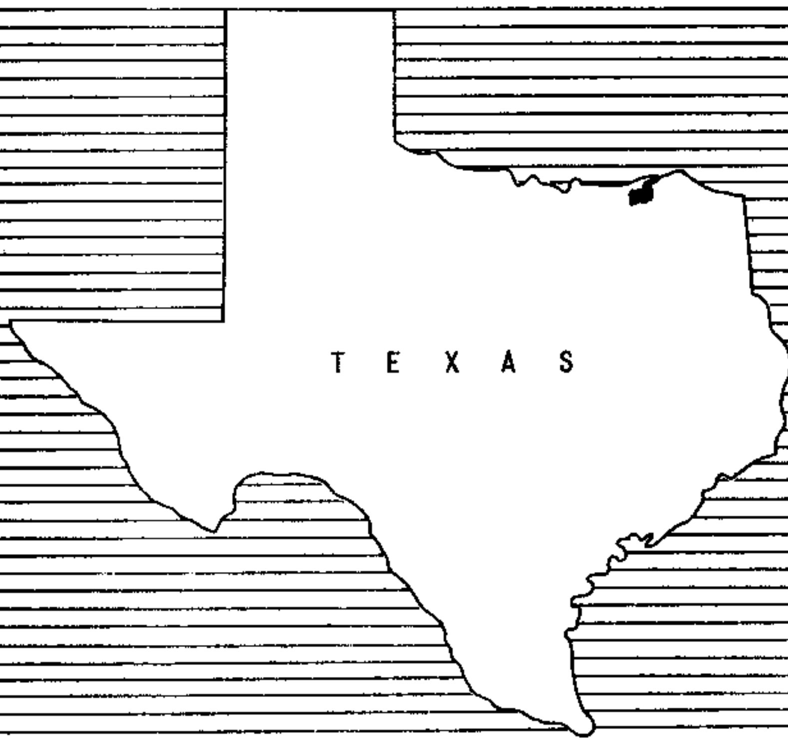
WORK PLAN

- For Watershed Protection and Flood Prevention

PINE CREEK WATERSHED

LAMAR COUNTY,. TEXAS



November 1962

MINOR WORK PLAN REVISIONS

Watershed Name		Date Approved
Pine Creek		
1. Site No. 9	- Deletion of original Site 9 and the addition of new Site 9A.	11-17-66
2. Pine Creek	- Minor change in design on Site 9A.	4-18-68
3. Site 1	- Deletion of Site 1 and the addition of Site 1A.	7-14-69
4. Site 5	- Slight relocation of the dam on Site 5.	11-25-70
5. Deletion of Site 6	- Delete Site 6.	7-31-70

WATERSHED WORK PLAN AGREEMENT

between the

North Texas Soil Conservation District
Local Organization

Lamar County Water Control and Improvement District Number 3
Local Organization

Lamar County Commissioners Court
Local Organization

Stste 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 Pine 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 Pine 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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4-62 4-L-16576-2

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 Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 558,818 .)

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

3. The percentages of construction costs of 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)
19 Floodwater Retarding Structures	0	100	1,269,180
19.5 Miles Channel Improvement	0	100	737,770

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

4. The 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)
19 Floodwater Retarding Structures	0	100	332,596
19.5 Miles Channel Improvement	0	100	151,537

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 10,000 .)

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

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 in the installation of works of improvement 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 or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

North Texas Soil Conservation District
Local Organization

By Frank Stone

Title Vice-Chairman

Date April 1, 1963

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

adopted at a meeting held on April 1, 1963

Albert Roach
(Secretary, Local Organization)

Date April 1, 1963

4-62 4-L-16578-4

4.77647 3-63

Lamar County Water Control and Improvement District No. 3
Local Organization

By [signature]

Title President

Date April 1, 1963

The signing of this agreement was authorized by a resolution of the governing body of the **Lamar County Water Control and Improvement District No. 3**
Local Organization
adopted at a meeting held on April 1, 1963.

[signature]
(Secretary, Local Organization)

Date April 1, 1963

Lamar County Commissioners Court
Local Organization

By [signature]

Title County Judge

Date April 2, 1963

The signing of this agreement was authorized by a resolution of the governing body of the **Lamar County Commissioners Court**
Local Organization
adopted at a meeting held on ______________.

JOHNNY M. STONE
County Clerk - Lamar County
PARIS, TEXAS

[signature]
(~~Secretary, Local Organization~~)

Date April 2, 1963

Soil Conservation Service
United States Department of Agriculture

By ______________
Administrator

Date ______________

4.17647 3.63

WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

PINE CREEK WATERSHED
Lamar County, Texas

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

Prepared By:

North Texas Soil Conservation District
(Cosponsor)

Lamar County Water Control and Improvement District No. 3
(Cosponsor)

Lamar County Commissioners Court
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service

November 1962

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WATERSHED WORK PLAN

PINE CREEK WATERSHED
Lamar County, Texas
November 1962

SUMMARY OF PLAN

General Summary

Pine Creek watershed, a tributary of the Red River, is located in Lamar County, Texas. The total area comprises 186 square miles or 119,040 acres. About 65 percent of the total drainage area is rangeland and pastureland, 21 percent is wooded pasture, 8 percent is cropland, and 6 percent is in miscellaneous use, such as roads, railroads, urban area, and stream channels. Approximately 1,000 acres of that part of former Camp Maxey, which is located in the watershed, is still in Federal ownership.

The principal problem in the watershed is one of frequent and prolonged flooding of approximately 12,900 acres of flood plain along the mainstem and tributaries of Pine Creek.

The North Texas Soil Conservation District, the Lamar County Water Control and Improvement District No. 3 and the Lamar County Commissioners Court propose installing a project for watershed protection and flood prevention during a 5-year period. The total installation cost is estimated to be $4,534,101. The share to be borne by other than Public Law 566 funds is $1,991,018. In addition, local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

The cost of land treatment measures is estimated to be $1,474,200, which includes Agricultural Conservation Program Service payments and $30,000 to be spent by the Soil Conservation Service for technical assistance under the going district program. Also, $52,000 will be provided from Public Law 566 funds for accelerated technical assistance. Land treatment measures will be installed during the 5-year installation period (table 1).

Structural Measures

Structural measures included in the plan consist of 19 floodwater retarding structures having 4,380 acre-feet of sediment storage and 31,793 acre-feet of floodwater detention capacity, and 19.5 miles of channel improvement including 195 appurtenant grade stabilization structures and improvement of tributaries entering the main channel. The total cost of structural measures is $3,059,901, of which the local share is $568,818. The local share of the

:ost includes land, easements, and rights-of-way, $558,818, and administering ontracts, $10,000. The structures will be installed during a 5-year period.

'amages and Benefits

'he reduction in floodwater, sediment, and indirect damages will directly enefit 85 landowners of 11,731 acres of flood plain land. The current alue of this land varies from $50 to $100 per acre, depending upon land use nd the frequency of flooding. With the project installed, per acre land alues for cultivated land are expected to increase about $100, improved asture by $50, and wooded pasture by about $25 or more.

he estimated average annual floodwater, sediment, erosion and indirect amages without the project total $238,286 at long-term price levels. The stimated average annual floodwater, sediment, erosion, and indirect damages ith the structural measures installed, amount to $39,052, a reduction of 199,234.

he average annual primary damage reduction benefits accruing to structural easures are distributed as follows:

Floodwater damage reduction	$174,852
Sediment damage reduction	8,361
Erosion damage reduction	172
Indirect damage reduction	12,782

econdary benefits will average $24,998 annually.

enefits incidental to the project amount to $11,295 annually. They are ecreation, $3,468 and redevelopment benefits from project employment of resently underemployed local labor, $7,827.

he ratio of the average annual benefits accruing to structural measures $232,460) to the average annual cost of these measures ($109,023) is 2.1 o 1.

rovisions for Financing Construction

he Lamar County Water Control and Improvement District No. 3 and the Lamar ounty Commissioners Court have the right of eminent domain and taxing uthority under applicable State laws. They will be responsible for the ocal share of the cost of the structural measures. The Lamar County Water ontrol and Improvement District No. 3 will contract for the construction of he structural measures. The sponsors do not plan to apply for a loan from he Farmers Home Administration.

peration and Maintenance

and treatment measures for watershed protection will be operated and main-
ained by landowners and operators under agreements with the North Texas
oil Conservation District. Structural measures will be operated and main-
ained by the Lamar County Water Control and Improvement District No. 3 and
he Lamar County Commissioners Court. The average annual cost of operating
nd maintaining the structural measures is estimated to be $8,300 at long-
erm price levels.

DESCRIPTION OF THE WATERSHED

hysical Data

ine Creek is a tributary of the Red River in northeast Texas and has a
rainage area of 186 square miles (119,040 acres). It heads approximately
miles west of the city of Paris in central Lamar County. It flows in a
ortheasterly direction across Lamar County for about 30 miles to empty
nto the Red River near the Lamar and Red River county line. Tributaries
nclude Little Pine Creek, Crooked Creek, Hicks Creek, and numerous smaller
nnamed creeks which enter Pine Creek from the northwest. South Branch
reek, Stillhouse Creek, Six Mile Creek, Morans Branch, and other unnamed
reeks flow into Pine Creek from the south and southeast.

he watershed lies within the Black Prairie and Forested Coastal Plain
hysiographic area. It has a dendritic drainage pattern with gentle to
oderate slopes predominating. Steeper slopes occur along the southeastern
dge of the alluvial flood plain and along stream valleys draining into the
ainstem from the southeast. Several distinct levels of river terraces are
ecognizable in the watershed. The older terraces have been dissected by
rosion but the more recent terraces are level or nearly level. Elevations
ange from 380 feet on the flood plain near the Red River to 630 feet above
ean sea level on the watershed divide near Brookston.

wo city-owned reservoirs, Lake Gibbons and Lake Crook, are in the watershed.
ake Gibbons, constructed in 1900 as a municipal water supply for Paris,
erved this purpose until 1923. It has a drainage area of 1.46 square miles.
he original capacity was 1,394 acre-feet and its surface area was 131 acres.
ake Crook, on Pine Creek below the mouth of Little Pine Creek, was built
n 1923 to replace Lake Gibbons as the municipal water supply for Paris.
t has a drainage area of 53.06 square miles, including Lake Gibbons and its
rainage area. The original capacity was 11,487 acre-feet and the surface
rea was 1,291 acres. Lake Lamar, a privately owned lake, also is in the
atershed. It has a drainage area of 1.2 square miles, a surface area of
9 acres, and a capacity of about 175 acre-feet. Water for domestic and
ivestock use in rural areas is supplied from ponds, wells, and springfed
treams. These sources have been adequate even during drought.

oils of the Blackland Prairie Land Resource Area occupy approximately 55 per-
ent of the watershed. The remaining 45 percent is made up of soils repre-
enting the western margin of the East Texas Timberlands Land Resource Area.

he East Texas Timberland soils are found on sandy Pleistocene terrace mate-ials which once covered the entire watershed. Erosion has removed these leposits from the Upper Cretaceous bedrock in the headwaters and in a east-est band across the central portion of the watershed (figure 5). Sandy oils of the Susquehana, Sawyer, and Edge series have developed on the emaining deeper terrace deposits. Other areas of these soils also have leveloped on the Blossom sand formation which crops out in the vicinity of aris and extends eastward along the southern edge of the watershed. Allu-ial soils of the Iuka series occur throughout the East Texas Timberlands and Resource Area but generally are not extensive within the watershed. he major land use for these soils is pasture and wooded pasture. At one ime loblolly and shortleaf pines, as well as quality hardwoods, including sage orange, probably grew along Pine Creek and on some of the upland areas n the eastern one-third of the watershed. Due to excessive exploitation of he forests and lack of conservation practices, pine and quality hardwoods, ncluding osage orange, were depleted to the extent that brush and low uality hardwoods became the dominant vegetation. Intensively cultivated oils of the Teller, Vanoos, and Portland series occur on the younger erraces near the Red River.

lackland Prairie soils of the Houston, Houston Black, and Hunt series ccur on the Brownstown and Bonham marl formations. Mixed clay loam to ine sandy loam soils of the Crockett and Wilson series occur on the areas lanketed by sandy terrace remnants.

he original vegetation on these soils was a tall grass prairie with a imited amount of hardwoods on the mixed sandy areas. They are now used ainly for pasture and meadows but were extensively cultivated in the past.

he alluvial soils of the flood plain consist mainly of the Trinity and aufman series. These generally productive soils have developed from ilts and clays of the Blackland Prairies.

and use in the flood plain is 20 percent cultivation, 40 percent pasture, nd 40 percent wooded pasture.

and use for the entire watershed area is as follows:

Land Use	Acres	Percent
Cropland	9,440	8
Pasture	60,890	51
Rangeland	16,282	14
Wooded Pasture (Non-commercial forest, grazed)	25,218	21
Miscellaneous 1/	7,210	6
Total	119,040	100

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

?our dominant range sites occur in the watershed. The Grayland site is found on the mixed, sandy Blackland Prairie soils. Vegetation consists mainly of prairie grasses although there is some hardwood vegetation. The Sandy Loam site occurs on medium textured East Texas Timberland soils which originally had a climax hardwood forest vegetation. The Rolling Blackland site is found on clay soils with a true prairie climax vegetation. Hardwoods and brush make up a sizeable overstory in the climax vegetation of the Bottomland site.

The principal grasses in the natural vegetation of all sites include little bluestem, big bluestem, Indiangrass, switchgrass, Eastern gamagrass, and perennial wildrye. Increasers with overuse include tall dropseed, sideoats grama, Texas wintergrass, and sedges. Invading weeds and brush include western ragweed, milkweeds, nightshades, persimmon, and sumac. Post oak and blackjack hardwood have increased with overuse of the grassland and exploitation of Southern Pine and quality hardwood.

The present hydrologic cover of the watershed is good. However, the type of range vegetation found is considered undesirable for forage production. Cover on pastures is generally in fair to good condition.

The recorded mean annual rainfall at Paris, Texas, is 43.67 inches. February generally has the least amount of rainfall with an average of 2.56 inches. May generally has the greatest, with an average of 4.98 inches. The mean annual temperature is 64 degrees which varies from 44 degrees in January to 83 degrees in July. The average growing season of 241 days extends from March 19 to November 15.

Economic Data

This watershed has been basically agricultural for many years. Settlement began in 1825 and county government was organized in 1841. Corn was the principal crop until about 1850, and wheat was predominant from 1850 to 1860. After 1860, cotton was the principal source of farm income and held this position until about 1920. Much of the present farm income is obtained from livestock, poultry, and dairy products.

Approximately 8 percent of the watershed is in cultivated crops. Principal crops are alfalfa, cotton, corn and vegetables. Vegetables will become a more important crop with the completion of a large soup plant now under construction near Paris, Texas. It is estimated that during the next 5 years about 8,000 acres of vegetables will be grown within a hundred mile radius of Paris. Results of investigations in the Pine Creek watershed show the soils have the capability to produce most vegetables needed by the plant. It is anticipated that some of the land now in pasture will be returned to its former cropland use.

In Lamar County the estimated value of land and buildings per farm has increased from $13,230 in 1954 to $20,315 in 1959. The average size farm has increased from 187 acres to 238 acres during the same period.

he value of land and buildings increased from about $71 per acre in 1954 to 85 in 1959. This is an increase of about 20 percent. Both the value per cre and the increase are below those usually found in prosperous agricul- ural areas. Value of land in the flood plain ranges from $50 per acre for requently flooded areas to $100 for areas flooded infrequently.

bout 90 percent of the livestock is sold through two local auctions and auled by truck to Fort Worth markets, a distance of 136 miles. Cotton ormally is sold to local buyers and compressed before shipment to terminal arkets. Most of the corn, hay and vegetables are sold and consumed locally.

here is no production of oil or natural gas in the watershed. Paris, with population estimated at 21,000 in 1960, is located partially in the water- hed. It is the county seat of Lamar County and is the banking, commercial, nd industrial center for a considerable portion of northeast Texas and outheast Oklahoma. The small villages of Givens, Reno, Caviness, Faught, rout and Powderly are located in the watershed.

amar County has been designated as an area of underemployment under the rea Redevelopment Act.

he watershed has approximately 232 miles of roads, of which 72 miles are aved. Adequate loading facilities and rail transportation are available n Paris over the Texas and Pacific, Santa Fe, Frisco and Southern Pacific ailroads.

and Treatment Data

ne watershed is located in the North Texas Soil Conservation District. echnical assistance is furnished by the Soil Conservation Service Work Unit t Paris. Of the 575 landowners in the watershed, 293 are now cooperating ith the district in the application of land treatment measures. Basic oil and water conservation plans have been prepared for 279 farms, of which 40 need to be revised. A total of 25 percent of all needed land treatment easures have been applied to date.

