PRELIMINARY
Flood Control Work Plan
LAKE CREEK WATERSHED
A Subwatershed of the Trinity River
TX-SCD-10 Tr. No. 44
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DESCRIPTION OF THE WATERSHED

Lake Creek rises at Montalba in Anderson County, Texas, and flows in a southwesterly direction for 20 miles, entering the Trinity River in the west central part of Anderson County approximately 12 miles west of Palestine. The subwatershed varies from 2 to 6 miles in width, averaging 4 miles. Rabbit and Sand Branches and Spring Creek are individual streams which drain directly into the Trinity River bottom and have no influence on the Lake Creek flood plain.

No incorporated towns are located in the watershed. There are 70 miles of roads, of which 15 miles are hard-surfaced. Of the 20 bridges, 4 are major bridges spanning the larger streams.

The watershed has an area of 51,000 acres, of which 50,279 acres are in farms. The remaining 721 acres, about 1.4 percent, are in roads and miscellaneous uses. The bottomland area includes 15,969 acres of flood plain and 310 acres of stream channels. Approximately 12,500 acres of the flood plain is Trinity River bottomland.

Soils

Trinity bottomland soils comprise approximately 30 percent of the watershed area. The remaining 70 percent is soils of the Forested Coastal Plain.

Topography and Land Use

The bottomlands are not intensively utilized, approximately 19 percent being in cultivation. About 28 percent of the upland area is cultivated.

Upland slopes generally range from 2 to 8 percent, with some slopes as steep as 30 percent adjacent to the bottomland areas on the larger streams. Most of the abandoned cropland is under some type of vegetative cover, mainly weeds and brush. The upland soils of the area which have been cultivated for a long period of time have lost much of their fertility and organic matter. However, the Trinity River bottomland soils are highly productive. The soils of the area respond rapidly to land treatment measures and practices. Of the total drainage area, 49 percent is woodland, 28 percent pasture, and 21 percent cultivated. Cultivated bottomlands are used chiefly for cotton, with truck and peanuts being the principal crops grown on the uplands.

Climate

The climate of the area is characterized by long summers and short winters. The winters usually are mild but occasional northers cause sudden drops in temperature. As a rule, these cold spells last only a few days. Few winters pass without a light fall of snow which generally melts as it falls.

Mean temperatures range from 82.2 degrees Fahrenheit in summer to 48.2 degrees in winter. The average temperature for the area is 65.9 degrees. The extreme recorded temperatures are four degrees below zero and 108 degrees above zero. The average date of the last killing frost is March 7 and that of the first killing frost is November 23, or a normal frost-free period of 261 days.

The mean annual precipitation of 40.35 inches is fairly evenly distributed, with the greatest amounts of rainfall occurring in April and May. Individual rains of excessive amounts which fall at irregular intervals during the year cause serious erosion and flood damage. The minimum recorded annual rainfall of 23.98 inches occurred in 1909 and the maximum annual rainfall of 61.19 inches fell in 1892.

Water Resources

The principal uses of water in the area are for stock water and domestic purposes. There are several natural springs in the watershed which cause most of the streams to flow permanently. These streams and small stock ponds are used for livestock water. Shallow wells supply water for domestic purposes.

ECONOMY OF THE WATERSHED

Agricultural Economy

There are some small dairies within the Lake Creek watershed which sell bulk raw milk to Houston industries. Sixty percent of the cattle are used for beef production. Because livestock production is not very extensive, 70 percent of the cropland is planted to cash crops such as peanuts, truck, and cotton. The remaining 30 percent is used to grow feed crops, including corn and hay.

Because of the frequency of flooding and the increasing value of livestock 30 percent of the flood plain area formerly used for cotton is now pasture or idle land.

Lake Creek watershed is served by one Soil Conservation Service work unit, which assists the Anderson-Houston Soil Conservation District. This work unit has assisted farmers and ranchers in preparing 81 conservation plans on 14,094 acres within the watershed boundaries. Where land treatment measures have been applied and maintained for as long as two or three years, crop yields have increased 25 to 30 percent.

Urban and Other Influences

There are two small villages in the watershed. The residents of these towns operate small businesses or have farms located nearby on which they depend for livelihood. Since there are few nearby industries to provide employment, most of the income is from agricultural resources; however, recent oil development is beginning to be a major source of income.

Since much of the area has never been cleared, the 70 miles of roads provide adequate access to all parts of the watershed. Frequent floods wash out road bridges, causing delays in travel and expense for replacements.

