pasture Planting	Acre	3,250	-	56,875	56,875
Proper Use	Acre	5,185	-	1,815	1,815
Rotation Grazing	Acre	6,780	-	N.C.	N.C.
Brush Control	Acre	425	-	31,875	31,875
Pond Construction	Each	36	-	8,100	8,100
Wildlife Area Improvement	Acre	110	-	1,485	1,485
Waterway Development	Acre	95	-	2,470	2,470
Terraces	Mile	120	-	19,800	19,800
Diversion Construction	Mile	8	-	2,000	2,000
Stabilizing Measures	Each	50	-	50,000	50,000
Technical Assistance (Accel.)			29,750	-	29,750
SCS Subtotal			29,750	-	377,378
TOTAL LAND TREATMENT			29,750	347,628	377,378
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	14	326,955	-	326,955
SCS Subtotal			326,955	-	326,955
Subtotal - Construction			326,955	-	326,955
Installation Services					
Soil Conservation Service					
Engineering Services			65,391	-	65,391
Other			39,234	-	39,234
SCS Subtotal			104,625	-	104,625
Subtotal - Installation Services			104,625	-	104,625
Other Costs					
Land, Easements & R/W			-	49,988	49,988
Administration of Contracts			-	7,000	7,000
Subtotal - Other			-	56,988	56,988
TOTAL STRUCTURAL MEASURES			431,580	56,988	488,568
TOTAL PROJECT			461,330	404,616	865,946
SUMMARY					
Subtotal SCS			461,330	404,616	865,946
TOTAL PROJECT			461,330	404,616	865,946

1/ Price Base: Current price levels. September 1957

inundated. The benefits from this structure will not justify the additional cost of relocation. At the present time traffic on this line is limited to one freight train each way per day and service may possibly be abandoned in the future. Cost estimates for this structure were made and the additional benefits were determined by a separate routing. Installation of a structure at this location if the railroad were to be abandoned, would produce additional benefits of approximately $3.00 for each dollar of cost.

The system of 14 floodwater retarding structures will have a total floodwater detention capacity of 6,233 acre feet and will temporarily detain runoff from 38.29 percent of the total watershed. Runoff will be detained from 42.41 percent of the watershed above valley cross-section R16, the lower limits of damaging flooding from storms in the evaluation series. An average of 6.17 inches of runoff will be detained from the watershed area above the planned structures. This is the equivalent of 2.36 inches of runoff from the entire 31,670 acre watershed. Figure 2 shows a section of a typical floodwater retarding structure. Land, easements, rights-of-way, and road and utility changes for all of the structures will be provided by local interests. The Lamar County Water Control and Improvement District No. 1 will let and administer all of the contracts for the structural measures. The location of the structural measures is shown on the Planned Structural Measures Map, figure 3. The total estimated cost of establishing these works of improvement is $488,568, of which $56,988 will be borne by local interests and $431,580 by P. L. 566 funds (table 1). The estimated annual equivalent cost for installation is $17,226, the estimated annual operation and maintenance cost is $1,497, a total annual cost of $18,723.

Sufficient detention storage can be developed at all structure sites to make possible the use of vegetative spillways, thereby effecting a substantial reduction in cost over concrete or similar types of spillways.

All applicable State water laws will be complied with in design and construction of the floodwater retarding structures.

BENEFITS FROM WORKS OF IMPROVEMENT

The combined program of land treatment and structural measures described above would confine damage from 85 of the total of 120 floods such as occurred in this watershed from 1923 to 1952, to areas of 500 acres or less. Average annual flooding throughout the watershed would be reduced from 3,978 acres to about 1,410.

The area on which sediment damage from overbank deposition will occur annually can be expected to be reduced from 1,892 acres to 870 acres, a reduction of 54 percent. Land treatment will effect 30 percent of this and structural measures 24 percent.

The area on which flood plain scour damage will occur annually can be expected to be reduced from 396 acres to 246 acres, a reduction of 38 percent.

Effect of Total Program in Reduction of Area Inundated

Inches Runoff	0.60		1.00		1.50		2.00		3.00		4.30	
	Acres Flooded											
Evaluation	Present	Future	Present	Future	Present	Future	Present	Future	Present	Future	Present	Future
Reach A (Mainstem above Cottonwood Branch)												
Valley Cross Section												
R-1	0	0	0	0	0	0	10	0	27	0	41	0
R-2	52	0	66	0	80	0	96	0	122	56	146	64
R-4	0	0	0	0	24	0	48	0	70	0	87	19
R-5	0	0	0	0	3	0	10	0	50	0	52	0
R-6	0	0	0	0	0	0	0	0	0	0	0	0
R-7	0	0	0	0	0	0	32	0	70	0	98	0
R-8	0	0	0	0	77	0	86	0	100	44	116	80
Total	52	0	66	0	184	0	282	0	439	100	540	163
Reach B (Cottonwood Branch)												
CB-1	0	0	10	0	13	0	15	0	17	0	20	0
CB-2	0	0	0	0	9	0	14	0	26	0	38	0
CB-3	15	0	24	0	35	0	45	0	53	0	60	0
Total	15	0	34	0	57	0	74	0	96	0	118	0
Reach C (Baker Branch)												
BB-2	2	0	12	5	42	14	62	40	73	69	79	74
BB-3	1	0	32	2	72	36	96	62	114	98	118	113
BB-4	0	0	38	3	45	38	52	43	55	51	57	54
Total	3	0	82	10	159	88	210	145	242	218	254	241
Reach D (Mainstem below Cottonwood Branch)												
R-9	16	0	94	0	142	0	172	34	206	86	212	128
R-10	84	34	130	70	154	106	172	128	194	150	206	169
R-11	12	0	122	1	178	84	196	124	222	170	237	196
R-12	105	0	250	100	300	200	335	265	395	300	405	350
R-13	70	0	105	75	145	100	185	115	235	160	268	215
R-14	0	0	42	0	104	10	144	66	204	124	215	180
R-15	0	0	0	0	0	0	95	0	266	0	282	257
Total	287	34	743	246	1,023	500	1,299	732	1,722	990	1,825	1,495
Reach E (Mainstem below Valley Cross Section R-16)												

There is no flooding under present conditions for 4.30 inches of runoff.

