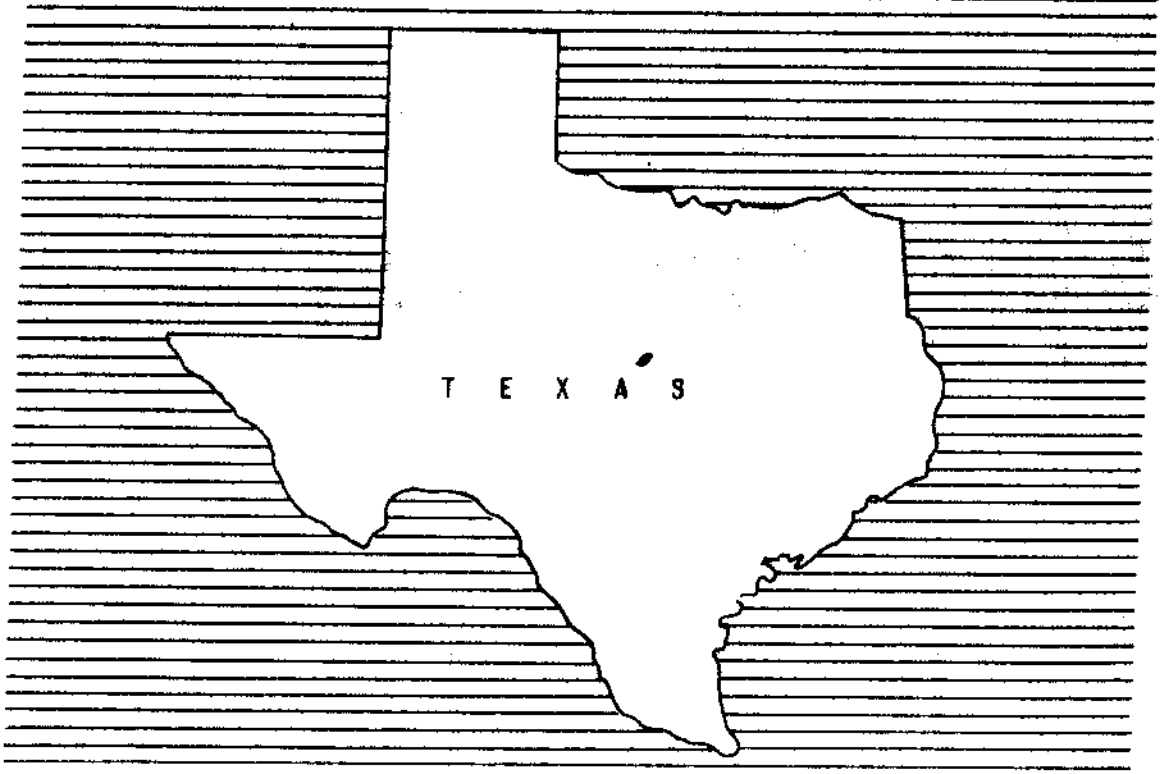
WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

PECAN CREEK WATERSHED

HAMILTON COUNTY, TEXAS



March 1966

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WATERSHED WORK PLAN AGREEMENT

between the

Hamilton-Coryell Soil and Water Conservation District
Local Organization

City of Hamilton
Local Organization

Hamilton County Commissioners Court
Local Organization

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

and the

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

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Pecan 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 Pecan 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;

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 3 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 $ 63,550.)

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)
5 Floodwater Retarding Structures	0	100	357,500

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)
5 Floodwater Retarding Structures	-	100	84,937

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 2,500 .)

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

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

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

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

10. The costs shown in this agreement rapresent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurrad 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 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.

14. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.13), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

Hamilton-Coryell Soil and Water Conservation Distric
Local Organization

By O.C. King
O.C. KING

Title Chairman

Date 8-31-66

The signing of this agreement was authorized by a resolution of the governing body of the Hamilton-Coryell Soil and Water Conservation District
Local Organization

adopted at a meeting held on 6-14-66

Paul Hinson
(Secretary, Local Organization)
PAUL HINSON

Date 8-31-66

City of Hamilton
Local Organization

By T.D. Craddock
T.D. CRADDOCK

Title MAYOR

Date 8-31-66

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

adopted at a meeting held on 8-31-66

Mildred Taylor
(Secretary, Local Organization)
MILDRED TAYLOR

Date 8-31-66

Hamilton County Commissioners Court
Local Organization

By H. W. Standifer
H. W. STANDIFER

Title COUNTY JUDGE

Date Sept 12, 1966

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

adopted at a meeting held on 9/12/66

Vada Williams
(County Clerk)
VADA WILLIAMS

Date Sept 12 - 1966

Local Organization

By

Title

Date

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

adopted at a meeting held on

(Secretary, Local Organization)

Date

Soil Conservation Service
United States Department of Agriculture

By

Date

WATERSHED WORK PLAN

PECAN CREEK WATERSHED
Hamilton County, Texas
March 1966

PREFACE

This work plan for watershed protection and flood prevention in the Pecan Creek watershed, Texas, was prepared by the city of Hamilton, the Hamilton County Commissioners Court, and the Hamilton-Coryell Soil and Water Conservation District, the local sponsoring organizations. Technical assistance was provided by the Soil Conservation Service of the U. S. Department of Agriculture. The Bureau of Sport Fisheries and Wildlife of the U. S. Department of Interior collaborated with the Texas Parks and Wildlife Department in the preparation of a reconnaissance report of the fish and wildlife aspects of the watershed. Financial assistance in developing the work plan was provided by the Texas State Soil and Water Conservation Board and the Soil Conservation Service. Office space for Soil Conservation Service personnel assisting in development of this work plan was furnished by Hamilton County.

WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

PECAN CREEK WATERSHED
Hamilton 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:

Hamilton-Coryell Soil and Water Conservation District

City of Hamilton

Hamilton County Commissioners Court

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
March 1966

WATERSHED WORK PLAN

Pecan Creek Watershed
Hamilton County, Texas
March 1966

SUMMARY OF PLAN

Pecan Creek watershed, which comprises an area of 30 square miles, is located slightly east-northeast of the approximate center of Hamilton County, Texas. About 21 percent of the project area is cropland, 66 percent is grassland, and 13 percent is used for miscellaneous purposes such as farmsteads, roads, the city of Hamilton, and Hamilton City Lake. Extensive damage occurs frequently in the city of Hamilton as the result of flooding by Pecan Creek and its tributaries. Flood damages to crops and pastures, other agricultural property, roads and bridges, and flood-plain soils are quite severe in the agricultural reach below the city of Hamilton. Total floodwater and erosion damages are estimated to be $26,015 annually.

This work plan proposes the application and maintenance of needed land treatment measures on 1,920 acres of cropland and 14,019 acres of grassland at an accelerated rate during a 3-year installation period. These measures will improve the hydrologic condition of both cropland and grassland. This improvement in soil and cover conditions will reduce sediment to floodwater retarding structures below, thus prolonging their life, and will also cause some reduction in flooding. The installation cost of these measures will be $129,410. Public Law 566 funds will bear $5,075 of these costs in order that application and maintenance of these measures may be accomplished at an accelerated rate.

Five floodwater retarding structures will be constructed during the second and third years of the installation period at an estimated cost of $508,487. The Public Law 566 share of the cost is $442,437. Local interests will provide all land, easements, rights-of-way, legal services, and contract administration at an estimated value of $66,050.

Damages, after project installation, will be reduced from $26,015 to $1,567 annually Total benefits will be $29,278 annually. The ratio of the average annual benefits accruing to structural measures ($27,978) to the average annual cost of these measures ($17,486) is 1.6 to 1.0.

The land treatment measures will be maintained by the owners and operators of the land upon which the measures are applied under agreements with the Hamilton-Coryell Soil and Water Conservation District. Structures 1 and 2 will be installed and maintained by the Hamilton County Commissioners Court, and structures 3, 4, and 5 by the City of Hamilton. The cost of maintenance is estimated at $827 annually.

DESCRIPTION OF THE WATERSHED

Physical Data

Pecan Creek, a tributary of the Leon River, is located in Hamilton County, Texas. It heads about 2 miles south of Hamilton, flows north and east through the town, and enters the Leon River near State Highway 22 about 6 miles east of Hamilton. Two major tributaries, Logan Branch and Twomile Creek, flow into Pecan Creek downstream of Hamilton. The watershed drains a total of 19,200 acres (30 square miles).

The watershed lies within the Lampasas Cut Plain and West Cross Timbers physiographic areas. These areas are underlain by sedimentary rocks of the Lower Cretaceous age. The Lampasas Cut Plain is divided into 2 areas by the West Cross Timbers, which extends across the central part of the watershed. The upper area is underlain by clays and limestone of the Walnut formation. The topography is gently rolling. The lower area, which is underlain by marls and limestones of the Glen Rose formation, has a moderately rolling topography. The valleys are deeply incised with moderately wide flood plain development. The West Cross Timbers is underlain by sandstones of the Paluxy formation. The topography is gently rolling north of, and becomes steeply rolling in and around, the town of Hamilton. This area thins southward and becomes obscure on the southern edge of the watershed. Elevations above mean sea level range from 915 feet in Pecan Creek channel near the Leon River to 1,300 feet on the watershed divide.

Soils of the Grand Prairie Land Resource Area cover 83 percent of the watershed and soils of the Cross Timbers, 17 percent. The Grand Prairies are dominantly fine textured and shallow grassland soils of the Denton and Tarrant series. Small areas of deep San Saba clay soils occur in the upper parts of the watershed and are cultivated. The medium textured soils of the Cross Timbers Land Resource Area are mainly of the Stephenville and Windthorst series. The natural vegetation includes oaks of the postoak and blackjack varieties. The land use is changing from cropland to grassland. The alluvial soils are dominantly clays and clay loams of the Frio series. Extensive areas have suffered severe erosion damage. They are now being used primarily for grassland. The land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	4,032	21
Grassland	12,672	66
Miscellaneous 1/	2,496	13
Total	19,200	100

1/ Roads, farmsteads, urban and Hamilton City Lake.

The mean annual rainfall of 30.0 inches is fairly well distributed throughout the year. The larger monthly amounts occur in April, May, June, and September.

Mean temperatures range from 45.9 degrees Fahrenheit in January to 83.8 degrees in July. The mean annual temperature is 67 degrees. The average date of the last killing frost is March 28, and that of the first killing frost is November 22, providing an average frost-free period of 228 days.

Economic Data

Pecan Creek watershed is located in a county which is dependent upon a highly diversified agriculture for 71 percent of its total income. Eighty-three percent of this agricultural income is derived from livestock and poultry. Cattle and calves provide 29 percent; sheep, lambs, and wool, 20 percent; poultry, 19 percent; goats and mohair, 6 percent; dairy products, 6 percent; swine, 2 percent; and miscellaneous products, 1 percent of the total farm income. The remaining 17 percent of farm income is from crops such as oats, grain sorghum, cotton, hay, corn, and wheat in descending order of importance. Peanuts, barley, rye, and pecans are produced in lesser quantities.

The flood plain of the watershed is used primarily for grazing and for production of livestock feed such as oats, hay, and grain sorghum. Crops in excess of the operators' requirements for livestock feed are sold.

