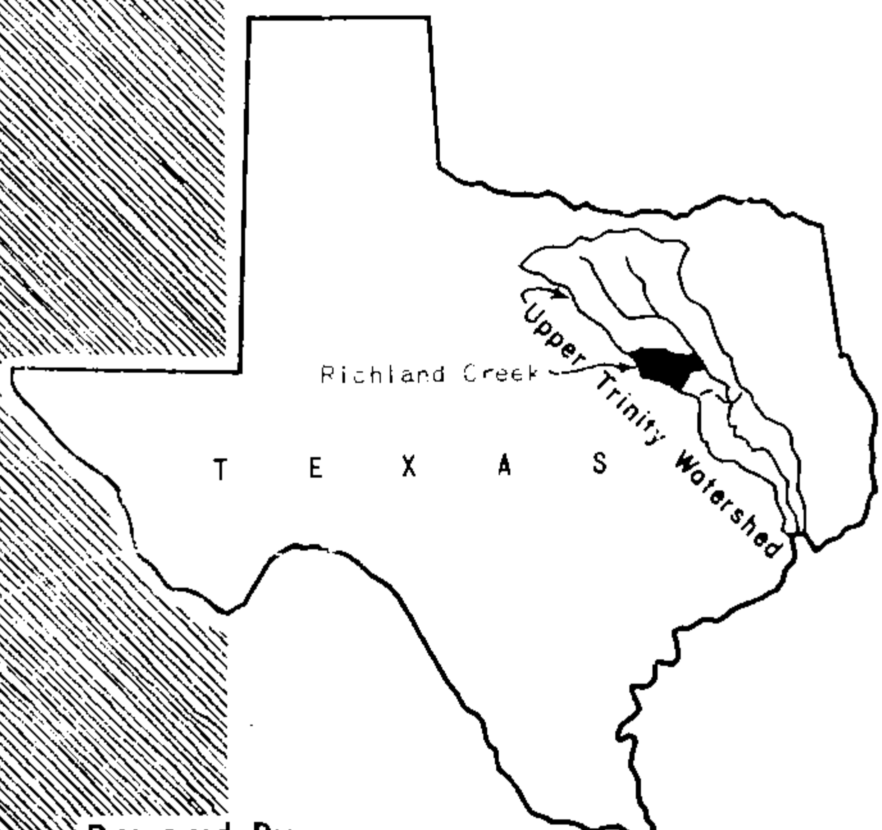
ENGINEERING FILE

WORK PLAN

RICHLAND CREEK WATERSHED

OF THE TRINITY RIVER WATERSHED NAVARRO, ELLIS, HILL, LIMESTONE AND FREESTONE COUNTIES, TEXAS



Prepared By
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Temple, Texas
October 1958

WATERSHED WORK PLAN AGREEMENT

between the

Limestone-Falls Soil Conservation District
Local Organization
McLennan County Soil Conservation District
Local Organization
Ellis-Prairie Soil Conservation District
Local Organization
Navarro-Hill Soil Conservation District
Local Organization

(Hereinafter referred to as the Districts)

Navarro County Commissioners Court
Local Organization
Ellis County Commissioners Court
Local Organization
Hill County Commissioners Court
Local Organization

(Hereinafter referred to as the Counties)

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 Richland 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 Richland Creek Watershed, State of Texas, hereinafter referred to as the Watershed Work Plan;

Whereas, the Counties 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 counties 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 District and/or the County 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.

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

6. The District will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

7. The District and the County 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.

Limestone-Falls Soil Conservation District
Local Organization

By R W Gibbs

Title Chairman

Date 5/21/59

The signing of this agreement was authorized by a resolution of the governing body of the **Limestone-Falls Soil Conservation District**
Local Organization

adopted at a meeting held on 5/20/59

Leon Johansen
(Secretary, Local Organization)

Date 5-22-59

McLennan County Soil Conservation District
Local Organization

By Dave Simons

Title Chairman

Date 5/21/59

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

adopted at a meeting held on May 20, 1959

Harry F. Holland, Jr.
(Secretary, Local Organization)

Date May 21, 1959

Ellis-Prairie Soil Conservation District
Local Organization

By *W. J. Hamm*

Title *Chrm*

Date *5/19-1959*

The signing of this agreement was authorized by a resolution of the governing body of the **Ellis-Prairie Soil Conservation District**
Local Organization

adopted at a meeting held on *5-19-59*

Marvin Borders
(Secretary, Local Organization)

Date *5-19-59*

Navarro-Hill Soil Conservation District
Local Organization

By *C. M. Newton Jr*

Title *Chairman*

Date *5-21-59*

The signing of this agreement was authorized by a resolution of the governing body of the **Navarro-Hill Soil Conservation District**
Local Organization

adopted at a meeting held on *5-21-59*

H. R. Lively
(Secretary, Local Organization)

Date *5-21-59*

Navarro County Commissioners Court
Local Organization

By *Kenneth A. Douglas*

Title *County Judge*

Date *5/21/59*

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

adopted at a meeting held on *5-21-59*

Harry F Clement
(Secretary, Local Organization)

Date *5/21/59*

Ellis County Commissioners Court

~~Soil Conservation District~~

Local Organization

By Milton Hartsfield

Title County Judge

Date May 30, 1959

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

Local Organization

adopted at a meeting held on 5-30-59

Chas W. Hoff

(Secretary, Local Organization)

Date 5-30-59

Commissioners Court Hill County

Local Organization

By Hugh Phillips

Title County Judge

Date May 21 1959

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

Local Organization

adopted at a meeting held on May 21, 1959

Glenn Morgan Co. Clerk

(Secretary, Local Organization)

By Mary Haney Deputy

Date May 26 1959

United States Department of Agriculture
Soil Conservation Service

By ______________________

State Conservationist

Date ______________________

WORK PLAN

RICHLAND CREEK WATERSHED
Of the Trinity River Watershed
Navarro, Ellis, Hill, Limestone, and Freestone 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

Navarro-Hill Soil Conservation District
Limestone-Falls Soil Conservation District
Ellis-Prairie Soil Conservation District
McLennan County Soil Conservation District
Ellis County Commissioners Court
Hill County Commissioners Court
Navarro County Commissioners Court

Prepared By:

Soil Conservation Service
U. S. Department of Agriculture
October 1958

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WORK PLAN

RICHLAND CREEK WATERSHED
Of the Trinity River Watershed
Navarro, Ellis, Hill, Limestone, and Freestone Counties, Texas
October 1958

SUMMARY OF PLAN

Description

Size: 586,696 acres - 916.7 square miles.

Land Use:

Cultivation	270,357 acres
Pasture	258,377 acres
Woodland pasture	13,379 acres
Miscellaneous (towns, roads, railroads, etc.)	44,583 acres

Flood plain area:

Excluding proposed Navarro Mills and Fort Worth reservoirs and proposed floodwater retarding structures	53,247 acres
In Fort Worth Reservoir	21,995 acres
In Navarro Mills Reservoir	3,600 acres
In proposed floodwater retarding structures	3,327 acres

Soil Conservation Districts:

Navarro-Hill	547,900 acres
Limestone-Falls	32,400 acres
Ellis-Prairie	1,770 acres
McLennan County	4,626 acres

Flood Frequency:

Total of 136 floods during 30-year period of study (1924 through 1953), of which 28 inundated more than half the flood plain area.

Land Treatment:

Practice	Unit	Applied to Date	Remaining to be Done
Contour Farming	Acre	66,513	121,989
Cover Cropping	Acre	73,014	168,438
Rotation Hay and Pasture	Acre	27,760	12,586

Practice	Unit	Applied to Date	Remaining to be Done
Crop Residue Utilization	Acre	106,816	147,171
Proper Use Range and Pasture	Acre	87,525	101,376
Range Seeding	Acre	0	6,317
Pasture Planting	Acre	47,989	67,835
Brush Control	Acre	6,623	19,482
Wildlife Area Improvement	Acre	22,963	14,481
Fish Pond Improvement	No.	940	1,265
Terracing	Mile	2,425	4,545
Diversion Construction	Mile	97	543
Waterway Development	Acre	2,044	3,921
Pond Construction	No.	2,854	2,408
Stabilizing Measures	No.	37	93
Fertilizing	Acre	76,923	180,392

Structural Measures:

Measure	Unit	Applied to Date	Remaining to be Done
Floodwater Retarding Structures	No.	9	144
Stream Channel Improvement	Mile	0	65.5

Total Cost:

Item	Federal (dollars)	Non-Federal (dollars)	Total (dollars)
Land Treatment	563,243	11,515,827	12,079,070
Structural Measures	8,598,765	1,080,620	9,679,385
Work Plan Preparation	98,076	-	98,076
Total	9,260,084	12,596,447	21,856,531

Average Annual Monetary Damages and Benefits:

Item	Damages			Benefits	
	Without[1/] Project (dollars)	With Land Treatment (dollars)	With Project (dollars)	Structural Measures (dollars)	Total (dollars)
Floodwater	765,946	713,376	134,750	578,626	631,196
Sediment	121,117	75,437	23,011	52,426	98,106
Erosion	25,340	22,869	3,673	19,196	21,667
Indirect	91,240	81,168	16,143	65,025	75,097
Land Use Change	-	-	-	42,690	42,690
Total	1,003,643	892,850	177,577	757,963	868,756

1/ Considering Navarro Mills and Fort Worth reservoirs in place.

Benefit-Cost Ratio - Structural Measures:

Average Annual Benefits - Structures	$757,963
Average Annual Cost - Structures	$382,153
Benefit-Cost Ratio	2.0:1

Operation and Maintenance:

Land Treatment Measures:

Navarro-Hill Soil Conservation District
Limestone-Falls Soil Conservation District
Ellis-Prairie Soil Conservation District
McLennan County Soil Conservation District

Structural Measures:

Navarro-Hill Soil Conservation District
Limestone-Falls Soil Conservation District
McLennan County Soil Conservation District
Ellis County Commissioners Court
Hill County Commissioners Court
Navarro County Commissioners Court

Annual Cost - $28,674

DESCRIPTION OF WATERSHED

Physical Data

Richland Creek heads in the northeastern part of Hill County about nine miles northwest of Milford. It flows to the south and east through parts of Ellis, Navarro and Freestone Counties and enters the Trinity River approximately 25 miles southeast of Corsicana. The larger tributaries are Pin Oak, Rush, Post Oak, White Rock, and Ash Creeks. Chambers Creek, drainage area 1,073 square miles, joins Richland Creek approximately 8.5 miles upstream from the Richland Creek - Trinity River confluence. Chambers Creek is not included in this work plan since a work plan has been previously prepared for this watershed. The Richland Creek watershed has an area of 586,696 acres (916.7 square miles), nearly all of which is in farms and ranches.

Upland slopes generally range from 1 to 5 percent, with some slopes as steep as 20 percent along the south sides of streams and in the upper reaches of the watershed. The main alluvial valley of Richland Creek ranges in width from 9,000 feet in the vicinity of Cheneyboro to 1,000 feet in its upper reaches. Valley widths of the main tributaries range from 7,000 feet at their confluence with Richland Creek to 800 feet near the headwaters. Elevations range from 250 feet to 790 feet above mean sea level.

Approximately 2.5 percent of the watershed lies in the Forested Coastal Plain Land Resource Area. These soils are deep, medium to coarse textured and very slowly to moderately permeable. The principal soil series are Boswell, Tabor and Lufkin. Only a small percent of this area is cultivated, with the rest in open and wooded pasture. Erosion rates are low in this area.

Approximately 97.5 percent of the watershed is in the Blackland Prairies Land Resource area. These 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 low to very high in the Blackland area, depending primarily upon the amount and treatment of cultivated land. A large percent of the Houston series, especially, is in cultivation. Some slopes of three to six percent have only a small amount of land treatment. The upper part of the watershed is in the Austin and Eddy soil series. Considerable amounts of small grain crops are grown in this area and erosion is fairly low.

The upper portion of the Richland Creek watershed is composed of geological formations of the Upper Cretaceous System. Formations of Tertiary age occupy the lower portion of the watershed, below Corsicana. The geological groups of the Upper Cretaceous System are the Austin chalk, Taylor marl and the Navarro formations. Those of Tertiary age consist of Midway and Wilcox.

The land use for the entire watershed is as follows:

Land Use	Acres	Percent
Cropland	270,357	46.1
Pasture	258,377	44.0
Wooded Pasture	13,379	2.3
Miscellaneous 1/	44,583	7.6
Total	586,696	100.0

Approximately 17 percent of the cultivated land in the watershed is in small grains and legumes, with the remainder in row crops. In areas where row type farming predominates, most of the soils are in poor condition. The open and wooded pasture cover conditions are:

Land Use	Good (Percent)	Fair (Percent)	Poor (Percent)
Pasture	37.7	47.1	15.2
Wooded Pasture	57.9	42.1	-

Most of the pastures have a fairly good grass cover which is good to excellent for erosion control. Some formerly cultivated areas now being used for pasture have never been established to a base grass, and are in poor condition.

The flood plain is that area inundated by the runoff from a storm which can be expected to occur on an average of once in 50 years. This storm would produce a runoff of 5.89 inches and inundate 53,247 acres exclusive of that inundated by the proposed Navarro Mills and Fort Worth reservoirs and the proposed floodwater retarding structures. These reservoirs and the sediment and detention pools will inundate approximately 28,922 acres of the flood plain. The flood plain land use is as follows:

Land Use	Acres	Percent
Cropland	28,888	54.2
Pasture	16,431	30.9
Wooded Pasture	4,302	8.1
Stream Channels	2,950	5.5
Miscellaneous 2/	676	1.3
Total	53,247	100.0

1/ Includes, roads, railroads, towns, and the proposed Navarro Mills and Fort Worth reservoir sites.

2/ Includes roads, railroads, etc.

The mean annual rainfall is 36.91 inches based on a 70-year Weather Bureau record at Corsicana. It is well distributed, with the wettest months being April, May, and December. Individual excessive rains causing serious floodwater and sediment damage may occur in any season, but are most frequent in the spring. The minimum recorded annual rainfall was 19.36 inches; the maximum was 53.89 inches.

Average temperatures range from 85 degrees Fahrenheit in the summer to 47 degrees in the winter. The normal frost-free period is 244 days.

Water for domestic and livestock uses in the rural areas is supplied largely by small farm ponds and shallow wells. Water for Coolidge, Dawson, and Hubbard is supplied by reservoir storage, while the remainder of municipalities obtained their water from wells.

Economic Data

The watershed economy is basically agricultural, with cotton, corn, and grain sorghums being the predominant crops. Livestock enterprises constitute a major source of income. Most of the recent increase in livestock farming has been in beef cattle production. The farms average approximately 210 acres in size with a value of $19,000 for land and buildings, according to the U. S. Census of 1954. Tenant operated farming is predominant.

Approximately 380 miles of hard-surfaced roads traverse the watershed. In addition, there are 2,020 miles of local or county roads. Rail service is adequate for all sections of the area.

Hubbard, population 1,768, is the largest town in the watershed. Other towns and populations are: Dawson, 1,107; Coolidge, 1,062; Blooming Grove, 736; Tehuacana, 389; and Malone, 352.

Principal industries affording employment opportunities for residents of the watershed are the manufacture of oil field machinery and equipment, glass bottles, rock wool insulation, hats, and cotton textiles. These industries are located in Corsicana, a city of 25,262 population, located just outside the watershed.

WATERSHED PROBLEMS

Floodwater Damage

Frequent flooding in the Richland Creek watershed has caused damages of considerable magnitude. Large floods have occurred on an average of once a year. During the 30-year period studied, 1924 through 1953, there were 28 major floods which covered more than half the flood plain and 108 minor floods covering less than half the flood plain (figure 1). Forty-six percent of the major floods and 53 percent of the smaller floods occurred

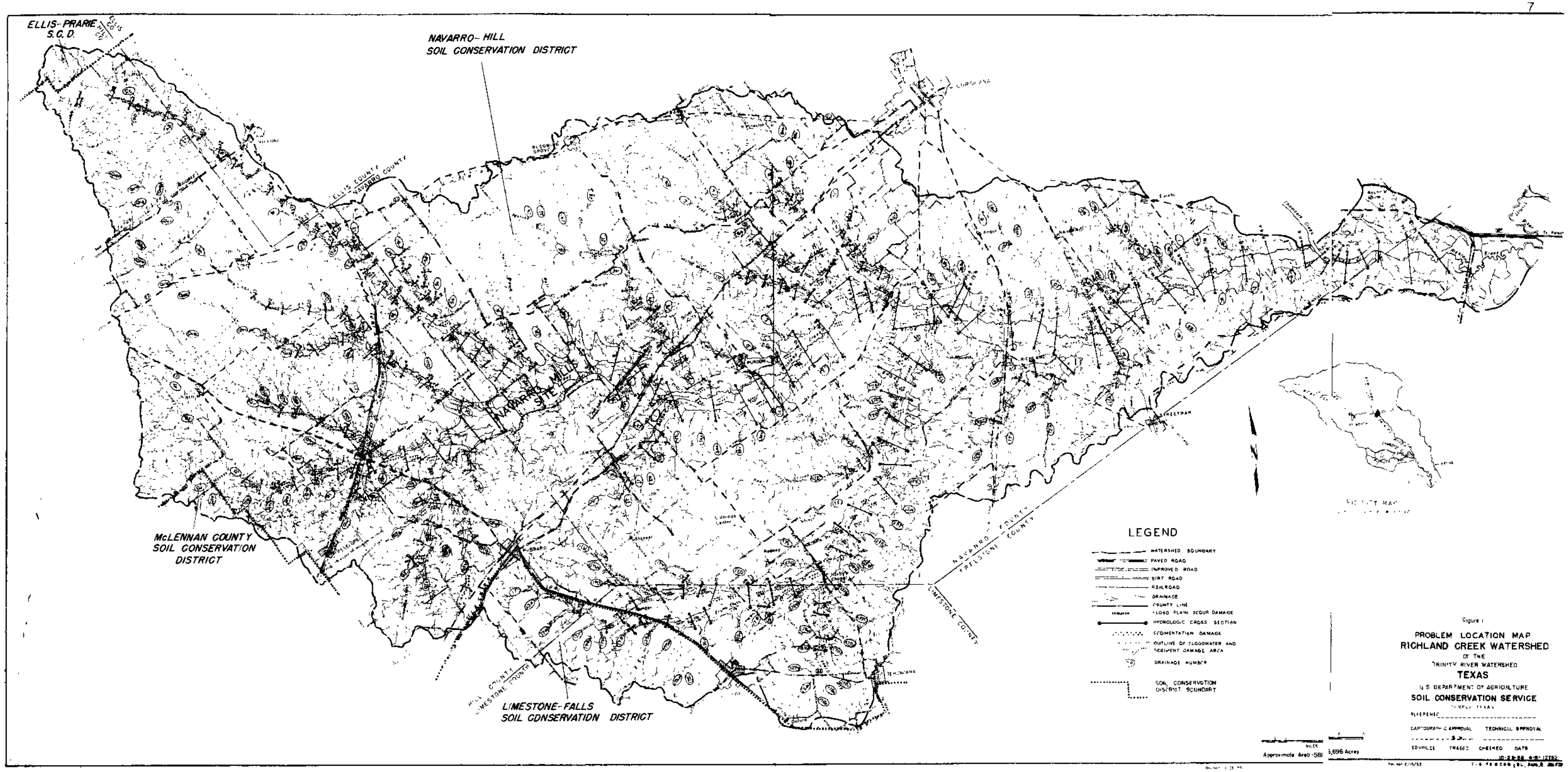


Figure 1
PROBLEM LOCATION MAP
RICHLAND CREEK WATERSHED
OF THE
TRINITY RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

during the growing season and caused heavy damage to growing crops. The most recent major flood occurred in April, 1957, and inundated 67,545 acres, including flood plain in the proposed Fort Worth and Navarro Mills reservoirs. Damage from this flood was estimated to be $1,073,583, of which $737,898 was to crops and pastures.

