WATERSHED WORK PLAN

JOHNSONS DRAW WATERSHED

Crockett County, Texas

Prepared Under The Authority Of The
Watershed Protection And Flood Prevention Act
(Public Law 566, 83rd Congress, 68 Stat. 666)

January 1956

WATERSHED WORK PLAN

AGREEMENT

between the

Crockett Soil Conservation District

(name of local organization)

Commissioners Court of Crockett County

(name of local organization)

(name of local organization)

(name of local organization)

STATE OF Texas

and the

SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

:eas, application has heretofore been made to the Secretary of Agriculture by

Crockett Soil Conservation District,

(name of local organization)

Commissioners Court of Crockett County,

(name of local organization)

and

(name of local organization)

(name of local organization)

e of Texas, hereinafter referred to as the local organization, assistance in preparing a plan for works of improvement for the Johnsons Draw Watershed, State of Texas, under the ority of the Watershed Protection and Flood Prevention Act (Public Law 566, Congress, 68 Stat, 666); and

eas, the responsibility for administration of the Watershed Protection and d Prevention Act has been assigned by the Secretary of Agriculture to the Soil ervation Service, hereinafter referred to as the Service; and

eas, there has been developed through the cooperative efforts of the local nization and the Service a mutually satisfactory plan for works of improvement said watershed, designated as the watershed work plan for Johnsons Draw Watershed, State of Texas, which watershed work plan is ked to and made a part of this agreement; and

y Houston Smith — COMMISSIONERS COURT OF CROCKETT COUNTY, TEXAS
(name of local organization)

itle County Judge — Date January 11, 1956

he signing of this agreement was authorized by a resolution of the governing ody of the Comm'rs Court of Crockett Co adopted at a meeting held on
(name of local organization)
January 11, 1956.

ate January 11, 1956 — Lita Powell
(Secretary, local organization)
County Clerk, Crockett County, Texas

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y _____ — _____
(name of local organization)

itle _____ — Date _____, 195___

he signing of this agreement was authorized by a resolution of the governing ody of the _____ adopted at a meeting held on
(name of local organization)
_____, 195___.

ate _____, 195___ — _____
(Secretary, local organization)

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y _____ — _____
(name of local organization)

itle _____ — Date _____, 195___

he signing of this agreement was authorized by a resolution of the governing ody of the _____ adopted at a meeting held on
(name of local organization)
_____, 195___.

ate _____, 195___ — _____
(Secretary, local organization)

ereas, the watershed work plan describes the watershed and its problems, and sets rth a plan for works of improvement including a schedule of operations, the kinds d quantities of measures to be installed, the estimated cost, cost-sharing rangements, maintenance and other responsibilities of those participating in the rks of improvement; and

ereas, the Watershed Protection and Flood Prevention Act provides (a) that the cal organization and the Secretary of Agriculture shall agree on the watershed rk plan prior to participation by the Secretary of Agriculture in the installa- on of the works of improvement as set forth in said plan, and (b) that, at least rty-five days (while Congress is in session) before such installation involving deral assistance is commenced, the watershed work plan and the justification erefor shall be transmitted by the Secretary of Agriculture to the Congress rough the President;

w, therefore, in view of the foregoing considerations, the local organization and e Secretary of Agriculture, through the Service, hereby agree on the watershed rk plan, and further agree that the works of improvement as set forth in said an will be installed, operated, and maintained substantially in accordance with e terms, conditions, and stipulations provided for therein.

is further understood that this agreement does not constitute a financial docu- nt to serve as a basis for the obligation of Federal funds, and that financial d other assistance to be furnished by the Service in carrying out the watershed rk plan is contingent on the appropriation of funds for this purpose and on the ecution of supplemental agreements setting forth the cost-sharing arrangements d other conditions that are applicable to specific works of improvement.

is further agreed that the watershed work plan may be amended or revised, and at this agreement may be modified or terminated, only by mutual agreement of the ties hereto.

member of or Delegate to Congress shall be admitted to any share or part of this eement, or to any benefit that may arise therefrom; but this provision shall not construed to extend to this agreement if made with a corporation for its general efit.

Wm. E. Davidson Jr. CROCKETT SOIL CONSERVATION DISTRICT
(name of local organization)

le Chairman Date January 11, 1956

signing of this agreement was authorized by a resolution of the governing body the Crockett S C D adopted at a meeting held on Jan. 11, 1956
(name of local organization)

e 1-11, 1956

(Setretary, local organization)

WATERSHED WORK PLAN
JOHNSONS DRAW WATERSHED
Crockett County, Texas

Prepared Under the Authority of the
Watershed Protection and Flood Prevention Act

Prepared by
Crockett Soil Conservation District

With Assistance by

U. S. Department of Agriculture
Soil Conservation Service
January 1956

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Crockett County, Texas
January, 1956

INTRODUCTION

Authority

The Watershed Work Plan for the Johnsona Draw watershed, Crockett County, Texas, hereinafter referred to as the Plan, will be carried out under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666).

Purpose and Scope of Plan

The Crockett Soil Conservation District provides through its present Program and Work Plan for the application of a complete program of soil and water conservation and improved plant management within this watershed. Its objectives are to use each acre of agricultural land in accordance with its capabilities for sustained agricultural production and to treat each acre in accordance with its needs for protection and improvement. Such a program, when applied and maintained on all the land within the watershed, will be effective in reducing peak runoff from small rains and will effect some reduction in peak flows from exceasive rains. An effective land treatment program will have a major effect in the reduction of upland erosion rates which, in turn, will reduce sediment yields. Additional structural measures for flood prevention are needed to complete the soil and water conservation and plant management program in the watershed and provide effective reductions in flood damage.

The purposes of this Plan are (1) to state specifically the planned land treatment and structural practices and measures which are designed primarily for, or contribute directly to flood prevention and (2) to specify how, when, and by whom they will be carried out to achieve the maximum practicable reduction of erosion, floodwater and sediment damages. The measures and practices planned herein constitute an integral part of the complete soil and water conaervation and plant management program in this watershed and have been incorporated in the work plan of the aoil conservation district concerned.

Application of this mutually developed plan will provide the protection to and improvement of land and water resources which can be undertaken at this time with the combined facilities of local interests and State and Federal agencies. Upon completion and continued maintenance of the measures set forth in this Plan, a material contribution will be made toward increasing agricultural production to a level consistent with the capabilities of the land, thereby promoting the welfare of the

landowners and operators, the community, the State and the Nation. The watershed lies in Crockett County, Texas, and contains 101,760 acres (159 square miles).

SUMMARY OF PLAN

This plan is a combination of land treatment practices and flood prevention measures which contribute directly to soil and water conservation, plant management and flood prevention. The works of improvement listed in Table 1 are planned to be installed during a 5-year period at an estimated total cost of $1,617,803 of which $779,284 is to be borne by non-Federal interests and $818,519 by the Federal Government. These estimates are inclusive of the current costs of private interests under the going National programs pertaining to the objectives of this plan.

The Crockett Soil Conservation District, under provisions of State enabling legislation, has agreed to assume responsibility for overall periodic inspection and maintenance of the floodwater retarding structures and channel improvement at an estimated annual cost of $1,330. The landowners and operators will maintain the land treatment measures in accordance with provisions of their farmer-district cooperative agreements.

Comparisons of Benefit and Cost

With the works of improvements applied and operating at full effectiveness, the ratio of the estimated average annual benefit ($54,146) to the estimated average annual cost ($41,411) is 1.31 to 1 for structural measures, based on current price levels for construction costs and long-term price levels for operation and maintenance costs and for benefits. Benefits accrue from the works of improvement in this Plan in the flood plain of Johnsons Draw below the boundaries of this watershed and account for $1,381 of the total.

DESCRIPTION OF WATERSHED

Physical Data

Johnsons Draw rises in the east-central part of Crockett County and flows through Crockett and Val Verde Counties, Texas, in a southerly direction for approximately 70 miles, entering Devils River about one and one-half miles south of the community of Juno in Val Verde County. The Johnsons Draw watershed, as designated in this Plan consists of that portion of the drainage area of Johnsons Draw which lies north of a point on the stream channel three miles south of Ozona, Texas. This watershed lies entirely within Crockett County and is approximately 20 miles in length. Garrett Draw and Gurley Draw are the major tributaries. (Figure 4).

The watershed has an area of 101,760 acres (159 square miles), of which 100,653 acres are in ranches and 1,107 acres are in urban areas, roads, and other miscellaneous uses. There are 5,700 acres of alluvial land

which lie along the streams and are subject to overflow. Of these 5,070 acres are flood plain and 630 acres are stream channels. These stream channels are shallow and wide and have a good cover of grass throughout most of their lengths. Under present conditions the entire flood plain would be inundated by a storm similar to the one of June, 1954, which produced 3.62 inches of runoff. This is the largest storm that occurred in the period of study and was estimated by Hazen's method to have a frequency of occurrence of once in 71 years.

The entire Johnsons Draw watershed lies within the Edwards Plateau Problem Area in Soil Conservation. The soils are dark colored, fine textured and well aggregated. They have developed from weathering of limestones and marls. Approximately 26 percent of the soils are very shallow, 45 percent shallow, and 29 percent deep. The exact nature of the soils within the area depends upon the topography and the geologic formation underlying them. Deep, aggregated soils are found along the stream valleys and at the top of the plateau. The shallow and very shallow stony soils are on the hillsides between the valleys and plateau. The soils, in general, are in good to fair physical condition. The upland range land has lost an estimated one-half inch of topsoil through sheet erosion. This loss has occurred largely as a result of overgrazing.

The topography of the watershed ranges from steep to very gently rolling. Within the watershed, the Edwards Plateau is well dissected by the dendritic stream pattern of Johnsons Draw. Well incised, but relatively wide stream valleys are bordered by steep hills of moderate relief. The relief of the hills dimishes rapidly upstream from Ozona to the top of the plateau. The stream bed drops approximately 200 feet in elevation within a distance of 12 miles between Site 1 and the bridge on Highway 290 at Ozona. The main alluvial flood plain ranges from 2,700 feet wide in the lower reaches to less than 150 feet wide near the headwaters. At the top of the plateau, the topography is extremely flat. The term "karst" is used to describe this area. Large, circular sink holes caused by the collapse of caverns in the limestone beds beneath the plateau exist in profusion in localized areas and are scattered singly in other areas of the watershed. The sink holes were considered as non-contributing in the production of sediment and runoff (See Figure 4).

At the present time, approximately 99 percent of the watershed is utilized as range. Only 50 acres are in cultivation. The total land use in the watershed is estimated as follows:

Land Use	Acres	Percent
Cultivation	50	0.05
Range	100,603	98.86
Miscellaneous 1/	1,107	1.09
Total	101,760	100.00

1/ Includes roads, highways, airports, towns, etc.

The geologic formations in the watershed are all of Lower Cretaceous age. These formations represent two geologic groups, the Fredericksburg and the Washita. The Fredericksburg group comprises the oldest rock in the watershed and is composed of the Edwards and Kiamichi formations. The Edwards is a massive and resistant limestone formation generally containing horizons honeycombed with small cavities. The younger Kiamichi formation is composed of yellow marls that are variable in hardness and resistance to excavation. The Georgetown formation of the Washita group contains the youngest rock materials in the area. It consists of alternating beds of hard limestone and soft marl.

The streams, through natural geologic processes of erosion, have etched deep valleys into the Edwards formation and completely through the Georgetown and Kiamichi formations. In the lower part of the watershed, the Georgetown and Kiamichi have been removed completely. The greater percent of the residual stony soils, therefore, have been developed from weathering of the porous Edwards limestone. The deep, well aggregated soils on top of the plateau have developed through weathering of the limestone of the Georgetown formation.

The Edwards limestone, because of the presence of numerous cavities and its very porous nature, is the most important aquifer in the watershed. Water from the Edwards formation adequately supplies municipal as well as domestic and livestock needs. Recharge of the city wells during and after pumping is rapid. The aquifer is recharged both from within and outside the watershed. On the flat area of the plateau, water collects in the sink holes and has direct entrance through fissures in the broken Georgetown formation into the Edwards formation. In the remaining area of the plateau, water penetrates the Georgetown down to the Edwards, but at a slower rate. Forty-four percent of the watershed is composed of stony soils which offer relatively little resistance to water passing through them.