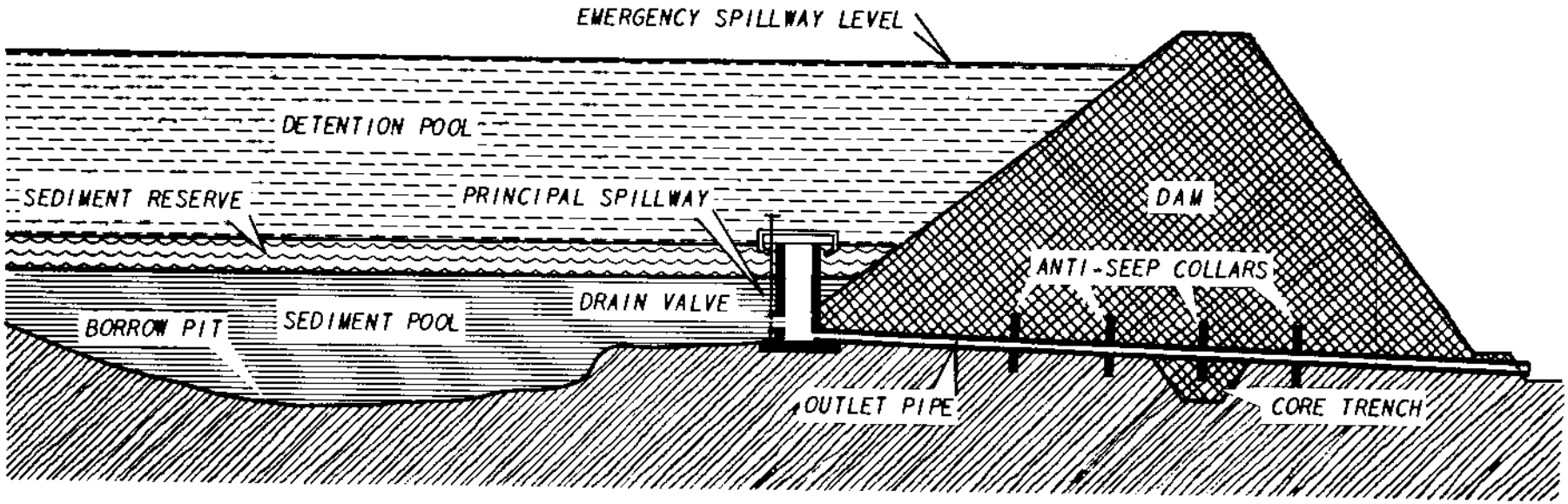


Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Revised 10-24-57 SCS-L-10,071

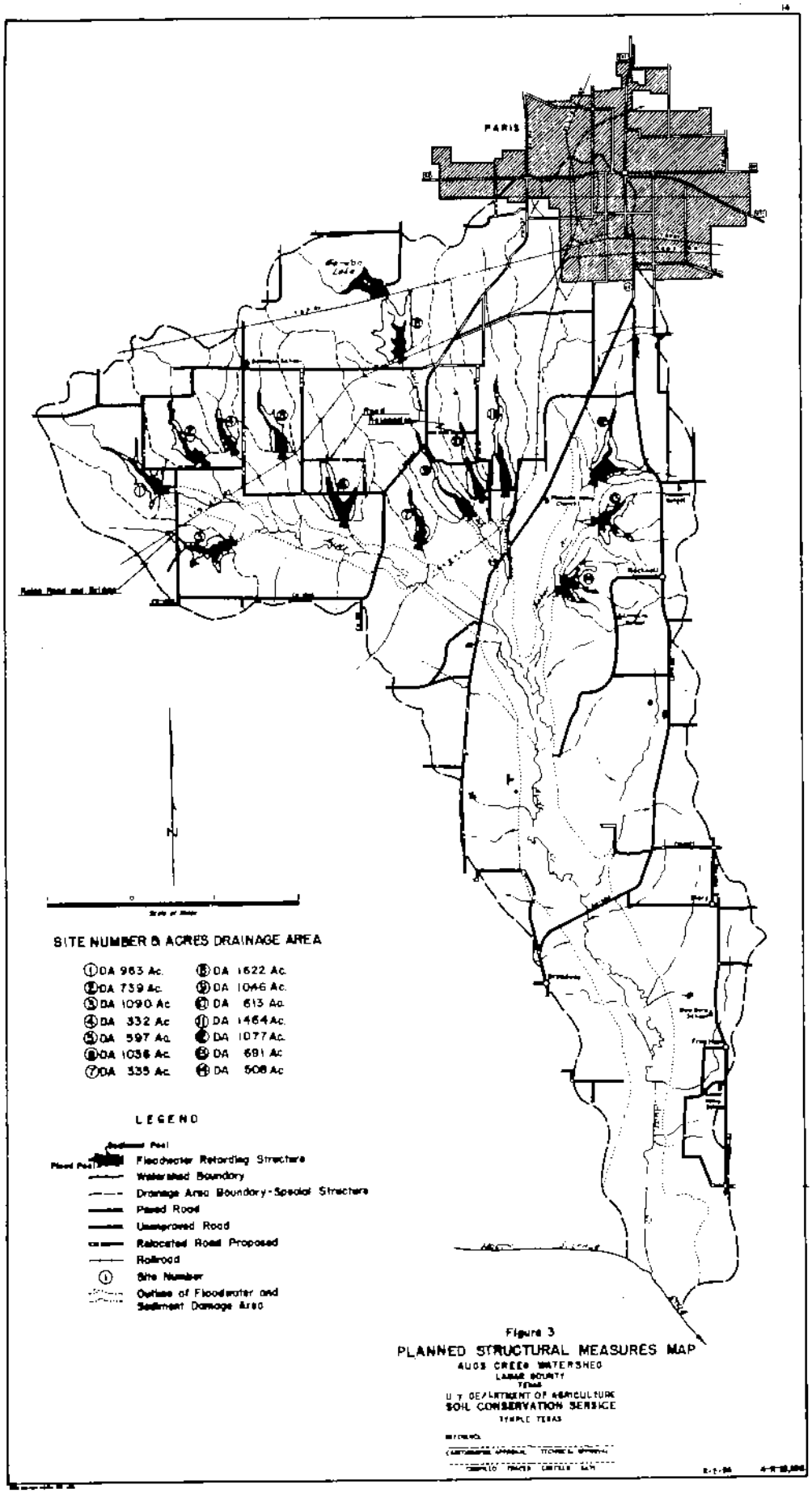


Figure 3

PLANNED STRUCTURAL MEASURES MAP

ALOE CREEK WATERSHED

LAMAR COUNTY

TEXAS

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

The planned land treatment program can be expected to reduce the total gross erosion rate from the watershed from 162.22 acre-feet annually to 84.53 acre-feet.

The estimated average annual floodwater, erosion, sediment,and indirect damages within the watershed would be reduced from $57,264 to $16,067, a reduction of $41,197 or 72 percent. Approximately 80 percent, $33,024, of the expected reduction in the average annual damage would result from the system of floodwater retarding structures.

By type of damage, these reductions will be:

	Benefit From	
	Total Program	Structures Only
	(dollars)	(dollars)
Crop and pasture	17,571	15,843
Other agricultural	8,301	6,843
Nonagricultural	2,005	1,536
Overbank deposition	6,673	3,497
Flood plain scour	1,274	998
Indirect	5,373	4,307

Owners and operators of flood plain lands say that, if adequate flood protection is provided, they will restore land now in Johngrass meadow and pasture to cotton, corn, alfalfa, and grain sorghum. Most of this land was in cultivation at one time but is now used for hay and pasture because of the frequency of flooding. Landowners generally own adjacent uplands which are now used for high value crops which they state will be shifted to the bottom lands following installation of the program. It is estimated that net income from such restoration will amount to $6,521 (long term price levels) annually.. This loss from the original production has been considered a crop and pasture damage and its restoration a benefit in table 7.

It is also expected that landowners will convert some pastureland to cropland which will result in an additional $791 increase in net annual income.

The total flood prevention benefits, as a result of structural measures, are estimated to be $34,496 annually. Of this amount, $681 represents downstream benefits on the North Sulphur River.

COMPARISON OF BENEFITS AND COST

The annual equivalent cost of structural measures (converted from total installation cost) plus the annual operation and maintenance cost is estimated to be $18,723. When the project is completely installed it is expected to produce average annual benefits of $34,496. Therefore, the project will produce $1.84 for each dollar of cost. Other substantial

values will accrue from the project such as increased opportunity for recreation, improved wildlife habitat, and a sense of security. These have not been used for project justification.

