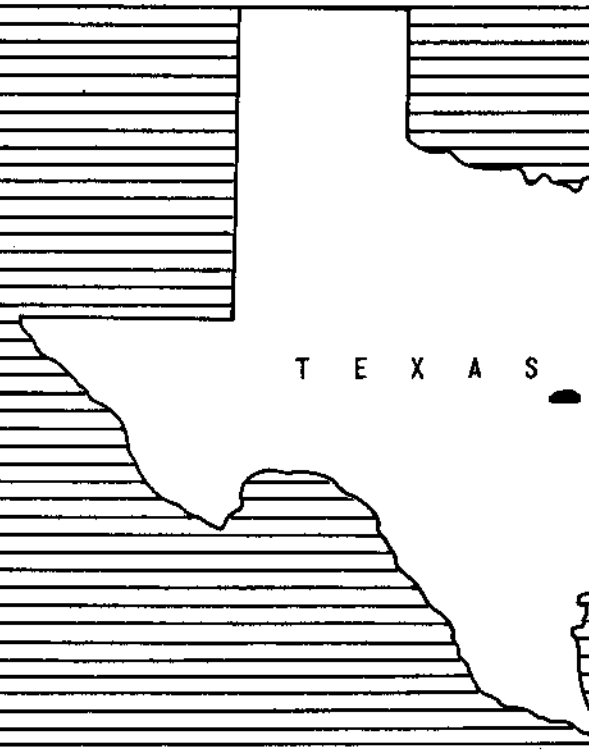
WORK PLAN

- FOR WATERSHED PROTECTION, FLOOD PREVENTION AND RECREATIONAL DEVELOPMENT

DONAHOE CREEK WATERSHED

BELL, WILLIAMSON, AND MILAM COUNTIES, TEXAS



September 1964

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WATERSHED WORK PLAN AGREEMENT

between the

Little River-San Gabriel Soil Conservation District
Local Organization

Donahoe Creek Watershed Authority
Local Organization

City of Bartlett
Local Organization

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

and the

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

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

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

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

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Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 5 years.

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

1. The Sponsoring Local Organizations will acquire all land, easements, and rights-of-way needed for installation of structural works of improvement (estimated cost $377,688). Cost sharing for land acquisition will be as follows:

Works of Improvement	Sponsoring Local Organizations (percent)	Service (percent)	Estimated Cost (dollars)
Multiple-Purpose Structure No. 4 and Basic Recreational Facilities			
Payments to landowners for 979 acres and cost of relocation or modification of improvements	50	50	182,583
Legal fees, survey costs, flowage easements, and other costs	100	0	2,940
9 Floodwater Retarding Structures (other than No. 4)	100	0	192,165

2. The Sponsoring Local Organizations will acquire water rights pursuant to State Law as may be needed in the installation and operation of the works of improvement. (Estimated cost $600).

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

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
1 Multiple-Purpose Structure	9.6	90.4	193,674
Basic Recreational Facilities	50.0	50.0	63,015
9 Floodwater Retarding Structures	0	100	804,670

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Multiple-Purpose Structure No. 4	0	100	37,685
Basic Recreational Facilities	50	50	14,974
9 Floodwater Retarding Structures	0	100	186,333

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 5,250 .)

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

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

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

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

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

11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. 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.

13. No member of 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.

Little River-San Gabriel Soil Conservation District
Local Organization

By G. E. Kretzschmar
G. E. Kretzschmar
Title Chairman

Date November 4, 1964

The signing of this agreement was authorized by a resolution of the governing body of the Little River-San Gabriel Soil Conservation District
Local Organization

adopted at a meeting held on November 4, 1964

James L. Terry
Acting (Secretary, Local Organization)
James L. Terry
Date November 4, 1964

Donahoe Creek Watershed Authority
Local Organization

By W. F. Blair
W. F. Blair

Title Chairman

Date November 4, 1964

The signing of this agreement was authorized by a resolution of the governing body of the Donahoe Creek Watershed Authority
Local Organization

adopted at a meeting held on November 4, 1964

R. E. Bunker
(Secretary, Local Organization)
R. E. Bunker

Date November 4, 1964

City of Bartlett
Local Organization

By T. A. Crittenden
T. A. Crittenden

Title Mayor

Date November 4, 1964

The signing of this agreement was authorized by a resolution of the governing body of the City of Bartlett
Local Organization

adopted at a meeting held on November 4, 1964

Cora Beckman
(Secretary, Local Organization)
Cora Beckman

Date November 4, 1964

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION AND RECREATIONAL DEVELOPMENT

DONAHOE CREEK WATERSHED
Bell, Williamson, and Milam Counties, Texas

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

Prepared By:

Little River-San Gabriel Soil Conservation District
(Sponsor)

Donahoe Creek Watershed Authority
(Sponsor)

City of Bartlett
(Sponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
September 1964

WATERSHED WORK PLAN

DONAHOE CREEK WATERSHED
Bell, Williamson, and Milam Counties, Texas
September 1964

SUMMARY OF PLAN

General Summary

The work plan for watershed protection, flood prevention, and recreational development for the Donahoe Creek watershed was prepared by the Little River-San Gabriel Soil Conservation District, the Donahoe Creek Watershed Authority, and the city of Bartlett as sponsoring local organizations. Technical assistance was provided by the Soil Conservation Service of the United States Department of Agriculture.

The objectives of the project are to provide proper land use and treatment in the interest of soil and water conservation, flood protection for the flood plain lands along Donahoe Creek and its tributaries, and additional water storage and basic facilities for public recreational development. The project as formulated meets these objectives. The sponsoring local organizations determined that no organized group was interested in including additional water storage for purposes other than recreation.

The principal problem in the watershed is one of frequent and extensive flooding on the 8,080 acres of flood plain lands along Donahoe Creek and its tributaries. Overflows average 4 per year on some portions of the flood plain and result in high damages to crops and to fences. Much land has been damaged by flood plain erosion and many farmers have been forced into a less profitable use of their flood plain lands.

There is a desire and need by the city of Bartlett for public recreational development. There is no present need for municipal water.

The watershed covers an area of 153.57 square miles, or 98,285 acres, in Bell, Williamson, and Milam Counties, Texas. Approximately 60 percent of the watershed is cropland, 35 percent is pasture, and 5 percent is in miscellaneous uses such as urban areas, roads, railroad rights-of-way, farmsteads, and stream channels.

There are no Federal lands in the watershed.

The work plan proposes installing, in a 5-year period, a project for the protection and development of the watershed at a total estimated installation cost of $2,127,327.

The share of the cost to be borne by Public Law 566 funds is $1,326,609.

The share to be borne by other than Public Law 566 funds is $764,718. In addition, the local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

Landowners and operators will establish land treatment which will help accomplish the project objectives. Primarily, this treatment will consist of measures, or combinations of measures, which contribute directly to watershed protection, flood prevention, and sediment control. Acres, by land use, to be treated during the 5-year project installation period, are listed in table 1.

The cost for land treatment measures is estimated to be $443,238 of which $414,864 will be borne by other than Public Law 566 funds. This amount includes expected reimbursements from Agricultural Conservation Program Service and $47,100 to be spent by the Soil Conservation Service for technical assistance under its going program during the project installation period. The Public Law 566 share, consisting entirely of accelerated technical assistance, is $28,374.

Structural Measures

The structural measures included in the plan consist of 9 floodwater retarding structures, 1 multiple-purpose structure for flood prevention and recreation, and basic recreational facilities. The 9 floodwater retarding structures have a total sediment storage and floodwater detention capacity of 20,302 acre-feet. The multiple-purpose structure has 7,963 acre-feet of sediment storage and floodwater detention capacity and 1,895 acre-feet for recreation. The total estimated cost of structural measures is $1,684,089 of which the local share is $349,854 and the Public Law 566 share is $1,362,609. The local share of the cost of structural measures consists of land, easements, and rights-of-way ($286,397), administering contracts ($5,250), construction ($50,120), installation services ($7,487), and water rights ($600).

The structural measures will be installed during a 5-year period.

Damage and Benefits

The reduction in floodwater, sediment, flood plain erosion, and indirect damages will directly benefit the owners and operators of about 130 farms in the watershed. In addition, the owners and operators of farms along the Little River immediately below Donahoe Creek will be benefited by the project.

The estimated average annual floodwater, sediment, erosion, and indirect damages, without a project, total $112,989 at long-term price levels.

With the proposed land treatment and structural measures installed, damages from these sources are estimated to be $27,015 a reduction of 76 percent.

The proposed recreational development will greatly increase the opportunity for water based recreation for an estimated 175,000 people living within a 40-mile radius. It is estimated that about 16,000 visitor days of use will be made of the proposed facilities annually.

The average annual primary benefits accruing to the structural measures are $103,382, which are distributed as follows:

Damage reduction benefits	$78,336
Benefits from recreational development	24,000
Benefits from recreation incidental to floodwater retarding structures	1,046

Net secondary benefits of $6,635 will result from the project.

The ratio of the total annual project benefits ($110,017) to the average annual cost of all structural measures ($60,876) is 1.8:1.

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

Provisions for Financing Local Share of Installation Cost

The Donahoe Creek Watershed Authority has powers of taxation and eminent domain under applicable State laws. A special district tax has been voted for the purpose of securing bond funds in the amount of $75,000 to finance the local share of installation costs of works of improvement for flood control. Revenue from the sale of these bonds is available and will be adequate for financing the local share of the installation costs of the 9 floodwater retarding structures.

The city of Bartlett will provide the local share of funds necessary for installation of the multiple-purpose structure and basic recreational facilities.

Operation and Maintenance

Land treatment measures for watershed protection will be operated and maintained by landowners or operators of the farms on which the measures will be installed under agreement with the Little River-San Gabriel Soil Conservation District.

The Donahoe Creek Watershed Authority will be responsible for the operation and maintenance of the 9 floodwater retarding structures and the multiple

purpose structure. Adequate revenue is presently being collected from a special district tax which has been voted for this purpose. The estimated average annual cost of operation and maintenance for the 9 floodwater retarding structures and the multiple-purpose structure is $2,050.

The city of Bartlett will be responsible for the operation and maintenance of the basic recreational facilities at an estimated average annual cost of $5,525.

DESCRIPTION OF WATERSHED

Physical Data

The watershed of Donahoe Creek is very narrow and lies within portions of Bell, Williamson, and Milam Counties, Texas. Donahoe Creek originates at the community of Jarrell in northern Williamson County, flows generally eastward, crosses the southeastern corner of Bell County, and enters the Little River in western Milam County. The distance of flow of this meandering stream, from head to mouth, is approximately 50 miles.

The lower 14 miles of the present Donahoe Creek channel is an old Little River channel which was abandoned as the river changed its course. Major tributaries are Long Branch, Indian Creek, Flag Branch, and Clays Creek. The watershed has a drainage area of 153.57 square miles, or 98,285 acres.

The topography of the watershed is closely related to the outcropping geologic strata. Upper Cretaceous formations of the Austin, Taylor, and Navarro groups underlie the watershed, but large portions of the Taylor and Navarro are covered by Tertiary and Quaternary terrace deposits. Gentle to steeply rolling topography is developed on the chalky and shaly limestones of the Austin formation which occupies the upper 15 percent of the watershed.

Nearly level to gently rolling topography is developed over most of the watershed on shales of the Taylor formation and on fine textured terrace deposits. Steep slopes have developed in these shales where partially cemented sandy and gravelly terrace remnants serve as a protective cap.

Nearly level topography exists on the flood plain, including the area of deep fertile alluvium in the lower portion of the watershed where Donahoe Creek and Little River share a common flood plain. The width of the flood plain ranges from 200 feet in the upper reaches to 7,800 feet in the lower reaches.

Elevations range from approximately 880 feet above mean sea level along the western watershed divide to 360 feet on the common flood plain of Donahoe Creek and the Little River.

Approximately 90 percent of the watershed is within the Blackland Prairies Land Resource Area. The remaining 10 percent, where coarse textured terrace deposits cover the surface, is classified as the East Texas Timberlands Land Resource Area.

The soil series within the Blackland Prairies portion of the watershed are Houston, Houston Black, Austin, Eddy, Wilson, Lewisville, Patrick, Knippa, Sumter, Frio, and Trinity. These are fine textured soils which range from very shallow to deep and from very slowly to moderately permeable. The soil series of the East Texas Timberlands Land Resource Area within the watershed are Axtell, Travis, and Milam. These are deep, medium textured soils which range from very slowly to moderately permeable.

The land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	58,971	60.0
Pasture 1/	34,653	35.3
Miscellaneous 2/	4,661	4.7
Total	98,285	100.0

1/ Includes wooded pasture.
2/ Includes roads, highways, railroad rights-of-way, towns, farmsteads, stream channels, etc.

The principal cultivated crops are cotton, grain sorghum, and corn which produce little effective hydrologic cover. Most of the pastureland in the fine textured soils has fair hydrologic cover. Much of the pastureland in the sandy soils was formerly cultivated and has poor grass cover. Upland wooded pastures are limited to the sandy areas and are characterized by a light to moderate canopy of post oak and various other oak species.

The climate is warm and sub-humid. Mean monthly temperatures range from 85 degrees Fahrenheit in July to 47 degrees in January. The normal growing season, extending from March 10 to November 22, is 257 days. The average annual rainfall is 34 inches. Rainfall is generally well distributed throughout the year, with the heaviest occurring during spring and fall months. Individual rains of excessive amounts fall at irregular intervals during the year and cause serious erosion and flood damage.

Water for livestock and rural domestic use is supplied mostly by shallow wells and surface ponds. Intermittent springs in the Austin limestone and at the base of coarse textured terrace deposits provide prolonged low flow in Donahoe Creek and some of its larger tributaries. During periods of prolonged drought, the supply from these sources is unreliable. The town of Barlett obtains its water from deep wells. The water producing sands are near the base of the Cretaceous system in the Trinity group.

Economic Data

The economy of the watershed is dependent almost entirely on its agricultural production. Production and sale of cash crops and livestock is the primary source of farm income. The most important crops produced for direct sale are cotton, grain sorghum, and corn. These crops account for nearly 60 percent of the total sales of agricultural products produced in the watershed. Oats and forage sorghums are grown primarily in support of livestock enterprices. Production and sale of livestock has increased steadily throughout the watershed in recent years. Considerable acreage of the less productive upland has been converted to improved pasture, primarily because of unfavorable cost-price relationships of cash crops and a shortage of farm labor. In the flood plain, above the old Little-River channel, large acreages of cropland have been converted to grassland because of floodwater and erosion damages. It is anticipated that the trend of increasing livestock production will continue in the uplands of the watershed.

The average size farm in the watershed is approximately 160 acres. This reflects a significant increase in recent years. The average size farm in the three counties in which the watershed is located increased from 180 acres in 1950 to about 240 acres in 1959. However, the increase in size of farms in the watershed has not been as pronounced as in the surrounding area. The majority of the farms are owner operated, with about 55 percent of the units fully owned by the operator and another 25 percent partly owned and partly rented.

The average value of land and buildings per farm is estimated at about $21,100 (1959 agricultural census). The estimated current value of flood plain land is $150 to $350 per acre. Upland ranges from $100 to $200 per acre.