The stream valleys are also important recharge areas. The flood plain at Ozona is underlain by vast deposits of gravel. The log of a water well in Ozona drilled 120 feet east of the present Johnsons Draw channel shows 160 feet of gravel. This gravel thins out upstream to become 4 to 6 feet deep at Site No. 1. All of this alluvium rests on the Edwards formation. A large quantity of water reaches the Edwards aquifer through this gravel. Frequently, water collected in upstream tributaries after a light rain disappears into the gravel deposits before reaching Ozona. An aquifer of this type is easily polluted.

The rangeland in Johnsons Draw watershed is mostly in fair and poor condition. However, several isolated areas are in good condition. The climax vegetation is a part of the mixed grass prairie plant group. There are three range sites in this watershed; namely, Deep Soil Site, Shallow Upland Site, and Low Stony Hills Site. These are described as follows:

The Deep Soil Site includes valleys, flats, and divides of deep productive

soils that take water moderately fast. The better grasses that grow on this site are plains bristlegrass, bluestems, sideoats grama, bush muhly, cottontop, vine-mesquite and buffalograss. The deep sites are characterized by a predominance of tobosa, an increaser, and mesquite, an invader.

The Shallow Upland Site has a shallow soil (10-20 inches) that takes water fairly fast. The better grasses growing on this site are bluestem, cottontop, sideoats gramma, green sprangletop, bush muhly, hairy gramma, buffalograss, and plains bristlegrass. Most of the poor condition range is found in this site. Red gramma grass predominates under poor condition and cedar and catclaw are common invaders.

The Low Stony Hills Site has very shallow soils that are less than ten inches deep. It may be further described as having rolling rock hills and ridges characterized by ledges and rock outcrops. Although the soils on this site are very shallow, rainfall infiltrates readily due to the fractured rock surface condition. The better grasses common to this site are bluestema, aideoats and green sprangletop and hairy gramma. Common invaders are catclaw and cedar.

The cover condition of these areas is shown in the following table:

Range Site and Condition Class

Range Site	Condition Class	Acres	Percent for Site
Deep Soil	Good	3,701	14.2
Deep Soil	Fair	22,275	85.8
Deep Soil	Poor	0	0
Subtotal		25,976	100.0
Shallow Upland	Good	0	0
Shallow Upland	Fair	27,439	56.3
Shallow Upland	Poor	21,276	43.7
Subtotal		48,715	100.0
Low Stony Hills	Good	4,618	17.8
Low Stony Hills	Fair	21,185	81.8
Low Stony Hills	Poor	109	0.4
Subtotal		25,912	100.0
All Sites	Good	8,319	8.3
All Sites	Fair	70,899	70.4
All Sites	Poor	21,385	21.3
Total All Range Lands		100,603	100.0

Mean temperatures range from 81 degrees Fahrenheit in summer to 48 degrees in winter. The extreme recorded temperatures are 7 degrees below zero and 112 degrees above zero. The average date of the last killing frost is March 30 and that of the first killing frost is November 12, a normal frost-free period of 227 days.

The mean annual precipitation is 18.85 inches, according to rainfall records at Ozona, Texas. It is well distributed, with the larger average monthly rainfalls occurring in May, June, and September. High intensity rains of excessive amounts occur frequently throughout the watershed but cover only small areas. Individual rains of excessive amounts, which may occur at any season, cause erosion and serious flood damage. Although these storms may occur during any season, the majority have occurred in the summer and fall months. The minimum recorded annual rainfall was 7.23 inches; the maximum was 38.08 inches.

Water for livestock and domestic uses is supplied by deep wells. These wells provide adequate and dependable water; however, due to the high cost of drilling, they are too few in number to insure adequate distribution of grazing. The town of Ozona obtains its water from deep wells.

The Johnsons Draw watershed is served by a Soil Conservation Service work unit at Ozona, assisting the Crockett Soil Conservation District. This work unit has assisted ranchers in preparing 18 conservation plans on 83,061 acres within the watershed. Where range conservation and plant management measures and practices have been applied and maintained for as long as three to five years, forage production has increased 25 to 30 percent.

Economic Data

Ranching is about the only agricultural enterprise in this watershed. Since 1920, when there was approximately an equal number of cattle and sheep, there has been a rapid increase in sheep numbers and a corresponding decline in cattle numbers. It is estimated that of the total livestock currently in this watershed 90 percent are sheep, 4 percent are cattle and 6 percent are goats.

About 35 acres of cultivated land immediately below Ozona are irrigated by effluent from the city sewage disposal plant. This irrigated land is used entirely from the production of forage crops. In addition, 15 acres of cultivated land located on Gurley Draw is currently used for the production of tame pasture grasses. There is no other cultivated land in the watershed.

The average size of ranches in the Johnsons Draw watershed above Ozona is about 8,400 acres. This acreage is sufficient for an economical unit. The average value of land and buildings per ranch is $249,773 (1950 census). Tenancy is not a problem since most ranches are owner-operated. The University of Texas owns 5,472 acres of range land located in the

upper portion of the watershed. This land is leased to local ranchers. This, however, does not present a tenancy problem as many of these leases have been in the same family for several generations. There are only 7 ranches that lie wholly within the watershed, although there are an additional 17 ranches that are partly within the watershed.

Even though farm and ranch income has been relatively high the past few years, the present drought situation has placed many ranchers in a "tight" financial position. The high feed prices and slump in livestock prices have been extremely unfavorable. Many have been forced to carry heavy livestock loans, and some have had to increase land loans.

Ranchers market most of their lambs and calves locally to feeder buyers, with delivery made at the nearest shipping point. Most of the livestock is trucked from Ozona to Barnhart, Sonora, Rankin or San Angelo, where it can be put on rail cars. These rail loading points range from 40 to 80 miles from Ozona and the Johnsons Draw watershed.

Wool and mohair is put on the market at the time of shearing. Practically all of the wool and mohair produced in Crockett County is marketed in Ozona.

Crude oil and natural gas production is important to the economy of Crockett County and Ozona; however, the production in this watershed is relatively small. Oil leases have furnished some income to supplement that from livestock. Some leases have sold for as high as $100 per acre; however, the average is probably about $4 or $5 per acre. Most of the ranchers get $0.50 per acre rental for 5-or 10-year leases.

Ozona, with a population of some three thousand, is the county seat and only town and community in the Johnsons Draw watershed as well as in Crockett County. It is unincorporated and is governed by the County Commissioners' Court. It is supported largely by county taxes. Most of the ranchers in the county have homes in Ozona.

The watershed is served by approximately 63 miles of roads, of which 35 miles are paved (US Highway 290, Texas State Highway 163 and FM 33 and FM-865). There are six bridges on these roads. There are no bridges on the 28 miles of county roads in the watershed. Many miles of private roads lead from the paved highways and county roads to ranch headquarters and over the various pastures. Floods occasionally make some of the roads impassable. The detours thus occasioned cause delay and extra travel distance to and from markets.

WATERSHED PROBLEMS

Floodwater Damage

Due to the extreme scarcity of suitable building sites, approximately 60 percent of the town of Ozona has been built within the flood plain

of Johnsons Draw. Approximately 95 percent of the average annual flood damage in the watershed occurs within the town.

Small floods occur on Johnsons Draw on an average of once each two years. They cause some loss of livestock and fence damage. These small floods do very little or no damage to urban property, as the county has improved the stream channel through town to the extent that it will carry small peak flows. Large floods occur on an average interval of once in five to ten years.

The most disastrous flood occurred on June 27 and 28, 1954, when 17 people lost their lives (Figure 1). In addition, there were 60 business establishments and 459 residential units in Ozona that suffered damages ranging from a few hundred dollars to complete destruction. Flood damages to transportation facilities consisted of damages to state highways and county roads. Damage to utilities was confined largely to electric power lines and sub-stations in or near Ozona. Telephone communications were also interrupted and, in many localities, were not restored for a month after the flood. The agricultural losses consisted chiefly of losses of livestock and damages to fences and equipment. The estimated direct damages for the June, 1954, flood are as follows:

1.	Agricultural	$ 32,847
2.	Transportation facilities	37,134
3.	Utilities	37,000
4.	Urban and suburban	3,590,584

In addition, there was a cost of $65,000 for rescue work, policing, relief and care of flood victims and combating insects and diseases.

At Ozona the floods of 1900 and 1922 were somewhat comparable to the flood of 1954 (Figure 2); however, there were few houses in the flood plain and, consequently, small urban damage. One house was floated away in 1922.

For the floods experienced during the period studied, the total direct floodwater, sediment and erosion damages were estimated to average $59,343 annually at long-term price levels. Annual floodwater damages were estimated to average $58,521 under present conditions, of which $42 is crop damage, $722 is other agricultural damage, and $57,757 is non-agricultural, such as damage to roads, bridges, public utilities, pipelines, retail and wholesale business establishments, and to residences.

Indirect damages such as interruption of travel, loss of business, breakdown of utility services and the like are unusually heavy in this watershed because of the concentration of damageable values in the flood plain. The total annual value of these indirect damages is estimated to be $8,768. The average annual monetary flood damages are summarized in Table 4.

Figure 1

17 lives were lost when Johnsons Draw flooded Ozona, Texas during the storm of June 28-28, 1954.

Sediment Damage

There are no large reservoirs in the watershed. Pond sedimentation is of minor significance since only three are known to exist. These ponds are usually dry due to the porosity of the underlying gravel and rock strata.

One hundred and forty-three acres of the flood plain below the proposed floodwater retarding structure sites have been damaged by deposits of gravel and sand. Practically all of the damaged land is utilized as range. There are 52 acres damaged 10 percent, 64 acres damaged 20 percent, and 27 acres damaged 60 percent. All of the damages are considered fully recoverable except for the 27 acres damaged 60 percent. In this instance, it is estimated the 27 acres will recover about 50 percent of its fertility after a ten year period. Sediment deposits of silt and clay are present but usually are not extensive and deep enough to be considered damaging. The most severe damage has occurred on four acres of a 35 acre irrigated field. This four acres has been covered by deposits of gravel ranging in thickness from one to three feet. Damage to cultivated land amounts to 3 percent of the sediment damage occurring on the flood plain. It is estimated that sediment damages to the flood plain in the future will be reduced 35 percent by the combined program of land treatment measures and floodwater retarding atructures.

Estimated benefits, based on the reduction in sediment damages to be effected by land treatment measures and floodwater retarding structures, were limited to that part of the flood plain area that was inundated by the June, 1954, storm and which lies downstream from the proposed floodwater retarding structure sites.

Erosion Damage

Erosion rates in the Johnsons Draw watershed are low. This is due primarily to the fact that most of the watershed is rangeland. Another factor accounting for the low erosion rates is the fact that the deep soils, which have higher basic erosion rates, are located on the flat area at the top of the plateau. All the cultivated land is located in the flood plain.

Sheet erosion is the major source of sediment. Slightly over 76 percent of the sediment produced annually in the watershed results from this process. Streambank erosion accounts for 7 percent. Gullies, in the usual sense, do not exist. At the extreme upper end of every small tributary stream, small gully-like areas were found to be incised into the rocky hillsides. Water which collects in these areas flows over limestone into the tributaries. Sediment from this source is negligible in quantity.

Seventeen percent of the total annual sediment production results from scouring of the flood plain. The major flood plain erosion damage is caused by sheet scour. Seven hundred and seventy-four acres of the

flood plain has been damaged by this process. However, the percent of damage is low since only a relatively thin layer of soil is lost during each flood. It is estimated that this scour damage occurs in a ten-year cycle from the time of original damage to recovery and that the amount of damage is not increasing appreciably. A few small scour channels were found but their areal extent was minor. Reduction of this damage by land treatment measures will be only 15 percent. Reduction through land treatment measures and floodwater retarding structures will be 69 percent. Streambank erosion is minor in extent. Land loss from this process amounts to less than one acre annually.