The largest storm in the evaluation series occurred in May, 1948 and produced a runoff of 5.89 inches. This storm inundated the entire flood plain.

It is estimated that the average annual direct monetary floodwater damage under existing conditions, exclusive of areas inundated by proposed major reservoirs, is $765,946, of which $716,860 is crop and pasture damage. 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 which are estimated to average $91,240 annually. The average annual monetary flood damages are summarized in table 5.

Due largely to the frequency of flooding, approximately 5 percent of the flood plain of Richland Creek and its tributaries is idle and about 7 percent has been retired from cultivation to Johnsongrass for hay production.

Erosion

Erosion rates in the watershed range from low to very high, depending primarily upon the intensity of use and treatment of cultivated land. Most of the erosion damage is caused by sheet erosion on cultivated areas. This type of erosion constitutes about 90 percent of the total annual gross erosion in the watershed with the remaining 10 percent derived from gully and streambank erosion.

The highest erosion and sediment production rates occur in four general areas within the watershed: (1) on the south side of Pin Oak Creek between Coolidge and the Hill County line, sites 4A to 9C; (2) along the slopes on the south side of the mainstem of Richland Creek, Purdon to Dawson, sites 109 to 116; (3) along the mainstem of Richland Creek above Emmett in the northwest part of Navarro County to the southwest corner of Ellis County just north of Mertens, sites 44 to 49, 58, 66, and 98 to 102; and (4) along Ash and Bynum Creeks in Hill County, sites 68 to 71, 78, 80 to 83, 85 to 89, and 91. All of these areas are characterized by a high percentage of cultivated land. A high degree of intensive land treatment will be necessary in all these areas if rates of sediment production are reduced to less than two inches during the 50-year expected life of the project.

Flood Plain Erosion Damage

There have been 1,447 acres of flood plain damaged by scour below floodwater retarding structures and excluding areas within the Navarro Mills and proposed Fort Worth Reservoirs. This is approximately 2.9 percent of the flood plain. The degree and extent of this damage is divided as follows:

Percent of damage	10	30	50	60	75	90
Acres damages	372.9	343.3	293.2	262.5	129.8	45.6

The annual value of this damage is estimated to be $25,340.

Streambank erosion in this watershed is so negligible that no monetary value was placed on it.

Sediment Damage

Overbank sediment deposits have damaged approximately 28,179 acres, or 56 percent of the flood plain. These deposits are similar in texture and color to the original alluvium but are lower in organic matter and plant nutrients. It is estimated that crop and pasture production has been reduced about five percent on 13,717 acres and 10 percent on 14,462 acres as a result of this damage, the annual value of which is estimated to be $92,288.

There are two proposed major reservoirs within the Richland Creek watershed. These are the Navarro Mills and the Fort Worth municipal water supply sites. In addition, there are municipal water supply lakes at Hubbard, Coolidge and Dawson. The estimated annual sediment yield in acre feet and monetary damage to the Navarro Mills and the Fort Worth municipal reservoirs, if installed would be as follows:

Reservoir	Without Project		With Land Treatment		With Structures and Land Treatment	
	(ac.ft.)	(dollars)	(ac.ft.)	(dollars)	(ac.ft.)	(dollars)
Navarro Mills	298.04	11,400	249.81	9,555	163.33	6,247
Fort Worth	321.69	17,049	261.09	13,837	174.21	9,233

There are no floodwater retarding structures planned above the other municipal water supply reservoirs, but the present rate of sediment accumulation in these reservoirs will be reduced by the application of land treatment measures. The annual capacity loss, in acre-feet, and the monetary damage under present conditions and with land treatment are as follows:

Site	Without Project		With Land Treatment	
	(ac.ft.)	(dollars)	(ac.ft.)	(dollars)
Dawson City Lake	3.76	207.00	1.35	74.00
Hubbard City Lakes	2.43	134.00	2.25	124.00
Coolidge City Lakes	0.71	39.00	0.35	19.00

Channel filling is occurring at an accelerated rate over most of the watershed. Loss of channel capacity has caused more frequent flooding, particularly in the Ash Creek bottom land where the channel has lost an estimated 50 percent of its original capacity. The loss of capacity in most other channels is somewhat less than this. Swamping damage occurring in low bottom land areas where water may stand due to the outlet being blocked by sediment was considered to be sediment damage.

Farm ponds are receiving sediment at various rates, depending largely on the amount and treatment of cultivated land in their drainage area. Neither sediment yield nor monetary value of this damage to farm ponds was estimated.

Problems Relating to Water Management

Problems relating to water management are minor and do not warrant a study at this time. There is little activity relative to drainage or irrigation. No individual landowners or groups of landowners have indicated an interest in providing additional capacity in any of the floodwater retarding structures for irrigation purposes. The municipality of Coolidge has arranged to store additional water in floodwater retarding structure No. 10. The towns of Dawson and Hubbard have indicated interest, but have made no arrangement for additional storage.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

The Federally authorized multipurpose Navarro Mills Reservoir, proposed to be constructed by the Corps of Engineers, and a municipal water supply reservoir, proposed to be constructed by the city of Fort Worth, are in this watershed. In the event either of these reservoirs is not constructed this plan will be revised to include additional flood prevention measures.

Individual farmers have attempted to prevent or control floods by straightening stream channels and building levees. These efforts have had little effect in the reduction of flooding and accompanying flood damage. During the past several years farmers cooperating with their respective soil conservation districts have been preparing conservation plans on a community and subwatershed basis in an attempt to protect their lands and to reduce flooding. The Richland-Chambers Creek Watershed Association has been formed for the purpose of promoting and coordinating flood prevention activities within the watershed.

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, 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 this objective is the establishment and maintenance of all applicable soil and water conservation and 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 586,696 acres, 231,085 acres lie above 9 constructed and 144 proposed floodwater retarding structures. There are 202,240 acres above the proposed Navarro Mills Reservoir, of which 96,730 acres lie above floodwater retarding structures. This constitutes a total of 336,595 acres controlled by the Navarro Mills Reservoir and the floodwater retarding structures. Land treatment is especially important to support and supplement the control of the floodwater retarding structures.

Prior to work plan development, landowners and operators have established land treatment measures at an estimated non-Federal cost of $4,873,940, exclusive of ACPS reimbursements, and a Federal expenditure of $279,961 of flood prevention funds for accelerated technical assistance to help landowners of the watershed in planning and applying land treatment measures. During the project installation period additional land treatment measures are to be established at an estimated non-Federal cost of $6,641,887 and a Federal cost of $283,282. Land treatment measures and costs are shown on table 1.

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 conservation cropping systems, cover cropping, rotation hay and pasture, crop residue utilization for croplands and pasture planting, range seeding, proper use, rotation grazing, deferred grazing and brush control to establish good cover on the grasslands. 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 range and 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 soak into 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 discharge by extending the course of runoff water from fields. These measures also help the soil improvement and cover measures to reduce erosion damage and sediment production.

Structural Measures

Prior to the development of this work plan, other flood prevention plans were developed on that portion of Richland and Pin Oak Creeks above the previously proposed Corps of Engineers site at Love Bridge, which is near the confluence of these streams. There have been nine floodwater retarding structures, (numbers 10, 19, 20, 20A, 21, 22, 23, 24, and 25) constructed on the Pin Oak Creek watershed which were a part of these plans. The relocation of the Corps of Engineers reservoir to the Navarro Mills site has necessitated the revision of these plans to include all of Richland Creek watershed except Chambers Creek.

The system of 153 floodwater retarding structures and 65.5 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 48 percent of the watershed above the proposed Navarro Mills site, and 50 percent of the area between the Navarro Mills site and the upper limits of the Fort Worth reservoir. The floodwater retarding structures above Navarro Mills Reservoir will detain an average of 4.86 inches of runoff from their combined drainage areas of 96,730 acres. This is an equivalent of 2.32 inches from the 202,240-acre drainage area of the proposed Navarro Mills Reservoir. The floodwater retarding structures between Navarro Mills and the upper limits of the Fort Worth reservoir will detain an average of 5.16 inches of runoff from their drainage area of 134,355 acres. This is equivalent to 2.57 inches from the total area of 269,440 acres between the two reservoirs.

Figure 2 shows a section of a typical floodwater retarding structure.

Stream channels will be improved to provide for the peak flow resulting from a storm producing 3.0 inches of runoff, which is a storm of approximately a 3-year frequency, and the release flows of the proposed floodwater retarding structures and Navarro Mills Reservoir.

Land, easements, and rights-of-way for the floodwater retarding structures and stream channel improvement will be provided by the sponsoring local organizations. The value of these is estimated to be $1,059,700, based on local market values. There will be an estimated $20,920 of additional costs for legal fees connected with obtaining these easements. The sediment pools of the 153 floodwater retarding structures will inundate 2,218 acres of flood plain land and the detention pools will temporarily inundate an additional 1,109 acres of flood plain. The sediment pools also will cover 2,955 acres of upland and the detention pools will include an additional 8,519 acres of upland.

The locations of floodwater retarding structures and stream channel improvement are shown on the Planned Structural Measures map, figure 3. All planned structural measures are located upstream from the upper pool limits of the proposed Fort Worth Reservoir. The total estimated cost of establishing these works of improvement is $9,679,385, of which $1,080,620 will be borne by non-Federal interests and $8,598,765 by the Federal government. The average annual equivalent cost is estimated to be $353,479 for installation and $28,674 for operation and maintenance, a total average annual cost of $382,153.

Benefits From Works of Improvement

The combined program of land treatment and structural measures, including the Navarro Mills Reservoir, will prevent flood damages from 32 of the 136 floods which occurred in this watershed from 1924 through 1953, and 25 of the 28 major floods will be reduced to minor floods. The average annual flooding will be reduced from 92,244 acres to 14,389 acres.

With the project installed the flood plain of the mainstem of Richland Creek between the proposed Fort Worth and Navarro Mills reservoirs will be essentially flood-free for all storms up to the size that can be expected to

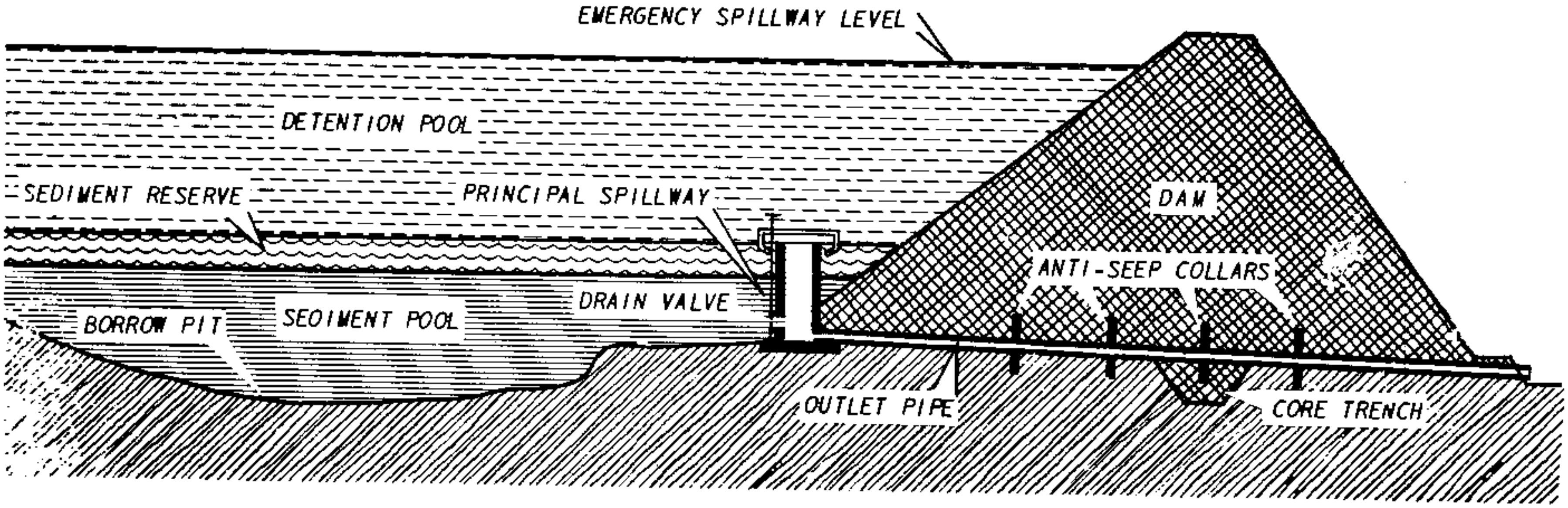
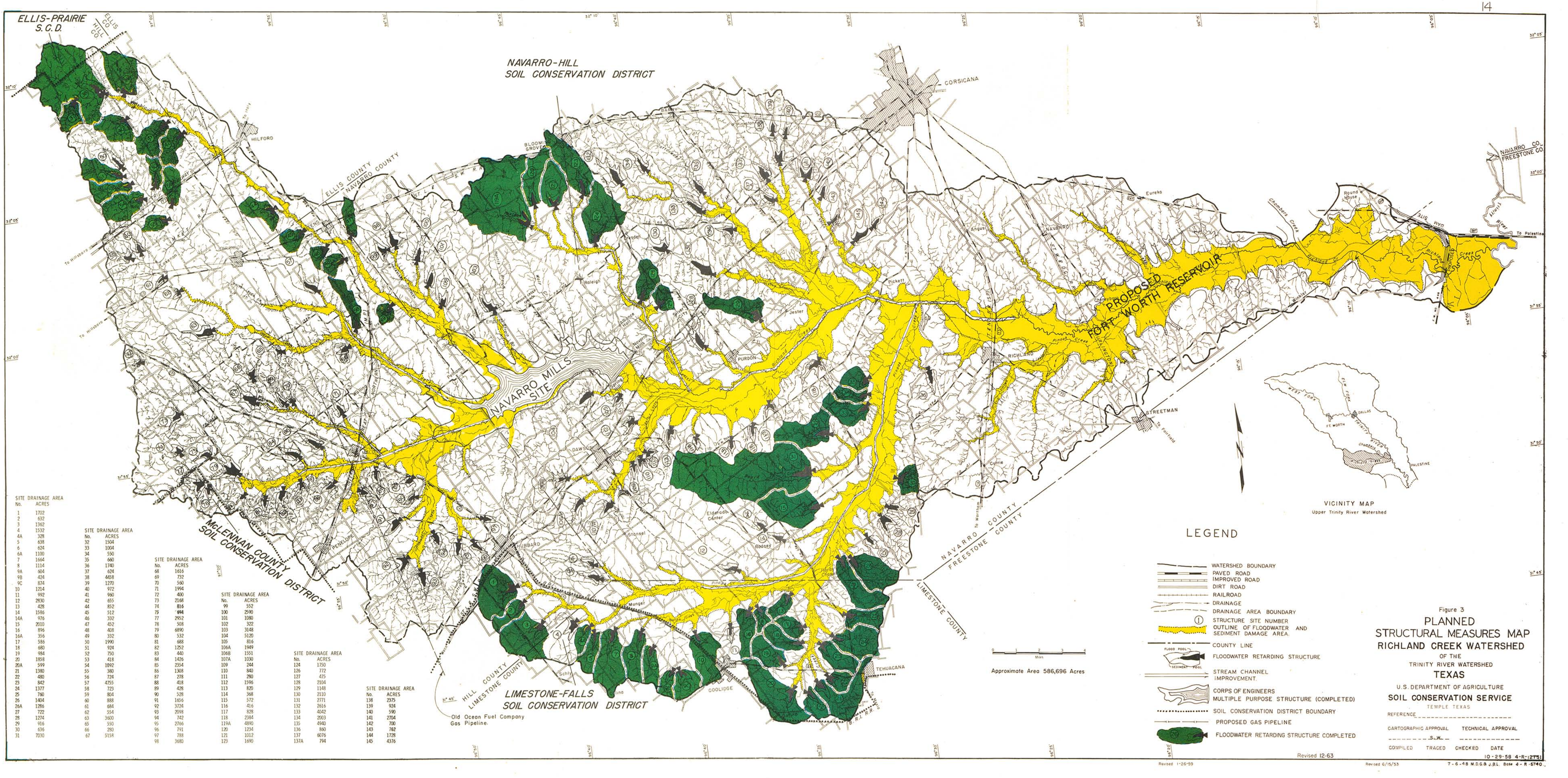


Figure 2
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

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



SITE No.	DRAINAGE AREA ACRES
1	1702
2	632
3	1362
4	1532
4A	328
5	638
6	624
6A	1100
7	1664
8	1114
9A	604
9B	424
9C	874
10	1214
11	992
12	2830
13	428
14	1586
14A	976
15	2010
16	896
16A	356
17	586
18	680
19	984
20	1858
20A	599
21	1380
22	480
23	842
24	1377
25	760
26	1404
26A	1286
27	722
28	1274
29	916
30	636
31	7030

SITE No.	DRAINAGE AREA ACRES
32	1504
33	1004
34	550
35	660
36	1740
37	624
38	4458
39	1270
40	972
41	960
42	655
44	852
45	512
46	332
47	452
48	408
49	332
50	1990
51	924
52	750
53	418
54	1092
55	380
56	724
57	4755
58	723
59	804
60	888
61	684
62	554
63	3600
65	550
66	280
67	5158

SITE No.	DRAINAGE AREA ACRES
68	1616
69	732
70	560
71	1994
72	400
73	2168
74	816
75	694
77	2952
78	508
79	6890
80	532
81	688
82	1252
83	440
84	1426
85	2354
86	1308
87	278
88	418
89	428
90	528
91	1656
92	3724
93	2098
94	742
95	2766
96	791
97	788
98	3680

SITE No.	DRAINAGE AREA ACRES
99	552
100	2590
101	1080
102	322
103	3148
104	5120
105	816
106A	1949
106B	1551
107A	1030
109	244
110	840
111	280
112	1596
113	820
114	368
115	572
116	416
117	828
118	2384
119A	4890
120	1234
121	1012
123	1690

SITE No.	DRAINAGE AREA ACRES
124	1750
126	772
127	475
128	2104
129	1148
130	2110
131	2771
132	2616
133	4042
134	2003
135	4940
136	860
137	6076
137A	794

SITE No.	DRAINAGE AREA ACRES
138	2375
139	924
140	590
141	2704
142	700
143	762
144	1728
145	4376

occur no more frequently than once in three years. The Pin Oak, Post Oak, Ash, and White Rock Creek flood plains will experience some flooding on their tributaries from storms larger than can be expected to occur once in three years. On the entire watershed storms expected to occur once in three years will flood approximately 16 percent of the flood plain, and storms expected to occur once in 25 years will flood approximately 57 percent of the flood plain.