ACCOMPLISHING THE PLAN

Federal assistance for carrying out the works of improvement on non-Federal land as described in this work plan, will be provided under the authority of the Watershed Protection and Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666, as amended by Public Law 1018, 84th Congress; 70 Stat. 1088).

The Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings, preparing press and radio releases, and using other methods of getting information to landowners and operators in the Auds Creek watershed. This activity will help to get both the land treatment practices and the structural measures for flood prevention carried out.

Land Treatment Measures

The land treatment measures itemized in table 1 will be established by farmers over a five-year period in cooperation with the North Texas Soil Conservation District, which is giving assistance in the planning and application of these measures under its going program. This assistance will be accelerated to assure application of the planned measures within the 5-year installation period for the project.

The governing body of the North Texas Soil Conservation District will assume aggressive leadership in getting an accelerated land treatment program underway, with the assistance of the Lamar County Water Control and Improvement District No. 1 in arranging for meetings according to a definite schedule. By this means and by individual contacts the landowners within the watershed will be encouraged to adopt and carry out soil and water conservation plans on their farms. District-owned equipment will be made available to the landowners in accordance with existing arrangements for equipment usage in the district. The soil conservation district governing body will make, or cause to be made, periodic inspections of the completed conservation measures within the watershed. The Soil Conservation Service will assign additional technicians and aids to the North Texas Soil Conservation District to assist landowners and operators cooperating with the district by accelerating the preparation and application of soil, plant, and water conservation plans.

The soil and water conservation loan program of the Farmers Home Administration is available to all eligible individual farmers and ranchers in the area. Educational meetings will be held in cooperation with other agencies outlining the services available and eligibility requirements. Present FHA clients will be encouraged to cooperate in the program.

The county ASC Committee will cooperate with the governing body of the soil conservation district by selecting and providing financial assistance for those ACPS practices which will accomplish the conservation objectives in the shortest possible time.

Structural Measures For Flood Prevention

The Lamar County Water Control and Improvement District No. 1 will obtain the necessary land, easements, and rights-of-way and will let contracts for the construction of the 14 floodwater retarding structures listed in the plan. Funds for the local share of the project costs including land, easements, rights-of-way, and administration of contracts, will be raised through a proposed ad valorem tax on flood plain land benefited.

The structural measures will be scheduled for construction within a three-year period as follows: Sites 1 through 6, first year; Sites 7 through 11, second year; and Sites 12 through 14, third year pursuant to the following conditions:

1. The required land treatment in the drainage area above structures has been installed or is in the process of being installed.

2. The necessary easements have been obtained.

3. Court orders have been obtained from the Commissioners Court showing that county roads affected by structural works of improvement will either be closed, raised two feet above emergency spillway crest elevation at no cost to the Federal Government, relocated, or permission granted to temporarily inundate the road provided equal alternate routes can be provided.

4. The contracting agency is equipped to handle its responsibilities.

5. Operation and maintenance agreements have been executed.

6. Federal funds are available.

This project was determined to be one construction unit. All land, easements, and rights-of-way will be provided for this construction unit before Federal funds are made available for construction.

Technical assistance will be provided by the Soil Conservation Service to assist in planning, design, preparation of specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificate of completion and related tasks necessary to establish the planned structural measures for flood prevention.

The various features of cooperation between the cooperating parties have been covered in appropriate memoranda of understanding and working agreements.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by the landowners and operators of the farms and ranches on which the measures are applied, under agreements with the North Texas Soil Conservation District. Representatives of the soil conservation district will make periodic inspections of the land treatment measures to determine maintenance needs and encourage landowners and operators to perform the management practices and maintenance needs. They will make district-owned equipment available for this purpose.

Structural Measures For Flood Prevention

The estimated annual operation and maintenance cost is $1,497 based on long term price levels. The Lamar County Water Control and Improvement District No. 1 will be responsible for operation and maintenance of the 14 floodwater retarding structures. The Lamar County Commissioners Court has agreed to cooperate with the Lamar County Water Control and Improvement District No. 1, by providing the necessary equipment, operators, and laborers to maintain the structures to the end of protecting said structures from erosion and other water damage. The Lamar County Water Control and Improvement District will perform all necessary operations and maintenance functions over and above those provided by the Lamar County Commissioners Court through the use of contributed labor and equipment, by contract, force account or combination of these methods and will establish a permanent reserve fund for this purpose in the following manner and amounts:

As structures are completed, $200 per year per structure will be placed in a reserve for operations and maintenance until the sum of $1,000 per structure is established for the first ten and a sum of $750 per structure for the other four. This will amount to $13,000 when all fourteen structures are built and will be maintained at this level.

All floodwater retarding structures will be inspected at least annually and after each heavy rain or stream flow by representatives of the Lamar County Water Control and Improvement District No. 1 and the North Texas Soil Conservation District. A Soil Conservation Service representative will participate in these inspections at least annually. Items of inspection will include, but not be limited to, the conditions of the principal spillway and its appurtenances, the earth fill, the emergency spillway, the vegetative cover of the earth fill and the emergency spillway, and fences and gates installed as a part of the structure.

The Soil Conservation Service, through the North Texas Soil Conservation District, will participate in operation and maintenance only to the extent of furnishing technical assistance to aid in inspections and

furnishing technical guidance and information necessary for the operation and maintenance program.

Provisions will be made for free access of representatives of the cosponsoring organizations and Federal representatives to inspect and provide maintenance for all structural measures and their appurtenances at any time.

The cosponsoring local organizations will maintain a record of and report to the Soil Conservation Service all maintenance inspections made and all maintenance work done.

The cosponsoring local organizations fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitation to bid on construction of the structural measures.

COST SHARING

Public Law 566 funds are exepcted to provide technical assistance in the amount of $29,750 during the 5-year installation period to accelerate the installation of land treatment measures included in the plan for reduction of erosion and peak rates of runoff. Private interests will install these measures at an estimated cost of $347,628, which includes ACPS payments based on present program criteria (table 1).

The required non-Federal cost for structural measures consists of the value of land, easements, and rights-of-ways, the capitalized value of operation and maintenance of works of improvement, and the costs of administering contracts. These estimated costs total $99,446.

The entire cost of constructing the structural measures amounting to $326,955 will be borne by the Federal Government. In addition, the installation services cost of $104,625 will be a Federal expense. This is a total Federal cost of $431,580 for the installation of structural measures to be borne by Public Law 566 funds.

The total project cost, $908,404, including the capitalized value of structure operation and maintenance, will be shared 50.8 percent ($461,330) by the Federal Government (P. L. 566 funds),and 49.2 percent ($447,074) by local interests (other than P. L. 566 funds).

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

This project plan conforms to all Federal laws and regulations and will have no known detrimental effects on any downstream projects which are now in existence or that might be constructed in the future.

For a period of three years from May 28, 1956, surplus crops grown on lands reclaimed by flood prevention and the lands so reclaimed, shall be ineligible for any benefits under the soil bank provisions of the Soil Bank Act and under price support legislation.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Land Treatment

Soil Conditions

The physical condition of the soil in the Auds Creek watershed ranges from good to very poor. The areas where row crops are grown continuously have very poor soil conditions, while in the areas where sweetclover or other soil-building legumes and grasses are grown in rotations, the soil is in fair physical condition with a few isolated areas in good condition. The soils, which are in the Blackland Prairies Land Resource Area, are dark-gray to light-gray clays, silty clays and sandy clay loams of the Wilson, Crockett, and Hunt series, which are slowly to very slowly permeable and usually deep.