Problems Relating to Methods now Used in the Conservation, Development, Utilization and Disposal of Water.

Problems relating to methods now used in the conservation, development, utilization, and disposal of water are of a minor nature in this watershed and do not warrant a study at this time. The planned works of improvement will produce no detrimental effects on any program which may be developed in the future.

INVESTIGATIONS AND ANALYSES

Program Determination

Determination was made first of the needed land treatment measures, based on current range condition classes, which remain to be applied in the watershed and which contribute directly to flood prevention. The hydraulic, hydrologic, sedimentation and economic investigations provided dsta on the effects of these measures in terms of the reduction of flood damages resulting from such treatment. Although significant benefits would result from application of these needed land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of watershed protection and flood damage reduction desired.

Determination was made secondly of structural measures for flood prevention which would be feasible to install. The study made and the procedures used in that determination were as follows:

1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. Using consecutive 4-inch aerial photographs and a stereoscope, all probsble floodwater retarding structure sites were located, the limits and the area of the flood plain delineated, and points marked where valley cross sections should be taken for the determination of hydraulic characteristics and for flood routing purposes. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were surveyed at the selected locations. Data developed from these cross sections permitted the computation of peak discharge-damage relationships for various flood flows. A map was prepared of the

flood plain on which land use, cross section locations and other pertinent information were recorded.

2. A field examination was made of all probable floodwater retarding structure sites previously located on the watershed base map. Sites which did not show good storage possibilities or which would inundate highways or improvements were dropped from further consideration. From the remaining sites a system of floodwater retarding structures was selected for further consideration and detailed survey.

3. A topographic map was made of the reservoir area of each of the proposed sites in order to determine the storage capacity of the site, the estimated cost of the dam and the areas of flood plain and upland that would be inundated by the sediment and flood pools. The height of the dams and the size of the pools were determined by the storage volume needed to temporarily detain five inches of runoff and to provide the additional storage needed for sediment. The limits of the flood pools and sediment pools of all satisfactory sites and the flood plain of the stream were drawn to scale on a copy of the base map. Structure data tables were developed to show for each structure the drainage area, the storage capacity needed for detention and for sediment storage in acre-feet and in inches of runoff from the drainage areas, the release rate of the principal spillway, the acres of flood plain inundatad by the sediment and detention pools, the volume of fill in the dams and the estimated cost of the structures (Tables 6 and 6B).

4. Damages resulting from floodwater, sediment and erosion were determined from damage schedules and surveys of sample areas. Reduction in these damages resulting from the proposed works of improvements were estimated on the basis of reduction of peak discharges as determined by flood routings. These flood routings were made using present conditions and future conditions for which it was assumed that the proposed works of improvement had been installed. Benefits so determined were allocated to individual measures or groups of interrelated measures on the basis of the effect of each on reduction of damages. In this manner it was determined that floodwater retarding structures and channel improvement could be economically justified. By further analysis those structures which had favorable benefit-cost ratios were determined. These were included in the plan. Alternate sites in connection with channel improvement were investigated and a system of floodwater retarding structures and channel improvement was developed which would give maximum net benefits.

When the land treatment measures and those structural measures for flood

prevention had been determined, a table was developed which gave the total cost of each type of measure. The summation of the total costs for all the needed measures represented the estimated cost of the proposed watershed protection and flood prevention project (Table 1). A second cost table waa developed to show separately the annual installation cost, annual maintenance cost and total annual cost of the structural measures (Table 3).

Hydraulic and Hydrologic Investigations

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

1. Basic meterologic and hydrologic data were tabulated and analyzed.

2. Engineering surveys were made to collect information on selected stream reaches, including valley cross sections, channel capacities and other hydraulic characteristics, and on proposed structure sites to collect data used in design.

3. Determination was made of the hydrologic conditions of the watershed, taking into consideration such factors as soils, land use, topography, cover and climate.

4. Determination was made of the rainfall-runoff relationship, using the soil-cover complex data. This was then compared to nearby actual gaged runoff. The frequency of meteorologic events was determined by plotting runoff and peak discharges on Hazen probability paper and compared with actual gaged data as taken from climatological papers. The relationships of runoff, peak discharge and damages was determined for various frequencies.

5. Determination was made of peak discharges under present watershed conditions, as related to damages caused by various peak discharge frequencies.

6. Determination was made of peak discharges and damages caused by various peak discharge frequencies which would 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 channel improvement.

Due to the scarcity of available meteorologic data and the high intensity thunderstorm patterns of this area, and after a study of the hydraulic and

hydrologic characteristics, available data, topography and geology of this watershed, it was determined that the annual flood frequency method for analysis should be used for this watershed.

The largest rain studied was one of 11.21 inches, falling over a 3-day period and producing 3.62 inches of runoff. This was the storm of June 27, 28, and 29, 1954. It was determined that this storm has a frequency of once in 71 years and produced a peak discharge at the town of Ozona of 73,340 cubic feet per aecond. If such a rain were to occur after the remaining needed land treatment meaaures had been applied, it is estimated that the peak discharge would be reduced to 64,000 cubic feet per second. With land treatment measures applied and the structural measures for flood prevention in operation, a peak discharge of only 14,000 cubic feet per second would be obtained, which determined the size of the channel to be constructed through town. Five inches of runoff was used to establish the minimum detention storage requirements in the floodwater retarding structures. This amount of runoff was selected due to the high degree of urban development and danger to life involved. It exceeds the 100-year frequency, which is 4.50 inches. Inflow hydrographs for structure design were developed uaing the runoff of twice the 100-year storm because of the danger to human lives, aince 17 lives were lost in the storm of June 1954. This amount of runoff would be produced by a 12-inch rain in a period of 6 hours.

It was found that urban damage would begin at a discharge of 7,500 cubic feet per aecond at cross section No. 4, located at the south edge of the town of Ozona. It was also determined that crop and pasture damage began at a discharge of 300 cubic feet per second at cross section No. 1, the control section, located 3 miles south of Ozona. Therefore, no storma producing less than these peak discharges were used in flood routing.

The channel capacity at the reference section is 300 cubic feet per second. The peak discharge at this point for the June, 1954 storm was 86,900 cubic feet per second. After installation and full functioning of the planned measures, the discharge at the same point would be reduced to 28,500 cubic feet per second.

Sedimentation Investigations

The field surveys of the sedimentation problems in the Johnsons Draw watershed were made in accordance with methods prescribed in the "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans", Water Conservation-6, SCS, Region 4, Revised February, 1954. Field studies of overbank deposits, flood plain scour, stream-bank erosion, and the nature of the channels and valley were made on or near all valley cross sections. Borings were made along all cross sections to determine the nature and thickness of sediment deposits. In the preparation of the work plan, tabular summaries of all the above findings, with explanatory text, were prepared. These were uaed by the economist as the basis for calculating monetary damages.

Investigations of sediment sources in the drainage areas above six of the proposed floodwater retarding structures were made according to standard procedures. Estimates were then made for both present and future sediment yields in the drainage area above the remaining structure site. One departure was made from recommended procedures. Sediment storage was not allocated to the sediment pool and to the flood pool areas separately as has been the practice in watersheds where sediment yields are much higher. On Johnsons Draw the sediment storage requirements were less than 0.5 inch for each of the sites. The allocation of such low quantities of aediment to different pool areas was deemed unnecessary.

Sediment Source Studies:

The sediment derived from sheet erosion was estimated by use of a formula shown in "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairie Problem Area in Soil Conservation", Soil Conservation Service, Region 4, February, 1953. The formula is based on data obtained by watershed surveys and includes the following:

1. Soil unit in acres by slope in percent, slope length in feet and present land use (cultivated or pasture).

2. Cover condition classes on pasture.

3. Past history of land use.

4. Maximum 30-minute rainfall intensity to be expected once in two years.

The amount of sediment derived from gully and streambank erosion was estimated by field studies, uae of aerial photographs, and by interviews with landowners in the watershed who were able to give information on the history of gully development and channel enlargement.

From these studies, total annual sediment yields above the proposed floodwater retarding structures were calculated as follows: 19.69 acre-feet from aheet erosion, none from gully erosion, and .041 acre-foot from channel enlargement. The average annual yield of sediment above structures is 0.21 acre-foot per square mile. The principal source of sediment is sheet erosion on rangeland.

Effect of Watershed Treatment on Sediment Yields:

Areas damaged by infertile overwash and flood plain scour will be rendered productive again after they have been protected from flooding and needed range improvement measures have been put into effect. In addition, the future rates of damage caused by these processes will be greatly reduced. Rangeland produces most of the sediment in the watershed. The application of needed range improvement measures will reduce the sediment yield from aheet erosion by an estimated 56 percent.

Foundation and Borrow Investigations

There are seven proposed floodwater retarding structure sites in the watershed. In a general sense, they fall into two separate categories based upon geological conditions and cost of construction. One group, exhibiting extremely stony conditions fostered by the hard but porous underlying Edwards limestone, is composed of five sites, numbers 2, 4, 5, 6, and 7 (Figure 4). The other group is composed of sites 1 and 3. In this group, the Georgetown and/or Kiamichi formations underlie the spillway areas and the upper parts of the abutments. The Edwards limestone underlies the lower abutments and the alluvium in the flood plain areas. Based on a cost per yard of spillway excavation, the first group will be the most expensive to construct. Reconnaissance geological investigations were msde on all of the sites to evaluate the foundation conditions of the structures. The nature of the materials in the proposed spillway cuts as well as availability and quality of the soils in the borrow areas were determined. In addition to the reconnaissance investigation, core drilling equipment was used to make a preliminary investigation on a representative site in each group.

All of the five sites in the first group contain the Edwards limestone in the proposed spillway cuts. The limestone, while slightly fractured and moderately segmented, will require the use of explosives for its excavation. Since extreme difficulty in excavation will be encountered, with resultant high costs, all possible methods will be used to keep spillway cuts to a minimum. This material will be suitable for use as rock blanket or riprap. Cost per cubic yard of spillway excavstion will be less in the second group of sites.

At sites 2, 4, 5, 6, and 7, limestone either outcrops or lies just beneath the surface under a thin mantle of stony soils. A minimum keyway in the abutments will require hard rock excavation that will involve blasting. In the flood plain area, limestone constitutes the foundation. It underlies approximately 6 feet of soil zoned as follows: Clay, gravelly clay, and gravel which usually rests directly upon the limestone. This condition will necessitate placing a core wall down through the gravel and keying into the hard limestone. However, in those localities where the Edwards limestone is very porous, some seepage will undoubtedly occur and floodwater retarding structures may not impound water for extended periods. Large cavities are known to exist in this limestone, and one of the primary objectives of the detailed core drilling investigation preceding construction will be to determine the location and extent of such cavities.

The foundation conditions on sites 1 and 3 are similar to those outlined above except that the soil mantle average about 3 feet in depth over limestone and marl of the Georgetown formation or marl of the Kiamichi formation in the upper parts of the abutments. The Edwards limestone underlies the lower abutments and the flood plain. The alluvisl mantle is about one foot thinner than at the other group of sites. However, problems pertaining to excavation of keyways are similar.

The soils in the borrow areas are adequate for use in construction both in quantity and quality. A top zone of clay, an intermediate zone of gravelly clay and a lower zone of gravel exist in a relatively uniform manner in the borrow areas. Good volume weights should result when the lower gravel zones are mixed with the clays above and compacted with rollers. The alluvial mantle of soils is thin and the borrow areas will be relatively large in area. Utilization of the borrow areas on sites 1, 2, and 3 will involve especially long hauls because either the alluvial soil mantles are thinner or the borrow areas more narrow than at sites 4, 5, 6, and 7.

Water needed in conatruction is scarce. The closest reliable source of supply is located at Ozona. There are some strong wells on ranches in the watershed that could supply construction needs.