WATERSHED PROBLEMS

loodwater Damage

ne flood plain area that would be covered on an average of once in 25 years omprises 12,900 acres (figure 4). This area was first cultivated during ne early settlement of Lamar County. Frequent flooding has resulted in etirement of most of the cultivated flood plain land to pasture and wooded asture. Cultivation has been discontinued on some of the more frequently looded reaches.

Uncontrolled floodwater inundates valuable bottom land along Pine Creek below U. S. Highway 271. April 27, 1957.

Crop and pasture lands are damaged by floodwater one mile below Lake Crook after a 5-inch rain. June 23, 1959.

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n average of four floods occur annually on Pine Creek, causing severe damage. f the 76 floods studied during the 20-year evaluation period, 1941 through 960, 40 covered more than half of the flood plain. In this evaluation the atter are classed as major floods. Many of the floods occurred during the rowing season, causing extensive crop damage. Often, planting operations ere delayed until after the optimum planting dates. The largest storm in he 20-year period, which occurred on November 2, 1946, flooded approximately 2,000 acres. Damage from this flood was less than that from the flood of pril 26 - 27, 1957, which covered 9,900 acres. Since the latter flood ccurred near the start of the growing season, estimated floodwater damage xceeded $113,500.

nder non-project conditions the average annual direct monetary floodwater amage is $211,587, of which $163,300 is crop and pasture, $41,861 is other gricultural, and $6,426 is non-agricultural damage to roads and bridges. ndirect damages such as interruption of travel, extra travel for school us and mail routes, loss in condition of livestock, extra expense of feed o replace pasture and similar losses average $16,332 annually.

ediment Damage

ne present rates of sediment production are low but have been high in the ast. Extensive cultivation in this region began on the sandy timbered oils of the uplands and sandy bottom lands of the Red River. It spread to ne clay prairie soils about 1875 when the railroad was extended to Paris. ultivation of clean tilled crops, predominantly cotton, resulted in severe oil erosion and high rates of sediment production. Conservation practices tarted in the 1930's. Adjustments in agriculture have resulted in a change rom cropland to grassland and a general improvement of all cover in the atershed.

ery little overbank deposition of sediment is occurring on flood plain ands. Old deposits of silty clays, clay loams, and sandy loams, ranging n depths from one to four feet, are found over a large part of the flood lain. Reduction in upland erosion during the last 20 to 30 years has esulted in a high rate of recovery on old damaged areas.

wamping on a large area of the flood plain has caused major problems uch as impeded surface drainage due to the sediment filled outlets, a aised water table, and more frequent overflows. The largest and most everely damaged area is in the vicinity of valley sections 20 to 23 in valuation reach 3 (figure 4). Less severely damaged areas occur in other ortions of evaluation reaches 3 and 3A. Approximately 2,200 acres of flood lain lands are damaged from 20 to 60 percent by swamping. Of this area, 00 acres of former cropland and open pasture have become wetland woods ince 1940. The estimated average annual monetary damage due to swamping s $7,615.

etailed sedimentation surveys were made by the Soil Conservation Service n both Lake Gibbons and Lake Crook in 1936 and again in 1956. The 1936 urvey on Lake Crook showed that the original capacity had been reduced rom 11,487 acre-feet to 10,755 acre-feet. This represents an average nnual sediment accumulation of 56 acre-feet. In 1956 the capacity had been urther reduced to 9,964 acre-feet. However, the average annual rate for the eriod 1936 through 1956 was only 40 acre-feet.

etailed investigations of land use practices and erosion conditions in the rainage area above Lake Crook indicate that the present average annual ate of sediment deposition in the reservoir has been reduced to approxi-ately 34 acre-feet. The average annual monetary value of this damage is stimated to be $2,557.

rosion Damage

he present upland erosion rates are low because less than 7 percent of the plands are in cultivation and vegetative cover is generally good. Of the otal estimated upland annual gross erosion, 95 percent is derived from heet erosion, 4 percent from gully erosion, and 1 percent from streambank rosion.

lood plain erosion also is low since most of the lands subject to scour amage have been returned to grass. This has resulted in a reduction of amages and a speed-up in the restoration of productivity on the damaged reas. Scour damage is confined to about 62 acres in evaluation reaches 3, A, 6 and 7 (figure 4). The reduction in the productive capability of the oil ranges from 10 to 40 percent. The estimated average annual damage from lood plain scour is $195.

roblems Relating to Water Management

rainage problems are concentrated in evaluation reaches 3 and 3A. The xisting Pine Creek channel is adequate to serve as a major outlet for n-farm drainage systems in this section. On-farm drainage will meet the rainage needs when the frequency of flooding is reduced and financing can e obtained. Isolated areas needing some on-farm drainage are scattered lsewhere in the watershed. Needs for these small areas can be met by inor on-farm systems.

here is no interest in developing additional storage of water for irriga-ion. Four permits to divert 1,596 acre-feet of water from Pine Creek ave been issued by the Texas Water Commission.

he city of Paris has permits to impound 15,600 acre-feet of water for unicipal and domestic use. Most of the storage capacity for this water s in Lake Crook and Lake Gibbons. Demands have been met from these ources. However, a large industry, which is scheduled for operation in 964, will require 3.6 million gallons daily during warm weather. The verage ultimate demand for the plant is expected to be 7 million gallons aily. Total water demand with population increases and additional industry s expected to reach 11 million gallons daily during peak periods.

o meet these increased demands, 99,700 acre-feet of storage will be proided in the Pat Mayse Reservoir on Sanders Creek, an adjoining watershed. his is a Corps of Engineers project which has been authorized by the ongress.

ake Crook affords opportunities for fishing recreation. Lake Gibbons is ocated on the John C. Gambill Canada Goose Refuge. There is no interest n developing additional storage in any of the floodwater retarding tructures.

aris discharges its treated sewerage effluent into Pine Creek. Unless rovisions are made to increase treatment facilities, pollution may become serious problem.

PROJECTS OF OTHER AGENCIES

ake Gibbons and Lake Crook are city lakes used for municipal water storage. ake Gibbons has served as a standby water supply since the completion of ake Crook and has been used primarily for recreation, fish and wildlife. his lake and the surrounding land area have been managed as the John C. ambill Canada Goose Refuge by the city of Paris and the Texas Game and ish Commission since 1934.

here are no improvements by Federal Agencies in the watershed. However, Corps of Engineers project on nearby Sanders Creek has been authorized or construction. This multiple-purpose reservoir, located in Fannin and amar Counties, will be used by the city of Paris to supplement its water upply. It is planned that water will be pumped from Pat Mayse Reservoir nto Lake Crook as needed.

BASIS FOR PROJECT FORMULATION

fter a reconnaissance of the watershed by specialists of the planning arty, meetings were held with the local sponsoring organizations to iscuss existing problems and to formulate the objectives of a watershed rotection and flood prevention project. This watershed depends almost ntirely on agricultural enterprises for its source of income. Livestock arming is the major type of operation. Frequent flooding prevents ntensive land use and causes loss of livestock and severe damage to flood lain lands, crops, pastures, and other agricultural properties.

he opportunities for including storage capacities for purposes other than lood prevention were explained. Local responsibilities in connection with ompleting a project were discussed. The sponsoring organizations conidered the possibility of providing storage for flood prevention, agricultural and nonagricultural water management, recreation, and fish and

ildlife development. It was determined that a project for watershed pro-
ection and flood prevention most nearly met local needs and that no other
roup or individual was interested in obtaining additional storage for
ther purposes.

ne following specific objectives were named by local interests:

1. Establish land treatment measures which contribute directly to watershed protection and flood prevention,based on current needs and can be installed in a 5-year period.

2. Attain a 75 to 80 percent reduction in average annual flood damages on agricultural lands to insure sustained agricultural production on the flood plain and to maintain the economy of the watershed.

ne Soil Conservation Service agreed that the desired level of protection
as reasonable.

n selecting the sites for floodwater retarding structures, consideration as given to locations which would provide the desired level of protec-ion to areas subject to flood damage. The size, number, design, and cost f the structures were influenced by the location of the damaged areas, the omplex topography, the geologic conditions of the watershed, and the avail-bility of embankment fill material.

lternate designs for channel improvement were evaluated to determine the ost economical design. The recommended system of 19 floodwater retarding tructures and 19.5 miles of channel improvement meet the project objectives y providing the desired level of protection for agricultural enterprises f the watershed at least cost.

WORKS OF IMPROVEMENT TO BE INSTALLED

and Treatment Measures

armers and ranchers cooperating with the North Texas Soil Conservation istrict have applied some of the needed conservation practices on many arms. The use of each acre of agricultural land within its capabilities nd its treatment in accordance with its needs is necessary for a sound atershed protection and flood prevention project on the watershed.

good hydrologic vegetative cover is found on the watershed. However, arge portions of this cover will be replaced by more productive varities f grass. Use of proper pasture planting methods while making this onversion is most important to assure that runoff and erosion from these reas will not be increased. Proper pasture use and pasture and hayland enovation are needed to maintain good cover conditions. Seeding, proper se, deferred grazing, brush and weed control, and farm ponds will assure aintenance and improvement of rangeland vegetation. Other practices, ncluding agronomic and mechanical treatment, are needed on the remaining pland cultivated areas to decrease erosion.

tructural Measures

ineteen floodwater retarding structures and 19.5 miles of channel improve-ent will be constructed to provide flood protection to 11,731 acres of gricultural land in the flood plain of Pine Creek and its tributaries. ne estimated total cost of these measures is $3,059,901.

ne locations of the planned structural measures are shown on the project ap (figure 6).

ne proposed system of floodwater retarding structures will detain runoff from 4.9 percent of the entire watershed. The total capacity of the 19 flood-ater retarding structures is 36,173 acre-feet, of which 4,380 acre-feet is rovided for sediment accumulation over a 100-year period. The floodwater etarding structures will detain an average of 7.13 inches of runoff from the atershed area above them. This is equivalent to 3.20 inches of runoff from ne entire 119,040-acre watershed. In addition, an operation study indicates nat, on the average, 1700 acre-feet of flood capacity will be available in ake Crook. Sites 17 and 18 are planned in series because of storage limita-ions at site 18. The amount of runoff controlled by each structure is nown in table 3. Figure 1 shows a section of a typical floodwater retard-ng structure.

ne 19.5 miles of channel improvement will have capacity to carry the peak low of the 1-year frequency flood.

ome snagging and enlarging will be required in many lower reaches of the) tributaries that will enter the improved channel. In general the apacities of these tributaries above the mainstem flood plain are greater nan the channel capacity through the flood plain. When such upstream apacities exceed that required for a one-year discharge it is planned to rovide a one-year capacity through the flood plain. If the upstream apacity is less than the one-year requirement, an equal capacity will be rovided through the flood plain. The enlargement of these tributary nannels, where required, will be considered an appurtenance to the channel nprovement.

pproximately 195 grade stabilization structures consisting of standard orrugated metal pipe drops will be installed as appurtenances to the nproved channel. These structures will be installed to prevent erosion nere small shallow ditches enter the larger and deeper channel. The inimum capacity of the structures will be equal to the capacity of the pproach channel. Figure 2 shows a grade stabilization structure typical of hose planned for this watershed.

etails on quantities, costs and design features of structural measures are hown in tables 1, 2, 3, and 3A.

EXPLANATION OF INSTALLATION COSTS

ocal interests will install the land treatment measures listed in table 1 t an estimated cost of $1,422,200. This includes $30,000 for technical ssistance under Public Law 46 and ACPS payments based on present program riteria. It was determined that $52,000 of Public Law 566 funds will be eeded to furnish accelerated technical assistance. Of this amount, $5,600 s for completing soil surveys at an early date. The land treatment measures o be applied and the unit cost of each measure were estimated by the North exas Soil Conservation District and the Soil Conservation Service Work Unit t Paris.

he required local costs for structural measures, consisting of land ease-ents ($479,675); changes in utilities ($4,110); changes in pipe lines $19,569); road and bridge changes ($22,564); construction of water gaps $23,700); legal fees ($9,200); and administration of contracts ($10,000) re estimated at $568,818.

he estimated value of land for rights-of-way is based on appraisals made y the sponsors and concurred in by the Service. Lamar County, utility ompanies, and the city of Paris furnished cost estimates for modification f their facilities. Costs of water gaps are based on estimates of mater-al plus an allowance for labor and equipment which might be required.

he share of the cost of structural measures to be borne by Public Law 66 funds is $2,006,950 for construction and $484,133 for installation ervices.

he engineers' estimates of construction costs were based on unit costs of tructural measures constructed in similar areas. Ten percent of the ngineers estimate was added as a contingency to provide funds for npredictable construction costs. Geological investigations were limited o surface observations and borings with a portable power auger at the loodwater retarding structure site locations and along the proposed route f the improved channel. More detailed foundation and borrow area investi-ations will be made before construction begins.

nstallation services include engineering and administrative costs based n Service experience for similar works. The engineering portion of this ost consists of, but is not limited to, detail surveys, geological nvestigations, laboratory reports, designs, cartographic services and nspection services. All of the costs for the structural measures were llocated to flood prevention. Public Law 566 funds will bear the entire onstruction and installation services costs of these structural measures. ocal interests will bear all of the cost of land easements, rights-of-way, elocations, and administration of contracts.

he estimated schedule of obligations for the 5-year installation period overing installation of both land treatment and structural measures is as ollows:

iscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
1st	Sites 9, 10, 11, and 12, and Land Treatment	363,515	406,515	770,030
2nd	Sites 13, 14, 15, and 16 and Land Treatment	305,195	356,354	661,549
3rd	Sites 17, 18, and 19, and Land Treatment	250,137	337,220	587,357
4th	Sites 6, 7, 8, and Channel Improvement and Land Treatment	1,150,395	435,100	1,585,495
5th	Sites 1, 2, 3, 4, and 5, and Land Treatment	473,841	455,829	929,670
	Total	2,543,083	1,991,018	4,534,100

EFFECTS OF WORKS OF IMPROVEMENT

he combined program of land treatment and structural measures would eliminate amage on the mainstem of Pine Creek below Lake Crook from all 36 of the minor loods such as occurred during the 20-year evaluation period. All but 3 of he 40 remaining floods would be reduced to minor floods.

ad the project been in place at the time of the November 2, 1946 flood, the rea flooded would have been reduced from 12,000 acres to about 7,000 acres, reduction of 40 percent. The area flooded by a 25-year, 5-year, and -year frequency flood will be reduced by 41, 58, and 65 percent, respectively, fter the project is in place. The following tabulation shows by reaches the xpected reduction in flooding from the 2-year, 5-year, and 25-year frequency loods. The location of the reaches is shown on figure 4.

Area Inundated and Land Use 1/

Evaluation Reach	Average Recurrence Interval: 2-Year: Without Project	2-Year: With Project	5-Year: Without Project	5-Year: With Project	25-Year: Without Project	25-Year: With Project	Pasture	Wooded Pasture	Cultivated
	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)	(Percent)	(Percent)	(Percent)
1	26	0	259	0	516	0	42	8	50
2	1,291	434	1,512	797	1,818	1,654	9	51	40
3A	3,040	540	3,205	963	3,335	1,933	34	54	12
3	2,295	90	2,450	166	2,514	279	34	54	12
4	767	563	781	598	811	652	80	20	0
5	560	397	569	403	584	425	38	27	35
6	366	264	412	323	451	398	27	13	60
7	831	461	874	520	940	646	69	15	16
8	371	351	382	366	401	382	100	0	0
9	117	35	120	60	125	98	51	49	0
10	197	145	216	166	236	203	70	22	8
Subtotal	9,861	3,280	10,780	4,362	11,731	6,670	-	-	-
X 2/	274	274	357	357	515	515	79	21	0
Total	10,135	3,554	11,137	4,719	12,246	7,185	40	40	20

1/ Exclusive of flood plain area in floodwater retarding structure pools.

2/ Flood plain areas above floodwater retarding structures and on tributaries for which no structural control is planned.