Cover Conditions

Sample areas, which represent approximately 20 percent of the area were selected at random and mapped to show hydrologic soil group, cover condition, land use, crop distribution, and land treatment. The information was expanded to represent the present soil-cover complex condition of the watershed. Land treatment needs were projected from these present conditions to determine the expected future soil-cover complex conditions. These studies indicate that approximately 52 percent of the watershed is in cultivation, and 44 percent is in pasture. The hydrologic cover condition of the pastureland is as follows: 24 percent poor condition, 40 percent fair condition, and 36 percent good condition. The predominant grasses, at the present time, are Bermudagrass, Johnsongrass, and annual grasses.

Land Use and Treatment Needs

The needed land treatment for the Auds Creek watershed was developed by the Soil Conservation Service work unit at Paris. Conservation needa data were compiled from existing conservation plans within the watershed. These data were expanded to represent the conservation needs of the entire watershed. That portion of these needs that will be applied during the five-year installation period are included in table 1.

Program Determination

Flood problems and program objectives were reviewed with representatives of the North Texas Soil Conservation District and Lamar County Water Control and Improvement District No. 1.

Determination was made, first, of the needed land treatment measures, based on current needs, which remain to be applied in the watershed and

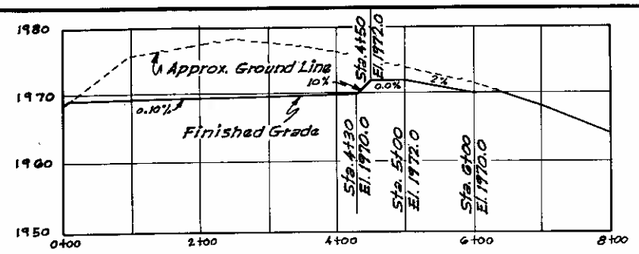
which contribute directly to flood prevention. The hydraulic, hydrologic, sedimentation, and economic investigations provided data on the effects of these measures in terms of the reduction of flood damages resulting from such treatment. Although significant benefits would result from application of these needed land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of watershed protection desired.

Determination was made, secondly, of structural measures for flood prevention which would be feasible to install. The study made and the procedures used in that determination were as follows:

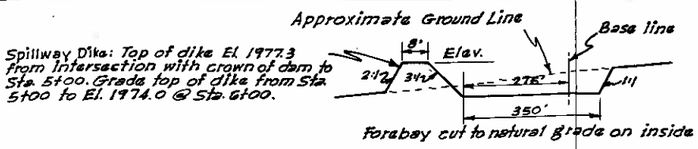
1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. Using consecutive 4-inch aerial photographs and a stereoscope, all probable floodwater retarding structure sites were located, the limits and the area of the flood plain delineated, and points marked where valley cross sections should be taken for the determination of hydraulic characteristics and for flood routing purposes. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were surveyed at the selected locations (figure 1). Data developed from these cross sections permitted the computation of peak discharge-damage relationships for various flood flows. A flood plain map was prepared on which land use, cross section locations and other pertinent information were recorded.

2. A field examination was made of all probable floodwater retarding structure sites previously located on the watershed base map. Sites which did not show good storage possibilities or which would inundate highways, railroads, or valuable improvements, the relocation of which would not be economically justified, were dropped from further consideration. From the remaining sites a system of floodwater retarding structures was selected for further consideration and detailed survey. Sites 8 and 9 were placed in series because no other sites are available and because the capacity of site 9 is very limited. Plans of a floodwater retarding structure, typical of those planned for the watershed, are illustrated by figures 4 and 4A.

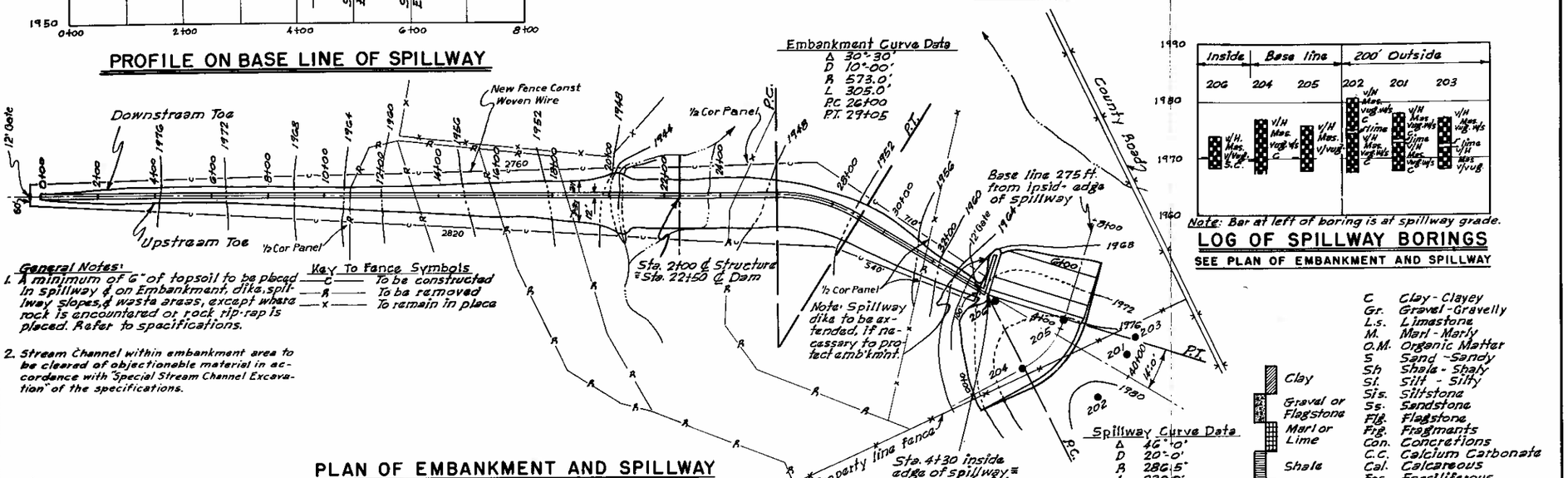
3. A topographic map was made of the reservoir area of each of the proposed sites to determine the capacity of the site, the estimated cost of the dam and the areas of flood plain and upland that would be inundated by the sediment and flood pools. The height of the dams and the size of the pools were determined by the criteria outlined in Soil Conservation Service Engineering Memo. No. 3. The limits of the flood pools and sediment pools of all satisfactory sites and the flood plain of the stream were drawn to scale on a copy of the base map. Structure data tables were developed to show for each structure



PROFILE ON BASE LINE OF SPILLWAY



TYPICAL SPILLWAY SECTION



General Notes:

1. A minimum of 6" of topsoil to be placed in spillway & on Embankment, dike, spillway slopes, & waste areas, except where rock is encountered or rock rip-rap is placed. Refer to specifications.
2. Stream Channel within embankment area to be cleared of objectionable material in accordance with "Special Stream Channel Excavation" of the specifications.