Economic Investigations

Determination of Annual Benefits from Reduction in Damage:

Damage schedules covering 99 percent of the flood plain area of Johnsons Draw and its major tributaries above Ozona were obtained from landowners or operators. These schedules covered land use, crop distribution, yields, and historical data on flooding and flood damages. The damage schedulea taken were supplemented by information obtained by the Corps of Engineers in a house to house canvass in Ozona immediately after the flood of June, 1954. This information, supplemented by additional investigations, was used in the evaluation of urban damagea. The frequency of flooding on Johnsons Draw is so low and such a high percentage of the damage comes from residential, business and other nonagricultural property that the frequency method instead of the historical method of analysis was used.

A contour map of the town site of Ozona was prepared. High water lines for the floods of 1922, 1949, and 1954 were obtained through interviews with local people and delineated on the map (Figure 2). Area inundated by incremental depths of flooding was obtained for each of the three floods. Weighted depth factors were applied and the total damage under the preaent state of development calculated for each flood. The monetary damage for these three floods was uaed as the basis for the economic evaluation of the future damages.

After analyzing the flood damage achedules, it was concluded that there waa no appreciable range and pasture damage. In the calculation of crop damage all expenses saved, such as costs of harvesting, were deducted from the gross value of the damage. The calculated rates of damages were applied to the frequency series.

Damagea to other agricultural property such as fences, livestock and farm equipment were obtained from analysis of schedules and correlated with size of floods. The major items of nonagricultural damage were those sustained by residences, business houses, achools, roads, bridges and public

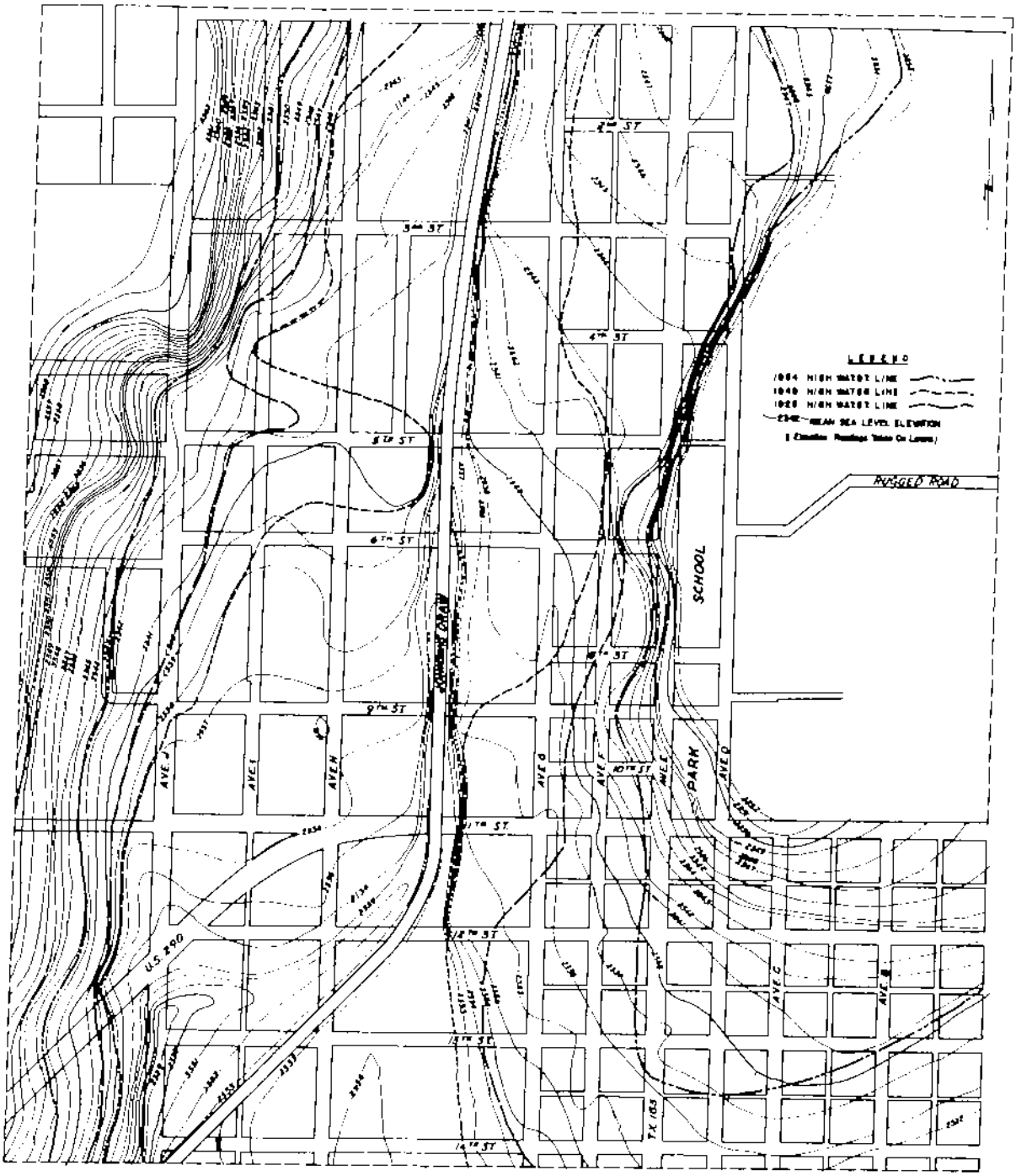

Figure 2

TOPOGRAPHIC
AND
FLOOD OUTLINE MAP

OZONA, TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TRIPLE ROAD

utilities. Estimates of these damages were obtained from county commissioners, State Highway Department officials and officials of public utilities.

Since a very large portion of the damages in this watershed are nonagricultural, indirect damages are higher than usually sustained in a primarily agricultural watershed. Nonagricultural indirect damages include delayed deliveries, interrupted travel, loss of business, and damages sustained by urban residents as a result of dislocation and interrupted public utility service. Indirect damage to agricultural enterprises include additional travel time to market, extra costs of purchasing feed for livestock, and the like. Information regarding damages of this type was obtained from ranchers, local residents, public utility officials, and owners or officials of business establishments. Upon analysis, it appeared that indirect damage amounted to at least 15 percent of the direct urban damage and 10 percent of the direct agricultural damages.

Floodwater, erosion and sediment damages on the flood plain were calculated under present conditions and under those which will prevail after installation of each class of measures included in the recommended project. The difference between average annual damages at the time of initiation of each class of measures and those expected after their installation constitutes the benefit brought about by that group.

Because of the hills on each side of town, the land available for development in Ozona is concentrated in the flood plain. The history of the development was analyzed carefully and it was concluded that the damageable valuea at the end of 50 years, even though no project is installed will be at least 20 percent higher than at present. A 20 percent increase occurring at a uniform rate and discounted over a 50-year period at 4 percent is equivalent to a 6.12 percent present increase. Therefore, all estimates of urban damages and benefits were increased by 6.12 percent in the determination of economic justification. The possibility of benefits from enhancement were investigated. After careful study and analysis of property values in the flood plain and the economy of the area, both past and present, it was concluded that benefits from enhancement are not predictable at this time.

Areas that will be inundated by the sediment and detention pools of floodwater retarding structures were excluded from the damage calculations. An estimate was made, however, of the value of the production lost in these areas after installation of the program. In this appraisal it was considered that there would be no production in the sediment pools. The land covered by the detention pool is already in grass, so no change was projected in the land use in these areas.

Determination of Annual Benefits Outside Watershed Resulting from the Project:

Similar investigations were made on the main stem of Johnsons Draw from the lower boundary of Johnsons Draw watershed to Government Canyon, which is approximately 20 miles downstream. Annual flood damages were calculated and benefits claimed from the reduction of these damages by the project.

Details of Methodology:

In general, details of the procedures used in the investigation are described in the Economic Section of Water Conservation 6, Revised, procedures for Developing Flood Prevention Work Plans, Region 4, March 26, 1952, except that the analysis was made on the basis of flood frequency rather than historical series.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

Efforts to prevent or to control flooding of agricultural lands in the Johnsons Draw watershed have been minor. However, during the past 15 years the city of Ozona, recognizing the great hazard to life and property, has made a concerted effort to control and reduce flooding in town.

Starting in the early 1940's, Ozona has worked continually on the channel of Johnsons Draw where it passes through the town. During this time the channel has been relocated, straightened, and enlarged for a distance of 1.05 miles. This channel improvement work has represented a cost to date of $71,686, all of which has been borne by Crockett County through general taxation.

It is understood that the Corps of Engineers is considering a flood control project on Devils River. If such a flood control project is constructed, it is believed that this project will contribute to its effectiveness.

The Crockett Soil Conservation District has been very active in initiating flood prevention work and has exerted its influence toward a high degree of participation in this program on the part of the ranchers and other interested parties in the watershed.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and treatment in accordance with its needs, such as is now being carried out by the Crockett Soil Conservation District, is essential in a sound and continuing flood prevention program on the watershed. Basic to the attainment of this objective is the establishment and maintenance of all applicable soil and water conservation and plant management practices. Emphasis will be placed on accelerating the establishment of those land treatment measures which have a measurable effect on the reduction of floodwater and sediment damages.

An important phase of work which will be done is the seeding or overseeding of adapted grasses on 20,000 acres of rangeland which has been so overgrazed and injured by drought that reseeding is necessary to establish adequate cover to reduce erosion and sediment yield.

Range pitting will be applied on 15,000 acres of rangeland to improve infiltration rates, reduce runoff and aid in establishment of desirable vegetative cover.

Other needed land treatment measures which have a direct effect on flood prevention and which will be applied are proper use of 91,961 acres of rangeland, deferred grazing of 93,846 acres of rangeland and eradication of brush on 12,419 acres. These measures will improve and maintain an effective vegetative cover on these lands.

Under the guidance and with assistance of the Crockett Soil Conservation District, landowners and operators will apply other needed land treatment measures which are needed in a complete soil and water conservation and plant management program but either do not contribute directly to flood prevention or their contribution is minor due to characteristics of the practice or small areas affected.

The estimated total cost of installing these measures over and above the going program is $510,618, as shown in Table 1.

Structural Measures for Flood Prevention

The floodwater retarding structures (Figure 3) and channel improvement needed to provide flood protection for human life, flood plain lands, highways and urban improvements are listed with their costs in Table 1. A system of 7 floodwater retarding structures and 1.6 miles of channel improvement is to be installed to protect the city of Ozona and flood plain lands in the Johnsons Draw watershed. The locations of the structures and channel improvement are shown on the Structure Location Map (Figure 4). Data concerning these waterflow control structures are summarized in Tables 6, 6A and 6B.