Bartlett, population 1,650, is the largest town in the watershed. While the population has remained relatively stable over the past 20 years, its economy has shown a gradual but steady growth. It is primarily an agricultural community and is the principal marketing and supply center for most of the watershed area. This trade center provides excellent facilities for cotton ginning, grain storage, and shipping. In addition, it provides adequate supply facilities for all agricultural enterprises in its trade area. Jarrell, population 410, is located at the headwaters of Donahoe Creek and is partially in the watershed. Other rural communities in the watershed are Davilla and Schwertner. Taylor, population 10,000, is located 15 miles south of the center of the watershed and Temple, population 32,600, is located 22 miles north of the watershed. Both of these towns provide excellent marketing and supply facilities for the area.

The watershed is served adequately by approximately 180 miles of Federal, State, and County roads, of which 58 miles are hard surfaced. Adequate rail facilities are provided at Bartlett.

Land Treatment Data

The Soil Conservation Service work unit at Bartlett is assisting the Little River-San Gabriel Soil Conservation District. There are 604 operating units in the watershed. The work unit has assisted Soil Conservation District cooperators in preparing 454 basic soil and water conservation plans and has given technical assistance in establishing and maintaining planned measures. Current revision is needed on 100 conservation plans. Satisfactory soil surveys have been made on 53,940 acres. Standard soil surveys are still needed on 44,345 acres.

Approximately 50 percent of the needed land treatment practices for the 93,624 acres of agricultural land have been applied. It is estimated that more than 65 percent of the watershed will be adequately treated within the next 5 years as a result of the planned accelerated land treatment program.

WATERSHED PROBLEMS

Floodwater Damage

An estimated 8,080 acres of the watershed, excluding stream channels, is flood plain (figure 1). As described herein, the flood plain is the area that will be inundated by the largest storm considered in the 28-year series used for evaluation. The runoff from this storm approximates a 33 year frequency of recurrence. Land use in the flood plain is 51 percent cropland, 47 percent pasture, and 2 percent miscellaneous.

Flooding from Donahoe Creek and its tributaries occurs frequently and causes severe damage to growing crops and other agricultural properties. Flood plain erosion has caused much of the flood plain of Donahoe Creek to be converted from cash crops to grass and temporary grazing crops which produce lower income. In the past the Little River also has flooded frequently the common flood plain of Donahoe Creek and the Little River. From 1921 until Belton Reservoir was constructed in 1954 on the Leon River, this common flood plain was flooded from both Donahoe Creek and Little River so frequently that little of it was used for crop production. Belton Reservoir reduced this flood hazard appreciably and since 1954 development of this area has been rapid. The completion of Stillhouse Hollow Reservoir, now under construction on the Lampasas River, will virtually eliminate Little River flooding of this common flood plain from all but extremely large storm events. Donahoe Creek, which has caused flooding much more frequently than the Little River, will remain as the primary cause of flooding and flood damage.

The largest floods of recent years occurred in October 1953 and in May 1957. These floods inundated the entire flood plain. The 1953 flood did little crop damage, but most of the cultivated land was bedded, and erosion of the flood plain land was very severe. Deposition of damaging sediment was extensive. The 1957 flood caused extensive loss of growing crops. Replanted

crops failed to produce good yields due to the lateness in the season. In addition to crop losses, sediment and erosion damages were extremely severe. Based on information obtained from landowners and operators, more than 65 miles of fence was destroyed. Damage to roads, bridges, and other nonagricultural property was in excess of $9,500.

During the 28-year period studied, 1925 through 1952, a period considered to be representative of normal rainfall in the area, there were 26 major floods that inundated more than half of the flood plain, as well as 88 minor floods that inundated less than half the flood plain. Nineteen of the 26 major floods and 72 of the minor floods occurred during the spring, summer, or early fall months when most of the crops were highly susceptible to damage. Cumulative totals of recurrent flooding indicate an average annual flooding of 7,628 acres during the period studied.

Based on the floods experienced during the period studied, the total direct floodwater damage is estimated to average $88,801 annually at long-term price levels (table 5). Of this amount, $53,929 is crop and pasture damage; $30,931 is other agricultural damage; and $3,941 is nonagricultural damage to roads and bridges.

Indirect damages such as interruption of travel, re-routing of school bus and mail routes, losses sustained by businesses in the area, and similar losses are estimated to average $9,788 annually.

This windmill was destroyed when it was washed away by floodwater and carried one-fourth mile down Indian Creek, a tributary of Donahoe Creek.

4-15909 8-84

Crop loss and sediment damage to flood plain of Donahoe Creek. Field had been planted to cotton prior to flood.

Sediment Damage

Sediment damage is moderate in the watershed. The most damaging sediment consists of silty sand and sandy gravel which originate on Tertiary terrace deposits in the lower portion of the watershed. This coarse textured sediment tends to be deposited at the base of steep slopes as colluvium or in stream channels and is subject to movement as bedload. Most of the fine textured sediments are transported farther downstream causing slight aggradation in the lower reach of Donahoe Creek. An estimated 262 acres have been damaged by overbank deposits of silty, sandy, and gravelly clay, silty sand, and sandy gravel. The deposition ranges from one-half to three feet deep and has reduced the productive capacity of flood plain soils as follows: 169 acres, 10 percent; 59 acres, 20 percent; and 34 acres, 30 percent. The average annual monetary value of this damage is estimated to be $1,580 at long-term price levels (table 5). There are additional areas where shallow deposition of clay is practically identical to the underlying soil. Slight to no loss of productive capacity results from this type of deposition.

Sheet erosion and flood plain scour are sources of the great majority of sediment volume produced in the watershed. Although streambank and gully erosion account for a very minor portion of the total average annual erosion, the high content of infertile material in sediment derived from these sources makes them significant contributors of sediment damage to flood plain lands.

About 22 percent of the average annual erosion in Donahoe Creek watershed is added to the sediment load of the Little River. The estimated average annual sediment yield at the mouth of the watershed is 150 acre-feet. This is equivalent to an average annual sediment production rate of 0.97 acre-foot per square mile.

Erosion Damage

The estimated average annual rate of gross erosion is 4.45 acre-feet per square mile. Of this, sheet erosion accounts for 78 percent, streambank and gully erosion 3 percent, and flood plain scour 19 percent. At present, the most rapid rate of erosion is sheet erosion of rolling cropland on the outcrop of the Austin chalky limestone. The installation of terraces, use of close growing and winter cover crops, and the planting of temporary pastures have been effective in reducing erosion on cropland.

Flood plain erosion is moderate to severe. The damaged areas range from broad sheet scour depressions to narrow channels 2 to 10 feet deep. It is estimated that the productive capacity of 2,002 acres has been reduced from 10 to 70 percent by scour. The following tabulation shows flood plain erosion damage by evaluation reaches:

Area Damaged by Flood Plain Scour

Evaluation Reach (Figure 1)	Percent Damage							Total
	10	20	30	40	50	60	70	
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
A	594	212	32	0	0	0	0	838
B	19	16	14	12	0	0	0	61
C	235	280	50	6	0	0	2	573
D	4	21	11	0	0	0	0	36
E	67	14	53	4	6	14	0	158
F	18	12	0	3	0	0	0	33
G	111	12	27	21	0	1	0	172
H	60	38	30	0	3	0	0	131
Total	1,108	605	217	46	9	15	2	2,002

The average annual monetary value of this damage is estimated to be $12,820 at long-term price levels (table 5).

Streambank erosion is not a serious problem. It is significant only on sharp bends in the lower reaches where Donahoe Creek has a low gradient and a pronounced meandering pattern.

Problems Relating to Water Management

There is no need for drainage, and irrigation is of minor importance in the watershed. There is no known local interest in providing additional storage in any of the reservoirs for municipal or industrial water supply. There is a strong desire on the part of the local people, however, for water-based recreational development. There are 27 towns and a total urban and rural population of 105,000 within a 25 mile radius of the proposed development. There are 175,000 people living within a radius of 40 miles.

At present, Belton Reservoir, located about 20 miles northwest of Bartlett, provides recreation for residents of this watershed and surrounding towns. Another reservoir, Stillhouse Hollow, located about 15 miles west of Bartlett, is under construction at the present time. The existing facilities are often crowded and inadequate during the summer season. A development is needed in this watershed to make adequate water-based recreation more readily available to residents of the watershed and the surrounding area. A development of this size will complement rather than compete with larger reservoirs.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed water resource development projects of any other agency within the watershed.

Belton Reservoir, located on the Leon River, was constructed by the Corps of Engineers. Stillhouse Hollow Reservoir, located on the Lampasas River, is under construction by the Corps of Engineers. These projects will provide flood protection to the common bottom of Donahoe Creek and the Little River from those floods originating upstream from Donahoe Creek.

The works of improvement included in this plan will have no known detrimental effects on any existing or proposed downstream works of improvement.

BASIS FOR PROJECT FORMULATION

An initial study was made by representatives of the Soil Conservation Service and sponsoring local organizations to determine watershed problems and possible solutions.

Meetings were held with the sponsoring local organizations to discuss existing flood problems, water resource development needs, and to formulate project objectives. Watershed protection, flood prevention, and recreational development were the desired objectives to be considered.

The following specific objectives were agreed to:

1. Establish land treatment measures which contribute directly to watershed protection and flood prevention.

2. Attain a reduction of at least 75 percent in average annual flood damages.

3. Include water storage in a multiple-purpose structure and basic recreational facilities for a public recreational development.

In selecting sites for floodwater retarding structures, consideration was given to locations which would provide the agreed upon level of protection to areas subject to damage. The size, number, design, and cost of the structures were influenced by the physical, topographic, and geologic conditions in the watershed. The recommended system of structural measures meets the project objectives at least cost in providing the desired level of protection to agricultural flood plain lands and satisfying the recreational needs.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Little River-San Gabriel Soil Conservation District is assisting farmers of the watershed in the planning and application of basic soil and water conservation plans on their land. The application of measures in these plans, which are based upon the use of each acre within its capabilities and treatment in accordance with its needs, is an essential part of watershed protection. The extent of needed land treatment measures which have been applied to date within the watershed represents an estimated expenditure by landowners and operators of $759,310 including reimbursements from ACPS (table 1A).

The accelerated application and continued maintenance of land treatment measures is particularly important for protection of the 42,861 acres which comprise the drainage areas above planned structural measures. The land treatment measures will reduce the capacity required for sediment accumulation in planned structural measures. They also will reduce the rate of runoff into the floodwater retarding structures. About 46,922 acres of upland below the planned structures contribute sediment and runoff to the flood plain areas. Land treatment measures on these lands will further reduce floodwater and sediment damages on 7,718 acres of flood plain.

Table 1 includes estimates of the acreage in each major land use which will receive accelerated land treatment during the 5-year project installation period. These measures will be established and maintained by landowners and operators in cooperation with the local soil conservation district.

PHOTO COURTESY PEGGY HOLT, HARTLETT, TEXAS

Terraces, contour farming and crop residue use in keeping with a conservation cropping system for soil conditioning and protection from erosion.

Utilizing plant residues left in cultivated field for conditioning and protection of the soil.

P-1930F P-6E

Terraces outletting into grassed waterway. These measures slow runoff from fields and reduce erosion damage and sediment production.

In addition to the technical assistance presently available, $25,910 will be made available from P. L. 566 funds to accelerate the establishment of these practices and measures. An additional $2,464 from P. L. 566 funds will be provided to complete standard soil surveys at an early date.

There is a trend toward conversion of small fields of rolling, eroded cropland to hay or pasture use. Most of the cropland in the watershed has a high productive capability and in recent years the trend has been toward better management and fertilization to increase cover and residues. Also, the use of small grains is increasing slightly.

About 10,592 acres of cultivated land will be treated with a combination of measures in keeping with a conservation cropping system for soil conditioning and protection from sheet erosion in the upland and from scour in the flood plain. The conservation cropping systems in this watershed includes high residue or cover crops, crop residue use, and contour farming. About 30 percent of this area will be terraced and provided with grassed waterways to control erosion and retard runoff from the more rolling areas.

Proper use will be practiced on 7,336 acres of pastureland. About 6,039 acres will be cleared of scattered trees and brush and will be protected for use as pasture. About 1,458 acres will be renovated and pasture planting will be applied on about 1,215 acres to attain a good base grass cover. The destruction of cover caused by over-use around present watering places will be reduced by establishing 27 farm ponds.

The installation of all land treatment measures will reduce average annual erosion by about 26 percent and increase infiltration of rainfall as a result of improved ground cover in cultivated areas and increased grass density and vigor in pastured areas. Terraces and waterways will have a measurable effect in slowing the runoff from cultivated fields and in reducing erosion damage and sediment production.

Structural Measures

A system of 9 single purpose floodwater retarding structures and 1 multiple-purpose structure with associated basic recreational facilities will be installed to afford the needed protection to flood plain lands which cannot be provided by land treatment measures alone and to provide water-based recreation for residents of the watershed and the surrounding area. The installation cost of these structural measures is $1,684,089.

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

The location of structural measures is shown on the Project Map (figure 6).

The capacity of the 9 floodwater retarding structures and the multiple-purpose structure total 30,160 acre-feet. Of this total, 10,595 acre-feet is provided for sediment accumulation over a 100-year period, 1,895 acre-feet for recreational development, and 17,670 acre-feet for floodwater detention. Runoff from 44 percent of the watershed will be retarded. This is an average of 4.95 inches from the area upstream from the structures. The capacity equivalents for each structure is shown in table 3.

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

All applicable State water laws will be complied with in design and construction of the planned structural measures.

Refer to tables 1, 2, and 3 for details on quantities, costs, and design features of the structural measures.

Basic facilities for recreational use will be installed at selected locations adjacent to multiple-purpose site No. 4. They will include access roads, parking areas, boat facilities, water supply, beach development, sanitary facilities, and picnicking and camping facilities. Figure 5 shows the locations of these facilities. The estimated total installation cost of recreational facilities is $83,518.

Minimum basic facilities will consist of the following items:

Item	Unit	Number
1. Roads		
Access Roads	Mile	2.29
Shore Trail	Mile	0.43
Cattle Guard	Each	1
2. Parking Areas		
Rock Base with Gravel	Sq.Ft.	36,000
Traffic Guard Barriers	Lin.Ft.	1,275
Parking Spurs	Each	10
3. Water Supply		
Pump-with motor, pressure tank, chlorinator, and pump house	Each	1
Water distribution	Foot	4,000
4. Electrical and Lighting Units	Each	5
5. Beach Development	Acres	2
6. Boat Facilities		
Boat Dock - 4 stall	Each	1
Concrete Boat Launch Ramp	Each	3
Gravel Area of Boat Launch Site	Each	3
7. Sanitary Facilities		
Rest Rooms with fixtures	Each	2
Pit Toilets	Each	6
8. Picnic Facilities		
Concrete Tables and Benches	Each	45
Bar-B-Cue Grills	Each	29
Concrete Pads for Trash Receptacles	Each	22
Incinerator	Each	1

Item	Unit	Number
9. Fencing	Foot	41,960
10. Vegetation		
Vegetative Planting	Acre	8
Trees	Each	100
11. Signs and Markers	Each	20

The multiple-purpose site contains a total of 1,041 acres. Water surface of the recreation pool is 480 acres. The basic recreational facilities will occupy a total of 27 acres. In addition, 429 acres will be available for public use for recreation as water level permits. A total of 105 acres, including the dam and spillway area and portions of the detention pool upstream from the recreation pool, will not be available for recreation.