It is assumed that idle land in the flood plain which will not be subject to flooding more often than once in three years after the project is installed will be returned to crop production. A portion of the area retired to Johnsongrass, as well as formerly cultivated open pasture land, is expected to go back to higher value crops. These changes are considered restoration to former productivity and are included in crop and pasture damage in table 5.

The estimated average annual floodwater, flood plain erosion, and sediment damage will be reduced from $912,403 to $161,434, a reduction of 82.3 percent. The structural measures will reduce the average annual damage from the $811,682 remaining after land treatment to $161,434, a reduction of 80.1 percent.

Benefits to the project from the reduction of indirect damage, such as interruption of travel, disruption of usual business activities, and similar items are estimated to be $65,025 annually.

Owners and operators of flood plain lands say that with an adequate reduction of flooding they will change the use of some of the land to the production of higher value crops. A shift from pasture, which has not been previously in cultivation to cropland is considered changed land use. Approximately 10 percent of the area subject to intensive use due to protection by structural measures falls in this category and is expected to be converted to higher value crops such as feed crops, or alfalfa. Increased net income expected from such changes will amount to $42,690 annually. This benefit is based on the assumption that the project will not cause an increase in the acreage of cotton, the crop in the watershed on which acreage allotments are in effect. Should acreage allotments be removed, the benefit would be increased as cotton is one of the more profitable crops in the watershed.

The total flood prevention benefits including reduction of flood damages, reduction of sediment deposition on flood plain lands and in the Navarro Mills and Fort Worth reservoirs, the reduction in flood plain scour damage, benefits from restoration and more intensive use of flood plain lands, and reduction of indirect damages are estimated to be $757,963 annually. These benefits will result from installation of the floodwater retarding structures and channel improvement.

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 to be $382,153. When the structures are completely installed they are expected to produce average annual benefits of $757,963, a benefit of $1.98 for each dollar of cost. 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 Navarro-Hill, Ellis-Prairie, Limestone-Falls and McLennan County 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, with flood prevention funds, has been made available for several years to get land treatment needed in conjunction with planned structural measures applied. 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. Educational meetings will be held in cooperation with other agencies to outline the services available and eligibility requirements. Present FHA clients will be encouraged to cooperate in the project.

The County ASC Committees will cooperate with the governing bodies of the soil conservation districts by selecting and recommending financial assistance for those ACPS 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 getting information to landowners and operators in the Richland Creek watershed.

Structural Measures

The Soil Conservation Service will contract for the construction of the 153 floodwater retarding structures and the 65.5 miles of stream channel improvement. Technical assistance will be provided to plan, design, prepare 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 following is a grouping of structures for construction purposes, each group of which has a favorable benefit-cost ratio, based on those benefits that will accrue within the boundary of each construction unit:

Construction Unit	Number Structures	Annual Benefit (dollars)	Annual Cost (dollars)	Benefit-Cost Ratio
1. Calina Creek, 7 through 10 *Built*	6	12,002	8,522	1.4:1
2. Elm Creek, 17 through 25 *Built*	10	25,488	13,165	1.9:1
3. Upper Pin Oak, 1 through 6A and 11, 12, 13, 16 and 16A	13	31,177	21,637	1.4:1
4. Board Creek, 31 and 32	2	7,448	5,842	1.3:1
5. Units 1,2,3,& 4 with 14,14A,15,26,26A, 27,28,29,30,33,34,35, and 36	44	138,397	68,853	2.0:1
6. Unit 5 and Pin Oak Channel Improvement	44	248,420	105,797	2.3:1
7. Richland Creek above Hackberry, 37 through 49	13	25,123	23,657	1.1:1
8. Hackberry Creek, 98 through 102	5	12,220	7,747	1.6:1
9. Strain Branch, 103	1	3,782	2,408	1.6:1
10. 50 through 66, and White Rock with Channel Improvement *Site 66 deleted from plan*	17	45,163	42,822	1.1:1
11. Bynum Creek, 67 through 71	5	13,942	10,066	1.4:1
12. Ash Creek excluding Bynum Creek, 72 through 89	17	49,681	28,963	1.7:1
13. Cottonwood, 90 through 94	5	28,188	9,173	3.1:1
14. East Cottonwood, 95 through 97	3	8,365	4,059	2.1:1
15. Units 11,12,13,& 14, and Ash and Bynum Creek Channel Improvement	30	155,854	67,271	2.3:1
16. Battle Creek, 106 through 112	7	18,665	13,616	1.4:1
17. Post Oak Creek, 119 through 127	9	29,857	17,253	1.7:1
18. Unit 17 & Post Oak Cr. Channel Improv.	9	40,163	24,766	1.6:1
19. Tributary H, 128	1	4,285	1,839	2.3:1
20. Tributary F, 129	1	3,263	1,332	2.4:1
21. Units 16,18,19,& 20 with 104,105,113, 114, 115, 116, 117, and 118	26	103,168	56,587	1.8:1
22. Melton Branch, 130 and 131	2	14,024	4,840	2.9:1
23. Rush Creek, 132 through 136	5	19,888	12,471	1.6:1
24. Brier Creek, 137 through 140	5	19,882	9,135	2.2:1
25. Corbet Branch, 141 through 145	5	8,494	7,748	1.1:1
26. Units 21 through 25, and Richland Creek Channel Improvement	43	258,928	132,451	2.0:1

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 any part of that construction unit.

The cooperating parties have agreed on an installation schedule of 10 years for the structural measures during the 10-year period for completion of the project. It is planned to construct structures in the following order:

Fiscal Year	Structure	Federal Cost (dollars)	Non-Federal Cost (dollars)	Total Cost (dollars)
Completed	10,19,20,20A,21,22,23,24, and 25	265,612	51,280	316,892
First	7,8,9A,9B,9C,17, and 18	195,896	34,110	230,006
Second	1,2,3,4,4A,5,6,6A,11,12,13, 16,16A,31,32	589,886	108,720	698,606
Third	14,14A,15,26,26A,27,28,29,30,33, 34,35,36 and Stream Channel Improvement Pin Oak	1,313,676	111,890	1,425,566
Fourth	37,38,39,40,41,42,43,44,45,46, 47,48,49,50,51,52,53,54,55,56,57, 58,59,60,61,62,63,64,65,66, Stream Channel Improvement on White Rock Creek	1,587,812	130,020	1,717,832
Fifth	90,91,92,93,94,95,96,97,119, 120,121,122,123,124,125,126, 127,128,129,141,142,143,144, and 145	868,156	181,610	1,049,766
Sixth	67,68,69,70,71,106,107,108, 109,110,111,112,137,137A,138 139,140, Stream Channel Improvement on Post Oak Creek	851,543	150,740	1,002,283
Seventh	98,99,100,101,102,132,133, 134,135,136	411,687	98,420	510,107
Eighth	72,73,74,75,77,78,79,80,81, 82,83,84,85,86,87,88,89, 130,131, Stream Channel Improvement on Bynum and Ash Creeks	1,072,843	148,490	1,221,333
Ninth	104,105,113,114,115,116, 117,118,103	390,032	57,990	448,022
Tenth	Stream Channel Improvement on Richland Creek	1,051,622	7,350	1,058,972
Total		8,598,765	1,080,620	9,679,385

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.

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 Navarro-Hill, Ellis-Prairie, Limestone-Falls, and McLennan County Soil Conservation Districts. Representatives of these soil conservation districts will make periodic 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 Hill County Commissioners Court and the McLennan County Soil Conservation District have entered into a watershed protection operation and maintenance agreement with the Soil Conservation Service to assume responsibility for operation and maintenance of sites 77 and 78. Similar agreements have been entered into by the Hill County Commissioners Court and the Limestone-Falls Soil Conservation District for sites 1, 2, and 3; Hill County Commissioners Court and Navarro-Hill Soil Conservation District for sites 6, 6A, 37 through 75, 79 through 97, and 16.93 miles of stream channel improvement (Ash, Bynum, and White Rock Creeks); Ellis County Commissioners Court and Navarro-Hill Soil Conservation District for sites 43 and 44; Navarro County Commissioners Court and Navarro-Hill Soil Conservation District for sites 12, 14, 14A, 15, 26A, 26 through 36, 98 through 145, 137A, and 45.07 miles of stream channel improvement (Richland, Post Oak, and the portion of Pin Oak in Navarro County); and the city of Coolidge and the Navarro-Hill Soil Conservation District for site 10. The Limestone-Falls Soil Conservation District will operate and maintain sites 4, 4A, 5, 7, 8, 9A, 9B, and 9C, and the Navarro-Hill Soil Conservation District sites 11, 13, 16A, 16 through 25, 20A, and stream channel improvement on the 3.5 miles of Pin Oak Creek located in Limestone County.

All structural measures 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 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, and fences and gates installed as a part of the floodwater retarding structures. 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 and Federal representatives to inspect the structural measures and their appurtenances at any time.

The estimated annual operation and maintenance cost is $28,674, based 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 through maintenance associations of benefited landowners.

The soil conservation districts 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 Richland Creek watershed would give added protection to flood plain lands along this stream and greatly reduce the sediment load carried by it. This project plan conforms to all Federal laws and regulations.

For a period of three years from date of plan surplus crops grown on lands reclaimed by flood prevention, irrigation, or drainage and the land so reclaimed shall be ineligible for any benefits under the soil-bank provisions of the Soil Bank Act and under price support legislation.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Land Treatment

The soil-cover complex data was developed from a 13 percent sample of the watershed. Soil units and slopes were mapped on cultivated land, together with the amounts of terraced land, small grains, and legumes and soil conditions. On pasture land, the soils were grouped by cover conditions. Future conditions were determined by needs based on land capability classes. The watershed was divided into three areas and hydrologic soil-cover complex curve numbers were developed for each. The divisions were Pin Oak Creek, Richland Creek above Navarro Mills site, and Richland Creek below Navarro Mills site.

Land use was determined from a 17 percent 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 Soil Conservation Service technicians of the local work units. Each work unit supplied the needs within their area and these were combined to obtain the total land treatment needs for the watershed. It was estimated that 80 percent of the total needed land treatment measures would be installed by the end of the 10-year project installation period.

Structural Measures

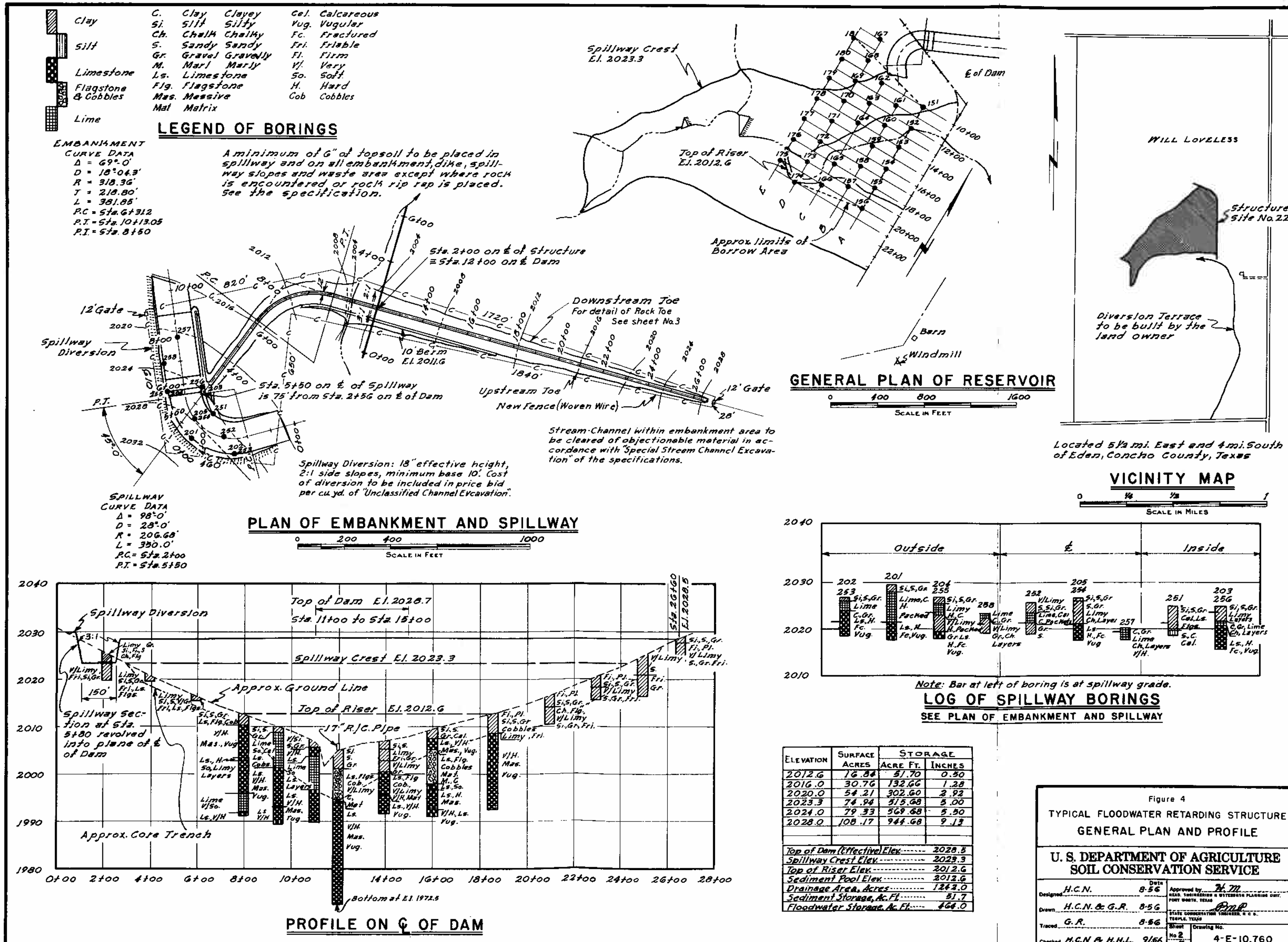
Determination was then made of structural measures for flood prevention which would be feasible to install. The study made and the procedures used in that determination were as follows:

1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. 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 expensive improvements, for which the cost of relocating was not economically feasible 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 figures 4 and 4A.