PLAN OF EMBANKMENT AND SPILLWAY

200 0 200 400 800 Feet

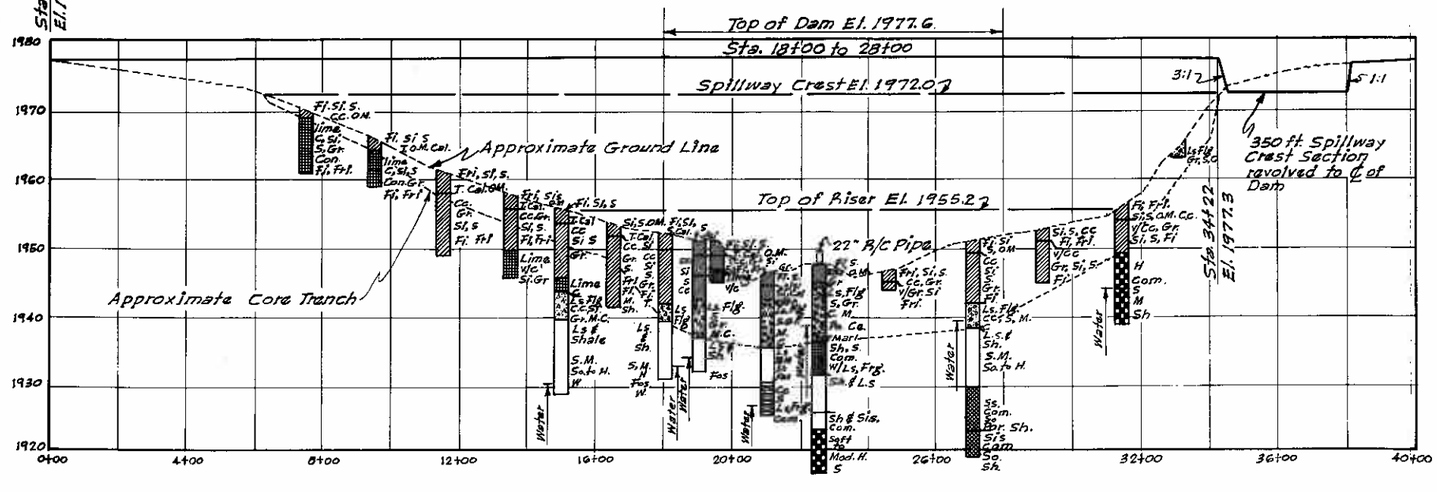
Note: Bar at left of boring is at spillway grade.

LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY

C	Clay - Clayey
Gr.	Gravel - Gravelly
L.s.	Limestone
M.	Marl - Marly
O.M.	Organic Matter
S	Sand - Sandy
Sh	Shale - Shaly
Sl.	Silt - Silty
Sis.	Siltstone
Ss.	Sandstone
Flg.	Flagstone
Frg.	Fragments
Con.	Concretions
C.C.	Calcium Carbonate
Cal.	Calcareous
Fos.	Fossiliferous
Com.	Compact
Fi	Firm
Fri.	Friable
H	Hard
Mas.	Massive
Mod.	Moderately
Po. Ce.	Poorly Cemented
Por.	Porous
So.	Soft
T.	Tough
v/	Very
Vug.	Vugular
w/	With
W.	Weathered

LEGEND OF BORINGS



PROFILE ON ℄ OF DAM

Figure 4

TYPICAL FLOODWATER RETARDING STRUCTURE

GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	G.W.T.	8/56	Approved by: A. M. — Area Engineer & Watershed Planning Unit, Fort Worth, Texas
Drawn	G.W.T. - D.S.	8/56	Area Conservationist, Temple, Texas
Traced	D.S.	8/56	Sheet No. 3 of 3
Checked	C.E.C. G.W.T.	9/56	Drawing No. 4-E-10,752

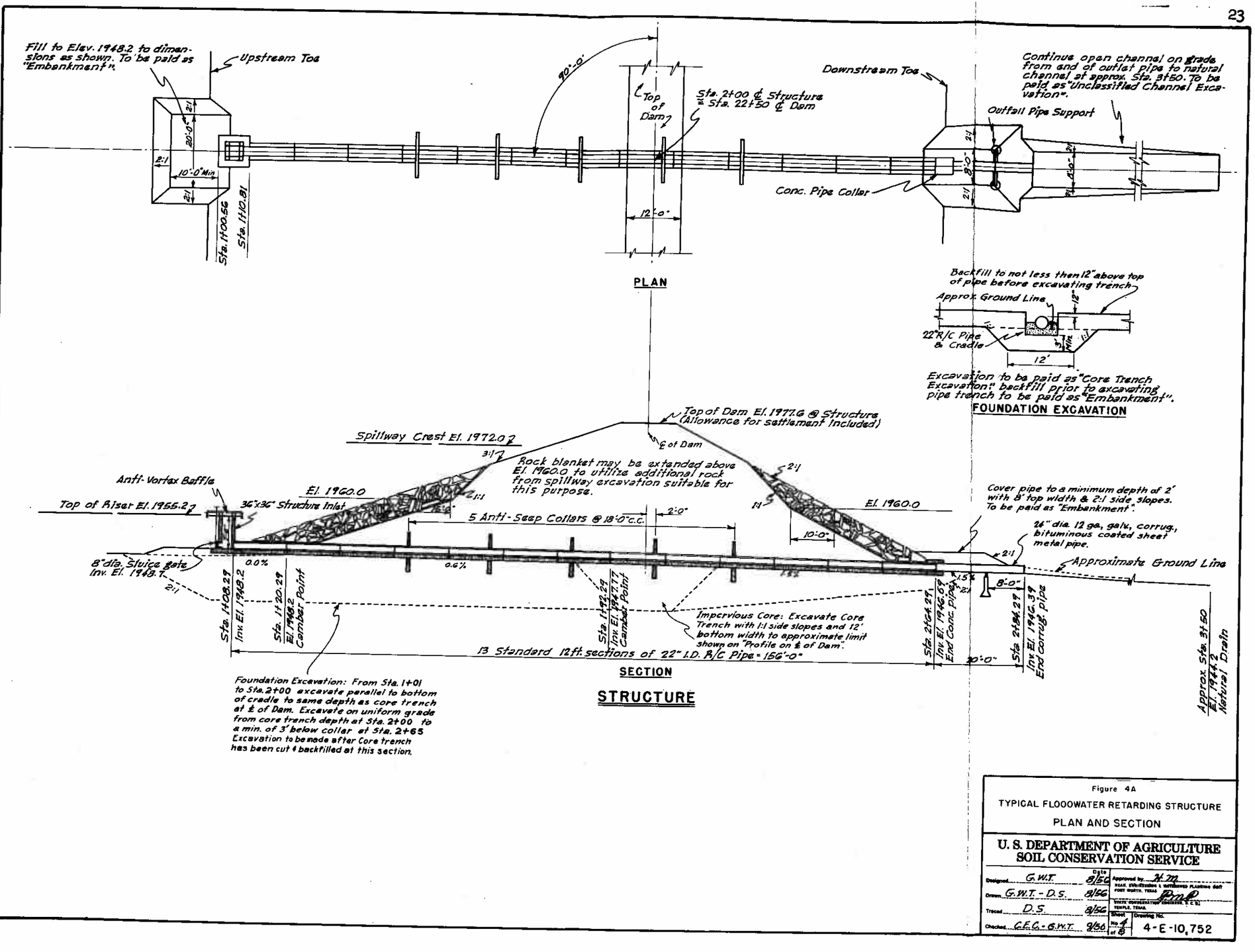


Figure 4A

TYPICAL FLOODWATER RETARDING STRUCTURE

PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	G.W.T.	8/56	Approved by	A.M.
Drawn	G.W.T. - D.S.	8/56		P.M.P.
Traced	D.S.	8/56	Sheet No.	4 of 8
Checked	C.E.C. - G.W.T.	9/56	Drawing No.	4-E-10,752

the drainage area, the capacity needed for detention and for sediment storage in acre-feet and in inches of runoff from the drainage areas, the release rate of the principal spillway, the acres of flood plain inundated by the sediment and detention pools, the volume of fill in the dams, the estimated cost of the structures, and other pertinent data (tables 2 and 3).