EXPLANATION OF INSTALLATION COSTS

Public Law 566 funds, in the amount of $28,374 for technical assistance during the 5-year installation period, will be provided to accelerate the application of the planned land treatment for watershed protection. This amount includes $2,464 for completion of standard soil surveys. These Public Law 566 funds will be in addition to $47,100 of Public Law 46 funds provided under the going program. Local interests will apply the planned land treatment at an estimated cost of $367,764, which includes reimbursements from Agricultural Conservation Program funds based on present program criteria (table 1). The costs are based on present prices being paid by landowners or operators to establish the individual measures in the area. The land treatment necessary to reach treatment goals and the unit cost of each measure were estimated by the Little River-San Gabriel Soil Conservation District.

The required local cost for the 9 floodwater retarding structures, consisting of the value of land easements ($174,175); change in utilities($8,860); improvements ($2,500); cemeteries ($4,500); legal fees ($2,180); and administration of contracts ($4,500) is estimated at $196,665. The Board of Directors of the Donahoe Creek Watershed Authority provided estimates of these costs.

The entire construction cost for floodwater retarding structures, amounting to $804,870, will be borne by Public Law 566 funds. In addition, the installation services cost of $186,333 will be a Public Law 566 cost. This is a total Public Law 566 cost of $991,203 for installation of the 9 floodwater retarding structures.

Construction costs include the engineer's estimate and contingencies. The engineer's estimates were based on the unit costs of floodwater retarding structures in similar areas modified by special conditions inherent to each individual site location. They include such items as permeable foundation conditions, rock excavation, and site preparation. Geologic investigations consisted of surface observations, hand auger and core drill borings, and field permeability tests. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs.

Installation services include engineering and administrative costs. These estimates were based on analysis of previous work in similar areas.

Construction costs, installation services costs, and cost of administering contracts for multiple-purpose structure No. 4, were allocated according to the Use of Facilities Method, as follows:

Purpose	Acre-Feet	Percent
Flood Prevention	7,963 1/	80.78
Recreation	1,895	19.22
Total	9,858	100.00

1/ Includes 2,968 acre-feet of sediment storage.

All costs of legal fees, land, easements, and modification of existing improvements were allocated to recreation as a specific cost.

Cost of minimum basic facilities and associated land was allocated to recreation as a specific cost.

Total costs for multiple-purpose structure No. 4 and basic recreational facilities are estimated at $496,221, of which Public Law 566 funds will share in the amount of $343,032 and other funds $153,189.

Public Law 566 funds will not bear any of the costs of administering contracts, legal fees, and engineering services needed to obtain land, easements, or rights-of-way.

Public Law 566 funds will bear the construction cost allocated to flood prevention, 50 percent of that allocated to recreation, all of the installation services cost of the multiple purpose structure, and 50 percent of the land costs and cost of relocation and modification of existing improvements.

Public Law 566 funds will bear 50 percent of the cost of minimum basic recreational facilities and associated land, excluding legal fees (table 2).

The Public Law 566 share of land, easements, and rights-of-way will be based on actual payments made by the sponsors or the fair market value

as jointly determined by the sponsors and the Soil Conservation Service, whichever is the lesser.

A summary of cost allocation and cost sharing by project purpose is shown in table 2A.

The estimated schedule of obligations for the 5-year installation period, covering installation of land treatment, floodwater retarding structures, multiple-purpose structure, and minimum basic recreation facilities, is as follows:

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
1st	Multiple-Purpose Structure No. 4	301,649	111,054	412,703
	Basic Recreational Facilities	41,383	42,135	83,518
	Floodwater Retarding Structure No. 1	218,436	55,200	273,636
	Land Treatment	7,646	82,973	90,619
2nd	Floodwater Retarding Structures Nos. 2 and 3	234,742	70,825	305,567
	Land Treatment	5,182	82,973	88,155
3rd	Floodwater Retarding Structures Nos. 5 and 6	237,634	42,690	280,324
	Land Treatment	5,182	82,973	88,155
4th	Floodwater Retarding Structures Nos. 7 and 8	159,183	16,325	175,508
	Land Treatment	5,182	82,973	88,155
5th	Floodwater Retarding Structures Nos. 9 and 10	141,208	11,625	152,833
	Land Treatment	5,182	82,972	88,154
	Total	1,362,609	764,718	2,127,327

This schedule may be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desirable and in the light of appropriations and accomplishments actually made.

EFFECTS OF WORKS OF IMPROVEMENT

This project will directly benefit the owners and operators of approximately 130 farms in the watershed. In addition, the owners and operators of the farms along the Little River immediately below Donahoe Creek, will be

benefited by the project. This benefit will result from a reduction in flooding caused by large concurrent flows of the Little River and Donahoe Creek.

The combined program of land treatment and structural measures will prevent flood damage to the flood plain below the proposed floodwater retarding structures from 40 of the 114 floods such as occurred in the watershed from 1925 through 1952. Flooding would be reduced to less than 100 acres, with all remaining flooding less than one foot in depth from each of 39 of the remaining floods. Of the 26 major floods that inundated more than half of the total flood plain, 22 would be reduced to minor floods each inundating less than half the flood plain. Average annual flooding in the watershed would be reduced from 7,628 acres to 2,477 acres, a reduction of 67.5 percent. This includes the flooding on the flood plain of Clays Creek for which no structural measures are planned.

Under present conditions 7,718 acres of flood plain, excluding stream channels and pool areas of the planned structural measures, have been inundated by runoff from the largest storm considered during the 28-year period, 1925-1952. It is estimated that the area inundated by a similar flood would be reduced to 5,287 acres following the installation of the planned project.

Reduction in area inundated varies with respect to location within the watershed. The general locations and reductions in inundations are shown in the following tabulations:

Average Annual Area Inundated 1/

Evaluation Reach (Figure 1)	General Location	Without Project (acres)	With Project (acres)	Reduction (percent)
A	Common Bottom	2,132	601	71.8
B	Clays Creek	437	410 2/	6.2
C	Common Bottom to Flag Branch	2,116	707	66.6
D	Flag Branch	390	10	97.4
E	Flag Branch to Indian Creek	1,162	367	68.4
F	Indian Creek	175	6	96.6
G	Indian Creek to Long Branch	853	295	65.4
H	Donahoe Creek Above Long Branch	363	81	77.7
	Total	7,628	2,477	67.5

1/ Exclusive of area of flood plain inundated by pools of structures.

2/ No structural control is planned on Clays Creek.

Area Inundated 1/

Evaluation Reach (Figure 1)	Average Recurrence Interval: 2-Year Without Project (acres)	2-Year With Project (acres)	5-Year Without Project (acres)	5-Year With Project (acres)	10-Year Without Project (acres)	10-Year With Project (acres)	25-Year Without Project (acres)	25-Year With Project (acres)
A	1,440	0	2,270	930	2,690	1,435	3,092	1,950
B	189	184	230	228	245	243	262	259
C	1,430	275	1,665	812	1,775	1,282	1,840	1,506
D	200	1	233	11	255	23	262	39
E	668	176	764	455	802	582	840	670
F	74	0	79	10	84	17	94	28
G	400	188	486	218	528	258	576	402
H	160	39	324	84	406	127	564	191
Total	4,561	863	6,051	2,748	6,785	3,967	7,530	5,045

1/ Exclusive of area of flood plain inundated by pools of structures.

The average annual volume of damaging sediment deposited upon flood plain lands is expected to be reduced an estimated 87 percent. About 17 percent of this reduction will result from the installation of planned land treatment.

Average annual flood plain erosion is expected to be reduced an estimated 81 percent. About 10 percent of this reduction will result from the installation of planned land treatment measures.

Planned land treatment will reduce the average annual gross erosion from 686 acre-feet to 508 acre-feet per year. Sediment transported from the watershed will be reduced from 150 to 64 acre-feet annually as a result of the combined program of land treatment and structural measures.

Present owners and operators of flood plain land say that if adequate flood protection is provided, particularly through a reduction of flood plain scour, they will restore land now idle or in low value production, such as unimproved pasture, to production of higher value crops. It is conservatively estimated that after the project is installed, 401 acres of flood plain land will be restored to a higher value use. All of this land was in production of high value crops until recent years but is now either idle or in low value production because of excessive flood damage. It is not anticipated that any flood plain lands that have never been in crop production will be converted as a result of project installation.

Shifts in upland land use will reduce the total acreage of cropland in the watershed by about 1,800 acres during the project installation period. The acreage of cotton will be reduced about 550 acres and corn about 400 acres. Decreases in cropland result from conversions in the pool areas of the

floodwater retarding structures, the area devoted to recreational use in the multiple-purpose structure, and from conversions of cropland to grassland and grassed waterways as a result of the planned accelerated land treatment program.

Some loss of wildlife habitat will result from the clearing of sediment pools at a limited number of sites, but all sites will offer opportunities for fish production. Floodwater detention pool areas will be more favorable than adverse to wildlife. Wildlife use in the flood plain areas will be improved by reduction of frequency, depth, and duration of flooding.

The 480-acre recreational pool of the multiple-purpose structure and its accompanying recreational area and facilities will provide a needed water-based public recreational development for the 175,000 inhabitants within a 40-mile radius. Recreational activities such as fishing, boating, water skiing, swimming, camping, and picnicking will be enjoyed by an estimated 6,000 people annually. The most intensive use will be during the period of May through September. Average use on peak days for the weekends is expected to be about 200 persons.

Additional recreational benefits will result from the installation of the floodwater retarding structures included in this plan. The sediment pools of these structures are very satisfactory for recreational use and cover 329 surface acres at the 50-year sediment storage level or 200 acre-feet capacity, whichever is less. Judging from experience to date on similar watersheds and in the opinion of the sponsors the pools will be open to the public either on a free or fee use basis. It is believed that these pool areas will be utilized primarily for fishing and hunting and that development of recreational facilities will be limited. It is estimated that these pools will attract at least 3,425 visitors annually.

Benefits from the project will result from reduction of floodwater damages on the flood plain of the Little River immediately below its confluence with Donahoe Creek. These damage reduction benefits will be minor in amount and will occur only from those storms that concurrently produce a large volume of runoff from both Donahoe Creek and the uncontrolled portion of the Little River watershed. No monetary evaluation was made of these benefits.

Secondary benefits, including increased business activities and improved economic conditions in the surrounding communities, will result from the installation of the complete project. In addition, the increased farm production will provide an outlet for sale of products used in agricultural production. It will provide added income to farm families to improve their standard of living. Local business will be stimulated by sales of boats, motors, fishing and camping equipment, and other items associated with recreational activities. These secondary benefits will have a significant effect upon the watershed and the surrounding trade areas.

Total water yield from the watershed will be reduced about 4 percent as a result of the installation of the structural measures included in the plan. More than half of this reduction is from the multiple-purpose reservoir.

PROJECT BENEFITS

The estimated average annual monetary floodwater, sediment, erosion, and indirect damages (table 5) within the watershed will be reduced from $112,989 to $27,015 by the proposed project. This is a reduction of 76 percent, 91 percent of which will result from installation of the structural measures.

Reductions in monetary flood damages vary with respect to locations within the watershed. The following tabulations show the general location of damage reduction benefits attributed to the combined program of land treatment and structural measures.

Average Annual Damage

Evaluation: Reach (Figure 1):	General Location	Without Project (dollars)	With Project (dollars)	Reduction (percent)
A	Common Bottom	46,153	10,975	76
B	Clays Creek	2,462	2,297	7
C	Common Bottom to Flag Branch	27,760	7,241	74
D	Flag Branch	6,079	125	98
E	Flag Branch to Indian Creek	12,320	3,509	72
F	Indian Creek	941	21	98
G	Indian Creek to Long Branch	8,854	2,476	72
H	Donahoe Creek above Long Branch	3,077	371	88
Total		107,646 1/	27,015 2/	75

1/ Exclusive of damage considered under restoration of former productivity ($5,343).

2/ Includes damages on Clays Creek for which no structural control is planned.

Direct Monetary Floodwater Damage (Summer Flood)

Evaluation Reach (Figure 1)	Average Recurrence Interval: 2-Year Without Project (dollars)	2-Year With Project (dollars)	5-Year Without Project (dollars)	5-Year With Project (dollars)	10-Year Without Project (dollars)	10-Year With Project (dollars)	25-Year Without Project (dollars)	25-Year With Project (dollars)
A	32,400	0	58,100	18,010	73,560	32,000	87,210	46,400
B	1,093	1,059	1,410	1,397	1,546	1,529	1,712	1,692
C	18,230	1,395	23,420	8,125	26,900	14,700	30,390	19,445
D	3,563	8	4,465	92	5,325	238	5,625	454
E	6,994	1,405	8,878	4,170	10,350	5,610	12,050	6,865
F	462	0	514	17	590	41	690	91
G	4,252	915	6,272	1,249	7,251	1,724	8,680	4,273
H	776	146	2,445	286	3,818	515	7,210	1,023
Total	67,770	4,928	105,504	33,346	129,340	56,357	153,567	80,243

It is estimated that the net increase in income from restoration of former productivity will amount to $5,343 (at long-term price levels) annually. This loss from the original production has been included in crop and pasture damage and its restoration a benefit in table 5.

The annual monetary value of recreational benefits from use of the multiple-purpose structure and its associated facilities is estimated to be $24,000. This is based on 16,000 visitor days annually at a value of $1.50 per visitor day.

Benefits from incidental recreational use of the sediment pools of the floodwater retarding structures are estimated to be $1,046 annually. This is based on an estimated gross value of $0.50 per visitor day, less associated costs, and discounted for the estimated useful life of the pools for recreational purposes.

It is estimated that the project will produce local secondary benefits averaging $6,635 annually. This is a net benefit after appropriate deductions for associated secondary losses resulting from project installation. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

Since the watershed is not in an area designated by the Secretary of Agriculture under the Area Redevelopment Act, no redevelopment benefits were included.

The total annual benefits from the 9 floodwater retarding structures and the multiple-purpose structure are estimated to be $110,017. In addition to the monetary benefits, there are other substantial benefits which will accrue to the project such as an increased sense of security, better living conditions, and improved wildlife conditions. None of these benefits were evaluated in monetary terms nor have they been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures and basic recreational facilities (amortized total installation cost, plus operation and maintenance) is estimated to be $60,876. These measures are expected to produce average annual primary benefits of $103,382 or $1.70 for each dollar of cost.

The ratio of total average annual project benefits ($110,017) to the average annual costs of structural measures and basic recreational facilities ($60,876) is 1.8 to 1 (table 6).

PROJECT INSTALLATION

Planned land treatment (table 1) will be established by farmers during a 5-year period in cooperation with the Little River-San Gabriel Soil Conservation District. Technical assistance in the planning and application of land treatment is provided under the going program of the district. A standard soil survey is in progress and has been completed on 53,940 acres. There are 44,345 acres needing standard soil survey.

The governing body of the Little River-San Gabriel Soil Conservation District will assume aggressive leadership in getting an accelerated land treatment program underway. The landowners and operators within the watershed will be encouraged to apply and maintain soil and water conservation measures on their farms. District owned equipment will be made available to the landowners in accordance with existing arrangements for equipment usage in the district. The Soil Conservation Service will provide additional technical assistance to the soil conservation district in accelerating the planning and application of soil, plant and water conservation measures. Additional technical assistance will be provided to accelerate completion of the standard soil survey.

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

The Donahoe Creek Watershed Authority and the city of Bartlett have the right of eminent domain by virtue of applicable State law and have the financial resources to fulfill their responsibilities.

The Donahoe Creek Watershed Authority will:

1. Obtain the necessary land, easements, rights-of-way, and permits for the 9 floodwater retarding structures to be dedicated to the Donahoe Creek Watershed Authority.

