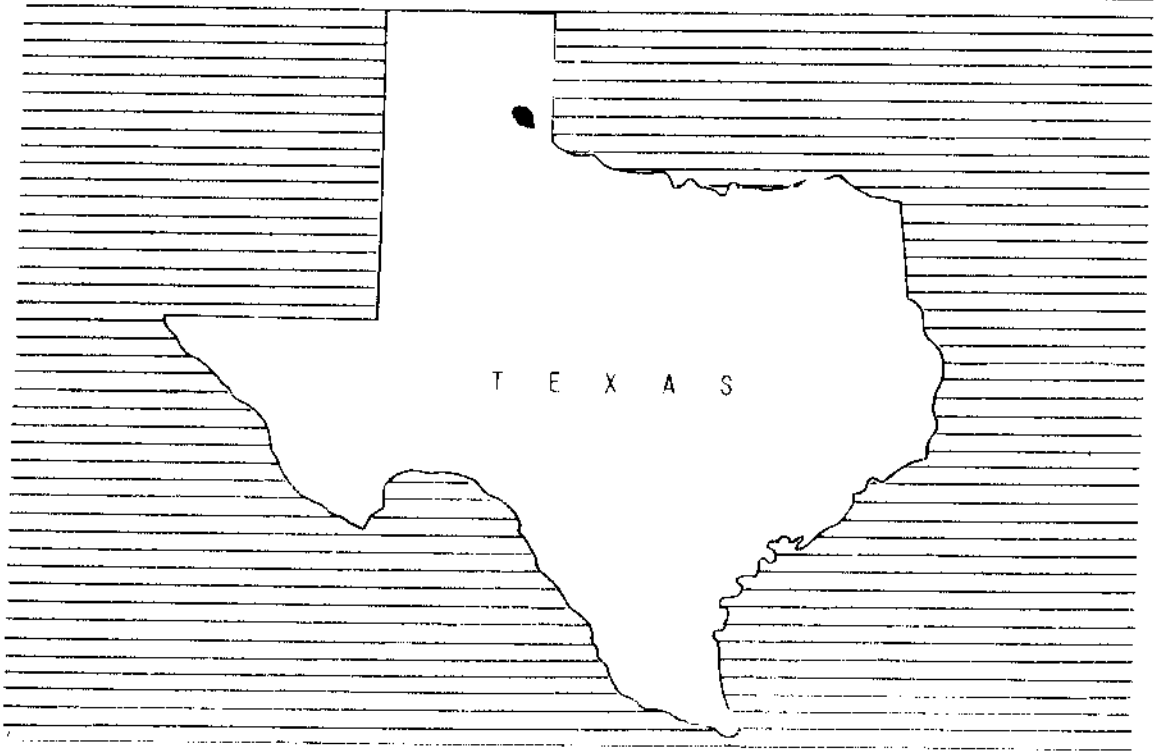
WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

LAKEVIEW WATERSHED

Hall and Donley Counties, Texas



September 1967

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Lakeview Watershed (Hall and Donley Counties, Texas)

Changes in original plan:

(1) Minor work plan revision (See attached)

(2) Addendum changing interest rate for benefit-cost evaluations.

(3) Supplement Watershed Plan Agreement, 1971, to comply with provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

(4) Supplement Watershed Work Plan Agreement II, 1977, eliminates the nonproject construction and installation services cost to be borne by the Sponsoring Local Organization.

(5) Supplemental Watershed Plan Agreement III, 1979, provides for use of PL-566 funds on a cost-share basis to install land treatment measures to control and stabilize critical sediment source areas.

(6) Minor work plan revision (See attached)

MINOR WORK PLAN REVISIONS

Watershed Name		Date Approved
Lakeview		8-12-69
1. Minor Work Plan Revision (Design change, Site 9)	- Deletion of 1,950 feet of channel (station 362+00 to station 381+50) on the O-D tributary.	12-18-69
2. Deletion	- Deletion of: Brush Creek Channel Oaks Creek Channel O. C. Trib Channel Floodwater Retarding Structure No. 108 Grade Stabilization Structure Nos. 201, 202, 205 Diversions I-V Dike 401	5-5-81

WATERSHED WORK PLAN AGREEMENT

between the

Hall and Donley Counties Water Control and Improvement District No. 1
(Local Organization)

Hall County Soil and Water Conservation District
(Local Organization)

Donley County Soil and Water Conservation District
(Local Organization)

Hall County Commissioners Court
(Local Organization)

Donley County Commissioners Court
(Local Organization)

City of Lakeview
(Local Organization)

In the State of Texas

(Hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

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

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

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

4-24806 7-68
USDA FORT WORTH, TEX 1458

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 10 years.

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

✓1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 309,947 .)

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

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

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures 1 thru 16, 102 and 106	0.0	100.0	1,631,256
Floodwater Retarding Structures			
101	2.3	97.7	22,203
103	4.2	95.8	16,877
104	4.3	95.7	16,591
105E	4.5	95.5	24,439
105W	3.7	96.3	30,486
107	1.7	98.3	28,028
108	4.7	95.3	31,715
92,015 feet of Stream Channel Improvement	0.0	100.0	317,106
Five Grade Stabilization Structures	0.0	100.0	111,377

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
31,320 feet of Floodwater Diversion	0.0	100.0	60,798
3,000 feet of dike	0.0	100.0	2,439
3,850 feet of Streambank Protection Structures	0.0	100.0	21,175

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

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Floodwater Retarding Structures Nos. 1 thru 16, 102 and 106	0.0	100.0	366,446
Floodwater Retarding Structures Nos.			
101	2.8	97.2	7,706
103	4.2	95.8	7,100
104	4.3	95.7	6,980
105E	5.4	94.6	8,518
105W	4.5	95.5	10,611
107	2.1	97.9	9,716
108	6.3	93.7	10,089
92,015 feet of Stream Channel Improvement	0.0	100.0	69,094
Five Grade Stabilization Structures	0.0	100.0	35,207
31,320 feet of Floodwater Diversion	0.0	100.0	14,451
3,000 feet of Dike	0.0	100.0	1,026
3,850 feet of Streambank Protection Structures	0.0	100.0	7,312

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 17,700 .)