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he combined program of land treatment and structural measures will reduce the nnual accumulation of sediment in Lake Crook from 34.3 acre-feet to 14.4 acre-eet. Land treatment measures will effect 29 percent of this reduction and loodwater retarding structures will account for the remainder.

and treatment measures will reduce by 15 percent the average annual sediment roduction rate from the watersheds of the 19 floodwater retarding structures.

ne area on which flood plain scour damage will occur is expected to be educed from 62 acres to 7 acres, a reduction of 88 percent.

ne improved channel will permit the farmers to restore to normal production ne 2,200 acres now damaged by swamping.

nis project will directly benefit about 85 owners of 11,731 acres of agricul-ural land. It is estimated that the value of land will increase by $100 per cre for cultivated land, $50 per acre for improved pasture and $25 per acre or wooded pasture.

ndirect damages will be reduced as a result of less frequent flooding. ractically all of the interruption of and extra travel for school busses nd mail carriers currently caused by flooded roads and washed out bridges ill be eliminated with the project installed.

wners and operators of flood plain lands report that they will restore ome of the formerly cultivated lands now in open pasture to higher value rop production with protection. In addition, it is expected that some ooded pasture will be restored to former levels of productivity as improved asture. This restoration of a portion of the flood plain land to its former evel of production will be made possible by the reduced area and depth of looding. Changes in crop distribution which will come about as a result of ne project are reflected in table A. There will be no increase in crops nder acreage allotment restrictions as a result of the project.

reconnaissance review of the project was made by the Bureau of Sport isheries and Wildlife, USDI and concurred in by the Texas Game and Fish ommission. Excerpts of their report state: "---that fish and waterfowl esources will be benefited and upland game will be adversely affected to minor extent by the watershed protection measures contemplated. Addi-ional fish habitat will be created ---. Waterfowl resources will be bene-ited by increased agriculture in the bottom lands and additional water reas provided by the reservoirs. Intensified farming will cause a loss valuable cover and denning areas for several species of upland game ---".

ne sediment pools of the floodwater retarding structures will provide ecreational facilities for fishing and picnicking to residents of the eighborhood. Such opportunities will decline gradually as the sediment ools fill. The facilities of these pools will not be competitive with arger nearby reservoirs as they will provide unique opportunities for un-rowded facilities. These will be benefits incidental to the flood preven-ion purpose as no additional project features will be needed for their ealization.

nstallation, operation and maintenance of the structural measures will rovide opportunities for the use of presently underemployed local labor.

ncreased farm production from the project will provide farm families with dditional income. In turn, this will be distributed through the community n the form of additional purchases to maintain a higher standard of living, mployment of additional labor, and demand for more services. Although ontractors have their own machine operators, they usually hire their un-killed labor for construction from local sources. The use of local nskilled labor will be especially helpful to the economy of the area as nderemployment is most serious with this class of labor.

n operation study was made to show the effect of the five upstream flood-ater retarding structures on Lake Crook. The following tabulation Lake Crook Reservoir Operation Study) shows the results of this study for 1), Lake Crook without floodwater retarding structures; (2) for the five loodwater retarding structures planned above Lake Crook; and (3), for ake Crook with the five planned structures. Included in the summary abulation are data showing annual precipitation at Paris, natural inflow, vaporation, demand, spillway flow and required water imports from Sanders reek. The average annual inflow to the five floodwater retarding structures s 15,433 acre-feet. The average annual outflow of 15,225 acre-feet is a eduction of 1.35 percent.

ne average annual inflow to Lake Crook will be reduced from 28,906 acre-feet o 28,699 acre-feet (0.7 percent) after the five floodwater retarding struc-ures are installed. However, available storage in Lake Crook will be pro-onged because sediment deposition will be reduced by 19.9 acre-feet per ear with the project installed.

o maintain Lake Crook at a minimum stage of three feet below the spillway evel without and with the structures will require an average annual import, rom Sanders Creek, of 1,173 and 1,273 acre-feet, respectively, or an ncrease of 100 acre-feet annually, with the planned floodwater retarding tructures installed.

ne maximum annual import of water (6,987 acre-feet without and 7,357 acre-eet with floodwater retarding structures) would have occurred in 1943. The aximum monthly import of 1,338 acre-feet would have occurred in September 956 and would not have changed with the floodwater retarding structures in lace. Thus, the size of pumping facilities to maintain Lake Crook at the inimum level used in the operation study would not be changed.

Lake Crook Reservoir Operation Study

Year	Lake Crook Without Floodwater Retarding Structures: Annual Precipi-tation	Inflow		Net Evapo-ration	Demand	Spill-way Flow	Water Import	Change in Content	Soil Conservation Service Structures: Inflow	Net Evapo-ration	Spill-way Flow	Change in Content	Reduc-tion in Inflow	Lake Crook With Floodwater Retarding Structures: Inflow	Net Evapo-ration	Demand	Spill-way Flow	Water Import	Change in Content	Reduc-tion in Inflow
	(inches)	(inches)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(pct.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(ac.ft.)	(pct.)
1941	48.56	9.07	25,666	386	8,427	17,317	0	- 464	13,704	74	3,630	0	0.5	25,592	387	8,427	17,336	0	- 558	0.3
1942	41.50	5.79	16,383	956	8,427	10,177	976	-2,201	8,746	191	8,555	0	2.2	16,192	952	8,427	10,088	1,181	-2,094	1.2
1943	26.61	1.04	2,943	1,918	8,427	0	6,987	- 415	1,571	453	1,186	-68	24.5	2,558	1,916	8,427	0	7,357	- 428	13.1
1944	53.13	11.65	32,964	498	8,427	21,317	358	3,080	17,600	102	17,430	68	1.0	32,796	490	8,427	21,397	598	3,080	0.5
1945	56.29	19.21	54,358	782	8,427	46,865	0	-1,716	29,022	164	28,941	-83	0.3	54,277	782	8,427	46,784	0	-1,716	0.1
1946	65.00	24.18	68,421	549	8,427	57,729	0	1,716	36,530	118	36,329	83	0.6	68,220	545	8,427	57,532	0	1,716	0.3
1947	40.01	3.59	10,158	971	8,427	2,636	1,694	- 182	5,423	212	5,211	0	3.9	9,946	969	8,427	2,691	2,001	- 140	2.1
1948	37.63	5.41	15,308	1,583	8,427	10,555	2,359	-2,898	8,154	348	7,806	0	4.3	14,960	1,571	8,427	10,644	2,742	-2,940	2.3
1949	43.96	7.03	19,893	728	8,427	11,809	1,071	0	10,621	157	10,509	-45	1.1	19,781	719	8,427	11,978	1,343	0	0.6
1950	50.02	13.02	36,842	448	8,427	27,409	0	558	19,670	81	19,647	-58	0.2	36,819	447	8,427	27,387	0	558	0.1
1951	40.41	9.07	25,693	1,330	8,427	14,463	286	1,759	13,718	277	13,357	84	2.6	25,332	1,331	8,427	14,140	325	1,759	1.4
1952	38.31	7.48	21,165	1,952	8,427	11,807	1,657	636	11,300	392	10,889	19	3.6	20,754	1,935	8,427	11,506	1,776	662	1.9
1953	44.31	6.01	17,006	921	8,427	7,531	0	127	9,080	189	8,891	0	2.1	16,817	920	8,427	7,369	0	101	1.1
1954	33.13	8.14	23,034	2,914	8,427	14,883	2,393	- 797	12,339	566	11,799	-26	4.4	22,494	2,913	8,427	14,344	2,393	- 797	2.3
1955	35.39	4.61	13,045	1,716	8,427	4,228	0	-1,326	6,964	365	6,683	-84	4.0	12,764	1,715	8,427	4,038	0	-1,416	2.2
1956	29.11	6.50	18,393	3,494	8,427	7,781	3,388	1,079	9,820	666	9,074	80	7.6	17,647	3,490	8,427	8,471	3,387	646	4.1
1957	75.65	27.39	77,505	- 497	8,427	69,227	0	348	41,380	-106	41,461	25	-0.2	77,586	- 489	8,427	68,777	0	871	-0.1
1958	42.35	9.02	25,523	- 37	8,427	18,244	0	-1,111	13,625	- 12	13,632	5	0	25,530	- 36	8,427	18,286	0	-1,147	0
1959	50.98	11.24	31,806	119	8,427	23,612	2,159	1,807	16,960	26	16,934	0	0.2	31,782	118	8,427	23,669	2,275	1,843	0.1
1960	57.90	14.85	42,021	- 419	8,427	34,134	121	0	22,434	- 95	22,529	0	0.4	42,126	- 420	8,427	34,203	84	0	-0.2
Total	910.25	204.31	578,127	20,312	168,540	412,724	23,449		308,661	4,168	304,493			573,973	20,255	168,540	410,640	25,462		
Average Annual	45.56	10.22	28,906	1,016	8,427	20,636	1,173		15,433	208	15,225		1.4	28,699	1,013	8,427	20,532	1,273		0.7

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loodwater detention capacity in the floodwater retarding structures will ffect a substantial reduction in peak discharges through the spillway of ake Crook. This will provide greater safety to the reservoir and reduce lood damages to installations on the lake and along the shore line. This lso may reduce construction cost if the city of Paris proceeds with a roposal to increase the capacity of Lake Crook.

oss in production will occur on 1,058 acres in the sediment pools and 2,989 cres located in the detention pools. Approximately 654 acres of flood plain re included in the pool areas. The land use in the pool areas is 79 percent asture and 21 percent wooded pasture.

PROJECT BENEFITS

he estimated average annual monetary floodwater, sediment, erosion, and ndirect damages within the watershed will be reduced from $238,286 to 39,052, a reduction of 84 percent, as shown in table 5.

he average annual damage reduction by evaluation reaches is presented elow:

Average Annual Damage 1/

valuation Reach	Without Project (dollars)	With Project (dollars)	Reduction (percent)
1	8,867	0	100 3/
2	34,792	5,450	84
3A	75,530	5,512	93
3	66,798	2,268	97
4	8,173	3,579	56
5	12,621	6,104	52
6	11,263	5,469	51
7	14,038	6,031	57
8	3,082	2,622	15
9	707	85	88
10	1,351	868	36
X 2/	1,064	1,064	0
Total	238,286	39,052	84

/ Includes restoration of former productivity.

/ Area for which no control is planned and area in floodwater retarding structure pools.

/ Except when flooded by the Red River.

enefits from the reduction of sediment deposition in Lake Crook are estiated to be $1,051 annually and were included in the average annual damage eduction benefits for evaluation reaches 4 and 5. Of this amount, $746 ccrues to the planned structural measures and $305 to land treatment easures.

t is estimated that the net increase from restoration of former producti- ity will amount to $58,634 (at long term price levels) annually. This loss rom the original production has been included in the crop and pasture damage nd its restoration a benefit in table 5.

t is estimated that the project will produce secondary benefits averaging 24,998 annually in the local area. Secondary benefits from a National iewpoint are not expected to be significant. Therefore only secondary enefits of a local or area nature were considered important in economic valuation and included as benefits.

edevelopment benefits from employment stemming from the project will amount o an annual value of $7,827.

he annual monetary value of incidental recreation benefits are estimated o be $3,468.

he total benefits from structural measures are estimated to be $232,460. n addition to the monetary benefits, there are other substantial benefits hich will accrue to the project such as an increased sense of security, etter living conditions, and improved wildlife habitat. None of these dditional benefits were evaluated in monetary terms; nor have they been sed for project justification.

he storm of April 26-27, 1957 produced a flood which inundated about ,900 acres and caused floodwater damage in excess of $113,500. Had the roject been in place, this storm would have flooded less than 3,200 acres nd produced damages less than $26,600, or a reduction of 68 percent in rea flooded and 76 percent in the amount of damages incurred. A storm of his magnitude is expected to occur on an average of once every 2 or 3 years.

COMPARISON OF BENEFITS AND COST

he average annual cost of structural measures (amortized from total instal- ation cost, plus operation and maintenance) is $109,023. The installation f the structural measures is expected to produce average annual primary enefits of $207,462. The ratio of primary benefits to cost will be 1.90:1.

otal benefits, including secondary benefits, from the structural measures ill provide a benefit-cost ratio of 2.13:1 (table 6).

PROJECT INSTALLATION

?armers and ranchers will establish the land treatment measures, itemized in :able 1, during the 5-year installation period. The North Texas Soil Conser-ation District will cooperate and will assist in the planning and applica-:ion of the conservation measures in the watershed. Its governing body will issume aggressive leadership in accelerating land treatment. The landowners vithin the watershed will be encouraged to adopt and carry out soil and vater conservation plans on their farms and ranches.

:he soil and water conservation loan program of the Farmers Home Administra-:ion is available to all eligible farmers and ranchers in the area. Educa-:ional meetings will be held in cooperation with other agencies to outline :he services available. Present FHA clients will be encouraged to cooperate .n the program.

:he County Agricultural Stabilization and Conservation committee will cooper-ite with the governing body of the soil conservation district in selecting nd providing financial assistance for those ACPS practices which will ccomplish the conservation objectives in the shortest possible time.

'he Extension Service will assist in the educational phase of the program y conducting general information and local farm meetings, preparing press, adio, and television releases, and using other methods of getting informa-ion to landowners and operators in the watershed.

'he Texas Forest Service will provide technical assistance to any landowner, pon request, on any phase of forest management activities. An active orest fire prevention program, U. S. Forest Service cooperating, was begun n April 1962.

'he Lamar County Water Control and Improvement District No. 3 and the Lamar ounty Commissioners Court have the right of eminent domain under applicable tate law and will obtain the necessary land, easements, and rights-of-way, ncluding utility, pipeline, road and improvement changes. The Commissioners ourt will determine the legal adequacy of easements, permits, etc., for the onstruction of the planned structural measures. The Lamar County Water ontrol and Improvement District No. 3 will provide necessary legal, admin-strative and clerical personnel, facilities, supplies and equipment to dvertise, award and administer contracts for all structural measures ncluded in the project.

he Soil Conservation Service will provide technical assistance in the esign, preparation of plans and specifications, supervision of construc-ion, preparation of contract payment estimates, final inspection, xecution of certificate of completion, and related tasks necessary to establish the planned structural measures.

he general sequence for installing the structural measures during the 5-year nstallation period is: First year sites 9, 10, 11, and 12; Second year sites 3, 14, 15, and 16; Third year sites 17, 18, and 19; Fourth year sites 6, 7, , and Channel Improvement; and Fifth year sites 1, 2, 3, 4, and 5. Since ite 17 is in series with and above site 18, it will be constructed prior to r simultaneously with site 18.

FINANCING PROJECT INSTALLATION

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

he Lamar County Water Control and Improvement District No. 3 is authorized y law "to levy, assess and collect taxes on land benefited by the construcion of dams and other flood control measures after the completion of such tructure by December 1 of the year for which the assessment is made". ualified voters of the district approved a tax rate of 50 cents on each cre of land within the district to be benefited by the structural measures. he tax is to be levied and collected annually after the completion of the irst structure by December 1 of the year for which the assessment is made. evenue from the tax can be used for acquiring rights-of-way, construction f works of improvement, and operation and maintenance purposes.

ne Lamar County Commissioners Court has entered into an agreement with the amar County Water Control and Improvement District No. 3 whereby the county greed to assume and guarantee the costs of land, easements and rights-ofay, and to use its power of eminent domain in securing land rights, if ecessary for all works of improvement in Lamar County on the Pine Creek atershed. In consideration of the guarantee of the necessary advancements nd expenditures to be made by the county, the Lamar County Water Control nd Improvement District No. 3 will reimburse the county for funds expended n its behalf.

ne sponsors do not plan to apply for a loan from the Farmers Home Administration.

ne cost of the land treatment measures will be borne by the individual armers and ranchers upon whose lands they will be installed. Federal cost haring will be available for those measures which are eligible for ACPS ayments based on present program criteria. Financing for the farmers and anchers share of the cost can be arranged through local lending institutions nd the Farmers Home Administration. The cost of technical assistance for oil surveys and to plan and apply the land treatment measures will be borne y Public Law 566 funds ($52,000) and Public Law 46 funds ($30,000).

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

1. The requirements for land treatment in the drainage area above structures have been satisfied.

2. All land, easements, and rights-of-way have been obtained for all structural measures or a written statement is furnished by the Lamar County Water Control and Improvement District No. 3, or the Lamar County Commissioners Court that its right of eminent domain will be used, if needed, to secure any remaining easements within the project installation period, and that sufficient funds are available to pay for those easements, permits and rights-of-way.

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

4. The contracting agency is prepared to discharge its responsibilities.

5. Project and operation and maintenance agreements have been executed.

6. Public Law 566 funds are available.

ıe various features of cooperation between the cooperating parties have ͽen covered in appropriate memoranda of understanding and working agreeͽnts.