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 flood plain erosion were determined from damage schedules and field surveys of flood plain areas and flood routing with the Navarro Mills and Fort Worth reservoirs assumed to be in place. 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, 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 on Richland Creek above the upper limits of the Fort Worth Reservoir could be economically justified. By further analysis, those individual floodwater retarding structures and interrelated 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



Elevation	Surface Acres	Storage Acre Ft.	Storage Inches
2012.6	16.84	51.70	0.50
2016.0	30.76	132.66	1.28
2020.0	54.21	302.60	2.92
2023.3	74.94	515.68	5.00
2024.0	79.33	569.68	5.50
2028.0	108.17	944.68	9.13

Top of Dam (Effective) Elev.	2028.5
Spillway Crest Elev.	2023.3
Top of Riser Elev.	2012.6
Sediment Pool Elev.	2012.6
Drainage Area, Acres	1242.0
Sediment Storage, Ac. Ft.	51.7
Floodwater Storage, Ac. Ft.	464.0

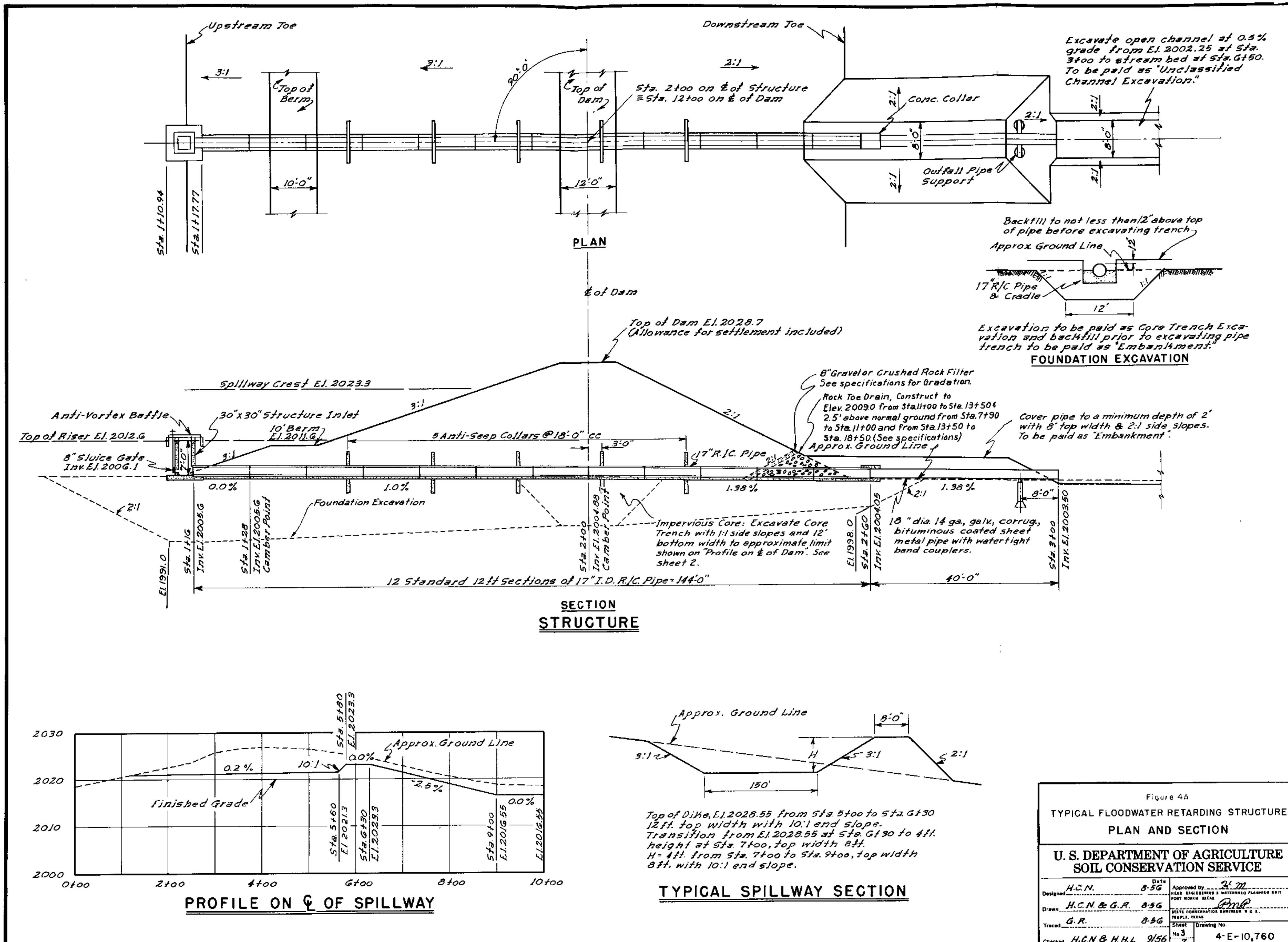
Figure 4

TYPICAL FLOODWATER RETARDING STRUCTURE

GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	H.C.N.	8-56	Approved by H.M. Head, Engineering & Watershed Planning Unit, Fort Worth, Texas
Drawn	H.C.N. & G.R.	8-56	State Conservation Engineer, S.C.S., Temple, Texas
Traced	G.R.	8-56	Sheet No 2 of 7
Checked	H.C.N & H.H.L.	9/56	Drawing No. 4-E-10,760



Upstream Toe
Downstream Toe
3:1
3:1
2:1
Top of Berm
Top of Dam
90°0'
Sta. 2+00 on ℄ of Structure ≡ Sta. 12+00 on ℄ of Dam
Excavate open channel at 0.5% grade from El. 2002.25 at Sta. 3+00 to stream bed at Sta. 6+50. To be paid as "Unclassified Channel Excavation."
Conc. Collar
2:1
8'0"
Outfall Pipe Support
10'0"
12'0"
Sta. 1+10.94
Sta. 1+17.77
PLAN
Backfill to not less than 12" above top of pipe before excavating trench
Approx. Ground Line
17" R/C Pipe & Cradle
12'
1:1
Excavation to be paid as Core Trench Excavation and backfill prior to excavating pipe trench to be paid as "Embankment."
FOUNDATION EXCAVATION
℄ of Dam
Top of Dam El. 2028.7 (Allowance for settlement included)
Spillway Crest El. 2023.3
8" Gravel or Crushed Rock Filter See specifications for Gradation.
Rock Toe Drain, Construct to Elev. 2009.0 from Sta. 11+00 to Sta. 13+50 & 2.5' above normal ground from Sta. 7+90 to Sta. 11+00 and from Sta. 13+50 to Sta. 18+50. (See specifications)
Approx. Ground Line
Anti-Vortex Baffle
30"x30" Structure Inlet
10' Berm El. 2011.6
Top of Riser El. 2012.6
8" Sluice Gate Inv. El. 2006.1
5 Anti-Seep Collars @ 18'0" cc
3'0"
17" R/C Pipe
Cover pipe to a minimum depth of 2' with 8' top width & 2:1 side slopes. To be paid as "Embankment".
0.0%
1.0%
1.38%
1.38%
2:1
Foundation Excavation
Impervious Core: Excavate Core Trench with 1:1 side slopes and 12' bottom width to approximate limit shown on "Profile on ℄ of Dam". See Sheet 2.
18" dia. 14 ga., galv., corrug., bituminous coated sheet metal pipe with watertight band couplers.
8'0"
El. 1991.0
Sta. 1+16
Inv. El. 2005.6
Sta. 1+28
Inv. El. 2005.6
Camber Point
Sta. 2+00
Inv. El. 2004.88
Camber Point
El. 1998.0
Sta. 2+60
Inv. El. 2004.05
Sta. 3+00
Inv. El. 2003.50
12 Standard 12 ft Sections of 17" I.D. R/C Pipe = 144'0"
40'0"
SECTION
STRUCTURE
2030
2020
2010
2000
0+00
2+00
4+00
6+00
8+00
10+00
Sta. 5+80
El. 2023.3
Approx. Ground Line
0.2%
10:1
0.0%
2.5%
0.0%
Finished Grade
Sta. 5+60
El. 2021.3
Sta. 6+30
El. 2023.3
Sta. 9+00
El. 2016.55
El. 2016.55
PROFILE ON ℄ OF SPILLWAY
Approx. Ground Line
8'0"
3:1
H
3:1
2:1
150'
Top of Dike, El. 2028.55 from Sta. 5+00 to Sta. 6+30 12 ft. top width with 10:1 end slope. Transition from El. 2028.55 at Sta. 6+30 to 4 ft. height at Sta. 7+00, top width 8 ft. H = 4 ft. from Sta. 7+00 to Sta. 9+00, top width 8 ft. with 10:1 end slope.
TYPICAL SPILLWAY SECTION
Figure 4A
TYPICAL FLOODWATER RETARDING STRUCTURE
PLAN AND SECTION
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Designed H.C.N. 8-56
Drawn H.C.N. & G.R. 8-56
Traced G.R. 8-56
Checked H.C.N. & H.H.L. 9/56
Approved by
Sheet No. 3 of 7
Drawing No. 4-E-10,760

which would give maximum net benefits. After evaluation of the floodwater retarding structures it was found that frequent flooding will continue on portions of the watershed. This is due to small existing channels and large drainages contributing to these areas. To alleviate this condition stream channel improvement is planned to carry the uncontrolled runoff from a 3-year expectancy storm and the release flows from the proposed Navarro Mills Reservoir and the floodwater retarding structures.

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 planned 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. This was then compared to actual gaged runoff. The frequency of occurrence of meteorologic events and the relationship of precipitation 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. Present conditions (Navarro Mills considered in place).

b. Effect of land treatment measures.

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

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

e. Consideration of alternative projects and measures.

7. Inflow hydrographs for structure sites were developed.

From a graph showing cumulative departures from normal precipitation, the rainfall for the period 1924 to 1953, inclusive, was selected as most representative of a normal rainfall period for the Richland Creek watershed. This period permitted the use of 15 years of gaged records on the 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 only on that portion of the watershed above the upper limits of the proposed Fort Worth Reservoir. Structural measures were not found to be feasible on the remainder of the watershed due to expected future flooding of the flood plain located in the proposed Fort Worth Reservoir.

The largest runoff-producing rain considered during the 30-year period of study was a storm of 8.28 inches, approximately a 50-year frequency, extending over a 3-day interval. An average rain of this magnitude assuming Moisture Condition II would produce 5.89 inches of runoff, under present conditions, and would inundate 53,247 acres. This storm was used in establishing the flood plain area. 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 52,926 acres. With land treatment measures applied and Navarro Mills constructed it is estimated that the area inundated would be reduced to 49,883 acres. With the flood prevention structural measures added this would be reduced to 31,694 acres. These areas include 2,950 acres of stream channel, but exclude areas in the two proposed major reservoirs. The runoff from the 6-hour, 25-year frequency storm was used to establish the minimum floodwater detention storage requirements. The minimum detention storage requirement, based on an analysis of the conditions existing in the watershed, was established as 3.3 to 3.9 inches. Inflow hydrographs for structure design were developed using the runoff that would be produced by a point rain of 14.6 to 14.8 inches in a period of 6 hours, assuming Moisture Condition II. The hydrograph of runoff was routed through each structure to determine the emergency spillway width and elevation of top of dam, which was set one foot above the depth of flow indicated by the freeboard hydrograph. Inflow hydrographs for determining design depth of flow and velocity of flow in exit channels of emergency spillways were developed using the runoffs that would be produced by 0.5"P" for Class A structures and

0.75"P" for Class B structures using a 6-hour point rainfall of 14.6 to 14.8 inches, adjusted to watershed size, and assuming Moisture Condition II.

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 1,000 cubic feet per second at the stream gage where U. S. Highway 75 crosses Richland Creek.

The peak discharge at this stream gage from the largest rain in the 30-year period used in the evaluation study is 58,900 cubic feet per second under present conditions. After installation and full functioning of the planned measures, including the Navarro Mills reservoir, the discharge from the same storm event at the same section would be reduced to 19,160 cubic feet per second.

Sedimentation

Field surveys to determine sedimentation and related damages in the Richland Creek watershed 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 the proposed floodwater retarding structures were made according to standard procedures and predictions were made for future sedimentation rates based on total effective land treatment of 60 to 75 percent. Detailed sediment production rates were computed for approximately one-third of the structure sites. The sediment production above the remaining sites were estimated using the detailed studies 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 (cultivated, pasture or woodland).
2. Average farming practices (percent row crops and/or percent small grains, terracing, etc.)

3. Cover condition classes on pasture and woods.

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

5. An estimate of annual gully and streambank erosion.

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 needed cropland treatment and pasture improvement measures to bring the total effective land treatment up to 60 percent will reduce the present sediment yield by an estimated 18 percent. Areas damaged by flood plain scour will be rendered productive again after they have been protected from flooding and needed land treatment measures have been put into effect.

Geologic

Reconnaissance geologic inspections were made at all the floodwater retarding structure sites. 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. It is characterized by much small-scale faulting and jointing. The faulting may range from a mere crack to several feet of displacement but these are filled with clay and there should be no leakage. Floodwater retarding structure sites within this formation are: 37 - 43, 50 - 56, 59 - 65, 67, 72 - 75, 77 and 79.

The Taylor group consists of thinly interbedded marls of varying colors, (mostly gray), and blue and yellow weathered and unweathered shales and clays. These shales and clays are dominant but in a few areas there are soft, poorly consolidated outcrops of the Pecan Gap formation. Floodwater retarding structure sites within the Taylor are 4 - 8, 44 - 49, 57, 58, 66, 68 - 71, 78, 80 - 103, 106 - 111, 113 - 117, 130 - 131, 133, 135 - 137A, 139 and 140. A rather extensive area within the Taylor formation is the Wolfe City sand. Sites within this area are 104 - 105, 112, 119 - 128, 132, and 134. Sites within the Taylor formation should have few, if any, construction problems.

The Navarro group consists of several formations that are outcropping in this area. They are the Neylandville marl, Nacatoch sand, Corsicana marl, and Kemp clay. The Neylandville marl consists of sandy marl and dark gray calcareous, sandy clays. Sites within the Neylandville are 9A - 12, 14, 14A, 16, 16A, 31, 32, 118, 129, 138, and 141. This material has low shear strength, and may require flatter than normal slopes on embankments. The Nacatoch formation, which overlays the Neylandville, is a medium to fine grained sand, which in places is cemented by lime to form hard, calcareous sandstone. Sites within the Nacatoch are 13, 15, and 142 - 145. Overlying the Nacatoch is the Corsicana marl which is mainly fairly dense shales and clays of varying colors. The sites within this formation are 17 - 20, 33, 34, and 35. Kemp clay is the other member of the Navarro group. This is mainly fairly dense shales and clays of varying colors. Sites within the Kemp are 20A - 30. Sites located within the Navarro formation should have few construction problems, except as noted above.

The Midway group has two formations, the Kincaid and Wills Point. The Kincaid is made up of sandy clays and some fairly soft sandstones, with a few thin lenses of limestone. The dip is to the southeast at approximately forty feet to the mile. There is one site within this formation, Site 36. The Wills Point consists dominantly of clays and some thinly interbedded silts. There are no sites proposed within this formation.

The Wilcox is generally characterized by poorly consolidated sandstones with thin beds of blue shale, and some partially consolidated siltstones of varying colors. There are no sites proposed within this formation.

Economic

Flood damage schedules for approximately 70 percent of the flood plain area of Richland 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. Land use was mapped in the field and normal yields were based on field data obtained on schedules, supplemented by information from other agricultural workers with experience in the area.

Because of the drainage pattern and the wide variance in land use and value of production in the watershed the flood plain was divided into 46 evaluation reaches, each with its own damageable value and characteristics of flooding. An 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 flooding 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 leads were often obtained from farmers concerning road and bridge damage, estimates of these damages were obtained from county commissioners, 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 for recovery of productivity.

Damage to the authorized Navarro Mills Reservoir and the proposed Fort Worth Reservoir for sediment deposition was determined by the straight line method. The estimated cost (4th quarter, 1952 price level) by Navarro Mills Reservoir and the estimated cost of the Fort Worth Reservoir including pipeline installations were used to determine the cost per acre-foot of storage lost by sediment deposition.

All damages were calculated under without project conditions 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 to structural measures were prorated according to percentage of control afforded by the structures. All calculations of damages and benefits were determined at 1954 prices which were projected to long-term levels (U.S.D.A., A.R.S. June 1956).

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 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 land values was used in the economic evaluation of the project in order to assure a conservative benefit-cost analysis.

During the course of field examinations, 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 both the benefits from restoration of flood plain lands to their former use and the expected change in land to a more intensive use than had formerly been possible. Additional factors considered in this analysis were the size and location of the areas affected, land capability, acreage allotment restrictions, 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 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. Increases in the acreage of allotment crops were excluded from the analysis of benefits from restoration and changed land use.

Details of the procedures used in the investigations are described in the Soil Conservation Service Interim Economics 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
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Prior to July 1958

Item	Unit	Number Applied	Estimated Cost: Federal	Estimated Cost: Non-Federal 1/	Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	66,513	-	65,900	65,900
Cover Cropping	Acre	73,014	-	636,763	636,763
Rotation Hay and Pasture	Acre	27,760	-	322,952	322,952
Crop Residue Utilization	Acre	106,816	-	213,632	213,632
Proper Use, Range & Pasture	Acre	87,525	-	262,575	262,575
Range Seeding	Acre	-	-	-	-
Pasture Planting	Acre	47,989	-	704,286	704,286
Brush Control	Acre	6,623	-	174,895	174,895
Wildlife Area Improvement	Acre	22,963	-	688,890	688,890
Fish Pond Improvement	No.	940	-	14,100	14,100
Terracing	Mile	2,425	-	268,719	268,719
Diversion Construction	Mile	97	-	25,273	25,273
Waterway Development	Acre	2,044	-	190,241	190,241
Pond Construction	No.	2,854	-	741,386	741,386
Stabilizing Measures	No.	37	-	21,613	21,613
Fertilizing	Acre	76,923	-	542,715	542,715
Technical Assistance (Accel.)			279,961	-	279,961
SCS Subtotal			279,961	4,873,940	5,153,901
TOTAL LAND TREATMENT			279,961	4,873,940	5,153,901
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	9	195,158	-	195,158
Channel Improvement	Mile		-	-	-
SCS Subtotal			195,158	-	195,158
Subtotal - Construction			195,158	-	195,158
Installation Services					
Soil Conservation Service					
Engineering Services			46,306	-	46,306
Other			24,148	-	24,148
SCS Subtotal			70,454	-	70,454
Subtotal - Installation Services			70,454	-	70,454
Other Costs					
Land, Easements, R/W and Legal Fees			-	51,280	51,280
Subtotal - Other			-	51,280	51,280
TOTAL STRUCTURAL MEASURES			265,612	51,280	316,892
WORK PLAN PREPARATION COST			98,076	-	98,076
TOTAL PROJECT			643,649	4,925,220	5,568,869
SUMMARY					
Subtotal SCS			643,649	4,925,220	5,568,869
TOTAL PROJECT			643,649	4,925,220	5,568,869

1/ Excludes $1,596,233 reimbursed from ACPS Funds.

October 1958

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Item	Unit	Number to be Applied	Estimated Cost Federal (dollars)	Estimated Cost Non-Federal[1/] (dollars)	Project Total (dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	121,989	-	121,989	121,989
Cover Cropping	Acre	168,438	-	1,390,706	1,390,706
Rotation Hay and Pasture	Acre	12,586	-	124,427	124,427
Crop Residue Utilization	Acre	147,171	-	294,342	294,342
Proper Use, Range & Pasture	Acre	101,376	-	304,128	304,128
Range Seeding	Acre	6,317	-	54,726	54,726
Pasture Planting	Acre	67,835	-	879,449	879,449
Brush Control	Acre	19,482	-	467,986	467,986
Wildlife Area Improvement	Acre	14,481	-	434,430	434,430
Fish Pond Improvement	No.	1,265	-	17,975	17,975
Terracing	Mile	4,545	-	488,891	488,891
Diversion Construction	Mile	543	-	93,555	93,555
Waterway Development	Acre	3,921	-	259,657	259,657
Pond Construction	No.	2,408	-	535,978	535,978
Stabilizing Measures	No.	93	-	61,244	61,244
Fertilizing	Acre	180,392	-	1,112,404	1,112,404
Technical Assistance (Accel.)			283,282	-	283,282
SCS Subtotal			283,282	6,641,887	6,925,169
TOTAL LAND TREATMENT			283,282	6,641,887	6,925,169
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	144	4,349,377	-	4,349,377
Channel Improvement	Mile	65.5	2,060,740	-	2,060,740
SCS Subtotal			6,410,117	-	6,410,117
Subtotal - Construction			6,410,117	-	6,410,117
Installation Services					
Soil Conservation Service					
Engineering Services			1,165,474	-	1,165,474
Other			757,562	-	757,562
SCS Subtotal			1,923,036	-	1,923,036
Subtotal - Installation Services			1,923,036	-	1,923,036
Other Costs					
Land, Easements, R/W and Legal Fees			-	1,029,340	1,029,340
Subtotal - Other			-	1,029,340	1,029,340
TOTAL STRUCTURAL MEASURES			8,333,153	1,029,340	9,362,493
WORK PLAN PREPARATION COST			-	-	-
TOTAL PROJECT			8,616,435	7,671,227	16,287,662
SUMMARY					
Subtotal SCS			8,616,435	7,761,227	16,287,662
TOTAL PROJECT			8,616,435	7,761,227	16,287,662

1/ Excludes $3,387,849 that will be reimbursed from ACPS or other Federal funds based on current program criteria.

