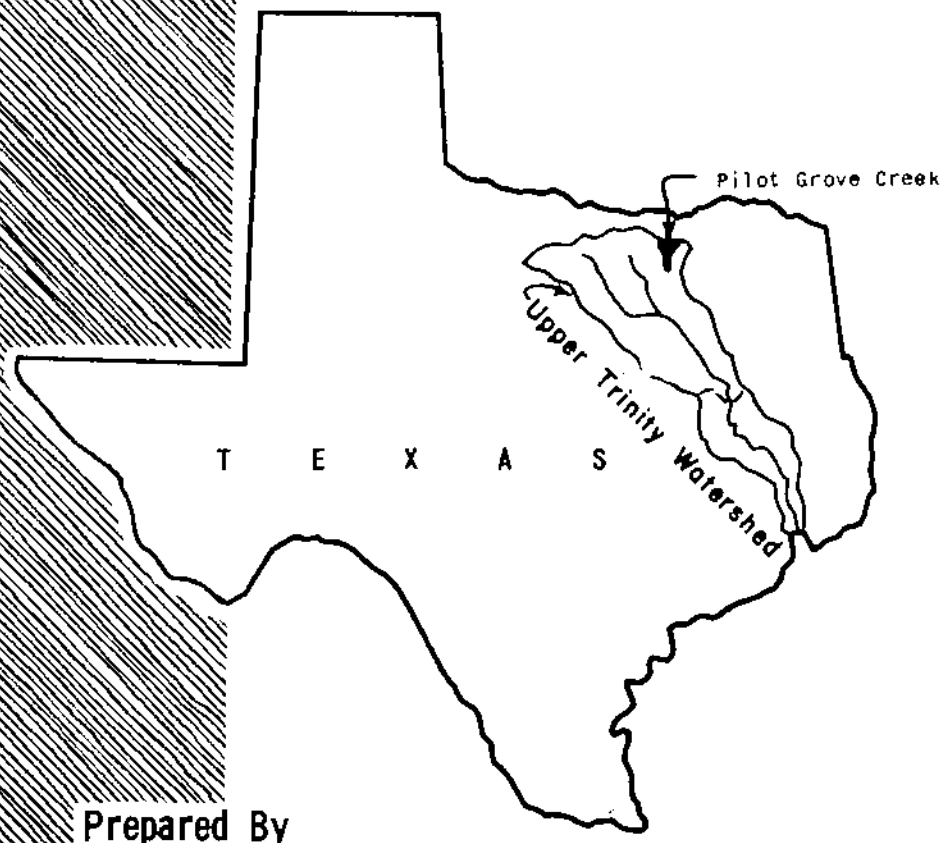
WORK PLAN

PILOT GROVE CREEK WATERSHED

OF THE TRINITY RIVER WATERSHED
COLLIN, FANNIN, GRAYSON, AND
HUNT COUNTIES, TEXAS



Prepared By
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Temple, Texas
January 1959

USDA-SCS-FORT WORTH, TEX 1959

WATERSHED WORK PLAN AGREEMENT

between the

Collin County Soil Conservation District
Local Organization

Fannin County Soil Conservation District
Local Organization

Upper Elm-Red Soil Conservation District
Local Organization

Upper Sabine Soil Conservation District
Local Organization

(Hereinafter referred to as the Districts)

Collin County Commissioners Court
Local Organization

Fannin County Commissioners Court
Local Organization

Hunt County Commissioners Court
Local Organization

(Hereinafter referred to as the County)

In the State of Texas

and the

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

Whereas, the Districts have heretofore entered into a Flood Control Supplemental Memorandum of Understanding with the Soil Conservation Service for assistance in constructing works of improvement for the prevention of floods in the Pilot Grove Creek Watershed, State of Texas, under the authority of the Flood Control Act of 1944 (58 Stat. 887).

Whereas, the responsibility for carrying out all or a portion of the work of the Department on the watershed has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Districts and the Service a mutually satisfactory plan for works of improvement for the Pilot Grove Creek Watershed, State of Texas, hereinafter referred to as the Watershed Work Plan;

Whereas, the County will benefit from the carrying out of the plan for works of improvement through the reduction of damages to property, including county roads and bridges in the county that are located within the flood plain of the watershed;

It is mutually agreed that in installing and operating and maintaining the Works of Improvement described in the Watershed Work Plan:

1. The Districts and/or the Counties 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. The Counties will not participate in the acquisition of land, easements or rights-of-way until the Districts have made every reasonable effort to secure all necessary easements, permits and rights-of-way in a hydrological unit or sub-watershed and the Districts and Counties desire to proceed with construction, the County will provide the Service with an assurance that all remaining necessary easements, permits and rights-of-way will be acquired by condemnation, if necessary, by a date acceptable to the State Conservationist.

2. The Districts 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 Service will provide all construction costs and installation services applicable to Works of Improvement for flood prevention.

4. The Districts will obtain agreements from owners of not less than 50 percent of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

5. The Districts will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the Watershed Work Plan.

6. The Districts will encourage landowners and operators to operate and maintain the land treatment.

7. The Districts and the Counties 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 an Operation and Maintenance Agreement which is to be entered into.

8. 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.

9. 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.

Collin County Soil Conservation District
Local Organization

By _____

Title Chairman

Date 1-18-60

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

adopted at a meeting held on 1-18-60

_____
(Secretary, Local Organization)

Date 1-18-60

Fannin County Soil Conservation District
Local Organization

By W. T. Hull

Title Chairman

Date 2-6-60

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

adopted at a meeting held on 2-6-60

A. H. McDonald
(Secretary, Local Organization)

Date 2-6-60

Upper Elm-Red Soil Conservation District
Local Organization

By John Levermann

Title Vice Chairman

Date 2-11-60

The signing of this agreement was authorized by a resolution of the governing body of the Upper Elm-Red Soil Conservation District
Local Organization

adopted at a meeting held on 2-11-60

Willard Kingston
(Secretary, Local Organization)

Date 2-11-60

Upper Sabine Soil Conservation District
Local Organization

By [signature]

Title Ch

Date 2/8/60

The signing of this agreement was authorized by a resolution of the governing body of the Upper Sabine Soil Conservation District
Local Organization

adopted at a meeting held on 2-8-60

[signature]
(Secretary, Local Organization)

Date 2-8-60

Collin County Commissioners Court
Local Organization

By Don Keenan Dan

Title County Judge

Date 1-25-60

The signing of this agreement was authorized by a resolution of the governing body of the Collin County Commissioners Court
Local Organization

adopted at a meeting held on 1-25-60

Jas P Webb, County Clerk
(Secretary, Local Organization)

Date 1-25-60

Fannin Count Commissioners Court
Local Organization

By Lonnie Moore

Title County Judge

Date February 29, 1960

The signing of this agreement was authorized by a resolution of the governing body of the Fannin County Commissioners Court
Local Organization

adopted at a meeting held on 29 day Feb. 1960

G. L. Hahman
(Secretary, Local Organization)

Date 2/29/60

Hunt County Commissioners Court
Local Organization

By Lee F Bostick

Title Co Judge

Date 3/29/1960

The signing of this agreement was authorized by a resolution of the governing body of the Hunt County Commissioners Court
Local Organization

adopted at a meeting held on 29th day March 1960

Bloann Johnson Co. Clerk
(Secretary, Local Organization) A Deputy

Date _____

United States Department of Agriculture
Soil Conservation Service

By _____
State Conservationist

Date _____

WORK PLAN

PILOT GROVE CREEK WATERSHED
Of the Trinity River Watershed
Collin, Fannin, Grayson and Hunt Counties, Texas

Plan Prepared and Works of Improvement
to be Installed Under the Authority of
the Flood Control Act of 1936 as Amended
and Supplemented.

Participating Agencies

Collin County Soil Conservation District
Fannin County Soil Conservation District
Upper Elm-Red Soil Conservation District
Upper Sabine Soil Conservation District
Collin County Commissioners Court
Fannin County Commissioners Court
Hunt County Commissioners Court

Prepared By:

Soil Conservation Service
U. S. Department of Agriculture
January 1959

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

List of Tables and Figures

SECTION 1

WORK PLAN

PILOT GROVE CREEK WATERSHED
Of the Trinity River Watershed
Collin, Fannin, Grayson and Hunt Counties, Texas
January 1959

SUMMARY OF PLAN

General Data

Drainage Area:

169,930 Acres - - - 265.5 Square Miles

Location of Watershed:

Upper Sabine Soil Conservation District	19,860 acres
Fannin County Soil Conservation District	5,822 acres
Collin County Soil Conservation District	135,780 acres
Upper Elm-Red Soil Conservation District	8,468 acres

Land Use:

Cultivation	75,520 acres
Pasture	78,736 acres
Wooded Pasture	4,276 acres
Miscellaneous (towns, roads, railroads, etc.)	11,398 acres

Flood Plain Area: - - 18,849 acres

Flood Frequency:

Total of 79 floods during 20-year period of study (1923 through 1942), of which 28 inundated more than half the flood plain area.

Land Treatment:

Practice	Unit	Applied to Date	To Be Applied January 1959 - January 1969
Contour Farming	Acre	25,000	27,546
Cover Cropping	Acre	13,698	29,296
Crop Residue Utilization	Acre	30,748	34,990
Rotation Hay and Pasture	Acre	8,806	9,305
Pasture Planting	Acre	20,585	25,363
Proper Use, Pasture	Acre	15,070	25,066

Land Treatment: Continued

Practice	Unit	Applied to Date	To be Applied January 1959 - January 1969
Pond Construction	No.	422	520
Brush Control	Acre	327	1,011
Diversion Construction	Mile	15	78
Terracing	Mile	1,250	1,377
Waterway Development	Acre	769	1,789
Drop Inlets & Drop Structures	No.	65	243
Sod Flumes	No.	19	701

Structural Measures:

	Unit	
Floodwater Retarding Structures	No.	84
Stream Channel Improvement	Mile	39.43

Cost Installation Period:

Item	Federal (dollars)	Non-Federal (dollars)	Total (dollars)
Land Treatment	119,796	1,414,198	1,533,994
Structural Measures	3,698,799	382,490	4,081,289
Work Plan Preparation	28,600	-	28,600
Total	3,847,195	1,796,688	5,643,883

Average Annual Damages and Benefits:

Item	Damage			Benefit
	Without Project	With Land Treatment	With Project	Structural Measures
	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Damage	318,500	298,433	53,215	245,218
Sediment Damage	29,022	25,607	5,903	19,704
Erosion Damage (Flood Plain)	5,460	4,645	431	4,214
Indirect Damage	32,788	30,358	5,934	24,424
Total	385,770	359,043	65,483	293,560

Benefit-Cost Ratio - Structural Measures:

Average Annual Benefits	$293,560
Average Annual Cost	163,990
Benefit-Cost Ratio	1.8:1

Operation and Maintenance:

Land Treatment Measures - Landowners and Operators Under Agreement With:

Upper Sabine Soil Conservation District
Fannin County Soil Conservation District
Collin County Soil Conservation District
Upper Elm-Red Soil Conservation District

Structural Measures:

Upper Sabine Soil Conservation District
Fannin County Soil Conservation District
Collin County Soil Conservation District
Upper Elm-Red Soil Conservation District
Collin County Commissioners Court
Fannin County Commissioners Court
Hunt County Commissioners Court

Annual Cost - $15,773

DESCRIPTION OF WATERSHED

Physical Data

Pilot Grove Creek rises in the southeastern part of Grayson County at the town of Tom Bean. Some tributaries rise in Fannin and Hunt Counties. It flows south through parts of Grayson and Collin Counties to enter Lavon Reservoir 4 miles west of Farmersville. The larger tributaries are Desert, Indian, Pot Rack, Arnold, Bear, Lee and Grove Creeks. Elm and Price Creeks and Harrington Branch drain directly into Lavon Reservoir. The watershed has an area of 169,930 acres (265.5 square miles), 93.3 percent of which is in farms and ranches.

Upland slopes generally range from 1 to 6 percent, with some slopes as steep as 20 percent adjacent to the valley plains. The main alluvial valley of Pilot Grove Creek ranges from 5,000 feet in width at the point of entrance into Lavon Reservoir to 500 feet at the headwaters. The valley widths of the main tributaries range from 4,500 feet near their confluence with the mainstem to 500 feet near the headwaters. Elevations range from 500 to 800 feet above mean sea level.

All the drainage area lies within the Blackland Prairies Land Resource Area. The soils are medium to fine textured, very slowly to moderately permeable, and deep to very shallow. The principal soil series are Wilson, Crockett, Houston, Austin, Eddy, Kaufman, and Trinity. Erosion ranges from slight to severe depending on land use and amount of conservation treatment. A large percent of the Houston series, especially, is in cultivation. The upper part of the watershed is in the Austin and Eddy soil series. A large portion of the cropland in this area is in small grains, thus erosion is fairly low.

The watershed is underlain by the Austin chalk and Taylor marl formations of the Upper Cretaceous system.

The land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	75,520	44.5
Pasture	78,736	46.3
Wooded Pasture	4,276	2.5
Miscellaneous 1/	11,398	6.7
Total	169,930	100.0

1/ Includes roads, towns, railroads, etc.

Approximately 46 percent of the cultivated land is in small grains and legumes with the remainder in row crops. As a result, most of the cultivated soils are in fair to good condition. The pasture and wooded pasture cover conditions in percent are as follows:

Land Use	Good	Fair	Poor
Pasture	26.1	58.4	15.5
Wooded Pasture	-	85.0	15.0

Most of the pastures have a grass cover which is good to excellent from the standpoint of erosion control. Some formerly cultivated areas have not been established to a base grass and are in poor condition.

The flood plain considered in this plan is that area inundated by the runoff from a storm which can be expected to occur on an average of once in 25 years. This storm will produce a runoff of 5.3 inches and inundate 18,849 acres, excluding 1,186 acres of stream channels. The flood plain land use is:

Land Use	Acres	Percent
Cropland	7,244	38.5
Pasture	7,997	42.4
Wooded Pasture	2,510	13.3
Idle	968	5.1
Miscellaneous 1/	130	0.7
Total	18,849	100.0

1/ Includes roads, railroads, etc.

Mean temperatures range from 83.8 degrees Fahrenheit in summer to 44.7 degrees in winter. The extreme recorded temperatures are 7 degrees below zero and 118 degrees above zero. The average date of the last killing frost is March 29 and that of the first killing frost is November 13, a normal frost-free period of 229 days.

The mean annual precipitation of 39.95 inches, based on a 27-year record at McKinney, Texas, is fairly evenly distributed, with the greatest amounts of rainfall occurring in April and May. Individual rains of excessive amounts cause serious floodwater and erosion damage. Although these storms may occur during any season, the majority have occurred in the spring months. The minimum recorded annual rainfall was 20.76 inches; the maximum was 54.79 inches.

Water for domestic and livestock uses in the rural areas is supplied largely by shallow wells and small ponds. Farmersville has two small lakes but obtains its water supply principally from Lavon Reservoir. Water for other municipalities is obtained from wells.

Economic Data

The more productive uplands of the watershed are devoted largely to the production of crops. Approximately 75 percent of the cultivated land is used to grow cotton, corn, and small grains. Other crops grown are grain sorghums, hay and truck crops.