There are no railroads in the watershed. However, Palestine has adequate market and shipping facilities.

FLOOD PROBLEMS AND DAMAGES

The main stem of Lake Creek has flooded frequently, but little flood damage occurs because the flood plain is largely in woods. Approximately 2,600 acres of Trinity River bottomland has been protected from river overflows by a levee and is flooded only by Spring Creek and Sand Branch. Spring Creek has been diverted from this area, but high intensity rains occasionally break the Spring Creek levee and cause much damage. Sand Branch floods frequently and causes moderate annual damage. Because Spring Creek and Sand Branch are the only streams causing appreciable damage, flood control damages and benefits for the remainder of the watershed are not considered in this plan. During the period 1923 to 1942 inclusive, there was one flood which broke the Spring Creek levee and covered 939 acres of flood plain. There were also 105 smaller floods during this period.

FLOOD CONTROL ACTIVITIES

Approximately 30 years ago the Anderson County Levee Improvement District was organized and a levee constructed to protect 2,600 acres from Trinity River flood water. This levee has been maintained and is in good condition. At the same time a levee was built and channel cut to divert Spring Creek from this area. It has broken several times but has been enlarged during the maintenance process. Flood routing shows it to be adequate for all but one flood in the rainfall series used.

LAND TREATMENT ACTIVITIES

During the past four years seven small neighborhood groups, lying wholly or partially in the Lake Creek subwatershed, have been cooperating with the Anderson-Houston Soil Conservation District in the planning and application of land treatment measures on their lands.

HYDRAULIC AND HYDROLOGIC INVESTIGATIONS

From a graph showing cumulative departures from normal precipitation, the rainfall series for the period 1923 to 1942 inclusive was selected as most representative for the Lake Creek watershed. The November, 1940 rain of

11.21 inches was not considered except to determine the total flood plain area, since its expected frequency of occurrence was much greater than 20 years. The design storm would produce 3.40 inches of runoff from the watershed under present conditions. Runoff of this magnitude is not expected to occur more frequently than once in 25 years, and this value was used in determining floodwater detention storage requirements.

From a study of rainfall-runoff relationships for this watershed it was found that a rain of 0.95 inch, occurring within a one-day period, was the minimum which would cause flooding at the smallest channel section. Therefore, no rains of less than this amount were considered for flood routing purposes.

The largest rain considered, which occurred during the 20-year period, was one of 8.00 inches which produced 2.78 inches of runoff. Under present conditions 939 acres of the flood plain behind the Trinity levee would be flooded by the runoff from this storm. If such a rain were to occur after land treatment practices and measures have been applied, it is estimated that the area inundated would be reduced to 427 acres. With land treatment measures applied and the proposed detention structures in operation, flooding would be eliminated. Approximately 16 acres of flood plain would lie within the permanent pools of the proposed detention structures , and 9 acres within the detention pools.

The channel capacity of Spring Creek at Section No. 1 is 45 cubic feet per second, and that of Sand Branch at Section No. 4 is 160 cubic feet per second. An 8.00 inch rain would break the Spring Creek levee and thus result in both streams having a common flood plain. The peak discharge at Section 4 of Sand Branch for an 8.00 inch rain under present conditions was 9,300 cubic feet per second. The discharge would be reduced to 150 cubic feet per second by the proposed system of detention structures.

SEDIMENTATION CONDITIONS

Most of the areas which have suffered gully erosion of major consequence in the past are now completely or partially stabilized. There are no major gullies, although numerous small gullies of short length occur throughout the watershed. Sheet erosion is occurring at only slight to moderate intensities on most of the cultivated land, except for one small area of severe sheet erosion along the lower reaches of the Spring Creek levee. Even where more intensive sheet erosion has occurred, only small amounts of sediment reached the main creek channels. This is due to the coarse texture of the sediment which causes it to lodge at the base of the slopes. Flood plain scour damage is of minor importance in the Lake Creek watershed.

The principal sedimentation damages in Spring Creek and Sand Branch valleys include (1) overbank deposition on valley lands, and (2) channel filling.

Overbank Deposition

Modern overbank deposits have occurred at varying rates in the Spring Creek and Sand Branch valleys. The overbank deposits range from a few inches to seven feet in depth. Damage resulting from overbank deposits was estimated to be slight over most of the area.