The system of floodwater retarding structures will detain the runoff from 61.7 percent of the Johnsons Draw watershed. Runoff will be detained from 78.4 percent of the area above the city of Ozona. Sufficient detention storage can be developed at all structure sites to make possible the use of vegetated or natural rock spillways, thereby effecting a substantial reduction in cost over concrete or similar type spillways. Approximately 62 acres of flood plain in the watershed will lie within the sediment pools of the proposed structures and 370 additional acres within the detention pools. An additional 190 acres of upland will be inundated by the sediment pools and 1,681 acres will lie within the detention pools (Table 6). These sites will be provided entirely by local interests. Their value is estimated to be $63,750, based on current market values as furnished by local people. Site costs were determined by adding the full value of the land in the sediment pool and one-half the value of the land in the flood pool, since the latter will remain in productive use as range. The amortized value of the structure sites exceeds the average annual value of the loss of production within the sites at long-term

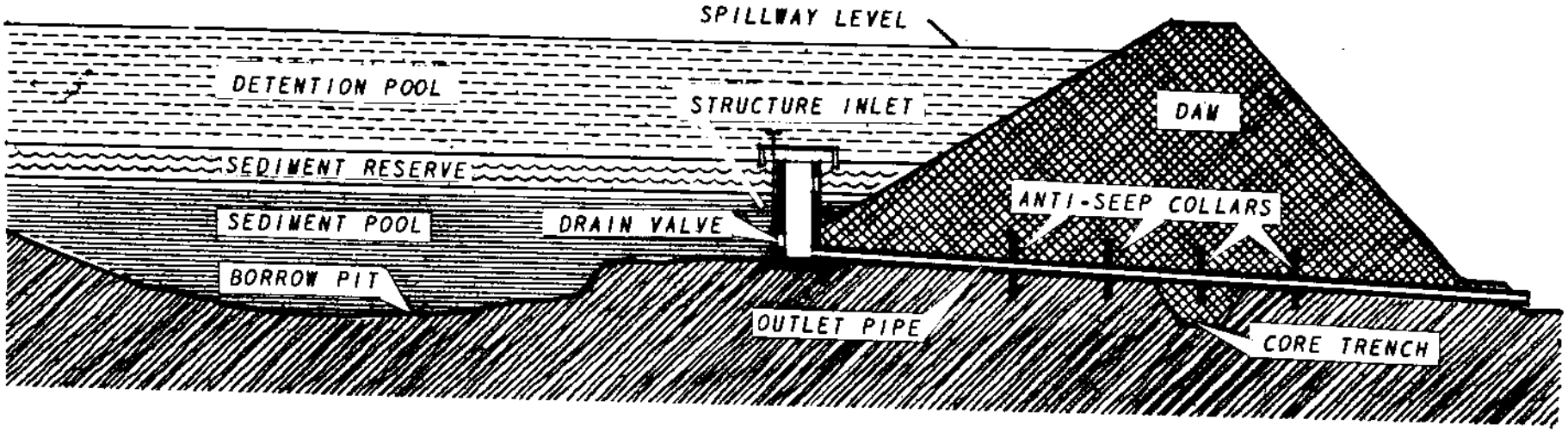

Figure 3

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U.S.D.A. SOIL CONSERVATION SERVICE

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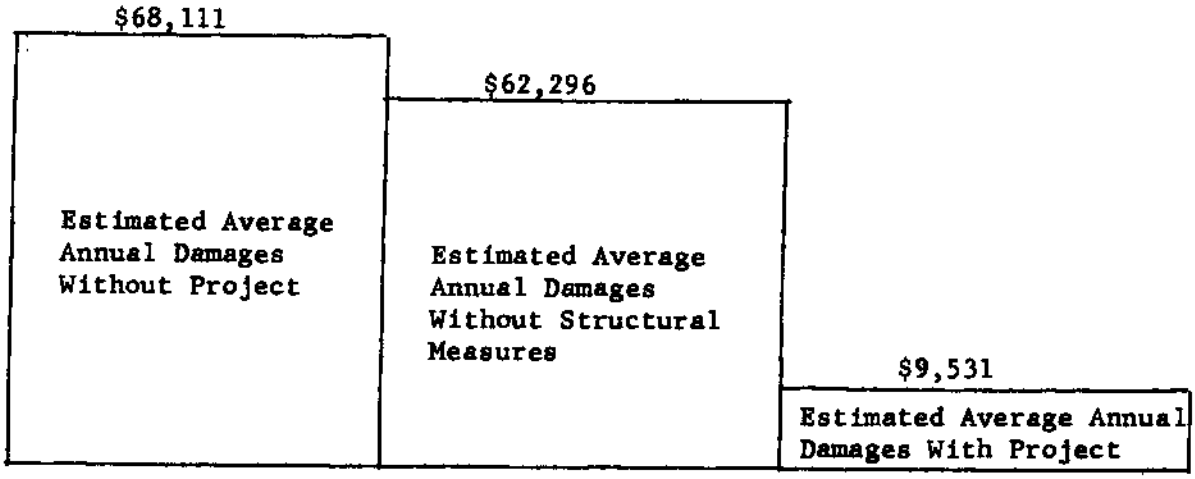
price levels; therefore, in accordance with sound procedures, the larger figure was used in determining the economic evaluation of the project. The estimated value of additional land required for channel improvement is $13,288. The total estimated cost of installing these works of improvement is $1,107,185. The annual equivalent cost, including installation and maintenance, is $41,411, based on current price levels for construction and long-term price levels for maintenance.

Effects of Works of Improvement on Damages and Benefits

The combined program of land treatment and waterflow control measures will eliminate all urban flood damage from floods of magnitude equal to that experienced in June, 1954.

The estimated average annual direct floodwater, sediment, and erosion damage is expected to be reduced from $59,343 to $8,321 or a reduction of 86 percent. Approximately 90 percent of this reduction would be due to the proposed system of floodwater retarding structures and channel improvement. The reduction in damage attributable to land treatment and to structural measures is illustrated in the following chart:



The estimated average annual floodwater damage based on the floods experienced in the period of study will be reduced from $58,521 to $8,014. Approximately 90 percent of the expected reduction would result from the system of floodwater retarding structures and channel improvement. The estimated reduction of annual sediment damage is from $155 to $40. This reduction would be attributable to the system of floodwater retarding structures. Flood plain erosion damage is estimated to be reduced from $667 to $207. Approximately 78 percent of this reduction would be the result of the system of floodwater retarding structures. Indirect damages will be reduced similarly from an estimated $8,768 to $1,210.

The total benefits resulting from reduction of damage outside the watershed are estimated to be $1,381.

The total flood prevention benefit from the reduction of damage by the project is $59,961, of which $54,146, or 90 percent, is the result of floodwater retarding structures and channel improvement. In addition to the primary benefits described above there are certain secondary benefits such as increased income to business establishments and better opportunities for employment of labor in the affected communities. These community benefits are estimated to average at least $3,407 annually, but they are not included in the economic justification of the project.

Seventeen lives were lost in Ozona in the flood of June 1954. The proposed watershed protection project would have reduced the peak discharge to such an extent that no loss of life from floodwater would have been expected in Ozona if the works of improvement had been in place.

The proposed watershed protection project on Johnsons Draw watershed will have no known detrimental effect on any downstream projects that might be constructed in the future.

COMPARISON OF COST AND BENEFIT

When the structural measures for flood prevention are installed and operating at full effectiveness, the ratio of the average annual benefit, $54,146, to the average annual cost of the measures, $41,411, is about 1.31 to 1, based on current price levels for installation costs and long-term prices for benefits and maintenance. These benefits are exclusive of those derived from land treatment measures.

In addition to the monetary benefits, there are other substantial intangible values which will accrue from the program, such as increased opportunity for recreation, better living conditions, sense of economic security, protection of public health, and the safeguarding of human life.

The recharge of groundwater will be of benefit to people whose water supply comes from the aquifer previously described. However, it is beyond the scope of this investigation to determine who would be benefited from where the benefits would accrue and the value of these benefits.

ACCOMPLISHING THE PLAN

The Extension Service will carry out the educational phase of the project by conducting general information and local ranch meetings, by preparing radio and press releases and using other means of disseminating information to reach the landowners and operators in the watershed. This action will help achieve understanding and stimulate participation in the entire plan to be carried out, including the land treatment measures and the structural measures for flood prevention.

Land Treatment Measures

The land treatment measures itemized on Table 1 will be established on the land by the ranch owners and operators in cooperation with the Crockett Soil Conservation District. The cost of applying these measures will be borne by these owners and operators. It is expected that they will be reimbursed for a portion of this cost through the existing Agricultural Conservation Program. The amount of reimbursement to be expected was estimated, based on the current program, and was not included in the total estimated non-Federal cost of the land trestment measures listed in Table 1. The soil conservation district is giving assiatance in the planning and application of these measures under the going program.

The governing body of the Crockett Soil Conservation District will arrange for meetings according to a definite schedule, and by individual contacts encourage the landowners and operators within the watershed to adopt and carry out soil and water conservation plans on their ranches. District-owned equipment will be made available to the landowners in accordance with the existing arrangements for equipment usage in the district. Existing facilities and personnel furnished by the Soil Conservation Service is adequate to assist the Crockett Soil Conservation District in accelerating the preparation and application of soil and water conservation plans.

The Farmers Home Administration soil and water conservation loan program will be made available to all eligible individual ranchers in this area. Educational meetings will be held in cooperation with other agencies outlining the services available and eligibility requirements. Present FHA clients will be encouraged to cooperate in the program.

The county ASC Committee will cooperate with the governing body of the soil conservation district by selecting and providing financial assistance for those ACPS practices which will accomplish the conservation objectives in the shortest possible time.

Structural Measures for Flood Prevention

The landowners, city of Ozona, and the Crockett Soil Conservation District plan to work in cooperation with the Crockett County Commissioners Court, which has powers of taxation and eminent domain under the State laws of Texas. These local interests placed $25,000 in a trust agreement with the Soil Conservation Service to expedite the planning of this watershed and initial installation services with the understanding that they would be credited with this amount on their share of the construction costs. Approximately $21,100 were expended in developing the work plan. The remaining $3,900 will be used to expedite installation services.

The Crockett County Commissioners Court will contract for the construction of all floodwater retarding structures and channel improvement listed in the Plan. Funds for the local share of the construction costs have been raised through a bond issue financed by a county-wide ad valorem tax.

Land easements for the sites of the floodwater retarding structures, the reservoirs created by them, and channel improvement will be obtained insofar as possible by private donation. In those instances where such donations would create excessive hardships, easements will be purchased by local interests. Construction of the structural measures will be started as soon as Federal funds are available. Floodwater retarding structures and the planned channel improvement will be scheduled for construction so as to complete the project within the 5-year period. Technical specialists will be provided by the Soil Conservation Service to assist in the planning, design, preparation of specification, supervision of construction, preparation of contract payment estimates, making final inspection, execution of certificates of completion, and to perform related duties for the establishment of the planned structural measures for flood prevention.

Table 1 indicates the schedule of operations for each phase of the program which the cooperating parties have agreed should be followed to achieve the most efficient prosecution of the work. This schedule will be adjusted from year to year on the basis of any significant changes in the accomplishments actually made.

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

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be operated and maintained by the landowners or operators of the ranches on which the measures are applied under agreements with the Crockett Soil Conservation District. Representatives of the Soil Conservation District will make periodic inspections of the land treatment measures to determine maintenance needs, encourage landowners and operators to perform maintenance and make district-owned equipment available for this purpose.

Structural Measures for Flood Prevention

The seven floodwater retarding structures and the 1.6 miles of channel improvement will be operated and maintained by the Crockett Soil Conservation District with assistance from the Crockett County Commissioners Court, which has legal authority to raise funds.

All floodwater retarding structures will be inspected at least annually and after each heavy rain or streamflow. Items of inspection will include but not be limited to the conditions of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and the emergency spillway and fences and gates installed as a part of the floodwater retarding structures. The improved channel will be inspected at least annually to determine the needs for

control of vegetation to prevent the reduction of chsnnel capacity and accumulation of sediment. The sponsoring local organization will maintain s record of all maintenance inspections.

The estimated annual operation and maintenance cost is $1,330, based on long-term price levels. The necessary maintenance work will be accomplished through the use of contributed labor and equipment, by contract, by force account, or a combination of these methods. Funds for accomplishing the maintenance work will be obtained from revenue derived through the sale of bonds of the Crockett County Commissioners Court. Provisions will be made for free access of District and Federal representatives to inspect the seven floodwater retarding structures and their appurtenances and the channel improvement at any time.

COST SHARING

Private interests will install the land treatment measures at an estimated cost of $510,618 (Table A).

Tables B through G show the allocation of costs of the structural works of improvement between local interests and the Federal Government on the basis of benefits received. The required non-Federal costs, consisting of the value of land easements and rights-of-wsy, the capitalized value of operation and maintenance of works of improvement (capitalized at 3 percent interest), and the cost of administering contrscts are estimated at $122,884. The value of installation services to be provided by the Federal government is estimated to be $233,429.

Construction costs were allocated in Table C on the basis of benefits received. All benefits resulting from reduction of flood or other damage were plsced in Class 1. This class wss further divided into subclasses A and B. Subclass B benefits were those where the principal beneficiaries were locsted outside the project area or were otherwise unidentifiable, or the msgnitude of the benefit was not significantly large. Benefits, significant in amounts, received by identifiable beneficiaries were assigned to subclass A. Benefits from reduction of damage to schools, churches, city and county property, roads and bridges were assigned to Class 1B because these benefits would accrue to taxpayers and those using the facilities, many of whom are located outside the watershed. Reductions to be expected in the severity of flooding were analyzed for representative sections along Johnsons Draw and its major tributaries. As a result of this analysis it was found that significant reductions in flooding would be effected in all areas in this watershed. Benefits accruing outside the watershed, such as benefits in the Johnsons Draw flood plain below this watershed, were classified as 1B. Likewise, benefits from the reduction of indirect damages were assigned to Class 1B.