2. Provide for the relocation or modification of utility lines and systems, roads, privately owned improvements, and

cemeteries necessary for the installation of the 9 floodwater retarding structures.

3. Provide for the necessary improvement of low water crossings on private roads to make them passable during prolonged release flows from the structures or obtain permission to inundate such roads where equal alternate routes are designated for use during periods of inundation.

4. Provide the necessary legal, administrative, and clerical personnel, facilities, supplies, and equipment to advertise, award, and administer contracts for the 9 floodwater retarding structures and the multiple-purpose structure.

5. Determine the legal adequacy of the easements and permits for construction of the 9 floodwater retarding structures.

6. Be the contracting agency, and let and service contracts for the 9 floodwater retarding structures and the multiple-purpose structure.

The city of Bartlett will:

1. Obtain fee-simple title to all areas dedicated to public recreational use and easements for the balance of the multiple-purpose reservoir area.

2. Provide for the relocation or modification of utilities and improvements necessary for the installation of the multiple-purpose structure.

3. Obtain water rights for storage of water for recreational purpose.

4. Provide the necessary legal, administrative, and clerical personnel, facilities, supplies and equipment to advertise, award, and administer contracts for the basic recreational facilities.

5. Determine the legal adequacy of titles, easements, and permits for construction of the multiple-purpose structure and basic recreational facilities.

6. Be the contracting agency and let and service contracts for the basic recreational facilities.

7. Bear all legal and engineering costs associated with obtaining land, easements, and rights-of-way for recreational development.

Payments for lands, easements, and rights-of-way for the public recreational development will be shared by Public Law 566 funds and the city of Bartlett.

Technical assistance will be provided by the Soil Conservation Service in preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificate of completion, and related tasks necessary to install the 9 planned floodwater retarding structures and the one multiple-purpose structure.

The city of Bartlett will employ a consulting engineer for the construction and installation of the basic recreational facilities. The Soil Conservation Service will assist in the general layout and make inspections to insure that the facilities are installed as planned. The Service will reimburse the city of Bartlett for 50 percent of the payments made for construction and installation services.

The 9 floodwater retarding structures and one multiple-purpose structure will be constructed during the 5-year installation period in the general sequence of sites 4, 1, 2, 3, 5, 6, 7, 8, 9, and 10.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out works of improvement described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended.

The voters of the Donahoe Creek Watershed Authority have approved a tax which is being levied and collected annually to secure bond funds in the amount of $75,000 for the local share of the project installation cost of the 9 planned floodwater retarding structures. Revenue from the sale of these bonds is available and adequate for financing the share of project installation costs of the 9 floodwater retarding structures to be borne by local interests.

It is anticipated that approximately 80 percent of the easements for the 9 floodwater retarding structures will be donated. The out-of-pocket costs of easements which will not be donated, relocation of utilities, roads, and improvements, legal services, and administration of contracts is estimated by the sponsors to be $60,000.

Funds necessary for the local share of the installation costs of multiple-purpose structure No. 4 and basic recreational facilities will be provided by the city of Bartlett.

The sponsoring local organizations agree that all land on which Federal assistance is provided will not be sold or otherwise disposed of for the

evaluated life of the project except to a public agency which will continue to maintain and operate the recreational development in accordance with the operation and maintenance agreement.

The sponsoring local organizations do not plan to use the loan provisions of the Act.

The soil and water conservation loan program of the Farmers Home Administration is available to all eligible farmers 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 program.

The County Agricultural Stabilization and Conservation committee will cooperate with the governing body of the soil conservation district by selecting and providing financial assistance for those practices which will accomplish the conservation objectives in the shortest possible time.

The structural measures will be constructed during a 5-year installation period pursuant to the following conditions:

1. The requirements for the land treatment in the drainage area above the floodwater retarding structures and the multiple-purpose structure have been satisfied.

2. All lands, easements, rights-of-way, and permits have been obtained for all structural measures or a written statement is furnished by the Donahoe Creek Watershed Authority and the city of Bartlett that their rights of eminent domain will be used, if needed, to secure any remaining land, easements, or rights-of-way within the project installation period and that sufficient funds are available for purchasing those easements and rights-of-way.

3. Water rights for storage of water for recreational purposes have been obtained.

4. A court order has been obtained from the Williamson County Commissioners Court showing that the county road affected by the detention pool of floodwater retarding structure No. 2 will either be raised two feet above emergency spillway crest elevation at no expense to the Federal Government, closed, or permission granted to temporarily inundate the road provided equal alternate routes are available.

5. Court orders have been obtained from the Bell County Commissioners Court showing that:

    a. County roads affected by the pools of floodwater retarding structures Nos. 5 and 6 will either be

raised two feet above emergency spillway crest elevation at no expense to the Federal Government, closed, or permission granted to temporarily inundate the roads provided equal alternate routes are available.

b. The county road affected by the detention pool and embankment of multiple-purpose structure No. 4 will be relocated to serve as part of the access road system for basic recreational facilities. Cost will be shared by Public Law 566 funds and the city of Bartlett.

6. Permission has been obtained from the Texas Highway Department to temporarily impound floodwater on the embankments of State Highway 95 and Farm Road 487, which will be affected by the spillway storage of floodwater retarding structure Nos. 1 and 3, and multiple-purpose structure No. 4 as the result of runoff from a 48 hour 50-year frequency storm event.

7. Permission has been obtained from the Missouri, Kansas, and Texas Railroad Company to temporarily impound floodwater on the railroad embankment affected by the spillway storage of floodwater retarding structure No. 3 and multiple-purpose structure No. 4.

8. Provisions have been made for improving low water crossings or bridges and/or culverts on public roads or court orders or necessary permits obtained granting permission to temporarily inundate the crossings, providing equal alternate routes are available for use by all people concerned, during periods when these crossings are impassable due to prolonged flow from the principal spillways of the floodwater retarding structures. If equal alternate routes are not available, provisions will be made, at no cost to the Federal Government, to make the crossings passable during prolonged periods of release flows from the structure.

9. Utilities, such as power lines, telephone lines, and pipelines, have been relocated or permission has been obtained to inundate the properties involved.

10. Cemeteries affected by the pools of floodwater retarding structures Nos. 1 and 3 have been relocated in accordance with applicable State laws.

11. The contracting agencies are prepared to discharge their responsibilities.

12. The project agreements have been executed.

13. Operation and maintenance agreements have been executed.

14. Public Law 566 funds are available.

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

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by landowners and operators of the farms on which the measures are applied under agreement with the Little River-San Gabriel Soil Conservation District. Representatives of the soil conservation district will make periodic inspections of the land treatment measures to determine maintenance needs and encourage landowners and operators to perform maintenance. They will make district-owned equipment available for this purpose in accordance with existing working arrangements.

Stuctural Measures

The Donahoe Creek Watershed Authority will be responsible for the operation and maintenance of the 9 floodwater retarding structures and the multiple-purpose structure.

An annual maintenance tax of 10 cents on each $100 of assessed property valuation has been voted and is being collected for the purpose of operation and maintenance. It is estimated that this tax will produce revenue of $3,000 annually.

The estimated average annual cost of operation and maintenance of the 9 floodwater retarding structures and the multiple-purpose structure is $2,050. Funds are available and adequate for this purpose.

The city of Bartlett will be responsible for the operation and maintenance of the basic recreational facilities. Funds for this purpose will be available from the city of Bartlett general fund which may include income from recreational development.

The estimated average annual cost of operation and maintenance for the basic recreational facilities is $5,525 which includes allowance

for operation, custodial care, maintenance, and replacement costs of facilities.

Admission fees charged for use of recreational facilities will be limited to those necessary to amortize the initial investment and provide adequate operation and maintenance.

The structural measures will be inspected at least annually and after each heavy rain by representatives of the Donahoe Creek Watershed Authority, the Little River-San Gabriel Soil Conservation District, and the city of Bartlett.

A Soil Conservation Service representative will participate in these inspections at least annually. For the floodwater retarding structures and the multiple-purpose structure, 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 part of the structures. The items of inspection are those most likely to require maintenance.

Representatives of the city of Bartlett will inspect the recreational facilities of the multiple-purpose structure following each major storm, period of heavy use, any event likely to produce damage, or at least monthly. Inspections during the season of heavy usage will be made as often as necessary to prevent deterioration of facilities. A representative of the Soil Conservation Service will participate in the inspections of the recreational facilities as often as may be required to assure their proper maintenance, but at least once each year.

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

The sponsoring local organizations will maintain a record of all maintenance inspections made and maintenance performed and have it available for inspection by the Soil Conservation Service personnel.

The sponsoring local organizations fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitation to bid on the construction of the structural measures included in this work plan.

The necessary maintenance work will be accomplished either by contract, force account, or equipment owned by the sponsoring organizations.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Donahoe Creek Watershed, Texas

Installation Cost Items	Unit	No. to be Applied Non-Federal Land 2/	Estimated Cost (Dolla Public Law 566 Funds	Other Funds	T
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	10,592	-	102,956	10
Pastureland	Acre	15,990	-	264,808	26
Technical Assistance			28,374	47,100	7
SCS Subtotal			28,374	414,864	44
TOTAL LAND TREATMENT			28,374	414,864	44
STRUCTURAL MEASURES					
Soil Conservation Service					
Multiple-Purpose Structure	No.	1	175,062	18,612	19
Basic Recreational Facilities	No.	1	31,507	31,508	6
Floodwater Retarding Structure	No.	9	804,870	-	80
SCS Subtotal			1,011,439	50,120	1,06
Subtotal - Construction			1,011,439	50,120	1,06
Installation Services					
Engineering Services			142,181	4,726	14
Other			89,324	2,761	9
SCS Subtotal			231,505	7,487	23
Subtotal - Installation Services			231,505	7,487	23
Other Costs					
Land, Easements, and Rights-of-Way			91,291	286,397	37
Administration of Contracts			-	5,250	
Water Rights			-	600	
Subtotal - Other			91,291	292,247	38
TOTAL STRUCTURAL MEASURES			1,334,235	349,854	1,68
TOTAL PROJECT			1,362,609	764,718	2,12
SUMMARY					
Subtotal SCS			1,362,609	764,718	2,12
TOTAL PROJECT			1,362,609	764,718	2,12

1/ Price Base: 1963

2/ For Land Treatment - Acres to be treated during project installation.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of work plan preparation)

Donahoe Creek Watershed, Texas

Measures	Unit	Number Applied to Date 1/	Total Cost (Dollars)
LAND TREATMENT			
Conservation Cropping System	Acre	31,410	0
Green Manure and Cover Crops	Acre	7,903	94,840
Crop Residue Use	Acre	31,410	54,970
Contour Farming	Acre	6,840	3,420
Pasture Proper Use	Acre	11,146	11,150
Brush Control	Acre	2,837	85,110
Pasture Renovation	Acre	9,390	225,360
Pasture Planting	Acre	3,040	72,960
Farm Ponds	Number	190	85,500
Grassed Waterway	Acre	297	29,700
Terraces, Gradient and Parallel	Feet	1,604,988	96,300
TOTAL			759,310

1/ Applied during last 10 years only.

2/ Price Base: 1963.

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TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Donahoe Creek Watershed, Texas

(Dollars) 1/

Structure Site Number or Name	Installation Cost - Public Law 566					Installation Cost - Other Funds							Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Land Easements and R/W	Total Public Law 566	Construction	Installation Services: Engineering	Installation Services: Other	Adm. of Contracts	Land Easements and R/W 2/	Water Rights	Total Other	
Floodwater Retarding Structures													
1	182,856	20,114	15,466	-	218,436	-	-	-	500	54,700	-	55,200	273,636
2	94,224	14,134	8,257	-	116,615	-	-	-	500	34,625	-	35,125	151,740
3	95,446	14,317	8,364	-	118,127	-	-	-	500	35,200	-	35,700	153,827
5	113,809	14,795	9,800	-	138,404	-	-	-	500	20,680	-	21,180	159,584
6	80,177	12,027	7,026	-	99,230	-	-	-	500	21,010	-	21,510	120,740
7	71,328	10,699	6,251	-	88,278	-	-	-	500	9,725	-	10,225	98,503
8	55,835	10,050	5,020	-	70,905	-	-	-	500	5,600	-	6,100	77,005
9	51,484	9,267	4,629	-	65,380	-	-	-	500	3,825	-	4,325	69,705
10	59,711	10,748	5,369	-	75,828	-	-	-	500	6,800	-	7,300	83,128
Subtotal	804,870	116,151	70,182	-	991,203	-	-	-	4,500	192,165	-	196,665	1,187,868
Multiple-Purpose Structure 4	175,062	21,304	16,381	88,902	301,649	18,612	-	-	500	91,342	600	111,054	412,703
Basic Recreational Facilities	31,507	4,726	2,761	2,389	41,383	31,508	4,726	2,761	250	2,890	-	42,135	83,518
Subtotal	206,569	26,030	19,142	91,291	343,032	50,120	4,726	2,761	750	94,232	600	153,189	496,221
GRAND TOTAL	1,011,439	142,181	89,324	91,291	1,334,235	50,120	4,726	2,761	5,250	286,397	600	349,854	1,684,089

1/ Price Base: 1963

2/ Includes survey and legal fees - $1,700.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Donahoe Creek Watershed, Texas
(Dollars) 1/

Item	Purpose		Total
	Flood Prevention	Recreation	
COST ALLOCATION			
Single-Purpose			
Floodwater Retarding Structure Nos. 1 through 3 and 5 through 10	1,187,868	-	1,187,86
Basic Recreation Facilities	-	83,518	83,51
Multiple-Purpose			
Structure No. 4	187,297	225,406	412,70
TOTAL	1,375,165	308,924	1,684,08
COST SHARING			
Public Law 566	1,178,096	156,139	1,334,23
Other Funds	197,069	152,785	349,85
TOTAL	1,375,165	308,924	1,684,08