No measurable damage to vegetation and cropland resulting from overbank deposition was observed on Spring Creek. However, it can be concluded that if the present rate of sediment output were to continue it would be necessary to increase the height of the present levee from time to time in order to maintain its present effectiveness.

Damaging deposition was found on 13 acres in the Sand Branch valley. This involved 10 acres of pasture land and 3 acres of cropland, with an estimated damage of 50 percent.

Channel Filling

Channel filling is occurring at an accelerated rate in both Spring Creek and Sand Branch valleys. Measurements show that Spring Creek and Sand Branch have lost 55 and 30 percent of their respective original capacities. The channel deposits consist chiefly of coarse sand bars.

Sediment Output Rates

Under present conditions it is estimated that the average rate of sediment output in the watershed ranges from 0.3 to 0.5 acre-foot per square mile of drainage area annually.

After upland land treatment measures and the proposed detention structures are installed the sediment output will be reduced as much as 50 percent.

FLOOD PLAIN SCOUR AND CHANNEL ENLARGEMENT

Scour damage is insignificant in the Lake Creek watershed. Only one small scour channel (150 feet long x 6 feet wide x 1 foot deep) was observed in a wooded section of the first bottom in Spring Creek valley. No scour channels were observed in the Sand Branch valley.

No significant bank erosion was found in the Spring Creek channel. The land destroyed by bank erosion along Sand Branch is estimated to be only 0.03 acre annually. Of the total area destroyed annually, .01 acre is pasture and .02 acre is woodland.

FLOOD DAMAGES

Flood damage information for all of the flood plain area of Spring Creek and Sand Branch was obtained from landowners or operators. Most of the specific information as to amounts and extent of damage related to the June, 1944 flood. Other information obtained included flood plain land

use, yields of major crops, property damages which would result from a major flood, and general flood problems. The monetary value of the percentage of damage to flood plain lands by sediment deposition and scour was determined on the basis of present prices. Damage to roads and bridges in the Spring Creek and Sand Branch flood plain area was negligible.

Damage rates as determined for the June, 1944 flood were used to indicate damage rates to be expected from floods of various sizes and seasons. These rates were multiplied by acreages covered by each flood, by size and season, in the evaluation series and adjustments made for recurrence of flooding. Flood plain areas lying within the pool limits of proposed detention structures were excluded from all damage calculations.

The total direct floodwater and sedimentation damages are estimated to average $5,910 annually under present conditions, of which $3,752 is crop and pasture damage. These figures are based on the entire flood plain area affected by Spring Creek and Sand Branch. After excluding the areas of flood plain which would be inundated by the proposed detention structures the average annual direct damage would be $5,686, of which $3,613 is crop and pasture damage. In addition there are indirect damages such as the interruption of travel, losses sustained by dealers and industries dependent upon agricultural products from or sales to residents of the flooded areas, depreciation in property values in the flooded areas, and similar items. Ten percent of the total annual value of the direct damages, $569, was taken as a conservative evaluation of the annual indirect flood damages. The average annual monetary flood damage is summarized in Table 1.

THE REMEDIAL PROGRAM AND ITS EVALUATION

Land Treatment Measures Needed

The major land treatment measure needed is the seeding of 8,562 acres of the following three types of areas: (1) idle land, (2) range land which has been so overgrazed that reseeding is necessary to establish adequate cover, and (3) areas now in cultivation on which a permanent grass cover needs to be established.

Approximately 115 miles of terraces need to be constructed to assist in the control of erosion on 2,300 acres of cultivated land. About 59 acres of vegetated waterways will be needed to carry the runoff water from these systems of terraces.

Other land treatment measures needed include 14 miles of diversion terraces; 40 farm ponds; 71 miles of fencing to inclose newly retired and reseeded areas; improved crop rotations on 4,000 acres of cropland; and 10,000 acres of improved range and pasture management.

The estimated total cost of installing these and other measures needed to expedite the application of land treatment is $311,958 and the annual cost, including installation and maintenance, is $12,069.

Flood Control Structures and Measures

The flood control structures and measures needed to provide agricultural flood protection are listed in Table 2, items 1 to 5 inclusive.

Two detention structures and 2.5 miles of floodwater diversions are needed to protect the flood plain lands on Spring Creek and Sand Branch. The proposed structures and their drainage areas are shown on the Work Plan Map. Descriptive information concerning the structures is summarized in Table 5.

The system of detention structures will detain the runoff from 83 percent of the drainage areas of Sand Branch and Spring Creek. Sufficient detention storage capacity can be developed at both proposed sites to permit the use of vegetated emergency spillways.