October 1958

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Item	Unit	Number to be Applied	Estimated Cost: Federal (dollars)	Estimated Cost: Non-Federal 1/ (dollars)	Total (dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	188,502	-	187,889	187,889
Cover Cropping	Acre	241,452	-	2,027,469	2,027,469
Rotation Hay and Pasture	Acre	40,346	-	447,379	447,379
Crop Residue Utilization	Acre	253,987	-	507,974	507,974
Proper Use, Range & Pasture	Acre	188,901	-	566,703	566,703
Range Seeding	Acre	6,317	-	54,726	54,726
Pasture Planting	Acre	115,824	-	1,583,735	1,583,735
Brush Control	Acre	26,105	-	642,881	642,881
Wildlife Area Improvement	Acre	37,444	-	1,123,320	1,123,320
Fish Pond Improvement	No.	2,205	-	32,075	32,075
Terracing	Mile	6,970	-	757,610	757,610
Diversion Construction	Mile	640	-	118,828	118,828
Waterway Development	Acre	5,965	-	449,898	449,898
Pond Construction	No.	5,262	-	1,277,364	1,277,364
Stabilizing Measures	No.	130	-	82,857	82,857
Fertilizing	Acre	257,315	-	1,655,119	1,655,119
Technical Assistance (Accel.)			563,243	-	563,243
SCS Subtotal			563,243	11,515,827	12,079,070
TOTAL LAND TREATMENT			563,243	11,515,827	12,079,070
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	153	4,544,535	-	4,544,535
Channel Improvement	Mile	65.5	2,060,740	-	2,060,740
SCS Subtotal			6,605,275	-	6,605,275
Subtotal - Construction			6,605,275	-	6,605,275
Installation Services					
Soil Conservation Service					
Engineering Services			1,211,780	-	1,211,780
Other			781,710	-	781,710
SCS Subtotal			1,993,490	-	1,993,490
Subtotal Installation Services			1,993,490	-	1,993,490
Other Costs					
Land, Easements, R/W and Legal Fees			-	1,080,620	1,080,620
Subtotal Other			-	1,080,620	1,080,620
TOTAL STRUCTURAL MEASURES			8,598,765	1,080,620	9,679,385
WORK PLAN PREPARATION COST			98,076	-	98,076
TOTAL PROJECT			9,260,084	12,596,447	21,856,531
SUMMARY					
Subtotal SCS			9,260,084	12,596,447	21,856,531
TOTAL PROJECT			9,260,084	12,596,447	21,856,531

1/ Excludes $4,984,082 that has been or will be reimbursed from ACPS or other Federal funds, based on current program criteria.

October 1958

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/

Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST: Contract (dollars)	Contin-gencies (dollars)	Installa-tion Services (dollars)	Adm. and Misc. (dollars)	Total Federal (dollars)	NON-FEDERAL INSTALLATION COST: Legal Fees (dollars)	Easement and R/W (dollars)	Total Non-Federal (dollars)	Estimated Total Cost (dollars)
1	35,902	3,590	7,180	4,667	51,339	20	6,600	6,620	57,959
2	18,047	1,805	3,609	2,346	25,807	40	3,600	3,640	29,447
3	19,968	1,997	3,994	2,596	28,555	60	7,650	7,710	36,265
4	39,197	3,920	7,839	5,096	56,052	100	8,850	8,950	65,002
4A	13,574	1,357	2,715	1,765	19,411	40	1,650	1,690	21,101
5	16,536	1,654	3,307	2,150	23,647	80	3,400	3,480	27,127
6	20,726	2,073	4,145	2,694	29,638	60	3,300	3,360	32,998
6A	39,851	3,985	7,970	5,181	56,987	80	6,950	7,030	64,017
7	29,680	2,968	5,936	3,858	42,442	80	8,850	8,930	51,372
8	23,100	2,310	4,620	3,003	33,033	80	5,650	5,730	38,763
9A	17,325	1,733	3,465	2,252	24,775	40	3,650	3,690	28,465
9B	18,305	1,830	3,661	2,380	26,176	20	2,950	2,970	29,146
9C	18,830	1,883	3,766	2,448	26,927	40	6,250	6,290	33,217
10 * 2/	19,829	0	3,966	2,380	26,175	120	7,750	7,870	34,045
11	41,059	4,106	8,212	5,338	58,715	60	5,050	5,110	63,825
12	37,191	3,719	7,438	4,835	53,183	120	16,550	16,670	69,853
13	20,103	2,010	4,021	2,613	28,747	60	2,450	2,510	31,25[illegible]
14	18,472	1,847	3,694	2,401	26,414	80	8,900	8,980	35,39[illegible]
14A	18,458	1,846	3,692	2,400	26,396	60	8,250	8,310	34,706
15	34,986	3,499	6,997	4,548	50,030	140	8,750	8,890	58,920
16	20,599	2,060	4,120	2,678	29,457	20	4,650	4,670	34,127
16A	11,037	1,104	2,207	1,435	15,783	40	1,850	1,890	17,673
17	15,750	1,575	3,150	2,048	22,523	40	2,800	2,840	25,363
18	14,000	1,400	2,800	1,820	20,020	60	3,600	3,660	23,680
19 *	24,932	0	5,124	3,006	33,062	60	2,800	2,860	35,922
20 *	27,370	2,737	5,474	3,558	39,139	80	9,700	9,780	48,919
20A *	18,768	0	7,048	2,582	28,398	60	5,000	5,060	33,458

(Footnotes last page)

October 1958

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST			Estimated Total Cost
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Legal Fees	Easement and R/W	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
21 *	25,830	2,583	5,166	3,358	36,937	20	7,000	7,020	43,957
22 *	13,650	1,365	2,730	1,775	19,520	20	3,400	3,420	22,940
23 *	16,690	0	7,123	2,381	26,194	60	4,550	4,610	30,804
24 *	23,275	2,328	4,655	3,026	33,284	40	6,550	6,590	39,874
25 *	15,801	0	5,020	2,082	22,903	20	4,050	4,070	26,973
26	24,397	2,440	4,879	3,172	34,888	100	7,350	7,450	42,338
26A	21,301	2,130	4,260	2,769	30,460	100	7,100	7,200	37,660
27	18,865	1,887	3,773	2,453	26,978	80	3,500	3,580	30,558
28	27,233	2,723	5,447	3,540	38,943	60	6,550	6,610	45,553
29	22,575	2,258	4,515	2,935	32,283	60	4,300	4,360	36,643
30	21,389	2,139	4,278	2,781	30,587	40	2,750	2,790	33,377
31	61,217	6,122	12,243	7,958	87,540	120	28,400	28,520	116,060
32	17,500	1,750	3,500	2,275	25,025	120	6,750	6,870	31,895
33	20,353	2,035	4,071	2,646	29,105	100	4,750	4,850	33,955
34	21,874	2,187	4,375	2,844	31,280	40	2,850	2,890	34,170
35	22,817	2,282	4,563	2,966	32,628	100	3,050	3,150	35,778
36	25,333	2,533	5,067	3,293	36,226	80	5,850	5,930	42,156
37	14,990	1,499	2,998	1,949	21,436	80	2,850	2,930	24,366
38	55,885	5,588	11,177	7,265	79,915	60	11,050	11,110	91,025
39	69,550	6,955	13,910	9,041	99,456	40	5,600	5,640	105,096
40	29,743	2,974	5,949	3,867	42,533	60	2,700	2,760	45,293
41	24,835	2,484	4,967	3,229	35,515	60	2,500	2,560	38,075
42	20,853	2,085	4,171	2,711	29,820	40	1,900	1,940	31,760
43	77,930	7,793	15,586	10,131	111,440	80	5,300	5,380	116,820
44	27,694	2,769	5,539	3,600	39,602	80	4,800	4,880	44,482
45	19,065	1,907	3,813	2,478	27,263	40	2,400	2,440	29,703
46	11,592	1,159	2,318	1,507	16,576	80	2,000	2,080	18,656

(Footnotes last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST: Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	NON-FEDERAL INSTALLATION COST: Legal Fees	Easement and R/W	Total Non-Federal	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
47	13,537	1,354	2,708	1,760	19,359	140	2,400	2,540	21,899
48	15,056	1,506	3,011	1,957	21,530	80	2,950	3,030	24,560
49	15,987	1,599	3,197	2,078	22,861	60	2,150	2,210	25,071
50	35,326	3,533	7,065	4,592	50,516	40	5,650	5,690	56,206
51	20,161	2,016	4,032	2,621	28,830	20	2,450	2,470	31,300
52	26,092	2,609	5,218	3,392	37,311	80	2,350	2,430	39,741
53	11,319	1,132	2,264	1,471	16,186	80	1,600	1,680	17,866
54	34,193	3,419	6,839	4,445	48,896	20	3,050	3,070	51,966
55	16,674	1,667	3,335	2,168	23,844	20	1,300	1,320	25,164
56	27,652	2,765	5,530	3,595	39,542	80	2,550	2,630	42,172
57	64,683	6,468	12,936	8,409	92,496	220	13,850	14,070	106,566
58	30,974	3,097	6,195	4,027	44,293	40	3,050	3,090	47,383
59	26,726	2,672	5,345	3,474	38,217	20	3,250	3,270	41,487
60	25,009	2,501	5,002	3,251	35,763	60	3,400	3,460	39,223
61	51,775	5,178	10,355	6,731	74,039	40	2,750	2,790	76,829
62	35,524	3,552	7,105	4,618	50,799	80	2,800	2,880	53,679
63	70,695	7,069	14,139	9,190	101,093	40	10,000	10,040	111,133
Deleted 3-16-61 64	~~44,850~~	~~4,485~~	~~8,970~~	~~5,830~~	~~64,135~~	~~180~~	~~13,250~~	~~13,430~~	~~77,565~~
65	17,565	1,757	3,513	2,283	25,118	60	2,300	2,360	27,478
66	10,425	1,043	2,085	1,355	14,908	40	1,850	1,890	16,798
67	66,677	6,668	13,335	8,668	95,348	160	16,750	16,910	112,258
68	25,205	2,521	5,041	3,277	36,044	40	6,750	6,790	42,834
69	14,351	1,435	2,870	1,866	20,522	60	3,850	3,910	24,432
70	18,698	1,870	3,740	2,431	26,739	80	3,400	3,480	30,219
71	27,295	2,730	5,459	3,548	39,032	80	9,550	9,630	48,662
72	12,507	1,251	2,501	1,626	17,885	60	2,300	2,360	20,245
73	46,085	4,609	9,217	5,991	65,902	100	9,100	9,200	75,102

(Footnotes last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST			Estimated Total Cost
	Contract	Contin-gencies	Installa-tion Services	Adm. and Misc.	Total Federal	Legal Fees	Easement and R/W	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
74	26,985	2,698	5,397	3,508	38,588	40	4,950	4,990	43,578
75	21,221	2,122	4,244	2,759	30,346	40	4,100	4,140	34,486
76	Not included								
77-A	~~43,067~~	~~4,307~~	8,613	5,599	61,586	100	10,800	10,900	72,486
78	16,633	1,663	3,327	2,162	23,785	20	3,300	3,320	27,105
79	64,278	6,428	12,856	8,356	91,918	280	23,250	23,530	115,448
80	22,589	2,259	4,518	2,937	32,303	40	3,800	3,840	36,143
81	21,971	2,197	4,394	2,856	31,418	60	4,550	4,610	36,028
82	29,974	2,997	5,995	3,897	42,863	100	6,650	6,750	49,613
83	14,200	1,420	2,840	1,846	20,306	60	3,200	3,260	23,566
84	22,813	2,281	4,563	2,966	32,623	140	6,300	6,440	39,063
85	37,046	3,705	7,409	4,816	52,976	120	10,150	10,270	63,246
86	21,351	2,135	4,270	2,776	30,532	140	7,700	7,840	38,372
87	13,161	1,316	2,632	1,711	18,820	40	2,100	2,140	20,960
88	12,270	1,227	2,454	1,595	17,546	80	2,300	2,380	19,926
89	14,188	1,419	2,837	1,844	20,288	40	2,500	2,540	22,828
90	13,538	1,354	2,708	1,760	19,360	80	2,650	2,730	22,090
91	27,782	2,778	5,557	3,611	39,728	140	7,650	7,790	47,518
92	47,293	4,729	9,459	6,148	67,629	140	15,700	15,840	83,469
93	24,005	2,400	4,801	3,121	34,327	60	8,600	8,660	42,987
94	23,454	2,345	4,691	3,049	33,539	60	3,950	4,010	37,549
95	29,728	2,973	5,946	3,865	42,512	100	7,800	7,900	50,412
96	12,696	1,270	2,539	1,650	18,155	80	3,250	3,330	21,485
97	19,497	1,950	3,899	2,535	27,881	40	3,050	3,090	30,971
98	23,347	2,335	4,669	3,035	33,386	140	16,650	16,790	50,176
99	11,764	1,176	2,353	1,529	16,822	80	3,450	3,530	20,352
100	35,781	3,578	7,156	4,652	51,167	140	13,600	13,740	64,907

(Footnotes last page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/ - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST Contract	Contin-gencies	Installa-tion Services	Adm. and Misc.	Total Federal	NON-FEDERAL INSTALLATION COST Legal Fees	Easement and R/W	Total Non-Federal	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
101	21,942	2,194	4,389	2,853	31,378	100	6,100	6,200	37,578
102	11,673	1,167	2,335	1,517	16,692	20	2,350	2,370	19,062
103	33,027	3,302	6,605	4,294	47,228	120	13,900	14,020	61,248
104	43,170	4,317	8,634	5,612	61,733	220	14,350	14,570	76,303
105	38,277	3,828	7,655	4,976	54,736	40	2,500	2,540	57,276
106	54,134	5,413	10,826	7,038	77,411	240	16,150	16,390	93,801
107	43,040	4,304	8,608	5,595	61,547	140	11,150	11,290	72,837
108	27,200	2,720	5,440	3,536	38,896	120	3,650	3,770	42,666
109	10,194	1,019	2,039	1,325	14,577	40	1,550	1,590	16,167
110	32,507	3,250	6,502	4,226	46,485	80	5,450	5,530	52,015
111	13,051	1,305	2,610	1,697	18,663	80	1,850	1,930	20,593
112	32,046	3,205	6,409	4,166	45,826	100	5,650	5,750	51,576
113	29,757	2,976	5,951	3,868	42,552	100	4,400	4,500	47,052
114	15,157	1,516	3,031	1,970	21,674	100	2,300	2,400	24,074
115	18,023	1,803	3,605	2,343	25,774	40	3,200	3,240	29,014
116	15,020	1,502	3,004	1,953	21,479	40	2,400	2,440	23,919
117	36,932	3,693	7,387	4,801	52,813	60	4,200	4,260	57,073
118	43,387	4,339	8,677	5,640	62,043	120	9,900	10,020	72,063
119	17,771	1,777	3,555	2,310	25,413	100	8,700	8,800	34,213
120	32,583	3,258	6,516	4,235	46,592	20	6,850	6,870	53,462
121	33,441	3,344	6,688	4,347	47,820	40	5,450	5,490	53,310
122	55,693	5,569	11,138	7,240	79,640	340	26,500	26,840	106,480
123	30,533	3,053	6,107	3,970	43,663	140	6,700	6,840	50,503
124	44,445	4,445	8,889	5,778	63,557	80	7,700	7,780	71,337
125	12,860	1,286	2,572	1,672	18,390	100	2,550	2,650	21,040
126	16,008	1,601	3,202	2,081	22,892	60	3,700	3,760	26,652
127	14,028	1,403	2,805	1,824	20,060	20	2,550	2,570	22,630

(Footnotes past page)

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/

Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST			Estimated Total Cost
	Contract	Contin-gencies	Installa-tion Services	Adm. and Misc.	Total Federal	Legal Fees	Easement and R/W	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
128	26,793	2,679	5,359	3,483	38,314	100	8,450	8,550	46,864
129	20,378	2,038	4,076	2,649	29,141	80	4,550	4,630	33,771
130	29,663	2,966	5,933	3,857	42,419	80	10,050	10,130	52,549
131	35,637	3,564	7,127	4,633	50,961	100	18,150	18,250	69,211
132	37,218	3,722	7,443	4,838	53,221	120	11,850	11,970	65,191
133	38,983	3,898	7,796	5,068	55,745	80	13,200	13,280	69,025
134	42,977	4,298	8,595	5,587	61,457	40	8,000	8,040	69,497
135	42,471	4,247	8,495	5,521	60,734	140	17,900	18,040	78,774
136	21,738	2,174	4,347	2,826	31,085	160	4,300	4,460	35,545
137	47,186	4,718	9,437	6,134	67,475	220	24,700	24,920	92,395
137A	17,780	1,778	3,556	2,311	25,425	120	4,950	5,070	30,495
138	22,492	2,249	4,499	2,924	32,164	160	13,650	13,810	45,974
139	19,498	1,950	3,900	2,535	27,883	140	5,450	5,590	33,473
140	15,330	1,533	3,066	1,993	21,922	80	3,700	3,780	25,702
141	28,042	2,804	5,609	3,645	40,100	200	13,700	13,900	54,000
142	15,046	1,505	3,009	1,956	21,516	80	3,700	3,780	25,296
143	12,676	1,268	2,535	1,648	18,127	60	3,200	3,260	21,387
144	20,520	2,052	4,104	2,668	29,344	100	6,400	6,500	35,844
145	28,291	2,829	5,658	3,678	40,456	140	15,900	16,040	56,496
Subtotal	4,140,123	404,412	837,100	538,168	5,919,803	12,720	997,500	1,010,220	6,930,023

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TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/

Richland Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Structure Site No.	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST			Estimated Total Cost
	Contract	Contin-gencies	Installa-tion Services	Adm. and Misc.	Total Federal	Legal Fees	Easement and R/W	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Channel Improvement									
Richland Creek	735,400	73,540	147,080	95,602	1,051,622	2,550	4,800	7,350	1,058,972
Pin Oak Creek	620,600	62,060	124,120	80,678	887,458	2,500	34,400	36,900	924,358
Post Oak Creek	108,800	10,880	21,760	14,144	155,584	1,000	9,600	10,600	166,184
White Rock Creek	164,000	16,400	32,800	21,320	234,520	750	3,200	3,950	238,470
Bynum Creek	32,200	3,220	6,440	4,186	46,046	400	4,600	5,000	51,046
Ask Creek	212,400	21,240	42,480	27,612	303,732	1,000	5,600	6,600	310,332
Subtotal	1,873,400	187,340	374,680	243,542	2,678,962	8,200	62,200	70,400	2,749,362
GRAND TOTAL	6,013,523	591,752	1,211,780	781,710	8,598,765	20,920	1,059,700	1,080,620	9,679,385

1/ Does not include work plan preparation cost.
2/ Excludes $4,018 paid by city of Coolidge for 200 acre-feet conservation storage (Municipal Water Supply) cost sharing based on incremental procedures in use at that time.
* Actual construction cost.