Present flood-plain land use is as follows: oats, 25 percent; sorghum hay, 8 percent; grain sorghum, 7 percent; alfalfa, 1 percent; corn, 1 percent; grasses for grazing and hay production, 57 percent; and miscellaneous uses, 1 percent. Future trends are toward increased grass and livestock production. There is no indication that crops in surplus supply will be increased.

Flood-plain lands were intensively cultivated from the early 1900's through the 1940's, but flooding, with resultant losses of crops and valuable topsoil, caused the abandonment of much of this land to poor quality pasture.

Farms in the watershed and in Hamilton County, as is true nationwide, are becoming fewer in number but larger in size. In 1954, Hamilton County had 1,496 farms averaging 338 acres in size and valued at $20,060 each. By 1959 farm numbers had dropped to 1,185, but acreage and value had risen to 412 and $29,018, respectively.

Pecan Creek watershed has 104 operating farm units located wholly or partially within its boundaries. These units average 177 acres in size. Eleven of these are family type farms averaging 769 acres in size and comprising 51 percent of the agricultural land in the watershed.

Most farms are small and have little cropland. Many farm operators do not make full use of their agricultural land because their farming equipment is old and new equipment is very expensive. Some are not physically able to do their own work. Their average age is 56 years (the highest in Texas).

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There are 16 farms in the flood plain receiving flood damage to crops, soils, and other property.

Average farm income is $2,582, as compared to a State average of $4,884. The average net income produced by the 11 family type farms is approximately $5,000 per year. All others net less than $5,000, with 51 percent netting $3,000 or less.

About 90 percent of all operators work off the farm about 60 percent of the time to supplement farm income. The remaining 10 percent are either too old for gainful employment or have outside income. The opportunity for promoting the Rural Area Development effort is excellent because farms are too small to be economical family type units, average farm income is less than $3,000 annually, off-farm employment is difficult to find, and prevailing wage rates are low.

The city of Hamilton, located in the upper portion of the watershed, has a population of 3,106, and is the county seat of Hamilton County. Its manufacturing industries supply livestock feeds, trailers, garments, building materials, meats, hides, tallow, sheet metal, and dairy products to both State and out-of-State markets. These manufacturers and processors employ approximately 130 people and have an annual payroll of approximately $400,000. Many of these employees are farm operators working to supplement farm income.

In addition to adequate retail stores and services, there are 2 cotton gins, 5 farm equipment suppliers, 6 feed stores, 2 wool and mohair buyers, and 3 hatcheries serving the surrounding area. The city has 6 motels and hotels and 10 eating establishments and is served by good highways, both north-south and east-west. Approximately 57 miles of all-weather roads provide adequate transportation facilities throughout the watershed.

Land Treatment Data

The watershed is served by the Soil Conservation Service Work Unit at Hamilton, which assists the Hamilton-Coryell Soil and Water Conservation District. This district was one of the first organized in the State of Texas.

Many sets of terraces and other soil and water conservation measures established in the early days of the district are still in use throughout the watershed. The upland was cultivated intensively from the early 1900's through the 1940's. Farm operators have made good progress in the establishment of land treatment measures needed for the continued utilization and conservation of agricultural land. This is especially true when one considers the many handicaps they have faced. The land, of which approximately 85 percent is shallow, is naturally low in moisture and nutrient holding capacity. This land, good only for grassland, should never have been cultivated. This natural limitation was not recognized by the early settlers, however, and many hundreds of acres felt the bite of the

plow. Production was low and sporadic from the outset, but these hardy pioneers were able to eke out a living because all labor was performed by the family, needs were simple, and taxes, if any, were low.

Then times changed and the land could no longer support the family. Production slumped as soil losses and decreasing fertility took their toll. Fields were gradually abandoned to become poor quality rangeland sparsely covered by shallow rooted invading grasses, forbs, and brush. Brush control, pasture planting and proper management, range seeding, deferred grazing, and proper use are needed to provide adequate watershed protection and a decent income for farm operators.

Farms are small; equipment is old, and new equipment is expensive; income is low; and the average age of farm operators is 56 years, the highest in Texas. This challenge must be met and overcome in order that project objectives be accomplished.

The Hamilton-Coryell Soil and Water Conservation District has done an excellent job, however, in the face of these obstacles. Basic soil and water conservation plans, covering 75 percent of the land, have been developed on 76 of the 104 operating units in the watershed. District cooperators have applied approximately 50 percent of all needed conservation practices. Table 1A lists the practices which have been established. The total cost of applying these practices is estimated at $121,464.

It is expected that approximately 80 percent of all needed land treatment measures can be applied and effectively maintained by the end of a 3-year project installation period.

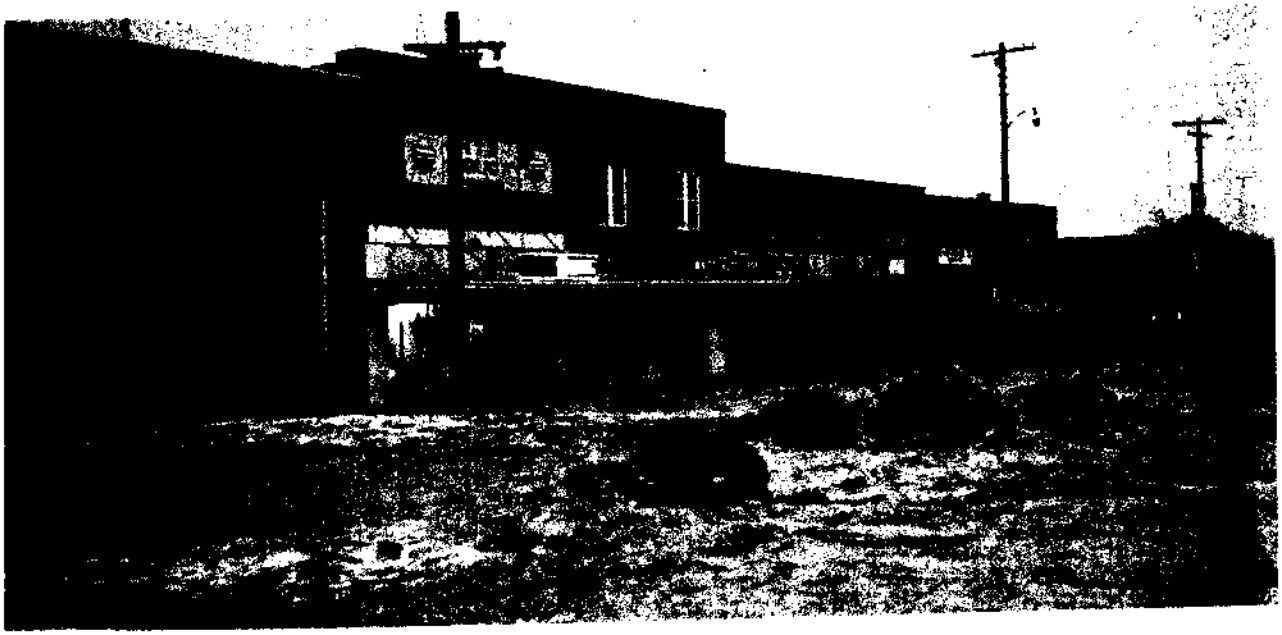
WATERSHED PROBLEMS

Floodwater Damages

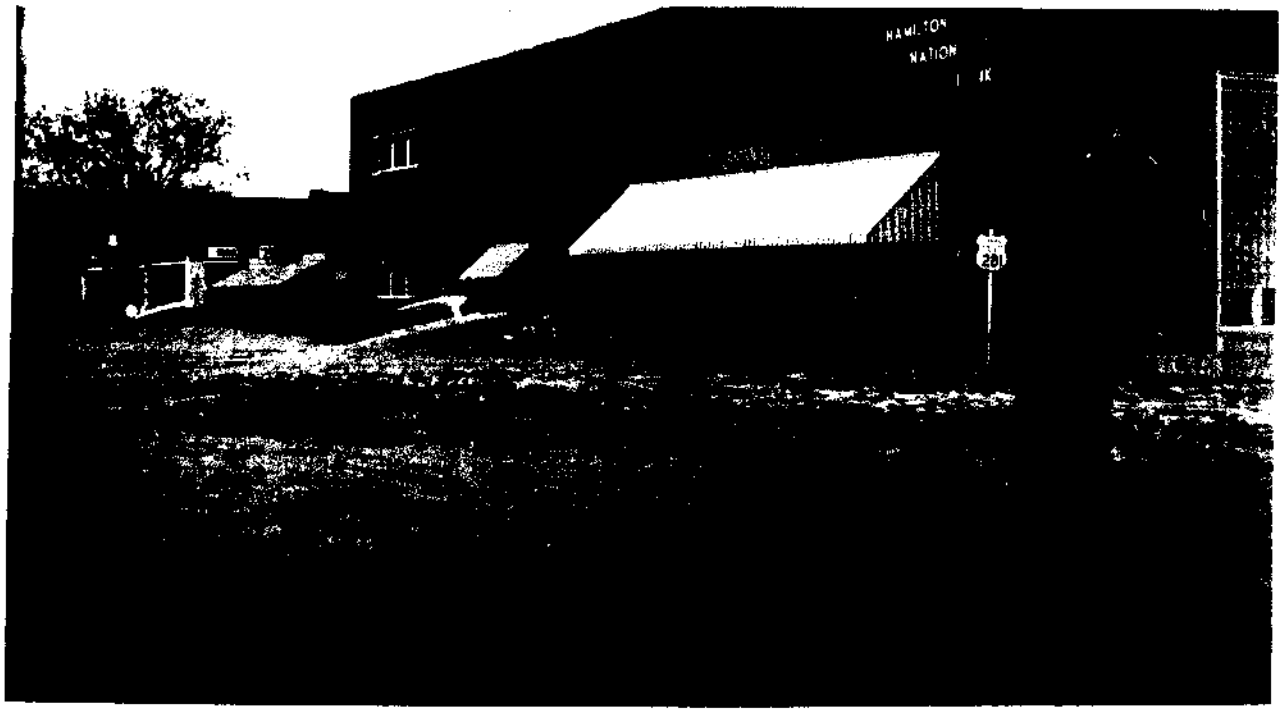
Floodwater damage occurs on 600 acres of agricultural land and 150 acres located within the city limits of Hamilton. As described herein, the flood plain is the area that was inundated by the flood of April 26, 1957. Figure 3 shows the area that was flooded in Hamilton. This was the most severe flood in the city's history. Heavy rains began falling at 4:30 p.m. The U. S. Weather Bureau gage at Hamilton recorded 4.4 inches; however, unofficial measurements ranging from 5 to 8 inches were recorded in the area above the city. Runoff was high because of the intensity of the storm and because the soil was saturated from rains that fell during the preceding week.

Floods are the result of storms of high intensity and short duration, such as occur frequently in this area. Recent floods in the business area and residential section of Hamilton occurred in 1923, 1938, 1942, and 1957.

Damaging waters in residential area of Hamilton during flood of 1957.