The one drop inlet structure listed in Table 2 is needed to control major gully erosion and thereby to protect the floodwater diversion from sedimentation. The floodwater diversion will carry the release flow from the detention structure on Sand Branch to a point below the Trinity River levee. This diversion is an integral part of the detention structure at Site 2. Without it the release from this structure would be impounded behind the Trinity levee when the river is in flood stage, thus causing as much damage as if the detention structure were not in place. As indicated, it will be necessary to raise or relocate portions of county roads which cross the pool areas of proposed detention structures.

Effect of These Measures on Damages and Benefits

The combined program of land treatment and flood control measures described above would prevent damage from all floods which occurred in the 20-year period from 1923 to 1942 inclusive.

Most of the expected reduction in annual flood damage would be effected by the system of detention structures and the floodwater diversions. The annual value of the reduction in flood damages attributable to these structures is estimated to be $3,329 out of the total of $6,255 from all measures, as shown in Table 1.

Owners and operators of flood plain lands say that if flood protection is provided they will intensify their use of these lands by growing high-value crops such as corn and vetch on areas now in woods or idle cropland, and improve the pasture lands by overseeding with clovers. It is estimated that this more intensive use would increase the net income from the land, after all expenses are deducted, by $10,556 annually.

The total flood control benefits, including both the reductions in flood damages and the benefits from more intensive use of the flood plain lands, are estimated to be $16,811 annually. In addition, it is estimated that the benefits to landowners and operators in upland areas of the watershed from application of land treatment measures would be $119,636 annually. The total expected benefit from the combined program would amount to $136,447 annually.

The expected benefits from land treatment were determined by estimating the increased net income to the land which would result from the application of the needed land treatment practices and measures. It was assumed that the proportion of the cropland used for each crop would not be changed, although the total area used for cropland would be decreased by the retirement of steep and severely eroded areas to pasture along with idle cropland. Likewise, it was assumed that there would be no change in the percentages of cattle used for dairying and beef production, although the total number of cattle would be increased materially because of the increased acreages of pasture and the greater per-acre hay production and pasture carrying capacity to be expected from the application of land treatment measures.

The estimated increase in annual net income is $85,512 from cropland and $34,124 from pasture; or, a total of $119,636 annually.

Comparison of Costs and Benefits

The ratio of the average annual benefit from detention structures, $13,885, to their average annual cost including the appurtenant structures for their protection, $3,442, is 4.03:1.

The ratio of the average annual benefit, $122,562, from the land treatment measures and practices to their average annual cost, $12,069, is 10.16:1.

The ratio of total average annual benefit, $136,447, to total average annual cost, $15,511, is 8.80:1. See Table 4.

ANNUAL MAINTENANCE

Estimated annual costs for maintenance after the land treatment measures and flood control structures have been installed are shown in Table 3.

It is expected that the flood control structures will be maintained by the benefited farmers under an agreement with the Soil Conservation District which carries the responsibility for maintenance. Group organizations of farmers will be developed for this purpose. The land treatment measures will be maintained by the landowners or operators of the farms on which the measures are installed.

Table 1

Summary of Average Annual Monetary Floodwater and Sediment Damage and Flood Control Benefit from the Recommended Program 1/

LAKE CREEK WATERSHED

Damages	Average Annual Damage			Average Annual Benefit		
	Under Present Conditions (dollars)	With Land Treatment Only (dollars)	With Land Treatment and Detention Storage (dollars)	From Land Treatment Only (dollars)	From Detention Storage Only (dollars)	Total Flood Control Benefits (dollars)
Floodwater Damage						
Crop and Pasture	3,613	1,900	0	1,713	1,900	3,613
Flood Plain Scour	50	35	0	15	35	50
Flood Plain Swamping 2/	1,200	684	0	516	684	1,200
Other Agricultural	753	367	0	386	367	753
Sub-Total	5,616	2,986	0	2,630	2,986	5,616
Sediment Damage						
Overbank Deposition	70	40	0	30	40	70
Sub-Total	70	40	0	30	40	70
Indirect Damage	569	303	0	266	303	569
Total Damage	6,255	3,329	0	xxx	xxx	xxx
Benefit from Reduction of Damage	xxx	xxx	xxx	2,926	3,329	6,255
Benefit from More Intensive Use of Flood Plain	xxx	xxx	xxx	xxx	10,556	10,556
Total Flood Control Benefit	xxx	xxx	xxx	2,926	13,885	16,811

1/ Areas to be inundated by proposed detention structures excluded.