PROVISIONS FOR OPERATION AND MAINTENANCE

ınd Treatment Measures

ınd treatment measures will be maintained by the landowners and operators : farms and ranches on which the measures are applied. Representatives of ıe soil conservation district will make periodic inspections of the land :eatment measures to determine maintenance needs. Landowners and operators ill be encouraged to perform the management practices and needed maintenance.

tructural Measures

he estimated annual operation and maintenance cost is $3,700 for the flood-ater retarding structures and $4,600 for the channel improvement and its ppurtenances based on long-term prices. The Lamar County Water Control and mprovement District No. 3 and the Lamar County Commissioners Court will be esponsible for operation and maintenance of the 19 floodwater retarding tructures and 19.5 miles of channel improvement, including appurtenant rade stabilization structures and tributary channels. The Lamar County ater Control and Improvement District No. 3 will establish a permanent eserve fund for operation and maintenance of structural measures in the ollowing manner and amounts: As floodwater retarding structures and channel nprovement are completed, $150 per year per structure and $150 per year per ile of channel improvement will be placed in a reserve fund for operation nd maintenance until the sum of $18,750 is established. The permanent reserve und will be maintained at this level by replacing used funds at the rate of 150 per structure and $150 per mile of channel per year. Funds for estab-ishing and maintaining the permanent reserve fund for operations and mainte-ance will come from tax revenue to be collected by the district. The current ax rate to be levied and collected is 50 cents per benefited acre within the istrict.

e Lamar County Commissioners Court will assume any and all expenses for eration and maintenance which exceed the resources of the Lamar County ater Control and Improvement District No. 3. Funds for this purpose will ome from existing county tax revenue which is available and adequate.

e necessary maintenance work will be accomplished through the use of ontributed labor and equipment, by contract, by force account, or a combi-ation of these methods.

e floodwater retarding structures and the channel improvement, including purtenances, will be inspected by representatives of the Lamar County ater Control and Improvement District No. 3 and the Lamar County Commis-ioners Court after each heavy streamflow or at least annually. A Soil onservation Service representative will participate in these inspections least annually. For the floodwater retarding structures, inspection ems covering features which may require attention will include, but will ot be limited to, the condition of the principal spillway and its appurte-ances, the earth fill, the emergency spillway, and the fences and gates nstalled as a part of the structure. For the channels, items of inspection ill include, but will not be limited to, the need for removal or control woody vegetation, removal of sediment bars, corrective measures to prevent lly erosion or head cutting and the condition of the appurtenant grade abilization structures.

e Soil Conservation Service, through the North Texas Soil Conservation istrict, will participate in operation and maintenance only to the extent f furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

rovisions will be made for free access of representatives of the Lamar ounty Water Control and Improvement District No. 3, the Lamar County ommissioners Court, and Federal representatives to inspect and provide aintenance for all structural measures and their appurtenances at any ime.

ie Lamar County Water Control and Improvement District No. 3 and the Lamar ounty Commissioners Court fully understand their obligations for operation id maintenance. Specific operation and maintenance agreements will be xecuted prior to the issuance of invitation to bid on construction of the tructural measures.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Pine Creek Watershed, Texas

Item	Unit	Number to be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other Funds	Total
D TREATMENT					
l Conservation Service					
nservation Cropping System	Acre	2,600	-	5,200	5,200
ntour Farming	Acre	1,400	-	1,400	1,400
ver and Green Manure Crop	Acre	1,800	-	25,900	25,900
op Residue Use	Acre	1,500	-	4,500	4,500
asses & Legumes in Rotation	Acre	300	-	3,800	3,800
yland Planting	Acre	1,200	-	15,000	15,000
sture & Hayland Renovation	Acre	12,000	-	172,800	172,800
sture Proper Use	Acre	25,500	-	25,500	25,500
sture Planting	Acre	12,000	-	549,000	549,000
nge Seeding	Acre	500	-	9,000	9,000
nge Proper Use	Acre	10,600	-	10,600	10,600
nge Deferred Grazing	Acre	3,000	-	3,000	3,000
ush & Weed Control	Acre	7,200	-	360,000	360,000
ldlife Habitat Development	Acre	900	-	22,500	22,500
itical Area Planting	Acre	40	-	2,400	2,400
ade Stabilization Structure	No.	20	-	20,000	20,000
version	Foot	46,200	-	3,700	3,700
rrace Gradient	Foot	63,400	-	2,500	2,500
assed Waterway or Outlet	Acre	80	-	9,600	9,600
rm Pond	No.	450	-	145,800	145,800
chnical Assistance			2/ 52,000	30,000	82,000
SCS Subtotal			52,000	1,422,200	1,474,200
L LAND TREATMENT			52,000	1,422,200	1,474,200
JCTURAL MEASURES					
l Conservation Service					
loodwater Retarding Structures	No.	19	1,269,180	-	1,269,180
ream Channel Improvement	Foot	103,000	737,770	-	737,770
SCS Subtotal			2,006,950	-	2,006,950
btotal - Construction			2,006,950	-	2,006,950
allation Services					
l Conservation Service					
gineering Service			307,647	-	307,647
her			176,486	-	176,486
SCS Subtotal			484,133	-	484,133
btotal - Installation Services			484,133	-	484,133
r Costs					
nd, Easements and Rights-of-Way			-	558,818	558,818
ministration of Contracts			-	10,000	10,000
btotal - Other			-	568,818	568,818
L STRUCTURAL MEASURES			2,491,083	568,818	3,059,901
L PROJECT			2,543,083	1,991,018	4,534,101
ARY					
btotal SCS			2,543,083	1,991,018	4,534,101
L PROJECT			2,543,083	1,991,018	4,534,101

Price Base: 1962
Includes $5,600 soil surveys.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Pine Creek Watershed, Texas

(Dollars) 1/

Structure Site No. or Name	Installation Cost - Public Law 566: Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566	Installation Cost - Other Funds: Other: Adm of Contracts	Other: Easements and R/W	Total Other	Total Installation Cost
1	96,250	14,534	8,447	119,231	500	56,550	57,050	176,281
2	74,800	12,417	6,650	93,867	500	34,789	35,289	129,156
3	85,580	13,522	7,556	106,658	500	40,000	40,500	147,158
4	51,480	9.987	4,686	66,153	500	15,050	15,550	81,703
5	61,050	10,989	5,493	77,532	500	22,500	23,000	100,532
6	99,880	14,982	8,758	123,620	500	32,535	33,035	156,655
7	50,380	9,522	4,568	64,470	500	11,800	12,300	76,770
8	48,510	9,653	4,435	62,598	500	12,425	12,925	75,523
9	58,850	10,711	5,304	74,865	500	36,500	37,000	111,865
10	42,570	8,982	3,931	55,483	500	10,275	10,775	66,258
11	97,350	14,700	8,544	120,594	500	41,950	42,450	163,044
12	81,840	13,094	7,239	102,173	500	31,350	31,850	134,023
13	58,080	10,629	5,239	73,948	500	20,814	21,314	95,262
14	65,560	11,473	5,874	82,907	500	18,150	18,650	101,557
15	37,070	8,415	3,468	48,953	500	8,800	9,300	58,253
16	70,730	11,953	6,304	88,987	500	22,150	22,650	111,637
17	66,770	11,551	5,972	84,293	500	18,900	19,400	103,693
18	64,900	11,358	5,815	82,073	500	17,550	18,050	100,123
19	57,530	10,643	5,198	73,371	500	14,830	15,330	88,701
Subtotal	1,269,180	219,115	113,481	1,601,776	9,500	466,918	476,418	2,078,194
Channel Improvement 2/	737,770	88,532	63,005	889,307	500	91,900	92,400	981,707
GRAND TOTAL	2,006,950	307,647	176,486	2,491,083	10,000	558,818	568,818	3,059,901

1/ Price base: 1962.

2/ Includes appurtenant grade stabilization structures and enlargement of tributary channels where required.

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES
Pine Creek Watershed, Texas

Item	Vnit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9	10
Drainage Area 1/	Sq.Mi.	10.64	4.42	7.51	2.17	3.59	5.17	1.62	2.02	6.50	1.87
Storage Capacity											
Sediment Pool (50-year or 200 acre-feet limit)	Ac.Ft.	199	146	196	81	109	146	78	71	159	33
Sediment Reserve (Below Riser)	At.Ft.	386	141	212	80	107	143	76	71	156	32
Sediment in Detention Pool	Ac.Ft.	56	19	20	16	21	28	14	13	31	10
Floodwater Pool	Ac.Ft.	4,183	2,205	2,908	812	1,410	1,779	605	782	2,496	683
Total	Ac.Ft.	4,824	2,511	3,336	989	1,647	2,096	773	937	2,842	758
Surface Area											
Sediment Pool (50-Year or 200 acre-feet limit)	Acre	77	44	53	22	40	46	25	25	57	13
Sediment Reserve Pool (Top of Riser)	Acte	145	67	95	39	57	71	38	36	84	16
Floodwater Pool	Acre	525	272	365	132	191	231	99	111	312	99
Volume of Fill	Cu.Yd.	172,400	140,000	159,000	91,000	109,400	163,600	91,700	91,100	84,300	67,600
Elevation Top of Dam	Foot	534.3	550.4	535.8	536.2	512.5	498.6	508.5	478.7	492.2	508.5
Maximum Height of Dam 2/	Foot	33	32	34	31	29	33	30	29	31	30
Emergency Spillway											
Crest Elevation	Foot	530.5	546.0	532.0	532.5	509.0	495.0	505.5	474.5	489.0	505.5
Bottom Width	Foot	160	200	160	50	100	140	80	50	160	80
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 3/		3.3	1.7	3.3	3.8	3.6	4.3	3.8	3.8	3.1	3.2
Average Curve No. - Condition II		82	82	81	81	82	82	82	82	78	75
Emergency Spillway Hydrograph											
Storm Rainfall (6-hour) 4/	Inch	6.11	9.71	6.28	6.67	6.60	6.42	6.74	6.69	6.34	6.71
Storm Runoff	Inch	4.08	7.50	4.14	4.50	4.54	4.37	4.67	4.62	3.89	3.89
Velocity of Flow (V_c) 5/	Ft./Sec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discharge Rate	C.F.S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Water Surface Elevation 6/	Foot	-	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph											
Storm Rainfall (6-hour) 7/	Inch	14.41	21.76	14.82	15.73	15.60	15.15	15.91	15.79	14.95	15.82
Storm Runoff	Inch	12.07	19.33	12.33	13.27	13.24	12.79	13.54	13.42	12.04	12.42
Velocity of Flow (V_c) 8/	Ft./Set.	8.30	8.75	8.15	8.10	8.00	8.00	7.20	8.70	7.65	7.35
Discharge Rate 6/	C.F.S.	2,855	4,315	2,720	832	1,591	2,260	930	1,047	2,228	978
Maximum Water Surface Elevation 6/	Foot	534.3	550.4	535.8	536.2	512.5	498.6	508.5	478.7	492.2	508.5
Principal Spillway											
Capacity - Low Stage (Maximum)	C.F.S.	85	35	60	18	29	60	20	13	52	12
Capatity Equivalents											
Sediment Volume	Inch	0.35	0.62	0.49	0.70	0.57	0.53	0.90	0.66	0.46	0.33
Sediment Reserve Volume (Below Riser)	Inch	0.68	0.60	0.53	0.69	0.56	0.52	0.88	0.66	0.45	0.32
Sediment in Detention Pool	Inch	0.10	0.08	0.05	0.14	0.11	0.10	0.17	0.12	0.09	0.10
Detention Volume	Inch	7.37	9.35	7.26	7.02	7.36	6.45	7.00	7.26	7.20	6.85
Spillway Storage 9/	Inth	4.10	6.20	4.07	4.85	4.30	3.45	3.75	5.05	3.25	3.45
Class of Structure		A	B	A	A	A	A	A	A	A	A

(Footnotes on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pine Creek Watershed, Texas

Item	Unit	Structure Number 11	12	13	14	15	16	17	18	19	Total
Drainage Area 1/	Sq.Mi.	8.49	6.67	3.37	2.84	1.13	5.61	3.86	2.67	3.43	83.58
Storage Capacity											
Sediment Pool (50-year or 200 acre-feet limit)	Ac.Ft.	154	114	66	42	43	72	64	54	75	1,902
Sediment Reserve (Below Riser)	Ac.Ft.	154	114	65	41	41	72	62	54	73	2,080
Sediment in Detention Pool	Ac.Ft.	36	28	18	12	5	21	18	17	15	398
Floodwater Pool	Ac.Ft.	3,301	2,501	1,289	844	432	1,893	1,451	1,028	1,191	31,793
Total	Ac.Ft.	3,645	2,757	1,438	939	521	2,058	1,595	1,153	1,354	36,173
Surface Area											
Sediment Pool (50-year or 200 acre-feet limit)	Acre	64	42	25	20	14	28	22	25	28	670
Sediment Reserve Pool (Top of Riser)	Acre	100	65	38	31	25	42	32	38	39	1,058
Floodwater Pool	Acre	389	307	159	146	75	208	171	133	122	4,047
Volume of Fill	Cu.Yd.	169,700	155,500	112,000	86,400	65,500	118,000	107,300	93,900	97,200	2,175,600
Elevation Top of Dam	Foot	478.3	480.0	495.2	447.8	471.0	456.5	474.5	434.6	440.8	xxx
Maximum Height of Dam 2/	Foot	31	28	29	22	28	35	35	26	35	xxx
Emergency Spillway											
Crest Elevation	Foot	475.0	476.0	491.5	445.5	468.0	452.0	470.5	430.5	437.0	xxx
Bottom Width	Foot	160	160	100	300	50	100	80	100	100	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		3.0	3.7	3.4	4.8	3.8	3.7	3.3	3.2	3.2	xxx
Average Curve No. - Condition II		81	80	80	75	81	75	79	79	74	xxx
Emergency Spillway Hydrograph											
Storm Rainfall (6-hour) 4/	Inch	6.23	6.33	6.55	6.60	6.82	6.40	6.52	6.61	6.55	xxx
Storm Runoff	Inch	4.09	4.08	4.28	3.79	4.63	3.62	4.15	4.23	3.66	xxx
Velocity of Flow (Vc) 5/	Ft./Sec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Discharge Rate	C.F.S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Maximum Water Surface Elevation 6/	Foot	-	-	-	-	-	-	-	-	-	xxx
Freeboard Hydrograph											
Storm Rainfall (6-hour) 7/	Inch	14.70	14.94	15.46	15.58	16.10	15.09	15.38	15.60	15.46	xxx
Storm Runoff	Inch	12.21	12.32	12.82	12.19	13.58	11.71	12.59	12.81	11.93	xxx
Velocity of Flow (Vc) 8/	Ft./Sec.	7.45	8.50	8.20	6.00	7.30	9.10	8.45	8.50	8.25	xxx
Discharge Rate 6/	C.F.S.	2,048	3,068	1,748	2,002	598	2,380	1,519	1,927	1,747	xxx
Maximum Water Surface Elevation 6/	Foot	478.3	480.0	495.2	447.8	471.0	456.5	474.5	434.6	440.8	xxx
Principal Spillway											
Capacity - Low Stage (Maximum)	C.F.S.	102	42	27	28	7	35	31	53	28	xxx
Capacity Equivalents											
Sediment Volume	Inch	0.34	0.32	0.37	0.28	0.72	0.24	0.31	0.38	0.41	xxx
Sediment Reserve Volume (Below Riser)	Inch	0.34	0.32	0.36	0.27	0.67	0.24	0.30	0.38	0.40	xxx
Sediment in Detention Pool	Inch	0.08	0.08	0.10	0.08	0.08	0.07	0.09	0.12	0.08	xxx
Detention Volume	Inch	7.29	7.03	7.17	5.57	7.18	6.33	7.05	7.22	6.51	xxx
Spillway Storage 9/	Inch	3.30	4.04	3.75	2.50	4.35	3.52	3.80	4.55	2.80	xxx
Class of Structure		A	A	A	A	A	A	A	A	A	

1/ Excluding the area from which runoff is controlled by other structures.
2/ Difference in elevation between the top of the settled dam and the bottom of the stream channel.
3/ Is the average number of times the emergency spillway will be expected to function in 100 years based on a regional analysis of gaged runoff.
4/ For Class A structures, .5 x P of the 6-hour rainfall shown by Figure 3.21, NEH-4, Supplement A, 0.75 x P for Class B structures.
5/ Where velocity is shown it was obtained from the formula V=Q/A and was determined from the routed H_p and Q. Critical velocity was not attained by any of the routings of the emergency spillway hydrograph due to little or no flow.
6/ Values obtained from routings.
7/ For Class A structures 1.18 x P for 6-hour rainfall shown on Figure 3.21-1, NEH, Section 4, Supplement A, and 1.68 x P for Class B structures.
8/ Obtained from curves drawn from Figure 4-R-11472, revised 3-59, and ES 98, dated 4-27-55, based on flows obtained from graphical routing of the Freeboard Hydrograph.
9/ Watershed inches stored between the emergency spillway crest and the top of the settled dam.