Allocation of construction costs on the above basis, Table C, shows 72.94 percent, $572,645, to be paid by local interests, and 27.06 percent, $212,445, payable by the Federal government.

Proposed Cost Sharing Adjustment

A combination of watershed characteristics, flood plain development, land treatment costs and other related financial needs establish $200,000, or 25.5 percent of the construction costs as the maximum sum, over and above the required non-Federal costs of the structural measures, which the local sponsors believe they can contribute to the construction cost of the floodwater retarding structures and channel improvement and still insure their ability to participate in the project. It is therefore proposed that $372,645 of the allocated non-Federal cost be borne by the Federal Government. The share of the total project cost to be borne by the local people after such an adjustment would be $833,502 or 50.45 percent. Including land treatment practices already established and channel improvement work already accomplished, the local costs would be $969,087, or 54 percent.

Several of the factors which prompted this proposal were:

1. Remaining land treatment costs are estimated to be $510,618. Landowners and operators have already established land treatment measures estimated to cost $63,899. Establishment of all planned land treatment measures will represent an expenditure by local people of $574,517 over and above any financial assistance received or which might be forthcoming from other going agricultural programs. As only 24 ranch units are located, either wholly or partially, in the watershed, this cost for land treatment measure represents an expenditure of approximately $23,938 by each ranch operator.

2. Due to the extreme drought condition which has existed in this area for the past several years, the income of the local landowners in the watershed and the residents of the city of Ozona has been decreased to such an extent that they do not have the financial ability needed to carry the full share of the cost as indicated by the ratio of local benefits to total benefits.

3. The 2,800 residents of Ozona suffered an estimated loss of $3,590,584 from the flood of June, 1954. This represents an average loss of $1,282 for every man, woman and child, affected, either directly or indirectly, by the flood. Such a loss has worked, and will continue to work an extreme financial hardship on these people for many years to come, and precludes their ability to make large financial contributions to this project.

4. The local people have exhausted all sources of credit due to the recent extended period of drought years and the extremely heavy financial loss and cost of rebuilding from the June, 1954 flood; most of which was not covered by insurance. In view of this fact, the $200,000 the local

sponsors have agreed to raise toward the cost of construction will impose an additional heavy burden upon them. The sponsoring organizations have recently expended $71,686 for installation of a portion of the recommended channel improvement, all of which can be used in this plan. Also, an additional $63,899 have been expended on establishment of land treatment measures, making a total of $135,585 expended.

5. The seven planned detention structures would detain floodwater, releasing it at a slower rate and permitting increased opportunities for ground water recharge to the Edwards Limestone aquifer. Considerable unidentifiable benefits will be realized which have not been considered in the evaluation of this program.

6. The flood of June, 1954, caused the loss of 17 lives, endangered many more, and caused untold hardships and suffering which cannot be evaluated. Floods of this magnitude have occurred before and can occur again. Because maximum design criteria was applied to these planned structures, where failure of the dam might cause loss of life, endangerment of others, untold hardships and suffering, or heavy property damage, the cost of construction was much greater than used in normal operations and design. As there is no way to determine and evaluate the loss of life or the hardships and suffering caused by floods and because the prevention of these happenings will contribute materially to the betterment and economy of the County, State and Nation, it is felt by the sponsoring organizations that the Federal Government should assume a larger share of the costs.

7. In accordance with Budget Bureau Circular A-47, local beneficiaries of the Navarro-Mills flood control reservoir authorized on Richland Creek, a tributary of the Trinity River, will be expected to contribute 11 percent of the construction cost. Also, in this instance, local beneficiaries are not expected to furnish land or easements at no cost to the Federal Government. The proposal made herein by the sponsoring agencies will amount to a local cash contribution of approximately 25.5 percent of the total construction cost. It is the feeling of the sponsoring agencies that this proposal is compatible with the intent of the Congress in accordance with the requirements for local contribution on other projects of local and public interest.

8. During the 1954 storm there was considerable damage to properties of temporary residents of the town of Ozona. This damage was to personal property on which no taxes are paid. In this analysis these damages were considered as identifiable to the local people, which increased the percentage of benefits chargeable to them. This results in placing a heavier burden on those who propose to share the local sponsor's cost of the program.

Table A - Land Treatment Costs

Type of Cost	Federal Cost (dollars)	Non-Federal Cost (dollars)	Total Cost (dollars)
Non-Federal Lands			
1. Technical Assistance	-	-	-
2. Installation Costs 1/	-	510,618	510,618
3. Total	-	510,618	510,618
4. Grand Total	-	510,618	510,618

1/ This cost is exclusive of any reimbursement from ACP or other Federal funds.

Date: January, 1956

Table B - Distribution of Average Annual Benefits and Allocation of Construction Costs by Purposes and by Class of Benefits

Step A	Distribution of Average Annual Benefits		
Class of Benefits	Purpose: Flood Prevention		Total
	(dollars)	(percent)	(dollars)
Class 1A Benefits	41,984	72.94	41,984
Class 1B Benefits	15,569	27.06	15,569
Total	57,553	100.00	57,553

Step B	Allocation of Construction Costs		
Class of Benefits	Purpose: Flood Prevention		Total
	(percent)	(dollars)	(dollars)
Class 1A Benefits	72.94	572,645	572,645
Class 1B Benefits	27.06	212,445	212,445
Total	100.00	785,090	785,090

Date January, 1956

Table C - Benefits and Allocated Construction Costs

Class of Benefits	Benefits		Allocated Construction Costs	
	(dollars)	(percent)	(dollars)	(percent)
1. Class 1A	41,984	72.94	572,645	72.94
2. Class 1B	15,569	27.06	212,445	27.06
3. Subtotal Class 1	57,553	100.00	785,090	100.00
4. Total	57,553	100.00	785,090	100.00

Table D - Required Non-Federal Costs

Type of Cost	Cost or Appraised Value
	(dollars)
1. Land Easements, R. O. W., etc.	85,966
2. Capitalized value of operation and maintenance during expected life of improvements	34,218
3. Cost of administering contracts	2,700
4. Total	122,884

Date, January, 1956

Table E - Installation Services

Agency	Cost	Total
	(dollars)	(dollars)
Soil Conservation Service	233,429	233,429
Total	233,429	233,429

Table F - Proposed Adjustment in Federal and Non-Federal Costs

Reason for Adjustment	Transfer from Federal to Non-Federal	Transfer from Non-Federal to Federal
	(dollars)	(dollars)
1. Limited financial ability as result of flood damage suffered in 1954, etc.	-	372,645
2. Total	-	372,645

Date, January, 1956

Table G - Proposed Cost-Sharing

Type of Costs	Federal Cost (dollars)	Non-Federal Cost (dollars)	Total Cost (dollars)
COSTS FOR STRUCTURAL MEASURES			
1. Required Non-Federal Costs (Item 4, Table D)	-	122,884	122,884
2. Installation Services (Table E)	233,429	-	233,429
3. Subtotal (Items 1 plus 2)	233,429	122,884	356,313
Allocation of Construction Costs			
4. Costs allocated to Class 1A benefits (Item 1, Table C)	-	572,645	572,645
5. Costs allocated to Class 1B benefits (Item 2, Table C)	212,445	-	212,445
6. Subtotal (Items 4 plus 5)	212,445	572,645	785,090
Recommended Adjustment of Construction Costs			
7. Increase of Federal Cost (Table F)	372,645	-	-
8. Decrease of Non-Federal Cost (Table F)	-	372,645	-
9. Subtotal (Items 7 plus 8)	372,645	- 372,645	-
10. Total Cost Sharing for Structural Measures (Items 3 plus 6 plus or minus 9	818,519	322,884	1,141,403
COSTS FOR LAND TREATMENT MEASURES			
11. Non-Federal Lands (Item 3, Table A)	-	510,618	510,618
12. Subtotal	-	510,618	510,618
13. Grand Total Project Cost-Sharing (Items 10 plus 12)	818,519	833,502	1,652,021

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)

Johnsons Draw Watershed, Texas

For: First Fiscal Year

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land: Federal (dollars)	Non-Federal (dollars)	Total (dollars)
ID TREATMENT					
ioil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	13,795	-	10,346	10,346
Deferred Grazing	Acre	14,076	-	11,260	11,260
Brush Eradication	Acre	1,863	-	6,986	6,986
Range Seeding	Acre	750	-	18,750	18,750
Range Seeding (Over Tobosa)	Acre	2,250	-	22,500	22,500
Range Pitting	Acre	2,250	-	6,750	6,750
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	76,592	76,592
AL LAND TREATMENT				76,592	76,592
UCTURAL MEASURES					
LOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Nos.	5,6,7	204,836	70,019	274,855
Channel Improvement	Mile	-	-	-	-
SCS Subtotal			204,836	70,019	274,855
AL FLOOD PREVENTION			204,836	70,019	274,855
AL CONSTRUCTION COSTS			204,836	70,019	274,855
TALLATION SERVICES					
otal SCS			81,557	-	81,557
AL INSTALLATION SERVICES			81,557	-	81,557
ER COSTS			-	25,978	25,978
AL STRUCTURAL MEASURES			286,393	95,997	382,390
ND TOTAL			286,393	172,589	458,982
MARY					
otal SCS			286,393	172,589	458,982
AL			286,393	172,589	458,982

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)

Johnsons Draw Watershed, Texas

For: Second Fiscal Yea

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land Federal (dollars)	Non-Federal (dollars)	Total (dollars)
ND TREATMENT					
Soil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	22,990	-	17,242	17,242
Deferred Grazing	Acre	23,462	-	18,770	18,770
Brush Eradication	Acre	3,104	-	11,640	11,640
Range Seeding	Acre	1,250	-	31,250	31,250
Range Seeding(Over Tobosa)	Acre	3,750	-	37,500	37,500
Range Pitting	Acre	3,750	-	11,250	11,250
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	127,652	127,652
TAL LAND TREATMENT			-	127,652	127,652
RUCTURAL MEASURES					
FLOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Nos.	1,2	163,106	55,753	218,859
Channel Improvement	Mile	-	-	-	-
SCS Subtotal			163,106	55,753	218,859
TAL FLOOD PREVENTION			163,106	55,753	218,859
TAL CONSTRUCTION COSTS			163,106	55,753	218,859
STALLATION SERVICES					
Total SCS			65,058	-	65,058
TAL INSTALLATION SERVICES			65,058	-	65,058
HER COSTS			-	22,475	22,475
TAL STRUCTURAL MEASURES			228,164	78,228	306,392
ND TOTAL			228,164	205,880	434,044
MARY					
Total SCS			228,164	205,880	434,044
TAL			228,164	205,880	434,044

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)

Johnsons Draw Watershed, Texas

For: Third Fiscal Year

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land: Federal (dollars)	Non-Federal (dollars)	Total (dollars)
LAND TREATMENT					
Soil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	22,990	-	17,243	17,243
Deferred Grazing	Acre	23,462	-	18,770	18,770
Brush Eradication	Acre	3,105	-	11,644	11,644
Range Seeding	Acre	1,250	-	31,250	31,250
Range Seeding (Over Tobosa)	Acre	3,750	-	37,500	37,500
Range Pitting	Acre	3,750	-	11,250	11,250
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	127,657	127,657
TOTAL LAND TREATMENT			-	127,657	127,657
STRUCTURAL MEASURES					
FLOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Nos.	3,4	170,562	58,303	228,865
Channel Improvement	Mile	-	-	-	-
SCS Subtotal			170,562	58,303	228,865
TOTAL FLOOD PREVENTION			170,562	58,303	228,865
TOTAL CONSTRUCTION COSTS			170,562	58,303	228,865
INSTALLATION SERVICES					
Total SCS			68,061	-	68,061
TOTAL INSTALLATION SERVICES			68,061	-	68,061
OTHER COSTS			-	24,825	24,825
TOTAL STRUCTURAL MEASURES			238,623	83,128	321,751
GRAND TOTAL			238,623	210,785	449,408
SUMMARY					
Total SCS			238,623	210,785	449,408
TOTAL			238,623	210,785	449,408