1/ Price Base: 1963

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Donahoe Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER										Total
		1	2	3	4	5	6	7	8	9	10	
Dralnage Area	Sq.Mi.	14.64	7.14	1/ 5.43	22.35	4.61	4.53	3.06	1.55	1.24	2.42	66.97
Storage Capacity												
Sediment Pool (50 yr. or 200 ac.ft.limit)	Ac.Ft.	200	200	200	2/2,146	200	200	200	102	77	151	3,676
Sediment Reserve (Below Riser)	Ac.Ft.	2,189	832	695	-	528	629	275	111	81	156	5,496
Sediment in Rerreation Pool	Ac.Ft.	-	-	-	608	-	-	-	-	-	-	608
Sediment in Oetention Pool	Ac.Ft.	188	80	72	214	56	62	57	26	21	39	815
Recreation	Ac.Ft.	-	-	-	1,895	-	-	-	-	-	-	1,895
Floodwater Detention	Ac.Ft.	3,943	2,373	1,468	4,995	1,276	1,259	881	441	355	679	17,670
Total	Ac.Ft.	6,520	3,485	2,435	9,858	2,060	2,150	1,413	680	534	1,025	30,160
Surface Area												
Sediment Pool (50 yr. or 200 ac.ft.limit)	Acre	43	50	63	2/ 266	46	40	34	17	13	23	595
Sediment Reserve Pool (Top of Riser)	Acre	249	147	159	-	100	107	61	28	20	36	907
Recreation Pool	Acre	-	-	-	480	-	-	-	-	-	-	480
Floodwater Detention Pool	Acre	509	328	313	798	188	197	114	68	46	83	2,644
Volume of Fill	Cu.Yd.	399,380	200,620	183,620	333,750	239,190	171,870	128,200	107,070	94,440	125,940	1,984,080
Elevation Top of Dam	Foot	734.7	593.9	564.5	544.8	505.3	496.9	500.3	479.2	442.7	431.8	xxx
Maximum Height of Dam	Foot	51	32	22	40	33	34	34	35	37	38	xxx
Emergency Spillway												
Crest Elevation	Foot	729.3	590.0	559.8	539.2	500.9	492.9	495.8	475.4	438.1	426.2	xxx
Bottom Width	Foot	400	350	350	400	250	250	200	150	100	100	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		4.0	2.6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	xxx
Average Curue No. - Condition II		83	82	82	82	83	83	83	83	83	83	xxx
Emergency Spillway Hydrograph												
Storm Rainfall (6-hour) 4/	Inch	6.52	6.86	6.59	6.32	7.05	7.05	7.13	7.36	7.45	7.24	xxx
Storm Runoff	Inch	4.57	4.79	4.53	4.28	5.07	5.07	5.15	5.37	5.45	5.25	xxx
Velocity of Flow (V_c) 5/	Ft./Sec.	1.0	0	0	0	1.2	1.0	1.0	1.0	1.0	1.4	xxx
Discharge Rate 5/	C.F.S.	100	0	0	0	250	45	24	60	50	140	xxx
Maximum Water Surface Elevation 5/	Foot	729.8	-	-	-	501.7	493.2	496.1	475.8	438.6	427.2	xxx
Freeboard Hydrograph												
Storm Rainfall (6-hour) 6/	Inch	15.89	16.71	16.09	15.42	17.20	17.20	17.39	17.96	18.19	17.66	xxx
Storm Runoff	Inch	13.67	14.33	13.72	13.06	14.96	14.96	15.15	15.72	15.94	15.42	xxx
Velocity of flow (V_c) 5/	Ft./Sec.	9.9	8.4	9.2	10.2	9.0	8.5	9.1	8.3	9.2	10.2	xxx
Discharge Rate 5/	C.F.S.	12,554	6,450	8,774	13,658	5,844	4,700	4,700	2,654	2,460	3,430	xxx
Maximum Water Surface Elevation 5/	Foot	734.7	593.9	564.5	544.8	505.3	496.9	500.3	479.2	442.7	431.8	xxx
Principal Spillway Capacity - Low Stage	C.F.S.	146	71	126	492	46	45	31	16	12	24	xxx
Capacity Equivalents												
Sediment Volume	Inch	3.30	2.92	3.34	2.49	3.19	3.69	3.26	2.89	2.71	2.68	xxx
Recreation Volume	Inch	-	-	-	1.59	-	-	-	-	-	-	xxx
Oetention Volume	Inch	5.05	6.23	5.07	4.19	5.19	5.21	5.40	5.33	5.36	5.26	xxx
Spillway Storage	Inch	4.20	3.75	6.19	4.33	3.90	3.65	3.64	3.58	3.73	4.21	xxx
Class of Structure	-	A	A	A	A	A	A	A	A	A	A	

1/ Exclusive of area controlled by other structure. The entire area considered in emergency spillway design.

2/ Multiple Purpose.

3/ Based on regional analysis of peak runoff.

4/ 0.5P reduced to controlling drainage area.

5/ Maximum during passage of hydrograph.

6/ 1.22P reduced to controlling drainage area.

TABLE 4 - ANNUAL COST

Donahoe Creek Watershed, Texas

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Floodwater Retarding Structures 1 through 3 and 5 through 10 and Multiple-Purpose Structure No. 4, and Basic Recreation Facilities	53,301	7,575	60,876
TOTAL	53,301	7,575	60,876

1/ Price Base: 1963 prices amortized for 100 years at 3.0 percent.

2/ Long-term prices as projected by ARS, September 1957.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFI

Donahoe Creek Watershed, Texas
(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	53,929	12,998	40,931
Other Agricultural	30,931	7,881	23,050
Nonagricultural			
Road and Bridge	3,941	450	3,491
Subtotal	88,801	21,329	67,472
Sediment			
Overbank Deposition	1,580	344	1,236
Erosion			
Flood Plain Scour	12,820	2,886	9,934
Indirect	9,788	2,456	7,332
TOTAL	112,989	27,015	85,974

1/ Long-term prices as projected by ARS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Donahoe Creek Watershed, Texas

(Dollars)

Measures	AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost 2/	Benefit Cost Ratio
	Flood Prevention						
	Damage Reduction	Incidental Recreation	Recreation	Secondary	Total		
Floodwater Retarding Structures No. 1 through 3 and 5 through 10 and Multiple-Purpose Structure No. 4, and Basic Recreational Facilities	78,336	1,046	24,000	6,635	110,017	60,876	1.8:1
GRAND TOTAL 3/	78,336	1,046	24,000	6,635	110,017	60,876	1.8:1

1/ Price Base: Long-term prices as projected by ARS, September 1957.

2/ From table 4.

3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $7,638 annually.

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment for the watershed was developed by the Little River-San Gabriel Soil Conservation District assisted by personnel from the Soil Conservation Service at Bartlett. Conservation needs data were compiled from existing conservation plans within the watershed and expanded to represent the conservation needs of the entire watershed. The quantity of each land treatment practice, or combination of practices, necessary for essential conservation treatment were estimated for each land use by capability class. Acres, by land use, to be treated during the 5-year installation period were estimated (table 1). The hydraulic, hydrologic, sedimentation, and economic investigations provided data as to the effects of land treatment measures in terms of the reduction of flood damage. Although measurable benefits would result from application of the planned land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of watershed protection and flood damage reduction desired by the local people.

Engineering Investigations

A study was made of the watershed to determine if project objectives for flood prevention and recreational development could be attained by including structural measures. The procedure used in making that determination was as follows:

1. A base map was prepared to show the watershed boundary, drainage pattern, system of roads and railroads, and other pertinent information.

2. A study of aerial photographs and available quadrangle sheets supplemented by field examination indicated the limits of flood plain subject to flood damage. All probable site locations for floodwater retarding structures were located on a map of the watershed. By making a stereoscopic study of aerial photographs, supplemented by field examination, it was possible to eliminate those sites for which sufficient storage capacity could not be developed.

3. A watershed map was used to show all possible locations of structure sites that could be used to develop a system of structural measures to meet project objectives. This map was submitted to the sponsoring local organizations who provided data on ownership of land apparently involved in each site. The sponsors also provided estimates on easements involved in each site.

4. Based on apparent physical, economic, and easement feasibility, the sponsoring local organizations and the Soil

Conservation Service agreed that 14 possible sites for floodwater retarding structures and one site for a multiple-purpose structure would be investigated.

It was necessary to plan two structures in series because of extensive involvement of obstacles at site No. 3. Comparative studies were made and it was determined that the inclusion of structures No. 2 and 3, in series, were more feasible than one structure at the lower location.

5. Each site location was classified for limiting criteria for design according to the damage that would result from a sudden major breach of the embankment. Breaching studies were made for one structure considered as having the greatest damage potential. These studies indicated that no undue hazard to life or property would result from a sudden breach. All structures were classified as "a".

6. Topographic maps of 8 of the 15 possible structure sites were developed by use of the stereoplotter. Topographic maps of the remaining 7 structure sites were developed by other standard survey procedures.

   A topographic map of each site was developed to cover the pools, dam, and emergency spillway areas. These maps and related surveys provided necessary information to determine if the required sediment and floodwater detention storage capacity could be obtained, the limit of the pool areas, estimated installation costs, and the most economical design for each structure.

7. The sediment and floodwater storage requirements, structure classification, and principal and emergency spillway layout and design meet or exceed criteria outlined in Engineering Memorandum SCS-27 and Texas State Manual Supplement 2441.

   Multiple routings of freeboard hydrographs were made for all sites to determine the spillway proportion and height of dam which would result in the most economical and feasible design of the structures.

   Plans of a floodwater retarding structure, typical of these planned for this watershed, are illustrated by figures 3 and 3A.

8. A detailed investigation was made of State, county, and farm roads having low water crossings on streams below the floodwater retarding structures. Where there are no equal alternate routes, the improvements required to provide passage

during periods of prolonged floodwater release from the structures were determined.

A detailed investigation also was made to see what effect floodwater retarding structures would have on State highways and railroads above the sites. The necessary reports were prepared for submission to the Texas State Highway Department in accordance with Texas State Manual Supplement 2441.4.

9. Structure data tables were developed to show for each structure the drainage area; the capacity needed for floodwater detention, sediment storage, and recreation in acre-feet and in inches of runoff from the drainage area; the release rate of the principal spillway; acres inundated by the sediment, sediment reserve, recreation, and detention pools; the volume of fill in the dam; the estimated costs of the structure; and other pertinent data (tables 2 and 3).

10. Damages resulting from floodwater, sediment, and flood plain erosion were determined from damage schedules, surveys of sample areas, and flood routings under without project conditions. Reductions in these damages resulting from the proposed works of improvements were estimated on the basis of reduction of sediment yields and reduction of peak discharges as determined by flood routings under future conditions for which it was assumed that the proposed works of improvements had been installed.

    Benefits so determined were allocated to individual measures or groups of interrelated measures on the basis of the contribution each measure had on the reduction of damages. In this manner, it was determined that structural measures for flood prevention could be economically justified.

    By further analysis those individual and interrelated structural measures which had favorable benefit to cost ratios were determined. Alternate sites were investigated until the most economical and feasible system of structural measures was developed which would provide the degree of protection desired by the sponsoring local organizations and meet the needs for recreational development.

    The system consisted of 9 interrelated floodwater retarding structures and one multiple-purpose structure necessary to provide the desired level of flood damage reduction and recreational development.

When the structural measures for flood prevention and recreational development had been determined, a table was developed to show the cost of the

measures (table 2). The summation of the total costs for all works of improvements represented the estimated cost of the planned watershed protection and flood prevention project (table 1).

A second cost table was developed to show separately the annual installation cost, annual maintenance cost, and the total annual cost of the structural measures (table 4).

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from Climatological Bulletins, U. S. Weather Bureau; Water Supply Papers, U. S. Geologic Survey; and local records. These data were analyzed to determine average precipitation depth-duration relationships, frequency of occurrence of meteorological events, the relationship of geology, soils, and climate to runoff depth for single storm events, and the runoff-peak discharge relationship.

2. Engineering surveys were made to collect information on selected stream reaches, including valley cross sections, channel capacities, high water elevations of selected floods, bridge capacities, and other hydraulic characteristics. The valley cross sections and evaluation reaches were selected in conference with the economist and geologist.

3. Hydrologic conditions of the watershed were determined by considering such factors as climate, geology, topography, soils, land use, and vegetative cover. The present hydrologic condition was determined from the soil-cover complex data assembled from sample areas covering 27 percent of the watershed. Rainfall-runoff relationships, as represented by curve numbers, were computed for use in determining the depth of runoff from individual storm events using monthly soil moisture indices.

4. Rating curves for valley cross sections of Donahoe Creek were developed from field survey data collected in 2, above, by solving water surface profiles for various discharges. Computations of the water surface profiles were made by the use of the IBM 650 computer. Rating curves for valley cross sections of tributary streams were computed by use of Manning's formula. The theory of concordant flow was used to determine the relationship of peak discharge to volume of runoff.

5. Stage-area inundated curves were developed from field survey data for each portion of the flood plain represented by a valley cross section (figure 1).

6. From a tabulation of cumulative departure from normal precipitation, the period from 1925 through 1952 was determined to be representative of the normal precipitation on the watershed. A historical evaluation series was developed for that period, with individual events limited to a period of two days. Precipitation data from the Temple and Taylor gages, weighted equally, were used.

7. The area, by depth increments, that would have been inundated by each storm in the evaluation series was determined for:

    a. Without project conditions.

    b. With land treatment measures applied.

    c. With land treatment measures applied and floodwater retarding structures installed.

    d. With alternate systems of structures.

8. The maximum release rates for the principal spillways of the floodwater retarding structures and the multiple-purpose structure were determined by a detailed study of the stream channel and the effects of these rates on design of the structures and emergency spillways. The maximum release rates will be 22 csm for site No. 4. All other sites will have 10 csm release rate.

9. The appropriate emergency spillway and freeboard design storms were selected from Figures 3.21-1 and 3.21-4 of NEH, Section 4, Supplement A, in accordance with criteria contained in Engineering Memorandum SCS-27 and Texas State Manual Supplement 2441. These exceed minimum requirements established by standard drawing No. ES 1020.

10. Emergency spillways were designed in accordance with Texas State Manual Supplement 2441.

11. Reservoir Operation Studies were made for the multiple-purpose reservoir considering the following:

    a. Storage data developed, tabulated, and plotted.

    b. The most critical drought period of record (calendar years 1951 through 1957).

c. Monthly rainfall records (Temple and Taylor weighted).

d. Gross lake surface evaporation based on Texas Water Commission data (Texas Board of Water Engineers' Bulletin 6006), with adjustment for pan coefficient to conform to Figure 2-1, Section 4, Texas Engineering Handbook.

The operation studies were made through the selected period to determine the minimum storage and surface area of the recreation pool. The result of these operations were plotted and are shown on figure 4. At the low point of supply during the drought period used in the study, water in storage (3,000 acre-feet) would exceed the 100-year sediment storage.

12. An operation study was made for the period 1941 through 1957 to show the water yield at the mouth of the watershed for "without project" conditions and for "with project" conditions for which it was assumed that all structural measures were installed. The procedures used in this study were the same as in 10 above except that a mass area-capacity curve was developed for all reservoirs. The results indicated that if the structural measures had been in place during the period considered, 96 percent of the watershed runoff would have been available as stream flow at the mouth of the watershed.

Sedimentation Investigations

Sedimentation investigations were made in accordance with procedures as outlined in Technical Letter EWP-WC-2, "Sedimentation Investigations in Work Plan Development", August 1959, Fort Worth, Texas; Technical Release No. 17, "Geologic Investigations for Watershed Planning", March 1961; and Technical Release No. 12, "Procedure for Computing Sediment Requirements for Retarding Reservoirs", September 1959.

Sediment Source Studies

Sediment source studies to determine the 100-year sediment storage requirements were made in the drainage areas of the 9 planned floodwater retarding structures and one multiple-purpose structure. Detailed investigations were made in 3 of these drainage areas. Estimates of the sediment production rates for the other 7 structures were based on data gathered in detailed investigations of similar drainage areas.

The three detailed investigations and computations included:

1. Mapping soils by units, percent slope, length of slope, land use, cover condition classes on pastureland, land treatment

on cultivated land, and land capability classes.

2. Measuring lengths, widths, and depths, and estimating rates of annual lateral erosion of all gullies and stream channels affected by erosion.

3. Computing annual gross erosion by sources (sheet, gully, and streambank).

Field studies and computations for the planned structures not surveyed in detail included:

1. Mapping the land use.

2. Studying soils, topography, and erosion for comparison of similarity to drainage areas surveyed in detail.

3. Computing annual gross erosion based on erosion rates of the detailed area.

Estimates of annual gross erosion reflect the effect of expected land treatment on drainage areas of planned structures. A gradual improvement of watershed conditions is expected as a result of the installation of planned land treatment measures.

Sediment storage requirements for planned structures were determined by adjusting average annual total erosion for expected sediment delivery ratios and trap efficiency. The ratio of sediment volume submerged in pools to soil in place was based on volume weights of 59 to 67 pounds per cubic foot for submerged sediment and 83 to 94 pounds per cubic foot for soil in place.