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Pine Creek Watershed, Texas

Item	Unit	11	12	13	14	15	16	17	18	19	Total
		STRUCTURE NUMBER									
Drainage Area 1/	Sq.Mi.	8.49	6.67	3.37	2.84	1.13	5.61	3.86	2.67	3.43	83.58
Storage Capacity											
Sediment Pool (50-year or 200 acre-feet limit)	Ac.Ft.	154	114	66	42	43	72	64	54	75	1,902
Sediment Reserve (Below Riser)	Ac.Ft.	154	114	65	41	41	72	62	54	73	2,080
Sediment in Detention Pool	Ac.Ft.	36	28	18	12	5	21	18	17	15	398
Floodwater Pool	Ac.Ft.	3,301	2,501	1,289	844	432	1,893	1,451	1,028	1,191	31,793
Total	Ac.Ft.	3,645	2,757	1,438	939	521	2,058	1,595	1,153	1,354	36,173
Surface Area											
Sediment Pool (50-year or 200 acre-feet limit)	Acre	64	42	25	20	14	28	22	25	28	670
Sediment Reserve Pool (Top of Riser)	Acre	100	65	38	31	25	42	32	38	39	1,058
Floodwater Pool	Acre	389	307	159	146	75	208	171	133	122	4,047
Volume of Fill	Cu.Yd.	169,700	155,500	112,000	86,400	65,500	118,000	107,300	93,900	97,200	2,175,600
Elevation Top of Dam	Foot	478.3	480.0	495.2	447.8	471.0	456.5	474.5	434.6	440.8	xxx
Maximum Height of Dam 2/	Foot	31	28	29	22	28	35	35	26	35	xxx
Emergency Spillway											
Crest Elevation	Foot	475.0	476.0	491.5	445.5	468.0	452.0	470.5	430.5	437.0	xxx
Bottom Width	Foot	160	160	100	300	50	100	80	100	100	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		3.0	3.7	3.4	4.8	3.8	3.7	3.3	3.2	3.2	xxx
Average Curve No. - Condition II		81	80	80	75	81	75	79	79	74	xxx
Emergency Spillway Hydrograph											
Storm Rainfall (6-hour) 4/	Inch	6.23	6.33	6.55	6.60	6.82	6.40	6.52	6.61	6.55	xxx
Storm Runoff	Inch	4.09	4.08	4.28	3.79	4.63	3.62	4.15	4.23	3.66	xxx
Velocity of Flow (V_t) 5/	Ft./Sec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Discharge Rate	C.F.S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Maximum Water Surface Elevation 6/	Foot	-	-	-	-	-	-	-	-	-	xxx
Freeboard Hydrograph											
Storm Rainfall (6-hour) 7/	Inch	14.70	14.94	15.46	15.58	16.10	15.09	15.38	15.60	15.46	xxx
Storm Runoff	Inch	12.21	12.32	12.82	12.19	13.58	11.71	12.59	12.81	11.93	xxx
Velocity of Flow (V_c) 8/	Ft./Sec.	7.45	8.50	8.20	6.00	7.30	9.10	8.45	8.50	8.25	xxx
Discharge Rate 6/	C.F.S.	2,048	3,068	1,748	2,002	598	2,380	1,519	1,927	1,747	xxx
Maximum Water Surface Elevation 6/	Foot	478.3	480.0	495.2	447.8	471.0	456.5	474.5	434.6	440.8	xxx
Principal Spillway											
Capacity - Low Stage (Maximum)	C.F.S.	102	42	27	28	7	35	31	53	28	xxx
Capacity Equivalents											
Sediment Volume	Inch	0.34	0.32	0.37	0.28	0.72	0.24	0.31	0.38	0.41	xxx
Sediment Reserve Volume (Below Riser)	Inch	0.34	0.32	0.36	0.27	0.67	0.24	0.30	0.38	0.40	xxx
Sediment in Detention Pool	Inch	0.08	0.08	0.10	0.08	0.08	0.07	0.09	0.12	0.08	xxx
Detention Volume	Inch	7.29	7.03	7.17	5.57	7.18	6.33	7.05	7.22	6.51	xxx
Spillway Storage 9/	Inch	3.30	4.04	3.75	2.50	4.35	3.52	3.80	4.55	2.80	xxx
Class of Structure		A	A	A	A	A	A	A	A	A	

1/ Excluding the area from which runoff is controlled by other structures.
2/ Difference in elevation between the top of the settled dam and the bottom of the stream channel.
3/ Is the average number of times the emergency spillway will be expected to function in 100 years based on a regional analysis of gaged runoff.
4/ For Class A structures, .5 x P of the 6-hour rainfall shown by Figure 3.21, NEH-4, Supplement A, 0.75 x P for Class B structures.
5/ Where velocity is shown it was obtained from the formula V=Q/A and was determined from the routed H_p and Q. Critical velocity was not attained by any of the routings of the emergency spillway hydrograph due to little or no flow.
6/ Values obtained from routings.
7/ For Class A structures 1.18 x P for 6-hour rainfall shown on Figure 3.21-1, NEH, Section 4, Supplement A, and 1.68 x P for Class B structures.
8/ Obtained from curves drawn from Figure 4-R-11472, revised 3-59, and ES 98, dated 4-27-55, based on flows obtained from graphical routing of the Freeboard Hydrograph.
9/ Watershed inches stored between the emergency spillway crest and the top of the settled dam.

TABLE 4 - ANNUAL COST

Pine Creek Watershed, Texas

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Floodwater Retarding Structures 1 through 19 and 19.5 miles of Channel Improvement and Appurtenances	100,723	8,300	109,023
TOTAL	100,723	8,300	109,023

1/ Price base: 1962 prices amortized at 2.875 percent for 100 years for floodwater retarding structures and 50 years for channel improvement.

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

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Pine Creek Watershed, Texas
(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	Estimated Average Annual Damage: With Project	Damage Reduction Benefits
Floodwater			
Crop and Pasture	163,300	25,206	138,094
Other Agricultural	41,861	7,057	34,804
Road and Bridge	6,426	1,710	4,716
Subtotal	211,587	33,973	177,614
Sediment			
Swamping	7,615	0	7,615
Reduction to Lake Crook	2,557	1,506	1,051
Subtotal	10,172	1,506	8,666
Erosion			
Flood Plain Scour	195	23	172
Indirect Damage	16,332	3,550	12,782
TOTAL	238,286	39,052	199,234

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

November 1962

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Pine Creek Watershed, Texas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/ Flood Prevention: Damage Reduction	Incidental Recreation	Secondary	Redevelopment	Total	Average Annual Cost 2/	Benefit Cost Ratio
Floodwater Retarding Structures 1 through 19 and 19.5 miles of Channel Improvement and Appurtenances	196,167	3,468	24,998	7,827	232,460	109,023	2.1:1
GRAND TOTAL 3/	196,167	3,468	24,998	7,827	232,460	109,023	2.1:1

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 $3,067 annually.

November 1962

INVESTIGATIONS AND ANALYSES

and Treatment Measures

he status of land treatment measures for the watershed was developed by upervisors of the North Texas Soil Conservation District with assistance rom personnel of the Soil Conservation Service Work Unit at Paris. The easures needed and those already applied were listed for each farm or group f farms on which conservation plans were available. This information was xpanded to represent the watershed. Amounts of land treatment practices lready applied, soil conditions, trends in farming operations, grassland over, and other pertinent data were used in estimating future land treat-ent needs. Estimates were made of practices that will be applied during he 5-year installation period for the entire watershed. The cost of these as based on current prices (table 1).

tructural Measures

base map of the watershed was prepared showing watershed boundary, drainage attern, systems of roads, utility lines, and other pertinent information. current ownership map of all farms in the watershed was prepared by the amar County Water Control and Improvement District Number 3.

study of photographs supplemented by field examination indicated the limits f flood plain subject to flood damage.

tereoscopic photo and topographic map studies and field examinations indi-ated 30 possible floodwater retarding structure site locations existed. tudies also indicated a need for extensive channel enlargement for the main tem of Pine Creek. This system of structural measures was recommended to he sponsoring local organizations for further consideration and detail sur-ey.

list of landowners whose farms probably would be affected by channel improve-ent and floodwater retarding structures was submitted to the local sponsors o facilitate their study of these structures.

ngineering surveys were started after agreement was reached with the spon-oring local organization on location of channels and floodwater retarding tructure sites to be studied. A base or reference line was surveyed for he channel. Profile and cross sections were made to obtain present capac-ties and to calculate volumes of excavation. For floodwater retarding tructure sites, topographic maps were made with a 4-foot contour interval nd a scale of 8 inches equal one mile. Topographic maps with a 2-foot ontour interval and a scale of 1 inch equals 100 feet were made for each mergency spillway. These surveys provided the necessary data to determine f the required sediment and floodwater detention storage could be obtained, stimate the installation cost, and determine the most economical design for ach structure. Criteria outlined in Engineering Memorandum SCS-27 and Texas tate Manual Supplement 2441 were used to determine the sediment and flood-ater detention storage requirements, structure classification, and principal nd emergency spillway design.

ata obtained in land treatment need studies as well as hydraulic, hydrologic, eologic, sedimentation, and economic investigations provided the necessary eans for evaluating floodwater retarding structures and channels in various ombinations. Plans of a floodwater retarding structure, typical of those lanned for the watershed, are illustrated by figures 3 and 3A. It was found hat to attain the desired degree of protection, channel improvement and a ystem of 19 or 20 floodwater retarding structures would be required and ould be feasible and economical. The two plans were reviewed with the sponoring local organizations for easement requirements and degree of protecion desired. At the request of the sponsoring organization it was agreed hat the plan would have 19 floodwater retarding structures and 19.5 miles f channel improvement. Limited studies showed that the proposed channel ould be stable.

ost distribution (table 2) and structure data tables (tables 3 and 3A) were repared to show for each structure: the estimated cost, drainage area, apacity needed for detention and for sediment storage in acre-feet and in nches of runoff from the drainage area, release rate of the principal spillay, acres inundated by the sediment and detention pools, volume of fill in he dam, and other pertinent data.

Hydraulic and Hydrologic Investigations

he following steps were taken as part of the hydraulic and hydrologic investiations and determinations:

1. Basic meteorologic and hydrologic data were tabulated for U. S. Weather Bureau Climatological Bulletins, and U. S. Geological Survey Water Supply Papers. These were analyzed to determine average precipitation, the historical flood series to be used in the evaluation of the project, and relationship of geology, soils, and climate to runoff depth for single storm events.

2. Engineering surveys were made of channel and valley cross sections selected to represent adequately the stream hydraulics and flood plain area. Preliminary locations for cross sections were made by stereoscopic examination of aerial photographs of the flood plain. The final locations were selected on the ground, giving due consideration to the needs of the economist and geologist. The evaluation reaches were delineated in conference with the economist and geologist.

3. The present hydrologic conditions of the watershed for evaluation purpose were determined by the hydrologist, geologist, work unit conservationist, and soil scientist using as a basis the existing land treatment, soil groups, and crop distribution. The hydrologic condition and runoff curve numbers were determined by investigating the soil-cover condition of representative site drainage areas. Results

of studies made by the United States Forest Service on the upland forest soils, were considered in determining the hydrologic conditions of the watershed. The area generally above Lake Crook was found to be in one hydrologic condition and the area below the lake in another.

Land treatment measures will permit the future hydrologic conditions of the watershed to remain the same. Favorable growing conditions in recent years have resulted in a good vegetative cover. Farmers and ranchers cooperating with the North Texas Soil Conservation District will maintain these conditions. Unless land treatment is emphasized there will be a period of some deterioration while better cover from a monetary standpoint is being established.

Runoff curve numbers were used with Figure 3.10-1, National Engineering Handbook, Section 4, Supplement A, to determine the depth of runoff from individual storms in the historical evaluation series.

4. Rating curves and stage-area inundated curves were computed with the IBM 650 computer from field survey data listed in item 2 above. Water surface profiles were solved for various discharges, using procedures described in United States Department of Agriculture, Soil Conservation Service, Technical Release 14, March 1, 1962, "Computation of Water Surface Profiles and Related Parameter by the IBM 650 Computer".

5. A tabulation of cumulative departure from normal precipitation showed the period 1941 through 1960 to be representative of normal. This period was used to develop the historical evaluation series. The series was limited to storms which did not exceed the 25-year frequency event. The evaluation series contained 76 storms or an average of 4 floods per year. One of these storms occurred at a time when the Red River was flooding evaluation reach 1. Therefore, this storm was not used in the evaluation of this reach.

6. The relationship of depth of runoff and frequency was obtained by plotting the annual storms on logarithmic normal (Hazen) paper and applying the appropriate runoff curve number. The annual series was converted to a partial duration frequency line using the procedure outlined in section 3.18, National Engineering Handbook, Section 4, Supplement A. The USWB gage records for Paris, Texas were used for the years 1923 through 1960.

7. A reservoir operation study was made on Lake Crook for the evaluation period (1941 through 1960). The city of Paris furnished information of expected demands in the immediate future and plans for the importation of water to Lake Crook from Sanders Creek. Watershed yields were based on individual storm rainfall-runoff analysis. These were correlated with stream gage records for the North Sulphur River.

   Demands on the reservoir were based on municipal and industrial needs for the city of Paris after the Campbell Soup Company is in full operation.

   The city planned that water demands will be met from Lake Crook but that the lake surface would not be drawn lower than three feet below the spillway. Water to maintain this level would be imported from Sanders Creek. The amounts of water needed from outside sources and that discharged through the spillway were determined. Under without project conditions, a plotting of storm runoff versus volume of spillway discharges revealed that an average of 0.6 inch of runoff would occur before spillway discharge would begin. A 3.0-inch flood volume routed through the reservoir would result in a peak discharge of 4,000 c.f.s.

   With a system of five floodwater retarding structures above Lake Crook, a 3.0-inch flood volume routed through the reservoir would produce a peak discharge of 625 c.f.s.

8. The relationship of peak discharge to runoff for the area below Lake Crook was determined by developing hydrographs for 0.6 and 3.0-inch volumes for incremental areas of the watershed. Storage routings through stream reaches using a variable time interval were made to determine the discharge at valley sections.

   The relationship of peak discharge to drainage area for the 53.06 square miles above Lake Crook was determined to be 4,200 cubic feet per second per inch of runoff. This discharge was related to other drainage areas above the lake by the concordant flow procedure, outlined in National Engineering Handbook, Section 4, Supplement A. The discharge per inch of runoff obtained by this method compared favorably with the discharges per inch of runoff obtained by the storage routings for similar sized drainage areas below Lake Crook.

9. Composite runoff-area inundated curves were developed for each evaluation reach.

10. Determinations were made of the area that would have been inundated by each storm in the evaluation series for each

of the following conditions:

a. The present condition of the watershed remaining static.

b. The installation of structural measures for flood prevention.

c. Alternate systems of flood prevention structures.

11. The improved channel was designed with a maximum permissible velocity of 5 feet per second. The stability of the channel was checked by critical tractive force for cohesive soils. Alternate channel size and alignments were evaluated to determine the most feasible design. Table 3A shows pertinent data for the improved channel.

12. Approximately 30 small tributaries enter the improved channel. To prevent erosion of the tributary channel and local flooding of the common flood plain, the channels of these tributaries were designed to carry the annual storm or the capacity of the tributary before it enters the common flood plain, whichever is the smaller.

It is estimated that 195 (10 per mile) standard pipe drops will be required as inlets to the improved channel to reduce erosion. The pipe drops will have a capacity equal to the discharge of the approach channel.

13. Detention volumes exceed the minimum criteria set forth in Engineering Memorandum SCS-27. Detention volumes exceed the Texas State Manual Supplement 2441 criteria in most sites to obtain a more economical or desirable emergency spillway or structure design. Percent chance of use of emergency spillway based on regional analysis of 2-day gaged runoff from similar watersheds, was determined by adding to the actual detention storage the volume which would be released by the principal spillways during a 2-day period.

14. The average principal spillway release rate is approximately 7 csm for the floodwater retarding structures.

15. The emergency spillway and freeborad 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.

16. Inflow hydrographs were developed for each site in the watershed. The principal spillway hydrographs represented a flood event

that will not be exceeded, on the average, more often than once in 25 years for Class (a) structures and 50 years for Class (b) structures. The emergency spillway and freeboard hydrogrphs were computed using moisture condition II with 0.5 and 1.18 for Class (a), and 0.75 and 1.68 for Class (b) structures, respectively, of the adjusted point rainfall for the 6-hour storm. Since routing of the emergency spillway hydrographs resulted in either no flow or very shallow flow the dimensions of the emergency spillways were determined from the freeboard hydrographs. Hydrographs were developed for each of the floodwater retarding structures by the the distribution graph method. An empirical equation was used to develop a curve to estimate a range of values from which the most economical spillway was determined. The final design was made by the flood routing method described on page 5.8-12 of the NEH, Section 5.