2/ Swamping represents temporary ponding and is not a permanent damage to land.

Table 2
Cost Estimate Table
LAKE CREEK WATERSHED

Structure or Measure	Unit	No.	Cost			
			To Farmer	To Federal Funds	To State, County or Other	Total
Detention Structures	Each	2	$	$ 88,065	$	$ 88,065
Site Acquisition	Total			6,675		6,675
Drop Inlet	Each	1		2,647		2,647
Floodwater Diversions	Mile	2.5		10,300		10,300
Relocating Roads	Mile	$\frac{1}{4}$			600	600
Farm Waterways	Acre	50	3,750	1,250		5,000
Seeding Retired Areas	Acre	8,562	87,332	58,222		145,554
Group Collective Outlets	Acre	9		900		900
Earth Gully Plugs	C.Y.	533		133		133
Terracing	Mile	115	14,375			14,375
Farm Diversions	Mile	14	2,100			2,100
Farm Ponds	Each	40	18,000			18,000
Farm Fencing	Mile	71	28,400			28,400
Drop Inlets	Each	6		9,600		9,600
Drop Structures	Each	7		11,396		11,396
Farm and Ranch Planning and Application	Acre	51,000		76,500		76,500
Total			$153,957	$265,688	$600	$420,245
Estimated Amount to be Expended During 1951 Fiscal Year			$ 15,000	$130,000		$145,000

Table 3
Annual Costs
LAKE CREEK WATERSHED

Structure or Measure	Unit	No.	Annual Cost		
			Installation	Maintenance	Total
Detention Structures	Each	2	$ 2,611	$ 200	$ 2,811
Site Acquisition	Total		167		167
Drop Inlet	Each	1	66	25	91
Floodwater Diversions	Mile	2.5	258	100	358
Relocating Roads	Mile	$\frac{1}{4}$	15		15
Farm Waterways	Acre	50	181	200	381
Seeding Retired Areas	Acre	8,562	4,949		4,949
Group Collective Outlets	Acre	9	23	36	59
Earth Gully Plugs	Each	1	3	15	18
Terracing	Mile	115	575	1,150	1,725
Farm Diversions	Mile	14	84	112	196
Farm Ponds	Each	40	720	720	1,440
Farm Fencing	Mile	71	1,136	1,420	2,556
Drop Inlets	Each	6	240	150	390
Drop Structures	Each	7	285	70	355
Total			$11,313	$4,198	$15,511

Flood Control Structures and Measures		$ 3,442
Land Treatment Measures		12,069
Annual Maintenance to Farmer	$4,198	