Flood Plain Sediment and Scour Damages

The following sediment and scour damage investigations were made to determine the nature and extent of physical damage to flood plain lands:

1. Field examinations were made within representative sample areas. Factors such as depth and texture of sediment deposits, depth and width of scour channels, channel degradation or aggradation, and channel bank erosion were recorded. Areas of damage were mapped.

2. Estimates of past physical flood plain damage were obtained through interviews with landowners and operators.

3. A damage table was developed to show percent damage by texture and depth increment for sediment and by depth and width for scour. Due consideration was given to the agronomic and land treatment practices, soils, crop yields,

and land capabilities in assigning damages.

4. The areas of sediment and scour damages were measured and tabulated by percent damage categories.

5. Damages measured within sample areas were expanded, by evaluation reaches, to represent the entire flood plain.

6. Estimates of recoverability of productive capacity were developed from field studies and interviews with farmers.

7. Average annual sediment yield from each source (sheet erosion, gully erosion, streambank erosion, and flood plain scour) was estimated from detailed sediment source studies and scour damage investigations. Sediment yields to evaluation reaches were computed for without project conditions, with land treatment measures applied, and with the combined program of land treatment and structural measures installed.

   The reduction in sediment yield was adjusted to reflect the relative importance of each sediment source as a contributor of damage. The reduction of monetary damage from overbank deposition was based on the reduction of area inundated by floodwater and reduction in damaging sediment yield.

8. Estimates of the reduction of scour damage due to the installation of the project were based on reduction of depth and area inundated by floodwater.

Geologic Investigations

Preliminary geologic investigations were made at each of the structure sites to obtain information on the nature and extent of embankment and foundation materials, emergency spillway excavation, emergency spillway stability, and possible problems that might be encountered during construction. These investigations included surface observations of valley slopes, alluvium, channel banks, exposed geologic formations, and hand auger borings. In addition, more detailed investigations with core drilling and field permeability testing equipment were made to determine the extent and permeability rate of Tertiary terrace material on the right abutment at multiple-purpose site No. 4. The findings of preliminary geologic investigations were used in making cost estimates of structures and to assure that the sites selected are feasible for construction.

Description of Problems

Upper Cretaceous strata, which dip gently toward the southeast, underlie all structure sites. One site is located on the outcrop of the Austin formation.

The other 9 structure sites are located on the outcrop of the Taylor formation. Portions of all sites on the Taylor outcrop are covered by Tertiary and younger terrace deposits.

The Austin formation consists of alternating beds of massive to thin bedded chalky limestone, shaly limestone, and calcareous shale. Site No. 1 is located on the Austin outcrop. The foundation consists of silty clays, gravelly clays, and cobbly clays underlain by limestone beds. Emergency spillway excavation will be in alternating beds of shale and limestone. It is estimated that blasting will be necessary for excavation of less than 10 percent of these materials. Borrow materials are scarce. Sufficient quantity can be obtained within a maximum distance of 4,000 feet and by utilizing materials available within the detention pool area. Soils for the embankment are CL and GC, as classified in accordance with the Unified Soils Classification System.

Site Nos. 2 through 10 are underlain by calcareous shales of the Taylor formation but terrace deposits, ranging from clay to conglomerate, cover much of the abutments and valley walls. Foundations are characterized by silty, sandy clay, gravelly clay, and clayey gravel underlain by shale. There will be no rock excavation in emergency spillways. An abundance of suitable soils for embankment purposes is available within sediment pool areas. These soils are primarily CL and GC, but some CH will be encountered.

At site No. 4, which will include storage for recreation, the cutoff will extend into the emergency spillway area to attain a positive cutoff to prevent leakage from the recreation pool through permeable terrace deposits. Minor drainage measures also may be needed to prevent saturation of the embankment, emergency spillway, and downstream areas caused by seepage from the detention pool.

Further Investigations

Detailed investigations, including exploration with core drilling equipment, will be made at all sites prior to construction. Laboratory tests will be made to determine the suitability of embankment and foundation materials and the methods of handling.

Economic Investigations

Selection of Evaluation Reaches

Because of the diversity of damageable values, frequency of flooding, flood plain characteristics, and the possible effects of remedial measures considered, the flood plain was divided into eight evaluation reaches (figure 1).

Determination of Damages

Agricultural damage estimates were based on schedules obtained in the field covering approximately 50 percent of the flood plain and representing about

the same percent of operating units having flood plain lands. These schedules covered land use, crop distribution, yields, and historical data on flooding, and flood damages.

In the calculation of crop and pasture damage, expenses saved such as the cost of harvesting and other production inputs were deducted from the gross value of the damage. The flood plain land use was mapped in the field. Estimates of present average flood-free yields were obtained from schedules and supplemented by information supplied by other agricultural workers in the area. Adjustments of present yields were made to allow for expected yield increases resulting from advances in technology during the project life.

Information on other agricultural damages such as fences, livestock, and farm equipment was obtained from schedules and correlated with size of floods.

The monetary value of the physical damage to the flood plain from erosion and from deposition of sediment was based on the value of production lost, taking into account the time lag necessary for recovery.

Estimates of damages to roads and bridges in the flood plain were obtained from county and State highway officials and supplemented by information from local farmers. These damage estimates were related to size of floods as reflected by high water elevation and peak discharge.

Indirect damages involving such items as interruption of travel or detours due to flooding, losses sustained through inability to gain access to fields at optimum time for cultural operations, additional expense for care of livestock, and losses sustained by businesses in the area were considered. Based on analysis of these factors, it was estimated that indirect damages would approximate 10 percent of the direct damage.

Benefits from Reduction of Damage

Average annual damages within the watershed were calculated for conditions without a project, with land treatment installed, and after installation of the complete project. The difference between the damage after the installation of a phase of the project and that before its installation constituted the benefit from reduction of damages creditable to that phase. At each phase considered, adjustments were made to take into account the effects of recurrent flooding when more than one flood occurred during the same year.

Installation of this project will result in some damage reduction benefits in the flood plain of the Little River immediately below Donahoe Creek. The area affected by Donahoe Creek is limited and with the installation of

Belton Reservoir on the Leon River and Stillhouse Hollow Reservoir on the Lampasas River, flooding will be infrequent. Therefore, no evaluation of monetary benefits was made in this investigation.

Restoration of Former Productivity Benefits

Farmers in the flood plain were asked to state changes made in land use as a result of past flooding. Operators also were asked what changes they would make in their use of flood plain land use if flooding were reduced. Analysis of their responses indicated that benefits from restoration of lands toward their former use would result from the anticipated reduction in flooding and flood plain erosion. Factors considered in this analysis were the size and locations of the areas affected, land capability, reduction in frequency and depth of flooding, age of operators, trends in agricultural production, and similar factors. Consideration was given to increased damage to higher values after restoration. All benefits are net benefits remaining after production, harvesting, and all other associated costs ware considered. Benefits so claimed were discounted for a 10-year lag in conversion to assure a conservative appraisal. It is expected that present operators will restore production to a more profitable level of use on 401 acres of flood plain land involving a net shift of 375 acres of crops. Consideration was given to the effects on acreage allotment restrictions and it was determined that such benefits are not dependent upon production increases in restricted crops. These restoration benefits are included as a crop and pasture benefit in table 5.

A summary of the effects of restoration of former productivity is shown in the following table.

Crop Distribution and Net Returns
Restoration of Former Productivity Benefits 1/

Crop Distribution	Without Project: Acres	Without Project: Yield	Without Project: Net Return (dollars)	With Project: Acres	With Project: Yield	With Project: Net Return (dollars)	Difference in Net Return (dollars)
Cotton	174	350 lb.	7,540	174	350 lb.	7,540	0
Corn	91	42 bu.	2,722	188	42 bu.	5,625	2,903
Grain Sorghum	291	26.5 cwt.	7,737	335	26.5 cwt.	8,907	1,170
Oats (Grain and Grazing)	141	36 bu. 1 aum	2,464	198	36 bu. 1 aum	3,467	1,003
Oats (Temporary Pasture)	212	4 aum	2,203	238	4 aum	2,473	270
Wheat (Grain and Grazing)	27	20 bu. 1 aum	557	27	20 bu. 1 aum	557	0
Sudan (Temporary Pasture)	577	4 aum	6,570	672	4 aum	7,606	1,036
Forage Sorghums	12	2.5 ton	284	12	2.5 ton	284	0
Alfalfa	8	2.75 ton	370	64	2.75 ton	2,958	2,588
Improved Pasture	48	4.75 aum	384	48	4.75 aum	384	0
Pasture	1,886	2 aum	11,957	1,543	2 aum	9,782	-2,175
Idle	32	-	-	-	-	-	-
Miscellaneous	63	-	-	63	-	-	-
Total	3,562		42,788	3,562		49,583	6,795

Difference in Net Returns	6,795
Less Discount for Lag in Conversion	869
Deduction for Associated Costs	420
Deduction for Added Flood Damage	163
Benefit from Restoration	5,343

1/ Long-term prices as projected by ARS, September 1957.

Recreation Benefits

An estimate of expected annual visitor days use of the proposed recreational development was made by comparing the proposed development with similar types of developments for which use information was available. The following factors were considered in these comparisons.

1. Population within a 25-mile radius and within a 40-mile radius of the development, both present and projected.
2. Facilities available at the development.
3. Accessibility.
4. Size of recreation pool and associated area devoted to recreation.
5. Charges for use.
6. Operations and maintenance levels.
7. Availability of competitive recreational developments.

Upon analysis of these factors, it appeared that visitor days of use correlated closely with population within the development zone of influence when other factors were similar. On this basis, it is estimated that the proposed development will attract an estimated 92 visitors annually per 1,000 present population within a 40-mile radius.

The present population in a 40-mile radius is about 175,000. Total annual visitor days of use is estimated at 16,000.

Value of a visitor day was estimated at $1.50. This is based on facilities and types of recreation activities to be offered, and availability of other service facilities convenient to the proposed development.

Incidental Recreation Benefits

Evaluation of incidental recreation benefits from the use of the sediment pools of the proposed floodwater retarding structures was based on data obtained from studies made in similar type watersheds. It is believed that the sediment pools of the proposed floodwater retarding structuras will be utilized for recreation activities, primarily fishing and hunting. In order to determine the minimum benefits, evaluation was limited to the pool areas that would result from the 50-year sediment storage elevation or 200 acre-feet at each structure, whichever was less. Therefore, benefits were estimated on the basis of a total surface area of 329 acres.

In estimating use of these pool areas such factors as location, access, and expected level of development were considered. In light of the facilities to be offered at the proposed multiple-purpose structure, it is not expected that the pool areas of the floodwater retarding structure will be developed extensively for recreational activities. It is believed that their prime attraction will be for fishing and hunting. It is estimated that total annual visitor days of use will be about 3,425.

Because of the unpredictable development of the pool areas, a gross value of $0.50 per visitor day was used in the economic evaluation. Associated costs, including operations and maintenance were deducted from the gross value of the benefits. A five-year period was considered for accrual of average use. It was also considered that approximately the same level of use would prevail for about 50 years at which time sediment deposition would gradually reduce the attraction of these pools. Total annual net benefits, discounted to present worth, were estimated to average $1,046.

Secondary Benefits

Values of local secondary benefits and local secondary losses were calculated in accordance with the interim procedures outlined in Watersheds Memorandum SCS-57, October 3, 1963.

Secondary benefits of a local nature were considered as either (1) stemming from the project or (2) induced by the project. Benefits stemming from the project were considered to be at least 10 percent of the direct primary project benefits. Benefits induced by the project were considered to be at least 10 percent of the average annual increased production cost associated with restoration of former productivity.

Secondary losses resulting from installation of structural works of improvement were calculated in the same manner as secondary benefits.

The total gross secondary benefits were estimated to be $10,447. Secondary losses in excess of annual allowance for land easements were estimated to be $3,812. The remaining net secondary benefits will be $6,635 annually.

Appraisal of Land and Easement Values

Areas that will be inundated by the pool areas of the structural measures were excluded from the damage calculations. An estimate was made, however, of the value of the production that would be lost in those areas after installation of the project. For floodwater retarding structures, it was considered that there would be no production in the sediment pools. The land covered by the detention pools was assumed to be converted to grassland under project conditions. For the multiple-purpose structure, it was considered that there would be no production on all land to be acquired by fee-simple title as this land will be devoted to purposes other than

agricultural production. The cost of land, easements, and rights-of-way for the 9 floodwater retarding structures were determined by individual appraisal in cooperation with representatives of the sponsoring local organizations. The floodwater retarding structure site costs were based on appraisals of the value of the easements with consideration given to the values that will remain after the land is devoted to project purposes. Site costs for the multiple-purpose structure was based on the prevailing land value for the area that will be acquired by fee-simple title and on the cost of acquiring easement to that area in the floodwater detention pool not to be devoted to recreation.

The average annual net loss in production and associated secondary losses, based on long-term prices, within the sites were calculated and compared with the amortized cost of the structural sites. The annual value of the easements exceeded the annual loss of production. The addition of associated secondary losses resulted in a total primary and secondary loss in excess of annual value of easements. Therefore, excess secondary losses were deducted from the gross value of secondary benefits.

Details of Methodology

The evaluation of flood damages was made by flood routing a historical storm series for the period from 1925 through 1952. Details of the procedures used in this method of evaluation are described in the Soil Conservation Service Economics Guide for Watershed Protection and Flood Prevention, December 1958.

Fish and Wildlife Investigations

The following is reproduced from the reconnaissance survey report for the Donahoe Creek watershed prepared by the Bureau of Sport Fisheries and Wildlife of the Fish and Wildlife Service, U. S. Department of Interior.

> "Donahue Creek is an intermittent stream with virtually no fisheries. The stream flows during periods of heavy rainfall and at such times a few youngsters fish for small sunfish and channel catfish.
>
> "The principal hunting in the watershed is for bobwhites and fox squirrels. There are good populations of both species. The majority of hunting is done with the consent of the landowners. Little leasing is done.
>
> "Our reconnaissance of the proposed Donahue Creek Watershed indicates that fish and wildlife generally will be benefited by the project. Permanent impoundments formed by floodwater retarding structures will increase opportunities for fishing and provide some habitat for waterfowl. Reduced runoff of floodwaters will be beneficial to ground-nesting species of wildlife in the downstream flood plain. The construction of farm ponds and other land-improvement measures also

will offer opportunities for the enhancement of fish and wildlife resources in the watershed.

"Most of the watershed is in cultivation, but it contains small acreages of timber. Clearing of brush and timber for the construction of floodwater retarding structures, farm ponds, terraces, diversions, and other structural practices will eliminate wildlife habitat, primarily for fox squirrels. Clearing of bottomland timber and brush probably will be accelerated with flood control, further reducing wildlife habitat.

"Donahue Creek Watershed provides excellent opportunities for the development of fish and wildlife under the provisions of the Watershed Protection and Flood Prevention Act. Watershed planning and practices should include proper water and land management to achieve good fishing and hunting. With a minimum of planning and expense, floodwater retarding structures, farm ponds, erosion prevention, and soil-building measures may be made to produce fish and wildlife in addition to their other conservation functions.

"The impoundment of water will not result automatically in additional good fishing in the watershed. Owners of new water areas or those persons responsible for managing new water areas should seek professional advice from the Texas Parks and Wildlife Department in the preparation of fishery management plans to insure the establishment and maintenance of good fishing. The same principle applies with respect to the development of wildlife habitat.