Geologic Investigations

reliminary geologic investigations were made at each floodwater retarding tructure site. These investigations included studies of exposed geologic ormations, valley slopes, alluvium, and channel banks. Borings with a ortable power auger were made at all sites to obtain preliminary informaion on depth to water table, depth to firm foundation, nature and extent f embankment materials and emergency spillway. Borings for channel stabilty studies were made at five valley cross sections to determine the nature f the soil and bed load material. Soil samples were collected from mateials located within and below the depth zone of the proposed new channel. echanical analyses of grain size, Atterberg limits, and laboratory tests or salt content and dispersion were made on three representative samples.

escription of Problems

errace deposits once covered the entire watershed. Subsequent erosion has emoved these deposits from the underlying Upper Cretaceous beds in the eadwaters and across the central portions of the watershed. Figure 5 was eveloped to show the location and extent of these deposits. Structure ites 9, 10, 13, 14, 16, 17 and 18 are located entirely within terrace deposts. Sites 1, 5, 6, 8, 11, and 12 are in the Bonham marl formation but have errace deposits under one abutment or parts of both abutments. Sites 3, , 7, and 15 are completely within the Bonham marl formation. Of the reaining two structures, site 2 is located in the Blossom sand and Brownsown marl formations and site 19 is in the Woodbine and Eagle Ford formations.

he terrace deposits consist of the following materials, listed in the order f predominance: clayey sands (SC), sandy clay (CL), silty sand (SM), and oorly graded sand (SP). Seepage through the permeable SM and SP materials robably will require installation of drainage measures at many of these ites.

eep weathering of the Brownstown and Bonham marls has produced clays classi-
ied as CH and CL. Soil materials of the Blossom sand consist mostly of SC
nd CL soils. Laboratory analyses of alluvial soils at site 11 showed moder-
te dispersion and slight soluable salt content. Slight to moderately dis-
ersed alluvial soils are suspected at all sites located in the upper part
f the Bonham marl formation (sites 7, 11, 12, and 13) and at site 2, located
n the Blossom sand.

he Eagle Ford formation consists mainly of soft sandstones which weather
nto silty sand (SM) soil materials. The Woodbine formation consists of
ayers of clay and crossbedded volcanic sands and tuffs. Weathering of
hese beds has produced clayey sand (SC) and sandy clay (CL) foundation
aterials at site 19. Borrow materials at this site consist predominant-
y of SM alluvium and colluvial deposits.

igh water tables exist under the surface of the alluvial valleys at all
ites except site 15. Depths to the water table range from 6 to 10 feet
ith 9 feet being most common. These measurements were taken during the
ummer growing season and will be shallower during the wet winter and spring
easons. Firm soil materials classified as CL and SC were found below the
ater tables at depths ranging from 10 to 14 feet.

orrow materials are ample and satisfactory at all sites. However, the
igh water tables will limit depth and amount of materials which will be
vailable from the sediment pool areas. Borrow areas probably will have
o be extended outside of the sediment pools at most sites.

ock is not expected in the emergency spillways. Excavated materials will
e suitable for use in some portions of the embankments.

he improved channel will be located in cohesive materials classified as
H and CL. It will follow the general course of the present channel. Depths
ill exceed those of the existing channel only in the severely aggraded
each above valley cross section 18. Field studies and observations indicate
hat the present channel is not eroding. Aggradation has occurred in evalua-
ion reach 3. The application of available procedures for determining
ritical tractive force values for compact, cohesive soils indicate that the
mproved channel also will be stable.

etailed geologic investigations and sampling with drilling equipment will
e made prior to final design.

Sedimentation Investigations

edimentation investigations for the work plan were made in accordance with
rocedures as outlined in Technical Release No. 17 (Tentative), "Geologic
nvestigations for Watershed Planning", March 1961, and Technical Release No.
2, "Procedures for Computing Sediment Requirements for Retarding Reservoirs",
eptember 1959, U. S. Department of Agriculture, Soil Conservation Service.

ediment Source Studies

etailed sediment source studies to determine the 100 year sediment storage equirements were made in the drainage areas of the 19 planned floodwater etarding structures according to the following procedures:

1. The field surveys included:

   a. Use of soil units by slope in percent, slope length, present land use, present cover condition classes, and land capability classes.

   b. Determining the lengths, depths, and estimating the annual lateral erosion of all gullies and stream channels affected by erosion.

2. Office computations included summarizing erosion by sources (sheet, gully, and streambank) in order to fit these data into formulas for computation of the gross erosion in tons.

3. The erosion rates were adjusted to reflect the effect of expected land treatment on the drainage areas of the planned floodwater retarding structures. The computed sediment storage requirement for each site is based on maintaining existing watershed conditions. Erosion rates were adjusted for expected delivery of annual gross erosion and trap efficiency of the floodwater retarding structures.

4. The ratio of sediment storage volume in the pools to soil in place was based on volume weights of 82 pounds per cubic foot (soil in place) and 42 pounds per cubic foot (sediment) for clays. Volume weights of 98 pounds per cubic foot for soil in place and 58 pounds per cubic foot for sediment was used for sandy soils. Volume weights between the above ranges were used for mixed clay, silt, and sand mixture.

5. The allocation of sediment to the structure pools ranged from 10 to 20 percent deposition in the detention pool and 80 to 90 percent deposition in the sediment pool, depending on variation of topography, channel slopes, and texture of the incoming sediment at each structure.

lood Plain Sedimentation and Scour Damage

he following sedimentation and scour damage investigations were made to valuate the nature and extent of physical damage to flood plain land:

1. Studies were made along each of the valley cross sections (figure 4) to determine extent and amount of sediment

damage, swamping, scouring, stream channel degradation or aggradation, and other factors contributing to flood plain damage.

2. Information obtained from interviews with landowners was used to supplement and substantiate flood plain damages. Damage from present overbank deposition was found to be insignificant, but swamping caused by older deposits was a problem.

3. Aerial photographs made in 1956 and 1958 were used to map scour and swamping damage. Old photographs (1940) were used to locate the more severely swamped areas in which formerly cultivated land and open pasture has reverted to bottomland woods.

4. Damage tables were developed to show percent damage by depth of scouring and estimated recovery after flooding is stopped.

5. Scour and swamping damages were measured and tabulated by evaluation reaches.

6. The reduction of scour damage is based on reductions in depth and area inundated. The complete reduction of swamping damage is based on channel improvement which will open sediment filled channels and lower the water tables in these areas.

Economic Investigations

asic methods used in the economic investigation and analysis are outlined n the Economics Guide issued December 1958.

etermination of Annual Benefits from Reduction in Damages

gricultural damage estimates were based upon schedules obtained from owners nd operators of flood plain property. The sample covered about 65 percent f the flood plain and was considered adequate and representative for the conomic evaluation. These schedules covered past and present land use, rop distribution under normal conditions, crop yields, and data on flooding and flood damage.

he flood plain land use was mapped in the field. Estimates of normal yields ere based on data obtained from the schedules and supplemental information rom agricultural workers in the area.

nalysis of this information formed the basis for determining damage rates or various depths and seasons of flooding. In calculating crop and pasture amage, expenses saved, such as costs of harvesting, were deducted from the ross value of the damage.

he proper rates of damage were applied to the floods covering the period 941-1960. An adjustment was made to take into account the effect of ecurrent flooding when several floods occurred within one year.

t was found that differences in land use, yields, frequency of flooding nd degree of future use justified division of the flood plain into eleven valuation reaches. A different damageable value was used for each reach ith exception of reach 3 and 3a. Reach 3 and 3a had the same damageable alue but were separated because of physical differences.

he location of the evaluation reaches as shown on figure 4 are:

Reach 1 - Mouth of Pine Creek through valley cross section 5.

Reach 2 - From valley cross section 5 through 11.

Reach 3a - Main stem and tributaries from valley cross section 11 through 20.

Reach 3 - Main stem and tributaries from valley cross section 20 to Lake Crook and B-1 through B-2.

Reach 4 - From Lake Crook to valley cross section to 33 and SB-1 through SB-3.

Reach 5 - From Lake Crook through valley cross section LP-5

Reach 6 - From valley cross section M-1 through M-6.

Reach 7 - From valley cross section SM-1 to SM-5 and SMA-1.

Reach 8 - From valley cross section SH-1 to SH-4.

Reach 9 - From valley cross section C-1 to C-4.

Reach 10 - From valley cross section H-1 to H-6.

Reach X - From valley cross section A7-1 through A7-3, 33 through 34, C-4 through C-7 and CA-1, U-1 through U-3, R-1, Q-2 through Q-3, B-3 through B-4, M-6 through M-7, SM-5 through SM-6, and SMB-1.

stimates of damages to other agricultural property such as fences, live-stock, on-farm roads and farm equipment were made from the analysis of flood lamage schedules.

he estimated monetary value of the physical damage to the flood plain from rosion was based on the value of production lost. The estimate took into ccount the lag in recovery of productivity and the cost of farm operations o speed recovery. Damage from erosion was related to depth of flooding, iving greater weight to deeper flows.

armers and ranchers were asked what changes they would make in their lood plain land use or cropping systems if flood protection were provided. hey indicated that they would make no changes in land use. Analysis of heir replies in connection with changes in cropping systems and other vailable information provided a basis for estimating benefits from restora-ion of productivity. Consideration was given to increased damage after estoration of productivity and this amount of damage was deducted from ross benefits. Among the factors considered in this analysis were the ize and location of the areas affected, land capability, acreage allot-ent restrictions, existence of available markets and reduction in fre-uency of flooding.

t is not expected that acreages of crops subject to acreage allotments ill be increased as a result of the project. Benefits from restoration f productivity are included as crop and pasture benefits.

11 benefits from flood plain restoration of productivity are net benefits emaining after production and harvest costs, additional costs for taxes nd overhead and clearing costs were subtracted where applicable. All enefits from restoration were discounted to provide for a 5-year lag in ccomplishment.

he straight-line depreciation method was used in evaluating the benefits hat are derived from reductions of sediment damage to the Lake Crook eservoir.

he value of local secondary benefits stemming from the project was con-idered to be equal to ten (10) percent of the direct primary project enefits. This excludes all indirect benefits from the computation of econdary benefits. The value of local secondary benefits induced by the roject was considered to be equal to ten (10) percent of the increased osts that primary producers will incur in connection with increased produc-ion.

econdary benefits from a national viewpoint were not considered pertinent o this economic evaluation.

edevelopment benefits which would accrue during project installation were alculated by applying prevailing wage rates to the amount of local labor y classes and types that will be used by the contractors. This estimate as then converted to an average annual equivalent value by the application f appropriate amortization factors. The estimate of the amount of local abor which will be used in project installation was based on an analysis of ecent contracts. Although it was recognized that benefits will be derived y employment of local labor in connection with operation and maintenance, o monetary value was assigned from this source.

tudies have been made in Texas and Oklahoma of the recreational use of ediment pools in watersheds similar to Pine Creek. These studies have hown that such pools fill a recreational need in the community by provi- ion of quiet locations for fishing, picnicking and, in some cases, boating nd water skiing. Many have such facilities as boat docks, picnic tables, nd sanitary facilities. They are often utilized by organizations such s Boy Scouts, Chambers of Commerce, Sunday Schools, or sportsmen's clubs. thers have served as informal community outdoor recreational centers. lany have been open to the public without charge or for a small fee. Their se does not appear to have been affected by nearby large bodies of water, s comparatively small, close-knit groups seem to be attracted by their acilities. Most of the studies have been in watersheds where cities com- arable in size to Paris would have been expected to have little effect n recreational demand.

'acts brought out by these studies were analyzed. They indicated that the ajor use of structures in Pine Creek watershed would be for fishing and icnicking. It was concluded that as sediment accumulated the use of the ools for recreation would decline and cease after 75 years. Visitor days f use based on the studies cited were estimated after comparison with tructures in this watershed. Net values per visitor day were determined fter deduction of associated costs of providing, operating and maintain- ng basic facilities. Allowance was made for the decline in use as sedi- ent accumulates. It was estimated that the structures would average 7,000 isitor-days use per year during the life of the project.

he value of easements was determined through local appraisal giving full onsideration to the real estate values involved. Flood plain areas which ill be inundated by the sediment and detention pools were excluded from he damage and benefit calculations. An estimate was made, however, of the alue of the production lost in the pool areas after installation of the rogram. In this appraisal it was considered that the sediment pool would ield no production. The land covered by the detention pools would con- inue to be used as pasture after installation of the program. The average nnual loss in production including the value of secondary effects within he structure sites was compared with the amortized value of easements. he easement value was found to be the greater and therefore was used in conomic justification to assure a conservative benefit-cost analysis.

Fish and Wildlife Investigations

he following is a summary of a reconnaissance study made by the Bureau of port Fisheries and Wildlife of the Fish and Wildlife Service, U. S. Depart- ent of Interior, and concurred in by the Texas Game and Fish Commission.

> "Our reconnaissance review of the project proposed for Pine Creek watershed indicates that fish and waterfowl resources

will be benefited and upland game will be adversely affected to a minor extent by the watershed-protection measures contemplated. Additional fish habitat will be created and the remaining stream habitat will be improved by the construction of reservoirs with pollution abatement provisions. Waterfowl resources will be benefited by increased agriculture in the bottom lands and additional water areas provided by the reservoirs. Intensified farming operations will cause a loss of valuable cover and denning areas for several species of upland game. Proper planning and application of wildlife conservation measures could prevent undue loss of critical habitat throughout the watershed.

"It is recommended:

(1) That the clearings for agriculture be made so as to retain as much vegetative cover as possible that is suitable for wildlife.

(2) That plantings made for soil protection and gully stabilization be of those species beneficial to wildlife.

(3) That areas potentially beneficial to wildlife be fenced to avoid grazing and unnecessary disturbance and be protected against loss from fire."

Table A - Representative Reach Showing Benefits From Restoration
Pine Creek Watershed, Texas

Land Use	Unit of Production	Without Project 1/					With Project 1/				
		Acres	Yield Per Acre	Gross Income	Production Cost	Net Return	Acres	Yield Per Acre	Gross Income	Production Cost	Net Return
				(dollars)	(dollars)	(dollars)			(dollars)	(dollars)	(dollars)
Cotton	Lb.Lt./Ac.	83	500	12,450	7,814	4,636	83	500	12,450	7,814	4,636
Corn	Bu.	28	50	1,946	1,151	795	48	50	3,336	1,973	1,363
Alfalfa	Ton	56	5.0	7,644	2,800	4,844	356	5.0	48,594	17,800	30,794
Clover and Vetch	Ton	111	4.0	9,990	4,662	5,328	211	4.0	18,990	8,862	10,128
Vegetables	Ton	56	6.25	8,400	6,720	1,680	156	6.25	23,400	16,099	7,301
Improved Pasture	AUM	945	6.0	11,737	1,418	10,319	745	6.0	9,253	1,118	8,135
Wooded Pasture	AUM	1,446	2.0	5,986	2,169	3,817	1,126	2.0	4,662	1,689	2,973
Miscellaneous Land Use	-	56	-	-	-	-	56	-	-	-	-
Total		2,781	-	58,153	26,734	31,419	2,781	-	120,685	55,355	65,330

Increased net return with project	$33,911
Less associated cost	2,158
Discount for lag in accrual	2,731
Discounted average annual benefits from restoration (Long-term price)	29,022

1/ Based on flood-free yields.