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TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 1	2	3	4	4A	5	6
Drainage Area 1/	sq.mi.	2.66	.99	2.13	2.39	0 51	1.00	0.98
Storage Capacity								
Sediment pool	ac.ft.	64	52	148	200	53	108	78
Sediment reserve below riser	ac.ft.	0	0	0	14	0	0	0
Sediment in detention pool	ac.ft.	0	6	11	17	4	9	6
Floodwater detention	ac.ft.	780	290	624	702	148	276	280
Total	ac.ft.	844	348	783	933	205	393	364
Surface Area								
Sediment pool 2/	acre	21	13	33	46	10	19	17
Floodwater detention pool	acre	111	59	120	131	23	49	49
Maximum Height of Dam	feet	26	22	26	26	27	23	24
Volume of Fill	cu.yd.	102,577	51,563	57,051	111,990	38,782	47,246	59,217
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of use 3/	years	35	33	35	35	31	30	32
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.80	7.03	6.86	6.82	7.16	7.06	7.03
Runoff	inches	4.95	4.94	4.79	4.75	4.86	4.86	4.83
Bottom width	feet	180	100	150	140	70	120	80
Design depth	feet	0	0	0	0	0	0	0
Design capacity	c.f.s.	0	0	0	0	0	0	0
Total freeboard 4/	feet	4.0	3.5	4.5	4.0	3.5	3.5	4.0
Total capacity	c.f.s.	3,978	1,775	4,050	3,094	1,243	2,130	1,760
Principal Spillway Capacity	c.f.s.	27	10	213	24	5	10	10
Capacity Equivalents								
Sediment volume	inches	0.45	0.98	1.30	1.68	1.95	2.04	1.49
Detention volume	inches	5.50	5.50	5.50	5.50	5.40	5.20	5.39
Sediment in detention pool	inches	0.0	0.12	0.10	0.13	0.15	0.16	0.12
Spillway storage	inches	3.92	4.67	6.41	4.69	3.70	3.60	3.90
Class of Structure		A	A	A	A	A	A	A
(Footnotes last page)	CN	84	82	82	82			

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 6A	7	8	9A	9B	9C	10*
Drainage Area 1/	sq.mi.	1.72	2.60	1.74	0.94	0.66	1.37	1.90
Storage Capacity								
Sediment pool	ac.ft.	127	200	200	86	81	177	155
Sediment reserve below riser	ac.ft.	0	118	0	0	0	0	200 5/
Sediment in detention pool	ac.ft.	10	25	16	10	6	14	15
Floodwater detention	ac.ft.	478	475	332	204	202	410	536
Total	ac.ft.	615	818	548	300	289	601	906
Surface Area								
Sediment pool 2/	acre	33	63	36	21	17	39	42
Floodwater detention pool	acre	106	114	77	52	42	86	113
Maximum Height of Dam	feet	23	24	25	21	24	21	24
Volume of Fill	cu. yd.	113,861	84,800	66,000	49,500	52,300	53,800	72,000
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	32	15	15	19	36	34	32
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.91	6.83	6.96	7.04	7.15	7.01	6.93
Runoff	inches	4.72	4.54	4.61	4.73	4.74	4.75	4.74
Bottom Width	feet	90	180	180	80	50	100	150
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	4.0	4.0	5.0	4.0	3.0	3.5	5.0
Total Capacity	c.f.s.	1,989	3,970	5,760	1,768	685	1,775	4,800
Principal Spillway Capacity	c.f.s.	17	26	17	9	7	14	19
Capacity Equivalents								
Sediment Volume	inches	1.39	2.29	2.16	1.71	2.29	2.43	3.51 5/
Detention Volume	inches	5.22	3.43	3.57	4.10	5.73	5.63	5.30
Sediment in Detention Pool	inches	0.11	0.18	0.17	0.19	0.18	0.19	0.15
Spillway Storage	inches	5.48	4.40	6.20	5.20	4.20	5.75	6.04
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	11	12	13	14	14A	15	16
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	1.55	4.42	0.67	2.48	1.52	3.14	1.40
Storage Capacity								
Sediment Pool	ac.ft.	115	200 }	46	198	151	137	117
Sediment Reserve Below Riser	ac.ft.	0	177 }	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	9	47	4	20	12	18	10
Floodwater Detention	ac.ft.	455	1,250	207	537	447	1,000	373
Total	ac.ft.	579	1,674	257	755	610	1,155	500
Surface Area								
Sediment Pool 2/	acre	21	86 ÷	13	50	44	30	26
Floodwater Detention Pool	acre	80	245	36	128	121	145	67
Maximum Height of Dam	feet	24	21	26	19	18	26	25
Volume of Fill	cu.yd.	117,312	106,259	57,437	52,776	52,737	99,959	58,854
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	35	68	35	19	33	45	29
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.98	6.70	7.15	6.84	6.96	6.77	7.00
Runoff	inches	4.58	4.57	5.00	4.82	4.93	4.69	4.58
Bottom Width	feet	60	200	80	300	120	110	90
Design Depth	feet	0	0	0	.5	0	0	0
Design Capacity	c.f.s.	0	0	0	100	0	0	0
Total Freeboard 4/	feet	4.5	4.0	3.5	2.8	3.0	4.5	4.0
Total Capacity	c.f.s.	1,620	4,420	1,420	4,830	1,644	2,970	1,989
Principal Spillway Capacity	c.f.s.	16	44	7	25	15	31	14
Capacity Equivalents								
Sediment Volume	inches	1.39	1.60	1.30	1.50	1.85	0.82	1.57
Detention Volume	inches	5.50	7.10	5.80	4.06	5.50	5.97	5.00
Sediment in Detention Pool	inches	0.11	0.20	0.10	0.15	0.15	0.11	0.10
Spillway Storage	inches	5.30	5.50	2.25	5.09	7.70	4.70	3.35
Class of Structure		A	A	A	A	A	A	A

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See revised release rates dated 3-10-67.

TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 16A	17	18	19*	20*	20A*	21*
Drainage Area 1/	sq.mi.	0.56	0.91	1.06	1.57	2.90	0.94	2.16
Storage Capacity								
Sediment Pool	ac.ft.	17	50	83	89	193	110	107
Sediment Reserve Below Riser	ac.ft.	0	0	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	1	6	9	10	22	13	12
Floodwater Detention	ac.ft.	163	277	301	450	895	262	856
Total	ac.ft.	181	333	393	549	1,110	385	975
Surface Area								
Sediment Pool 2/	acre	6	13	19	13	53	34	29
Floodwater Detention Pool	acre	31	43	53	43	141	66	111
Maximum Height of Dam	feet	17	24	24	22	25	20	23
Volume of Fill	cu.yd.	31,535	45,000	40,000	73,200	78,200	57,866	73,800
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	33	37	34	35	42	30	40
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.18	7.12	7.08	7.00	6.84	7.10	6.92
Runoff	inches	4.68	4.87	4.80	4.80	4.60	4.95	4.67
Bottom Width	feet	50	75	75	125	200	50	150
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	3.5	5.7	7.8	5.1	5.0	5.3	5.0
Total Capacity	c.f.s.	888	2,925	2,325	4,125	6,400	1,750	4,800
Principal Spillway Capacity	c.f.s.	6	9	11	15	29	9	22
Capacity Equivalents								
Sediment Volume	inches	0.56	1.03	1.46	1.08	1.25	2.21	0.71
Detention Volume	inches	5.50	5.73	5.48	5.50	5.78	5.27	5.71
Sediment in Detention Pool	inches	0.05	0.12	0.16	0.12	0.14	0.25	0.08
Spillway Storage	inches	4.50	4.52	4.56	5.50	4.13	7.97	5.60
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	22*	23*	24*	25*	26	26A	27
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	0.75	1.32	2.35	1.19	2.19	2.01	1.35
Storage Capacity								
Sediment Pool	ac.ft.	57	35	92	57	102	139	67
Sediment Reserve Below Riser	ac.ft.	0	0	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	6	4	8	6	8	11	5
Floodwater Detention	ac.ft.	220	387	622	343	721	589	331
Total	ac.ft.	283	426	722	406	831	739	403
Surface Area								
Sediment Pool 2/	acre	18	14	31	18	33	42	18
Floodwater Detention Pool	acre	50	77	100	63	114	100	52
Maximum Height of Dam	feet	20	23	21	20	21	20	26
Volume of Fill	cu.yd.	39,000	55,479	66,500	54,266	69,707	60,861	53,900
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	34	39	36	34	49	35	35
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.16	7.04	6.92	7.06	6.88	6.92	7.05
Runoff	inches	4.89	4.38	4.62	4.70	4.53	4.57	4.74
Bottom Width	feet	40	80	150	100	90	90	60
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	5.5	5.6	5.0	3.6	4.0	4.0	4.0
Total Capacity	c.f.s.	1,480	3,040	4,800	1,860	1,989	1,989	1,326
Principal Spillway Capacity	c.f.s.	8	13	20	12	22	20	11
Capacity Equivalents								
Sediment Volume	inches	1.42	0.50	0.80	0.90	0.87	1.30	1.11
Detention Volume	inches	5.50	5.52	5.43	5.42	6.16	5.50	5.50
Sediment in Detention Pool	inches	0.16	0.06	0.07	0.10	0.07	0.10	0.09
Spillway Storage	inches	9.72	6.32	5.47	5.58	4.75	4.90	4.10
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 28	29	30	31	32	33	34
Drainage Area 1/	sq.mi.	2.01	1.43	0.99	10.98	2.39	1.57	0.86
Storage Capacity								
Sediment Pool	ac.ft.	78	74	48	200	90	104	54
Sediment Reserve Below Riser	ac.ft.	0	0	0	550	0	0	0
Sediment in detention pool	ac.ft.	7	6	4	94	11	13	7
Floodwater Detention	ac.ft.	717	408	287	3,111	688	427	242
Total	ac.ft.	802	488	339	3,955	789	544	303
Surface Area								
Sediment Pool 2/	acre	28	22	14	140	23	24	14
Floodwater Detention Pool	acre	103	64	41	428	112	71	43
Maximum Height of Dam	feet	21	22	22	36	25	26	20
Volume of Fill	cu.yd.	77,810	64,499	61,112	174,906	49,999	58,150	62,498
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	58	33	35	41	33	28	29
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.92	6.98	7.06	6.30	6.82	6.94	7.05
Runoff	inches	4.57	4.71	4.64	4.19	4.86	4.97	5.05
Bottom Width	feet	120	110	70	250	150	130	70
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	3.5	4.0	4.0	5.0	4.0	4.0	4.0
Total Capacity	c.f.s.	2,130	2,431	1,547	8,000	3,315	2,873	1,547
Principal Spillway Capacity	c.f.s.	20	14	10	110	24	16	9
Capacity Equivalents								
Sediment Volume	inches	0.73	0.97	0.91	1.28	0.71	1.25	1.17
Detention Volume	inches	6.70	5.35	5.42	5.31	5.40	5.10	5.28
Sediment in Detention Pool	inches	0.07	0.08	0.07	0.16	0.09	0.15	0.15
Spillway Storage	inches	4.17	4.10	3.75	4.25	4.50	3.40	4.70
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	35	36	37	38	39	40	41
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	1.03	2.72	0.98	6.97	1.98	1.52	1.50
Storage Capacity								
Sediment Pool	ac.ft.	88	106	35	200	121	45	59
Sediment Reserve Below Riser	ac.ft.	0	0	0	8	0	0	0
Sediment in Detention Pool	ac.ft.	11	10	3	15	10	3	5
Floodwater Detention	ac.ft.	289	645	274	1,727	546	445	352
Total	ac.ft.	388	761	312	1,950	677	493	416
Surface Area								
Sediment Pool 2/	acre	17	25	9	43	28	9	9
Floodwater Detention Pool	acre	44	92	36	178	94	45	41
Maximum Height of Dam	feet	23	27	28	35	25	27	34
Volume of Fill	cu.yd.	65,192	72,380	42,829	159,670	198,714	84,980	70,957
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	29	25	41	37	42	45	28
Design Storm (Emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.06	6.82	6.89	6.34	6.78	6.84	6.80
Runoff	inches	5.13	4.58	3.84	3.37	3.70	3.97	3.93
Bottom Width	feet	100	160	50	360	60	50	90
Design Depth	feet	0	.2	0	0	0	0	0
Design Capacity	c.f.s.	0	30	0	0	0	0	0
Total Freeboard 4/	feet	4.0	4.3	4.0	4.2	4.0	5.0	4.5
Total Capacity	c.f.s.	2,210	4,320	1,105	8,280	1,326	1,350	2,430
Principal Spillway Capacity	c.f.s.	10	27	10	80	20	15	15
Capacity Equivalents								
Sediment Volume	inches	1.60	0.73	0.68	0.56	1.15	0.55	0.74
Detention Volume	inches	5.25	4.45	5.27	4.65	5.16	5.50	4.40
Sediment in Detention Pool	inches	0.20	0.07	0.05	0.04	0.09	0.04	0.06
Spillway Storage	inches	3.80	3.60	3.20	2.10	4.20	3.21	2.70
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	42	43	44	45	46	47	48
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	1.15	3.44	1.33	0.80	0.57	0.71	0.64
Storage Capacity								
Sediment Pool	ac.ft.	34	200	165	95	59	84	101
Sediment Reserve Below Riser	ac.ft.	0	113	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	2	26	12	6	5	7	8
Floodwater Detention	ac.ft.	337	686	348	186	168	181	181
Total	ac.ft.	373	1,025	526	289	232	272	290
Surface Area								
Sediment Pool 2/	acre	6	23	30	16	13	15	20
Floodwater Detention Pool	acre	32	83	66	32	27	33	39
Maximum Height of Dam	feet	32	39	28	28	26	25	24
Volume of Fill	cu.yd.	59,581	222,657	79,126	54,470	33,119	38,679	43,018
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	44	20	28	22	37	25	33
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.86	6.64	6.88	6.97	7.07	7.05	7.04
Runoff	inches	3.98	4.13	4.54	4.66	4.58	4.79	4.69
Bottom Width	feet	62	230	100	130	60	85	120
Design Depth	feet	0	.7	0	.3	0	0	0
Design Capacity	c.f.s.	0	150	0	35	0	0	0
Total Freeboard 4/	feet	4.0	3.8	4.0	3.2	3.5	3.5	3.0
Total Capacity	c.f.s.	1,547	6,210	2,210	2,308	1,065	1,509	1,644
Principal Spillway Capacity	c.f.s.	12	34	13	8	6	7	6
Capacity Equivalents								
Sediment Volume	inches	0.56	1.71	2.32	2.22	1.93	2.22	2.97
Detention Volume	inches	5.50	3.74	4.90	4.35	5.50	4.80	5.32
Sediment in Detention Pool	inches	0.04	0.14	0.18	0.18	0.15	0.18	0.24
Spillway Storage	inches	2.50	2.41	4.50	3.25	3.32	3.80	3.89
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	49	50	51	52	53	54	55
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	0.52	3.11	1.44	1.17	0.65	1.71	0.59
Storage Capacity								
Sediment Pool	ac.ft.	72	126	43	61	36	69	29
Sediment Reserve Below Riser	ac.ft.	0	0	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	6	10	3	5	3	4	2
Floodwater Detention	ac.ft.	149	892	419	297	178	500	169
Total	ac.ft.	227	1,028	465	363	217	573	200
Surface Area								
Sediment Pool 2/	acre	13	24	8	10	7	15	7
Floodwater Detention Pool	acre	30	89	41	34	25	46	19
Maximum Height of Dam	feet	26	37	35	30	32	35	25
Volume of Fill	cu.yd.	45,676	100,930	57,604	74,550	32,346	97,693	47,641
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	32	46	43	62	38	45	39
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.03	6.66	6.86	6.90	7.01	6.79	7.03
Runoff	inches	4.83	3.73	3.98	4.02	4.16	3.91	4.08
Bottom Width	feet	70	65	60	80	60	65	50
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	3.5	5.0	4.5	4.0	3.5	4.5	4.0
Total Capacity	c.f.s.	1,243	2,080	1,620	1,768	1,065	1,755	1,105
Principal Spillway Capacity	c.f.s.	5	31	14	12	7	17	6
Capacity Equivalents								
Sediment Volume	inches	2.60	0.76	0.56	0.99	1.02	0.76	0.93
Detention Volume	inches	5.40	5.38	5.44	6.40	5.30	5.50	5.35
Sediment in Detention Pool	inches	0.20	0.06	0.04	0.08	0.08	0.04	0.07
Spillway Storage	inches	4.60	3.10	2.76	3.48	2.84	2.52	2.65
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 56	57	58	59	60	61	62
Drainage Area 1/	sq.mi.	1.13	7.77	1.13	1.26	1.39	1.07	0.87
Storage Capacity								
Sediment Pool	ac.ft.	58	200	143	65	82	58	81
Sediment Reserve Below Riser	ac.ft.	0	339	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	5	41	11	5	7	5	4
Floodwater Detention	ac.ft.	317	2,121	245	372	407	308	259
Total	ac.ft.	380	2,701	399	442	496	371	344
Surface Area								
Sediment Pool 2/	acre	10	67	19	15	16	12	15
Floodwater Detention Pool	acre	41	208	42	50	52	43	41
Maximum Height of Dam	feet	25	37	28	32	25	28	25
Volume of Fill	cu.yd.	79,005	184,807	88,498	76,359	71,455	147,928	101,497
Emergency Spillway								
Type		Veg	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	41	38	19	48	45	44	40
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.84	6.38	6.96	6.89	6.96	6.94	7.04
Runoff	inches	3.81	4.03	4.70	3.80	3.85	3.84	4.30
Bottom Width	feet	80	300	130	50	55	50	50
Design Depth	feet	0	0	.7	0	0	0	0
Design Capacity	c.f.s.	0	0	90	0	0	0	0
Total Freeboard 4/	feet	3.5	4.5	3.3	4.0	4.0	4.0	4.0
Total Capacity	c.f.s.	1,420	8,100	2,873	1,105	1,215	1,105	1,105
Principal Spillway Capacity	c.f.s.	11	78	11	13	14	10	9
Capacity Equivalents								
Sediment Volume	inches	0.97	1.30	2.38	0.97	1.11	1.02	1.76
Detention Volume	inches	5.25	5.12	4.08	5.55	5.50	5.40	5.60
Sediment in Detention Pool	inches	0.08	0.10	0.19	0.08	0.09	0.08	0.09
Spillway Storage	inches	2.80	2.68	3.45	3.50	3.20	3.50	3.85
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued

FLOODWATER RETARDING STRUCTURES

Richland Creek Watershed, Texas

(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 63	64	65	66	67	68	69
Drainage Area 1/	sq.mi.	5.63	7.79	0.93	0.44	8.06	2.53	1.14
Storage Capacity								
Sediment Pool	ac.ft.	200	200	83	71	200	200	148
Sediment Reserve Below Riser	ac.ft.	151	224	0	0	462	75	0
Sediment in Detention Pool	ac.ft.	27	33	6	6	52	22	12
Floodwater Detention	ac.ft.	1,611	1,952	266	115	2,364	492	264
Total	ac.ft.	1,989	2,409	355	192	3,078	789	424
Surface Area								
Sediment Pool 2/	acre	45	67	13	12	80	42	25
Floodwater Detention Pool	acre	155	208	33	25	255	93	52
Maximum Height of Dam	feet	35	33	26	20	33	28	22
Volume of Fill	cu.yd.	201,986	128,142	50,185	29,785	190,505	72,014	41,002
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	46	37	33	27	48	17	22
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.49	5.88	6.98	7.12	6.30	6.73	6.86
Runoff	inches	3.72	3.18	4.67	4.72	3.92	4.45	4.62
Bottom Width	feet	240	300	120	71	230	350	100
Design Depth	feet	0	0	0	0	0	1.0	.3
Design Capacity	c.f.s.	0	0	0	0	0	350	30
Total Freeboard 4/	feet	4.0	5.0	3.5	3.0	4.5	3.0	3.7
Total Capacity	c.f.s.	5,304	9,600	2,130	973	6,210	7,735	2,210
Principal Spillway Capacity	c.f.s.	56	78	9	4	80	25	11
Capacity Equivalents								
Sediment Volume	inches	1.17	1.02	1.67	3.04	1.54	2.04	2.43
Detention Volume	inches	5.37	4.70	5.35	4.95	5.50	3.65	4.33
Sediment in Detention Pool	inches	0.09	0.08	0.13	0.24	0.12	0.16	0.19
Spillway Storage	inches	2.37	2.70	2.65	3.50	2.64	3.25	4.35
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	70	71	72	73	74	75	77-A
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	0.88	3.12	0.63	3.39	1.28	1.08	4.61
Storage Capacity								
Sediment Pool	ac.ft.	112	200	49	200	126	118	200
Sediment Reserve Below Riser	ac.ft.	0	154	0	103	0	0	257
Sediment in Detention Pool	ac.ft.	9	28	4	26	10	9	37
Floodwater Detention	ac.ft.	238	548	142	764	364	312	1,058
Total	ac.ft.	359	930	195	1,093	500	439	1,552
Surface Area								
Sediment Pool 2/	acre	20	65	13	48	30	23	62
Floodwater Detention Pool	acre	48	127	33	134	69	59	154
Maximum Height of Dam	feet	19	22	20	26	18	19	28
Volume of Fill	cu.yd.	53,423	77,987	35,733	131,670	77,100	60,632	123,049
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	29	14	22	25	37	36	25
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.98	6.66	7.01	6.60	6.88	6.92	6.51
Runoff	inches	4.72	4.43	4.37	3.98	4.37	4.46	3.93
Bottom Width	feet	170	290	50	145	50	50	80
Design Depth	feet	0	1.1	.1	0	0	0	0
Design Capacity	c.f.s.	0	325	5	0	0	0	0
Total Freeboard 4/	feet	3.0	2.9	3.9	4.5	4.0	4.4	5.0
Total Capacity	c.f.s.	2,329	6,409	1,105	3,915	1,105	1,300	2,560
Principal Spillway Capacity	c.f.s.	9	31	6	34	13	11	46
Capacity Equivalents								
Sediment Volume	inches	2.41	2.13	1.48	1.68	1.85	2.04	1.86
Detention Volume	inches	5.10	3.30	4.25	4.23	5.35	5.40	4.30
Sediment in Detention Pool	inches	0.19	0.17	0.12	0.14	0.15	0.16	0.15
Spillway Storage	inches	3.70	4.20	7.25	3.65	5.05	3.80	3.79
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 78	79	80	81	82	83	84
Drainage Area 1/	sq.mi.	0.79	10.77	0.83	1.20	1.96	0.69	2.23
Storage Capacity								
Sediment Pool	ac.ft.	137	200	165	186	200	124	200
Sediment Reserve Below Riser	ac.ft.	0	701	0	0	61	0	9
Sediment in Detention Pool	ac.ft.	11	75	14	15	20	10	17
Floodwater Detention	ac.ft.	216	2,497	239	281	574	195	539
Total	ac.ft.	364	3,473	418	482	855	329	765
Surface Area								
Sediment Pool 2/	acre	23	138	26	32	44	20	36
Floodwater Detention Pool	acre	43	327	50	59	89	44	90
Maximum Height of Dam	feet	21	34	21	21	22	23	25
Volume of Fill	cu.yd.	47,524	183,653	64,540	62,774	85,639	40,571	65,180
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	29	31	31	28	37	33	27
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.02	6.20	7.12	6.94	6.84	7.02	6.72
Runoff	inches	4.71	3.65	4.70	4.64	4.55	4.76	4.39
Bottom Width	feet	100	400	90	70	110	60	135
Design Depth	feet	0	0	0	0	0	0	0
Design Capacity	c.f.s.	0	0	0	0	0	0	0
Total Freeboard 4/	feet	3.5	5.1	3.5	4.0	4.0	3.0	4.0
Total Capacity	c.f.s.	1,775	1,320	1,598	1,547	2,431	822	2,984
Principal Spillway Capacity	c.f.s.	8	107	8	12	20	7	22
Capacity Equivalents								
Sediment Volume	inches	3.24	1.57	3.73	3.24	2.50	3.39	1.76
Detention Volume	inches	5.10	4.35	5.40	4.90	5.50	5.34	4.54
Sediment in Detention Pool	inches	0.26	0.13	0.30	0.26	0.20	0.27	0.14
Spillway Storage	inches	4.10	3.75	4.47	4.80	3.80	2.40	4.01
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 85	86	87	88	89	90	91
Drainage Area 1/	sq.mi.	3.68	2.04	0.43	0.65	0.67	0.83	2.59
Storage Capacity								
Sediment Pool	ac.ft.	200	200	46	81	69	66	200
Sediment Reserve Below Riser	ac.ft.	200	75	0	0	0	0	69
Sediment in Detention Pool	ac.ft.	31	21	4	6	5	8	21
Floodwater Detention	ac.ft.	1,049	581	120	173	189	241	552
Total	ac.ft.	1,480	877	170	260	263	315	842
Surface Area								
Sediment Pool 2/	acre	62	48	14	22	15	15	53
Floodwater Detention Pool	acre	141	106	28	44	35	38	100
Maximum Height of Dam	foot	30	21	20	15	20	20	24
Volume of Fill	cu.yd.	105,846	61,002	37,603	35,058	40,536	38,681	79,377
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	year	31	35	30	28	32	34	20
Design Storm (emergency spillway hydrograph)								
Duration	hour	6	6	6	6	6	6	6
Rainfall	inch	7.14	6.82	7.19	7.06	7.08	7.04	6.67
Runoff	inch	4.87	4.54	4.61	4.64	4.66	4.86	4.39
Bottom Width	foot	120	110	80	70	80	100	160
Design Depth	foot	0	0	0	0	0	0	0.5
Design Capacity	c.f.s.	0	0	0	0	0	0	80
Total Freeboard 4/	foot	4.5	4.0	3.0	3.0	3.5	3.5	4.0
Total Capacity	c.f.s.	3,240	2,431	1,096	959	1,420	1,775	4,320
Principal Spillway Capacity	c.f.s.	37	21	4	7	7	8	26
Capacity Equivalents								
Sediment Volume	inch	2.04	2.52	2.00	2.32	1.95	1.51	1.95
Detention Volume	inch	5.35	5.33	5.18	4.96	5.30	5.47	4.00
Sediment in Detention Pool	inch	0.16	0.20	0.16	0.18	0.15	0.19	0.15
Spillway Storage	inch	3.95	4.35	4.26	4.50	4.00	3.43	3.60
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 92	93	94	95	96	97	98
Drainage Area 1/	sq.mi.	5.82	3.28	1.21	4.32	1.24	1.23	5.75
Storage Capacity								
Sediment Pool	ac.ft.	200	200	90	170	74	79	567
Sediment Reserve Below Riser	ac.ft.	318	40	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	41	19	7	14	6	6	46
Floodwater Detention	ac.ft.	1,775	920	351	934	286	361	1,254
Total	ac.ft.	2,334	1,179	448	1,118	366	446	1,867
Surface Area								
Sediment Pool 2/	acre	92	51	23	39	17	17	104
Floodwater Detention Pool	acre	222	121	56	117	48	44	229
Maximum Height of Dam	feet	26	28	22	26	21	16	23
Volume of Fill	cu.yd.	135,123	68,586	67,011	84,938	36,274	55,706	66,707
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	48	35	35	21	21	36	22
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.44	6.72	6.96	6.57	6.98	6.94	6.55
Runoff	inches	4.23	4.57	4.54	4.40	4.78	4.53	4.33
Bottom Width	feet	165	150	70	220	200	90	350
Design Depth	feet	0	0	0	.7	.5	0	.4
Design Capacity	c.f.s.	0	0	0	150	100	0	130
Total Freeboard 4/	feet	4.5	4.5	4.0	3.3	3.0	4.0	4.1
Total Capacity	c.f.s.	4,455	4,050	1,547	7,040	3,550	1,989	9,450
Principal Spillway Capacity	c.f.s.	58	33	12	43	13	12	58
Capacity Equivalents								
Sediment Volume	inches	1.67	1.37	1.39	0.74	1.12	1.20	1.85
Detention Volume	inches	5.72	5.26	5.43	4.05	4.34	5.50	4.09
Sediment in Detention Pool	inches	0.13	0.11	0.11	0.06	0.09	0.10	0.15
Spillway Storage	inches	3.78	3.66	4.17	2.65	2.85	3.10	2.90
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 99	100	101	102	103	104	105
Drainage Area 1/	sq.mi.	0.86	4.05	1.69	0.50	4.92	8.30	1.28
Storage Capacity								
Sediment Pool	ac.ft.	107	200	200	69	200	200	84
Sediment Reserve Below Riser	ac.ft.	0	240	9	0	165	154	0
Sediment in Detention Pool	ac.ft.	8	35	16	6	29	44	9
Floodwater Detention	ac.ft.	239	1,187	473	113	1,258	2,235	373
Total	ac.ft.	354	1,662	698	188	1,652	2,633	466
Surface Area								
Sediment Pool 2/	acre	20	80	38	16	73	65	12
Floodwater Detention Pool	acre	49	192	84	31	205	222	38
Maximum Height of Dam	feet	16	24	22	19	22	33	35
Volume of Fill	cu.yd.	33,611	102,230	62,693	33,350	94,363	123,344	109,363
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	30	38	32	19	29	34	34
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.99	6.68	6.90	7.07	6.56	638	684
Runoff	inches	4.74	4.45	4.60	4.73	4.39	4.38	4.88
Bottom Width	feet	90	199	161	120	300	310	110
Design Depth	feet	0	0	0	.5	0	0	0
Design Capacity	c.f.s.	0	0	0	60	0	0	0
Total Freeboard 4/	feet	3.5	4.0	3.5	2.5	4.0	5.0	4.0
Total Capacity	c.f.s.	1,598	4,398	2,858	1,644	6,630	9,920	2,431
Principal Spillway Capacity	c.f.s.	9	41	17	5	49	83	13
Capacity Equivalents								
Sediment Volume	inches	2.32	2.04	2.32	2.59	1.39	0.80	1.24
Detention Volume	inches	5.20	5.50	5.25	4.20	4.80	5.05	5.48
Sediment in Detention Pool	inches	0.18	0.16	0.18	0.21	0.11	0.10	0.16
Spillway Storage	inches	2.05	4.20	3.70	3.50	2.70	2.75	2.42
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	106	107	108	109	110	111	112
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	7.97	3.05	1.79	0.38	1.31	0.44	2.49
Storage Capacity								
Sediment Pool	ac.ft.	200	197	102	49	191	61	118
Sediment Reserve Below Riser	ac.ft.	178	0	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	47	15	13	4	15	5	15
Floodwater Detention	ac.ft.	2,126	894	387	107	284	121	712
Total	ac.ft.	2,551	1,106	502	160	490	187	845
Surface Area								
Sediment Pool 2/	acre	78	43	19	9	37	12	25
Floodwater Detention Pool	acre	245	180	54	22	72	25	88
Maximum Height of Dam	feet	33	30	28	20	21	20	26
Volume of Fill	cu.yd.	154,669	122,971	77,715	29,125	92,876	37,288	91,561
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	33	38	18	28	18	29	33
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.43	6.77	6.90	7.18	6.97	7.05	10.23
Runoff	inches	4.44	4.48	4.93	4.75	4.55	4.74	8.12
Bottom Width	feet	330	117	220	80	120	100	268
Design Depth	feet	0	0	1.3	0	.4	0	1.7
Design Capacity	c.f.s.	0	0	570	0	45	0	1,290
Total Freeboard 4/	feet	5.0	4.0	2.7	3.0	3.6	3.0	3.3
Total Capacity	c.f.s.	10,560	2,586	4,862	1,096	2,652	1,370	8,576
Principal Spillway Capacity	c.f.s.	80	30	18	4	13	5	25
Capacity Equivalents								
Sediment Volume	inches	0.89	1.21	1.07	2.41	2.73	2.60	0.89
Detention Volume	inches	5.00	5.50	4.05	5.27	4.06	5.20	5.35
Sediment in Detention Pool	inches	0.11	0.09	0.13	0.19	0.21	0.20	0.11
Spillway Storage	inches	2.90	6.10	2.55	3.83	4.50	3.60	4.00
Class of Structure		A	A	A	A	A	A	B

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TABLE 3 - STRUCTURE DATA - Continued