"Wildlife losses would be minimized if care were taken to retain or replace woody vegetation wherever possible when applying land treatment measures. Wildlife habitat could be improved in the watershed by planting idle lands to species of trees, shrubs, and grasses which are valuable as food and cover for wildlife.

"Maximum fishing and hunting would be realized if public access were provided to the floodwater retarding structures.

"In addition to the general steps outlined above, consideration should be given to the inclusion of fishing and hunting measures in multipurpose development for municipal or industrial water supply.

"It is recommended:

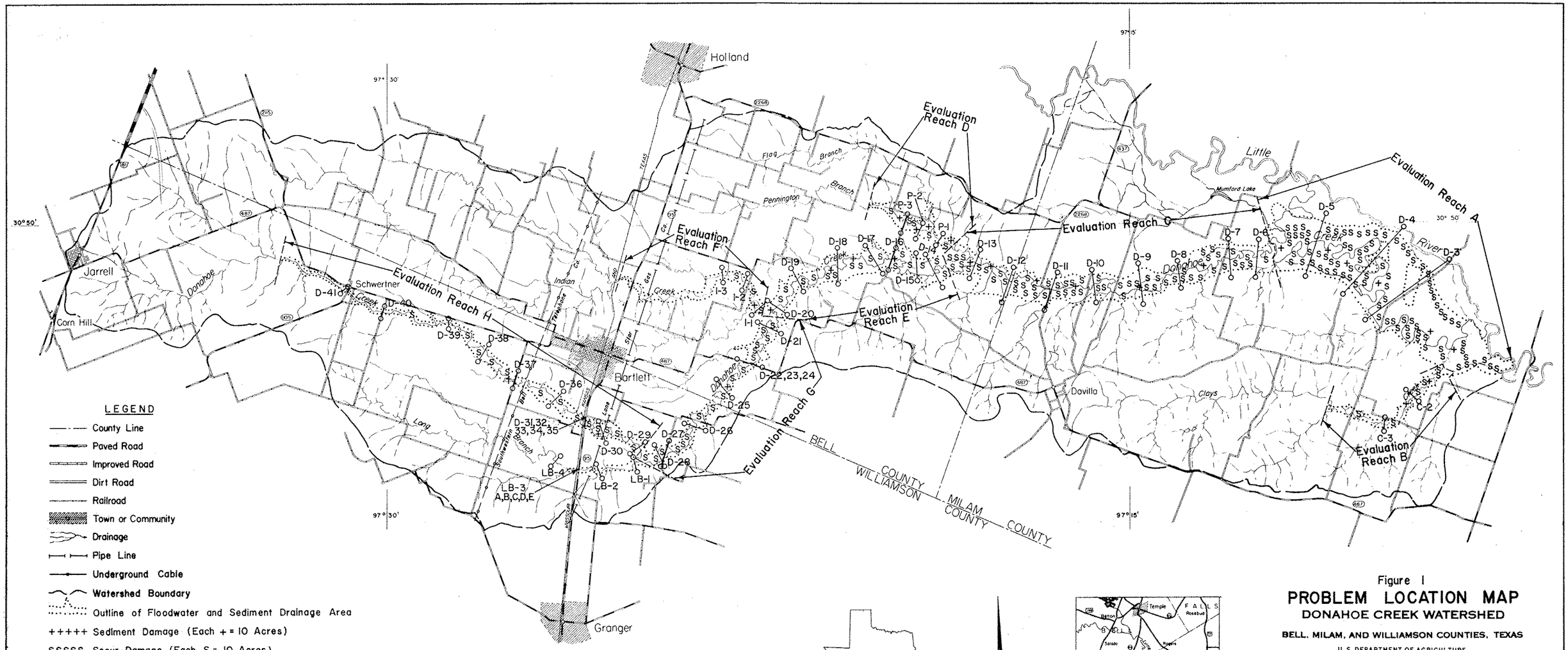
"1. That clearing specifications for the construction of floodwater retarding structures, diversions, terraces, farm ponds, and other structural measures allow for the retention or replacement of all possible woody vegetation.

"2. That plant species having value as food and cover for wildlife be planted near floodwater retarding structures and be included in erosion control plantings.

"3. That public access be provided to the floodwater detention sites.

"4. That newly constructed floodwater retarding reservoirs and farm ponds be stocked with fish recommended by the Texas Parks and Wildlife Department.

"No detailed studies by the Bureau of Sport Fisheries and Wildlife are considered necessary at this time. If local interests express a desire to include measures for the enhancement of fish and wildlife in the project development, our Bureau, in cooperation with the Texas Parks and Wildlife Department, will be happy to offer advice in the preparation of plans for inclusion of such measures."



COMPILED FROM UNCONTROLLED MOSAIC 4-R-17056

Figure 1

PROBLEM LOCATION MAP

DONAHOE CREEK WATERSHED

BELL, MILAM, AND WILLIAMSON COUNTIES, TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Approximate Scale 1 0 1 2 3 Miles

Approximate Drainage Area 98,080 Acres

4-R-18,848

REVISED 3-64 REVISED 8-28-62

4-R-11037

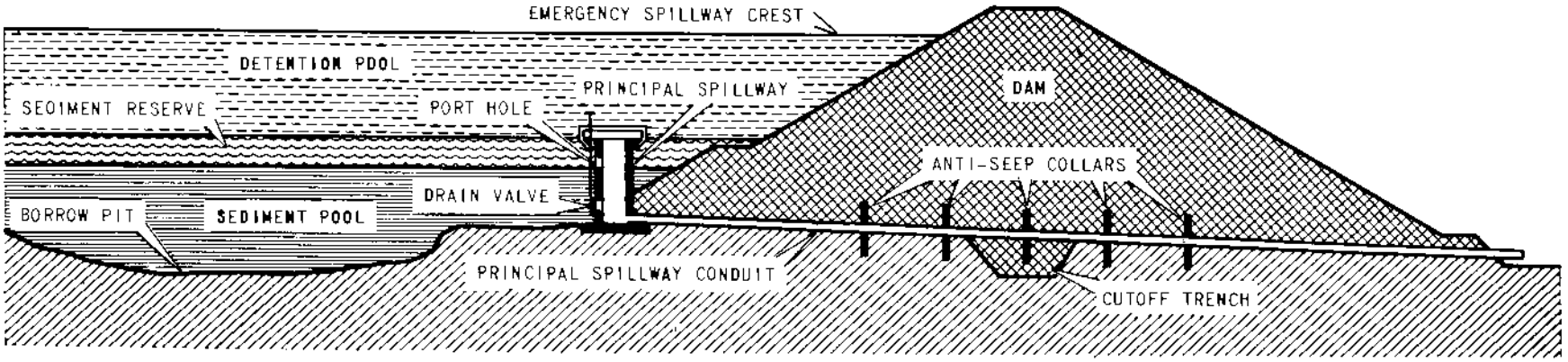


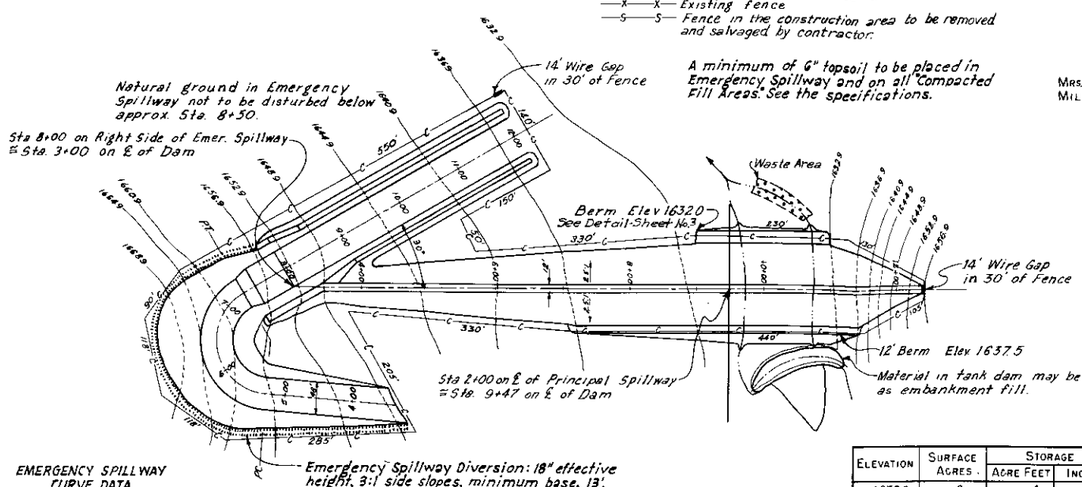
Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

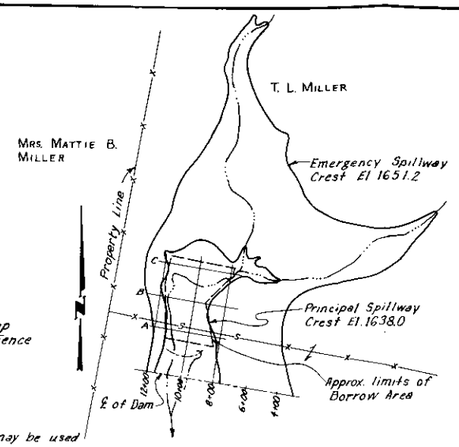
Revised 10-31-60 N-L-10,011

FENCE LEGEND
—C—C— Fence to be constructed under contract
—X—X— Existing fence
—S—S— Fence in the construction area to be removed and salvaged by contractor.

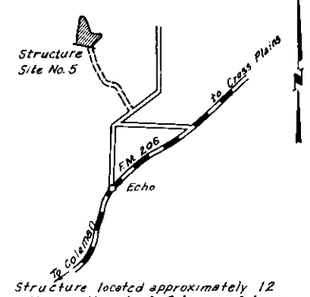


EMERGENCY SPILLWAY CURVE DATA
Δ = 144°00'
D = 71°37'
R = 80.35'
L = 201.0'
P.C. = Sta. 5+29
P.T. = Sta. 7+30

PLAN OF EMBANKMENT AND SPILLWAYS
0 100 200 300 400 500
SCALE IN FEET



GENERAL PLAN OF RESERVOIR
0 400 800 1200 1600
SCALE IN FEET

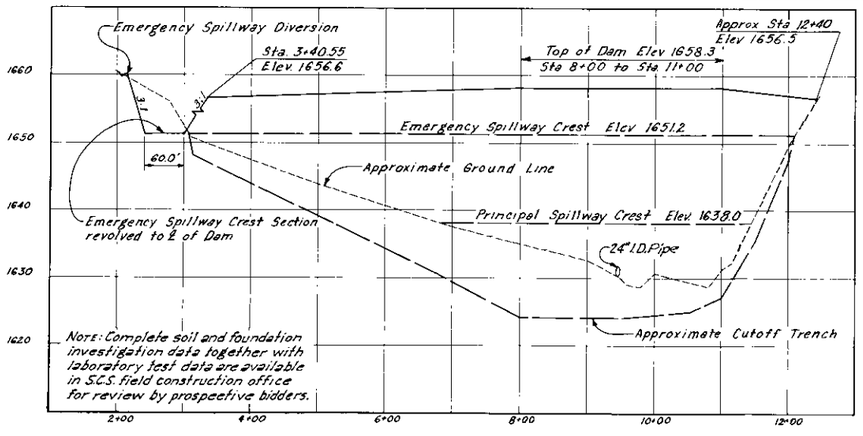


Structure located approximately 12 miles northeast of Coleman, Coleman County, Texas.

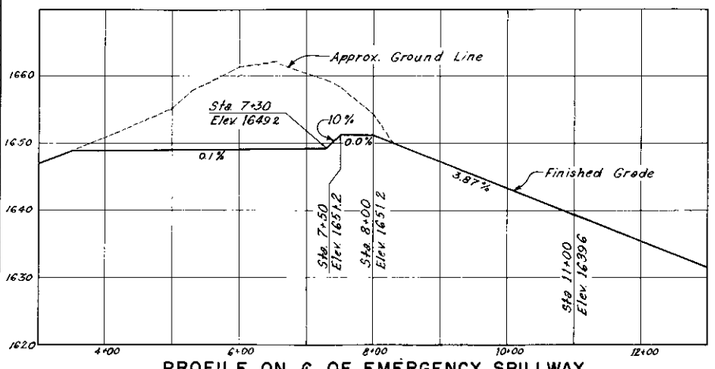
VICINITY MAP
0 1 2 3 4
SCALE IN MILES

ELEVATION	SURFACE ACRES	STORAGE ACRE FEET	STORAGE INCHES
1632.9	2	4	0.05
1636.9	6	20	0.27
1638.0	8	28	0.37
1640.9	14	60	0.80
1644.9	20	128	1.70
1648.9	29	226	3.00
1651.2	36.4	301	3.99
1652.9	42	368	4.88
1656.9	53	558	7.40
1660.9	64	792	10.51

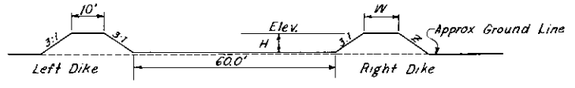
Top of Dam (Effective) Elev.	1656.5
Emergency Spillway Crest Elev.	1651.2
Principal Spillway Crest Elev.	1638.0
Sediment Pool Elev.	1638.0
Drainage Area, Acres	904
Sediment Storage, Acre Feet	32
Floodwater Storage, Acre Feet	269
Max. Emergency Spillway Cap., c.f.s.	1830



PROFILE ON ℄ OF DAM



PROFILE ON ℄ OF EMERGENCY SPILLWAY



Left Dike:
Approx. Sta. 7+75 to Sta. 8+00 Elev 1656.6 From Sta 8+00 to Sta 8+50, grade uniformly to H=3.0'. From Sta 8+50 to 12+00, H=3.0'

Right Dike:
Approx. Sta 7+40 to Embankment Elev 1656.6, W=14.0', Z=2.5:1. From Embankment to Sta. 9+00 Transition Section. Sta. 9+00 to Sta. 12+00 H=3.0', W=10.0', Z=3:1.