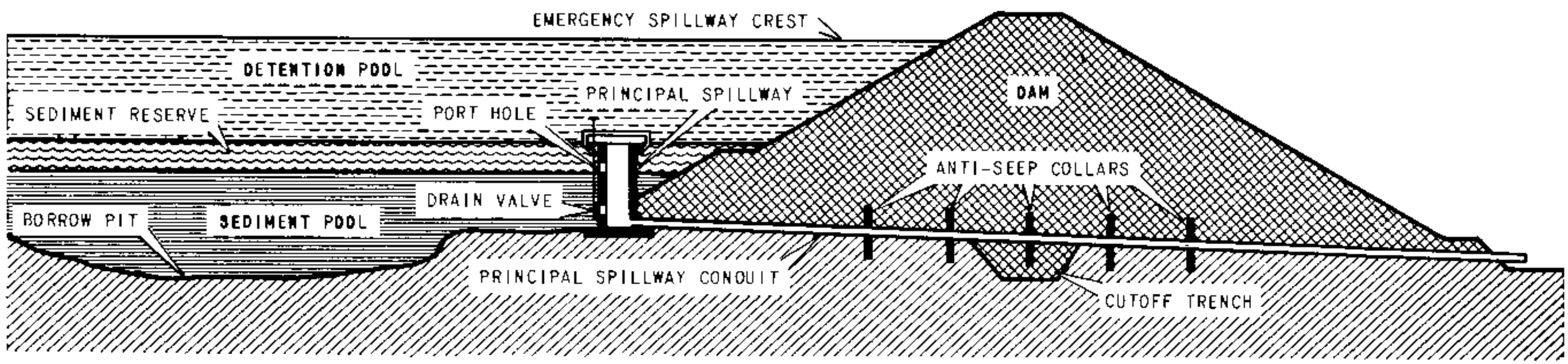


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

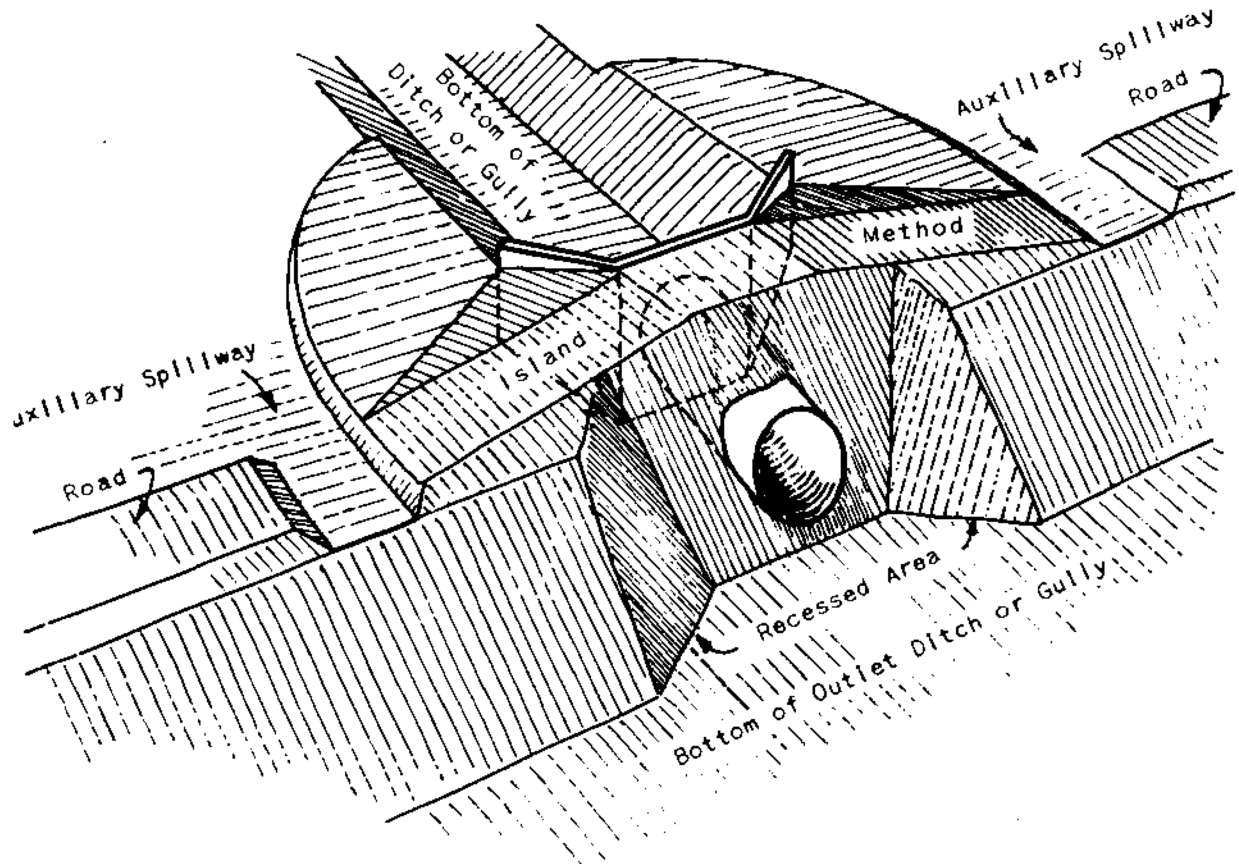
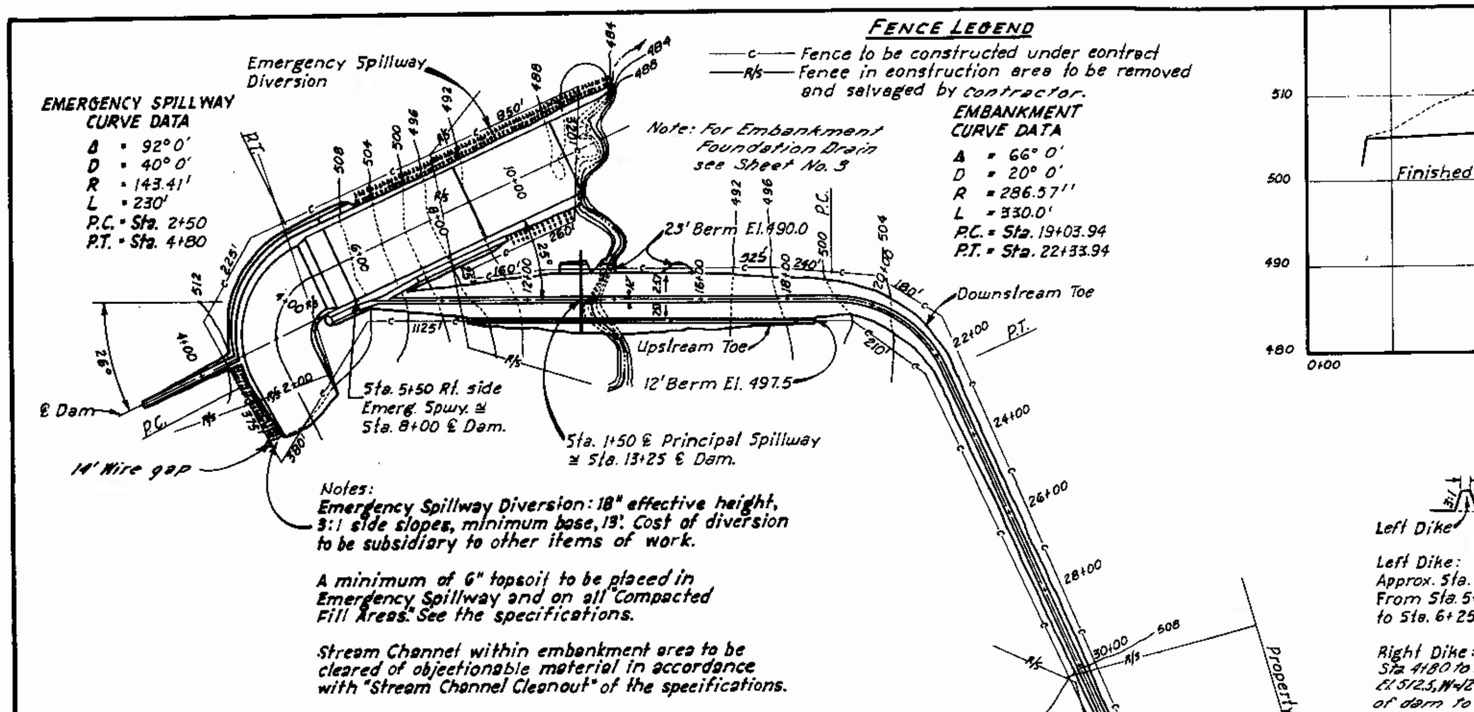
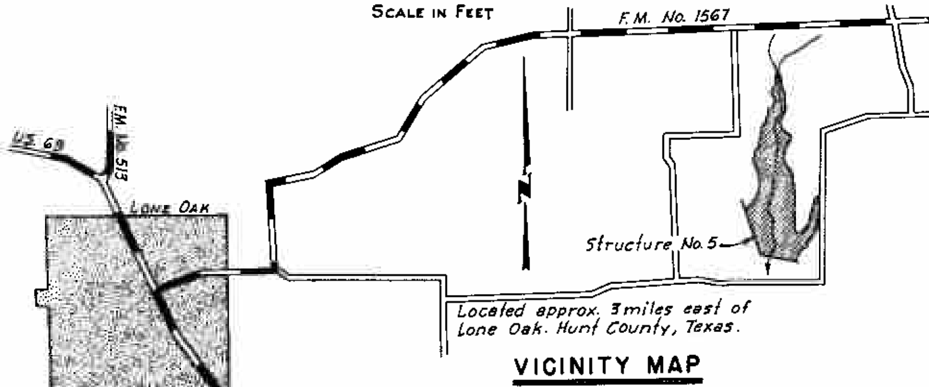


Figure 2
PIPE OVERFALL STRUCTURE



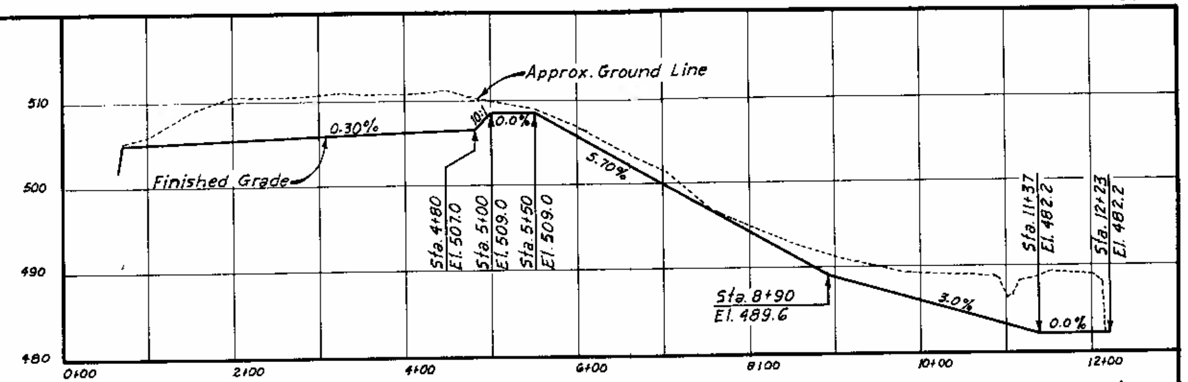
PLAN OF EMBANKMENT AND SPILLWAYS

SCALE IN FEET (0 200 400 600 800 1000)

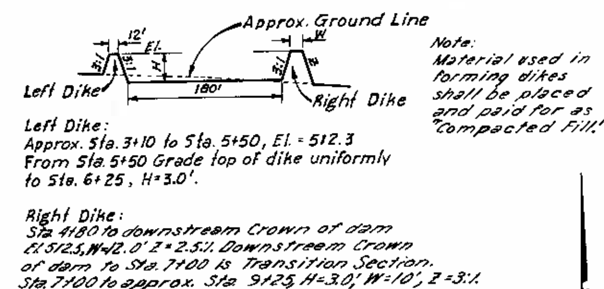


VICINITY MAP

SCALE IN MILES (0 1 2)



PROFILE ON ℄ OF EMERGENCY SPILLWAY

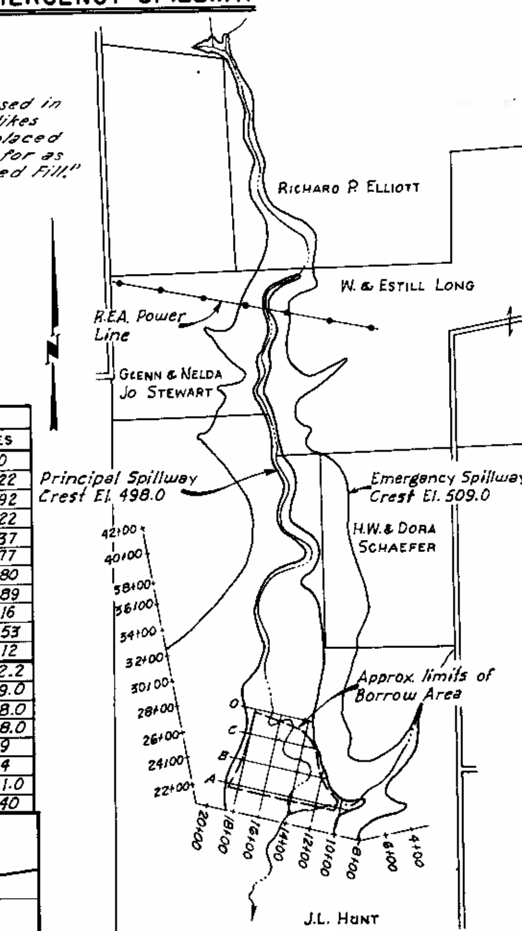


TYPICAL SECTION

EMERGENCY SPILLWAY

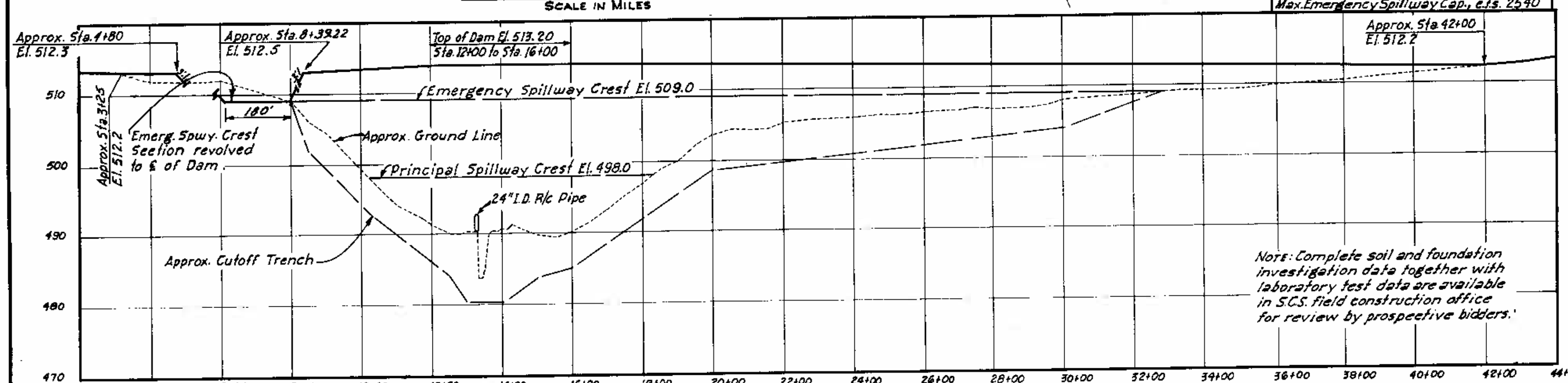
ELEVATION	SURFACE ACRES	STORAGE ACRE FEET	STORAGE INCHES
490	0.0	0.0	0.0
494	11.5	23.0	0.22
498	25.0	96.0	0.92
502	42.6	231.2	2.22
506	69.0	454.4	4.37
509	96.6	705.0	6.77
510	109.5	811.0	7.80
511	120.5	925.0	8.89
512	134.0	1058.0	10.16
513	150.0	1200.0	11.53
514	167.5	1365.4	13.12

Top of Dam (Effective) Elev.	512.2
Emergency Spillway Crest Elev.	509.0
Principal Spillway Crest Elev.	498.0
Sediment Pool Elev.	498.0
Drainage Area, Acres	1249
Sediment Storage, Acre Feet	104
Floodwater Storage, Acre Feet	601.0
Max. Emergency Spillway Cap., c.f.s.	2540



GENERAL PLAN OF RESERVOIR

SCALE IN FEET (0 660 1320 1980 2640)

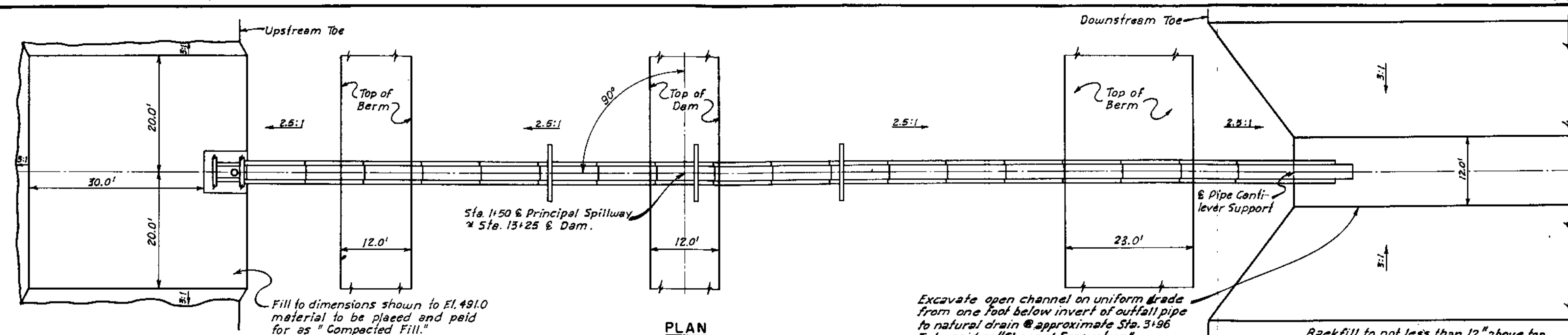


PROFILE ON ℄ OF DAM

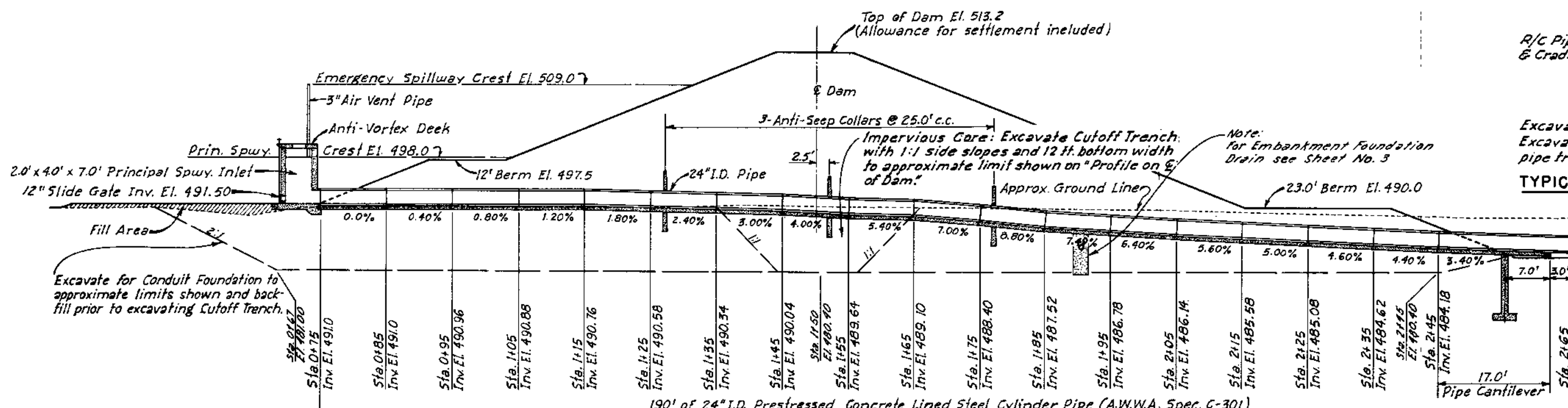
Figure 3
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	A.E.G.	9-61	Approved by
Drawn	A.E.G. & G.H.D.	10-61	
Traced	G.H.D.	11-61	Sheet No. 2 of 8
Checked	A.E.G. & H.H.K.	11-61	Drawing No. 4-E-16,122