The more broken lands are used for pasture. Beef enterprises predominate, but there are several dairies within the watershed. Milk is sold to processors and distributors located outside the watershed.

Farms average 151 acres in size, with an average value of $22,000 for land and buildings, according to the U. S. Census of 1954. Tenant-operated farming is predominant.

Approximately 105 miles of hard-surface roads traverse the watershed. In addition, there are 420 miles of unimproved county roads. Rail service is adequate for all sections of the area.

Farmersville, with a population of 1,955, is the largest town in the watershed. Others, with the latest available population figures are: Leonard, 1,211; Trenton, 603; Blue Ridge, 306; Tom Bean, 286; and Westminister, 192. Many residents of these communities commute to and from their work in Sherman, McKinney, Greenville, Dallas, and Fort Worth.

WATERSHED PROBLEMS

Floodwater Damage

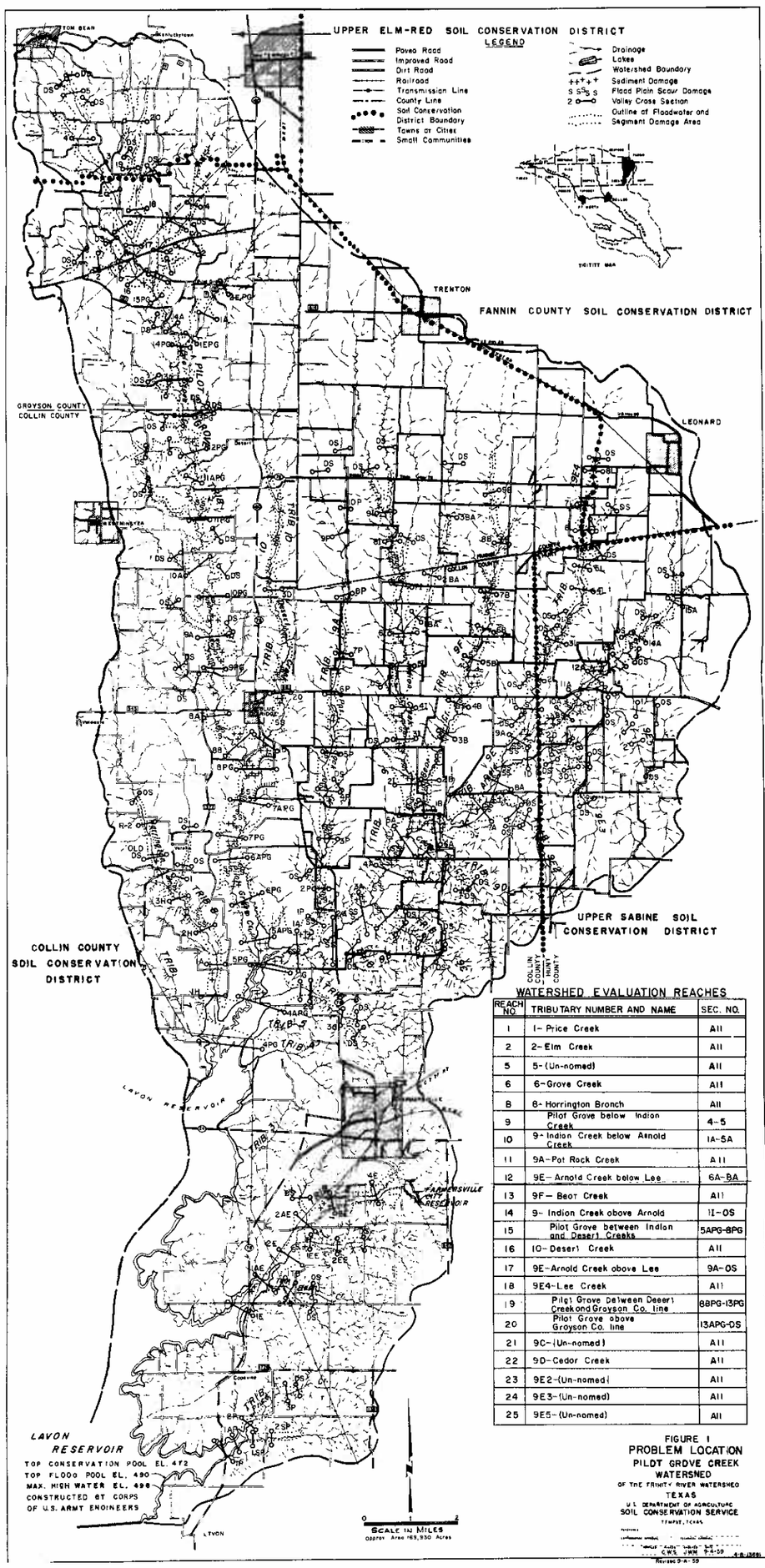
Frequent flooding has caused damages of considerable magnitude in the watershed (figure 1). Large floods have occurred on an average of more than once a year. During the 20-year period studied, 1923 through 1942, there were 28 major floods which covered more than half the flood plain and 51 smaller floods covering less than half the flood plain. Seventy-five percent of the major floods and 73 percent of the smaller floods occurred during the growing season and caused heavy damage to growing crops. The most recent major flood occurred in May 1958 and inundated as estimated 16,800 acres.

The largest storm in the evaluation series occurred in June 1935 and produced a runoff of 5.3 inches. This storm inundated 18,849 acres of flood plain.

It is estimated that the average annual direct monetary floodwater damage is $318,500 under existing conditions and exclusive of damage to areas which will be inundated by proposed floodwater detention structures. Included are $188,663 crop and pasture damage; $66,670 other agricultural damage, such as damage to fences, farm buildings, livestock, farm equipment, and farm levees and drains; and $63,167 nonagricultural damage, such as damage to roads, bridges and railroads. In addition, there are numerous indirect damages, such as interruption of travel, losses in business sustained by dealers and industries in the area, and other losses estimated to average $32,788 annually.

Erosion Damage

Erosion rates in the watershed range from low to high, depending primarily upon land use and the intensity of treatment. Most of the upland erosion damage is caused by sheet erosion of cultivated land. This type of erosion



WATERSHED EVALUATION REACHES

REACH NO.	TRIBUTARY NUMBER AND NAME	SEC. NO.
1	1- Price Creek	All
2	2- Elm Creek	All
5	5- (Un-named)	All
6	6- Grove Creek	All
8	8- Horrington Branch	All
9	Pilot Grove below Indian Creek	4-5
10	9- Indian Creek below Arnold Creek	1A-5A
11	9A- Pot Rock Creek	All
12	9E- Arnold Creek below Lee	6A-8A
13	9F- Bear Creek	All
14	9- Indian Creek above Arnold	11-OS
15	Pilot Grove between Indian and Deseri Creeks	5APG-8PG
16	10- Deseri Creek	All
17	9E- Arnold Creek above Lee	9A-OS
18	9E4- Lee Creek	All
19	Pilot Grove Between Deseri Creek and Grayson Co. line	8BPG-13PG
20	Pilot Grove above Grayson Co. line	13APG-OS
21	9C- (Un-named)	All
22	9D- Cedar Creek	All
23	9E2- (Un-named)	All
24	9E3- (Un-named)	All
25	9E5- (Un-named)	All

FIGURE 1
PROBLEM LOCATION
PILOT GROVE CREEK WATERSHED
OF THE TRINITY RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

CWS JNN 9-4-59
Revised 9-A-59

constitutes about 90 percent of the total annual gross erosion in the watershed. The remaining 10 percent is derived from gully and streambank erosion and flood plain scour.

The areas of highest erosion and sediment production rates are not confined to any definite portion of the watershed. Drainage areas of the floodwater retarding structures at Sites 43, 50, 53, 60, 64, 69, 71, and 83 have sediment rates of over 2.0 inches estimated on the basis of 75 percent effective land treatment applied on 80 percent of the area. All of these drainage areas are characterized by a high percent of cultivated land.

Flood Plain Scour Damage

Damage by flood plain scour has occurred on 406 acres of flood plain below the floodwater retarding structure sites. This is 2.2 percent of the flood plain. The degree and extent of this damage, expressed in terms of reduced productive capacity, is divided as follows:

Percent of Damage	10	30	50	60	75
Acres Damaged	126	120	99	59	2

The average annual monetary damage is estimated to be $5,460.

Damage by streambank erosion in this watershed is negligible and no monetary value was placed on it.

Sediment Damage

Overbank sediment deposits have damaged approximately 9,064 acres or 50 percent of the flood plain. These deposits are similar in texture and color to the original alluvium, but are somewhat lower in organic matter and plant nutrients. It is estimated that the productive capacity has been reduced about 5 percent on 5,983 acres, and about 10 percent on 3,081 acres as a result of this damage. The average annual monetary damage is estimated to be $23,418.

Pilot Grove Creek watershed drains into Lavon Reservoir. The estimated average annual sediment yield is 211.3 acre-feet and average annual damage is $5,604 to Lavon Reservoir.

Channel filling is occurring at an accelerated rate over approximately the lower two-thirds of the watershed. This loss of channel capacity has caused more frequent and increased depths of flooding. Losses due to swamping or ponding were considered as sediment damage. This condition was caused or aggravated by overbank deposition of sediment which interferes with the drainage of surface water from the lower areas of the flood plain.

Problems Relating to Water Management

Problems relating to water management are minor and do not warrant a study

at this time. There is little drainage or irrigation activity. No individual landowner or group of landowners has indicated sufficient interest to warrant providing additional capacity in any of the floodwater retarding structures for irrigation purposes.

None of the municipalities in the watershed indicated an interest or need for storing municipal water in a multiple-purpose structure.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

The watershed drains into Lavon Reservoir, a Federally authorized multiple-purpose project constructed by the U. S. Corps of Engineers. Benefits to this reservoir will accrue through reduction of sediment deposition as a result of the watershed project. Although these benefits were evaluated and included in the plan, they were not needed for project justification.

For the past 30 years landowners of the flood plain have spent large sums of money attempting to provide adequate channels and levees to contain floodwaters. Satisfactory control has never been obtained by these efforts. Each year these levees break, causing floodwater and sediment damage to most of the flood plain.

The watershed is served by the Upper Sabine, Fannin County, Collin County, and Upper Elm-Red Soil Conservation Districts. Soil Conservation Service Work Units at Van Alstyne, Farmersville, and Rockwall have assisted landowners and operators in preparing 854 conservation plans on 103,825 acres within the watershed. Approximately 39 percent of the planned conservation practices have been applied.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

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 for protection and improvement, such as is now being carried out by the four soil conservation districts serving the watershed, is essential for a sound flood prevention program on the watershed. Basic to reaching the objective is the establishment and maintenance of all applicable soil and water conservation and plant management practices necessary to proper land use. Emphasis will be placed on accelerating the establishment of land treatment measures which have a measurable effect on reducing floodwater and sediment damage.

Of the total watershed area of 169,930 acres, 77,341 acres (45.5 percent) lies above the 84 planned floodwater retarding structures. Land treatment is especially important for protection of these watershed lands to support and supplement the structural measures.

Prior to work plan development, landowners and operators have established

land treatment measures at an estimated non-Federal cost of $909,499, exclusive of Agricultural Conservation Program Service reimbursements. In addition $130,000 of Federal flood prevention funds have been expended to provide accelerated technical assistance to the landowners in the planning and application of land treatment measures. During the project installation period additional land treatment measures are to be established at an estimated non-Federal cost of $1,414,198 and a Federal cost of $119,796. Land treatment measures and costs are shown on tables 1, 1A and 1B.

Most of the land treatment measures will function principally to decrease erosion damage to fields and pastures by providing improved soil-cover conditions. These measures include cover cropping, conservation crop rotation, crop residue utilization, and rotation hay and pasture for croplands and pasture planting and brush control to establish good cover on pasturelands. They also include the construction of farm ponds to provide adequate livestock water and a better distribution of grazing to prevent cover-destroying concentrations of livestock; and proper use of pasture to provide improvement, protection, and good maintenance of grass stands. These measures, especially the cropland measures and pasture planting, also effectively improve soil conditions, allowing larger amounts of rainfall to enter the soil.

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

Structural Measures

A system of 84 floodwater retarding structures and 39.43 miles of stream channel improvement will be installed to effect the needed protection to flood plain lands that cannot be provided by land treatment measures alone. The system of floodwater retarding structures will temporarily detain runoff from 45.5 percent of the watershed. They will detain 5.1 inches of runoff from their combined drainage areas, 77,341 acres, or an equivalent of 2.3 inches from the 169,930 acres in the watershed. Figure 2 is a schematic drawing of a structure typical of the 84 floodwater retarding structures included in this plan.

Stream channels will be improved to provide for the peak flow resulting from a storm producing 2.5 inches of runoff from the uncontrolled area plus the release flow from the floodwater retarding structures.

Lands, easements, and rights-of-way for the floodwater retarding structures and stream channel improvement will be provided by local interests. The value of these easements, based on appraised values, is estimated to be $366,840. There will be an estimated $15,650 of legal fees connected with obtaining these easements. The sediment pools of the 84 structures will

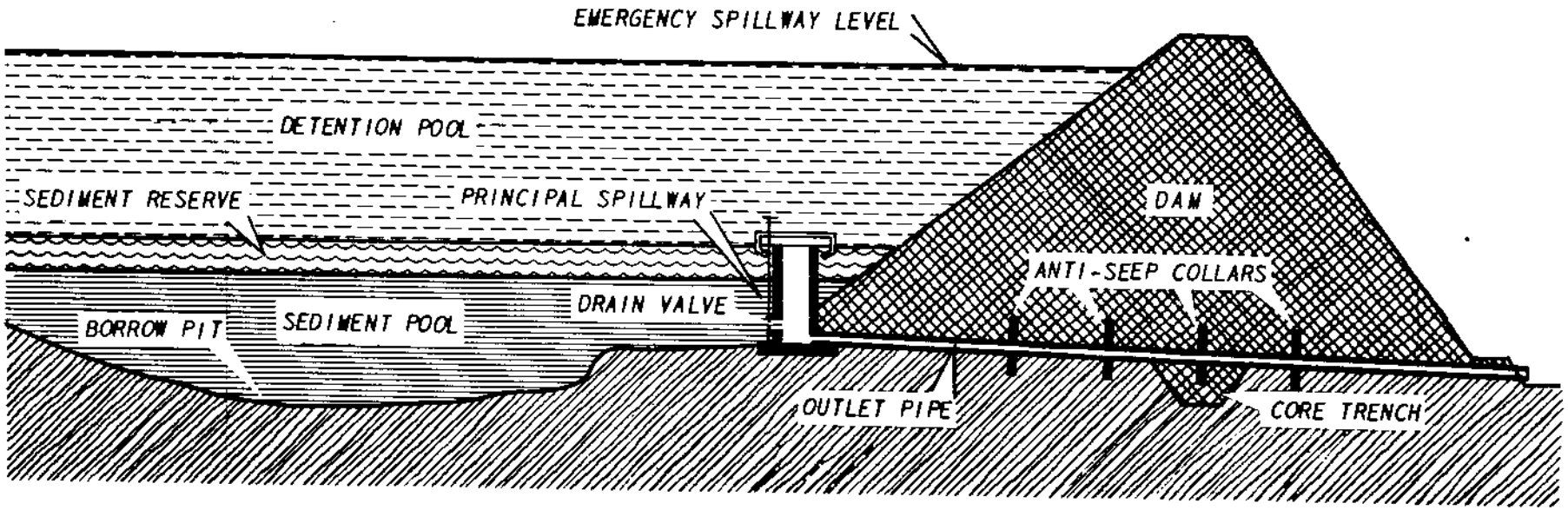


Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Revised 10-24-57 4-L-10,071

contain 453 acres of flood plain and 1,306 acres of upland. The detention pools will temporarily inundate an additional 226 acres of flood plain and 3,027 acres of upland.

The locations of floodwater retarding structures and stream channel improvement are shown on figure 3, Planned Structural Measures.

The estimated Federal cost of installing all structural measures is $3,698,799, and the non-Federal cost is $382,490, making the total cost $4,081,289. The average annual equivalent cost is $148,217 for installation and $15,773 for operations and maintenance, or a total of $163,990.

BENEFITS FROM WORKS OF IMPROVEMENT

The combined program of land treatment and structural measures would prevent flood damages from 34 of the 79 floods such as occurred in the watershed from 1923 through 1942. Twenty-three of the 28 major floods would be reduced to minor floods. The average annual flooding would be reduced from 32,246 acres to 5,317 acres.

The estimated average annual floodwater, erosion, sediment, and indirect damage in the watershed would be reduced from $385,770 to $65,483, a reduction of 83 percent. About 92 percent of the expected reduction in average annual damage would result from the structural measures. Annual damage reductions attributable to the project, including those from land treatment, average $156,731 in crop and pasture damage, $55,058 in other agricultural damage, $53,496 in railroad, road and bridge damage, $5,029 in damage from flood plain scour, $20,605 in damage from overbank deposition, $2,514 in damage from sediment to Lavon Reservoir, and $26,854 in indirect damage.

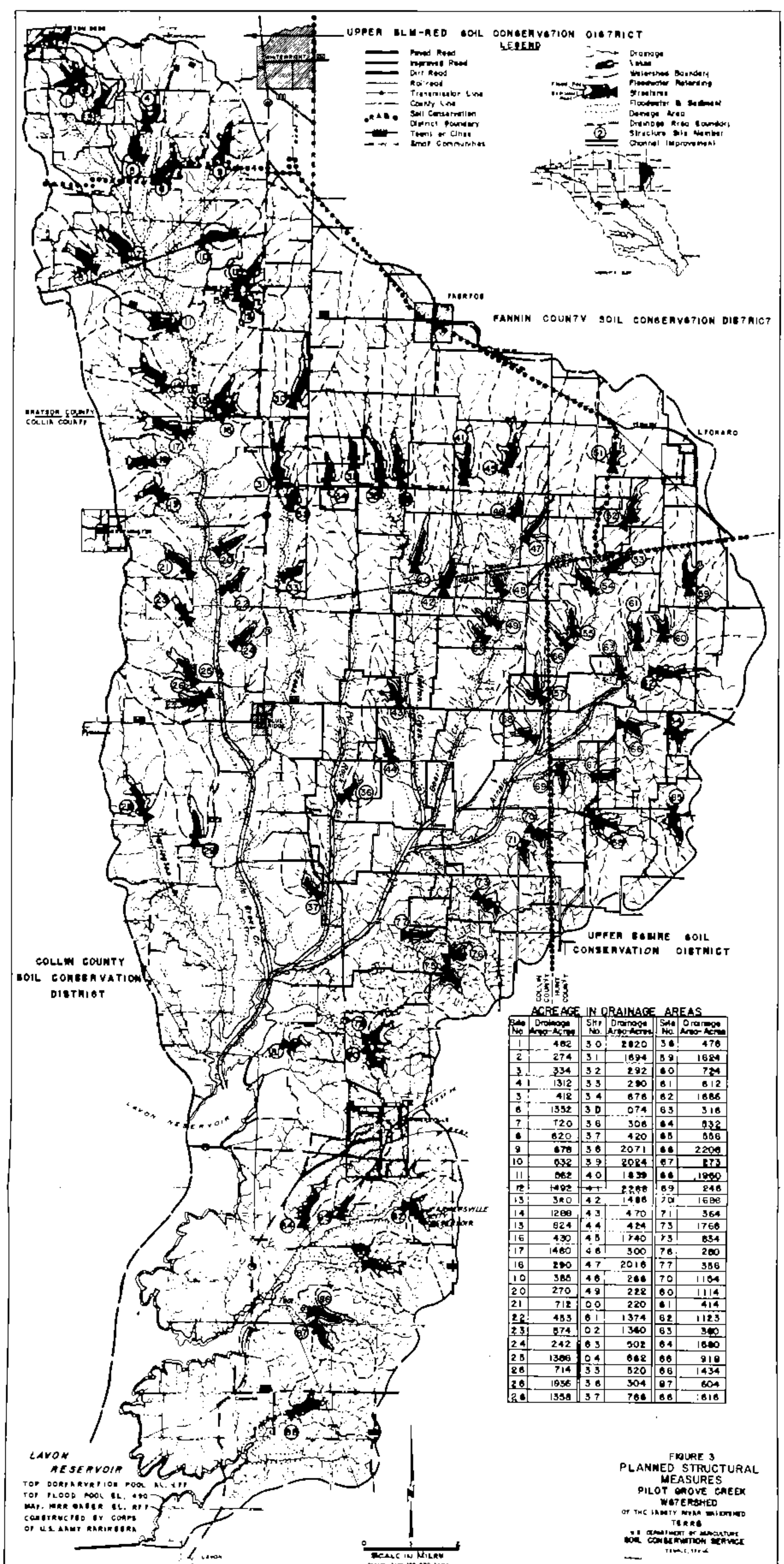
Restorstion of a portion of the flood plain land to its former level of production will be made possible by the reduced frequency, area, and depth of flooding and by the reduction of sediment deposition. The benefits allocable to the structural program from the restoration of these flood plain lands are estimated to average $25,106 annually. This loss from the original production has been considered a crop and pasture damage and its restoration a benefit in table 5.

No benefits from increased acreages or income from crops presently restricted under crop allocations were calculated.

The total flood prevention benefits, including reduction of floodwater damages; the reduction of sediment deposition on flood plain lands and in Lavon Reservoir; the reduction in flood plain scour damage; and the reduction of indirect damages are estimated to average $320,287 annually, of which $293,560 will be the result of structural measures.

COMPARISON OF BENEFITS AND COSTS

The average annual equivalent cost of the structural measures (converted from total installation cost, plus operation and maintenance) is estimated



ACREAGE IN DRAINAGE AREAS

Site No.	Drainage Area-Acres	Site No.	Drainage Area-Acres	Site No.	Drainage Area-Acres
1	462	30	2820	38	476
2	274	31	1694	59	1624
3	334	32	292	60	724
4	1312	33	290	61	612
5	412	34	676	62	1686
6	1352	30	074	63	316
7	720	36	306	64	632
8	620	37	420	65	666
9	676	36	2071	66	2206
10	632	39	2024	67	273
11	662	40	1839	66	1960
12	1492	[illegible]	2268	69	246
13	380	42	1486	70	1688
14	1288	43	470	71	364
15	824	44	424	73	1766
16	430	45	1740	73	834
17	1460	46	300	76	280
18	290	47	2016	77	356
10	386	46	266	70	1164
20	270	49	222	60	1114
21	712	00	220	61	414
22	483	61	1374	62	1123
23	874	02	1340	63	340
24	242	63	502	64	1680
25	1366	04	662	66	918
26	714	33	820	66	1434
26	1936	36	304	87	604
26	1358	37	766	66	1616

FIGURE 3
PLANNED STRUCTURAL MEASURES
PILOT GROVE CREEK WATERSHED
OF THE TRINITY RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

to be $163,990. When the structures are completely installed, they are expected to produce average annual benefits of $293,560, a benefit of $1.79 for each dollar of cost. (Refer to table 6 for benefit-cost analysis of groups of structures.) There are other substantial values which will accrue from these structural measures, such as increased opportunity for recreation, improved wildlife conditions, and a sense of security, which have not been used for project justification.

ACCOMPLISHING THE PLAN

Land Treatment Measures

Land treatment measures itemized in table 1 will be established by farmers over a 10-year period in cooperation with the Upper Sabine, Fannin County, Collin County and Upper Elm-Red Soil Conservation Districts. The cost of applying these measures is exclusive of expected reimbursement from the Agricultural Conservation Program or other Federal programs, based on current program criteria, and will be borne by the owners and operators of the land. The Soil Conservation Districts, assisted by the Soil Conservation Service, are giving assistance in the planning and application of these measures under their going programs. Accelerated assistance from the Soil Conservation Service has been made available with flood prevention funds for several years to get needed land treatment applied in conjunction with planned structural measures. This assistance will be continued to assure application of the planned land treatment measures within the 10-year installation period of the project.

The governing bodies of the four soil conservation districts will arrange for meetings according to a definite schedule. By this means and by individual contacts they will encourage the landowners and operators 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 the existing arrangements for equipment usage in the districts. The district governing bodies will make periodic inspections of the completed conservation measures within the districts and follow through to see that needed maintenance is performed.

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

The Agricultural Stabilization and Conservation County Committees will cooperate with the governing bodies of the soil conservation districts by selecting and recommending financial assistance for those Agricultural Conservation Program Service practices which will accomplish the conservation objectives in the shortest possible time.

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

Structural Measures for Flood Prevention

The Soil Conservation Service will contract for the construction of the 84 floodwater retarding structures and the 39.43 miles of stream channel improvement. Technical assistance will be provided to prepare plans and specifications, supervise construction, prepare contract payment estimates, make final inspections, certify completion, and perform related duties for the installation of these structural measures.

The soil conservation districts will furnish the land, easements and rights-of-way for all the structural measures at no cost to the Federal Government. The district wherein the works of improvement is located will determine the legal adequacy of the easements and rights-of-way.

A grouping of structures by construction units is shown on page 16. Each unit has a favorable benefit-cost ratio based on those benefits that will accrue within the boundary of the unit.

All necessary land, easements, and rights-of-way will be obtained for each construction unit before Federal financial assistance is made available for installation of that unit.

The cooperating parties have agreed on an installation schedule of 9 years for the structural measures during the 10-year period for completion of the project. This schedule will be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desired and in light of appropriations and accomplishments actually made.

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

It is planned to carry out the construction work in the manner shown on page 17.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be operated and maintained by the owners and operators of the farms and ranches on which the measures are installed, under agreements with the Upper Sabine, Fannin County, Collin County, and Upper Elm-Red Soil Conservation Districts.

Representatives of these soil conservation districts will make periodic

Subwatershed Construction Units	Number of Sites	Annual Benefits (dollars)	Annual Costs (dollars)	Benefit-Cost Ratio
1. Price Creek - Site 88	1	2,018	1,810	1.1:1
2. Elm Creek - Sites 82 thru 87	6	10,284	7,877	1.3:1
3. Tributary 5 - Site 81	1	1,229	704	1.7:1
4. Grove Creek - Sites 79 and 80	2	3,480	3,180	1.1:1
5. Harrington Branch - Sites 28 and 29	2	5,682	3,452	1.6:1
6. Desert Creek - Sites 30 thru 33	4	10,307	6,666	1.5:1
7. Pot Rack Creek - Sites 34 thru 37	4	5,731	3,809	1.5:1
8. Indian Creek - Sites 38 thru 44	7	19,065	13,593	1.4:1
9. Bear Creek - Sites 45 thru 50	6	11,171	7,068	1.6:1
10. Lee Creek - Sites 51 thru 58	8	14,583	10,848	1.3:1
11. Arnold Creek above Lee - Sites 59 thru 66	8	19,679	12,666	1.6:1
12. Tributary 9E3 - Sites 67, 68, 69	3	3,710	3,572	1.1:1
13. Units 10, 11, 12, and Sites 70 and 71	21	51,251	30,419	1.7:1
14. Unit 13 and Site 73	22	51,680	32,210	1.6:1
15. Units 8, 9 & 14, and Sites 75 thru 77	36	97,232	55,705	1.7:1
16. Unit 6, and Pilot Grove Creek - Sites 1 thru 26	30	44,533	39,755	1.1:1
17. Unit 4, 7, 15 and 16	74	155,792	102,449	1.5:1
18. Unit 17 and Channel Improvement Reach 9		187,091	109,951	1.7:1
19. Unit 18 and Channel Improvement Reach 15		224,413	119,543	1.9:1
20. Unit 19 and Channel Improvement Reach 19		246,809	128,668	1.9:1
21. Unit 18 and Channel Improvement Reach 10		205,963	116,935	1.8:1
22. Unit 21 and Channel Improvement Reach 14		210,546	119,479	1.8:1
23. Unit 21 and Channel Improvement Reach 11		215,049	121,044	1.8:1
24. Unit 22 and Channel Improvement Reach 13		212,969	121,445	1.8:1
25. Unit 23 and Channel Improvement Reach 12		222,627	123,800	1.8:1
26. Unit 25 and Channel Improvement Reach 17		225,563	125,938	1.8:1
27. Unit 26 and Channel Improvement Reach 18		227,848	126,917	1.8:1

Fiscal Year	Land Treatment Measures: Federal Funds (dollars)	Land Treatment Measures: Non-Federal Funds (dollars)	Land Treatment Measures: Total (dollars)	Site Numbers	Structural Measures: Federal Funds (dollars)	Structural Measures: Non-Federal Funds (dollars)	Structural Measures: Total (dollars)	Total Cost (dollars)
1st	12,000	113,136	125,136					125,136
2nd	12,000	141,420	153,420	Sites 30 thru 33 and 82 thru 88	366,185	51,720	417,905	571,325
3rd	12,000	155,562	167,562	Sites 34 thru 44, 79, 80 and 81	480,459	65,310	545,769	713,331
4th	12,000	169,704	181,704	Sites 1 thru 4, 28, 29, 45 thru 50, 67, 68 and 69	420,495	60,415	480,910	662,614
5th	12,000	183,846	195,846	Sites 5 thru 11 and 51 thru 58	418,146	52,230	470,376	666,222
6th	12,000	183,846	195,846	Sites 59 thru 66 and 70, 71, 73, 75, 76, and 77	482,254	48,830	531,084	726,930
7th	12,000	141,420	153,420	Channel Improvement Pilot Grove Creek 1/	615,553	31,490	647,043	800,463
8th	12,000	169,704	181,704	Sites 12 thru 26	481,519	44,075	525,594	707,298
9th	12,000	84,850	96,850	Channel Improvement, Indian and Pot Rack Creeks	290,702	15,310	306,012	402,862
10th	11,796	70,710	82,506	Channel Improvement, Arnold, Lee, and Bear Creeks	143,486	13,110	156,596	239,102
Total	119,796	1,414,198	1,533,994		3,698,799	382,490	4,081,289	5,615,283

1/ Minimum existing channel capacity on Pilot Grove Creek is 148 c.f.s. (Valley Section 5-A PG). The combined capacities of principal spillways of floodwater retarding structures constructed above this valley section will not exceed 148 c.f.s. until channel improvement is installed. All other channels, including the section of Pilot Grove Creek below its confluence with Indian Creek, have sufficient capacity to carry the release from the planned floodwater retarding structures.

inspections of the land treatment measures to determine maintenance needs and to encourage landowners and operators to perform maintenance. They will make district-owned equipment available for this purpose.

Structural Measures

The 84 floodwater retarding structures and the 39.43 miles of stream channel improvement will be maintained by the soil conservation district in which the measure is located and the appropriate county commissioners court.

The Upper Elm-Red Soil Conservation District and the Collin County Commissioners Court will be jointly responsible for the operation and maintenance of floodwater retarding structures 1 through 6, and 9 located in Grayson County.

The Collin County Soil Conservation District and the Collin County Commissioners Court will be jointly responsible for the operation and maintenance of floodwater retarding structures 7, 8, 10 through 16 and 30, located in Grayson County; 17 through 26, 28, 29, 31, 32, 33, 36, 37, 42, 43, 44, 48, 49, 50, 57, 58, 70, 71, 73, 75, 76, 77, 79 through 88, located in Collin County; and all channel improvement except approximately 2 miles located in Hunt County.

The Collin County Soil Conservation District and the Fannin County Commissioners Court will be jointly responsible for the operation and maintenance of floodwater retarding structures 34, 35, 38, 39, 40, 41, 45, 46, and 47, located in Fannin County.

The Collin County Soil Conservation District, Fannin County Soil Conservation District and the Fannin County Commissioners Court will be jointly responsible for the operation and maintenance of floodwater retarding structure 51 located in Fannin County.

The Fannin County Soil Conservation District and the Fannin County Commissioners Court will be jointly responaible for the operation and maintenance of floodwater retarding structure 52 located in Fannin County.

The Upper Sabine Soil Conservation District and the Hunt County Commissioners Court will be jointly responsible for the operation and maintenance of floodwater retsrding structures 53 through 56, 59 through 69, and approximately 2 miles of channel improvement located in Hunt County.

Each structural measure will be inspected at least annually and after each heavy rain or streamflow by representatives of the soil conservation district in which the structure is located. A Soil Conservation Service representative will participate in these inspections at least annually. Items of inspection will include, but will not be limited to, the conditions of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and the emergency spillway of each floodwater retarding structure, the need for control of vegetation, bank stabilization, and the removal of sediment and debris in improved

channels; and the condition of fences and gates installed as a part of any structural measure. The responsible soil conservation district will maintain a record of all maintenance inspections and work done.

Provisions will be made for free access of district, County, and Federal representatives to inspect the structural measures and their appurtenances at any time.

The estimated annual operation and maintenance cost is $15,773, bssed on long-term price levels. The necessary maintenance work will be accomplished through the use of resources of the soil conservation districts, the county commissioners courts and benefited landowners.

The soil conservation districts, and Collin County Commissioners Court, Hunt County Commissioners Court, and the Fannin County Commissioners Court fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of any invitation to bid.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

The installation of the flood prevention project on the watershed will give added protection to flood plain lands along this stream and greatly reduce its annual sediment load. This project plan conforms to all Federal laws and regulations.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Project Formulation

Reconnaissance Survey

The reconnaissance survey of the watershed was made by the specialists of the planning party and representatives of the State, Area and Work Unit offices. Its purpose was to obtain sufficient information to estimate planning input requirements and to be able to furnish the local people with technical information needed for their determination of project objectives.

Project Objectives

At a series of meetings with the local people, the flood prevention program and findings of the reconnaissance survey were discussed. Considering this information together with their needs and desires, the local people set the following project objectives as those that would most nearly fulfill their local needs and desires:

1. Replan the portion of the Pilot and Sister Grove Creeks work plan not included in the Sister Grove Creek work plan (Revised June 1956), and Indian Creek.

2. Provide sufficient protection from flooding to allow restoration of flood plain lands which have been damaged by flooding, to their former levels of productivity. To obtain this objective, it was agreed that it would be necessary to provide protection from damaging floods occurring more often than once in three years.

Land Treatment Measures

The soil-cover complex data were developed from a 14 percent sample of the watershed. Soil unit conditions, and slopes were mapped on cultivated land, together with the amount of terraced land and area in small grains or legumes. The pastureland soils were grouped by cover conditions. Future conditions were determined by land treatment needs based on soil capability units. The watershed was divided into two areas and hydrologic soil-cover complex curve numbers developed for each. The divisions were (1) the part of the watershed drained by the mainstem of Pilot Grove Creek, and (2) the eastern part of the watershed.

Land use also was determined from the above sample which was expanded to the total watershed area. The land use of the flood plain was planimetered from aerial photographs. The land treatment needs were supplied by the technicians of local work units of the Soil Conservation Service, and these figures adjusted to the soil-cover complex data.

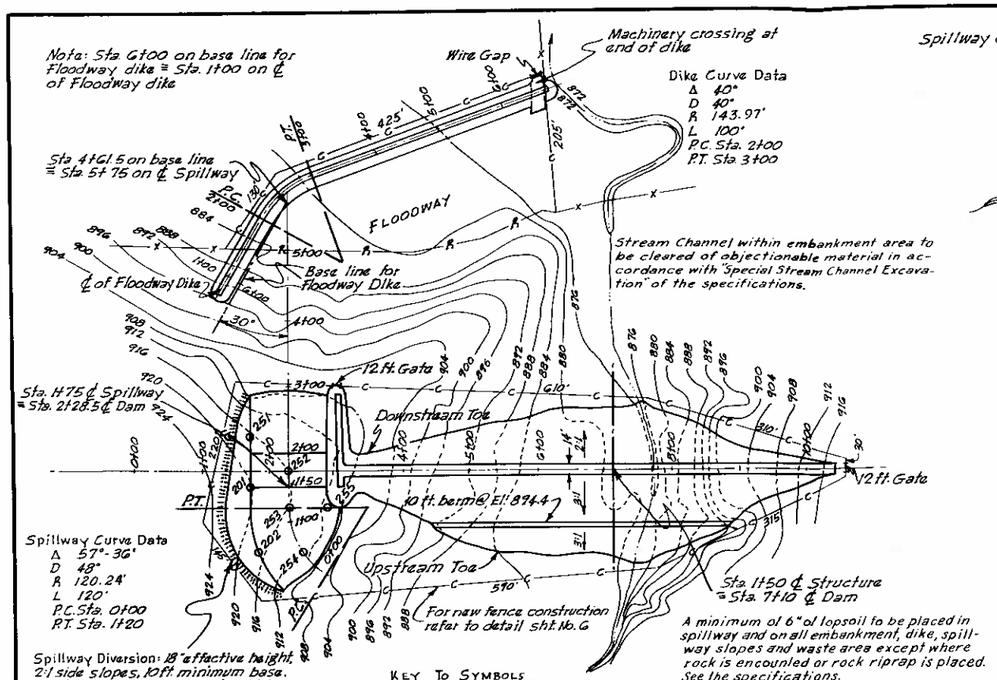
Determination was made, first, of the needed land treatment measures, based on current needs, which remain to be applied in the watershed and which contribute directly to flood prevention. The hydraulic, hydrologic, sedimentation and economic investigations provided data on the effects of these measures 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 structural measures would be required to attain the degree of watershed protection and flood damage reduction desired.

Structural Measures

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

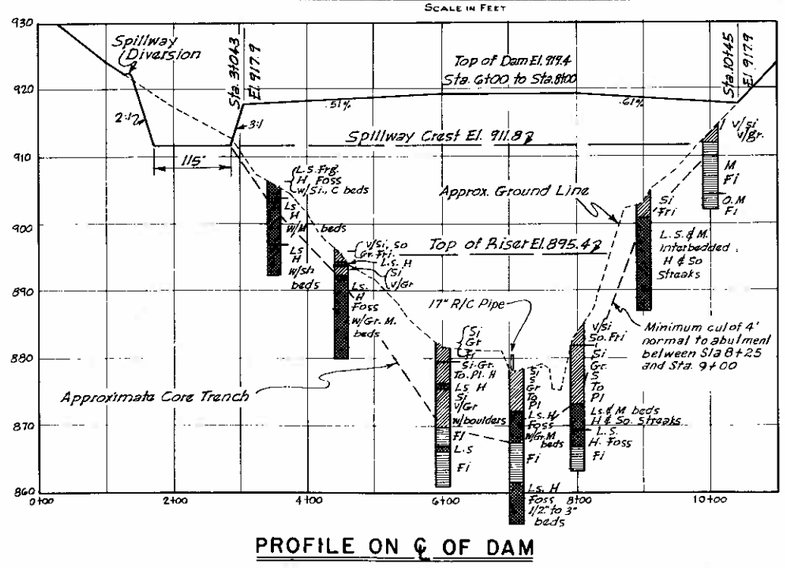
1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. A stereoscopic study of consecutive 4-inch aerial photographs located all probable floodwater retarding structure sites, the limits and the area of the flood plain and points where valley cross sections should be taken for the determination of hydraulic characteristics of the channel and valley and for flood routing purposes. A field reconnaissance was made to substantiate further the location of these sections. 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 stage-area inundated relationships for various flood flows. A map was prepared of the flood plain 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 stereoscopically. Sites which did not show good storage possibilities or which would inundate highways or costly improvements were dropped from further consideration. From the remaining sites a system of floodwater retarding structures was selected for further consideration and detailed survey. Plans of a floodwater retarding structure, typical of those planned for this watershed, are illustrated by figure 4 and 4A.

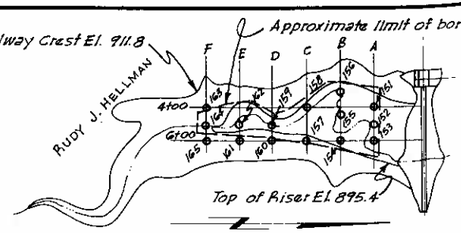


PLAN OF EMBANKMENT AND SPILLWAY

0 100 200 300 400'
SCALE IN FEET

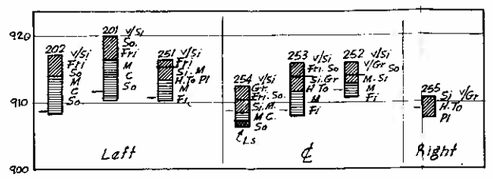


PROFILE ON ℄ OF DAM



GENERAL PLAN OF RESERVOIR

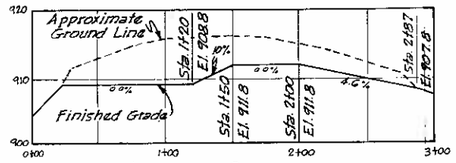
0 400 800 1200 1600
SCALE IN FEET



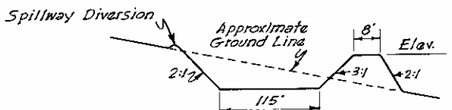
Note: Bar at left of boring is at spillway grade.

LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY



PROFILE ON ℄ OF SPILLWAY



Top of Dike El. 917.9 from Sta. 11+50 to Sta. 21+00 (Crest Section)
Top of Dike El. 911.8 @ Sta. 21+87. Grade top of dike between Sta. 21+00 and Sta. 21+87.

TYPICAL SPILLWAY SECTION

Clay S Sandy - Sandy H Hard
Si Silt - Silty Foss Fossiliferous
C Clay - Clayey W/ With
Gr Gravel - Gravelly V/ Very
Rock Sh Shale - Shaley So Soft
M. Marl - Marly Fri. Friable
O.M. Organic Matter Fi. Firm
L.S. Limestone To. Tough
Shale Frg Fragments Pl. Plastic

LEGEND OF BORINGS

Located 1 mile west and 1.7 miles south of Myra, Cooke County, Texas

VICINITY MAP

0 1/8 1/4 1/2
SCALE IN MILES

Elevation	Surface Acres	Storage Acre. Ft.	Storage Inches
895.4	7.5	64.0	1.31
898	10.0	86.5	1.78
902	13.2	132.9	2.73
906	17.5	194.3	3.99
910	22.1	273.6	5.62
914	27.0	371.7	7.64
918	33.7	493.1	10.13

Top of Dam (Effective) Elev.	917.9
Spillway Crest Elev.	911.8
Top of Riser Elev.	895.4
Sediment Pool Elev.	895.4
Drainage Area, Acres	584
Sediment Storage, Ac. Ft.	73
Floodwater Storage, Ac. Ft.	251

NOTICE

CHANGES MADE DURING CONSTRUCTION ARE NOT SHOWN ON THESE DRAWINGS.

FOR "AS BUILT" CHANGES, SEE PRINTS ON FILE IN CARTOGRAPHIC UNIT, FORT WORTH, TEXAS.

Figure 4
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	G.W.T.	Date 11/54	Approved by ... Head Engineering & Watershed Planning Unit, Fort Worth, Texas
Drawn	G.W.T. & D.S.		... State Conservationist Temple, Texas
Traced	D.S.	12/55	Sheet No. 2 of 6
Checked	G.W.T.	4/56	Drawing No. 4-E-10,184

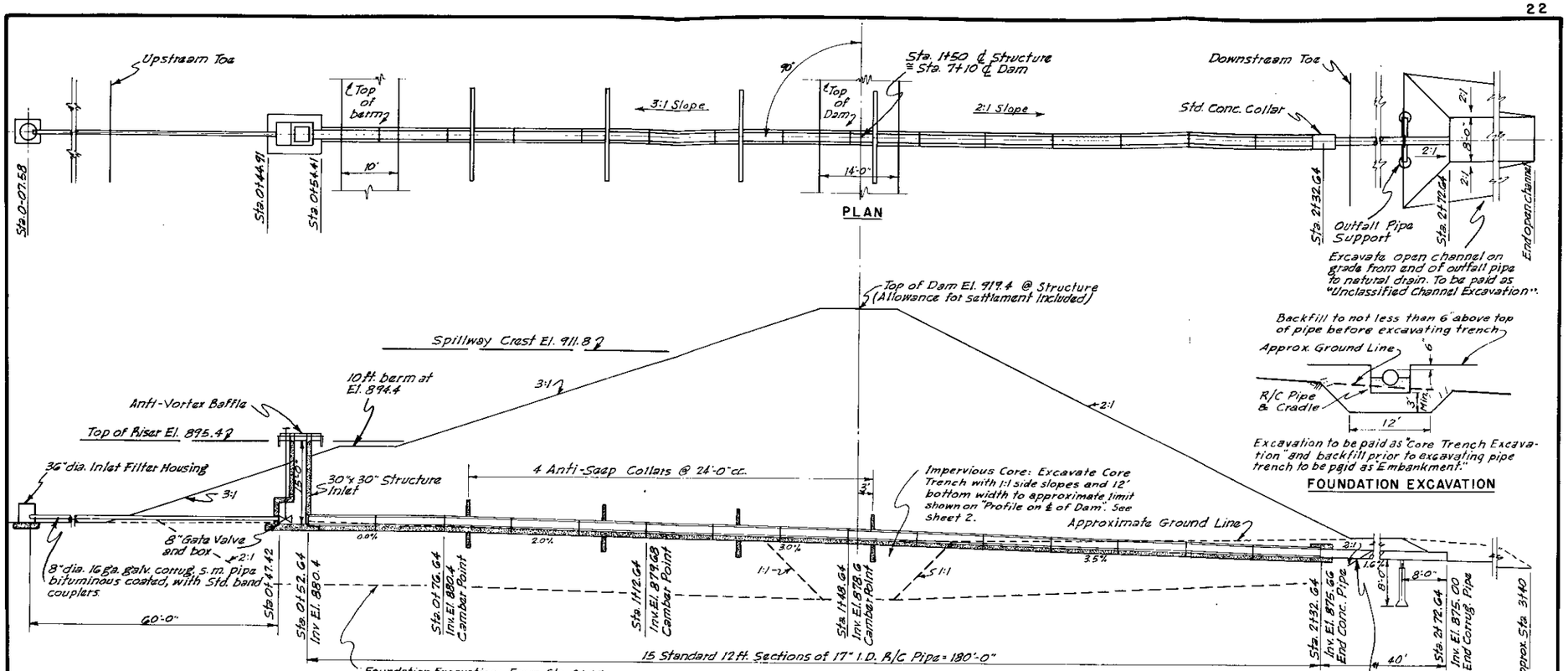


Figure 4a
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed G.W.T.	Date 11/54	Approved by H. M. HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS	
Drawn G.W.T. & D.S.		STATE CONSERVATIONIST TEMPLE, TEXAS	
Traced D.S.	12/55	Sheet No. 3 of 6	Drawing No. 4-E-10,184
Checked G.W.T.	5/56		

3. A topographic map was made of the pool area of each of the proposed sites to determine the storage 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 detention pools. The heights of the dams and the sizes of the pools were determined by the storage volume needed to temporarily detain the runoff from the design storm and to provide the additional storage needed for sediment, with due consideration to site differences and minimization of costs. The limits of the detention pools and sediment pools of all satisfactory sites and the flood plain of the streams were drawn to scale on a copy of the base map. Structure data tables were developed to show, for each structure, the drainage area, the storage capacity needed for floodwater 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 inundated by the sediment and detention pools, the volume of fill in the dams, the width and depth of flow of the emergency spillways, and the estimated cost of the structures (tables 2 and 3).

4. Damages resulting from floodwater, sediment and erosion were determined from damage schedules and field surveys of flood plain 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 area inundated and depth of inundation as determined by flood routing under future conditions and reduction of sediment deposition assuming that the works of improvement had been installed. Benefits so determined were allocated to individual measures or groups of interrelated measures on the basis of the effect of each on reduction of damages. In this manner it was determined that a system of floodwater retarding structures in the watershed could be economically justified. By further analysis, those individual floodwater retarding structures and interrelated groups of structures which had favorable benefit-cost ratios were determined. These were included in the plan. Those which were unfavorable were dropped from further consideration and, where replacements were found to be necessary to effect needed control, alternate sites were investigated until a system of floodwater retarding structures was developed which would most nearly meet project objectives at the least cost. After evaluation of the floodwater retarding structures, it was found that frequent flooding would continue on portions of the watershed. This is due to small existing channels and the release flows and uncontrolled areas contributing to these channels. To meet project objectives stream channel improvement was planned to carry the flow from a 3-year frequency storm after land treatment and floodwater retarding structures are applied.

When the land treatment measures and those 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 represented the estimated cost of the 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 4).

Hydraulic and Hydrologic

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

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

2. Engineering surveys were made to collect information on selected stream reaches, including valley cross sections, channel capacities and other hydraulic characteristics, and on proposed structure sites to collect data used in design.

3. Determination was made of the hydrologic conditions of the watershed, taking into consideration such factors as geology, soils, land use, topography, cover and climate.

4. Determination was made of the rainfall-runoff relationship, using the soil-cover complex data. The frequency of occurrence of meteorologic events and the relationships of rainfall to runoff, peak discharge, flood stage, and area inundated were determined.

5. Determination was made of peak discharges under present watershed conditions, as related to area inundated and damages.

6. Determination was made of peak discharges and area inundated under conditions which would exist due to:

   a. Effect of land treatment measures.

   b. Effect of land treatment measures and floodwater retarding structures.

   c. Effect of land treatment measures, floodwater retarding structures and stream channel improvement.

   d. Consideration of alternative projects and measures.

7. From a graph showing cumulative departures from normal precipitation, the rainfall for the period 1923 to 1942, inclusive, was selected as most representative of a normal rainfall period for the Pilot Grove Creek watershed.

   After investigation and analysis of the meteorologic, hydraulic, hydrologic, geologic, and economic characteristics of the watershed, it was determined that a structural program was feasible.

   The largest runoff-producing rain considered during the 20-year rainfall period studied was a storm of 7.68 inches which approximated a 25-year frequency storm extending over a 2-day interval. An average rain of this magnitude, assuming Moisture Condition II, would produce 5.3 inches of runoff, under present conditions, and would inundate 18,849 acres of flood plain. If such a rain were to occur after land treatment practices had been applied, it is estimated that the area inundated would be reduced to 18,093 acres. With land treatment measures applied and structural measures installed, it is estimated that the flood plain area inundated would be reduced to 13,114 acres, excluding all flood plain areas in floodwater retarding structure pools.

   From a study of the relationship between runoff and flood stage for this watershed it was found that a runoff of 0.10 inch was the minimum that would cause flooding to a depth of 6 inches at the smallest cross section. Due to changes in runoff-producing characteristics at different antecedent moisture conditions, rains of 0.50 inch to 2.00 inches would be required, on an average, to cause 0.10 inch of runoff and produce a discharge of 450 cubic feet per second at the upper limits of Lavon Reservoir.

   The peak discharge at this point from the largest runoff-producing rain in the 20-year period used in the evaluation study, under present conditions, is 24,000 cubic feet per second. After installation and full functioning of the planned measures, the discharge from the same storm at this point would be reduced to 12,600 cubic feet per second.

8. In accordance with the criteria set forth in Washington Engineering Memorandum SCS-27, the minimum floodwater detention volume was determined using Yarnell's 6-hour, 25-year rainfall for Class A structures and 50-year rainfall for Class B structures.

   The expected runoff from the 25-year rainfall ranged from 2.35 inches to 3.90 inches and from the 50-year rainfall from 2.74 inches to 3.90 inches, depending on the soil-cover complex conditions and the size of the drainage area of

each structure. The minimum floodwater detention volume as specified in the Texas State Manual Supplement 2404.2 and determined by the method set up in the Fort Worth Engineering and Watershed Planning Unit Hydrology Memorandum EWP-2 ranges from 4.8 inches to 6.5 inches for Class A structures and 6.1 inches to 8.0 inches for Class B structures, depending on the soil-cover complex conditions and the size of the drainage area of the watershed of each structure.

The recommended detention volume was used in all structures except those limited by site conditions; however, the volumes actually used are in excess of the minimum required by Washington Engineering Memorandum SCS-27.

Frequency of use of the emergency spillway was based on regional stream gage analysis and soil-cover complex characteristics of the watershed of the individual structure.

9. Point rainfall of the emergency spillway and freeboard design storms was selected from figures 3.21-1 and 3.21-4 of National Engineering Handbook 4A in accordance with criteria contained in Washington Engineering Memorandum SCS-27 and Texas State Manual Supplement 2404.2. After making area adjustment of the point rainfall as prescribed in the references above, the expected runoff from the design storms was determined by using the Moisture Condition II curve number for each individual site.

   Inflow hydrographs of the runoff from the design storms were developed for each structure using the distribution graph method. In all cases routing of the emergency spillway hydrograph produced little or no outflow with which to proportion the emergency spillway. Therefore, the dimensions of the emergency spillway were determined by using the outflow produced by routing of the freeboard hydrograph and adding one foot of dry freeboard. Where alternate designs were used to determine the most economical combination of spillway width and depth and elevation of the top of the dam, spillway dimensions were estimated by using an empirical formula. Final design of all structures was determined by using the graphical flood-routing method described on page 5.8-12 of National Engineering Handbook, Section 5.

Sedimentation

Field surveys to determine sedimentation and related damages were made according to methods described in the "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans," Water Conservation-6, Soil

Conservation Service, Region 4, Revised February 1954. Field studies included reconnaissance surveys of geology and soils, studies of overbank sediment deposits, flood plain scour, streambank erosion, and the nature of channels and valleys on or near valley cross sections.

Investigations of sediment sources in the watershed above proposed floodwater retarding structures and estimates of sediment storage requirements were made for each structure. The estimates were based on an expected application of 80 percent of the needed land treatment measures being maintained at 75 percent effectiveness. Detailed sediment storage requirements were computed for approximately three-fourths of the sites. The remaining sites were estimated, using information from the detailed sites as a guide. The sediment derived from sheet erosion was estimated by the method presented in "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairies Problem Area in Soil Conservation," Soil Conservation Service, Region 4, February 1953. The formula is based on watershed surveys including the following data:

1. Soil unit in acres, by slope in percent, slope length in feet, and land use.

2. Average farming practices (percent row crops and/or percent small grains, terracing, etc.).

3. Cover condition claases on pasture and woods.

4. Maximum 30-minute rainfall intensity to be expected once in 2 years.

Gully erosion was determined by (1) study of individual gullies to determine estimates of annual growth, (2) comparison of old and recent aerial photographs and (3) interviews with landowners and operators who were able to furnish information on the rate of growth of the gullies.

Cultivated land produces most of the sediment in the watershed, but pasture with poor cover is an important contributor in some areas. The application of the cropland treatment and pasture improvement measures expected to be applied in the watershed will reduce the present sediment yield by an estimated 10 percent. This seemingly low reduction is explained by the fact that a large proportion of these practices have been applied and are effective at the present time.

Areas of the flood plain presently damaged by sediment and scour will increase in productivity after they have been protected from flooding and needed land treatment measures have been applied.

Geologic

Reconnaissance geologic inspections were made of a large number of representative floodwater retarding dam sites within each geologic formation,

in order to make more accurate estimates of construction problems and costs. These included studies of the valley slopes, alluvium, channel banks, and exposed rock outcrops. Some hand auger borings were also made.

The Austin formation consists of alternating beds of chalk, shaly limestone and marls, with soils having Unified Soil Classification System designations of CL, CH and MH. It is characterized by much small-scale faulting and jointing. The faulting may range from a mere crack to several feet of displacement. The faults are filled with clay and should permit little, if any, seepage. Some of these sites will have rock excavation in the emergency spillway. Some steep bluffs and danger of differential settlement may be encountered. Sites within this formation are 1-26, 30-32, 34, 35, 38-41, 45-47, 51-53, 59 and 60.

The Taylor group consists of thinly interbedded marls of varying colors, mostly gray, blue and yellow shales and clays. Soils are montmorillonitic (high swell-shrinkage) CH and MH, sometimes moderately dispersed, gypseous, or of low shear strength. Sites within this part of the Taylor are 28, 29, 33, 36, 37, 42-44, 48-50, 54-58, 61-71, 73, 77, and 81.

A division of the Taylor group is the Wolfe City sand. This member consists of calcareous gray sand or sandy marl with a few concretions of calcareous sandstone. The sand weathers to greenish yellow. Soils are classified as chiefly SM, SC, and CL, sometimes moderately dispersed. Sites within this formation are 75, 76, 79, and 80.

Another division of the Taylor group is the Pecan Gap chalk. This consists of bluish gray, shaly, sandy chalk, weathering to light grey and white. The soils are chiefly montmorillonitic CH and MH soils. Sites within this formation are 82-88.

Economic

Flood damage schedules covering approximately 54 percent of the flood plain area of Pilot Grove Creek and its tributaries were obtained from owners and operators. Information on these schedules included land use and crop distribution, yields and historical data on flooding and flood damages. Flood plain land use was mapped in the field and normal yields were based on field data contained in schedules, supplemented by information from other agricultural workers with experience in the area.

Since land use and value of production varied considerably, and due to drainage pattern of the watershed, the flood plain was divided into 25 evaluation reaches, each with its own damageable value and characteristics of flooding. Analysis of the information obtained formed the basis for determining crop and pasture damage rates for various depths and seasons of flooding. Applicable rates of damage were applied to each flood event recorded in the historical series and adjustment was made for recurrence of flooding within the same crop year.

Damages to other agricultural property, such as fences, livestock, levees and farm equipment, were evaluated from the damage schedules taken from farmers. These damages were correlated with depth and size of floods. The major items of nonagricultural damage were roads, bridges and railroads. Although locations of road and bridge damage were often obtained from farmers, estimates of these damages were obtained from county commissioners and highway department and railroad company personnel.

The monetary value of damage from flood plain scour and overbank deposition was based on the value of production lost, taking into account the lag in recovery of productivity.

Damage to Lavon Reservoir was determined by the straight-line method. The total cost of Lavon Reservoir, as estimated by the U. S. Corps of Engineers, was used to determine the cost per acre-foot of storage lost by sediment deposition.

All damages were calculated under conditions without the project and those which will prevail after installation of each progressive phase of the project. Benefits from reduction of floodwater damages and flood plain scour resulted from the combined effects of a smaller area flooded and reduced depth of inundation. Reductions in sediment output and in area flooded were jointly responsible for benefits from reduction of damage by overbank deposition. Benefits attributed to structural measures were prorated according to degree of protection afforded by the structures. All calculations of damages and benefits were determined at 1956 prices which were projected to long-term levels (U. S. D. A., A.R.S. June 1956. The September 1957 price projection was not available at the time planning was begun on this watershed).

Indirect damages involve such items as disruption of travel to markets, extra farming expense, extra costs of purchasing feed for livestock, and losses in business sustained by dealers and industry in the area. Based on information obtained and data for watersheds previously analyzed, it was determined that 10 percent of the direct damage would be an equitable estimate for the indirect damage.

Areas that will be inundated by the sediment and detention pools of floodwater retarding structures were excluded from calculation of damages due to flooding. Although it is considered that there will be no production in the sediment pools after construction of floodwater retarding structures and that the land covered by detention pools will be converted to grassland under project conditions, it was determined that the annual loss of production within structure sites at long-term price levels will be less than the amortized current values of land in pool areas. Consequently, the higher figure of $14,822 was used in the economic evaluation of the project in order to assure a conservative benefit-cost analysis.

During the course of field investigations, farmers were asked to state the

changes made in the use of their flood plain lands as a result of past flooding. They were also asked what change they would make if flooding was reduced 50 percent. Analysis of these responses provided the basis for estimating benefits from restoration of flood plain lands to their former use. Additional factors considered in this analysis were the size and location of the areas affected, land capability, existence of available markets, and reduction in frequency of flooding. All benefits from change in flood plain land use were discounted over a 5-year buildup period, following the installation period, to allow for lag in installation. Associated restoration and development expenses, and added damage expected due to more intensive use, were deducted as associated costs to obtain the net benefits.

Details of the procedures used in the investigations are described in the Soil Conservation Service Interim Economic Guide for Watershed Protection and Flood Prevention Revised April 1, 1956. Methods described therein for use with the historical series were applied to the economic analysis for this work plan.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956 Installation Period January 1959 - January 1969

Item	Unit	Number to be Applied	Estimated Cost		
			Federal	Non-Federal 1/	Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	27,546	-	27,546	27,546
Cover Cropping	Acre	29,296	-	290,030	290,030
Crop Residue Utilization	Acre	34,990	-	52,485	52,485
Rotation Hay and Psture	Acre	9,305	-	123,757	123,757
Pasture Improvement for Watershed Protection:					
Pasture Planting	Acre	25,363	-	329,719	329,719
Proper Use, Pasture	Acre	25,066	-	50,132	50,132
Pond Construction	Each	520	-	97,500	97,500
Brush Control	Acre	1,011	-	35,385	35,385
Diversion Construction	Mile	78	-	19,695	19,695
Terracing	Mile	1,377	-	145,411	145,411
Waterway Development	Acre	1,789	-	69,771	69,771
Drop Inlets & Drop Structures	Each	243	-	111,780	111,780
Sod Flumes	Each	701	-	60,987	60,987
Technical Assistance (Accel.)			119,796	-	119,796
SCS Subtotal			119,796	1,414,198	1,533,994
TOTAL LAND TREATMENT			119,796	1,414,198	1,533,994
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	84	2,030,832	-	2,030,832
Channel Improvement	Mile	39.43	804,760	-	804,760
Subtotal - Construction			2,835,592	-	2,835,592
Installation Services					
Soil Conservation Service					
Engineering Services			567,121	-	567,121
Other			296,086	-	296,086
Subtotal - Installation Services			863,207	-	863,207
Other Costs					
Land, Easements and R/W			-	366,840	366,840
Legal Fees			-	15,650	15,650
Subtotal - Other			-	382,490	382,490
TOTAL STRUCTURAL MEASURES			3,698,799	382,490	4,081,289
Work Plan Prepsration Cost			28,600	-	28,600
TOTAL PROJECT			3,847,195	1,796,688	5,643,883
SUMMARY					
Subtotal SCS			3,847,195	1,796,688	5,643,883
TOTAL PROJECT			3,847,195	1,796,688	5,643,883

1/ Excludes $880,080 that may be available from other Federal Funds (ACPS) to reimburse private interest.

January 1959

TABLE 1A - ESTIMATED PROJECT INSTALLATION COST
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956

Item	Unit	Number Applied	Estimated Cost Applied Prior to June 1958		Total
			Federal	Non-Federal 1/	
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	25,000	-	25,000	25,000
Cover Cropping	Acre	13,698	-	135,610	135,610
Crop Residue Utilization	Acre	30,748	-	46,122	46,122
Rotation Hay and Pasture	Acre	8,806	-	117,120	117,120
Pasture Improvement for Watershed Protection:					
Pasture Planting	Acre	20,585	-	267,605	267,605
Proper Use, Pasture	Acre	15,070	-	30,140	30,140
Pond Construction	Each	422	-	79,125	79,125
Brush Control	Acre	327	-	11,445	11,445
Diversion Construction	Mile	15	-	3,788	3,788
Terracing	Mile	1,250	-	132,000	132,000
Waterway Development	Acre	769	-	29,991	29,991
Drop Inlets & Drop Structures	Each	65	-	29,900	29,900
Sod Flumes	Each	19	-	1,653	1,653
Technical Assistance (Accel.)			130,000	-	130,000
SCS Subtotal			130,000	909,499	1,039,499
TOTAL LAND TREATMENT			130,000	909,499	1,039,499
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	-	-	-	-
Channel Improvement	Mile	-	-	-	-
Subtotal - Construction			-	-	-
Installation Services					
Soil Conservation Service					
Engineering Services			-	-	-
Other			-	-	-
Subtotal - Installation Services			-	-	-
Other Costs					
Land, Easements and R/W			-	-	-
Legal Fees			-	-	-
Subtotal - Other			-	-	-
TOTAL STRUCTURAL MEASURES			-	-	-
Work Plan Preparation Cost			-	-	-
TOTAL PROJECT			130,000	909,499	1,039,499
SUMMARY					
Subtotal SCS			130,000	909,499	1,039,499
TOTAL PROJECT			130,000	909,499	1,039,499

1/ Excludes $570,939 that was reimbursed from other Federal Funds (ACPS) to private interest.

January 1959

TABLE 1B - ESTIMATED PROJECT INSTALLATION COST
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956

Item	Unit	Number Applied and to be Applied	Estimated Cost (Total Project) Federal (dollars)	Non-Federal 1/ (dollars)	Total (dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	52,546	-	52,546	52,546
Cover Cropping	Acre	42,994	-	425,640	425,640
Crop Residue Utilization	Acre	65,738	-	98,607	98,607
Rotation Hay and Pasture	Acre	18,111	-	240,877	240,877
Pasture Improvement for Watershed Protection:					
Pasture Planting	Acre	45,948	-	597,324	597,324
Proper Use, Pasture	Acre	40,136	-	80,272	80,272
Pond Construction	Each	942	-	176,625	176,625
Brush Control	Acre	1,338	-	46,830	46,830
Diversion Construction	Mile	93	-	23,483	23,483
Terracing	Mile	2,627	-	277,411	277,411
Waterway Development	Acre	2,758	-	99,762	99,762
Drop Inlets & Drop Structures	Each	308	-	141,680	141,680
Sod Flumes	Each	720	-	62,640	62,640
Technical Assistance (Accel.)			249,796	-	249,796
SCS Subtotal			249,796	2,323,697	2,573,493
TOTAL LAND TREATMENT			249,796	2,323,697	2,573,493
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	84	2,030,832	-	2,030,832
Channel Improvement	Mile	39.43	804,760	-	804,760
Subtotal - Construction			2,835,592	-	2,835,592
Installation Services					
Soil Conservation Service					
Engineering Services			567,121	-	567,121
Other			296,086	-	296,086
Subtotal - Installation Services			863,207	-	863,207
Other Costs					
Land, Easements and R/W			-	366,840	366,840
Legal Fees			-	15,650	15,650
Subtotal - Other			-	382,490	382,490
TOTAL STRUCTURAL MEASURES			3,698,799	382,490	4,081,289
Work Plan Preparation Cost			28,600	-	28,600
TOTAL PROJECT			3,977,195	2,706,187	6,683,382
SUMMARY					
Subtotal SCS			3,977,195	2,706,187	6,683,382
TOTAL PROJECT			3,977,195	2,706,187	6,683,382

1/ Excludea $1,451,019 that may be available from other Federal Funds (ACPS) to reimburse private interest.

January 1959

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST				
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Easements (Land Value)	Legal Fees	Removing Obstacles	Total Non-Federal	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures										
1	29,468	2,947	6,483	3,385	42,283	1,720	90	-	1,810	44,093
2	13,604	1,360	2,993	1,563	19,520	840	90	-	930	20,450
3	12,805	1,281	2,817	1,470	18,373	1,320	60	-	1,380	19,753
4	21,511	2,151	4,732	2,471	30,865	10,000	210	-	10,210	41,075
5	6,184	618	1,361	710	8,873	3,100	120	-	3,220	12,093
6	34,695	3,469	7,633	3,986	49,783	7,400	270	-	7,670	57,453
7	18,580	1,858	4,088	2,134	26,660	2,680	60	-	2,740	29,400
8	16,244	1,624	3,574	1,866	23,308	1,680	30	-	1,710	25,018
9	15,184	1,519	3,340	1,744	21,787	2,080	150	-	2,230	24,017
10	15,847	1,585	3,486	1,820	22,738	1,800	180	-	1,980	24,718
11	12,593	1,259	2,770	1,447	18,069	2,080	90	-	2,170	20,239
12	48,829	4,883	10,742	5,609	70,063	4,440	120	-	4,560	74,623
13	16,319	1,632	3,590	1,874	23,415	2,240	90	-	2,330	25,745
14	37,444	3,744	8,238	4,301	53,727	4,000	120	-	4,120	57,847
15	20,732	2,073	4,561	2,381	29,747	2,080	90	-	2,170	31,917
16	22,348	2,235	4,917	2,567	32,067	2,745	90	650	3,485	35,552
17	29,942	2,994	6,587	3,439	42,962	5,265	150	240	5,655	48,617
18	15,865	1,587	3,490	1,822	22,764	1,170	150	600	1,920	24,684
19	10,250	1,025	2,255	1,177	14,707	1,485	60	-	1,545	16,252
20	9,946	995	2,188	1,142	14,271	1,305	30	-	1,335	15,606
21	20,110	2,011	4,424	2,310	28,855	2,345	150	-	2,495	31,350
22	18,008	1,801	3,962	2,068	25,839	2,070	120	-	2,190	28,029
23	26,970	2,697	5,933	3,098	38,698	1,960	150	650	2,760	41,458
24	9,587	959	2,109	1,101	13,756	440	90	-	530	14,286
25	32,850	3,285	7,227	3,773	47,135	4,680	180	-	4,860	51,995

(Footnote last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued

Pilot Grove Creek Watershed, Texas

(Trinity River Watershed)

Price Base: 1956

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST				Estimated Total Cost
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Easements (Land Value)	Legal Fees	Removing Obstacles	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures										
26	16,387	1,639	3,605	1,882	23,513	2,610	210	1,300	4,120	27,633
28	25,084	2,508	5,519	2,881	35,992	8,600	180	650	9,430	45,422
29	24,753	2,475	5,446	2,843	35,517	6,500	210	-	6,710	42,227
30	43,258	4,326	9,517	4,968	62,069	9,950	210	-	10,160	72,229
31	36,176	3,618	7,959	4,155	51,908	9,090	330	-	9,420	61,328
32	12,696	1,270	2,793	1,458	18,217	1,035	150	-	1,185	19,402
33	11,304	1,130	2,487	1,299	16,220	1,305	30	-	1,335	17,555
34	18,105	1,810	3,983	2,080	25,978	3,645	120	-	3,765	29,743
35	14,523	1,452	3,195	1,668	20,838	3,550	120	-	3,670	24,508
36	10,874	1,088	2,392	1,249	15,603	1,620	120	-	1,740	17,343
37	14,466	1,447	3,183	1,661	20,757	1,790	120	-	1,910	22,667
38	34,164	3,416	7,516	3,924	49,020	5,920	210	250	6,380	55,400
39	42,741	4,274	9,403	4,909	61,327	8,640	240	-	8,880	70,207
40	34,017	3,402	7,484	3,907	48,810	6,600	150	-	6,750	55,560
41	47,858	4,786	10,529	5,497	68,670	10,950	210	1,300	12,460	81,130
42	24,545	2,455	5,400	2,819	35,219	6,160	270	-	6,430	41,649
43	14,431	1,443	3,175	1,658	20,707	1,755	210	-	1,965	22,672
44	15,314	1,531	3,369	1,759	21,973	2,350	150	600	3,100	25,073
45	26,104	2,610	5,743	2,998	37,455	7,700	150	300	8,150	45,605
46	19,303	1,930	4,247	2,217	27,697	2,450	150	-	2,600	30,297
47	34,704	3,470	7,635	3,986	49,795	6,020	270	500	6,790	56,585
48	12,103	1,210	2,663	1,390	17,366	900	120	-	1,020	18,386
49	9,482	948	2,086	1,089	13,605	1,125	120	-	1,245	14,850
50	8,007	801	1,761	920	11,489	1,080	90	-	1,170	12,659
51	29,053	2,905	6,392	3,337	41,687	3,700	120	3,820	7,640	49,327

(Footnote last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST				
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Easements (Land Value)	Legal Fees	Removing Obstacles	Total Non-Federal	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
52	30,979	3,098	6,815	3,558	44,450	5,900	120	-	6,020	50,470
53	13,373	1,337	2,942	1,536	19,188	1,720	120	-	1,840	21,028
54	27,925	2,793	6,144	3,207	40,069	2,080	120	2,600	4,800	44,869
55	12,560	1,256	2,763	1,443	18,022	1,920	90	-	2,010	20,032
56	11,400	1,140	2,508	1,309	16,357	1,240	60	-	1,300	17,657
57	30,190	3,019	6,642	3,468	43,319	2,450	210	2,050	4,710	48,029
58	16,612	1,661	3,655	1,908	23,836	2,040	150	-	2,190	26,026
59	26,002	2,600	5,720	2,987	37,309	4,838	240	1,734	6,812	44,121
60	34,722	3,472	7,639	3,988	49,821	2,813	90	-	2,903	52,724
61	17,654	1,765	3,884	2,028	25,331	2,363	120	700	3,183	28,514
62	37,300	3,730	8,206	4,284	53,520	5,460	180	1,300	6,940	60,460
63	10,933	1,093	2,405	1,256	15,687	880	120	182	1,182	16,869
64	21,668	2,167	4,767	2,489	31,091	2,050	90	-	2,140	33,231
65	21,298	2,130	4,686	2,446	30,560	2,400	120	-	2,520	33,080
66	33,358	3,336	7,339	3,831	47,864	9,240	210	-	9,450	57,314
67	9,360	936	2,059	1,075	13,430	1,360	90	-	1,450	14,880
68	35,840	3,584	7,885	4,116	51,425	6,000	90	-	6,090	57,515
69	10,930	1,093	2,405	1,255	15,683	1,400	30	-	1,430	17,113
70	41,456	4,146	9,120	4,762	59,484	4,040	180	-	4,220	63,704
71	14,803	1,480	3,257	1,700	21,240	1,320	90	-	1,410	22,650
73	30,277	3,028	6,661	3,477	43,443	3,520	120	-	3,640	47,083
75	23,729	2,373	5,220	2,726	34,048	2,120	120	-	2,240	36,288
76	9,625	963	2,117	1,106	13,811	880	90	-	970	14,781
77	13,273	1,327	2,920	1,525	19,045	1,160	60	-	1,220	20,265

(Footnote last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1956

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST				
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Easements (Land Value)	Legal Fees	Removing Obstacles	Total Non-Federal	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
79	20,983	2,098	4,616	2,411	30,108	3,520	120	-	3,640	33,748
80	32,300	3,230	7,106	3,710	46,346	2,800	90	-	2,890	49,236
81	10,526	1,052	2,316	1,209	15,103	1,640	90	-	1,730	16,833
82	14,864	1,487	3,270	1,707	21,328	2,610	60	-	2,670	23,998
83	14,854	1,485	3,268	1,707	21,314	1,440	150	-	1,590	22,904
84	24,466	2,447	5,383	2,810	35,106	5,000	180	-	5,180	40,286
85	20,088	2,009	4,419	2,308	28,824	2,760	150	-	2,910	31,734
86	30,013	3,001	6,603	3,448	43,065	4,200	270	2,750	7,220	50,285
87	20,081	2,008	4,418	2,307	28,814	2,700	180	-	2,880	31,694
88	27,403	2,740	6,029	3,148	39,320	7,020	150	-	7,170	46,490
Subtotal	1,846,212	184,620	406,169	212,057	2,649,058	288,854	11,550	22,176	322,580	2,971,638
Stream Channel Improvement										
Tributary										
Indian Creek	146,400	14,640	32,208	16,815	210,063	6,240	860	3,000	10,100	220,163
Pot Rack Creek	56,200	5,620	12,364	6,455	80,639	3,170	540	1,500	5,210	85,849
Arnold Creek	68,400	6,840	15,048	7,856	98,144	3,640	620	-	4,260	102,404
Lee Creek	9,400	940	2,068	1,080	13,488	1,010	200	1,000	2,210	15,698
Bear Creek	22,200	2,220	4,884	2,550	31,854	1,380	260	5,000	6,640	38,494
Pilot Grove Creek	429,000	42,900	94,380	49,273	615,553	16,070	1,620	13,800	31,490	647,043
Subtotal	731,600	73,160	160,952	84,029	1,049,741	31,510	4,100	24,300	59,910	1,109,651
GRAND TOTAL	2,577,812	257,780	567,121	296,086	3,698,799	320,364	15,650	46,476	382,490	4,081,289

1/ Does not include work plan preparation cost.

January 1959

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9	10	11
Orainage Ares	Sq.Mi.	0.75	0.43	0.52	2.05	0.64	2.42	1.12	0.91	1.06	0.83	0.88
Storage Capacity												
Sediment Pool	Ac.Ft.	38	9	32	152	37	137	79	51	54	50	61
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	3	-	3	12	3	10	7	4	4	4	4
Floodwater Oetention	Ac.Ft.	209	119	145	569	179	700	316	251	294	230	244
Total	Ac.Ft.	250	128	180	733	219	847	402	306	352	284	309
Surface Area												
Sediment Pool 2/	Acre	10	4	8	60	16	36	19	10	12	13	14
Floodwater Detention Pool	Acre	33	17	25	108	46	112	48	37	40	32	38
Maximum Height of Oam	Poot	23	21	20	20	16	22	23	24	25	24	26
Volume of Pill	Cu.Yd.	73,670	34,010	35,570	56,420	15,790	90,820	51,610	40,610	37,960	44,020	34,980
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	39	37	34	32	34	41	44	35	42	37	32
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.8	6.9	6.8	6.9	6.8	6.5	6.7	6.8	6.7	6.8	6.8
Runoff	Inch	3.9	4.0	4.2	4.5	4.3	4.2	4.4	4 3	3.7	4.2	4.6
Bottom Width	Poot	50	60	70	90	64	84	86	60	50	70	80
Design Depth	Poot	0	0	0	0	0	0	0	0	0	0	0
Oesign Capacity	c.f.s.	0	0	0	0	0	0	0	0	0	0	0
Freebosrd 5/	Poot	3.5	3.0	3.0	4.0	3.0	4.0	3.5	4.0	4.0	3.5	3.5
Total Capacity	c.f.s.	890	822	1,020	1,990	419	1,860	1,530	1,330	1,110	1,250	1,420
Principal Spillway												
Capacity (Maximum)	c.f.s.	10	8	8	20	8	30	14	12	11	10	11
Capacity Equivalents												
Sediment Below Riser	Inch	0.95	0.40	1.16	1.39	1.09	1.06	1.32	1.05	0.95	1.12	1.30
Sediment in Oetention Pool	Inch	0.08	-	0.09	0.11	0.09	0.08	0.11	0.08	0.08	0.09	0.10
Detention Volume	Inch	5.20	5.20	5.20	5.20	5.20	5.41	5.27	5.20	5.20	5.20	5.20
Spillwsy Storage 6/	Inch	2.97	2.60	3.12	4.30	4.82	3.86	3.25	3.07	3.27	2.71	3.40
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 12	13	14	15	16	17	18	19	20	21	22
Orainsge Area	Sq.Mi.	2.33	0.84	2.01	0.98	0.67	2.31	0.45	0.60	0.42	1.11	0.71
Storage Capaclty												
Sediment Pool	Ac.Ft.	153	59	136	68	48	160	27	29	42	87	70
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	12	5	11	5	4	12	2	3	3	7	6
Floodwater Detention	Ac.Pt.	647	234	558	271	186	642	126	157	117	304	200
Total	Ac.Ft.	812	298	705	344	238	814	155	189	162	398	276
Surface Area												
Sediment Pool 2/	Acre	33	14	26	14	11	30	8	8	8	14	14
Floodwster Detention Pool	Acre	78	42	74	38	50	87	18	25	21	39	32
Maximum Height of Oam	Poot	30	25	33	25	28	31	22	21	24	31	28
Volume of Pill	Cu.Yd.	131,970	45,330	94,360	57,590	60,690	82,340	42,680	27,640	26,240	54,470	48,910
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Prequency of Use 3/	Year	34	33	33	40	38	36	36	33	34	31	38
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.6	6.8	6.6	6.8	6.8	6.6	6.8	6.0	6.9	6.8	6.8
Runoff	Inch	4.4	4.5	4.4	4.0	3.9	4.3	4.1	3.9	4.3	4.6	4.2
Bottom Width	Poot	100	70	58	60	76	80	70	50	58	104	54
Design Depth	Poot	0	0	0	0	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0	0	0	0	0
Freeboard 5/	Poot	4.5	3.5	5.0	3.5	3.0	4.0	3.0	3.5	3.3	3.5	3.5
Total Capacity	c.f.s.	2,700	1,250	1,860	1,070	1,040	1,770	960	890	928	1,850	960
Principal Spillway												
Capacity (Maximum)	c.f.s.	24	11	25	13	9	29	8	8	8	14	8
Capacity Equivalents												
Sediment Below Riser	Inch	1.23	1.32	1.27	1.31	1.34	1.30	1.11	0.90	1.85	1.46	1.85
Sediment in Detention Pool	Inch	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.10	1.15	0.12	0.15
Detention Volume	Inch	5.20	5.20	5.20	5.20	5.20	5.20	5.20	4.90	5.20	5.13	5.32
Spillway Storage 6/	Inch	3.27	3.58	3.93	2.99	3.04	3.90	2.00	3.20	3.20	2.69	3.28
Class af Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes last page)

January 1959

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 23	24	25	26	28	29	30	31	32	33	34
Drainage Area	Sq.Mi.	1.37	0.38	2.17	1.12	3.03	2.12	4.41	1/ 2.96	0.46	0.45	0.90
Storage Capacity												
Sediment Pool	Ac.Ft.	92	19	122	89	200	195	200	200	42	40	61
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	76	-	120	22	-	-	-
Sediment in Detention Pool	Ac.Ft.	7	1	9	7	23	15	26	17	3	3	5
Floodwater Detention	Ac.Ft.	338	105	601	298	742	609	1,111	1,200	127	126	325
Total	Ac.Ft.	437	125	732	394	1,041	819	1,457	1,439	172	169	391
Surface Area												
Sediment Pool 2/	Acre	10	5	21	16	49	33	47	42	6	7	16
Floodwater Detention Pool	Acre	39	17	83	42	123	97	152	160	17	22	65
Maximum Height of Dam	Foot	30	21	28	22	24	31	30	30	24	26	26
Volume of Fill	Cu.Yd.	72,140	26,630	89,860	45,520	68,290	65,980	89,460	100,490	33,600	31,400	49,250
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	26	32	35	29	25	34	29	50	29	36	50
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.7	6.9	6.6	6.7	6.5	6.6	9.5	9.2	6.9	6.9	10.1
Runoff	Inch	4.2	4.5	4.3	4.7	4.6	4.8	7.4	7.1	5.1	4.9	7.5
Bottom Width	Foot	152	70	80	65	150	90	430	400	50	66	100
Design Depth	Foot	0	0	0	0	0.9	0	1.6	0	0	0	0.8
Design Capacity	c.f.s.	0	0	0	0	120	0	1,850	0	0	0	80
Freeboard 5/	Foot	3.7	3.0	4.5	4.0	3.6	4.2	3.2	5.7	3.7	3.0	3.2
Total Capacity	c.f.s.	2,950	960	2,160	1,440	4,050	2,160	12,900	14,520	975	904	2,980
Principal Spillway												
Capacity (Maximum)	c.f.s.	14	8	22	14	31	21	66	111	8	8	9
Capacity Equivalents												
Sediment Below Riser	Inch	1.26	0.93	1.06	1.50	1.71	1.72	1.36	1.41	1.73	1.65	1.27
Sediment in Detention Pool	Inch	0.10	0.07	0.08	0.12	0.14	0.14	0.11	0.11	0.14	0.13	0.10
Detention Volume	Inch	4.64	5.20	5.20	5.01	4.60	5.38	4.73	7.60	5.20	5.22	6.78
Spillway Storage 6/	Inch	3.03	2.90	4.36	3.37	3.70	5.56	3.80	6.28	2.43	3.15	5.65
Class of Structure		A	A	A	A	A	A	B	B	A	A	B

(Footnotes last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER										
		35	36	37	38	39	40	41	42	43	44	45
Drainage Area	Sq.Mi.	0.90	0.48	0.66	3.24	3.16	2.87	3.54	1/ 2.32	0.73	0.66	2.72
Storage Capacity												
Sediment Pool	Ac.Ft.	73	47	58	200	200	200	200	200	76	63	200
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	66	66	62	117	11	-	-	12
Sediment in Detention Pool	Ac.Ft.	6	4	5	21	20	21	25	39	6	5	17
Floodwater Detention	Ac.Ft.	227	133	182	897	1,349	797	1,529	644	204	184	735
Total	Ac.Ft.	306	184	245	1,184	1,635	1,080	1,871	894	286	252	964
Surface Area												
Sediment Pool 2/	Acre	18	10	11	45	47	37	51	39	15	12	33
Floodwater Detention Pool	Acre	53	26	31	103	145	95	168	114	35	35	120
Maximum Height of Dam	Foot	18	20	23	31	33	31	32	26	23	24	28
Volume of Fill	Cu.Yd.	38,120	28,540	39,350	88,650	118,730	90,880	132,940	68,180	40,090	42,540	72,510
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	28	33	29	34	50	33	23	33	29	29	31
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.8	6.9	6.8	9.7	10.6	7.1	9.6	6.3	6.8	6.8	6.5
Runoff	Inch	4.4	4.4	5.0	7.7	7.6	5.1	7.7	4.5	5.0	5.0	4.2
Bottom Width	Foot	60	72	70	210	260	120	160	200	84	70	71
Design Depth	Foot	0	0	0	1.2	0	0.6	0	0	0.6	0	0
Design Capacity	c.f.s.	0	0	0	432	0	51	0	0	40	0	0
Freeboard 5/	Foot	3.5	3.0	4.0	4.2	4.5	3.9	5.0	3.8	2.9	3.5	4.5
Total Capacity	c.f.s.	1,070	986	1,550	5,040	6,240	3,240	10,080	2,100	1,500	1,250	1,920
Principal Spillway												
Capacity (Maximum)	c.f.s.	9	8	8	48	32	29	53	76	8	8	28
Capacity Equivalents												
Sediment Below Riser	Inch	1.53	1.84	1.66	1.54	1.58	1.71	1.68	1.70	1.95	1.78	1.46
Sediment in Detention Pool	Inch	0.12	0.15	0.14	0.12	0.12	0.12	0.13	0.32	0.16	0.14	0.12
Detention Volume	Inch	4.75	5.20	5.20	5.20	8.00	5.20	8.09	5.20	5.20	5.20	5.07
Spillway Storage 6/	Inch	5.00	2.23	3.50	3.14	4.50	3.35	6.10	4.08	3.59	3.88	4.45
Class of Structure		A	A	A	B	B	A	B	A	A	A	A

(Footnotes last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 46	47	48	49	50	51	52	53	54	55	56
Drainage Area	Sq.Mi.	0.78	3.15	0.47	0.35	0.34	2.15	2.13	0.78	1.03	0.81	0.48
Storage Capacity												
Sediment Pool	Ac.Ft.	66	200	37	27	39	160	128	86	96	66	34
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	-	-	-	-	-	-	-
Sediment In Detention Pool	Ac.Ft.	5	16	3	2	3	12	10	7	8	5	3
Floodwater Detention	Ac.Ft.	217	874	129	96	68	538	589	172	287	225	132
Total	Ac.Ft.	288	1,090	169	125	110	710	727	265	391	296	169
Surface Area												
Sediment Pool 2/	Acre	13	33	8	6	9	31	29	15	17	14	8
Floodwater Detention Pool	Acre	36	110	22	19	18	74	89	28	45	34	24
Maximum Height of Dam	Foot	24	30	20	22	18	23	27	26	24	22	23
Volume of Fill	Cu.Yd.	53,620	95,010	33,620	26,340	21,130	80,700	83,830	34,370	77,570	34,890	30,280
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	29	32	31	30	16	28	34	20	32	37	31
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.9	6.6	6.9	6.9	6.9	10.7	6.6	6.9	6.8	6.8	6.8
Runoff	Inch	4.9	4.5	4.6	4.7	4.7	7.7	4.5	4.5	4.5	4.7	4.5
Bottom Width	Foot	60	110	90	60	90	220	70	70	60	50	50
Design Depth	Foot	0.5	0	0	0	0.6	1.5	0	0.8	0	0	0
Design Capacity	c.f.s.	30	0	0	0	14	787	0	50	0	0	0
Freeboard 5/	Foot	3.5	5.0	3.0	3.2	2.4	3.4	4.5	3.2	4.1	3.5	3.5
Total Capacity	c.f.s.	1,330	3,520	1,230	920	1,230	6,820	1,890	1,550	1,380	890	890
Principal Spillway												
Capacity (Maximum)	c.f.s.	8	32	8	8	8	33	22	8	10	8	8
Capacity Equivalents												
Sediment Below Riser	Inch	1.58	1.19	1.48	1.48	2.13	1.40	1.13	2.06	1.74	1.53	1.35
Sediment in Detention Pool	Inch	0.13	0.10	0.12	0.12	0.17	0.10	0.09	0.16	0.14	0.12	0.11
Detention Volume	Inch	5.20	5.20	5.20	5.20	3.70	4.70	5.20	4.12	5.20	5.20	5.20
Spillway Storage 6/	Inch	4.09	4.11	4.60	3.40	2.75	4.60	4.38	2.66	3.32	3.35	3.59
Class of Structure		A	A	A	A	A	B	A	A	A	A	A

(Footnotes last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 57	58	59	60	61	62	63	64	65	66	67
Drainage Area	Sq.Mi.	1.23	0.74	2.85	1.13	0.96	2.63	0.49	0.83	0.87	1/ 3.45	0.43
Storage Capacity												
Sediment Pool	Ac.Ft.	75	62	128	124	89	187	46	97	73	200	38
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	-	-	-	-	-	37	-
Sediment in Detention Pool	Ac.Ft.	6	5	11	10	7	15	4	8	6	19	5
Floodwater Detention	Ac.Ft.	341	165	790	246	265	731	90	230	242	955	118
Total	Ac.Ft.	422	232	929	380	362	933	140	335	321	1,211	161
Surface Area												
Sediment Pool 2/	Acre	16	16	24	25	17	46	11	18	17	64	11
Floodwater Detention Pool	Acre	54	36	105	50	47	110	21	41	47	167	23
Maximum Height of Dam	Foot	22	20	26	23	23	26	19	23	20	25	17
Volume of Fill	Cu.Yd.	80,530	44,200	70,840	96,460	49,040	90,830	30,370	64,630	59,160	92,660	26,000
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	30	19	37	20	33	32	14	30	29	33	26
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.8	6.8	6.6	6.7	6.8	6.7	6.9	6.9	6.8	6.4	7.0
Runoff	Inch	4.7	4.7	4.2	4.4	4.4	4.6	4.6	4.8	5.0	4.0	5.4
Bottom Width	Foot	80	67	78	72	53	72	50	60	60	150	105
Design Depth	Foot	0	0.2	0	0.7	0	0	1.0	0.3	0.5	0	0
Design Capacity	c.f.s.	0	10	0	34	0	0	50	12	20	0	0
Freeboard 5/	Foot	4.0	3.8	4.5	3.4	4.0	5.0	3.0	3.7	3.5	4.5	3.0
Total Capacity	c.f.s.	1,780	1,490	2,110	1,600	1,180	2,300	1,110	1,330	1,330	4,050	1,440
Principal Spillway Capacity (Maximum)	c.f.s.	13	8	36	15	10	27	8	8	9	52	8
Capacity Equivalents												
Sediment Below Riser	Inch	1.15	1.57	0.84	2.06	1.75	1.33	1.76	2.18	1.58	1.29	1.69
Sediment in Detention Pool	Inch	0.09	0.13	0.07	0.10	0.14	0.11	0.14	0.17	0.13	0.10	0.21
Detention Volume	Inch	5.20	4.15	5.20	4.08	5.20	5.20	3.40	5.20	5.20	5.20	5.20
Spillway Storage 6/	Inch	4.16	4.25	3.69	3.85	4.31	4.66	3.85	4.45	5.29	5.01	2.15
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 68	69	70	71	73	75	76	77	79	80	81
Drainage Area	Sq.Mi.	3.05	0.38	2.63	0.57	2.76	1.30	0.44	0.56	1.80	1.74	0.65
Storage Capacity												
Sediment Pool	Ac.Ft.	200	42	149	67	74	40	26	30	78	82	47
Sediment Reserve Below Riser	Ac.Ft.	29	-	-	-	-	-	-	-	-	-	-
Sediment in Detention Pool	Ac.Ft.	29	5	13	5	6	3	2	3	6	6	4
Floodwater Detention	Ac.Ft.	824	106	731	158	766	361	121	154	500	483	179
Total	Ac.Ft.	1,082	153	892	230	846	404	149	187	584	571	230
Surface Area												
Sediment Pool 2/	Acre	47	11	39	15	21	9	6	6	21	17	9
Floodwater Detention Pool	Acre	120	23	101	33	88	44	22	23	67	53	32
Maximum Height of Dam	Foot	25	22	25	20	25	23	22	23	24	30	26
Volume of Fill	Cu.Yd.	98,170	30,360	115,160	41,120	82,710	65,080	26,740	36,870	53,910	87,500	29,240
Emergency Spillway												
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	Year	31	26	34	30	34	37	38	30	33	33	30
Design Storm												
Duration	Hour	6	6	6	6	6	6	6	6	6	6	6
Rainfall 4/	Inch	6.5	7.0	6.5	6.9	6.5	6.7	6.9	6.9	6.6	6.6	6.8
Runoff	Inch	4.6	5.4	4.5	4.8	4.5	4.0	4.0	4.8	4.5	4.5	4.7
Bottom Width	Foot	138	85	90	60	90	75	50	50	144	132	50
Design Depth	Foot	0	0	0	0	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0	0	0	0	0
Freeboard 5/	Foot	4.5	3.0	4.5	3.3	5.0	4.0	3.0	4.0	4.0	4.0	4.0
Total Capacity	c.f.s.	3,730	1,160	2,030	960	2,880	1,670	685	1,110	3,200	2,930	1,110
Principal Spillway Capacity (Maximum)	c.f.s.	31	8	26	8	28	13	8	8	18	18	8
Capacity Equivalents												
Sediment Below Riser	Inch	1.41	2.03	1.06	2.21	0.50	0.57	1.12	1.01	0.81	0.88	1.37
Sediment in Detention Pool	Inch	0.18	0.26	0.09	0.18	0.04	0.05	0.09	0.08	0.06	0.07	0.11
Detention Volume	Inch	5.07	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20	5.20
Spillway Storage 6/	Inch	3.49	4.01	4.05	4.41	3.46	2.88	3.09	3.41	3.03	2.70	4.62
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes next page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pilot Grove Creek Watershed, Texss
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 82	83	84	85	86	87	88	Total
Drainage Area	Sq.Mi.	1.76	0.56	2.62	1.43	2.27	0.94	2.52	120.75
Storage Capacity									
Sediment Pool	Ac.Ft.	127	62	141	104	151	65	200	8,099
Sediment Reserve Below Riser	Ac.Ft.	-	-	-	-	-	-	44	662
Sediment in Detention Pool	Ac.Ft.	10	5	11	8	12	5	19	731
Floodwater Detention	Ac.Ft.	348	131	872	398	630	317	700	34,440
Total	Ac.Ft.	485	198	1,024	510	793	387	963	43,932
Surface Area									
Sediment Pool 2/	Acre	14	11	29	17	28	11	48	1,759
Floodwater Detention Pool	Acre	44	25	96	52	56	43	108	5,012
Maximum Height of Dam	Foot	25	25	27	29	26	26	29	xxx
Volume of Fill	Cu.Yd.	38,510	41,260	67,970	55,800	83,370	55,780	76,120	4,982,580
Emergency Spillway									
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Frequency of Use 3/	Year	22	23	50	42	33	25	39	xxx
Design Storm									
Duration	Hour	6	6	6	6	6	6	6	xxx
Rainfall 4/	Inch	6.6	6.9	10.1	6.7	6.6	6.8	6.6	xxx
Runoff	Inch	3.5	4.4	6.4	3.7	4.5	5.0	4.3	xxx
Bottom Width	Foot	52	50	200	50	134	88	92	xxx
Design Depth	Foot	0	0	0	0	0	0	0	xxx
Design Capacity	c.f.s.	0	0	0	0	0	0	0	xxx
Freeboard 5/	Foot	4.0	4.0	5.0	4.0	4.5	3.5	4.3	xxx
Total Capacity	c.f.s.	1,150	1,110	5,700	1,110	3,620	2,110	2,300	xxx
Principal Spillway									
Capacity (Maximum)	c.f.s.	18	8	27	23	23	9	26	xxx
Capacity Equivalents									
Sediment Below Riser	Inch	1.35	2.07	1.01	1.36	1.25	1.30	1.81	xxx
Sediment in Detention Pool	Inch	0.11	0.16	0.08	0.11	0.10	0.10	0.14	xxx
Detention Volume	Inch	3.72	4.37	6.23	5.20	5.20	6.30	5.20	xxx
Spillway Storage 6/	Inch	5.56	3.40	3.91	3.33	3.55	3.50	3.35	xxx
Class of Structure		A	A	B	A	A	A	A	xxx

1/ Excludes area from which runoff is controlled by other structures.
2/ Surface area at top of riser.
3/ Based on regional stream gage analysis and soil-cover complex characteristics of the watershed of the individual structure.
4/ Class A structures - 0.5F; Class B Structures - 0.75P. Value of P from Figure 3.21-1, Supplement A, Section 4, Nstional Engineering Haodbook.
5/ Class A - (H_p for 1.0P) - (H_p for 0.5P) + 1.0'
Class B - (H_p for 1.5P) - (H_p for 0.75P) + 1.0'
6/ Storage from emergency spillway crest to top of dam.

TABLE 3A - STRUCTURE DATA
STREAM CHANNEL IMPROVEMENT
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Station Numbering For Reach		Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
Station	Station	(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Indian Creek Below Arnold Creek (Reach 10)									
0 + 00	58 + 00	30,684	3,252	32	2:1	12.0	.0011	4.84	144
58 + 00	109 + 30	23,944	2,826	26	2:1	12.0	.0011	4.71	114
109 + 30	161 + 30	22,565	2,696	24	2:1	12.0	.0011	4.68	111
161 + 30	256 + 10	21,288	2,550	22	2:1	12.0	.0011	4.62	194
								Subtotal	563
Indian Creek Above Arnold Creek (Reach 14)									
256 + 10	301 + 30	13,821	1,574	14	2:1	10.0	.0015	4.63	57
301 + 30	347 + 50	4,596	1,023	12	2:1	8.5	.0015	4.16	42
347 + 50	440 + 50	3,994	907	12	2:1	7.5	.0020	4.49	70
								Subtotal	169
Pot Rack Creek (Reach 11)									
0 + 00	105 + 90	6,777	1,669	22	2:1	8.0	.0024	5.49	119
105 + 90	160 + 60	5,408	1,537	20	2:1	8.0	.0024	5.43	58
160 + 60	270 + 30	4,768	1,352	16	2:1	8.0	.0024	5.28	104
								Subtotal	281
Arnold Creek Below Lee Creek (Reach 12)									
0 + 00	92 + 50	9,684	1,586	14	2:1	10.8	.0011	4.13	132
92 + 50	152 + 40	6,969	1,286	14	2:1	9.8	.0011	3.91	73
								Subtotal	205

(Footnote last page)

January 1959

TABLE 3A - STRUCTURE DATA - Continued

STREAM CHANNEL IMPROVEMENT

Pilot Grove Creek Watershed, Texas

(Trinity River Watershed)

Station Numbering For Reach		Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
Station	Station	(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Arnold Creek Above Lee Creek (Reach 17)									
152 + 40	211 + 00	6,330	1,255	14	2:1	8.5	.0019	4.77	57
211 + 00	253 + 10	4,128	1,015	12	2:1	8.0	.0019	4.53	35
253 + 10	283 + 60	3,296	838	12	2:1	7.3	.0019	4.32	22
283 + 60	323 + 00	2,054	639	12	2:1	6.4	.0019	4.02	23
								Subtotal	137
Lee Creek (Reach 18)									
0 + 00	54 + 20	3,315	883	12	2:1	7.4	.0020	4.46	25
54 + 20	105 + 80	2,886	834	12	2:1	7.2	.0020	4.39	22
								Subtotal	47
Bear Creek (Reach 13)									
0 + 00	39 + 70	4,051	1,046	14	2:1	8.0	.0017	4.36	35
39 + 70	87 + 90	3,859	993	14	2:1	7.8	.0017	4.30	41
87 + 90	136 + 00	3,386	947	14	2:1	7.0	.0024	4.83	35
								Subtotal	111
Pilot Grove Creek Below Indian Creek (Reach 9)									
0 + 00	100 + 00	72,352	5,704	78	2:1	12.0	.00081	4.66	453
100 + 00	149 + 80	64,646	5,334	72	2:1	12.0	.00081	4.63	212
								Subtotal	665
Pilot Grove Creek Between Indian and Desert Creeks (Reach 15)									
149 + 80	194 + 10	62,573	5,200	70	2:1	12.0	.00081	4.61	185
194 + 10	283 + 20	30,554	3,525	44	2:1	12.0	.00081	4.32	269
283 + 20	356 + 20	29,357	3,399	38	2:1	11.0	.0013	5,15	178
356 + 20	425 + 20	27,482	3,254	36	2:1	11.0	.0013	5.10	154
								Subtotal	786

(Footnote last page)

TABLE 3A - STRUCTURE DATA - Continued
STREAM CHANNEL IMPROVEMENT
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Station Numbering For Reach		Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
Station	Station	(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Pilot Grove Creek Between Desert Creek and Grayson County Line (Reach 19)									
425 + 20	470 + 20	21,600	2,843	30	2:1	11.0	.0013	4.97	95
470 + 20	575 + 20	20,634	2,734	30	2:1	10.2	.0016	5.32	200
575 + 20	664 + 70	18,752	2,630	30	2:1	10.0	.0016	5.26	166
664 + 70	709 + 20	17,555	2,615	30	2:1	9.4	.0020	5.71	75
709 + 20	763 + 00	16,646	2,510	30	2:1	9.2	.0020	5.64	89
763 + 00	806 + 10	14,874	2,411	30	2:1	9.0	.0020	5.58	69
								Subtotal	694
								GRAND TOTAL	3,658

1/ Uncontrolled area below floodwater retarding structures.

January 1959

TABLE 4 - ANNUAL COSTS 1/
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Measures	Amortization of Installation Costs 2/			Operation and Maintenance Costs 3/	Total
	Federal	Non-Federal	Total	Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures Number					
1 through 26, 30 through 71, 73, 75, 76, 77, 79 and 80, and Channel Improvement 39.43 Miles	119,680	15,594	135,274	14,873	150,147
28 and 29	2,521	751	3,272	180	3,452
81	533	81	614	90	704
82 through 87	6,292	1,045	7,337	540	7,877
88	1,386	334	1,720	90	1,810
TOTAL	130,412	17,805	148,217	15,773	163,990

1/ Does not include work plan preparation cost.
2/ Amortization period, 50 years; Federal interest rate, 2½ percent; non-Federal interest rate, 4 percent; based on 1956 prices.
3/ Based on long-term price levels as projected by ARS, June 1956.

January 1959

TABLE 5 - MONETARY BENEFITS FROM STRUCTURAL MEASURES
Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)
Price Base: Long-Term 1/

Item	Estimated Average Annual Damage			Average Annual Monetary Benefits
	Without Project	After Land Treatment For W/S Protection	With Project	
	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Damage				
Crop and Pasture	188,663	178,214	31,932	146,282
Other Agricultural	66,670	61,734	11,612	50,122
Nonagricultural	63,167	58,485	9,671	48,814
Subtotal	318,500	298,433	53,215	245,218
Sediment Damage				
Overbank Deposition	23,418	20,568	2,813	17,755
Lavon Reservoir	5,604	5,039	3,090	1,949
Subtotal	29,022	25,607	5,903	19,704
Erosion Damage				
Flood Plain Scour	5,460	4,645	431	4,214
Subtotal	5,460	4,645	431	4,214
Indirect Damage	32,788	30,358	5,934	24,424
Total, All Damage	385,770	359,043	65,483	293,560
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	293,560
TOTAL PRIMARY BENEFITS	xxx	xxx	xxx	293,560
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	293,560

1/ USDA, ARS, June 1956.

January 1959

TABLE 6 - BENEFIT-COST ANALYSIS

Pilot Grove Creek Watershed, Texas
(Trinity River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost 2/	Benefit-Cost Ratio
	Flood Prevention						
	Flood-water	Sediment	Erosion	Indirect	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures Number							
1 through 26, 30 through 71, 73, 75, 76, 77, 79 and 80, and Channel Improvement 39.43 Miles	231,314	16,628	3,656	22,749	274,347	150,147	1.8:1
28 and 29	4,509	581	147	445	5,682	3,452	1.6:1
81	1,004	114	-	111	1,229	704	1.7:1
82 through 87	6,857	2,154	338	935	10,284	7,877	1.3:1
88	1,534	227	73	184	2,018	1,810	1.1:1
TOTAL	245,218	19,704	4,214	24,424	293,560	163,990	1.8:1

1/ Long-term prices as projected by ARS, June 1956.
2/ Derived from installation costs based on 1956 price levels and operation and maintenance cost based on long-term prices, as projected by ARS, June 1956; work plan preparation cost not included.

January 1959