4. Damages resulting from floodwater, sediment, and erosion were determined from damage schedules, surveys of sample areas, and flood routing under present conditions. Reductions in these damages resulting from the proposed works of improvement were estimated on the basis of reduction of peak discharges as determined by flood routing under future conditions for which it was assumed that the proposed works of improvement had been installed. Benefits so determined were allocated to individual structures or groups of interrelated structures on the basis of the effect of each on reduction of damages. In this manner it was determined that a system of 14 floodwater retarding structures, could be economically justified.

When the land treatment measures and these structural measures for flood prevention had been determined, a table was developed to show the total cost of each type of measure. The summation of the total costs for all the needed measures comprises the estimated cost of the planned watershed protection and flood prevention project (tables 1 and 2). A second cost table was developed to show separately the annual installation cost, annual maintenance cost, and total annual cost of the structural measures (table 6).

Hydraulic and Hydrologic Investigations

The following steps were taken as a part of the hydraulic and hydrologic investigations and determinations:

1. Basic meteorologic and hydrologic data were tabulated and analyzed.

2. Engineering surveys were made on selected stream reaches and structure sites and basic hydraulic relationships were determined.

3. Hydrologic conditions of the watershed were studied by considering such factors as climate, geology, topography, soils, land use, and cover. Soil-cover complex data were assembled from which curve numbers were computed for use in determining depth of runoff from individual storms, using monthly soil moisture indices. These data were compared to the best available gaged runoff data.

4. Data from recent floods were used to determine relationships

The minimum floodwater detention volume in the structures was determined in accordance with Soil Conservation Service Engineering Memorandum No. 3, Revised, using a six-hour rainfall of the specified frequency assuming moisture condition II. Sites 3, 13 and 14 require detention of 4.35 inches of runoff and all the others require 4.03 inches. The actual detention planned is shown in table 3.

Principal spillway capacities were determined by the capacity of the smallest channel section through which the released water would pass. Higher release rates were used for sites 3, 6, and 9, in order to decrease the frequency of flooding portions of roads and cultivated fields and to decrease the length of time that the roads and cultivated fields would be inundated. The higher release rate for site 9 will also insure available storage for emergency spillway flow from sites 8 and 10, thus decreasing the frequency of flow through the emergency spillway.

Emergency spillway capacities were designed in accordance with Soil Conservation Service Engineering Memorandum No. 3, Revised, and the Soil Conservation Service National Engineering Handbook, Section 4, Supplement A, Chapter 3.21.

Sedimentation Investigation

The field surveys of the sedimentation problems in the Auds Creek watershed were made in accordance with methods prescribed in the "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans," Water Conservation - 6, SCS, Region 4, revised February, 1954. Field studies of overbank deposits, flood plain scour, streambank erosion, and the nature of the channels and valleys were made on or near all the valley cross sections. Borings were made along all cross sections to determine the nature and thickness of sediment deposits. In the preparation of the work plan, tabular summaries of all the above findings, with explanatory texts, were prepared. These were used by the economist as a basis for calculating monetary damages.

Sediment Source Studies

Investigations of sediment sources in the drainage areas above eleven of the proposed floodwater retarding structures were made according to standard procedures. Estimates were then made for both present and future sediment production in the drainage areas above the remaining sites. The sediment derived from sheet erosion was estimated by the use of a formula shown in "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairie Problem Area in Soil Conservation," Soil Conservation Service, Region 4, February, 1953. The formula is based on data obtained by watershed surveys including the following:

1. Soil unit in acres, by slope in percent, slope length in feet, and present land use (cultivated or pasture).

2. Cover condition classes on pasture.

3. Past history of land use.

4. Maximum 30-minute rainfall intensity to be expected once in two years.

The amount of sediment derived from gully and streambank erosion was estimated by field studies, use of aerial photographs, and by interviews with landowners in the watershed who were able to give information on the history of gully development and channel enlargement.

The total annual sediment yield above the 14 planned floodwater retarding structures was calculated to be 19.07 acre-feet. The average rate of sediment deposition per square mile is 0.84 acre-foot annually. It is estimated that 91 percent of the sediment yield is derived from sheet erosion and 9 percent from modern gully and streambank erosion.

Effect of Watershed Treatment on Sediment Yield

Areas damaged by overbank deposition and flood plain scour should again become productive after they have been protected from flooding and adapted soil improving crop rotations have been put into effect. It is estimated that after the installation of the complete program the present rate of sediment damage will be reduced by 54 percent. Analysis of present conditions indicates that the major portion of the annual sediment production results from sheet erosion of cultivated land. The proper application of the needed land treatment will reduce sediment production from sheet erosion by an estimated 30 percent, and the installation of the structural meaaures will afford an additional 24 percent reduction.

The installation of the complete program will have a measurable effect on the reduction of flood plain scour damage. The rate of damage, by this process, in the future, will be reduced by approximately 38 percent. This reduction is based on the area inundated by floodwater after the complete program is installed as compared to the present area inundated.

Geological Investigations

Reconnaissance geologic investigations were made at all of the planned floodwater retarding structure sites. These included brief lithologic and stratigraphic studies of the valley slopes, alluvium, channel banks, and exposed geologic formation. Borings, with a hand auger, were made at representative sites to determine the nature and extent of fill material, and other possible problems that might be encountered in construction.

Description of Problems

The Pecan Gap, Wolf City, Taylor (undivided), Gober, and Brownstown formations, which are members of the Taylor Group of Upper Cretaceous

age, occur in the Auds Creek watershed. No floodwater retarding structures are planned in the Pecan Gap, Wolf City, Taylor (undivided), or Gober formations.

The Brownstown formation outcrop covers the northern one-fourth of the watershed. This formation is the oldest of the Taylor Group, and consists of dark, calcareous clay containing irregularities filled with limy, sandy clay. All of the floodwater retarding structures are located within this outcrop. The embankment material at these sites should be excellent and few problems should be encountered in construction.

Detailed investigations, including exploration with core-drilling equipment, will be made at all floodwater retarding structure sites prior to their construction. Laboratory tests will be made to determine the suitability of the available embankment and core wall material.

Economic Investigation

Basic methods used in the economic investigation and analysis are outlined in the Soil Conservation Service Interim Economics Guide issued May 14, 1956.

Determination of Annual Benefits from Reduction in Damages

Agricultural damage estimates were based upon schedules obtained in the field covering 85 percent of the flood plain of Auds Creek and its tributaries. These schedules covered land use, crop distribution under normal conditions, crop yields and historical data on flooding and flood damage.

Most of the flood damage information obtained was for floods which occurred in 1953 and 1956.

Analysis of this information formed the basis for determining damage rates for various depths and seasons of flooding. In calculation of crop and pasture damage, expenses saved, such as costs of harvesting, were deducted from the gross value of the damage.

The proper rates of damage were applied flood by flood, to the floods covering the historical period 1923 to 1952 and an adjustment was made to take into account the effect of recurrent flooding when several floods occurred within one year. The flood plain land use was mapped in the field. Normal yields were based on data obtained from the schedules supplemented by information obtained from agricultural workers in the area.