Looking northeast of north side of square. City Drug (left center of photo) had approximately 36 inches of water gushing through store shortly after photograph was taken. All inventory was lost.



Looking northeast on North Rice Avenue (U. S. 281).Water was 41 inches deep at highway sign, and was much deeper to left of photo.

Looking north along North Rice Avenue (U. S. 281). Note automobiles almost completely submerged.

The channel is large, but accumulations of sediment and debris, growth of weeds and trees, and manmade improvements encroaching along and across the channel have combined to severely reduce its capacity in the city.

The flood of 1957 damaged approximately 60 businesses and homes within the city as well as damaging valuable cropland and other property in the agricultural reach below the city of Hamilton. This flood, the most devastating in Hamilton's history, would have been much more damaging had the city not been prepared. Local radio broadcasts carried weather reports and warnings, giving the inhabitants time to "batten down the hatches." It was well they did, for the raging waters played havoc with everything not watertight or moved to high ground. One drug store had the doors battered down, both front and back. A 3-foot wall of water rampaged through the store, destroying or washing away everything of value. Nothing was salvaged. The owner said, "I felt like throwing up my hands and quitting."

One car dealer had seven automobiles washed away. A man was trapped in the sales office of this automobile business and was forced to hang from a tire rack for "what seemed like two hours," to keep from drowning. All furnishings, files, and records were lost. Miraculously, no one was drowned, although there have been reported drownings in the past.

More than 60 people were evacuated from homes near Pecan Creek. A young mother, with her infant in her arms, strove valiantly to reach higher ground, but the raging torrent trapped her. She clung perilously to a fence post until an emergency rescue team was able to fight its way to her side.

One plumbing business, building and all, was completely washed away. A large combination gin, farm equipment, and feed store was extensively damaged. The owner said, "This is the fourth flood I have had since 1938."

Although no caskets were lost, 80 graves were bared by floodwaters in Hamilton cemeteries. About 400 cubic yards of fill were required to repair burial plots.

The Red Cross established headquarters in the city and provided food, quarters, and other necessities for victims of the flood. Volunteers from surrounding towns pitched in to help victims clean up and reorganize businesses and homes. A Boy Scout troop from a neighboring town, preparing for a camping trip, voted instead to lend a hand in the clean-up operation. One hard-hit businessman said, "It was a blessing in disguise. I had forgotten how wonderful people can be."

With Hamilton's designation as a "disaster area," representatives of the Small Business Administration made direct loans for repairing buildings, replacing inventories, fixtures, etc., in order that flood victims could stay in business. Some businesses, however, in spite of this financial aid, closed their doors, never to re-open. Actual damage from this flood amounted

to approximately $269,000 in the city of Hamilton. Had this flood occurred unexpectedly, for example, during the middle of the night, damage could have exceeded $460,000.

One farm operator on the creek below Hamilton lost 50 registered Rambouillet ewes and miles of fence, and suffered heavy damage to farming equipment. Others reported losses of barns, hay and feeds, and fences.

For evaluation purposes the flood plain was divided into two reaches, one urban and one agricultural. The damageable value in the agricultural reach varies from $5.50 to $130.85 per acre depending upon land use. Under non-project conditions the average annual direct monetary floodwater damage is $23,065. Of this amount, $1,962 is crop and pasture; $703, other agricultural; $500, road and bridge; and $19,900, urban damage in the city of Hamilton. Indirect damage, such as interruption of travel, re-routing of school buses and mail routes, losses to businesses, evacuation of premises when floods threaten, and similar losses, is expected to average $2,365 annually.

Erosion Damage

The most severe erosion damage now occurring is caused by flood-plain scour. Approximately 100 acres of flood-plain land have been damaged from 10 to 80 percent through loss of topsoil. Most of this land is now in low producing grassland. The average damage from scour is $585 annually.

Upland erosion is low. The present gross erosion is estimated to be 1.09 acre-feet per square mile annually. Nearly all of this volume is produced by sheet erosion.

Sediment Damage

The flood of April 26, 1957 deposited a thick slimy blanket of mud on and in everything it touched. Mud alone was responsible for thousands upon thousands of dollars worth of damage to furnishings, carpets, and clothing in both residences and businesses. Mud was shoveled out and hauled away by the truckload, but this backbreaking labor was the easy part of the clean-up campaign.

The most demoralizing aspect of the task was the tedious, seemingly never-ending chore of dismantling, cleaning, lubricating, and re-assembling of intricate motors, engines, machinery, and appliances. In order to save delicate mechanisms it was necessary to labor night and day until the job was done. Any delay resulted in the complete loss of damaged items. Many electrical appliances were ruined.

Floors and walls of buildings were scrubbed time and again. Soap, water and disinfectants were used in enormous quantities before the flooded

Severe erosion damage to upland soils of Pecan Creek watershed.

Boy Scout troop assisting in clean-up operation following flood of 1957. People from surrounding towns and communities flocked to the disaster area to help in any way they could.

area became livable again. Sediment clogged sewers and drains and repeated cleaning and flushing were required before proper functioning was restored. These sediment damages have been included in the urban floodwater damages.

Overbank sediment deposition damages are low. Older deposits of fine sandy loam materials 1 to 2 feet deep occur in isolated areas. Current damages, however, are not significant.

Inadequate land treatment in the drainage area of Hamilton City Lake has resulted in the loss of approximately 20 percent of its original capacity. Until additional land treatment measures are established and effectively maintained, the lake will continue to lose capacity at the rate of 2.8 acre-feet per year.

Problems Relating to Water Management

The city of Hamilton obtains its water supply from Proctor Reservoir on the Leon River. Hamilton City Lake serves as an emergency water supply and recreation lake. Water for domestic and livestock use is supplied by wells and farm ponds.

Opportunities for water-based recreation are very limited for the residents of this area. Hamilton City Lake and the Leon River are available for fishing. Although the lake has not been developed for recreation, a plan for its development has been made by the city in cooperation with the Hamilton-Coryell Soil and Water Conservation District. Civic organizations will install recreational facilities as finances and time permit. The only large lake with facilities for water-based recreation is Proctor Reservoir about 30 miles northwest of Hamilton.

Hamilton discharges treated sewage effluent into Pecan Creek. Pollution could become a problem if treatment facilities are not expanded to keep pace with population increases.

PROJECTS OF OTHER AGENCIES

Hamilton City Lake, constructed in 1923 as a water supply reservoir, is located on Twomile Creek, a tributary of Pecan Creek. At the time of construction, the reservoir had a capacity of 614 acre-feet and a water surface area at spillway crest of 53 acres. The lake is now used only as an emergency water supply and recreation area.

BASIS FOR PROJECT FORMULATION

A meeting was held with the sponsoring local organizations to discuss problems in the watershed and to determine their objectives and the degree of development desired. The City of Hamilton listed as its primary objectives the installation of structural measures to provide protection to the urban area from floods such as the one which occurred in 1957.

In addition, the City asked that the Service determine if the city lake could be developed as a multiple-purpose structure to include recreation facilities. The Hamilton-Coryell Soil and Water Conservation District listed as its objectives the improvement of low farm income and a level of flood protection to the flood plain of Pecan Creek which would be commensurate with its use. It was agreed that the application of 80 percent of needed land treatment measures prior to the end of the project installation period is essential in order that project objectives be accomplished. The Hamilton County Commissioners Court joins the Hamilton-Coryell Soil and Water Conservation District and the City of Hamilton as an active partner to assist them in accomplishing their objectives.

A study of topographic maps and aerial photographs, supplemented by field investigation, indicated that there were only five locations for floodwater retarding structures that would provide protection to the urban area. Subsequent investigation showed that stream channel improvement, in lieu of floodwater retarding structures, or a combination of these structural measures, would require extensive modification of all street crossings in the city.

There were several locations for floodwater retarding structures that would provide additional protection to the agricultural land in the floodplain area downstream from Hamilton.

A detailed investigation of a site on Logan Creek, which appeared to offer the best potential, revealed that its cost would exceed the monetary benefits that could be expected by a sizeable amount.

A study made by Service representatives revealed that the existing dam at the city lake could not be modified to develop the lake as a multiple-purpose structure for recreation and flood prevention. City officials did not feel that the city is financially able to share in the cost of constructing a new dam at a location a short distance downstream. The City has entered into an agreement with the Hamilton-Coryell Soil and Water Conservation District for development of its property at the city lake as a recreational area.

The system of five floodwater retarding structures represents the least costly system of structural measures that will meet the objectives of the sponsors. The city will remove, independently of the PL 566 project, all obstructions and restrictions from stream channels and drainage structures in the urban area.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The use of each acre of land within its capabilities and its treatment in accordance with its needs has long been recognized as basic in the

building of a strong and free community, state, or nation. One has but to review the pages of world history to verify this truth. Sponsors of this project are well aware of this fact, and the installation of needed land treatment measures is considered essential.

Realizing that adequate soil surveys are the first step in the planning and application of land treatment measures, approximately 4,520 acres of surveys remaining are scheduled for completion during the first year of the 3-year installation period. Public Law 566 funds in the amount of $647 will be provided for this specific purpose. With this accomplished, planning and application of needed measures can be achieved without interruption and on schedule.

In addition to effectively maintaining those land treatment measures already established (table 1A), additional conservation practices to be applied and maintained include: conservation cropping system, 576 acres; contour farming, 510 acres; cover crops, 192 acres; crop residue use, 576 acres; terraces, 104,105 feet; diversions, 6,000 feet; and grassed waterways, 34 acres.

Pasture planting and pasture management will be accomplished on 1,069 acres. These measures will be applied on marginal cropland and on rangeland now infested with invading brush. Yields from these acreages are marginal at best. Invading brush will be controlled by both chemical and mechanical means on approximately 4,700 acres of rangeland, with due consideration given to encouragement of wildlife species. It is expected that proper management of this acreage will enable native grasses to become re-established.

Native and adapted introduced grasses will be seeded on approximately 80 acres where seed sources are inadequate to assure rapid re-establishment of native grasses. Range proper use and range deferred grazing will also be followed on 5,236 acres. Ten farm ponds will be constructed to provide more uniform distribution of grazing. These measures, combined with improved livestock management, such as planned salting and supplemental feeding locations, will result in proper utilization of forage and will reduce heavily over-grazed areas.

These planned land treatment measures will improve soil structure and condition tremendously. This improvement will hold soil and water losses to a minimum, will result in longer useful life of floodwater retarding structures, will reduce flooding, and will increase the income of the operators of agricultural lands to a comfortable level in harmony with a prosperous expanding economy.

In addition, the acreage of crops in surplus supply is expected to diminish as a result of project installation.

Structural Measures

Five floodwater retarding structures will be constructed to provide flood protection to the urban area of Hamilton and to the agricultural land in the flood plain of Pecan Creek. These structures will control runoff from 70 percent of the drainage area above valley section 9 in Hamilton (figure 4). The proposed system of floodwater retarding structures will detain runoff from 16.5 percent of the entire watershed. The total capacity of the floodwater retarding structures is 1,996 acre-feet, of which 312 acre-feet is provided for sediment accumulation over a 100-year period and 1,684 acre-feet is provided for floodwater detention storage. Floodwater retarding structures will detain an average of 6.37 inches of runoff from the watershed area above them. Principal spillway capacities average 22.5 c.s.m. for Sites 1 through 4. A rate of 50 c.s.m. was used for Site 5 because site conditions limited the detention storage capacity.

All sites are located on sedimentary rocks of the Lower Cretaceous age. The structure of these beds is simple, with a slight dip to the southeast.

Sites 1 and 2 are located on marls and thin bedded, hard limestones of the Walnut formation; soft sandstone of the Paluxy formation occurs in the foundations. The borrow materials consist of alluvial and residual highly plastic clays (CH) and silty clays (CL) with 10 percent or more by volume being boulders.

Sites 3, 4, and 5 are located on soft, fine-grained sandstone of the Paluxy formation. Marls and thin bedded, hard limestones of the Walnut formation occur in the upper parts of the abutments and emergency spillways. The Glen Rose formation occurs at greater depths in the foundations. The alluvial and colluvial materials consist of silty and sandy clays (CL), clayey sands (SC), silty sand (SM), and basal gravelly materials (GM, GC, and GP) with cobbles and boulders. Seepage may be a problem at these sites.

The estimated cost of the floodwater retarding structures is $508,487. Figures 1, 2, and 2A illustrate features which are typical of the floodwater retarding structures to be installed. Tables 1, 2, and 3 also show details on quantities, cost, and design features.

EXPLANATION OF INSTALLATION COSTS

Land treatment measures listed in table 1 will be applied by local interests at an estimated cost of $129,410. This includes funds for Public Law 46 technical assistance to be furnished by the Soil Conservation Service and Agricultural Conservation Program cost-sharing as administered by the Agricultural Stabilization and Conservation Service. Current costs were used for the establishment and application of the various measures. To expedite the application of these measures, $5,075 of Public Law 566 funds will be provided to accelerate technical assistance during the 3-year installation period. This amount includes $647 for the completion of soil surveys during the first year.

The total installation cost of the five floodwater retarding structures is estimated to be $508,487. Of this total, $357,000 is for construction and $84,937 is for installation services, all of which will be borne by Public Law 566 funds. The local share of the cost is $63,550 for land, easements, rights-of-way, relocations, and legal fees and $2,500 for contract administration (table 2).

The construction cost includes the engineer's estimate and contingencies. The engineer's estimate was based on the unit cost of construction items planned for each structural measure. The unit cost was based on actual cost of structural measures in similar areas modified to conditions found in this watershed. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs.

Installation services consist of engineering and administrative costs and are based on analysis of previous work in similar areas. The engineering portion of this cost consists of, but is not limited to, detailed surveys, geological inveatigations, laboratory reports, design, cartographic services, and inspection services.

The sponsors' cost for land was based on the appraised value of the land needed for the installation of these structures. Appraisals were based on current prices being paid for land in the area. The estimated cost of altering the utility lines was obtained from the utility companies. The estimated cost of legal fees was based on the number of easements to be obtained. The contract administration cost is based on experience in other watersheds.

The estimated schedule of obligations for the 3-year installation period, covering installation of land treatment and structural measures, is as follows:

Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
1st	Land Treatment	1,692	41,445	43,137
2nd	Sites 1 and 2 and Land Treatment	260,463	61,270	321,733
3rd	Sites 3, 4, and 5 and Land Treatment	185,357	87,670	273,027
Total		447,512	190,385	637,897

EFFECTS OF WORKS OF IMPROVEMENT

Installation of structural measures will benefit directly more than 16 owners and operators of agricultural flood plain in addition to owners of 60 business establishments and residences in Hamilton. More than 15,000 people will benefit from this project during its life.

*****No longer will it be necessary for parents with children in Ann Whitney School to cast worried glances toward every threatening cloud which appears on the horizon, then when heavy rains begin to fall, dash madly for the school to bring loved ones to safety.

*****No longer need businessmen or homeowners away from Hamilton on business or well-earned vacations listen anxiously to weather reports and then dash madly homeward, fearful of what they will find.

*****No longer need dwellers of low-lying areas scramble to higher ground for safety, clutching what few belongings they have had time to save.

*****No longer need farm operators, awakened by roaring water, arise in the middle of the night in a futile attempt to rescue livestock; nor need they spend precious savings or hours of drudgery in attempts to salvage wire and rebuild fences.

Had the project been installed during the storm of April 1957, there would have been no devastating flood. There would have been no flooding of homes, businesses, or other improvements. Damage would have been practically nil. Only minor flooding of low-water crossings, one small bridge, and a few low-lying areas along the channel would have occurred (figure 3).

Flooding in the agricultural reach between valley section 10 and the Leon River would have been reduced from 410 acres to 360 acres (figure 4). By the same token, flooding from a 5-year frequency storm will inundate only 84 acres with the project installed as compared to 198 acres normally flooded under without project conditions. Approximately 74 acres of fertile land in the flood plain, once highly productive but now low quality pasture, will be restored to its highly productive state. This land will be cleared of invaders and planted to high quality pasture. Proper management will result in increased farm incomes. In addition, 190 acres of flood-plain land not below floodwater retarding structures will receive some benefits from the application and maintenance of land treatment measures.

The application of needed land treatment measures will also reduce upland erosion rates and sediment production by 40 percent. This will prolong the life of Hamilton City Lake and will reduce the sediment load carried into the Leon River. The installation of the complete program will reduce flood plain scour damage by 53 percent. It will also allow natural recovery of productivity on the damaged areas.

Sediment pools of the 5 floodwater retarding structures, when properly managed, will provide excellent angling for largemouth bass, channel catfish, and sunfish. Those pools open to the public will also provide excellent opportunities for picnicking and "campouts" by youth organizations such as Boy Scouts, Girl Scouts, and church groups. Heavy use is expected since there is a dearth of such facilities in this area. Sediment pools will also provide hunting for both doves and wild fowl during the open seasons. These pools will provide 3,060 visitor-days of incidental recreation for people of Hamilton and the surrounding area.

The installation of land treatment and structural measures will provide a sorely needed opportunity for the development of income producing recreation enterprises by low income farm operators. This is one of the objectives of the Hamilton-Coryell Soil and Water Conservation District. All landowners and operators in the watershed are urged to become district cooperators. Each cooperator will be encouraged to make wildlife habitat development and preservation, primarily for dove and quail, an integral part of his basic conservation plan. Fish pond stocking with adapted species and the proper management of these ponds will also be encouraged.

The surface has hardly been scratched insofar as income producing recreation is concerned. The combination of an expanding populace and shorter working hours has increased the demand for out-of-doors recreation manyfold, and few would dare hazard a guess as to what these demands will become during the life of this project. Proper management and treatment of the land will serve to reduce acreages of crops in surplus supply, yet will improve the condition and fertility of the land itself. This land can be considered as being held in reserve until increased demands for food and fiber warrant its use for that purpose.

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The installation of the project will create increased business to those who furnish farm equipment, petroleum products, fertilizers, seed and other farm supplies, sporting goods, and the various services associated with a farming and ranching community.

PROJECT BENEFITS

The estimated average annual monetary damages (table 5) within the watershed will be reduced from $26,015 to $1,567, a reduction of 94 percent. Crop and pasture damages will be reduced from $1,962 to $375 or 81 percent. Other agricultural damages, such as loss of fences, farm equipment, livestock, and other property, will be reduced from $703 to $176 or 75 percent. Road and bridge damage will be reduced from $500 to $100 or 80 percent. Flood plain scour damages now occurring at the rate of $585 annually will be reduced to $274, a reduction of 53 percent. Urban damage in the city of Hamilton will be reduced from $19,900 to $500 or 97 percent. Of the $24,448 damage reduction benefits attributable to the project, $23,148, or 95 percent, is the result of structural measures, with the remaining 5 percent reduction the result of land treatment.

Benefits from restoration of flood plain land to its former state of productivity, as a result of project installation, are expected to accrue at the rate of $1,149 annually. These benefits will result from brush control, pasture planting, and pasture management on approximately 74 acres of low producing grassland now heavily infested with brush and invading forbs. This loss from the original productivity of this land has been included in the crop and pasture damage and its restoration, a benefit in table 5.

Incidental recreation benefits from use of sediment pools of floodwater retarding structures open to the public will be $2,015 annually. Secondary benefits, although not considered pertinent from a national viewpoint, will amount to $2,815 annually in the immediate locale. This amount, which excludes indirect benefits in any form, results from $2,393 in benefits stemming from the project and $422 in benefits induced by the project.

Additional substantial benefits will accrue to the project. The local populace will have an increased sense of security, the knowledge that they are living in a more wholesome community, and the satisfaction of knowing that this is indeed an excellent locality in which to live and rear a family. These benefits, although real and extremely worthwhile, have not been evaluated in monetary terms, nor have they been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures (amortized total installation cost, plus operation and maintenance) is $17,486. These measures are expected to produce average annual primary benefits of $25,163. The benefit-cost ratio without secondary benefits is 1.4 to 1.0.

The ratio of total average annual project benefits accruing to structural measures ($27,978) to the average annual cost of structural measures ($17,486) is 1.6 to 1.0 (table 6).

PROJECT INSTALLATION

The project installation period will be three years. Sufficient Public Law 566 funds will be provided to supplement Public Law 46 funds in order that soil surveys can be completed during the first year, and to assure that adequate technical assistance is available so that all needed land treatment measures will be applied and maintained prior to the end of the installation period.

The goal of application and maintenance of 80 percent of needed land treatment by or before the end of the installation period is expected to be accomplished as follows:

Land Use	Fiscal Year			Total
	1st	2nd	3rd	
	(Acres)	(Acres)	(Acres)	(Acres)
Cropland	320	320	320	960
Grassland	2,567	2,567	2,566	7,700
Total	2,887	2,887	2,886	8,660

The removal of all obstructions and restrictions from stream channels in the urban area and application of land treatment are scheduled for the first year. The construction of floodwater retarding structures and the application of needed land treatment measures are scheduled for the second and third years.

The success of this project in providing protection to the urban area of Hamilton from a flood such as that of 1957 is contingent upon measures taken by the City to reduce retardance in the channels within the urban area. As a condition for providing Federal assistance, the City will remove or cause to be removed all trees, brush, rock, debris, posts, etc., from within the cross sectional area of the stream prior to the construction of the floodwater retarding structures. Constrictions will be enlarged to maintain a uniform section throughout. All openings of drainage structures will be cleaned out. Obstructions will be removed from the approach section of these structures.

The City and the County will select and appoint a contracting officer to administer the contracts for the construction of the floodwater retarding structures. His letter of appointment will include a listing of duties,

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responsibilities, and authorities. The individual appointed as contracting officer shall be available at all times to carry out his duties. He should be selected on the basis of his administrative ability. Legal, accounting, and/or engineering background would be helpful assets. He will be provided with clerk-typist assistance, available to him at all times. He will also be provided with office space at a recognized location easily accessible to the public and construction contractors. Arrangements will be made by the contracting officer to handle formal construction contract bid openings, publicly conducted, and attended by approximately 20 persons. The contracting officer will be provided with transportation facilities so that he will be able to make inspection trips to the locations of apparent low bidders' equipment plants and to all construction sites as necessary to perform his duties.

The City and the County will make arrangements for necessary legal, administrative and clerical personnel, and facilities, supplies and equipment to advertise, award, and administer the contracts. Land, easements, and rights-of-way, including utility, pipe line, road, and improvement changes, will be acquired for Sites 1 and 2 by the Hamilton County Commissioners Court and for Sites 3, 4, and 5 by the City of Hamilton.

The Hamilton County Commissioners Court and the City of Hamilton have authority under applicable State laws to exercise the right of eminent domain, if necessary, to acquire such land, easements, or rights-of-way, including utility, pipe line, road and improvement changes, as will be needed in connection with the works of improvement to be installed with Federal assistance. The legal adequacy of easements, permits, etc., for the construction of the planned structural measures will be determined by the sponsoring organization that has the responsibility for acquiring these rights.

The structural measures will be installed during the second and third years of the 3-year installation period pursuant to the following conditions:

1. The requirements for land treatment in the drainage area above the floodwater retarding structures have been met.

2. All land, easements, rights-of-way, and permits have been obtained for all structural measures or written statements have been furnished by the City of Hamilton and the Hamilton County Commissioners Court, giving a schedule for remaining non-cleared sites, by site number, and the exact date by which all land rights therefor shall be obtained, or the right of eminent domain of the county will be used to secure any remaining land, easements, or rights-of-way; and that sufficient funds are available for purchasing those easements and rights-of-way and for condemnation proceedings and awards.

3. The City of Hamilton has fulfilled its responsibility for removal of obstructions and constrictions within the cross-sectional area of the stream channels throughout the urban area.

4. The City and the County are prepared to discharge their responsibilities.

5. Project, land rights, and operation and maintenance agreements have been executed.

6. Public Law 566 funds are available.

All applicable State water laws will be complied with in design and construction of the planned floodwater retarding structures.

FINANCING PROJECT INSTALLATION

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

The cost of installing the needed land treatment measures during the 3-year installation period will be borne by the landowners and operators of the land on which these measures are installed. The Agricultural Stabilization and Conservation Service will provide financial assistance for the installation of those land treatment measures which are eligible for this assistance. The Farmers Home Administration, local banks, and other lending institutions can arrange financing for the landowners and operators' share of the cost. The Soil Conservation Service will provide funds in the amount of $8,225 to finance the cost of technical assistance for soil surveys, planning, and application of the land treatment measures. This consists of $5,075 of Public Law 566 funds and $3,150 to be provided from Public Law 46 funds (table 1).

Funds for the local share of the cost of installing the structural measures will be provided by the Hamilton County Commissioners Court and the City of Hamilton. This consists of the cost of acquiring those land easements and rights-of-way that are not donated, the cost of modification or relocation of utilities, and contract administration.

Financial and other assistance to be furnished by the Service is contingent on the appropriation of funds for this purpose. In addition, all prerequisite conditions will be met before Federal funds will be made available for the installation of the structural measures.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by the landowners and operators of farms on which the measures are installed under agreements with the Hamilton-Coryell Soil and Water Conservation District. Representatives of the district will make periodic inspections of the completed land treatment measures to determine maintenance needs. The landowners and operators will be encouraged to perform needed maintenance and management practices. District-owned equipment will be made available for this purpose in accordance with existing working arrangements.

Floodwater retarding structures 1 and 2 will be operated and maintained by the Hamilton County Commissioners Court. The City of Hamilton will operate and maintain structures 3, 4, and 5. In addition, the City will maintain the stream channels within the urban area to keep them free from obstructions and constrictions. An operations and maintenance agreement will be executed by the parties hereto, prior to the issuance of invitation to bid on construction of the structural measures. The agreement will set forth specific details on procedure in line with recognized assignments of responsibility. The estimated value of the annual operation and maintenance cost is $827, based on long-term prices. This consists of $503 for floodwater retarding structures 1 and 2 and $324 for structures 3, 4, and 5. Maintenance work will be accomplished through the use of contributed labor and equipment, by contract, by force account, or by a combination of these methods.

Inspections of the structural measures will be made in accordance with procedural details of the Operation and Maintenance Agreement. The City of Hamilton, the Hamilton-Coryell Soil and Water Conservation District, and the Hamilton County Commissioners Court will be represented on each joint inspection group making scheduled inspections of works of improvement.

The Service and the sponsors will make a joint inspection annually, or after unusually severe floods, or in the event of other unusual conditions that may adversely affect the works of improvement, for three years following installation of each structure. Inspection after the third year will be made annually by the sponsors. The Service will participate in annual inspections as often as it elects to do so after the third year.

Inspection items are those items which may need maintenance. These include, but will not be limited to, the condition of the principal spillways, earth fills or embankments, vegetative cover of the earth fills and emergency spillways; the need for removal of woody vegetation, sediment bars and debris from stream channels in the urban area; and the condition of fences, gates, and other appurtenances installed as part of the structural measures.

The representatives of the City and the County will prepare a report of all maintenance inspections. A copy of the report will be submitted to the

Service representative. The City and the County will keep summary control records as evidence that proper maintenance has been performed.

The Soil Conservation Service, through the Hamilton-Coryell Soil and Water Conservation District, will participate in operation and maintenance by furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

Provisions will be made to provide for free access of representatives of the City of Hamilton and the Hamilton County Commissioners Court, and Federal representatives to inspect and provide for maintenance for all structural measures and their appurtenances at any time.

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

Installation Cost Item	Unit	Number to Be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	960	-	13,291	13,291
Grassland	Acre	7,700	-	107,894	107,894
Technical Assistance			5,075	3,150	8,225
SCS Subtotal			5,075	124,335	129,410
TOTAL LAND TREATMENT			5,075	124,335	129,410
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	5	357,500	-	357,500
SCS Subtotal			357,500	-	357,500
Subtotal - Construction			357,500	-	357,500
Installation Services					
Soil Conservation Service					
Engineering Services			53,592	-	53,592
Other			31,345	-	31,345
SCS Subtotal			84,937	-	84,937
Subtotal - Installation Services			84,937	-	84,937
Other Costs					
Land, Easements, and Rights-of-Way			-	63,550	63,550
Administration of Contracts			-	2,500	2,500
Subtotal - Other Costs				66,050	66,050
TOTAL STRUCTURAL MEASURES			442,437	66,050	508,487
TOTAL PROJECT			447,512	190,385	637,897
SUMMARY					
Subtotal SCS			447,512	190,385	637,897
TOTAL PROJECT			447,512	190,385	637,897

1/ Price Base: 1966

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Pecan Creek Watershed, Texas

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Cropland			
Conservation Cropping System	Acre	960	-
Contour Farming	Acre	850	425
Cover and Green Manure Crop	Acre	320	3,840
Crop Residue Use	Acre	960	2,160
Terraces, Gradient	Foot	162,000	8,100
Terraces, Parallel	Foot	2,145	129
Diversion	Foot	10,000	1,000
Grassed Waterway or Outlet	Acre	30	3,150
Grassland			
Brush Control	Acre	5,000	50,000
Range Seeding	Acre	135	1,620
Range Deferred Grazing	Acre	4,500	4,500
Range Proper Use	Acre	5,000	5,000
Farm Ponds	No.	54	27,000
Fish Pond Stocking	No.	45	450
Fish Pond Management	No.	43	860
Land Clearing	Acre	160	4,800
Pasture and Hayland Planting	Acre	228	5,700
Pasture and Hayland Management	Acre	182	2,730
TOTAL			121,464

1/ Price Base: 1966

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Pecan Creek Watershed, Texas

(Dollars) 1/

Structure Site Number	Installation Cost - Public Law 566 Funds				Installation Cost - Other Funds			Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566	Other: Adm. of Contracts	Other: Easements and R/W	Total Other	
Floodwater Retarding Structures								
1	122,100	15,873	10,520	148,493	500	9,925	10,425	158,918
2	89,100	13,365	7,813	110,278	500	8,900	9,400	119,678
3	44,000	7,920	3,959	55,879	500	11,750	12,250	68,129
4	66,000	9,900	5,787	81,687	500	25,225	25,725	107,412
5	36,300	6,534	3,266	46,100	500	7,750	8,250	54,350
GRAND TOTAL	357,500	53,592	31,345	442,437	2,500	63,550	66,050	508,487

1/ Price Base: 1966

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Pecan Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	Total
Drainage Area	Sq. Mi.	1.82	1.64	0.27	0.78	0.44	4.95
Storage Capacity							
Sediment Pool (50-year or 200 acre-feet)	Ac. Ft.	58	61	13	33	12	177
Sediment in Detention Pool	Ac. Ft.	48	44	9	25	9	135
Floodwater Pool	Ac. Ft.	642	563	96	280	103	1,684
Total	Ac. Ft.	748	668	118	338	124	1,996
Surface Area							
Sediment Pool	Acre	12	13	3	6	2	36
Floodwater Pool	Acre	65	62	14	29	15	177
Volume of Fill	Cu. Yd.	232,000	163,000	56,000	93,000	44,000	588,000
Elevation Top of Dam 1/	Foot	1,233.7	1,236.3	1,199.8	1,222.3	1,211.5	xxx
Maximum Height of Dam 2/	Foot	42	39	30	44	28	xxx
Emergency Spillway							
Crest Elevation	Foot	1,228.5	1,230.5	1,195.5	1,217.0	1,206.5	xxx
Bottom Width	Foot	400	300	100	200	140	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		1.0	1.0	1.0	1.0	1.0	xxx
Average Curve No. - Condition II		80	80	80	80	80	xxx
Emergency Spillway Hydrograph							
Storm Rainfall (6-hour) 4/	Inch	13.1	13.1	13.1	13.1	13.1	xxx
Storm Runoff	Inch	10.5	10.5	10.5	10.5	10.5	xxx
Velocity of Flow (V_c) 5/	Ft./Sec.	5.0	5.1	4.0	4.7	5.4	xxx
Discharge Rate 1/	C.F.S.	1,530	1,259	206	652	689	xxx
Maximum Water Surface Elevation 1/	Foot	1,230.2	1,232.4	1,196.7	1,218.5	1,208.4	xxx
Freeboard Hydrograph							
Storm Rainfall (6-hour) 4/	Inch	30.8	30.8	30.8	30.8	30.8	xxx
Storm Runoff	Inch	28.0	28.0	28.0	28.0	28.0	xxx
Velocity of Flow (V_c) 5/	Ft./Sec.	9.6	9.8	8.6	9.8	9.5	xxx
Discharge Rate 1/	C.F.S.	11,272	9,175	2,013	5,922	3,809	xxx
Maximum Water Surface Elevation 1/	Foot	1,233.7	1,236.3	1,199.8	1,222.3	1,211.5	xxx
Principal Spillway							
Capacity (Maximum)	C.F.S.	41	37	6	18	88	xxx
Capacity Equivalents							
Sediment Volume	Inch	0.60	0.70	0.90	0.80	0.50	xxx
Sediment in Detention Pool	Inch	0.49	0.50	0.60	0.60	0.40	xxx
Detention Volume	Inch	6.61	6.43	6.70	6.72	4.36	xxx
Spillway Storage	Inch	4.13	5.29	5.22	4.18	3.44	xxx
Class of Structure		C	C	C	C	C	xxx

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1/ Values obtained from routing.

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.

4/ Based on Engineering-Hydrology Memorandum TX-1, "Emergency Spillway and Freeboard Hydrograph Development," August 16, 1965.

5/ Obtained from curves drawn from figure 4-R-11472 revised March 1959 and ES-98 dated April 27, 1955, based on flows obtained from routing of hydrographs.

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TABLE 4 - ANNUAL COST

Pecan Creek Watershed, Texas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Floodwater Retarding Structures (5)	16,659	827	17,486
TOTAL	16,659	827	17,486

1/ Price Base: 1966. Prices amortized for 100 years at 3.125 percent.

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

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Pecan Creek Watershed, Texas

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	1,962	375	1,587
Other Agricultural	703	176	527
Non-Agricultural			
Road and Bridge	500	100	400
Urban	19,900	500	19,400
Subtotal	23,065	1,151	21,914
Erosion			
Flood Plain Scour	585	274	311
Subtotal	585	274	311
Indirect	2,365	142	2,223
TOTAL	26,015	1,567	24,448

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

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Pecan Creek Watershed, Texas

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS				Average Annual Cost 2/	Benefit Cost Ratio
	Flood Prevention					
	Damage Reduction	Incidental Recreation	Secondary	Total		
Floodwater Retarding Structures (5) 3/	23,148	2,015	2,815	27,978	17,486	1.6:1

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 $1,300 annually.

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INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment for the watershed was developed by supervisors of the Hamilton-Coryell Soil and Water Conservation District, with assistance from personnel of the Soil Conservation Service Work Unit at Hamilton, Texas. A 50 percent sample of current basic conservation plans of the watershed was analyzed to develop conservation needs data for the entire watershed. Acres to be treated by land use during the 3-year installation period were based upon a study of total conservation needs, accomplishments to date, remaining needs, and the priority of planning and servicing established by the Soil and Water Conservation District.

Technical assistance needs were based on the amount of time now required for soil surveys, development and preparation of basic conservation plans, and application of conservation measures. The amount of Public Law 566 funds needed to assure the application and maintenance of all scheduled land treatment measures prior to the end of the installation period were determined in accordance with paragraph 1121.11 of the Watershed Protection Handbook.

Engineering Investigations

The procedures used to determine the most feasible plan of structural measures to meet the objectives of the sponsoring local organizations that could not be accomplished by land treatment measures were as follows:

1. A base map of the watershed was prepared using U.S.G.S. topographic maps of 7.5 minute series. A study of photographs, supplemented by field examinations and interviews with residents, indicated the limits of flood plain subject to flood damage.

2. Based on topographic map studies and field examinations, a system of 7 floodwater retarding structure sites was recommended to the sponsoring local organizations for consideration and detailed survey.

3. Engineering surveys were started after agreement was reached with the sponsoring local organization on location of floodwater retarding structure sites to be studied. All surveys were made in accordance with Watersheds Memorandum TX-2, June 3, 1959, as revised.

4. Designs of floodwater retarding structures were initiated as surveys progressed. Criteria outlined in Engineering Memorandum-27 (1965) and Texas State Manual Supplement 2441 were used to determine the sediment and floodwater detention storage requirements, structure classification, and principal spillway and emergency spillway

design. Preliminary layouts of pools, centerlines of dams, and emergency spillways were prepared and then reviewed on the ground with the sponsors. These preliminary layouts showed the approximate surface area of the dam, the emergency spillway, and the sediment and detention pools affecting each landowner. After any adjustments found desirable and feasible were made, the final pool elevations were determined, release rates for the principal spillways were established, and emergency spillways were designed.

The elevations of the sediment pools were determined in accordance with Engineering Memorandum-16 and Section 3107, Watershed Protection Handbook. Detention volumes meet or exceed the minimum criteria set forth in Engineering Memorandum-27 (1965) and State Manual Supplement 2441 for all structures.

5. The adjusted long-term average cost of maintaining the floodwater retarding structures is based on the following equation:

$$M = .73 (\$40 + \$10V + \$15F),$$

where: M = the cost of maintenance.

V = the number of acres to be vegetated in the dam and emergency spillway.

F = The percent chance of use of the emergency spillway.

(table 3).

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from U. S. Weather Bureau Bulletins for the gage at Hamilton, Texas. Rainfall frequency data for the watershed were obtained from U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas for the United States." Rainfall information associated with historical floods was obtained from residents of the watershed to supplement official gage data. The depth of runoff from storms was estimated, using hydrologic soil cover complex curve numbers with figure 10.1, National Engineering Handbook, Section 4, Hydrology, Part 1.

2. The present hydrologic conditions were determined from a 10 percent sampling of soil and cover conditions. The future condition was determined by considering the effect of changes in land use and treatment that could be expected during the installation period.

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The following is a summary of curve numbers by land resource areas:

Land Resource Area	Without Project Conditions	With Project Conditions
Grand Prairie	81	80
Cross Timbers	76	75
Watershed Average	80	79

3. The area subject to flood damage was determined by stereoscopic photo study and by information obtained from residents of the watershed. High water marks and the area inundated by the flood of April 1957 were determined by interviewing residents of the city.

4. Engineering surveys were made of 33 valley cross sections selected to represent the stream hydraulics and flood-plain area.

5. Stage discharge relationships were determined for the vally cross sections by developing water surface profiles with the IBM 650 computer.

6. The peak discharge runoff relationship was developed at each proposed floodwater retarding structure site and at each valley cross section, using the IBM 7090/7094 computer program outlined in USDA Technical Release No. 20, "Project Formulation Program - Hydrology," June 8, 1965. Various combinations of floodwater retarding structures were analyzed to determine the system of structures which would accomplish the project objectives most efficiently.

7. Elevation-frequency of flooding profiles were developed for the urban area of Hamilton for both without project and with project conditions. Stage-area inundated curves were developed for each portion of the flood plain represented by a single cross section in the agricultural reach. Acres inundated by 0-1, 1-3, and 3 feet plus depth increments were determined for selected floods. A composite frequency-area inundated curve was developed for both without project and with project conditions.

8. Detention volumes for floodwater retarding structures were determined using Engineering-Hydrology Memorandum TX-2, November 5, 1965, and Engineering Memorandum-27 (Rev.), March 19, 1965.

9. The emergency spillway and freeboard hydrograph were developed using Engineering-Hydrology Memorandum TX-1, "Emergency Spillway and Freeboard Hydrograph Development," August 16, 1965, and Engineering

Memorandum-27 (Rev.), March 19, 1965. The dimensions of the emergency spillway were determined by flood routing the freeboard hydrograph. The Monrobot computer was used to flood route the hydrographs through the structure.

Sedimentation Investigations

Sedimentation investigations were made in accordance with procedures outlined in "Guide to Sedimentation Investigations," South Regional Technical Service Area, U. S. Department of Agriculture, Soil Conservation Service, March 1965.

1. The required 100-year sediment storage requirements for the floodwater retarding structures were made as follows:

   a. A 10 percent sample of the watershed was selected and studies made to determine gross erosion for both without and with project conditions in accordance with Chapters VII and X of the Guide.

   b. The appropriate sediment delivery ratios and trap efficiency adjustments were made in accordance with Chapter VIII.

   c. Allowances for differences in density were based on volume weights of 84 pounds per cubic foot for sediment.

   d. The following tabulation shows how sediment was allocated to the pools:

Period of Deposition	Pool	Condition	Percent
First 50 years	Detention	Aerated	10
	Sediment	Submerged	90
Last 50 years	Detention	Aerated	100

2. Sedimentation and scour damage investigations were made by the valley cross-section method, as explained in Chapter XI of the Guide. Damage categories, measurements, and summaries of all physical damages were made in accordance with suggested procedures.

Geologic Investigations

Preliminary dam site investigations were made at each of the 5 floodwater retarding structure sites included in the plan and 2 additional sites, including Hamilton City Lake. Reports were prepared in accordance with Chapter 6 of "Guide to Geologic Site Investigations," South Regional Technical Service Area, U. S. Department of Agriculture, Soil Conservation Service, July 1965. These investigations included making studies of valley slopes, alluvium, channel banks, and exposed geologic formations.

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

Economic Investigations

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention," U. S. Department of Agriculture, Soil Conservation Service, March 1964. Two reaches, one for the urban and one for the agricultural area, were evaluated. The agricultural reach extends from valley section 10 to the mouth of Pecan Creek (figure 4).

Urban damage calculations were based upon information obtained by interviewing an estimated 75 percent of those individuals suffering damage of any consequence from the 1957 flood. Project benefits exclude any benefit attributable to channel restoration.

Agricultural damage calculations were based upon information obtained in interviews with owners and operators of approximately 50 percent of the acreage of the flood plain. Schedules covered past, present, and intended future use; crop distribution under normal conditions; planting dates; yields; historical data on flooding and resultant damages to crops and pastures, as well as other agricultural property. Verification of information gained by interviews in the field was obtained from local agricultural workers. The land use of the entire flood plain was obtained by field mapping.

The monetary value of the physical damage from flood plain scour was based upon the value of production lost. The value of recovery from this damage was discounted in accordance with time required for recovery.

Indirect damages were estimated to approximate 10 percent of direct damages.

Incidental recreation benefits were evaluated for sediment pools of floodwater retarding structures by using a value of $.90 per visitor-day in keeping with recommendations in Watersheds Memorandum-57, October 3, 1962. Benefits were calculated allowing for full level of use and attractiveness for 40 years, with a gradual diminishing of attractiveness during the next 10 years to zero at the end of 50 years and for the balance of the evaluation period.

The value of easements was determined by local appraisal, giving full consideration to current real estate market values.

A comparison of the value of agricultural production lost in the pool areas of the planned structures with the amortized value of land involved showed the latter to be greater. The easement value was therefore used in economic evaluation in the interest of a conservative analysis.

Fish and Wildlife Investigations

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

"Fishing is of little importance in the project streams. Hamilton City Lake is the only permanent fishing water of significance in the watershed. The principal species of fish are largemouth bass, channel catfish, flathead catfish, crappies, and several other species of sunfish. The amount of fishing in the watershed is moderate and is not expected to change without the project.

"There is no commercial fishing in the watershed, and none is expected to develop in the future.

"Construction and operation of the proposed floodwater retarding structures would provide additional good fish habitat in the watershed.

"Wildlife species of significance in the watershed are mourning dove, bobwhite, fox squirrel, white-tailed deer, cottontail, raccoon, red fox, gray fox, and ring-tailed cat. Ducks use farm ponds and other available water for resting during migration.

"Hunting for most species is moderate and is done primarily by landowners and their friends. Foxes and raccoons are run occasionally for sport with hounds. There is also a limited amount of trapping for fur animals. These conditions are not expected to change in the future.

"The application of land treatment measures generally would improve wildlife habitat. The stirring of the soil would stimulate weed production which would benefit doves, bobwhites, and other seed-eating birds. The floodwater reservoirs may provide resting habitat for migrating waterfowl.

"Brush control, clearing for floodwater retarding structures, and channel improvement would destroy badly needed wildlife food and cover plants.

"Often, in the construction phase of a project of this type, a few minor changes in design and construction procedures could greatly reduce the destruction of and possibly improve fish and wildlife habitat. These changes could have a surprising beneficial effect on fish and wildlife populations for many years.

"Upon completion of each structure and prior to impounding water, all barren and borrow areas in the basin should be disked and planted to

grasses or small grains adaptable to the area. Such plantings would improve fish habitat by increasing initial fertility, reducing erosion, and decreasing turbidity.

"Floodwater retarding structures should be fenced when practicable to prevent damage to the dams and muddying of the water by livestock. A watering device, if required, should be installed below the dams and outside the enclosures. These measures would improve the quality of fish habitat within the structures and also would provide more desirable water and watering conditions for livestock.

"Lands in the vicinity of floodwater retarding structures, which are devoid of vegetation, should be planted to native grasses to prevent soil erosion and deposition of sediment in the reservoir basins. Such measures would improve fish habitat by preventing silt from entering the reservoirs.

"Stocking of fish in the reservoirs should be done only under the guidance of the Texas Parks and Wildlife Department. Improper stocking of impoundments results in the presence of undesirable species and in high populations of stunted fish.

"During the construction phase of the project, timber clearing should be kept to a minimum. Minimal clearing of timber would reduce construction costs and retain much of the original wildlife habitat of the area.

"Improvement of wildlife habitat could be achieved by the planting of wildlife food and cover plants. Wildlife plantings could be made in eroded areas, gullies, impoundment enclosures, along fence rows and along driveways.

"In view of the above, it is recommended:

"1. That the basins of floodwater retarding reservoirs be disked and planted to small grains or grasses adaptable to the area upon completion and prior to storage of water.

"2. That floodwater retarding structures be fenced when practicable and, if needed, a watering device for cattle be installed below the dam and outside of the enclosure.

"3. That lands in the vicinity of floodwater retarding structures which are devoid of vegetation be planted to native grasses to prevent soil erosion and deposition of sediment in these impoundments.

"4. That the stocking of fish in the reservoirs be done under the guidance of the Texas Parks and Wildlife Department.

"5. That the clearing of brush and timber be kept to a minimum throughout the construction of the project.

6. That planting of wildlife food and cover plants be made in eroded areas, gullies, impoundment enclosures, along fence rows, and along driveways."

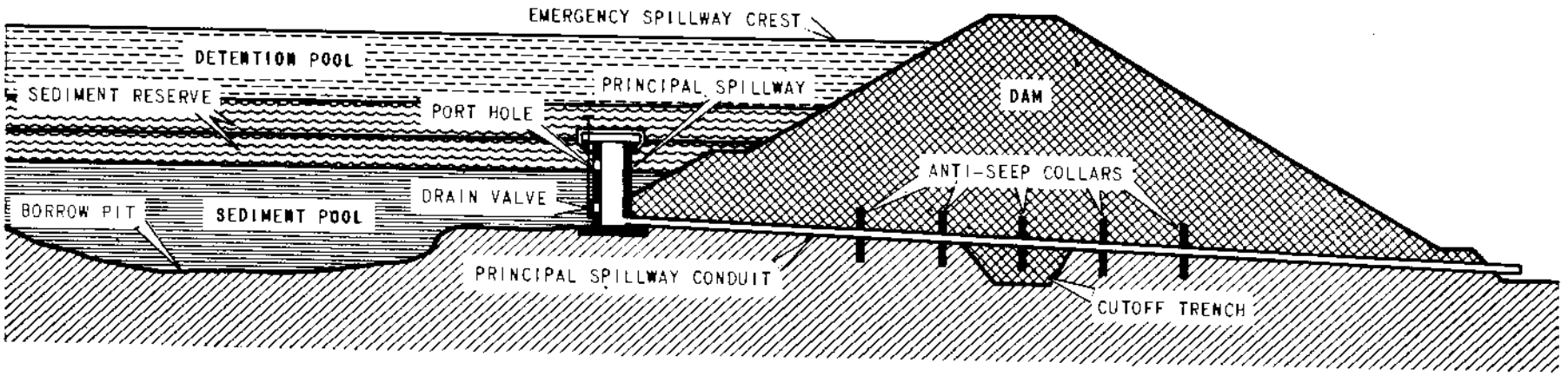


Figure 1

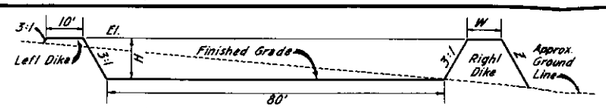
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Rev. 3-65 A-L-10,071

Elevation	Surface Acres	Storage Acre Feet	Storage Inches
994	1.5	1.5	.01
998	11.9	28	.18
1002	26.0	104	.67
1002.8	27.7	125	.81
1003.3	28.8	139	.90
1006	34.8	226	1.46
1010	44.1	383	2.48
1014	60.3	592	3.84
1018	80	873	5.65
1020	91.6	1044	6.76

Top of Dam (Effective) Elev.	1021.6
Emergency Spillway Crest Elev.	1018.0
Principal Spillway Crest Elev.	1002.8
Sediment Pool Elev.	1002.8
Drainage Area, Acres	1853
Sediment Storage, Acre Feet	139
Floodwater Storage, Acre Feet	734
Max. Emergency Spillway Cap., c.f.s.	1344

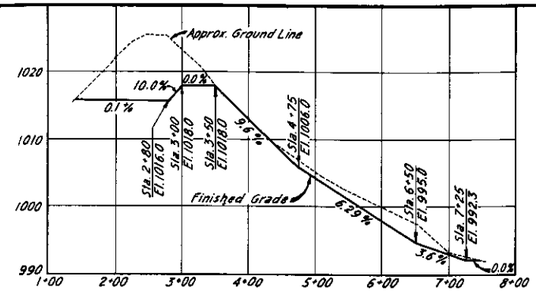


Left Dike:
Approx. Sta. 2+80 to Approx. Sta. 5+80, H=3.0'

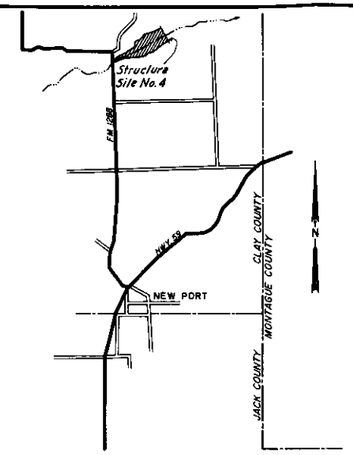
Right Dike:
Approx. Sta. 3+00 to Embankment, Z = 2½:1, W=14', El. 1021.7
Embankment to Sta. 4+00, Transition Section
Sta. 4+00 to Sta. 7+00, Z = 3:1, W=10', H=3.0'

Material forming Dikes shall be placed and paid as "Compacted Fill".

TYPICAL SECTION - EMERGENCY SPILLWAY



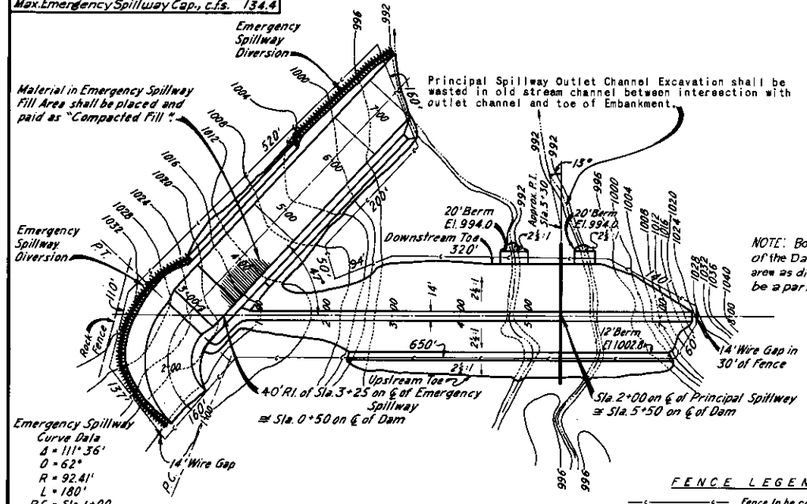
PROFILE ON ℄ OF EMERGENCY SPILLWAY



Structure located 4.0 miles north and 0.4 mile east of New Port, Clay County, Texas

VICINITY MAP

0 1 2 3 4
SCALE IN MILES

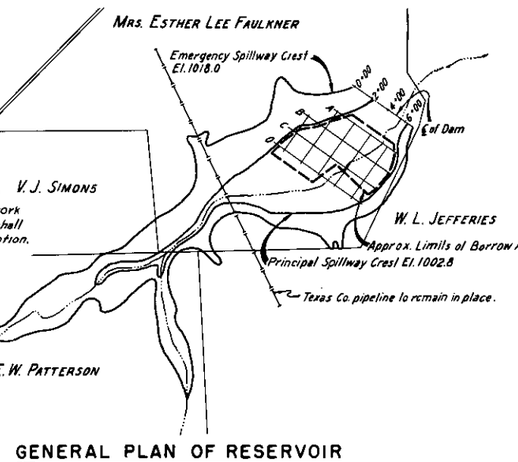


PLAN OF EMBANKMENT AND SPILLWAYS

0 100 200 300 400 500
SCALE IN FEET

NOTE: Boulders in the area of the end of the Dam shall be removed from the work area as directed by the Engineer. This shall be a part of the Embankment preparation.

FENCE LEGEND
Fence to be constructed under this contract.



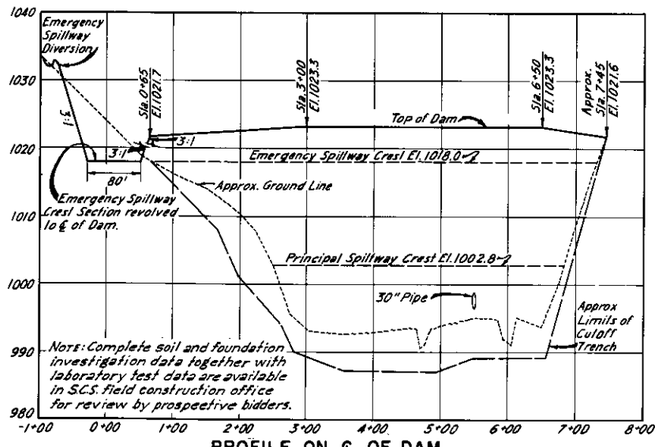
GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640
SCALE IN FEET

Emergency Spillway Diversion: 18° effective height, 3:1 side slopes, minimum base, 13'. Cost of diversion to be subsidiary to other items of work.

A minimum of 6" topsoil to be placed in Emergency Spillway and on all "Compacted Fill Areas". See the specifications.

Stream Channel within embankment area to be cleared of objectionable material in accordance with "Stream Channel Cleanout" of the specifications.



NOTE: Complete soil and foundation investigation data together with laboratory test data are available in SCS field construction office for review by prospective bidders.