Note:
Material forming both dikes to be placed and paid for as "Compacted Fill"
Natural ground in Emergency Spillway not to be disturbed below approx. Sta 8+50

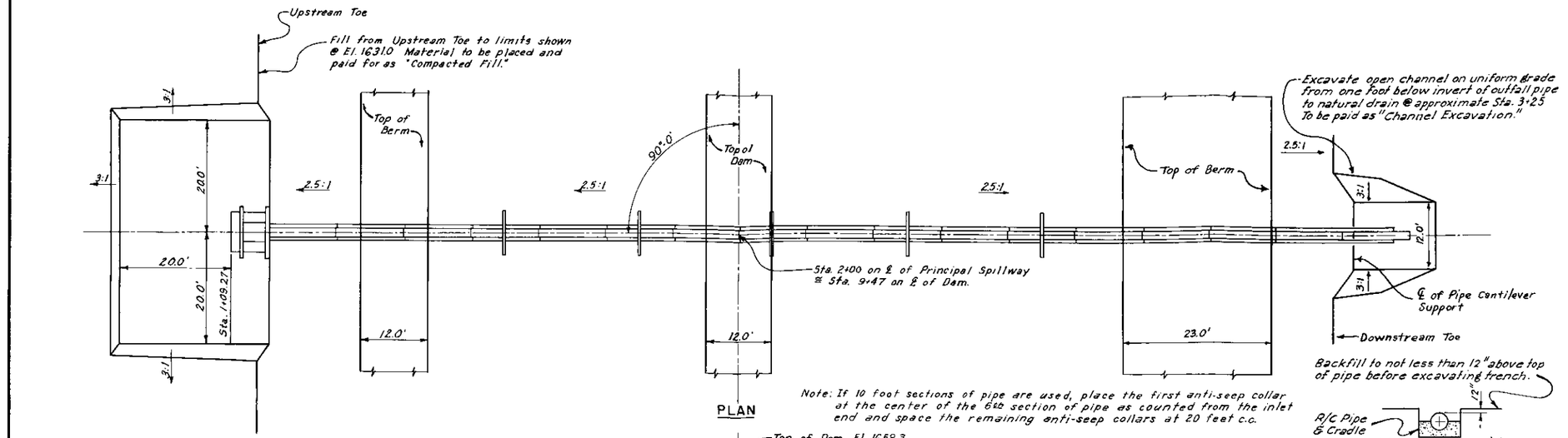
TYPICAL SECTION — EMERGENCY SPILLWAY

Figure 3

TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed W.E.C.	Date 3-61	Approved by	
Drawn W.E.C. & H.R.T.	3-61	HEAD, ENGINEERING & WATERSHED PLANNING UNIT, TEMPLE, TEXAS	
Traced H.R.T.	3-61	STATE CONSERVATION ENGINEER, S.C.S.	
Checked W.E.C. & G.W.T.	4-61	Sheet No. 2 of 8	Drawing No. 4-E-15,357



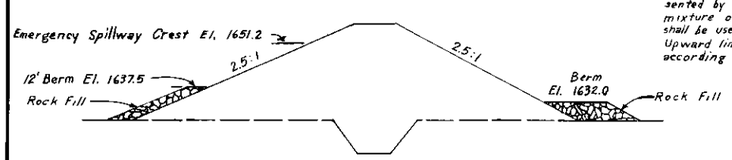
SECTION

PRINCIPAL SPILLWAY

Notes: No Formal Embankment Zoning is required. Selection of materials represented by Laboratory Curve No. 1, 3, and 4 shall be used in Cutoff Trench and center section of Embankment. The material represented by Laboratory Curve No. 2 shall be used in the outer shell. The mixture of rock and earth excavation from the emergency spillway shall be used in the upstream and downstream Berms. Upward limits of moisture will be determined by the Project Engineer according to the workability aspects of materials during construction.

MATERIALS					
LAB TEST		COMPACTION REQUIREMENTS			Lab. Curve
Modified		Min. Dry Density	Moisture Range		
Max. Dry Den.	Opt'm Moist	Lbs Per Cu. Ft.	Percent From	To	No
119.5	12.5	107.2	13.0	UP	1
146.0	6.1	136.7	6.1	UP	2
126.1	10.9	113.9	10.9	UP	3
124.5	11.5	112.0	12.0	UP	4

If the material being placed in the fill contains ¼ inch or larger material in amounts differing from the percentages found in the laboratory sample, the minimum dry density and moisture requirement will be corrected for this variation.



TYPICAL SECTION

EMBANKMENT DATA

Note: The detail above is planned for 12 foot sections of pipe. Section lengths of 10 feet may be used with invert of joints set on grade line as established above, utilizing 200 feet of pipe, ending at station 3+16. Section lengths in excess of 12 feet will not be permitted.

Figure 3A

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	W.E.C.	3-61	Approved by ... HEAD, ENGINEERING & WATERSHED PLANNING UNIT, FORT WORTH, TEXAS
Drawn	W.E.C. & H.R.T.	3-61	... STATE CONSERVATION ENGINEER, TEMPLE, TEXAS
Traced	H.R.T.	3-61	Sheet No. 3 of 8 — Drawing No. 4-E-15,357
Checked	W.E.C. & G.W.T.	4-61	

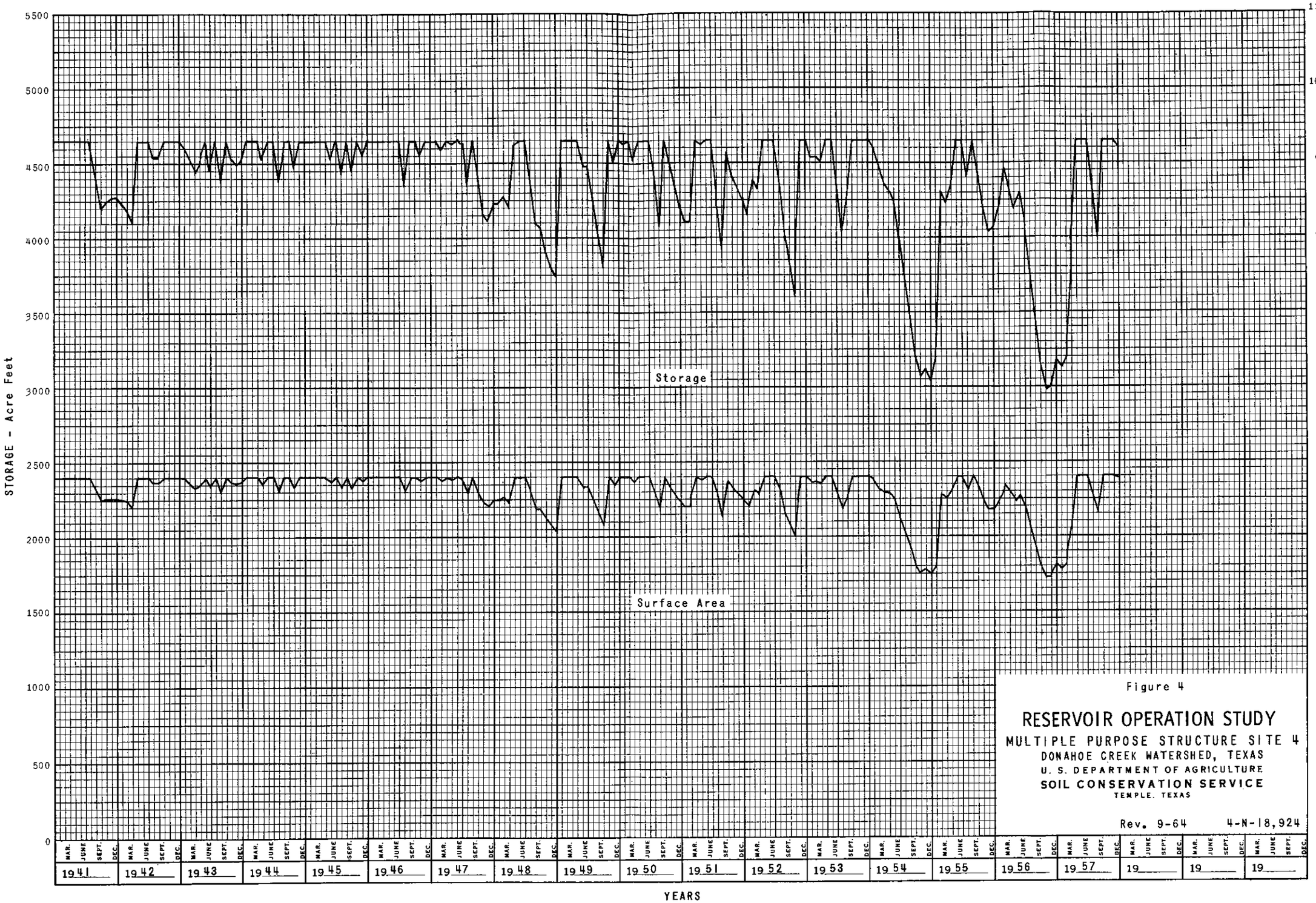


Figure 4

RESERVOIR OPERATION STUDY

MULTIPLE PURPOSE STRUCTURE SITE 4
DONAHOE CREEK WATERSHED, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Rev. 9-64 4-N-18,924

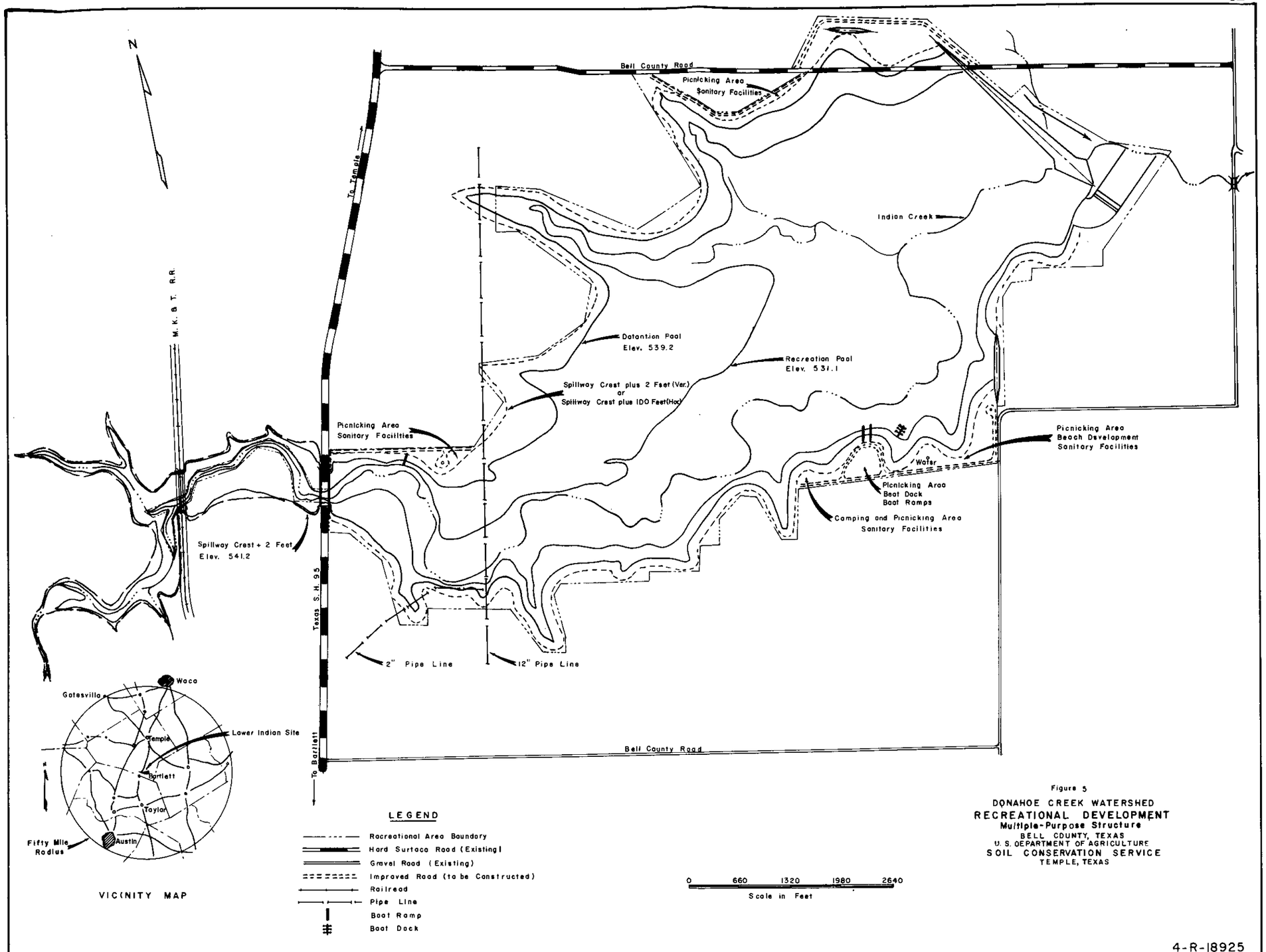
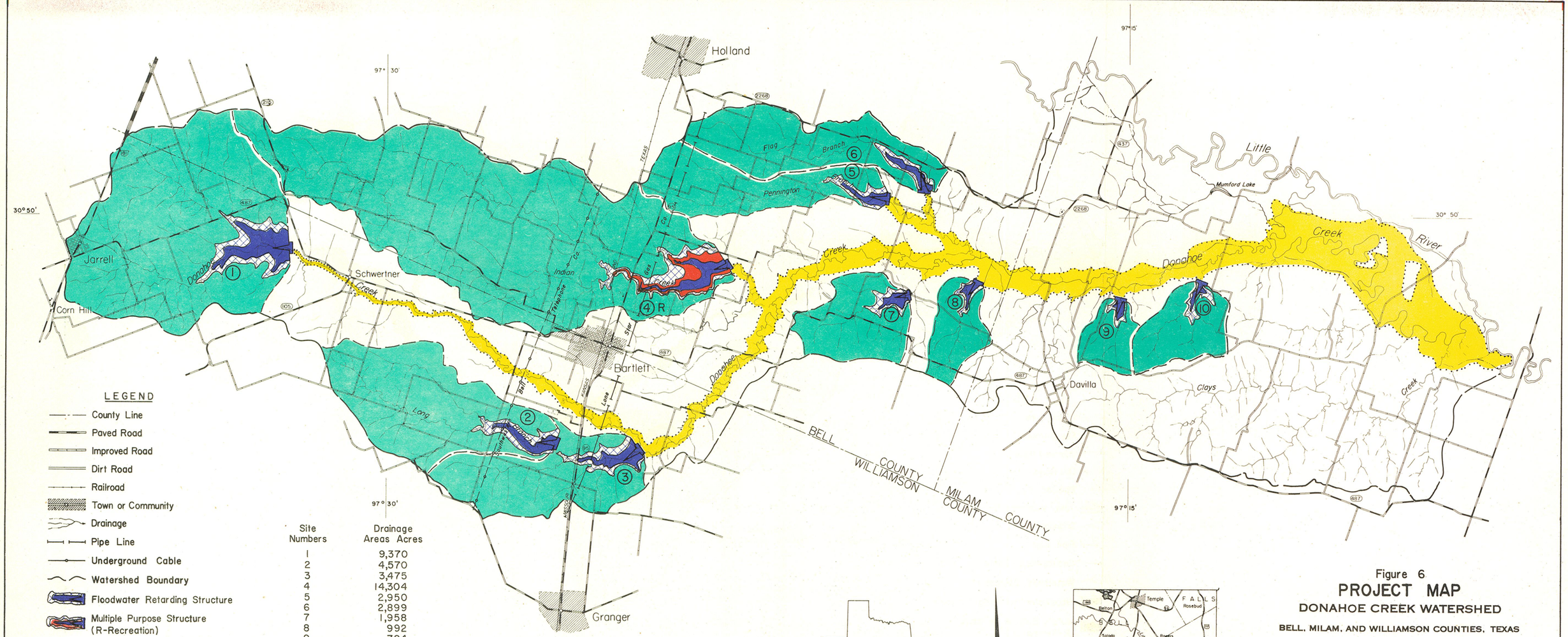


Figure 5

DONAHOE CREEK WATERSHED
RECREATIONAL DEVELOPMENT
Multiple-Purpose Structure
BELL COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

4-R-18925

I-64 Rev. 2-64; 4-64



COMPILED FROM UNCONTROLLED MOSAIC 4-R-17056

Figure 6

PROJECT MAP

DONAHOE CREEK WATERSHED

BELL, MILAM, AND WILLIAMSON COUNTIES, TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Approximate Scale
Approximate Drainage Area 98,285 Acres

Revised 9-64 4-R-18,847

REVISED 3-64 REVISED 8-28-62 4-R-11037