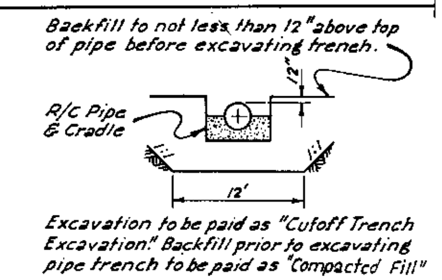


PLAN



SECTION

PRINCIPAL SPILLWAY

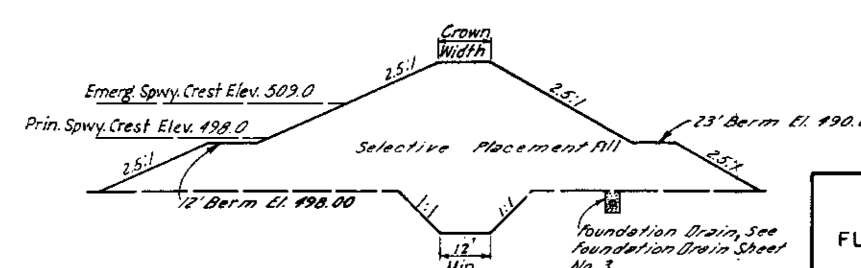


TYPICAL FOUNDATION EXCAVATION

USE OF EXCAVATED MATERIALS					
LAB. TEST		COMPACTION REQUIREMENTS			Lab. Curve
Standard		Min. Dry Density	Moisture Range		
Max.Dry Den.	Opt'm Moist	Lbs. Per Cu. Ft.	Percent From	To	No.
110.0	15.5	104.5	15.0	7	4
105.0	18.0	99.8	16.0	7	5
110.5	16.0	105.0	16.0	7	2
110.5	14.5	105.0	14.0	7	3
110.5	14.0	105.0	14.0	7	1

The clay materials represented by Laboratory Curves 4 & 5 may be used any place in the embankment. The clay and silty clay materials represented by Curves 2 & 3 shall be used in the outer sections of the Embankment. The silty materials represented by Curve 1 shall be placed in the downstream sections.

EMBANKMENT DATA

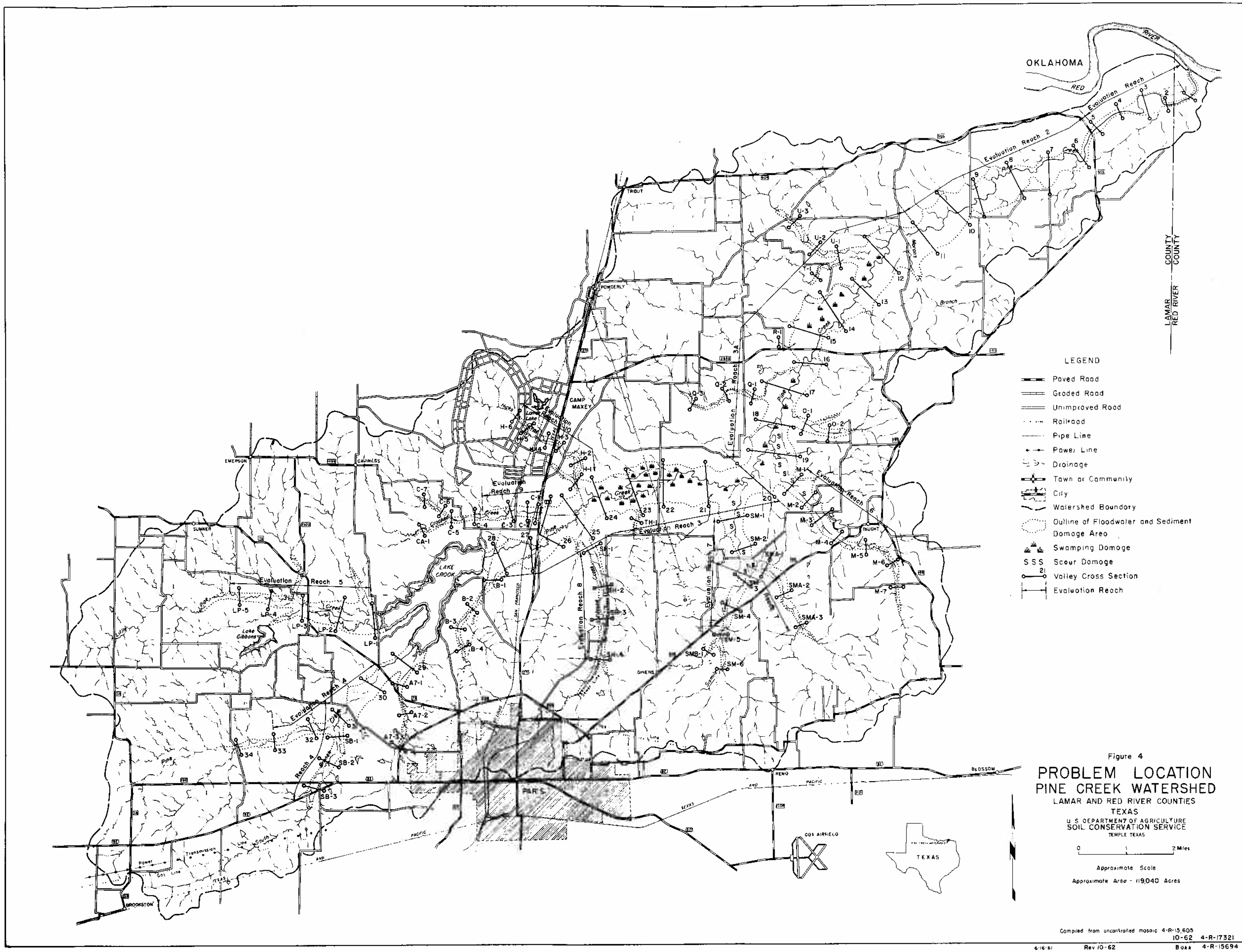


TYPICAL SECTION

Figure 3A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE - PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	A.E.G.	9-61	Approved by Head Engineering & Watershed Planning Unit, Fort Worth, Texas
Drawn	A.E.G. & G.H.D.	10-61	State Conservation Engineer S.C.S., Temple, Texas
Traced	G.H.D.	11-61	Sheet No. 4 of 8
Checked	A.E.G. & H.N.K.	11-61	Drawing No. 4-E-16,122


OKLAHOMA
RED RIVER
LAMAR COUNTY
RED RIVER COUNTY
Evaluation Reach 1
Evaluation Reach 2
Evaluation Reach 3
Evaluation Reach 3A
Evaluation Reach 4
Evaluation Reach 5
Evaluation Reach 6
Evaluation Reach 7
Evaluation Reach 8
TROUT
POWDERLY
CAMP MAXEY
EMERSON
SUMNER
LAKE CROOK
Lake Gibbons
GIVENS
PARIS
RENO
BLOSSOM
BROOKSTON
COX AIRFIELD
TEXAS
LEGEND
Paved Road
Graded Road
Unimproved Road
Railroad
Pipe Line
Power Line
Drainage
Town or Community
City
Watershed Boundary
Outline of Floodwater and Sediment Damage Area
Swamping Damage
S S S Scour Damage
Valley Cross Section
Evaluation Reach
Figure 4
PROBLEM LOCATION
PINE CREEK WATERSHED
LAMAR AND RED RIVER COUNTIES
TEXAS
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE TEXAS
0 1 2 Miles
Approximate Scale
Approximate Area - 119,040 Acres
Compiled from uncontrolled mosaic 4-R-15,605
10-62 4-R-17321
6-16-61
Rev 10-62
4-R-15694

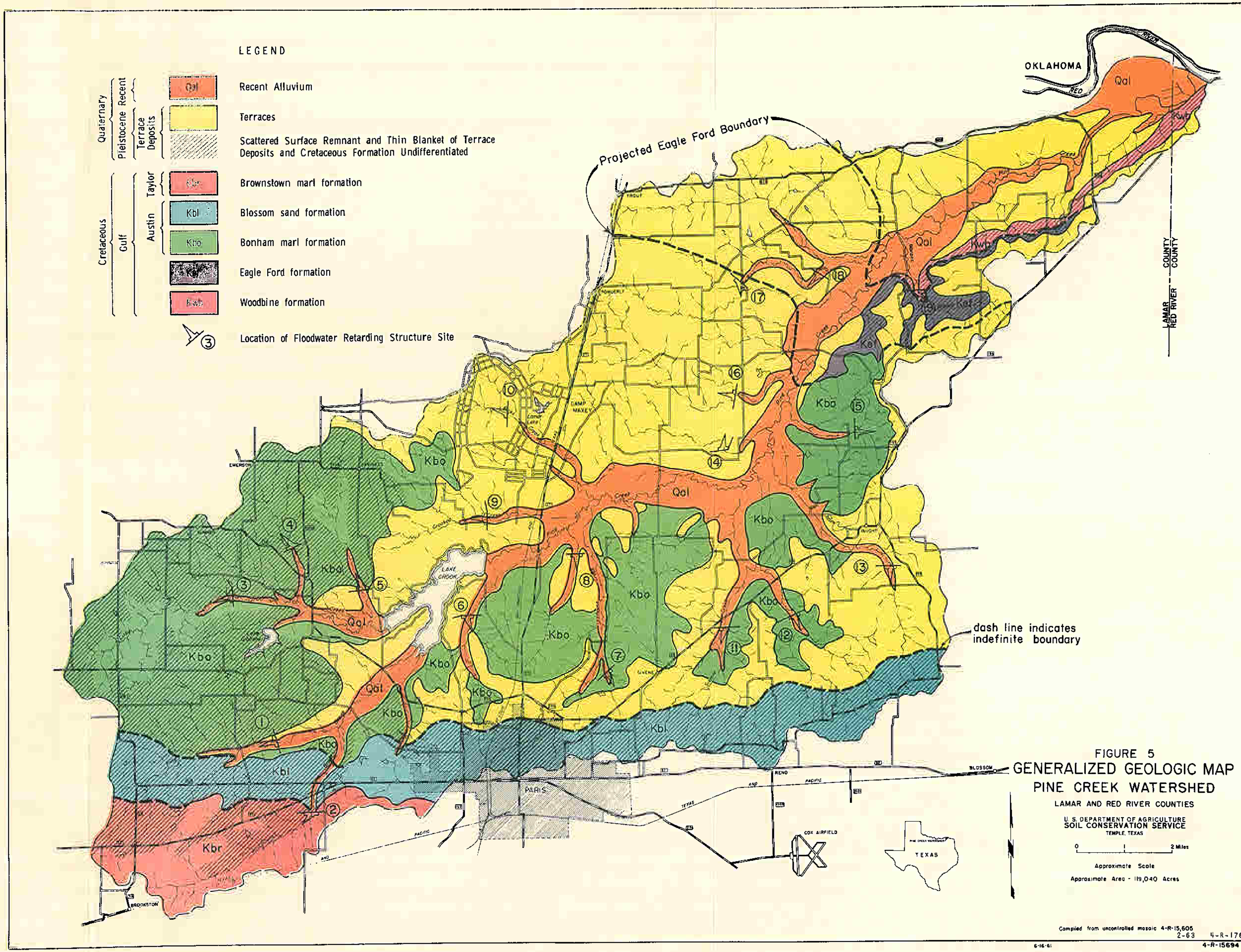


FIGURE 5
GENERALIZED GEOLOGIC MAP
PINE CREEK WATERSHED
LAMAR AND RED RIVER COUNTIES

Site Number	Drainage Area-Acres
1	6,810
2	2,829
3	4,806
4	1,389
5	2,298
6	3,309
7	1,037
8	1,293
9	4,160
10	1,197
11	5,434
12	4,269
13	2,157
14	1,818
15	723
16	3,590
17	2,470
18	1,709
19	2,195

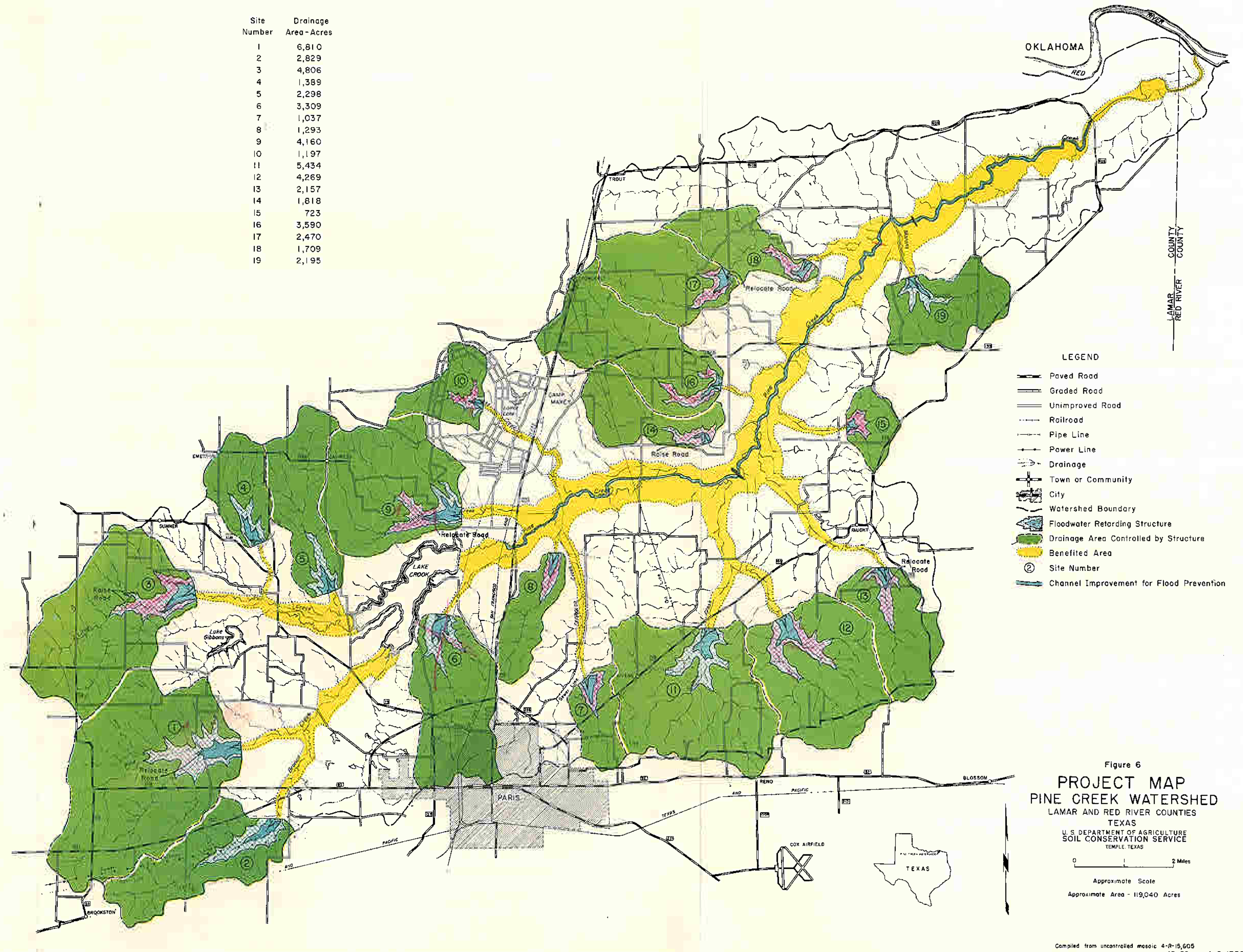


Figure 6

PROJECT MAP
PINE CREEK WATERSHED
LAMAR AND RED RIVER COUNTIES
TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS