# PRELIMINARY WORK PLAN

# CALAVERAS CREEK WATERSHED

Of the San Antonio River Watershed

Bexar and Wilson Counties, Texas

Prepared By

SOIL CONSERVATION SERVICE

U.S. DEPARTMENT OF AGRICULTURE

Fort Worth, Texas

March 1954

Agr-SCS-Ft.Worth, Tex., 1954

March 17, 1954

Chairman, County ASC Committee
County Extension Agents
County Administrator, F. H. A.
County Commissioners, Bexar County
Vocational Agriculture Dept.
Chairman, San Antonio River Authority

In accordance with the specific request of the farmers and others living in the Calaveras Creek Watershed, a Work Plan has been prepared primarily for flood prevention, and a copy is being provided you herewith.

As a result of the discussion held during the development of the plan and as reviewed finally with various members of the group on December 1 and 3, 1953, it is our understanding that the unit costs and schedules shown are in harmony with those currently used by the agencies and organizations which will participate in the carrying out of the plan.

We believe you will be interested in the attached copies of letters from the Alamo and Wilson Soil Conservation District Governing Bodies concurring in the work plan and indicating that they have incorporated the pertinent aspects in their respective district work plans.

It is our observation, and we believe also that all who have helped in the development of this plan, that parties who are to participate are "ready to go".

We have in the Soil Conservation Service budget for fiscal year 1954, the money for initiating our part of the work as set forth in the schedule of the work plan for 1954.

If any significant changes should be needed during the application of this plan, it is expected that the revision will be brought to your attention.

/s/ John Herring
John Herring, Area Conservationist

/s/ Dudley Mann
Dudley Mann, Area Conservationist

Attachments

C O P Y

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December 1, 1953

Mr. Dudley Mann, Area Conservationist
Mr. Don A. Windrow, Work Unit Conservationist

Dear Sirs:

At our regular meeting of the above date, the supervisors of our district reviewed the completed work plan for the Calaveras Creek watershed.

We believe that this plan that has been developed through the joint effort of interested landowners, the District Supervisors, Soil Conservation Service technicians and other interested groups and individuals will give the greatest amount of soil and water conservation and floodwater reduction when installed as planned.

We are lending our full support to pushing this plan through to completion as soheduled.

A Revised Memorandum of Understanding has been entered into between the District and the Soil Conservation Service conveying the general terms of oooperation and responsibilities.

We have officially incorporated into our District Work Plan that part that direotly ooncerns our district.

In addition, we have assumed the responsibility for the maintenance of the floodwater retarding struotures in the watershed.

Very truly yours,

/s/ E. E. Voigt
Chairman of the Board
Alamo Soil Conservation
District

C O P Y

OFFICE OF SOIL CONSERVATION DISTRICT NO. 301
FLORESVILLE, TEXAS
December 3, 1953

To: John Herring, Area Conservationist - SCS
L. C. Boswell, Work Unit Conservationist - SCS

Dear Sirs:

At our regular meeting of this date we have reviewed the work plan for the Calaveras Creek Pilot Watershed, prepared by interested groups and individuals in conjunction with the District Supervisors.

We believe that this plan will give the maximum protection to the lands of the watershed and are interested in seeing it carried through to completion as scheduled.

We have signed a revised memorandum of understanding with the Soil Conservation Service setting forth the responsibilities of each.

We have officially made that part of the Calaveras Work Plan that pertains to our District a part of our District Work Plan.

Very truly yours,

(signed) I. B. Ray
I. B. Ray, Chairman of Board
Wilson County Soil Con. Dist.-301

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SAN ANTONIO RIVER AUTHORITY
San Antonio, Texas

Reply to:

W. B. Tuttle
P. O. Box 1771
San Antonio, Texas

November 10, 1953

Alamo Soil Conservation District
610 S. Flores Street, Bldg 1,
San Antonio, Texas

Dear Sirs:

The following is an extract from the minutes of the San Antonio River Authority of September 11, 1953:

> "Mr. McGimsey made a motion, which was seconded by Mr. Giesecke, 'Whereas, the Board of Supervisors of the Alamo Soil Conservation District have agreed to sponsor the Calaveras Creek Pilot Dam Project which is an important link in the Flood Control Program for the San Antonio River Watershed, therefore, the San Antonio River Authority approves and endorses this project as an important feature in the Flood Control Program for the San Antonio River'. This motion was unanimously passed."

Very truly yours,

/s/ W. B. Tuttle

W. B. Tuttle, Chairman
San Antonio River Authority

C O P Y

Washington 25, D. C.
August 24, 1953

TO: L. P. Merrill, Regional Director, SCS
Fort Worth, Texas

FROM: Robert M. Salter, Chief, SCS

SUBJECT: Designation of Calaveras Creek Watershed, Texas

This is to inform you that I have designated Calaveras Creek Watershed in Bexar County, Texas, as a project eligible for Federal assistance in the installation of improvement measures under the Watershed Protection item in the appropriation bill for fiscal year 1954.

Calaveras Creek Watershed has been designated on the basis of the formal assurance of the Alamo Soil Conservation District that it is ready to sponsor the program on the watershed and to cooperate with the Federal Government, state and local agencies and individuals in carrying it out.

Calaveras Creek watershed, with an area of 50 square miles, is to be completely treated within 5 years at an estimated cost of $427,000 to the Federal Government. The program is based on local interests making at least an equal contribution. The treatment will consist of interrelated land treatment and structural measures designed to prevent the formation of damaging floods, soil erosion and to retard runoff and thereby conserve and improve the agricultural resources of the area.

Local interests will be assisted by the Federal Government in the development of a watershed plan and in the installation of watershed protection measures in accordance with this plan. This assistance will consist of (1) providing technical services to accelerate the planning and applying land-treatment measures on the farms of the watershed, (2) designing and supervising the construction of control measures, and (3) issuing invitations to bid and entering into contracts for the installation of structural and related measures.

It is also intended to initiate studies in the Calaveras Creek watershed that will provide factual information on the effects of a watershed protection program on crop yields, soil loss and sediment production, runoff, and flood flows. The cooperation of the Geological Survey and other agencies will be sought in carrying out these evaluations. The installation of this program will also serve to demonstrate the willingness and ability of local interests to cooperate with the Federal Government in solving their watershed problems.

The Congress has fixed a ceiling of $28,706,000 in Federal costs to be expended in a five-year period throughout the Nation on this Watershed Protection program. The ceiling for this project as indicated above is $427,000 and cannot be exceeded.

I am sure you have plans to get the work started at once in this watershed and I hope you will do so.

/s/ Robt. M. Salter

# PRELIMINARY WORK PLAN
# CALAVERAS CREEK WATERSHED
## Of The San Antonio River Watershed
## Bexar and Wilson Counties, Texas

Participating Agencies

The San Antonio River Authority
Alamo Soil Conservation District
Wilson County Soil Conservation District
Bexar County Highway Department
Soil Conservation Service
Extension Service, USDA
Agricultural Conservation Programs Branch, USDA
Vocational Agricultural Department
Farm & Home Administration, USDA

Prepared by
Soil Conservation Service
United States Department of Agriculture
December 1953

PRELIMINARY WORK PLAN
CALAVERAS CREEK WATERSHED
Of The San Antonio River Watershed
Bexar and Wilson Counties, Texas
December 1953

## Introduction

### Authority

The Federal participation outlined in this work plan will be performed under the authority of Public Law No. 46 of the 74th Congress approved April 27, 1935, as amended and supplemented. 1/

The Calaveras Creek watershed was designated August 24, 1953. A copy of the official designation is included in this work plan.

### Purpose and Scope of Plan

This plan calls for the installation of floodwater retarding structures, combined with the proper sequence and amounts of conservation treatment practices, to achieve the maximum practicable reduction of erosion and floodwater and sediment damages.

The application of this mutually developed plan, to be installed by the combined facilities of local interests and State and Federal agencies, will provide the best use of the land and water resources of the watershed and insure maximum sustained production and the constant improvement of the soils. This will promote the welfare of the landowners and operators, the community, the state and the nation. The area in the watershed includes parts of the counties, Bexar and Wilson, and contains 61,440 acres.

## SUMMARY OF PLAN

The Soil Conservation Service assisting the Alamo and Wilson County Soil Conservation Districts will plan, design, let contracts for, and supervise the construction of the necessary floodwater retarding structures. Local landowners and other interested individuals and groups will provide the necessary land easements and rights-of-way for the structures. The Commissioners Court of Bexar County will make the necessary road relocation above Site No. 4.

The Board of Supervisors of the above named Soil Conservation Districts have signed Revised Memoranda of Understanding with the Soil Conservation

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1/ H. B. 5227 "A bill making appropriations for the Department of Agriculture for the Fiscal Year ending June 30, 1954 and for other purposes", House of Representatives Report No. 900; Senate Amendment No. 26.

Service pertaining to construction and maintenance of watershed protection measures to be applied on small watersheds.

Local landowners and operators in the watershed will install and maintain the needed conservation practices for the protection and conservation of the soil and water. The Soil Conservation Service will provide additional technical assistance above the needs of the going land treatment program, in order to accelerate the rate of planning and installing the land treatment practices.

The works of improvement listed in Table 1 are planned to be installed during a 5-year period at an estimated total cost of $1,036,447. This cost will be shared as follows: $511,808 by private individuals, $11,221 by other private or public interests and $513,418 by the Federal Government. These estimates include the current costs to local interests and State and Federal agencies under the going program which pertain to the objectives of this plan.

The local Soil Conservation District Supervisors will make periodic inspections and maintain the floodwater retarding structures at an estimated annual cost of $750. Landowners and operators will maintain the land treatment measures, in accordance with provisions of the farmer-district agreements, at an estimated annual cost of $23,569.

The total average annual benefit from the installation of the land treatment measures and floodwater retarding structures is expected to be $260,621. The average annual cost of installing, maintaining and operating these measures is estimated to be $75,575.

Benefits due to reductions in floodwater and sediment damages in the amount of $28,119 were claimed on the Calaveras flood plain. An additional average annual benefit of $3,527 is expected to accrue to the flood plain lands along the main stem of the San Antonio River following the installation of the proposed program. This figure is based on the Survey Report, San Antonio River watershed, prepared by the Soil Conservation Service in 1952.

When all tributary watersheds of the San Antonio River are treated partial flood damage reduction on the main stem flood plain can be expected, as well as a reduction in sedimentation rates in any major structures that might be constructed at a later date.

Comparison of Benefit and Cost

When these works of improvement are installed and operating at full effectiveness, the ratio of the estimated average annual benefit ($260,621) to the estimated average annual cost ($75,575) is 3.45 to 1. The estimates are based on current price levels for costs and long-term prices for benefits.

## DESCRIPTION OF THE WATERSHED

### Physical

Calaveras Creek rises in Bexar County, approximately 12 miles east of the City of San Antonio, Texas, and flows in a southerly direction for 15 miles, emptying into the San Antonio River in the southwest corner of Wilson County. Chopaderas, Parita, Hondo and Eagle Creeks are the major tributaries. The watershed is crossed by two major highways, U. S. 87 on the north and U. S. 181 on the south. The Texas and New Orleans Railroad runs along the southern edge and across the north end of the watershed.

The area of the watershed is 61,440 acres (96 square miles), of which 60,230 acres are in farms. The remaining 1,210 acres are in urban areas, roads and miscellaneous uses. The area inundated by the design storm which would occur over a one-day period and produce 4.7 inches of runoff includes 3,666 acres of flood plain and 721 acres of stream channel.

The land use of the flood plain of Calaveras Creek and its tributaries is as follows: 37 percent cropland, 10 percent open pasture, 49 percent wooded pasture, and 4 percent in miscellaneous uses.

The topography of the watershed ranges from rolling along the watershed divides to gently rolling to flat in the central section. Local relief along the major stream valleys ranges from a minimum of 25 feet in the upper reaches to about 100 feet in the central and lower section of the watershed. Elevations range from about 600 feet above mean sea level at the headwaters of Calaveras Creek to about 390 feet in the stream channel at the confluence of Calaveras Creek with the San Antonio River. Calaveras Creek has an average gradient of 12 feet per mile.

The stream channels in the central and lower reaches are 150 to 350 feet wide, averaging about 250 feet in width. The banks are 10 to 27 feet high, with an average of 20 feet. Stream channels in the upper reaches average 50 feet wide and the banks are about 10 feet high. The flood plain averages 3000 feet wide in the lower reaches and 1500 feet wide in the upper reaches.

The Calaveras Creek watershed lies within two soil conservation problem areas. About 85 percent of the area is Rio Grande Plain and 15 percent Forested Coastal Plain.

The Rio Grande Plain area is covered mostly by deep clay soils. These soils are black to dark gray in color and slowly permeable. The texture ranges from fine to medium. Soils of the Forested Coastal Plain are brown or reddish brown fine sandy loams, with slowly permeable clay subsoils.

The dark clay soils were developed from highly calcareous marl and normally are high in natural fertility. The sandy loam soils were developed from beds of yellowish-gray and orange marl sand and clay. Approximately 97 percent of the soils are deep and two percent are shallow. One percent of the area is rough broken land.

Most of the soils in cropland (37 percent) are in fair physical condition. The average depth of the topsoil in the dark clay areas is about 16 inches on the flat or almost level areas; on the gently rolling to rolling lands the average depth of topsoil is only 8 inches, with an annual soil loss of 0.1 of an inch. Fertility of these cultivated areas has been greatly lowered through erosion, oxidation of organic matter and leaching of plant nutrients.

The formerly cultivated land (27 percent) and most of the open and wooded pasture lands (34 percent) are in fair to poor condition. Most of the formerly cultivated lands, which are presently used for grazing, have suffered moderately severe to severe erosion and have lost much of their original fertility.

The pasture lands, especially the open pasture, have been affected by moderately severe erosion, caused by continuous overgrazing.

The principal crops in the dark clay area are corn, cotton, grain sorghums and hay crops. Most of the sandy land grows peanuts, truck crops, sweet potatoes, cantaloupes and watermelons, but requires fertilization for highly profitable yields. The production of cash crops and beef cattle are the major farm enterprises.

The present land use of the watershed is estimated as follows:

| Land Use | Acres | Percent |
|---|---|---|
| Cropland | 22,887 | 37.2 |
| Pasture (open) | 15,368 | 25.0 |
| Wooded Pasture | 5,200 | 8.5 |
| Formerly Cropland | 16,775 | 27.3 |
| Miscellaneous | 1,210 | 2.0 |
| Total | 61,440 | 100.0 |

The climate of the area is characterized by long summers and short winters. Winters are usually mild but short, light freezes of sufficient intensity to damage crops may occur several times each winter. Snowfall is of rather rate occurence and the snow usually melts immediately. The average annual temperature is 67° Fahrenheit. The length of the average frost-free growing season is 282 days. The mean annual precipitation of 27.9 inches is rather evenly distributed, with the greatest amount of rainfall occurring during the period from March through June and during the month of September. The maximum annual rainfall of 50.30 inches fell in 1919.

There are no large bodies of surface water within the watershed. The principal source of water is deep wells extending into the Edwards limestone. Most of this water is of good quality and contains only a small amount of dissolved solids. The present use of water is principally for livestock and domestic purposes. There are a number of small and medium size farm ponds scattered throughout the watershed.

The larger farms are located near the upper and lower parts of the watershed. In the central part the ownership is in small tracts, many of these farms being used only as residential acreages by commuters who work or own businesses in San Antonio. As a result, they contribute very little to commercial agricultural production.

There are several small dairies in the watershed which sell raw milk to the bottling plants in San Antonio, but approximately 80 percent of the cattle in the watershed are used for beef production.

The Calaveras Creek watershed is served by two Soil Conservation Service work units, which are assisting the Alamo and Wilson County Soil Conservation Districts. These work units have assisted farmers in preparing 104 conservation plans on 15,940 acres within the watershed. It is expected that when land treatment practices have been applied and maintained for as long as two or three years the yields in the watershed will be increased approximately 25 percent.

There are 123 miles of roads in the watershed, of which 36 miles are hard surfaced. Of the 100 bridges, 12 are major bridges spanning the larger streams.

## FLOOD AND EROSION PROBLEMS AND DAMAGES

Floods occur frequently on Calaveras Creek and cause moderately high annual flood damage. Large floods occur approximately every four to five years. The latest major flood occurred in September 1946. During the 20-year evaluation period from 1922 to 1942 inclusive there were 8 floods that covered more than half the flood plain and 38 smaller floods. Five of the larger floods occurred during the growing season and caused a large amount of crop and pasture damage. Flood damage information on approximately 60 percent of the flood plain area of Calaveras Creek and its major tributaries was obtained from land owners and operators. Most of the specific information as to amounts and extent of damage was related to the September 1946 flood. Other information obtained included flood plain land use, yields of major crops and estimates of other property damage such as loss of livestock and destruction of fences and buildings and general flood problems. The monetary value of the damage to flood plain lands by sediment deposition and scour was determined on the basis of reduced yields and added costs of operations.

Information concerning flood damages to roads was obtained from the County Commissioners. Estimates of damage to the railroad property was obtained from the Texas and New Orleans Railroad.

Damage rates, as determined from damage schedules, were adjusted on the basis of relationships found from surveys of other watersheds of similar characteristics to indicate damage rates to be expected from floods of various sizes and seasons. These rates were multiplied by acreages flooded by each flood, by size and season, in the evaluation series and damages adjusted for reourrence of flooding.

The total direct floodwater and sedimentation damages to the flood plain of Calaveras Creek below the proposed floodwater retarding structures are estimated to average $29,051 annually under present conditions. Flood plain areas lying within the pool limits of the proposed floodwater retarding structures were excluded from all damage calculations.

Additional indirect damages, such as the interruption of travel, losses sustained by dealers and industries dependent upon agricultural products, depreciation in property values in the flooded areas, and similar items, amount to $3,486 annually. The average annual monetary flood damages are summarized in Table 4.

Erosion rates have been moderate to severe in Calaveras Creek watershed. Sheet erosion is the dominant process, with only minor gully and stream bank erosion. Erosion has been slight on approximately 10 percent of the dark clay soils, moderate to moderately severe on 65 percent; and severe to very severe on 25 percent.

About 25 percent of the fine sandy loam soils has suffered only slight erosion; 35 percent moderate; 30 percent moderately severe to severe, and 10 percent very severe. The deeper sands in the extreme southern part of the watershed have been affected by moderately severe wind erosion.

Cultivated lands have suffered the major erosion damage, and much of the pasture land has suffered moderate to moderately severe erosion. These pasture lands have been overstocked and overgrazed to the extent that most of the area supports only a low density cover of grasses and is very susceptible to sheet erosion. Much of the formerly cultivated land is presently in poor range condition and is subject to moderately severe sheet and gully erosion.

The major sources of sediment in the Calaveras Creek watershed are estimated as follows: sheet erosion 67 percent, flood plain scour 25 percent, and gully and streambank erosion 8 percent. These estimates are based on detailed upland sample watershed studies and reconnaissance investigations in the remainder of the watershed.

The predicted sedimentation rate for each of the flood water retarding structures was based on: (1) present land use and vegetative cover of the watershed lands; (2) erosion rates, and (3) the location of high sediment production areas with relation to the structure site. The present sediment output rates for the watershed range from 0.8 to 1.8 acre-feet annually per square mile of drainage area. In general the low rates occur on the larger watersheds (4.0 to 10.0 square miles) and the higher rates are on the small watersheds (1.0 to 3.0 square miles). It has been computed that conservation treatment applied to the watershed lands will reduce sediment output rates up to 60 percent.

Farm Pond Sedimentation

No large impounding reservoirs now exist in the watershed. The majority

of the farm and ranch ponds in the watershed are located in pasture areas and have moderate sedimentation rates.

Channel Enlargement

Stream bank erosion and channel entrenchment are of minor importance in the Calaveras Creek watershed. Bank erosion occurs throughout the flood plain area for short sections (50-200 feet) with only slight shifting in the sharp meanders of the stream channels. The average annual land loss from bank erosion is estimated to be 0.4 of an acre. The most severe bank erosion occurs along the main stream channel of Parita Creek. Annual lateral erosion of as much as 1.0 foot is occurring in some of the winding sections of the stream reaches.

It is estimated that bank erosion contributes only one percent of the total sediment yield at the mouth of the watershed.

Overbank Deposition

Most of the flood plain on Calaveras Creek and its tributaries has received substantial amounts of sediment deposition but only 12 percent of the total flood plain is considered damaged by this process. Approximately 455 acres have been damaged 10 to 30 percent in 50 years. The estimated annual damages are as follows:

1.7 acres damaged 10 percent
3.3 acres damaged 20 percent
4.1 acres damaged 30 percent

The highest damage occurs on Parita Creek. It is estimated that one-third of its flood plain has suffered a productivity loss of 25 percent due to the deposition of harmful sediment. Most of the overbank deposits are fine textured and were deposited at the rate of a few inches during each major flood. Much of the area damaged by harmful sediment is affected by impaired drainage caused by the deposition of fine silt and clay. The thickness of the deposits ranges from 0.5 foot to 3.0 feet.

Channel filling by coarse sandy sediments has caused increased frequency and depth of flooding in numerous valley sections but no account has been taken of this effect in estimating future damages. Estimated benefits based on reduction in sedimentation damage to be brought about by the floodwater retarding structures were limited to the flood plain area below structures that was inundated by the largest storm considered in the 20-year rainfall series investigated.

Flood Plain Scour

Flood plain scour is causing extensive damage in the Calaveras Creek drainage system. Over 30 percent (1202 acres) of the total flood plain has been scoured by flood water, with resulting damage ranging from 10 to 75 percent. The most severe damages are caused by scour channels

2.0 to 4.0 feet deep, but larger areas are affected by sheet scour. Sheet scour occurring on freshly plowed fields has eroded the soil down to plow depth during peak flood flows.

The average annual flood plain scour damages are estimated as follows:

16.6 acres damaged 10 percent
73.6 acres damaged 25 percent
23.5 acres damaged 50 percent
6.5 acres damaged 75 percent

It was estimated that scour damage for the Calaveras Creek watershed occurs in about a ten-year cycle from the original damage to recovery and that the amount of damage is not increasing appreciably in most areas.

Flood plain scour is producing an estimated 25 percent of the sediment yield at the mouth of the watershed.

## EXISTING OR PROPOSED WATER MANAGEMENT PROJECTS

Efforts to prevent or control floods in the Calaveras Creek watershed have been minor. During the past 12 years, several small neighborhood groups of farmers, cooperating with the Alamo and Wilson County Soil Conservation Districts, have prepared soil and water conservation plans on a community basis. These plans have provided an added stimulus for getting conservation treatment on the land.

The San Antonio River Authority has been very active in flood prevention work, having provided funds to the Soil Conservation Service for developing a program for runoff and waterflow retardation and soil erosion prevention for the entire San Antonio River watershed.

## FLOOD PREVENTION WORKS OF IMPROVEMENT TO BE INSTALLED

### Measures Primarily for Flood Prevention

The floodwater retarding structures needed to provide flood protection for flood plain lands, highways and other improvements are listed with their cost in Table 2. For location of these structures see Figure 2. The floodwater retarding structure data sheet (Table 6) gives information as to size and storage capacity of these structures. This system of structures will control the rainfall runoff from 42 percent of the watershed. The county road above structure Site No. 4 will have to be raised to clear the sediment pool, and will be closed during periods of high stages in the detention pool.

Sites for the floodwater retarding structures will be provided by local interests at no cost to the Federal Government. The value of the lands donated for sites is estimated at $50,815, based on market values obtained from qualified appraisers and other disinterested parties. Land was

appraised at 100 percent of value on the sediment pool area and 50 percent on the detention pool area, since the latter will remain productive as pasture. The average annual loss of production within the sites was caloulated to be $514 on the basis of long-term projected prices. The amortized cost of the structure sites is $2,575. Therefore, in accordanoe with sound procedures, the larger of the two figures was used in determining the economic evaluation of the program.

The total estimated cost of the 10 floodwater structures is $379,702. The annual cost, including installation, operation and maintenance, is $14,762.

Foundation and Borrow Investigations

In order to have data on the suitability of foundation conditions and construction materials at the proposed 10 floodwater retarding structure sites in advance of detailed design and the procuring of easements, semi-detailed investigations were made of all sites.

Measures for Conservation of Water and Watershed Lands

The major land treatment measures needed are: The seeding of 14,963 acres of retired land, the seeding of 588 acres of farm waterways for terraoe outlet protection, the planting of 8,686 acres of cover crops, and the construction of 1,505 miles of terraces. Other land treatment measures needed include 18 miles of diversion terraces, 135 farm ponds, improved crop rotation on 22,406 acres, and 37,524 acres of improved range and pasture management. The estimated cost of installing these measures including the cost of technical assistance under the going program is $700,380. The annual cost, including installation and maintenance is $60,813.

Instrumentation

The effects of the watershed program have been computed by sound hydraulio, hydrologic, and economic principles and prooedures. However, as a part of the operations on this watershed, necessary rain gages and stream gages will be installed to provide information on the actual effect of the recommended watershed protection program on runoff, erosion, sedimentation and evaporation. It is anticipated that cooperative arrangements will be made with the U. S. Geological Survey, the Weather Bureau and other agencies to assist in installing and operating the gages and analyzing the effeots of the floodwater retarding structures and land treatment measures.

Effect of these Measures on Damage and Benefits

A combination of the needed land treatment measures and measures primarily for flood prevention would eliminate 27 of the 46 floods which occurred during the period from 1922 to 1942 inclusive. Six of the 8 major floods would be reduced to minor floods.

The average annual flooding on Calaveras Creek will be reduced from 1,853 acres to approximately 301 acres, which will reduce the average

annual floodwater damage from $32,537 to $4,418, or 86 percent.

Approximately 61 percent of the reduction in annual damages will result from the system of floodwater retarding structures. The annual value of the reduction in flood damages within the watershed from the measures primarily for flood prevention is estimated to be $17,203 out of the total of $28,119 from all measures, as shown in Table 4. In the San Antonio River Watershed Survey Report, reductions in flooding resulting from land treatment measures and floodwater retarding structures were routed downstream on the main stem of the San Antonio River. Based on these routings average annual reductions in floodwater damage on the flood plain of the river are expected to equal $1,019 from land treatment and $2,508 from floodwater retarding structures in the Calaveras Creek watershed.

It is anticipated that if adequate flood protection is provided, the use of the flood plain will be intensified by growing more corn and grain sorghum on the idle land and Johnson grass meadows. Some of the wooded land in the flood plain will also be cleared and put into cropland. This more intensive land use will increase the net income, after all the associated expenses are deducted, by $9,793.

The total flood prevention benefits including both the reduction in flood damages and the benefits from more intensive land use are estimated to be $41,439 annually. There are no existing or proposed projects below this watershed on the main stem of the San Antonio River.

The expected conservation benefits from land treatment measures were determined by estimating the increased net income which would result from the application and maintenance of the needed practices and measures. Although the total area used for cropland would be decreased by the retirement of steep and eroded land and idle cropland to pasture, it was assumed that the percentage used for each crop would not change. Likewise, it was assumed that there would be no change in the percentage of cattle used for dairying and beef production, although the total number of cattle would be increased materially because of the increased acreage of pasture and the greater pasture carrying capacity to be expected from the application of land treatment measures.

The estimated increase in annual net income due to the application of land treatment measures is $146,916 from crops and $72,266 from pasture, or a total of $219,182 annually.

Comparison of Cost and Benefit

The ratio of the average annual benefit from the floodwater retarding structures, $29,504, to the average annual cost, $14,762, is 2.00 to 1. The ratio of the average annual benefit from the conservation treatment measures, $231,117, to their average annual cost, $60,813, is 3.80 to 1.

The ratio of the total average annual benefit, $260,621, to the total annual cost, $75,575 is 3.45 to 1. See Table 5. In addition to the

monetary benefits there are other substantial values which will accrue from the program such as increased opportunity for recreation, better living conditions, sense of security, etc., which have not been evaluated.

## ACCOMPLISHING THE PLAN

The Board of Supervisors of the Alamo and Wilson County Soil Conservation Districts will arrange for meetings and tours to encourage landowners and operators within the watershed to adopt and carry out the soil and water conservation plans on their individual farms. They will arrange for radio and television programs and newspaper articles to dispense information to the landowners and operators within the Calaveras Creek watershed to help achieve understanding and to stimulate participation in carrying out the provisions of the work plan in the specified time limit.

District-owned equipment will be made available to the landowners and operators to assist in applying the conservation plans on their farms.

The Extension Service and Vocational Agriculture Department will conduct educational programs to further the needed watershed program. The Farm Home Administration has indicated that farm loans for the application of conservation practices can be obtained. Local landowners and operators will be urged to avail themselves of the monetary assistance provided through the local Agricultural Conservation Program Service to further speed up land treatment. These funds will assist landowners in carrying out the land treatment practices and measures needed in the watershed within the 5-year period specified for completion of the program.

The Soil Conservation Service will assign additional technical personnel as needed to the Soil Conservation District to assist landowners and operators cooperating with the District in the preparation and application of soil and water conservation plans on their farms.

The Soil Conservation Service will provide technical specialists to assist in planning, design, supervision of construction including related tests, and certification of payment for measures primarily for flood prevention. Since structural work on private lands will be done by contract, the Soil Conservation Service will be responsible for preparing specifications and discharging the various steps in the letting of contracts in accordance with customary Federal procedure.

Table 1 and Figure 1 show the schedule of operation planned for each phase of the program. This schedule will be adjusted from year to year, based on any changes in the plan found to be mutually desired by all cooperating parties and in light of appropriations received and accomplishments actually made.

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

## PROVISIONS FOR MAINTENANCE

The estimated annual operation and maintenance cost of the land treatment measures and flood prevention structures is shown in Table 3. The floodwater retarding structures will be maintained by the Alamo Soil Conservation District and the Wilson County Soil Conservation District which will deposit $1,000 in escrow annually for this purpose. The land treatment measures will be maintained by the landowners and operators of the farms on which the measures are installed.

Table 1
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | FY 1954 No. to be Applied | Estimated Cost Fiscal Year 1954 Federal | Non-Federal Public | Private | Total |
|---|---|---|---|---|---|---|
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | No. 3 | $65,218 | - | $7,920 1/ | $ 73,138 |
| Total A-Measures | | | $65,218 | - | $7,920 | $ 73,138 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 1,086 | - | - | $8,688 | $ 8,688 |
| Terraces | Mile | 105 | - | - | 16,590 | 16,590 |
| Diversion Construction | Mile | 2 | - | - | 1,584 | 1,584 |
| Waterway Development | Acre | 108 | - | - | 1,944 | 1,944 |
| Pasture Reseeding | Acre | 775 | - | - | 11,625 | 11,625 |
| Farm Ponds | Each | 24 | - | - | 9,600 | 9,600 |
| Range & Pasture Improvement | Acre | 1,000 | - | - | 500 | 500 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 666 | 1,090 | - | - | 1,090 |
| Total B-Measures | | | $ 1,090 | - | $50,531 | $ 51,621 |
| Total A and B-Measures | | | $66,308 | - | $58,451 | $124,759 |
| Facilitating Measures | | | | | | |
| Program Evaluation (SCS) | | | $ 4,875 | - | - | $ 4,875 |
| Work Plan Development (SCS) | | | 12,012 | - | - | 12,012 |
| Work Plan Development San Antonio River Authority | | | - | $4,800 | - | 4,800 |
| Local Assistance for Easements etc. | | | | | 605 | 605 |
| Total SCS | | | $83,195 | | | |
| Grand Total | | | $83,195 | $4,800 | $59,056 | $147,051 |
| Going Program SCS | Acre | 4,133 | $ 6,200 | | | |

1/ Easement Costs.

Agr-SCS-Ft.Worth,Tex.,1954

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FORT WORTH, TEXAS

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | FY 1955 No. to be Applied | Estimated Cost Fiscal Year 1955 Federal | Non-Federal Public | Private | Total |
|---|---|---|---|---|---|---|
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | Nos.1,2,4 | $90,316 | $1,521 2/ | $ 16,460 1/ | $108,297 |
| Total A-Measures | | | $90,316 | $1,521 | $ 16,460 | $108,297 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 1,900 | - | - | $15,200 | $ 15,200 |
| Terraces | Mile | 274 | - | - | 43,292 | 43,292 |
| Diversion Construction | Mile | 3 | - | - | 2,376 | 2,376 |
| Waterway Development | Acre | 204 | - | - | 3,672 | 3,672 |
| Pasture Reseeding | Acre | 1,550 | - | - | 23,250 | 23,250 |
| Farm Ponds | Each | 24 | - | - | 9,600 | 9,600 |
| Range & Pasture Improvement | Acre | 2,938 | - | - | 1,469 | 1,469 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 3,334 | 5,450 | - | - | 5,450 |
| Total B-Measures | | | $5,450 | - | $98,859 | $104,309 |
| Total A and B-Measures | | | $95,766 | $1,521 | $115,319 | $212,606 |
| Facilitating Measures | | | | | | |
| Program Evaluation SCS | | | $ 2,822 | - | - | $ 2,822 |
| Work Plan Development SCS | | | - | - | - | - |
| Work Plan Development San Antonio River Authority | | | - | - | - | - |
| Local Assistance for Easements etc. | | | - | - | $ 3,895 | 3,895 |
| Total SCS | | | $98,588 | - | - | - |
| Grand Total | | | $98,588 | $1,521 | $119,214 | $219,323 |
| Going Program SCS | Acre | 9,000 | $13,500 | | | |

2/ Relocating and raising roads.

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | FY 1956 No. to be Applied | Estimated Cost Fiscal Year 1956 Federal | Non-Federal Public | Private | Total |
|---|---|---|---|---|---|---|
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | Nos.6,7,5 | $76,829 | - | $13,500 1/ | $90,329 |
| Total A-Measures | | | $76,829 | - | $13,500 | $90,329 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 1,900 | - | - | $15,200 | $15,200 |
| Terraces | Mile | 300 | - | - | 47,400 | 47,400 |
| Diversion Construction | Mile | 4 | - | - | 3,168 | 3,168 |
| Waterway Development | Acre | 204 | - | - | 3,672 | 3,672 |
| Pasture Reseeding | Acre | 4,000 | - | - | 60,000 | 60,000 |
| Farm Ponds | Each | 30 | - | - | 12,000 | 12,000 |
| Range & Pasture Improvement | Acre | 4,000 | - | - | 2,000 | 2,000 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 3,334 | 5,450 | - | - | 5,450 |
| Total B-Measures | | | $5,450 | - | $143,440 | $148,890 |
| Total A and B-Measures | | | $82,279 | - | $156,940 | $239,219 |
| Facilitating Measures | | | | | | |
| Program Evaluation SCS | | | $ 2,822 | - | - | $ 2,822 |
| Work Plan Development SCS | | | - | - | - | - |
| Work Plan Development San Antonio River Authority | | | - | - | - | - |
| Local Assistance for Easements etc. | | | - | - | - | - |
| Total SCS | | | $85,101 | - | - | - |
| Grand Total | | | $85,101 | - | $156,940 | $242,041 |
| Going Program SCS | Acre | 9,000 | $13,500 | - | - | - |

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | FY 1957 No. to be Applied | Estimated Cost Fiscal Year 1957 Federal | Non-Federal Public | Private | Total |
|---|---|---|---|---|---|---|
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | Nos. 8,9 | $39,440 | - | $ 5,840 1/ | $ 45,280 |
| Total A-Measures | | | $39,440 | - | $ 5,840 | $ 45,280 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 1,900 | - | - | $15,200 | 15,200 |
| Terraces | Mile | 370 | - | - | 58,460 | 58,460 |
| Diversion Construction | Mile | 4 | - | - | 3,168 | 3,168 |
| Waterway Development | Acre | 72 | - | - | 1,296 | 1,296 |
| Pasture Reseeding | Acre | 4,353 | - | - | 65,295 | 65,295 |
| Farm Ponds | Each | 33 | - | - | 13,200 | 13,200 |
| Range & Pasture Improvement | Acre | 4,500 | - | - | 2,250 | 2,250 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 3,334 | 5,450 | - | - | 5,450 |
| Total B-Measures | | | $5,450 | - | $158,869 | $164,319 |
| Total A and B-Measures | | | $44,890 | - | $164,709 | $209,599 |
| Facilitating Measures | | | | | | |
| Program Evaluation | | | $ 2,822 | - | - | $ 2,822 |
| Work Plan Development SCS | | | - | - | - | - |
| Work Plan Development San Antonio River Authority | | | - | - | - | - |
| Local Assistance for Easements etc. | | | - | - | - | - |
| Total SCS | | | $47,712 | - | - | - |
| Grand Total | | | $47,712 | - | $164,709 | $212,421 |
| Going Program | Acre | 9,000 | $13,500 | - | - | - |

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | FY 1958 No. to be Applied | Estimated Cost Fiscal Year 1958 Federal | Non-Federal Public | Private | Total |
|---|---|---|---|---|---|---|
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | 10 | $33,851 | 400 2/ | $ 7,095 1/ | $ 41,346 |
| Total A-Measures | | | $33,851 | $400 | $ 7,095 | $ 41,346 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 1,900 | - | - | $15,200 | $ 15,200 |
| Terraces | Mile | 456 | - | - | 72,048 | 72,048 |
| Diversion Construction | Mile | 5 | - | - | 3,960 | 3,960 |
| Waterway Development | Acre | 0 | - | - | - | - |
| Pasture Reseeding | Acre | 4,285 | - | - | 64,275 | 64,275 |
| Farm Ponds | Each | 24 | - | - | 9,600 | 9,600 |
| Range & Pasture Improvement | Acre | 4,000 | - | - | 2,000 | 2,000 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 2,667 | 4,360 | - | - | 4,360 |
| Total B-Measures | | | $ 4,360 | - | $167,083 | $171,443 |
| Total A and B-Measures | | | $38,211 | $400 | $174,178 | $212,789 |
| Facilitating Measures | | | | | | |
| Program Evaluation | | | $ 2,822 | - | - | $ 2,822 |
| Work Plan Development SCS | | | - | - | - | - |
| Work Plan Development San Antonio River Authority | | | - | - | - | - |
| Local Assistance for Easement etc. | | | - | - | - | - |
| Total SCS | | | $41,033 | - | - | - |
| Grand Total | | | $41,033 | $400 | $174,178 | $215.611 |
| Going Program | Acre | 8,732 | $13,098 | - | - | - |

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
Calaveras Creek Watershed
(San Antonio River Watershed)

| Measures | Unit | No. of Units to be Applied | Estimated Total Cost | | | |
|---|---|---|---|---|---|---|
| | | | Federal | Non-Federal Public | Private | Total |
| A-Measures Primarily for Flood Prevention (SCS) | | | | | | |
| Floodwater Retarding Structures | Each | 10 | $ 305,654 | $ 1,921 | $ 50,815 | $ 358,390 |
| Total A-Measures | | | $ 305,654 | $ 1,921 | $ 50,815 | $ 358,390 |
| B-Measures for Conservation of Watershed Lands that Contribute Directly to Flood Prevention (SCS) | | | | | | |
| Cover Crops | Acre | 8,686 | - | - | 69,488 | 69,488 |
| Terraces | Mile | 1,505 | - | - | 237,790 | 237,790 |
| Diversion Construction | Mile | 18 | - | - | 14,256 | 14,256 |
| Waterway Development | Acre | 588 | - | - | 10,584 | 10,584 |
| Pasture Reseeding | Acre | 14,963 | - | - | 224,445 | 224,445 |
| Farm Ponds | Each | 135 | - | - | 54,000 | 54,000 |
| Range & Pasture Improvement | Acre | 16,438 | - | - | 8,219 | 8,219 |
| Farm & Ranch Planning & Application Assistance Accelerated Program | Acre | 13,335 | 21,800 | - | - | 21,800 |
| Total B-Measures | | | $21,800 | - | $618,782 3/ | $640,582 |
| Total A and B-Measures | | | $327,454 | $ 1,921 | $669,597 | $998,972 |
| Facilitating Measures | | | | | | |
| Program Evaluation | | | $ 16,163 | - | - | $ 16,163 |
| Work Plan Development SCS | | | 12,012 | - | - | 12,012 |
| Work Plan Development San Antonio River Authority | | | - | 4,800 | - | 4,800 |
| Local Assistance for Easements etc. | | | - | - | 4,500 | 4,500 |
| Total SCS | | | $355,629 | - | - | - |
| Grand Total | | | $355,629 | $6,721 | $674,097 | $1,036,447 |
| Going Program SCS | Acre | 39,865 | $ 59,798 | - | - | - |

3/ Estimated ACP participation = $157,789 included.

Table 2
Status of Conservation Job in Watershed
Calaveras Creek Watershed
(San Antonio River Watershed)

| | Unit | Total Conservation Job: Number | Total Conservation Job: Total Cost (Dollars) | Applied to Date | Estimated Cost to Date: Federal 1/ (Dollars) | Estimated Cost to Date: Non-Federal: Public (Dollars) | Estimated Cost to Date: Non-Federal: Private 2/ (Dollars) | Remaining to be Applied |
|---|---|---|---|---|---|---|---|---|
| A-Measures | | | | | | | | |
| Floodwater Retarding Structures | Number | 10 | 379,702 | 0 | | | | 10 |
| Sub-total "A" Measures | | | 379,702 | | | | | |
| B-Measures | | | | | | | | |
| Cover Crops | Acre | 20,286 | 162,288 | 11,600 | 27,840 | | 64,960 | 8,686 |
| Terraces | Mile | 1,521 | 240,318 | 16 | 645 | | 1,883 | 1,505 |
| Diversion Construction | Mile | 19 | 15,048 | 1 | 202 | | 590 | 18 |
| Waterway Development (Upland) | Acre | 592 | 10,656 | 4 | | | 72 | 588 |
| Pasture Reseeding | Acre | 15,440 | 231,600 | 477 | | | 7,155 | 14,963 |
| Pond Construction | Number | 161 | 64,400 | 26 | 5,200 | | 5,200 | 135 |
| Pasture & Range Improvement | Acre | 17,438 | 8,719 | 1,000 | | | 500 | 16,438 |
| Farm & Ranch Planning & Application Assistance | Acre | 60,230 | 92,143 | 7,030 | 10,545 | | | 53,200 |
| Sub-total "B" Measures | | | 825,172 | | 44,432 | | 80,360 | |
| Total "A" & "B" Measures | | | 1,204,874 | | 44,432 | | 80,360 | |

1/ ACP payments included
2/ ACP payments deducted

| | | |
|---|---|---|
| Total estimated cost | | $1,204,814 |
| Total estimated Federal expenditure prior to designation of watershed (Table 2) | $44,432 | |
| Total estimated future Federal expenditure (exclusive of W.P. funds)(See Note 1 Calculation Sheet) | 217,587 | 262,019 |
| Difference | | 942,855 |
| 50 percent of difference | | 471,428 |
| Non-Federal expenditure prior to designation of watershed (80,360 private Table 2) | | 80,360 |
| Amount of Non-Federal contribution required to meet 50-50 cost-sharing objective of the project | | 391,068 |
| Amount of Non-Federal contributions to be made through installation of land treatment measures furnishing land easements and rights-of-way, road relocation, local services etc. (See Note 2, Calculation Sheet) | | 523,029 |
| Additional funds to be furnished by non-Federal interests | | None |

## Calculation Sheet

Note 1: Calculation of Total Estimated Future Federal Expenditures exclusive of Watershed Protection Funds

| | |
|---|---|
| $157,789 | ACP payments (see footnote 3/, Table 1) |
| 59,798 | Farm and Ranch Planning and Application Going Program |
| $217,587 | |

Note 2: Calculations of non-Federal Contributions to be made through:

| | | |
|---|---|---|
| Installation of Land Treatment Measures | 618,782 | |
| Less ACP payments, future | 157,789 | 460,993 |
| Easements and Rights-of-way | | 50,815 |
| Relocation and raising roads | | 1,921 |
| Time and legal fees for easements | | 4,500 |
| Assistance in work plan development | | 4,800 |
| | | 523,029 |

Table 3

Annual Costs

Calaveras Creek Watershed

(San Antonio River Watershed)

| | Amortization of Installation Costs 3/ | | | | Operation & Maintenance 4/ | | | |
|---|---|---|---|---|---|---|---|---|
| | Federal 1/ | Non-Federal Public 1/ | Private 2/ | Total | Federal | Non-Federal Public | Private | Grand Total |
| | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) |
| A-Measures | | | | | | | | |
| Floodwater Retarding Structures | 11,200 | 237 | 2,575 | 14,012 | | 750 5/ | | 14,762 |
| Sub-total | 11,200 | 237 | 2,575 | 14,012 | | 750 | | 14,762 |
| B-Measures | 8,440 | 0 | 28,804 | 37,244 | | | 23,569 6/ | 60,813 |
| Total A & B Measures | 19,640 | 237 | 31,379 | 51,256 | | 750 | 23,569 | 75,575 |

1/ 3.5258 percent of Federal and Non-Federal public installation costs for "A" and "B" measures (50 yr. period) including interest at 2.5 percent on investment.

2/ 4.6550 percent of private installation costs for "A" and "B" measures, including interest at 4 percent on investment.

3/ 1952 prices - the last complete year for which information is available.

4/ Long term prices (B.A.E.)

5/ Based on estimated average annual maintenance cost of $75 per structure during the 50 year period following installation.

6/ Based on estimated average annual maintenance cost of individual land treatment measures during the 50 year period following application.

Table 4

Summary of Average Annual Monetary Floodwater and Sediment Damage
and Flood Prevention Benefit from the Plan
Calaveras Creek Watershed
(San Antonio River Watershed)

(Long-term Prices)

| | Average Annual Damage | | | Average Annual Benefit | | |
|---|---|---|---|---|---|---|
| | Under Present Conditions | B-Measures Only | With A & B Measures | From B-Measures Only | From A-Measures Only | Total Flood Prevention Benefit From A and B |
| | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) |
| **Floodwater Damage** | | | | | | |
| Crop and Pasture | 6,066 | 4,083 | 1,072 | 1,983 | 3,011 | 4,994 |
| Flood Plain Scour | 5,595 | 3,603 | 907 | 1,992 | 2,696 | 4,688 |
| Other Agricultural | 10,223 | 6,691 | 1,301 | 3,532 | 5,390 | 8,922 |
| Roads, Bridges and Railroads | 6,911 | 4,762 | 624 | 2,149 | 4,138 | 6,287 |
| Sub-total | 28,795 | 19,139 | 3,904 | 9,656 | 15,235 | 24,891 |
| **Sediment Damage** | | | | | | |
| Valley Sediment Deposition | 256 | 165 | 41 | 91 | 124 | 215 |
| Sub-total | 256 | 165 | 41 | 91 | 124 | 215 |
| Indirect Damage | 3,486 | 2,317 | 473 | 1,169 | 1,844 | 3,013 |
| Total Damage | 32,537 | 21,621 | 4,418 | - | - | - |
| Benefit from Reduction of Damage | - | - | - | 10,916 | 17,203 | 28,119 |
| Benefit from More Intensive Use of Flood Plain | - | - | - | - | 9,793 | 9,793 |
| Main Stem Benefits | - | - | - | 1,019 | 2,508 | 3,527 |
| Total Flood Prevention Benefit | - | - | - | 11,935 | 29,504 | 41,439 |

Table 5

Distribution of Costs and Benefits by Measures and Groups of Measures
Calaveras Creek Watershed
(San Antonio River Watershed)

| | Total Cost | Average Annual Cost | Average Annual Benefit | | | | Benefit to Cost Ratio |
|---|---|---|---|---|---|---|---|
| | | | Floodwater & Sediment | More Intensive Use of Land | Conservation | Total | |
| | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | (Dollars) | |
| **A-Measures** | | | | | | | |
| Floodwater Retarding Structures No's 1-10 incl. | 379,702 | 14,762 | 19,711 | 9,793 | - | 29,504 | 2.00:1 |
| Sub-total | 379,702 | 14,762 | 19,711 | 9,793 | - | 29,504 | 2.00:1 |
| **B-Measures** | 700,380 | 60,813 | 11,935 | - | 219,182 | 231,117 | 3.80:1 |
| **All Measures** | 1,080,082 | 75,575 | 31,646 | 9,793 | 219,182 | 260,621 | 3.45:1 |

## Table 6

Floodwater Retarding Structure Data
Calaveras Creek Watershed
(San Antonio River Watershed)

| Site No. | Drainage Area Sq.Mi. | Storage Capacity Acre Feet: Sediment Pool 1/ | Detention Pool | Total | Storage Capacity Inches of Runoff: Sediment Pool 1/ | Detention Pool | Total | Surface Area Acres: Top of Sediment Pool 1/ | Top of Detention Pool | Max. Ht. of Dam Feet | Flood Plain Area Inundated - Acres: Under Sediment Pool | Under Detention Pool | Total | Volume of Fill Cu.Yds. | Draw Down Rate cfs | Type of Spillway | Estimated Total Cost (Dollars) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 5.76 | 338 | 1,444 | 1,782 | 1.1 | 4.7 | 5.8 | 65 | 182 | 30.0 | 8 | 65 | 73 | 58,794 | 29 | Veg. | 38,243 |
| 2 | 1.78 | 143 | 447 | 590 | 1.5 | 4.7 | 6.2 | 25 | 70 | 32.9 | 0 | 0 | 0 | 51,764 | 9 | " | 31,571 |
| 3 | 5.43 | 348 | 1,362 | 1,710 | 1.2 | 4.7 | 5.9 | 69 | 194 | 29.3 | 5 | 70 | 75 | 119,665 | 27 | " | 73,138 |
| 4 | 4.99 | 319 | 1,251 | 1,570 | 1.2 | 4.7 | 5.9 | 70 | 160 | 30.0 | 7 | 51 | 58 | 55,161 | 25 | " | 38,483 |
| 5 | 1.36 | 116 | 341 | 457 | 1.6 | 4.7 | 6.3 | 24 | 54 | 23.1 | 0 | 0 | 0 | 32,050 | 7 | " | 19,417 |
| 6 | 7.01 | 337 | 1,906 | 2,243 | 0.9 | 5.1 | 6.0 | 51 | 212 | 30.0 | 4 | 16 | 20 | 53,480 | 35 | " | 35,857 |
| 7 | 3.93 | 272 | 985 | 1,257 | 1.3 | 4.7 | 6.0 | 45 | 130 | 28.3 | 4 | 21 | 25 | 55,441 | 20 | " | 35,055 |
| 8 | 2.39 | 176 | 598 | 776 | 1.4 | 4.7 | 6.1 | 36 | 84 | 22.0 | 2 | 8 | 10 | 37,474 | 12 | " | 24,163 |
| 9 | 1.46 | 109 | 367 | 476 | 1.4 | 4.7 | 6.1 | 26 | 58 | 24.0 | 0 | 0 | 0 | 34,894 | 8 | " | 21,117 |
| 10 | 6.30 | 336 | 1,580 | 1,916 | 1.0 | 4.7 | 5.7 | 69 | 189 | 32.7 | 8 | 30 | 38 | 62,111 | 32 | " | 41,346 |
| Total | 40.41 | 2,494 | 10,281 | 12,777 | | | | 480 | 1,333 | | 38 | 261 | 299 | 560,834 | | | 358,390 2/ |

1/ Maximum may be reduced by final design.

2/

| | |
|---|---|
| Construction Cost | $224,334 |
| Technical Services | 33,650 |
| Contingencies | 22,433 |
| Land Easements and Rights-of-way | 50,815 |
| Administration, Design Cartographic Service etc. | 25,237 |
| Relocation & Raising Roads | 1,921 |
| | $358,390 |

Table 7

Summary of Program Data
Calaveras Creek Watershed
(San Antonio River Watershed)

| Item | Unit | Quantity |
|---|---|---|
| Years to Complete Program | Year | 5 |
| Total Remaining Installation Cost | | |
| Federal | Dollar | 573,216 1/ |
| Non-Federal | Dollar | 523,029 2/ |
| Annual O & M Cost | | |
| Federal | Dollar | 0 |
| Non-Federal | Dollar | 24,319 |
| Annual Benefits | Dollar | 260,621 |
| Floodwater Retarding Structures | Each | 10 |
| Areas Inundated by Structures | | |
| Flood Plain | Acre | 38 |
| Upland | Acre | 442 |
| Watershed Area above Structures | Acre | 25,862 |
| Reduction of Floodwater Damage | | |
| A-Measures | Percent | 52.9 |
| B-Measures | Percent | 33.5 |
| Reduction of Sediment Damage | | |
| A-Measures | Percent | 48.4 |
| B-Measures | Percent | 33.5 |
| Reduction of Upland Erosion Damage | | |
| A-Measures | Percent | 0 |
| B-Measures | Percent | 60 |
| Other Benefits | | |
| A-Measures | Dollar | 9,793 Annual |
| B-Measures | Dollar | 219,182 Annual |

1/ Estimated future ACP participation $157,789 included.
2/ Estimated future ACP participation $157,789 not included.

Table 8

Summary of Physical Data
Calaveras Creek Watershed
(San Antonio River Watershed)

| Item | Unit | Quantity Without Program | Quantity With Program |
|---|---|---|---|
| Watershed Area | Sq.Mi. | 96.0 | 96.0 |
| Watershed Area | Ac. | 61,440 | 61,440 |
| Area of Cropland | Ac. | 22,887 | 22,224 |
| Area of Grassland | Ac. | 32,143 | 32,806 |
| Area of Woodland | Ac. | 5,200 | 5,200 |
| Floodplain Area Subject to Damage by Structure Design Storm | Ac. | 3,666 | 2,514 |
| Annual Rate of Erosion: | | | |
| Sheet | Tons/Yr. | 631,512 | 325,752 |
| Gully | Tons/Yr | 58,370 | 29,185 |
| Streambank | Tons/yr | 10,587 | 10,587 |
| Scour | Tons/Yr | 236,415 | 118,208 |
| Area Damaged Annually by: | | | |
| Sediment | Ac. | 9.1 | 4.5 |
| Flood Plain Scour | Ac. | 120.2 | 60.1 |
| Swamping | Ac. | 8.0 | 8.0 |
| Streambank erosion | Ac. | 0.4 | 0.4 |
| Sheet Erosion | Ac. | 44,726 | 17,865 |
| Sediment Produotion 1/ | Ton/ac./Yr | 3.5 | 1.4 |
| Sediment Accumulation in Existing Reservoirs | Ac.Ft./Yr | No. res. | No res. |
| Frequency of Flooding | Events/Yr | 2.3 | 0.95 |
| Average Annual Rainfall | Inches | 29.70 | 29.70 |
| Average Annual Surface Runoff | Inches | 2.17 | 1.80 2/ |

1/ Net leaving watershed

2/ There is no factual information available which would indicate that the reduction in surface runoff causes a corresponding reduction in annual water yield from this watershed.

UNIVED STRTEE
DEPAATMENT OT AGRICULTURE

SOIL CORSERVATION SERVICE
FOEV WORTH, TEERS

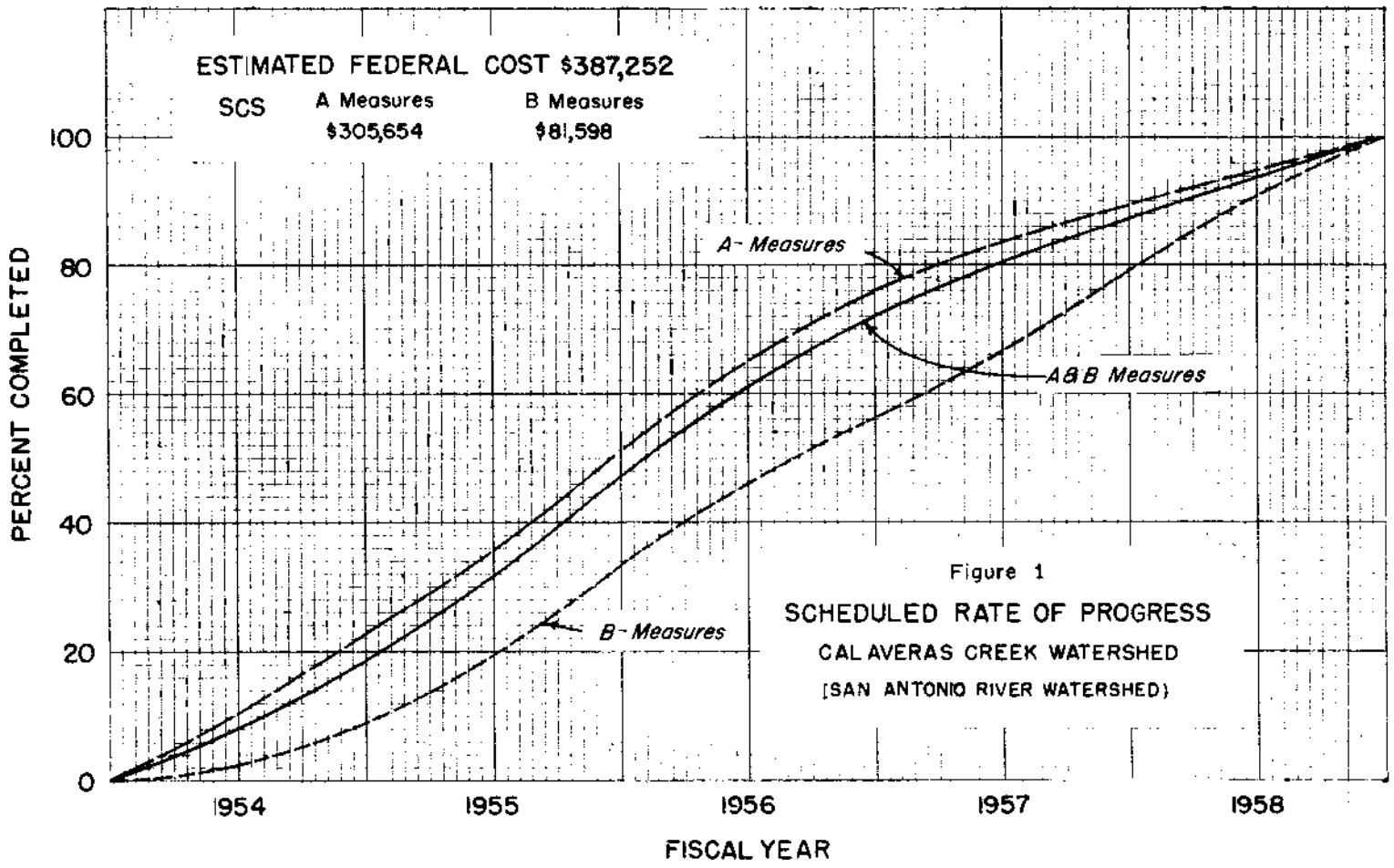



Figure 1

SCHEDULED RATE OF PROGRESS

CAL AVERAS CREEK WATERSHED

[SAN ANTONIO RIVER WATERSHED)

Agr-SCS-Ft.Worth,Tex.,1954

W.C.B. 3-12-54 4-L-8965

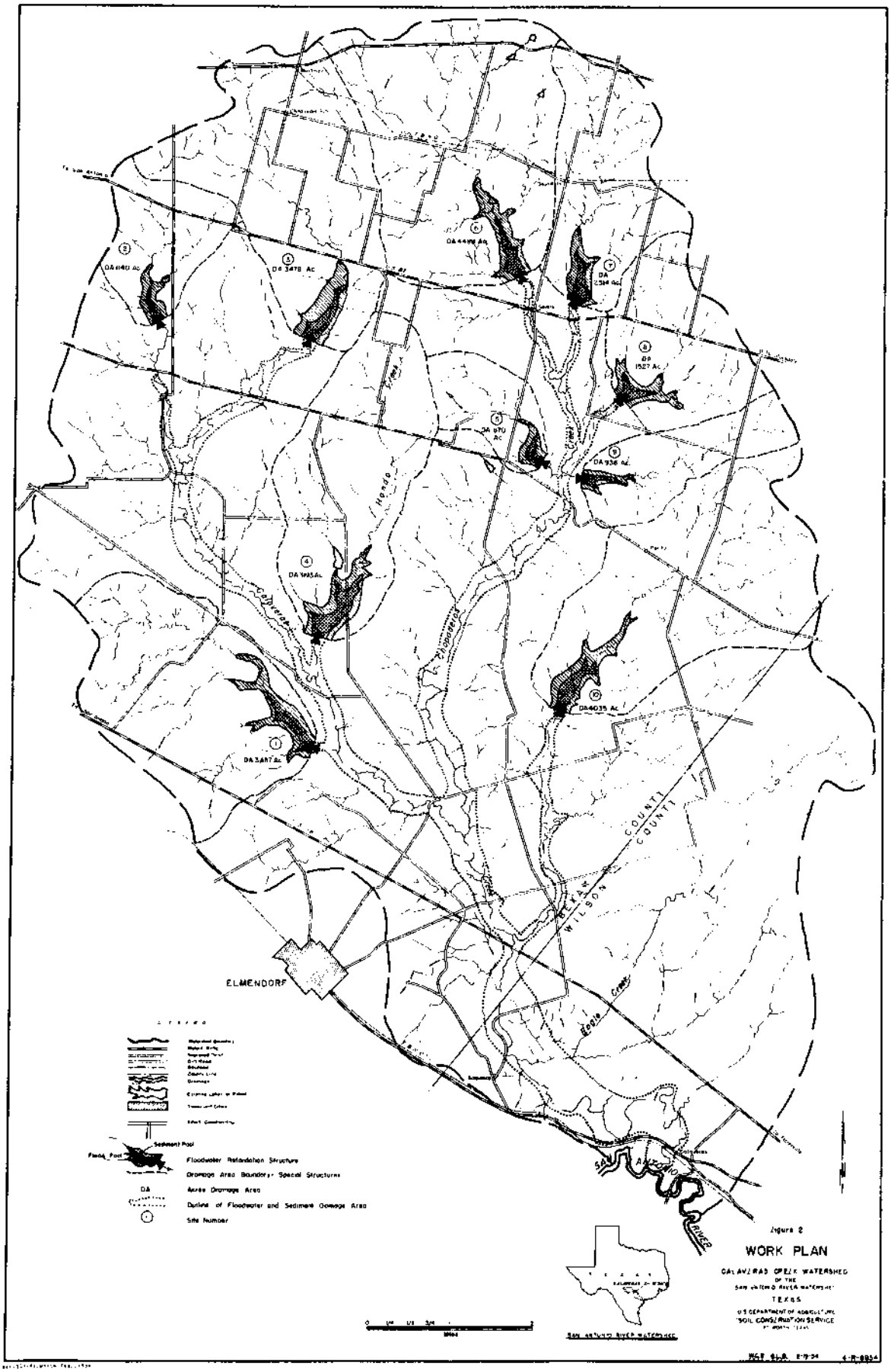



Figure 2

# WORK PLAN

CALAVERAS CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WGF 6-A 8-19-54 4-R-8854

# APPENDIX

# A P P E N D I X

## HYDRAULIC AND HYDROLOGIC INVESTIGATIONS

### Methodology

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

1. Tabulation and analysis of basic meteorologic and hydrologic data.

2. Engineering surveys to collect information on stream reaches including valley cross-sections, channel capacities, and other hydraulic characteristics; structure locations and other data for design purposes.

3. Determination of the hydrologic conditions of the watershed, taking into consideration soils, land use, topography, cover, climate, etc.

4. Determination of rainfall-runoff relationships; frequency of occurrence of meteorologic events; and relationship of runoff to flood stage and area inundated.

5. Determination of peak discharges under present watershed conditions, as related to area inundated and damages.

6. Determination of peak discharges and area inundated under conditions which will exist due to:

   a. Effect of land treatment measures.

   b. Effect of land treatment measures and floodwater retarding structures.

   c. Effect of land treatment measures, floodwater retarding structures, and other associated works of improvement.

   d. Consideration of alternative programs and measures.

### Determinations

From a graph showing cumulative departures from normal precipitation the rainfall for the period 1923 to 1942, inclusive, was selected as most representative of a normal rainfall period on the Calaveras Creek watershed.

The largest rain which occurred during the 20-year period was a storm of 8.48 inches. This rain produced 2.86 inches of runoff. Under present conditions 3,098 acres of the flood plain would be flooded by the runoff from this storm. If such rain were to occur after land treatment practices and measures had been applied, it is estimated that the area inundated would be reduced to 2,981 acres. With land treatment applied and the measures primarily for flood prevention in operation, only 1,890 acres would be flooded.

Appendix

Approximately 38 acres of flood plain would lie within the sediment reserve pools of the proposed structures and 261 additional acres within the detention pools.

The runoff from the 25-year frequency storm was used to establish the minimum detention storage requirements. The 25-year frequency storm which would produce the maximum runoff was found by plotting intensity-frequency-infiltration curves and selecting the maximum ordinate between them. For the Calaveras Creek watershed this 25-year maximum runoff was 4.70 inches.

From a study of the rainfall-runoff relationships for this watershed it was found that a rain of 1.90 inches, which would produce 0.25 inches of runoff on the average, was the minimum that would cause flooding to a depth of six inches at the smallest channel cross-section. Therefore no rains of less than this amount were considered for flood routing purposes. A runoff of 0.25 inches would produce a discharge of 1,390 cubic feet per second at the minimum cross-section and 2,570 cubic feet per second at the reference cross-section.

The minimum cross-section is No. 7, located 4 miles north of U. S. Highway No. 181. The reference cross-section, No. 1, is located about one mile above the confluence of Calaveras Creek and San Antonio River.

Channel capacity at the reference section is 3,660 cubic feet per second. The peak discharge at this point for a 8.48-inch rain under present conditions was 29,370 cubic feet per second. After installation and full functioning of the measures in the watershed plan, the discharge at the same point would be reduced to 14,460 cubic feet per second.

## SEDIMENTATION INVESTIGATIONS

### Methodology

The field surveys of the sedimentation problems in the Calaveras Creek watershed were made according to methods described in the revised "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans", Water Conservation-6, SCS Region 4, March 26, 1952. Field studies included reconnaissance surveys of geology and physiography, studies of overbank sediment deposits, flood plain scour, stream bank erosion, and nature of channels and valleys on and near all hydrologic cross-sections. Borings were made where required to measure and study the modern sediment deposits. In preparation of the report tabular summaries of all the above problems with explanatory text were included. These show the basis for calculation of damages by the economist.

Investigations of sediment sources in the watersheds above ten proposed waterflow retardation structures were made according to standard procedures used in Region 4, and predictions were made for future

sedimentation rates in each basin.

Sediment Source Studies

The sediment derived from sheet erosion was estimated by the method presented in, "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairies Problem Area in Soil Conservation", SCS Region 4, February, 1953. The formula is based on watershed surveys including the following data: (1) Soil unit in acres by slope in percent, slope length in feet and land use (cultivated, pasture or woods), (2) average farming practicing (percent row crop and/or percent small grain, etc.), (3) cover condition classes on pasture and woods, (4) past history of land use, and (5) maximum 30-minute rainfall intensity to be expected once in two years. The history of the gully development as given by early settlers indicate that the gullies in the area have developed during the past 60 years. Similar historic information was used to determine the rate of channel enlargement.

From these studies total annual sediment yields above the proposed floodwater retarding structures were calculated to be as follows: 39.3 acre-feet from sheet erosion, 6.0 acre-feet from modern gullies, and 5.0 acre-feet from channel enlargement. The average yield of sediment per square mile is 1.25 acre-feet annually.

The principal source of sediment above the proposed structures is sheet erosion on cultivated land. It is estimated that 78 percent of the sediment is produced by sheet erosion, 12 percent by modern gully erosion, and 10 percent by channel enlargement.

Effect of Watershed Treatment on Sediment Yields

Areas damaged by overbank deposition and flood plain scour should be rendered productive again after they have been protected from flooding and adapted soil-improving crop rotations put into effect.

Deep-rooted legumes (sweet clover) should be grown in the crop rotations to break up the plow pan, improve percolation rates, and reduce runoff. Field observations indicate that such crops would need the application of commercial fertilizers, which should be applied according to soil tests.

Present analysis indicate that 37 percent of the watershed is in cropland. The soil is in fair physical condition. However, it is recommended that the present acreage of small grain (about 2,300 acres) be increased 50 percent and that deep-rooted legumes be planted on at least one-fourth of the cropland annually. In addition, terraces are recommended on the steeper slopes in order to reduce erosion and control runoff. It is estimated that 70 percent of the gross sheet erosion from the watershed is derived from this source.

The amount of sediment coming from the former cropland is estimated to

be 22 percent of the total gross sheet erosion from the watershed. The former cropland consists of about 16,775 acres, or 27 percent of the watershed. Most of these lands will require the application of commercial fertilizers, reseeding and proper range management practices.

Erosion on the open pasture and wooded pasture land (33.5 percent of the watershed) is, in general, slight. However, there are areas of over-use which would be improved by proper range management practices. These areas yield 8 percent of the total gross sheet erosion from the watershed.

The application of conservation practices in the watershed will reduce sediment from sheet erosion by an estimated 49 percent.

Modern gullies in the pasture land and wooded areas are beginning to heal. No overfalls of any consequence were present, and very little ancient gully erosion was noted.

The application of needed land treatment measures is expected to reduce modern gully erosion by 50 percent.

It is estimated that these reductions in sediment yield throughout the watershed will increase the average life of the sediment reserve pools of floodwater retarding structures by 48 percent.

## FOUNDATION AND BORROW INVESTIGATIONS

### Methodology

Detail soil and foundation investigations were made at three representative dam sites. These investigations included studies of the valleys, the exposed rock sections, including lithology, stratigraphy and structure. Borings were made along the center lines and in the borrow areas at the proposed sites, and both alluvium and bedrock as they might affect construction were described. These investigations were made with a Failing - 1500 core drill rig. Geologic cross-sections of the valleys were plotted at all three dam sites.

### Description of Formations

The center lines of the proposed locations of all three dams are located in the Wilcox Group of early Tertiary, Eocene age. This group represents non-marine and shallow marine deposition. The principal bedrocks of the area are thin bedded limestones, lignitic limestones, sandstones and siltstones. Some sections of the bedrock are almost pure, unconsolidated sands.

### Valley Slopes

The valley slopes, from the ends of the dam down to the valley floor, are fairly uniform as to surface and underlying material. The soils on the slopes are principally residual silty, sandy and heavy clay beds and are underlain by shales, limestones or silts.

Borrow Areas

The borrow materials appear to be of adequate quantities and should be suitable for construction throughout the depth examined and sampled. These materials consist principally of sandy and silty clays.

Preliminary Recommendations

The beds outcropping on the slopes should present no difficulties in tying in the abutments. In some sections of the abutments and along the center line of the dams, the clays are underlain by a sandy member of the formation. This sandy formation should offer no foundation problem, but its recognition may necessitate special design. The flood plains are fairly narrow and contain varying deposits of loose sands and gravels. These materials, when of sufficient quantity, should be removed during construction. Laboratory tests are being made to determine the quality of materials for embankments and core walls.

The three dam sites investigated are sufficiently representative of the ten proposed sites to indicate that economical construction, with some variation because of local conditions, can be expected.

## ECONOMIC INVESTIGATIONS

Methodology

The procedures outlined in the Economic Section of Water Conservation-6, Revised, were followed in the economic investigation. The following data have been submitted to the Fort Worth Office to substantiate the findings in this work plan:

1. Map of flood plain showing current land use,
2. Table showing damageable value per acre of flood plain,
3. Table showing crop damage rates by seasons and depths,
4. Tables showing damage by floods in the evaluation series to crops, other agricultural and non-agricultural property,
5. Table summarizing damage at current prices,
6. Table showing intensification of flood plain land use,
7. Table showing conservation benefit,
8. Table showing loss of production in reservoir areas,
9. Table showing individual structure justification.

Determination of Damage

Flood damage information for 60 percent of the flood plain area of Calaveras Creek and its major tributaries was obtained from landowners or operators. Most of the specific information as to the amount and extent of damage related to the September 1946 flood. Other information obtained included flood plain land use, yields of major crops, property damage which would result from a major flood and general flood problem. The monetary value of the percentage of damage to flood plain lands by sediment deposition and scour was determined on the basis of present values and costs.

Damage rates were determined for both season and depth of flooding. Monetary evaluation was based on present (1952) prices and costs. After determining the amount of crop damage which would have resulted from single floods during the 20-year rainfall period, this figure was adjusted for recurrence of flooding. Other agricultural damage rates were based on acres inundated by a given flood. The percentage of damage to flood plain lands by sedimentation and scour was determined on the basis of reduced productivity and increased cost of production.

Determination of Benefits

1. Floodwater Reduction Benefits.

Floodwater and sediment damages were calculated under present conditions and those which will prevail after the installation of each class of measures included in the recommended program. The difference between average annual damages at the time of initiation of each class of measures and those expected after their installation constitutes the benefits brought about by that group through reduction of damage.

Benefits from reduction of crop and pasture damages were estimated from the combined effects of reduction in area inundated and depth of inundation. No benefits were estimated for pool areas of the floodwater retarding structures.

Benefits from the reduction of valley sediment damages, flood plain scour, and other agricultural damages derived from each class of measures were determined on the basis of the reduction in area inundated.

2. Determination of Annual Benefit from Intensified Use of the Flood Plain.

More intensive agricultural use of flood plain soils will be made possible by the reductions in extent and frequency of flooding resulting from the floodwater retarding structures.

PROGRAM DETERMINATION

Determination was made first of the conservation measures which contribute directly to flood prevention remaining to be done in the watershed, based on land capability classes developed from soil survey.

The hydraulic, hydrologic, sedimentation and economic investigations provided data on the effects of land treatment in terms of conservation benefits and the reduction of flood damages resulting from such treatment.

Significant benefits would result from installation of land treatment measures; however, to give the desired degree of watershed protection and flood damage reduction it was obvious that additional measures would be required.

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

A base map was prepared showing the watershed boundary, drainage pattern, system of roads and railroads, the limits of towns, and other needed data.

Using consecutive 4" aerial photographs and a stereoscope, possible floodwater retarding sites were located and the limits and area of the flood plain delineated. This information was placed on the watershed base map. The original San Antonio River Survey provided much needed data since the Calaveras Creek watershed was used as a sample for that survey. However, some sites proposed in this survey were not now feasible since a number of years had elapsed from the time of that survey and changes in ownership, installation of buildings, road, etc. made it necessary to relocate some of the original structure sites.

A topographic map was made of each proposed reservoir site to determine the storage capacity, the estimated cost of the dam, the areas of flood plain and upland that would be inundated by the sediment reserve and flood pool. The height of the dam, and size of the pools were determined by the storage volume needed to detain the runoff from the design storm and additional storage needed for sediment.

The limits of the flood pools and sediment reserve pools of all satisfactory sites and the flood plain of the stream were drawn to scale on a copy of the base map. A structure data table was developed to show for each structure the drainage area, storage capacity separately for detention and for sediment storage in acre feet, and inches of runoff from the drainage area, release rate of the outlet tube, and the acres of flood plain inundated by the sediment reserve and detention pools, volume of fill in the dams and estimated cost of the structures.

When the land treatment measures and those measures primarily for flood prevention had been determined (giving consideration to alternate proposals) a table was developed which gave total cost of each type of measure and that portion of the cost to be borne by the participants. The summation of the total costs for all the needed measures represented the estimated cost of the flood prevention-conservation program for the watershed.

A second cost table was developed to show separately the annual installation cost, annual maintenance cost and total annual cost of the A & B measures. This information was used for comparison with annual expected benefits to determine the benefit-cost ratio of the plan of improvement.

# APPENDIX

## Table 1

Increase in Income Through More Intensive Use of Flood Plain Lands
Calaveras Creek, San Antonio River.
1952 Prices

| Land Use | Acres | Yield | Production | Gross Income | Cost | Net Income |
|---|---|---|---|---|---|---|
| Present Conditions: | | | | | | |
| Corn | 440 | 34 Bu. | 14,960 | $27,377 | $ 9,662 | $17,715 |
| Grain Sorghum | 294 | 20 CWT | 5,880 | 15,994 | 5,589 | 10,405 |
| Peanuts, Nuts | 18 | 640 Lbs. | 11,520 | 1,164 | 728 | 436 |
| Peanuts, Hay | | 0.8 T. | 14.4 | 553 | 107 | 446 |
| Oats, Grain | 117 | 30 Bu. | 3,510 | 3,545 | 1,973 | 1,572 |
| Oats, Grazing | | 2 AUM. | 234 | 1,133 | - | 1,133 |
| Johnson Grass Meadow | 173 | 1.5 T | 259.5 | 7,287 | 2,720 | 4,567 |
| Idle | 44 | - | - | - | - | - |
| Pasture | 1,737 | 0.7 AUM | 1,216 | 5,885 | - | 5,885 |
| Miscellaneous | 112 | | | | | |
| | 2,935 | | | $62,938 | $20,779 | $42,159 |
| After Land Treatment and Detention Storage | | | | | | |
| Corn | 734 | 34 Bu. | 24,956 | $45,669 | $16,119 | $29,550 |
| Grain Sorghum | 587 | 20 CWT | 11,740 | 31,933 | 11,159 | 20,774 |
| Peanuts, Nuts | 18 | 640 Lbs. | 11,520 | 1,164 | 728 | 436 |
| Peanuts, Hay | | 0.8 Lbs | 14.4 | 553 | 107 | 446 |
| Oats, Grain | 117 | 30 Bu. | 3,510 | 3,545 | 1,973 | 1,572 |
| Oats, Grazing | | 2 AUM | 234 | 1,133 | - | 1,133 |
| Pasture | 1,367 | 0.7 AUM | 957 | 4,632 | - | 4,632 |
| Miscellaneous | 112 | | | | | |
| | 2,935 | | | $88,629 | $30,086 | $58,543 |

| | |
|---|---|
| Net Increase | 16,384 |
| Less Added Damage | 458 |
| Less Clearing Cost | 1,036 |
| Less Overhead | 788 |
| | $14,102 |
| Discounted to Present Worth | 0.926 |
| | $13,058 |
| Long-term Price Adjustment | 0.75 |
| Net Benefit | $ 9,793 |

# APPENDIX
## Table 2

Individual Justification - Floodwater Retarding Structures
Calaveras Creek Watershed
San Antonio River Watershed

Total Benefits from Floodwater Retarding Structures = $29,504
Drainage Area Controlled (Table 6) = 40.41 Square Miles
Benefit per Square Mile Controlled = $730.12

Individual Structure Justification

| Site No. | Drainage Area Sq. Mi. | Total Cost | Annual Cost | Annual Benefit | Benefit-Cost Ratio |
|---|---|---|---|---|---|
| 1 | 5.76 | 41,280 | 1,606 | 4,205 | 2.62 : 1 |
| 2 | 1.78 | 32,509 | 1,262 | 1,300 | 1.03 : 1 |
| 3 | 5.43 | 76,002 | 2,852 | 3,964 | 1.39 : 1 |
| 4 | 4.99 | 41,116 | 1,609 | 3,643 | 2.26 : 1 |
| 5 | 1.36 | 20,134 | 809 | 993 | 1.23 : 1 |
| 6 | 7.01 | 39,554 | 1,554 | 5,118 | 3.29 : 1 |
| 7 | 3.93 | 37,128 | 1,444 | 2,869 | 1.99 : 1 |
| 8 | 2.39 | 25,424 | 1,016 | 1,745 | 1.72 : 1 |
| 9 | 1.46 | 21,887 | 871 | 1,066 | 1.22 : 1 |
| 10 | 6.30 | 44,668 | 1,739 | 4,600 | 2.65 : 1 |
| Total | 40.41 | 379,702 | 14,762 | 29,504 | 2.00 : 1 |