PROFILE ON ℄ OF DAM

MATERIAL PLACEMENT DATA

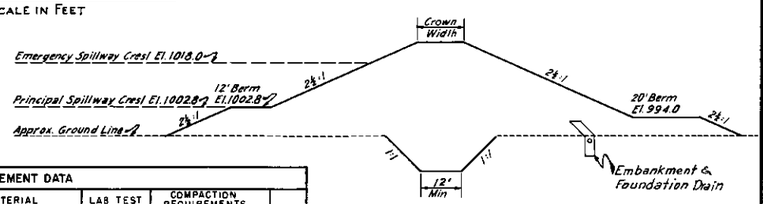
Embankment Section	Source of Fill Material	Lab Test			Compaction Requirements			Lab. Curve
Description	Location	Ave. Depth Feet		Standard		Min. Dry Density	Moisture Range		
		From	To	Max. Dry Den.	Optim Moist	Lbs Per Cu Ft.	Percent From	To	No.
Any Section	Borrow	0	10	121.0	11.5	115.0	11	15	1
	Borrow	2	7	117.5	11.5	112.5	11	16	2
Interior of Upstream Section	Emergency Spillway	0	12	116.5	13	111.5	13	17	3
Around Drain & in Downstream Toe	Borrow	0	4	117.0	11.5	112.0	11	15	4

Material from Cutoff Trench and other required excavation may be used for "Compacted Fill" with compaction requirements and limits of placement moisture being the same as for similar materials from Borrow and Emergency Spillway.

The Engineer will direct placement of all fill materials in consideration of the preferred uses shown in the table.

Maximum dry density, optimum moisture, minimum acceptable dry density and moisture range shown are for material particles passing the number 4 sieve.

EMBANKMENT DATA



TYPICAL SECTION

Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	R.L.M., L.L.	1-65
Drawn	R.L.M., L.L.	1-65
Traced	F.I.B.	4-65
Checked	L.L. & G.W.T.	5-65

Approved by REGIONAL CONSERVATIONIST & EXPERIMENTAL PLANNING UNIT, FORT WORTH, TEXAS
STATE CONSERVATIONIST, TEMPLE, TEXAS
Sheet No. 2 of 9
Drawing No. 4-E-20,079

USDA-SCS-FORT WORTH TEX 1966

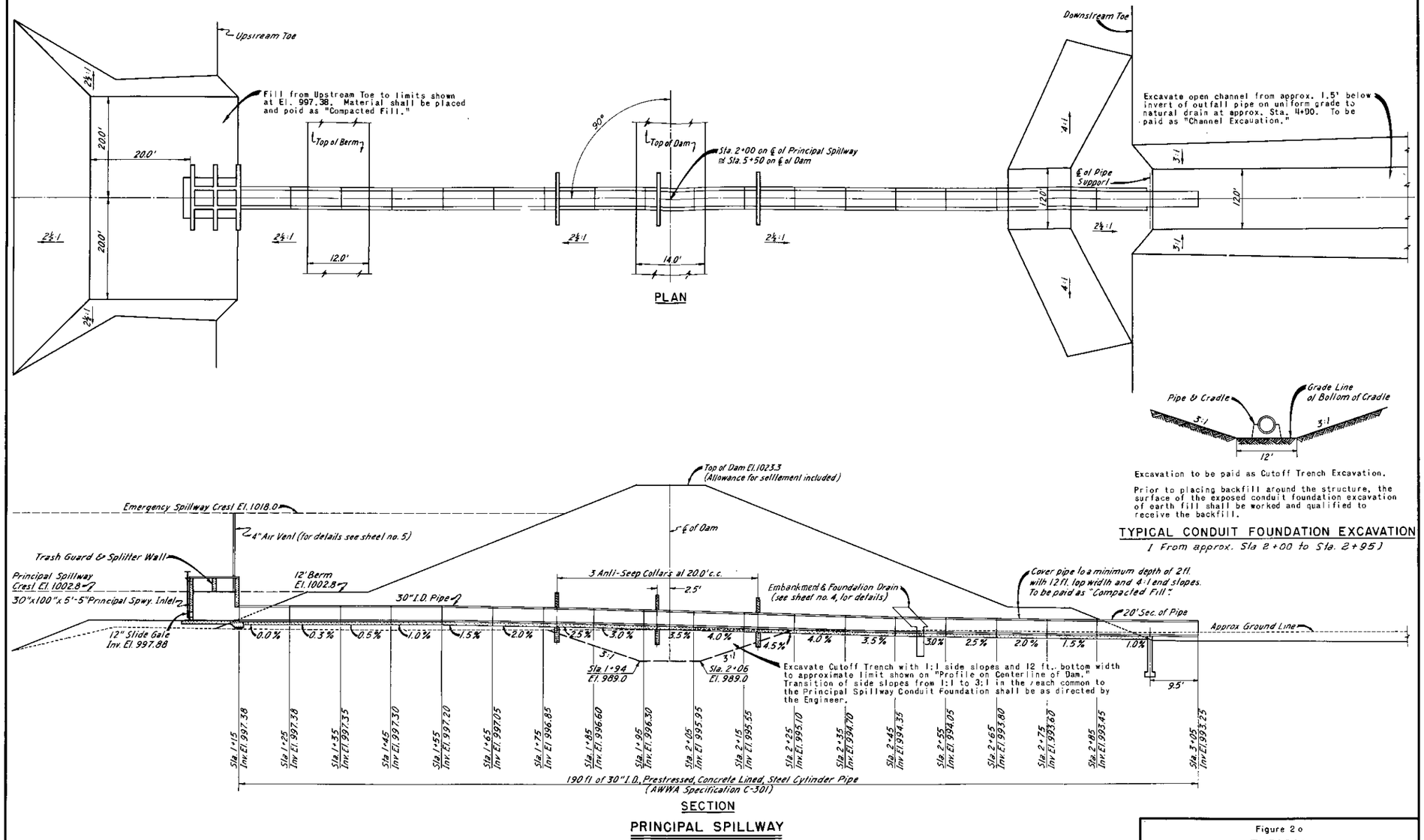


Figure 2 o

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed L. L.	4-65	Approved by ... HEAD ENGINEERING & WATERSHED PLANNING UNIT FORT WORTH, TEXAS
Drawn L. L.	4-65	STATE CONSERVATIONIST
Traced F. I. B.	5-65	STATE CONSERVATION ENGINEER
Checked L. L. & G. W. T.	5-65	TEMPLE, TEXAS Sheet No. 3 of 9 — Drawing No. 4-E-20,079

USDA SCS FORT WORTH, TEX. 1966

L E G E N D

April 1957 Flood Without Project

April 1957 Flood With Project

(2) Floodwater Retarding Structure and Number

0 660 1320 1980 2640

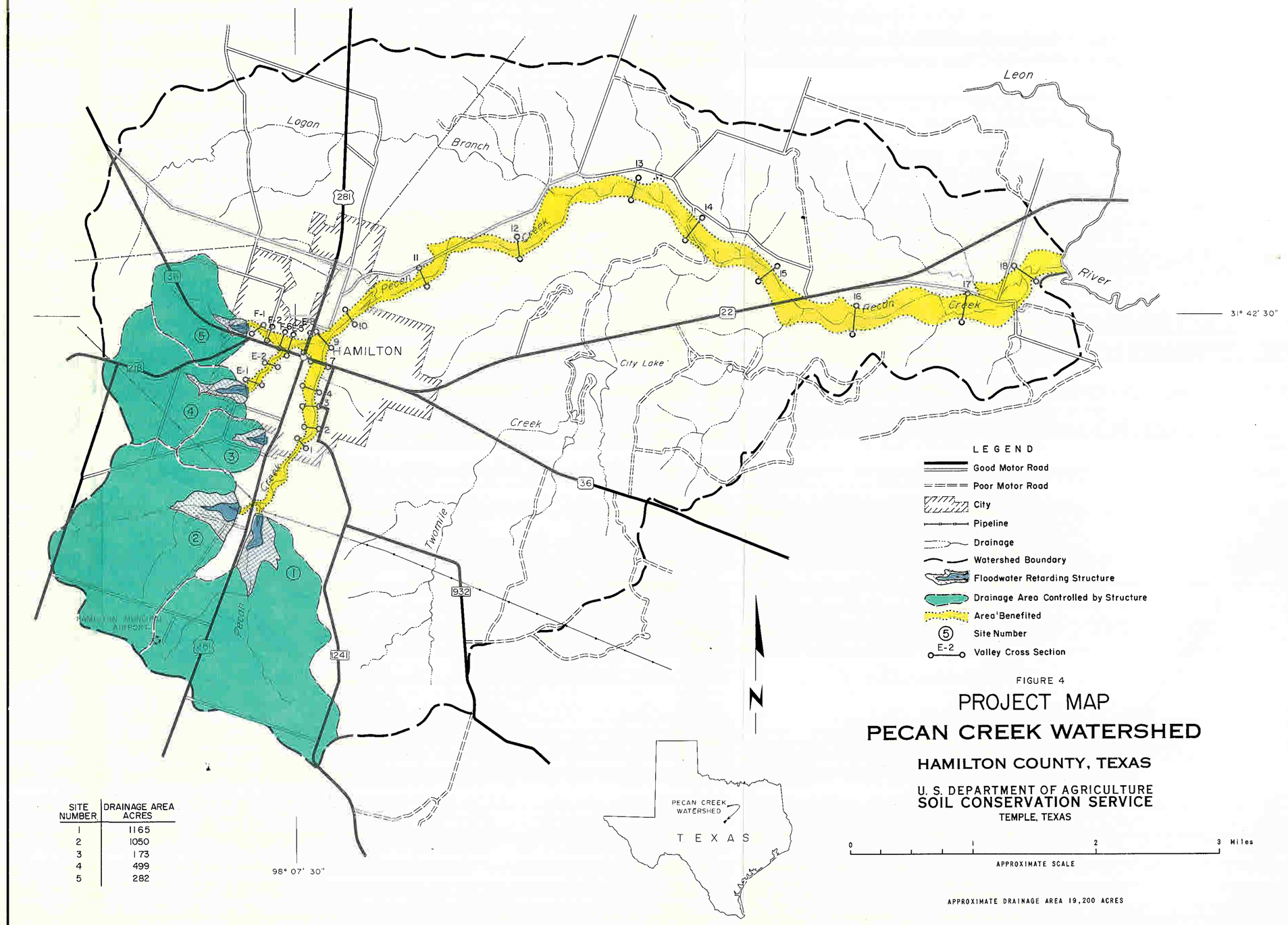
FEET

USDA-SCS-FORT WORTH, TEX. 1966

Figure 3

URBAN BENEFIT AREA
HAMILTON, TEXAS
APRIL 1957 FLOOD
PECAN CREEK WATERSHED
HAMILTON COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

3-66 4-R-21,351



SITE NUMBER	DRAINAGE AREA ACRES
1	1165
2	1050
3	173
4	499
5	282

FIGURE 4

PROJECT MAP

PECAN CREEK WATERSHED

HAMILTON COUNTY, TEXAS

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

APPROXIMATE DRAINAGE AREA 19,200 ACRES

USDA-SCS-FORT WORTH, TEX. 1966

4-66 4-R-21370

REVISED MARCH 1966 4-R-20273-A