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)

Johnsons Draw Wstershed, Texas

For: Fourth Fiscal Year

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land: Non-Federal (dollars)	Non-Federal (dollars)	Total (dollars)
LAND TREATMENT					
Soil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	22,990	-	17,243	17,243
Deferred Grazing	Acre	23,462	-	18,770	18,770
Brush Eradication	Acre	3,105	-	11,644	11,644
Range Seeding	Acre	1,250	-	31,250	31,250
Range Seeding (Over Tobosa)	Acre	3,750	-	37,500	37,500
Range Pitting	Acre	3,750	-	11,250	11,250
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	127,657	127,657
TOTAL LAND TREATMENT			-	127,657	127,657
STRUCTURAL MEASURES					
FLOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Nos.	-	-	-	-
Channel Improvement	Mile	1.6	46,586	15,925	62,511
SCS Subtotal			46,586	15,925	62,511
TOTAL FLOOD PREVENTION			46,586	15,925	62,511
TOTAL CONSTRUCTION COSTS			46,586	15,925	62,511
INSTALLATION SERVICES					
Total SCS			18,753	-	18,753
TOTAL INSTALLATION SERVICES			18,753	-	18,753
OTHER COSTS			-	15,388	15,388
TOTAL STRUCTURAL MEASURES			65,339	31,313	96,652
GRAND TOTAL			65,339	158,970	224,309
SUMMARY					
Total SCS			65,339	158,970	224,309
TOTAL			65,339	158,970	224,309

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)
Johnsons Draw Watershed, Texas

For: Fifth Fiscal Year

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land: Non-Federal (dollars)	Non-Federal (dollars)	Total (dollars)
LAND TREATMENT					
Soil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	9,196	-	6,897	6,897
Deferred Grazing	Acre	9,384	-	7,506	7,506
Brush Eradication	Acre	1,242	-	4,657	4,657
Range Seeding	Acre	500	-	12,500	12,500
Range Seeding(Over Tobosa)	Acre	1,500	-	15,000	15,000
Range Pitting	Acre	1,500	-	4,500	4,500
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	51,060	51,060
OTAL LAND TREATMENT			-	51,060	51,060
TRUCTURAL MEASURES					
FLOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Nos.	-	-	-	-
Channel Improvement	Mile	-	-	-	-
SCS Subtotal		-	-	-	-
OTAL FLOOD PREVENTION			-	-	-
OTAL CONSTRUCTION COSTS			-	-	-
NSTALLATION SERVICES					
Total SCS			-	-	-
OTAL INSTALLATION SERVICES			-	-	-
THER COSTS			-	-	-
OTAL STRUCTURAL MEASURES			-	-	-
RAND TOTAL			-	51,060	51,060
UMMARY					
Total SCS			-	51,060	51,060
OTAL			-	51,060	51,060

Date, January, 1956

TABLE 1 - ESTIMATED INSTALLATION COSTS
(Based on 1954 Price Levels)

Johnsons Draw Watershed, Texas

For: Total Project

Items	Unit	No. to be Applied Non-Federal Land	Estimated Cost Non-Federal Land Federal (dollars)	Non-Federal (dollars)	Total (dollars)
LAND TREATMENT					
Soil Conservation Service					
Land Treatment Measures					
Proper Use	Acre	91,961	-	68,971	68,971
Deferred Grazing	Acre	93,846	-	75,076	75,076
Brush Eradication	Acre	12,419	-	46,571	46,571
Range Seeding	Acre	5,000	-	125,000	125,000
Range Seeding (Over Tobosa)	Acre	15,000	-	150,000	150,000
Range Pitting	Acre	15,000	-	45,000	45,000
Technical Assistance (Accl.)			-	-	-
SCS Subtotal			-	510,618	510,618
TOTAL LAND TREATMENT			-	510,618	510,618
STRUCTURAL MEASURES					
FLOOD PREVENTION					
Soil Conservation Service					
Waterflow Control					
Floodwater Retarding Structures	Each	7	538,504	184,075	722,579
Channel Improvement	Mile	1.6	46,586	15,925	62,511
SCS Subtotal			585,090	200,000	785,090
TOTAL FLOOD PREVENTION			585,090	200,000	785,090
TOTAL CONSTRUCTION COSTS			585,090	200,000 1/	785,090
INSTALLATION SERVICES					
Total SCS			233,429	-	233,429
TOTAL INSTALLATION SERVICES			233,429	-	233,429
OTHER COSTS			-	88,666	88,666
TOTAL STRUCTURAL MEASURES			818,519	288,666	1,107,185
GRAND TOTAL			818,519	799,284	1,617,803
SUMMARY					
Total SCS			818,519	799,284	1,617,803
TOTAL			818,519	799,284	1,617,803

1/ $25,000 of this amount was placed in trust with the SCS in accordance with a trust agreement to expedite the development of the watershed work plan and installation services. See note 1/ on Table 6B.

Date, January, 1956

TABLE 2 - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(Based on 1954 Price Levels)
December 31, 1955
Johnsons Draw Watershed, Texas

Measures	Unit	Applied to Date	Total Non-Federal Cost
			(dollars)
LAND TREATMENT			
Proper Use	Acre	8,642	6,481
Deferred Grazing	Acre	6,757	2,027
Brush Eradication	Acre	23,412	48,286
Wildlife Area Improvement	Acre	10	125
Range Pitting	Acre	5,900	5,900
Irrigation Land Leveling	Acre	35	490
Land Clearing	Acre	10	50
Diversion Construction	Mile	.19	120
Laterals Constructed	Yards	2,941	420
Subtotal			63,899
STRUCTURAL MEASURES FOR FLOOD PREVENTION			
Floodwater Retarding Structures	Each	0	0
Channel Improvement	Miles	1.05	71,686 1/
Subtotal			71,686
Total		xx	135,585

1/ This channel improvement started in about 1942 and completed during an 11-year period. All is usable in proposed channel improvement and will reduce total cost by this amount.

Date January, 1956

TABLE 3 - ANNUAL COSTS

Johnsons Draw Watershed, Texas

Item	AMORTIZATION OF INSTALLATION COSTS 1/			OPERATION AND MAINTENANCE COSTS 2/			Total
	Federal (dollars)	Non-Federal (dollars)	Total (dollars)	Federal (dollars)	Non-Federal (dollars)	Total (dollars)	(dollars)
STRUCTURAL MEASURES FOR FLOOD PREVENTION							
Waterflow Control							
1. Floodwater Retarding Structures Nos. 1 and 2	8,045	3,126	11,171	-	304	304	11,475
2. Floodwater Retarding Structures Nos. 3 and 4	8,413	3,292	11,705	-	266	266	11,971
3. Stream Channel Improvement in Combination with Floodwater Retarding Structures Nos. 5 & 6	9,526	3,693	13,219	-	646	646	13,865
4. Floodwater Retarding Structure No. 7	2,875	1,111	3,986	-	114	114	4,100
Subtotal	28,859	11,222	40,081	-	1,330	1,330	41,411
TOTAL STRUCTURAL MEASURES FOR FLOOD PREVENTION	28,859	11,222	40,081	-	1,330	1,330	41,411
GRAND TOTAL	28,859	11,222	40,081	-	1,330	1,330	41,411

1/ Based on 1954 price levels
2/ Based on long-term price levels

Date, January, 1956

TABLE 4 - SUMMARY OF BENEFITS

(Based on Long-Term Price Levels)
Johnsons Draw Watershed, Texas

Item	Estimated Average Annual Damage Without Project	Estimated Average Annual Damage Without Structural Measures	Estimated Average Annual Damage With Project	Benefits From Structural Measures	Classes of Benefits	
					1	2
					A	B
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
BENEFITS IN PROJECT AREAS						
Floodwater	58,521	53,551	8,014	45,537	41,569	3,968
Sediment	155	155	100	55	55	-
Erosion	667	567	207	360	360	-
Indirect	8,768	8,023	1,210	6,813	-	6,813
Subtotal	68,111	62,296	9,531	52,765	41,984	10,781
TOTAL BENEFITS IN PROJECT AREA	-	-	-	52,765	41,984	10,781
BENEFITS OUTSIDE OF PROJECT AREA						
Benefits from Main Stem Johnsons Draw Below Project Area	-	-	-	1,381	-	1,381
TOTAL BENEFITS OUTSIDE OF PROJECT AREA	-	-	-	1,381	-	1,381
TOTAL FLOOD PREVENTION BENEFITS	-	-	-	54,146	41,984	12,162
GRAND TOTAL ALL BENEFITS	$54,146					

Date January, 1956

TABLE 5 - BENEFIT COST ANALYSIS

Johnsons Draw Watershed, Texas

Measures	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost 2/	Benefit-Cost Ratio
	Flood-water	Sediment	Erosion	Indirect	Outside Project Area	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
STRUCTURAL MEASURES FOR FLOOD PREVENTION								
Waterflow Control								
1. Floodwater Retarding Structures Nos. 1 and 2	12,744	17	113	1,906	434	15,214	11,475	1.33:1
2. Floodwater Retarding Structures Nos. 3 and 4	14,802	20	131	2,214	504	17,671	11,971	1.48:1
3. Stream Channel Improvement in Combination with Floodwater Retarding Structures Nos. 5 & 6	13,146	11	73	1,968	278	15,476	13,865	1.12:1
4. Floodwater Retarding Structure No. 7	4,845	7	43	725	165	5.785	4,100	1.41:1
Subtotal	45,537	55	360	6,813	1,381	54,146	41,411	1.31:1
TOTAL STRUCTURAL MEASURES FOR FLOOD PREVENTION	45,537	55	360	6,813	1,381	54,146	41,411	1.31:1
GRAND TOTAL	45,537	55	360	6,813	1,381	54,146	41,411	1.31:1

1/ Based on long-term price levels.
2/ From Table 3.

Date, January, 1956

TABLE 6 - STRUCTURE DATA
Preliminary Estimates for Floodwater Retarding Structures

Johnsons Draw Watershed, Texas

Site No.	Drainage Area	STORAGE CAPACITY						SURFACE AREA		Max. Ht. of Dam	FLOOD PLAIN AREA INUNDATED			Volume of Fill	PRINCIPAL SPILLWAY	
		Sed. Pool	Det. Pool	Total	Sed. Pool	Det. Pool	Total	Top Sed. Pool	Top Det. Pool		Under Sed. Pool	Under Det. Pool	Total		Size	Max. Disch. Cap.
	sq.mi.	acre-feet			inches			acres		ft.	acres			cu.yd.	sq.ft.	cfs
1	17.00	181	4,569	4,750	0.2	5.0	5.2	50	520	39	0	0	0	206,528	3.40	85
2	12.41	132	3,298	3,430	0.2	5.8	6.0	30	275	51	30	162	192	230,200	5.12	147
3	16.66	180	4,450	4,630	0.2	5.0	5.2	50	500	38	0	0	0	181,516	3.32	83
4	17.50	187	4,663	4,850	0.2	5.0	5.2	32	328	56	32	208	240	242,600	5.62	171
5	6.22	66	1,691	1,757	0.2	5.0	5.2	20	170	36	0	0	0	145,000	1.28	31
6	12.66	135	3,415	3,550	0.2	5.0	5.2	30	225	53	0	0	0	278,000	2.13	63
7	11.18	179	2,976	3,155	0.3	5.0	5.3	40	285	45	0	0	0	172,000	2.02	56
Total	93.63	1,060	25,062	26,122				252	2,303		62	370	432	1,455,844		

Note: Vegetative emergency spillways provided for all structures

Date January, 1956

TABLE 6A - STRUCTURE DATA
Preliminary Estimates for Channel Improvement

Johnsons Draw Watershed, Texas

Location	Length : Miles	Excavation : Cu. Yds	Capacity : CFS
Johnsons Draw	1.6	163,153	14,000
Total	1.6	163,153	14,000