Analysis of Installation Costs

| Site No. | Total Cost | Easement | | Construction & Other | | Total Annual Installation Cost |
|---|---|---|---|---|---|---|
| | | Total | Annual | Total | Annual | |
| 1 | 41,280 | 6,200 | 289 | 35,080 | 1,242 | 1,531 |
| 2 | 32,509 | 3,360 | 156 | 29,149 | 1,031 | 1,187 |
| 3 | 76,002 | 7,920 | 369 | 68,082 | 2,408 | 2,777 |
| 4 | 41,116 | 6,900 | 321 | 34,216 | 1,213 | 1,534 |
| 5 | 20,134 | 1,950 | 91 | 18,184 | 643 | 734 |
| 6 | 39,554 | 6,710 | 312 | 32,844 | 1,167 | 1,479 |
| 7 | 37,128 | 4,840 | 225 | 32,288 | 1,144 | 1,369 |
| 8 | 25,424 | 3,740 | 174 | 21,684 | 767 | 941 |
| 9 | 21,887 | 2,100 | 98 | 19,787 | 698 | 796 |
| 10 | 44,668 | 7,095 | 330 | 37,573 | 1,334 | 1,664 |
| Total | 379,702 | 50,815 | 2,365 | 328,887 | 11,647 | 14,012 |

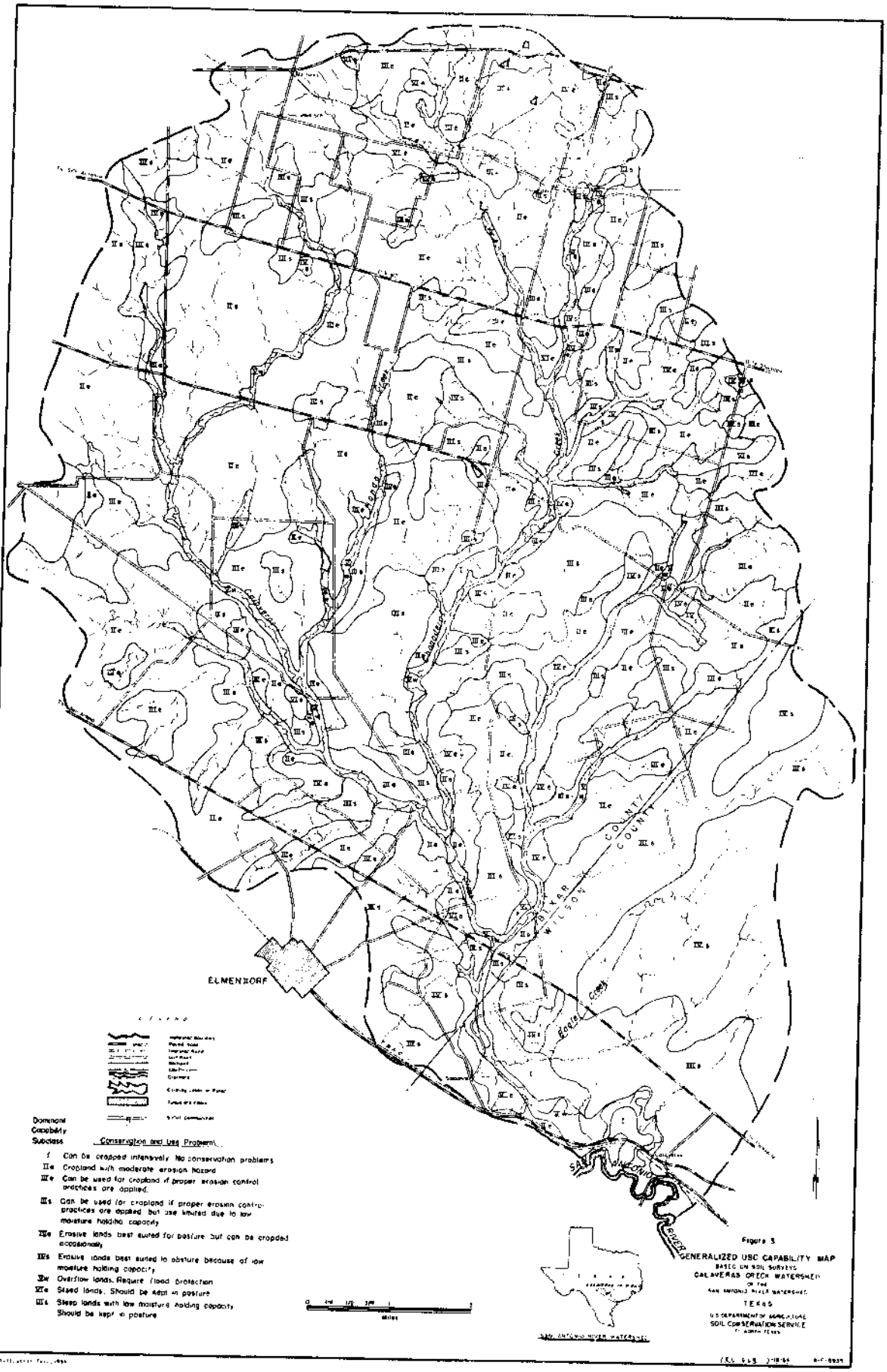



Figure 5

GENERALIZED USC CAPABILITY MAP

BASED ON SOIL SURVEYS

CALAVERAS CREEK WATERSHED

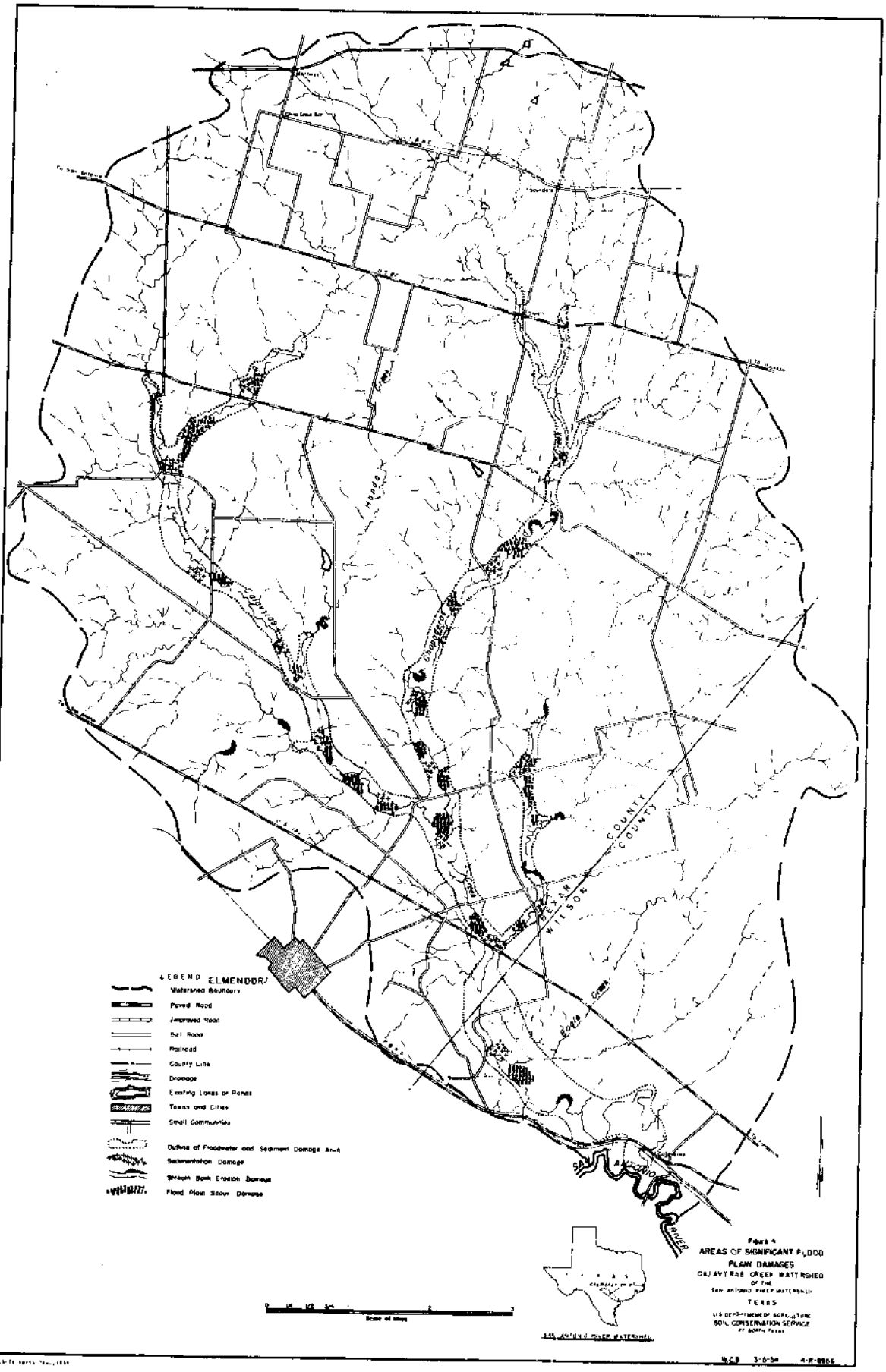
OF THE

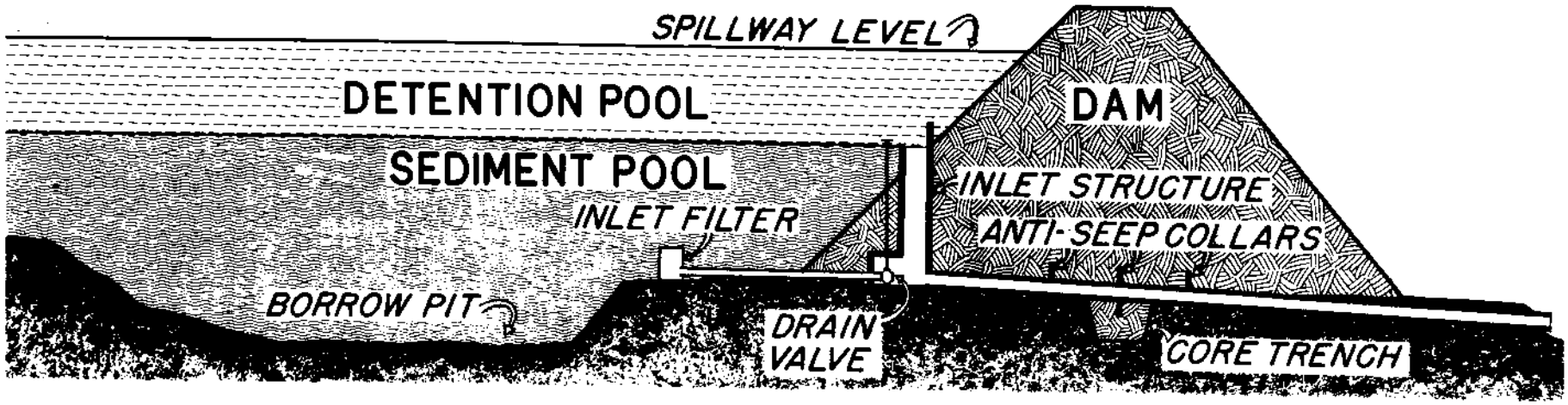
SAN ANTONIO RIVER WATERSHED

TEXAS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE


LEGEND
ELMENDORF
Watershed Boundary
Paved Road
Improved Road
Dirt Road
Railroad
County Line
Drainage
Existing Lakes or Ponds
Towns and Cities
Small Communities
Outline of Floodwater and Sediment Damage Area
Sedimentation Damage
Stream Bank Erosion Damage
Flood Plain Scour Damage
Medio Creek
Salado Creek
Bexar County
Wilson County
San Antonio River
Scale of Miles
SAN ANTONIO RIVER WATERSHED
Figure 4
AREAS OF SIGNIFICANT FLOOD PLAIN DAMAGES
GALVESTON CREEK WATERSHED
OF THE
SAN ANTONIO RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
FT. WORTH, TEXAS
W.S.P. 3-6-64 4-R-8866




SECTION OF TYPICAL FLOODWATER RETARDING STRUCTURE