FLOODWATER RETARDING STRUCTURES

Richland Creek Watershed, Texas

(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 113	114	115	116	117	118	119
Drainage Area 1/	sq.mi.	1.28	0.58	0.89	0.65	1.29	3.73	1.95
Storage Capacity								
Sediment Pool	ac.ft.	168	76	106	76	106	177	127
Sediment Reserve Below Riser	ac.ft.	0	0	0	0	0	0	0
Sediment in Detention Pool	ac.ft.	14	6	8	5	8	22	19
Floodwater Detention	ac.ft.	274	161	231	187	355	1,043	476
Total	ac.ft.	456	243	345	268	469	1,242	622
Surface Area								
Sediment Pool 2/	acre	30	17	21	14	23	48	42
Floodwater Detention Pool	acre	58	29	43	34	61	150	132
Maximum Height of Dam	feet	22	16	21	22	24	20	16
Volume of Fill	cu.yd.	85,019	43,305	51,495	42,915	105,522	123,962	50,776
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	18	28	26	32	31	32	25
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.98	7.12	7.07	7.10	6.97	6.76	6.86
Runoff	inches	4.59	4.97	4.82	4.90	4.58	4.74	4.90
Bottom Width	feet	120	100	110	80	130	264	100
Design Depth	feet	.5	0	0	0	0	0	.2
Design Capacity	c.f.s.	60	0	0	0	0	0	20
Total Freeboard 4/	feet	3.5	3.5	3.5	3.5	3.5	4.0	3.8
Total Capacity	c.f.s.	2,652	1,775	1,953	1,420	2,308	5,834	2,210
Principal Spillway Capacity	c.f.s.	13	6	9	7	13	37	20
Capacity Equivalents								
Sediment Volume	inches	2.46	2.50	2.22	2.19	1.53	0.89	1.22
Detention Volume	inches	4.01	5.25	4.85	5.39	5.15	5.25	4.57
Sediment in Detention Pool	inches	0.20	0.20	0.18	0.17	0.12	0.11	0.18
Spillway Storage	inches	4.33	3.75	3.75	3.95	3.50	3.55	6.53
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 120	121	122	123	124	125	126
Drainage Area 1/	sq.mi.	1.93	1.58	9.77	2.64	2.73	1.04	1.21
Storage Capacity								
Sediment Pool	ac.ft.	101	52	200	100	168	57	80
Sediment Reserve Below Riser	ac.ft.	0	0	269	0	0	0	0
Sediment in Detention Pool	ac.ft.	12	7	62	13	22	7	10
Floodwater Detention	ac.ft.	514	455	2,750	761	627	238	347
Total	ac.ft.	627	514	3,281	874	817	302	437
Surface Area								
Sediment Pool 2/	acre	27	21	120	24	42	13	19
Floodwater Detention Pool	acre	110	88	410	110	112	38	55
Maximum Height of Dam	feet	22	20	25	25	23	25	21
Volume of Fill	cu.yd.	93,094	95,546	159,123	87,233	126,987	36,743	45,737
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	24	34	39	35	21	19	32
Design Storm(emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.88	6.79	6.32	6.73	6.80	7.03	6.94
Runoff	inches	4.86	4.78	4.21	4.71	4.84	5.06	4.80
Bottom Width	feet	150	180	250	160	220	150	90
Design Depth	feet	0	0	0	0	.5	.9	0
Design Capacity	c.f.s.	0	0	0	0	100	125	0
Total Freeboard 4/	feet	4.0	3.5	5.0	4.0	3.5	3.1	4.0
Total Capacity	c.f.s.	3,315	3,195	8,000	3,536	4,862	3,315	1,989
Principal Spillway Capacity	c.f.s.	19	16	98	27	27	11	12
Capacity Equivalents								
Sediment Volume	inches	0.98	0.62	0.90	0.71	1.15	1.02	1.24
Detention Volume	inches	5.00	5.40	5.28	5.40	4.30	4.30	5.40
Sediment in Detention Pool	inches	0.12	0.08	0.90	0.09	0.15	0.13	0.16
Spillway Storage	inches	6.00	4.30	4.90	3.90	3.90	3.25	4.10
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 127	128	129	130	131	132	133
Drainage Area 1/	sq.mi.	0.74	3.29	1.79	3.30	5.51	4.09	6.32
Storage Capacity								
Sediment Pool	ac.ft.	52	156	51	200	200	200	200
Sediment Reserve Below Riser	ac.ft.	0	0	0	28	235	90	100
Sediment in Detention Pool	ac.ft.	4	19	7	18	35	37	37
Floodwater Detention	ac.ft.	208	956	538	934	1,528	1,166	1,425
Total	ac.ft.	264	1,131	596	1,160	1,998	1,493	1,762
Surface Area								
Sediment Pool 2/	acre	12	41	19	46	98	57	72
Floodwater Detention Pool	acre	39	128	72	155	265	180	192
Maximum Height of Dam	feet	18	26	20	26	23	32	21
Volume of Fill	cu.yd.	40,080	76,550	58,224	84,751	101,820	106,336	112,380
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	29	36	31	32	34	35	24
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	7.09	6.68	7.02	10.00	9.75	6.68	6.52
Runoff	inches	5.00	4.66	4.84	7.77	7.54	4.61	4.36
Bottom Width	feet	150	200	151	325	500	160	350
Design Depth	feet	0	0	0	1.5	1.4	0	.2
Design Capacity	c.f.s.	0	0	0	1,170	1,525	0	70
Total Freeboard 4/	feet	3.0	4.0	4.0	2.5	3.4	4.5	4.3
Total Capacity	c.f.s.	2,055	4,420	3,337	10,400	20,000	4,320	9,450
Principal Spillway Capacity	c.f.s.	8	33	18	33	55	41	63
Capacity Equivalents								
Sediment Volume	inches	1.30	0.89	0.53	1.30	1.48	1.33	0.89
Detention Volume	inches	5.27	5.46	5.63	5.20	5.20	5.35	4.23
Sediment in Detention Pool	inches	0.10	0.11	0.07	0.10	0.12	0.17	0.11
Spillway Storage	inches	3.83	3.34	3.47	5.80	6.60	4.45	3.07
Class of Structure		A	A	A	B	B	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	134	135	136	137	137A	138	139
		STRUCTURE NUMBER						
Drainage Area 1/	sq.mi.	3.06	7.72	1.34	9.49	1.27	3.71	1.44
Storage Capacity								
Sediment Pool	ac.ft.	124	200	95	200	144	200	126
Sediment Reserve Below Riser	ac.ft.	0	360	0	519	0	111	0
Sediment in Detention Pool	ac.ft.	14	45	7	91	12	25	10
Floodwater Detention	ac.ft.	897	1,988	394	2,657	338	1,069	322
Total	ac.ft.	1,035	2,593	496	3,467	494	1,405	458
Surface Area								
Sediment Pool 2/	acre	25	100	20	137	31	73	34
Floodwater Detention Pool	acre	135	258	66	357	68	200	75
Maximum Height of Dam	feet	25	22	25	24	21	18	10
Volume of Fill	cu.yd.	122,791	121,347	62,109	134,816	50,799	64,264	55,707
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Frequency of Use 3/	years	39	30	32	37	27	39	21
Design Storm (emergency Spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	6
Rainfall	inches	6.76	6.44	6.96	6.34	7.00	6.71	7.00
Runoff	inches	4.45	4.55	4.75	4.20	4.69	4.32	4.60
Bottom Width	feet	140	375	110	370	100	250	110.
Design Depth	feet	0	0	0	0	0	0	.4
Design Capacity	c.f.s.	0	0	0	0	0	0	44
Total Freeboard 4/	feet	4.0	4.5	4.0	4.5	4.0	4.2	3.6
Total Capacity	c.f.s.	3,094	10,125	2,431	9,990	2,210	5,850	2,431
Principal Spillway Capacity	c.f.s.	31	77	13	95	13	37	14
Capacity Equivalents								
Sediment Volume	inches	0.76	1.36	1.32	1.42	2.13	1.57	1.64
Detention Volume	inches	5.50	4.83	5.50	5.25	5.00	5.40	4.18
Sediment in Detention Pool	inches	0.09	0.11	0.10	0.18	0.17	0.13	0.13
Spillway Storage	inches	4.05	3.30	4.48	3.85	4.70	5.00	5.45
Class of Structure		A	A	A	A	A	A	A

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TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 140	141	142	143	144	145	Total
Drainage Area 1/	sq.mi.	0.92	4.23	1.09	1.19	2.70	6.84	361.07
Storage Capacity								
Sediment Pool	ac.ft.	87	200	39	32	89	200	18,982
Sediment Reserve Below Riser	ac.ft.	0	126	0	0	0	26	7,028
Sediment in Detention Pool	ac.ft.	7	41	5	0	12	29	2,378
Floodwater Detention	ac.ft.	259	1,221	323	298	649	1,750	96,946
Total	ac.ft.	353	1,588	367	330	750	2,005	125,334
Surface Area								
Sediment Pool 2/	acre	21	62	14	10	20	70	5,173
Floodwater Detention Pool	acre	53	212	60	54	108	248	14,801
Maximum Height of Dam	feet	16	26	17	17	25	21	xxx
Volume of Fill	cu.yd.	43,802	80,120	42,987	36,216	58,629	80,832	11,867,388
Emergency Spillway								
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Frequency of Use 3/	years	31	34	29	25	24	30	xxx
Design Storm (emergency spillway hydrograph)								
Duration	hours	6	6	6	6	6	6	xxx
Rainfall	inches	7.02	6.74	7.02	7.00	6.80	6.49	xxx
Runoff	inches	4.64	4.76	4.99	4.77	4.66	4.44	xxx
Bottom Width	feet	90	260	80	100	190	270	xxx
Design Depth	feet	0	0	0	.1	0	0	xxx
Design Capacity	c.f.s.	0	0	0	10	0	0	xxx
Total Freeboard 4/	feet	3.5	4.0	4.0	3.9	4.0	5.2	
Total Capacity	c.f.s.	1,598	5,746	1,768	2,210	4,199	9,018	xxx
Principal Spillway Capacity	c.f.s.	9	42	11	12	27	68	xxx
Capacity Equivalents								
Sediment Volume	inches	1.77	1.45	0.67	0.50	0.62	0.62	xxx
Detention Volume	inches	5.27	5.42	5.54	4.70	4.51	4.80	xxx
Sediment in Detention Pool	inches	0.14	0.18	0.09	0.00	0.08	0.08	xxx
Spillway Storage	inches	4.42	4.55	4.70	4.60	3.04	4.10	xxx
Class of Structure		A	A	A	A	A	A	xxx

(Footnotes next page)

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See revised release rates dated 3-10-67.

TABLE 3 - STRUCTURE DATA - Continued
FLOODWATER RETARDING STRUCTURES
Richland Creek Watershed, Texas
(Trinity River Watershed)

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* Construction completed.

1/ Excludes the area from which runoff is controlled by other floodwater retarding structures.
2/ Area at the elevation of the top of riser.
3/ Frequency of use based on three-day duration and will exceed 25 years based on 6-hour duration storm.
4/ 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'
5/ Includes 1.98 inches (200 ac.ft.) conservation storage paid for by the city of Coolidge.
6/ Bermuda Grass.

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See revised release rates dated 3-10-67.

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

Station Numbering For Reach: Station	Station Numbering For Reach: Station	Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
		(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Richland Creek									
0 + 00	103 + 65	129,773	10,938	81	2:1	20.0	.00043	4.52	714
103 + 65	191 + 40	123,143	10,706	66	2:1	20.0	.00057	5.05	559
191 + 40	372 + 20	122,051	10,584	65	2:1	20.0	.00057	5.04	639
372 + 20	481 + 10	54,583	5,756	60	2:1	16.0	.00046	3.91	311
481 + 10	656 + 00	49,781	5,448	55	2:1	16.0	.00046	3.90	515
656 + 00	773 + 45	33,695	4,009	35	2:1	16.0	.00046	3.74	302
773 + 45	865 + 20	32,188	3,848	33	2:1	16.0	.00046	3.70	309
865 + 20	961 + 55	30,232	3,779	32	2:1	16.0	.00046	3.64	188
961 + 55	1121 + 35	26,055	3,444	26	2:1	15.0	.00065	4.10	140
								Total	3,677
Pin Oak Creek									
0 + 00	87 + 00	55,519	7,154	65	2:1	16.0	.00062	4.61	500
87 + 00	150 + 40	52,997	6,933	62	2:1	16.0	.00062	4.61	353
150 + 40	196 + 55	51,422	6,797	44	2:1	16.0	.00098	5.59	208
196 + 55	320 + 60	50,130	6,684	43	2:1	16.0	.00098	5.57	462
320 + 60	377 + 35	48,580	6,571	42	2:1	16.0	.00098	5.55	172
377 + 35	434 + 70	46,220	6,359	40	2:1	16.0	.00098	5.52	89
434 + 70	613 + 70	44,968	6,163	40	2:1	15.0	.0012	5.87	365
613 + 70	777 + 30	38,442	5,626	35	2:1	15.0	.0012	5.77	457
777 + 30	979 + 10	24,954	4,430	28	2:1	14.0	.0013	5.65	377
979 + 10	1039 + 10	16,530	3,603	26	2:1	13.0	.0013	5.33	120
								Total	3,103

1/ Uncontrolled area below floodwater retarding structures.

October, 1958

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

Station Numbering For Reach: Station	Station Numbering For Reach: Station	Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
		(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Post Oak Creek									
0 + 00	62 + 00	9,258	2,890	16	2:1	12.0	.0020	6.02	110
62 + 00	112 + 00	8,458	2,611	13	2:1	12.0	.0020	5.88	82
112 + 00	157 + 50	7,727	2,428	12	2:1	11.8	.0020	5.78	71
157 + 50	194 + 00	6,052	2,076	12	2:1	11.0	.0020	5.55	51
194 + 00	276 + 25	5,353	1,736	12	2:1	10.4	.0018	5.09	104
276 + 25	340 + 30	4,057	1,490	12	2:1	9.7	.0018	4.90	72
340 + 30	404 + 90	2,517	1,044	12	2:1	8.0	.0018	4.69	54
								Total	544
White Rock Creek									
0 + 00	75 + 00	26,458	4,752	43	2:1	12.0	.0015	5.91	223
75 + 00	131 + 00	24,858	4,500	40	2:1	12.0	.0015	5.86	156
131 + 00	179 + 00	22,850	4,078	35	2:1	12.0	.0015	5.76	126
179 + 00	222 + 00	22,032	3,988	34	2:1	12.0	.0015	5.73	103
222 + 00	277 + 00	20,892	3,817	32	2:1	12.0	.0015	5.68	95
277 + 00	329 + 50	9,416	3,312	26	2:1	12.0	.0015	5.52	117
								Total	820

1/ Uncontrolled area below floodwater retarding structures.

October 1958

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

Station Numbering For Reach: Station	Station Numbering For Reach: Station	Watershed Area 1/	Planned Channel Capacity	Bottom Width	Side Slope	Depth	Fall	Velocity at Design Depth	Volume of Excavation
		(acre)	(c.f.s.)	(feet)		(feet)	(ft./ft.)	(ft./sec.)	(1000 cu.yd.)
Bynum Creek									
0 + 00	58 + 50	3,572	1,490	12	2:1	9.7	.0018	4.90	66
58 + 50	100 + 00	3,044	1,333	12	2:1	9.2	.0018	4.76	43
100 + 00	152 + 00	2,520	1,269	12	2:1	9.0	.0018	4.70	52
								Total	161
Ash Creek									
0 + 00	77 + 00	34,388	5,953	65	2:1	12.0	.0012	5.60	303
77 + 00	151 + 50	25,576	4,962	53	2:1	12.0	.0012	5.37	255
151 + 50	227 + 00	16,330	3,839	38	2:1	12.0	.0012	5.16	208
227 + 00	288 + 00	11,052	3,110	30	2:1	12.0	.0012	4.80	146
288 + 00	327 + 80	5,149	1,664	12	2:1	11.2	.0012	4.31	55
327 + 80	369 + 60	4,095	1,443	12	2:1	10.5	.0012	4.17	54
369 + 60	412 + 60	3,339	1,247	12	2:1	8.7	.0020	4.87	41
								Total	1,062
								GRAND TOTAL	9,367

1/ Uncontrolled area below floodwater retarding structures.

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

Measures	Amortization of Installation Costs 2/			Operation & Maintenance Costs 3/		Total
	Federal	Non-Federal	Total	Non-Federal	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures 4/ Number 1,2,3,4,4A,5,6, 6A,7,8,9A,9B,9C,10,11,12, 13,14,14A,15,16,16A,17,18,19, 20,20A,21,22,23,24,25,26, 26A,27,28,29,30,31,32,33,34, 35,36, 104 through 145 & 137A Stream Channel Improvement: Post Oak Creek Pin Oak Creek Richland Creek	188,067	31,643	219,710	18,538	18,538	238,248
Floodwater Retarding 4/ Structures Number 37 through 49 and 98 through 102	25,271	4,288	29,559	1,845	1,845	31,404
Floodwater Retarding 4/ Structures Number 67 through 75 and 77 through 89 and Number 90 through 97 Stream Channel Improvement: Ash Creek Bynum Creek	52,192	9,971	62,163	5,108	5,108	67,271
Floodwater Retarding 4/ Structure Number 103	1,665	653	2,318	90	90	2,408
Stream Channel Improvement, 4/ White Rock Creek, and Floodwater Retarding Structures Number 50 through 66	35,981	3,748	39,729	3,093	3,093	42,822
TOTAL	303,176	50,303	353,479	28,674	28,674	382,153

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 1957 prices.
3/ Based on long-term price levels as projected by ARS, June 1957.
4/ Interdependent structures.

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

Item	Estimated Average Annual Damage 2/: Without Project (dollars)	After Land Treatment For W/S Protection (dollars)	With Project (dollars)	Average Annual Monetary Benefits (dollars)
Floodwater Damage				
Crop and Pasture	716,860	671,714	130,957	540,757
Other Agricultural	32,112	27,351	2,615	24,736
Road and Bridge	16,974	14,311	1,178	13,133
Subtotal	765,946	713,376	134,750	578,626
Sediment Damage				
Overbank Deposition	92,288	51,828	7,314	44,514
Reservoirs	28,829	23,609	15,697	7,912
Subtotal	121,117	75,437	23,011	52,426
Erosion Damage				
Flood Plain Scour	25,340	22,869	3,673	19,196
Indirect Damages	91,240	81,168	16,143	65,025
Total, All Damages	1,003,643	892,850	177,577	715,273
Changed Land Use to Crop Production	xxx	xxx	xxx	42,690
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	757,963

1/ Projection by ARS June 1956
2/ Assuming Navarro Mills and proposed Fort Worth reservoirs in place.

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TABLE 6 - BENEFIT-COST ANALYSIS
Richland Creek Watershed, Texas
(Trinity River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost 2/	Benefit-Cost Ratio
	Flood Prevention							
	Flood-water (dollars)	Sediment (dollars)	Erosion (dollars)	Indirect (dollars)	Changed Land Use (dollars)	Total (dollars)	(dollars)	
Floodwater Retarding Structures Number 1,2,3,4,4A,5,6,6A,7,8, 9A,9B,9C,10,11,12,13,14,14A, 15,16,16A,17,18,19,20,20A,21, 22,23,24,25,26,26A,27,28,29, 30,31,32,33,34,35,36, 104 through 145 & 137A	240,430	29,469	10,402	28,030	17,277	325,608	152,123	2.1:1
Floodwater Retarding Structures Number 37 through 49 and 98 through 102	36,269	3,750	1,632	4,165	-	45,816	31,404	1.5:1
Floodwater Retarding Structures Number 67 through 75, and 77 through 89	51,735	5,384	720	5,784	-	63,623	39,029	1.6:1
Floodwater Retarding Structures Number 90 through 97	28,235	3,689	1,306	3,323	-	36,553	13,232	2.8:1
Floodwater Retarding Structure Number 103	2,861	418	159	344	-	3,782	2,408	1.6:1
Stream Channel Improvement, White Rock Creek, and Floodwater Retarding Structures Number 50 through 66	33,883	3,409	2,262	3,955	1,654	45,163	42,822	1.1:1

(Footnotes next page)

TABLE 6 - BENEFIT-COST ANALYSIS - Continued
Richland Creek Watershed, Texas
(Trinity River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost 2/	Benefit-Cost Ratio
	Flood Prevention							
	Floodwater	Sediment	Erosion	Indirect	Changed Land Use	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Stream Channel Improvement Ash Creek	41,012	1,092	249	4,236	-	46,589	12,578	3.7:1
Stream Channel Improvement Bynum Creek	8,105	86	72	826	-	9,089	2,432	3.7:1
Stream Channel Improvement Post Oak Creek	8,946	298	125	937	-	10,306	7,513	1.4:1
Stream Channel Improvement Pin Oak Creek	87,344	4,125	2,180	9,365	7,009	110,023	36,944	3.0:1
Stream Channel Improvement Richland Creek	39,806	706	89	4,060	16,750	61,411	41,668	1.5:1
TOTAL	578,626	52,426	19,196	65,025	42,690	757,963	382,153	2.0:1

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.

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