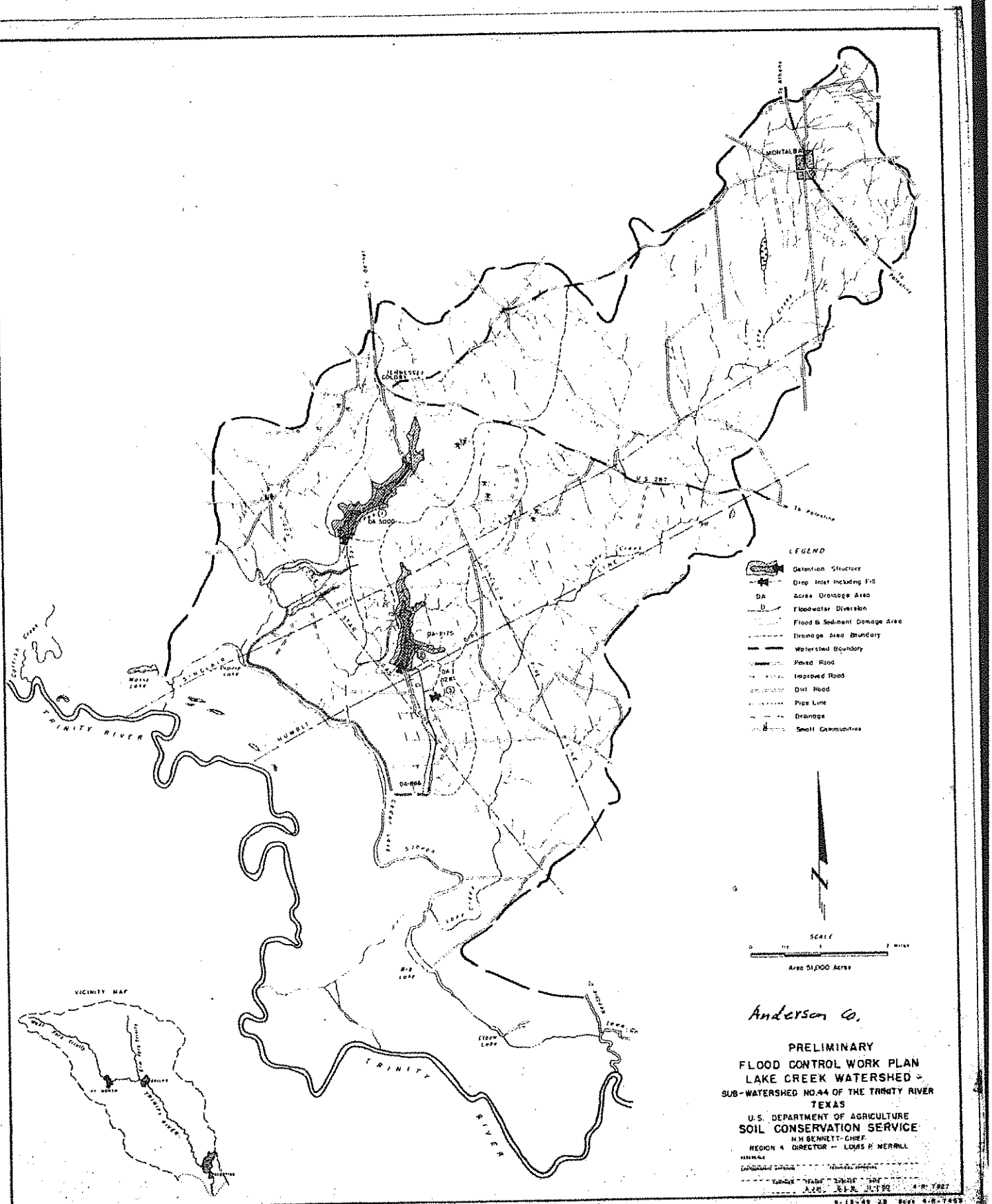
Table 4
Comparison of Average Annual Benefit and Cost of the Recommended Program
LAKE CREEK WATERSHED

Source of Benefit	Annual Cost	Annual Benefit	Benefit per Dollar of Cost
	(dollars)	(dollars)	(dollars)
Detention Storage	3,442	13,885	4.03
Land Treatment			
Flood Control	xxx	2,926	xxx
Land Treatment	xxx	119,636	xxx
Total	12,069	122,562	10.16
All Sources	15,511	136,447	8.80

Table 5
Detention Structure Data
LAKE CREEK WATERSHED

Site No.	Drainage Area Sq. Mi.	Storage Capacity Acre Feet Perm. Pool	Det. Pool	Total	Inches of Runoff Perm. Pool	Det. Pool	Total	Surface Area Acres Top of Perm. Pool	Top of Det. Pool	Max. Ht. of Dam Ft.	Flood Plain Inundated Perm. Pool Ac.	Det. Pool Ac.	Total Acres	Volume of Fill Cu. Yds.	Draw-down Rate cfs	Type of Spillway	Estimated Total Cost
1	7.8	695	2313	3008	1.7	5.5	7.2	86	206	30	3	7	10	91,800	39	Veg.	$41,310
2	3.4	435	1000	1435	2.4	4.4	6.8	47	106	28	6	9	15	103,900	17	"	46,755
Total	11.2	1130	3313	4443				133	312		9	16	25	195,700	56		$88,065 1/

1/ Construction Cost - $76,578
Technical Services - 11,487


LEGEND
Detention Structure
Drop Inlet Including Fill
DA Acres Drainage Area
D Floodwater Diversion
Flood & Sediment Damage Area
Drainage Area Boundary
Watershed Boundary
Paved Road
Improved Road
Dirt Road
Pipe Line
Drainage
Small Communities
N
SCALE
Area 51,000 Acres
VICINITY MAP
TRINITY RIVER
Anderson Co.
PRELIMINARY
FLOOD CONTROL WORK PLAN
LAKE CREEK WATERSHED
SUB-WATERSHED NO.44 OF THE TRINITY RIVER
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
H.H. BENNETT-CHIEF
REGION 4 DIRECTOR -- LOUIS P. MERRILL