It was found that significant differences in land use, yields, frequency of flooding, and degree of future use were sufficient to divide the flood plain into five evaluation reaches, each with its own damageable value. Reach A covered that portion of the flood plain from Site No. 1 to just

downstream from State Highway 24, Reach B covered Cottonwood Branch, Reach C covered Baker Branch, and Reach D covered Auds Creek downstream from Highway 24 to valley cross section R-16. Reach E included the area downstream from this point where no damage occurred from any storm in the evaluation period. Damages to other agricultural property, such as fences, livestock, and farm equipment, were obtained from analysis of flood damage schedules and correlated with sizes of floods.

Benefits on each tributary flood plain were allocated to the structures on that tributary on the basis of drainage area controlled. Benefits on the common flood plain below the confluence of Baker Branch were allocated to all the structures on the basis of drainage area controlled by each structure.

The monetary value of the physical damage to the flood plain from erosion and from deposition of sediment was based on the net value of the production lost, taking into account lag in recovery and/or the cost of farm operations to speed recovery. Damage from erosion was related to depth of flooding, giving greater weight to deeper flows.

Estimates of damages to roads and bridges in the flood plain were obtained from the county commissioner for the precinct and from the state highway district maintenance engineers. These estimates were supplemented by information obtained from local farmers.

Indirect damages in this watershed primarily involve extra farming expense, additional travel time for farmers, school bus transportation and mail delivery, and costs for extra feed. Upon analysis, it appeared that these damages are about 15 percent of the direct damage.

Farmers in the flood plain were asked to state changes made in land use as a result of past flooding. This information, together with landowners' and operators' estimates of changes in land use and crop distribution as a result of reduction in flood extent and frequency, was the basis for estimating benefits from changed land use and restoration of productivity. These estimated benefits were divided between intensification and restoration of productivity based upon farm by farm analysis. Benefits from restoration of productivity are included as crop and pasture benefits. They involve changes in crop distribution, increased yields due to earlier dates of planting and lower costs of tillage. Consideration was given to increased damage after restoration of productivity and the added damage was deducted.

All benefits from flood plain land use changes and restoration of productivity are net benefits remaining after production and harvest costs, additional costs for taxes and overhead, and clearing costs where applicable. All benefits from changed flood plain land use were discounted to provide for a five year lag in accomplishment. Flood plain areas which will be inundated by the sediment, sediment reserve and detention pools were excluded from the damage calculations. An

estimate was made, however, of the value of the production lost in these areas after installation of the program. In this appraisal it was considered that there would be no production in the sediment pools, and that the land covered by the detention pools would continue to be used as pasture after installation of the program.

The costs of land, easements, and rights-of-way for the 14 floodwater retarding structures were determined by individual appraisal in conjunction with directors of the Lamar County Water Control and Improvement District No. 1. This evaluation was based on full value for the sediment pools and half value for the detention pools since the latter will remain in use as pasture.

The average annual loss in production within the sites was calculated to be $1,021 based on long term price levels. The amortized cost of the structure sites is $1,136. Therefore, in accordance with sound economic principles, the larger of the two figures was used in the economic evaluation of the program to assure a conservative benefit-cost analysis. At the request of the local interests an investigation was made to determine the possibility of dividing the structures into construction units. After benefits were allocated to each group of structures it was found that no single structure or group of structures had benefits upstream from the common flood plain sufficient to establish them as construction units.

Determination of Benefits Outside of the Watershed

Benefits outside the watershed were estimated from benefits obtained in watersheds having similar flood plain land use. Analysis of these data indicated that benefits of $0.109 would accrue for each acre foot of detention storage. Benefits to the North Sulphur River flood plain were therefore calculated on that basis.

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

AUDS CREEK WATERSHED, TEXAS
Price Base: Current Price Levels

Site No.	P. L. 566 Installation Cost					Other Installation Cost			Estimated Total Cost
	Construction		Instal. Services			Other			
	Eng. Est.	Contingencies	Engineering	Other	Total P.L. 566	Adm. of Contracts	Easement & R/W	Total Other	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures									
1	22,757	2,276	5,006	3,004	33,043	500	3,350	3,850	36,893
2	20,652	2,065	4,543	2,726	29,986	500	2,705	3,205	33,191
3	26,240	2,624	5,773	3,463	38,100	500	3,455	3,955	42,055
4	16,006	1,601	3,521	2,113	23,241	500	1,300	1,800	25,041
5	22,090	2,209	4,860	2,916	32,075	500	1,748	2,248	34,323
6	20,354	2,035	4,478	2,687	29,554	500	6,895	7,395	36,949
7	10,639	1,064	2,341	1,404	15,448	500	1,118	1,618	17,066
8	31,044	3,104	6,830	4,098	45,076	500	8,470	8,970	54,046
9	18,080	1,808	3,978	2,386	26,252	500	4,440	4,940	31,192
10	18,548	1,855	4,080	2,448	26,931	500	5,450	5,950	32,881
11	28,224	2,822	6,209	3,726	40,981	500	4,100	4,600	45,581
12	24,212	2,421	5,327	3,196	35,156	500	3,325	3,825	38,981
13	21,100	2,110	4,642	2,785	30,637	500	2,112	2,612	33,249
14	17,286	1,729	3,803	2,282	25,100	500	1,520	2,020	27,120
GRAND TOTAL	297,232	29,723	65,391	39,234	431,580	7,000	49,988	56,988	488,568

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TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES

AUDS CREEK WATERSHED, TEXAS

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8
Drainage Area	sq.mi.	1.51	1.16	1.70	0.52	0.93	1.62	0.52	2.53
Storage Capacity									
Sediment	ac.ft.	80	51	156	44	68	85	32	65
Sediment reserve above riser	ac.ft.	6	4	13	4	5	7	3	5
Floodwater detention	ac.ft.	508	384	564	166	315	552	171	801
Total	ac.ft.	594	439	733	214	388	644	206	871
Surface Area									
Sediment pool	acre	26	15	33	12	20	26	9	25
Floodwater detention pool	acre	82	63	77	33	57	88	32	132
Maximum Height of Dam	foot	23	23	22	21	23	23	22	23
Volume of Fill	cu.yd.	60,340	54,660	68,000	42,430	58,310	53,980	28,140	76,650
Emergency Spillway									
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of use 1/	year	85	80	100	95	85	100	100	90
Design storm rainfall									
Duration	hour	6	6	6	6	6	6	6	6
Total	inch	13.6	13.8	13.6	14.0	13.9	13.6	14.0	13.4
Bottom width	foot	110	100	100	30	100	50	30	100
Design depth	foot	3.0	3.5	3.0	3.0	3.0	3.0	3.0	4.0
Design capacity	c.f.s.	1,510	1,780	1,370	410	1,370	680	410	2,220
Freeboard	foot	1.0	2.0	1.0	1.0	2.0	1.0	1.0	2.0
Total capacity	c.f.s.	2,440	3,700	2,220	670	3,200	1,110	670	4,200
Principal Spillway Capacity	c.f.s.	10	8	34	5	6	32	5	25
Capacity Equivalents									
Sediment volume	inch.	1.07	0.90	1.86	1.71	1.50	1.06	1.24	0.52
Detention volume	inch	6.33	6.24	6.21	6.01	6.37	6.40	6.14	5.93
Spillway storage	inch	4.82	7.56	4.05	6.16	6.28	4.32	5.82	7.55
Class of Structure		A	B	A	A	B	A	A	B

1/ Based on gaged runoff from similar watershed plus drawdown from the principal spillways.

TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES

AUDS CREEK WATERSHED, TEXAS

Item	Unit	STRUCTURE NUMBER 9	10	11	12	13	14	Total
Drainage Area	sq.mi.	1.63	0.96	2.32	1.68	1.08	0.79	18.95
Storage Capacity								
Sediment	ac.ft.	31	66	125	84	85	65	1,037
Sediment reserve above riser	ac.ft.	2	5	10	6	7	5	82
Floodwater detention	ac.ft.	551	317	737	545	352	270	6,233
Total	ac.ft.	584	388	872	635	444	340	7,352
Surface Area								
Sediment pool	acre	15	18	32	25	17	17	290
Floodwater detention pool	acre	96	63	116	88	63	44	1,034
Maximum Height of Dam	foot	18.5	23	27	20	22	20	xxx
Volume of Fill	cu.yd.	44,180	47,020	74,350	64,110	55,260	45,660	773,090
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Frequency of use 1/	year	100	100	65	100	100	100	xxx
Design storm rainfall								
Duration	hour	6	6	6	6	6	6	xxx
Total	inch	13.6	14.5	13.4	13.6	13.8	13.9	xxx
Bottom width	foot	300	100	200	100	80	100	xxx
Design depth	foot	3.0	2.5	3.5	3.0	3.0	2.0	xxx
Design capacity	c.f.s.	4,110	1,010	3,560	1,370	1,096	670	xxx
Freeboard	foot	2.0	1.0	2.0	1.0	1.0	1.0	xxx
Total capacity	c.f.s.	9,600	1,780	7,400	2,220	1,776	1,370	xxx
Principal Spillway								
Capacity	c.f.s.	58	10	17	17	11	8	xxx
Capacity Equivalents								
Sediment volume	inch	0.38	1.40	1.09	1.01	1.59	1.65	xxx
Detention volume	inch	6.32	6.20	5.96	6.07	6.12	6.39	xxx
Spillway storage	inch	6.85	5.10	6.05	4.72	5.07	3.96	xxx
Class of Structure		B	A	B	A	A	A	

1/ Based on gaged runoff from similar watershed plus drawdown from the principal spillways.

TABLE 4 - SUMMARY OF PHYSICAL DATA

AUDS CREEK WATERSHED, TEXAS

Item	Unit	Quantity Without Program	Quantity With Program
Watershed Area	Sq.Mi.	49.48	xxx
Watershed Area	Acre	31.670	xxx
Area Privately Owned	Acre	31,670	xxx
Area of Cropland	Acre	16,354	16,948
Area of Grassland	Acre	13,891	13,297
Miscellaneous Area	Acre	1,425	1,425
Overflow Area Subject to Damage	Acre	3,108	1,935
Overflow Area Damaged Annually By: 1/			
Sediment	Acre	1,892	870
Flood plain scour	Acre	396	246
Streambank erosion	Acre	0.6	0.6
Annual Rate of Erosion			
Sheet	Acre-Feet	104.90	48.25
Gully	Acre-Feet	10.81	4.97
Streambank	Acre-Feet	3.09	3.09
Scour	Acre-Feet	43.42	28.22
Average Annual Rainfall	Inches	40.30	xxx

1/ The acreage on which production loss occurs each year.

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TABLE 5 - SUMMARY OF PLAN DATA

AUDS CREEK WATERSHED, TEXAS

Item	Unit	Quantity
Years to complete project	Year	5
Total installation coat		
Public Law 566 funds	Dollar	461,330
Other	Dollar	404,616
Annual O & M cost		
Federal	Dollar	0
Non-Federal	Dollar	1,497
Average annual monetary benefits 1/	Dollar	34,496
Agricultural	Percent	95
Nonagricultural	Percent	5
Structural meaaures		
Floodwater retarding structures	Each	14
Area inundated by atructures		
Flood plain		
Sediment pool	Acre	34
Detention pool	Acre	18
Upland		
Sediment pool	Acre	256
Detention pool	Acre	726
Watershed area above structures	Acre	12,128
Reduction of floodwater damage	Dollar	27,877
By Land Treatment Measures -		
Watershed Protection	Percent	10
By Structural Measures	Percent	64
Reduction of sediment damage	Dollar	6,673
By Land Treatment Measures -		
Watershed Protection	Percent	30
By Structural Measures	Percent	33
Reduction of eroaion damage	Dollar	1,274
By Land Treatment Measures		
Watershed Protection	Percent	16
By Structural Measures	Percent	60
Flood Prevention benefit from changed land use	Dollar	791
Benefits outside of watershed	Dollar	681

1/ From structural measures.

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TABLE 8 - BENEFIT COST ANALYSIS

AUDS CREEK WATERSHED, TEXAS

Measures	AVERAGE ANNUAL BENEFITS 1/							Average Annual Cost 2/	Benefit Cost Ratio
	Flood Prevention								
	Flood-water	Sediment	Erosion	Indirect	Changed Land Use	Other	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures									
1	2,223	321	92	343	61	52	3,092	1,416	2.18:1
2	1,708	247	70	264	47	40	2,376	1,285	1.85:1
3	2,503	361	103	387	68	59	3,481	1,597	2.18:1
4	766	111	32	118	20	18	1,065	973	1.09:1
5	1,369	198	56	211	38	32	1,904	1,325	1.44:1
6	2,384	344	98	368	67	57	3,318	1,418	2.34:1
7	765	111	32	118	21	18	1,065	692	1.54:1
8 and 9 3/	4,706	679	195	945	166	143	6,834	3,247	2.10:1
10	1,088	157	45	218	39	33	1,580	1,250	1.26:1
11	2,626	379	107	527	90	80	3,809	1,697	2.24:1
12	1,930	279	81	382	67	57	2,796	1,490	1.88:1
13	1,243	179	50	245	43	37	1,797	1,287	1.40:1
14	911	131	37	181	64	55	1,379	1,046	1.32:1
GRAND TOTAL	24,222	3,497	998	4,307	791	681	34,496	18,723	1.84:1

1/ Price Base - long-term price levels, as projected by ARS, June 1956.
2/ Derived from installation costs based on 1957 price level and operations and maintenance cost based on long-term price level, as projected by ARS, June 1956.
3/ Sites 8 and 9 are interdependent.

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TABLE 9 - COST SHARING SUMMARY

AUDS CREEK WATERSHED, TEXAS
Price Base: 1957 1/

Type of Cost	P.L. 566 Funds		Other		Total Cost	
	Dollars	Percent	Dollars	Percent	Dollars	Percent
Land Treatment						
Non-Federal Land For Watershed Protection	29,750	7.9	347,628	92.1	377,378	43.6
Subtotal	29,750	7.9	347,628	92.1	377,378	41.5
Structural Measures						
Installation Flood Prevention	431,580	88.3	56,988	11.7	488,568	56.4
Subtotal	431,580	88.3	56,988	11.7	488,568	53.8
Total Installation Cost	461,330	53.3	404,616	46.7	865,946	95.3
Operation and Maintenance 2/	0	0	42,458	100.0	42,458	4.7
Total Structural Cost	431,580	81.3	99,446	18.7	531,026	58.5
TOTAL PROJECT COST	461,330	50.8	447,074	49.2	908,404	100.0

1/ Except operation and maintenance which is based on long-term prices, as projected by ARS, June 1956.
2/ Capitalized for 50 years at 2.5 percent.

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