Date January, 1956

TABLE 6B - STRUCTURE DATA
Estimated Structure Cost Distribution
(Based on 1954 Price Levels)

Johnsons Draw Watershed, Texas

Structure Site Number or Name	FEDERAL INSTALLATION COST					NON-FEDERAL INSTALLATION COST					Estimated Total Cost
	Contract	Contingencies	Installation Services	Adm. and Misc.	Total Federal	Contrsct	Contingencies	Adm. of Contract	Easements and R/W	Total Non-Federal	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
FLOODWATER RETARDING STRUCTURES											
1	59,199	5,920	15,887	10,026	91,032	20,235	2,023	300	15,675	38,233	129,265
2	89,079	8,908	23,906	15,239	137,132	30,450	3,045	300	8,387	42,182	179,314
3	55,755	5,575	14,963	9,426	85,719	19,059	1,906	300	16,587	37,852	123,571
4	99,302	9,930	26,650	17,022	152,904	33,944	3,394	300	9,200	46,838	199,742
5	44,543	4,454	11,954	7,470	68,421	15,226	1,523	300	4,950	21,999	90,420
6	88,628	8,863	23,785	15,160	136,436	30,295	3,029	300	6,575	40,199	176,635
7	53,044	5,304	14,235	8,953	81,536	18,132	1,814	300	8,325	28,571	110,107
Total	489,550	48,954	131,380	83,296	753,180	167,341	16,734	2,100	69,699	255,874	1,009,054
OTHER											
Channel Improvement	42,351	4,235	11,365	7,388	65,339	14,477	1,448	600	16,267	32,792	98,131
Total	42,351	4,235	11,365	7,388	65,339	14,477	1,448	600	16,267	32,792	98,131
GRAND TOTAL	531,901	53,189	142,745	90,684	818,519	181,818 1/	18,182	2,700	85,966	288,666	1,107,185

1/ $25,000 of this amount was placed in trust with the SCS by the local people to expedite the planning of the watershed and installation services. Approximately $21,100 have been expended in developing the work plan. The remaining $3,900 will be used to expedite installation services.

Date: January, 1956

TABLE 7 - SUMMARY OF PHYSICAL DATA

Johnsons Draw Watershed, Texas

Item	Unit	Quantity Without Program	Quantity With Program
Watershed Area	Sq.Mi.	159.0	xxx
Watershed Area	Acre	101,760	xxx
Area of Cropland	Acre	50	50
Area of Grassland	Acre	100,603	100,603
Area of Woodland	Acre	-	-
Area Damaged Annually by			
Sediment	Acre	143	44.3
Flood Plain Scour	Acre	778.3	241.3
Streambank Erosion	Acre	1	1
Sheet Erosion 1/	Acre	63,746	10,774
Average Annual Rainfall	Inches	18.85	18.85

1/ Does not include non-contributing areas.

Date January, 1956

TABLE 8 - SUMMARY OF PLAN DATA

Johnsons Draw Watershed, Texas

Item	Unit	Quantity
Years to Complete Program	Year	5
Total Installation Cost		
Federal	Dollar	818,519
Non-Federal	Dollar	799,284
Annual O and M Cost		
Federal	Dollar	-
Non-Federal	Dollar	1,330
Annual Benefits	Dollar	54,146
Structural Measures		
Floodwater Retarding Structures	Each	7
Channel Improvement	Mile	1.6
Area Inundated by Structures		
Flood Plain		
Detention Pool	Acre	370
Sediment Pool	Acre	62
Upland		
Detention Pool	Acre	1,681
Sediment Pool	Acre	190
Watershed Area Above Structures	Acre	59,923
Reduction of Floodwater Damage		
Land Treatment Measures	Percent	8
Structural Measures	Percent	78
Reduction of Sediment Damage		
Land Treatment Measures	Percent	0
Structural Measures	Percent	35
Reduction of Erosion Damage		
Land Treatment Measures	Percent	15
Structural Measures	Percent	54

Date January, 1956

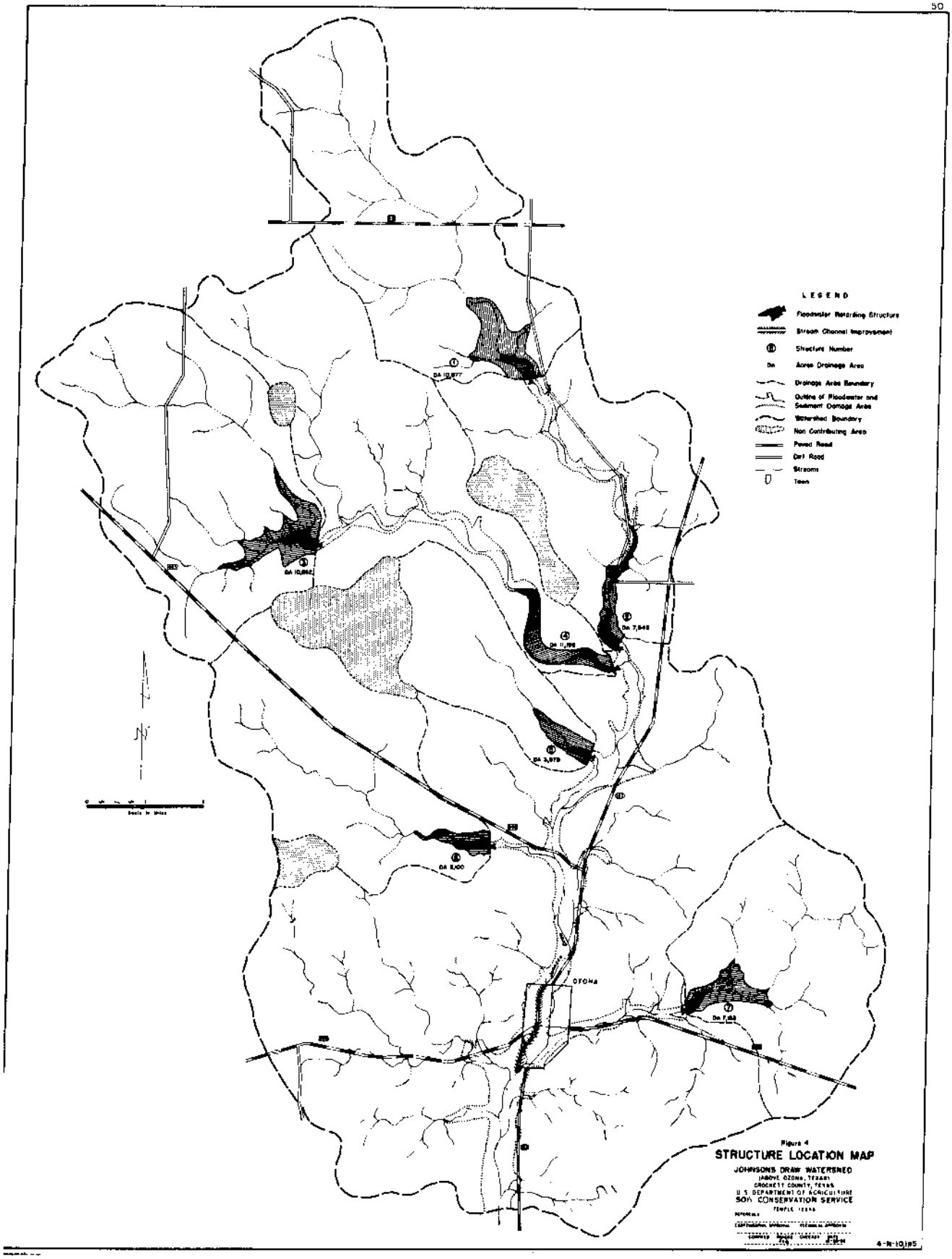


Figure 4

STRUCTURE LOCATION MAP

JOHNSONS DRAW WATERSHED
(ABOVE OZONA, TEXAS)
CROCKETT COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

4-N-10,185

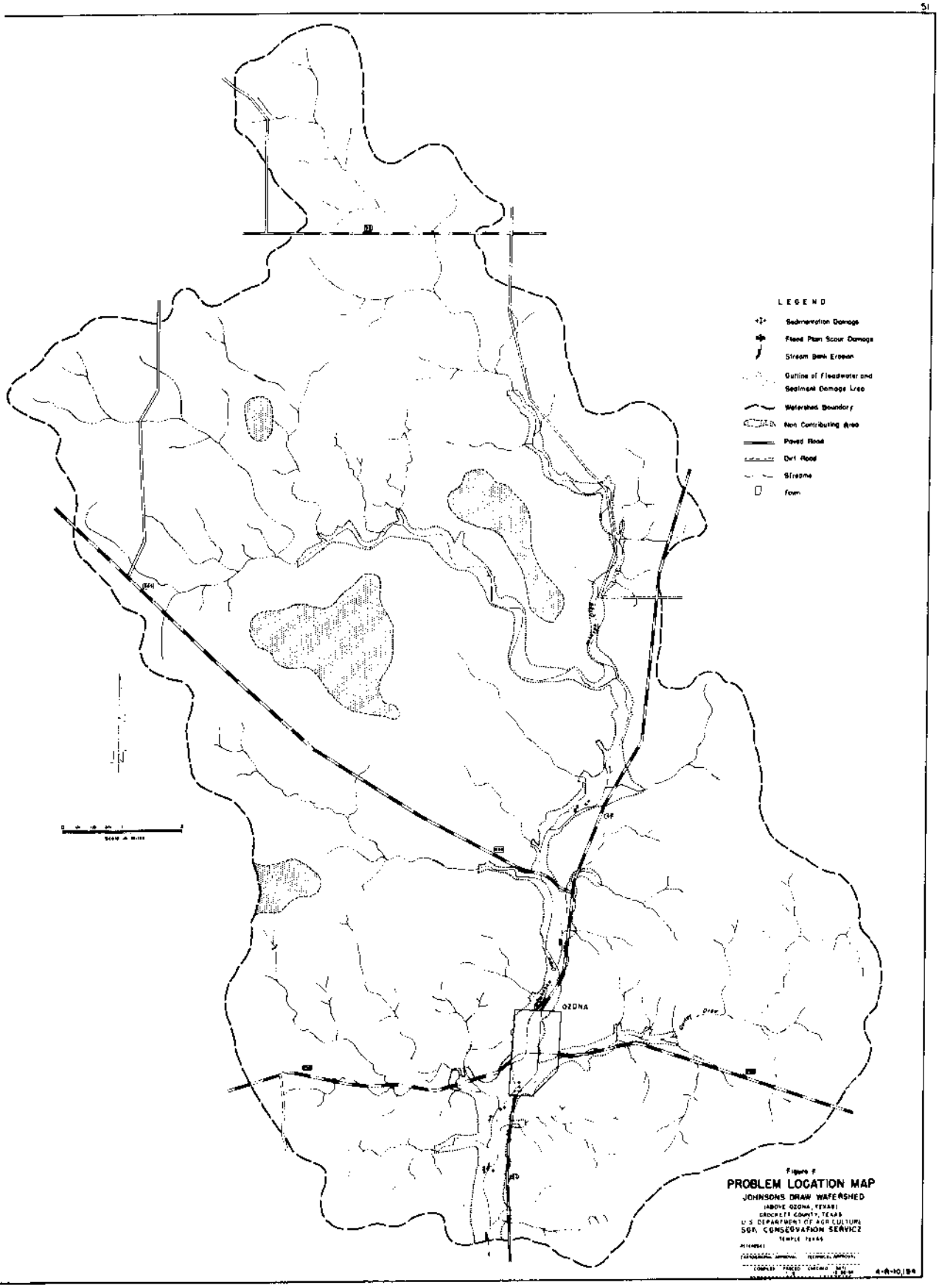


Figure 5

PROBLEM LOCATION MAP

JOHNSONS DRAW WATERSHED

(ABOVE OZONA, TEXAS)

CROCKETT COUNTY, TEXAS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

4-A-10,194