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

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

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

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

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

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

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

    The Sponsoring Local Organization must have sufficient funds to cover its share of the estimated cost of installation services to be performed by the Service in advance of the services being rendered.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

13. No member of Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

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

Hall and Donley Counties Water Control and Improvement District No. 1
(Local Organization)

By Paul Montgomery
Paul Montgomery

Title Chairman

Date July 9, 1968

The signing of this agreement was authorized by a resolution of the governing body of the Hall and Donley Counties Water Control and Improvement District No. 1 (Local Organization) adopted at a meeting held on January 23, 1969.

Joyce Webster
(Secretary, Local Organization)
Joyce Webster

Date July 9, 1968

Hall County Soil and Water Conservation District
(Local Organization)

By Ernest Rea
Ernest Rea

Title Chairman

Date July 9, 1968

The signing of this agreement was authorized by a resolution of the governing body of the Hall County Soil and Water Conservation District
(Local Organization)

adopted at a meeting held on December 13, 1967

Kenneth Ellis
(Secretary, Local Organization)
Kenneth Ellis

Date July 9, 1968

Donley County Soil and Water Conservation District
(Local Organization)

By T. C. D'Spain
T. C. D'Spain

Title Chairman

Date July 9, 1968

The signing of this agreement was authorized by a resolution of the governing body of the Donley County Soil and Water Conservation District
(Local Organization)

adopted at a meeting held on January 11, 1968

(Secretary, Local Organization)
Jno C. Knorpp

Date July 9, 1968

WATERSHED WORK PLAN

LAKEVIEW WATERSHED
Hall and Donley Counties, Texas

ADDENDUM

Since the preparation of this watershed work plan, the Federal interest rate for benefit and cost evaluations has been increased from 3.25 percent to 4.625 percent.

As a result, annual equivalent costs for the installation of these structural measures will increased from $107,999 to $149,023. The total average annual cost of structural measures (amortized total installation cost, plus operation and maintenance costs) will be increased to $160,436. Average annual benefits, excluding secondary benefits, accruing to structural measures will change to $232,133, resulting in a benefit-cost ratio of 1.4 to 1.0.

Total average annual project benefits, including secondary benefits, will change to $254,356, resulting in a benefit-cost ratio of 1.6 to 1.0.

WATERSHED WORK PLAN

LAKEVIEW WATERSHED
Hall and Donley Counties, Texas
September 1967

SUMMARY OF PLAN

General Summary

This work plan for watershed protection and flood prevention for the Lakeview watershed was prepared by the Hall County and Donley County Soil and Water Conservation Districts, Hall and Donley Counties Water Control and Improvement District No. 1, the Commissioners Courts of Hall and Donley Counties, and the City of Lakeview, the local sponsoring organizations. Technical assistance was provided by the Soil Conservation Service of the U. S. Department of Agriculture. The Bureau of Sport Fisheries and Wildlife of the U. S. Department of the Interior collaborated with the Texas Parks and Wildlife Department in the preparation of a reconnaissance report of the fish and wildlife aspects of the watershed. Financial assistance for development of the work plan was provided by the Texas State Soil and Water Conservation Board and the Soil Conservation Service.

Lakeview watershed, comprising an area of 237 square miles (151,680 acres), is located in the southeastern part of the Panhandle of Texas. The upper portion of the watershed is located in Donley County and the lower portion in Hall County. The watershed consists of five separate stream systems, which drain into Mulberry Creek and the Prairie Dog Town Fork of the Red River. These stream systems, from west to east, are Brushy, Bitter, John Mann, Hogland Flat, and Oak Creeks. Approximately 51 percent of the watershed is cropland, 47 percent is grassland, and 2 percent is in miscellaneous uses such as urban areas, farmsteads, roads, and stream channels.

There is no Federal land in the watershed.

The principal problems in the watershed are frequent damages occurring on about 18,000 acres of intensively managed agricultural land from floodwater, sediment, and scour. The small town of Lakeview suffers frequent damage to streets, low-water crossings, residences, and commercial buildings. The communities of Plaska and Brice experience nuisance-type flooding periodically.

An additional 4,600 acres of less intensively managed land are located along the common flood plain of Mulberry Creek and the Prairie Dog Town Fork of the Red River.

The estimated average annual floodwater, sediment, erosion, and indirect damages without project total $256,211 at adjusted normalized prices.

The objectives of the project are to provide proper land use and treatment in the interest of soil and water conservation and flood protection for the flood plain lands in the watershed. The project, as formulated, meets these objectives. The sponsoring local organizations indicated a desire to develop one multiple-purpose structure to include recreation storage capacity, but geologic and hydrologic investigations revealed that no feasible site was available.

The work plan proposes installing, during a 10-year period, a project for the protection and development of the watershed at a total estimated installation cost of $3,880,379. The share of this cost to be borne by Public Law 566 funds is $2,946,902. The share to be borne by other than Public Law 566 funds is $933,477. In addition, the local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

Landowners and operators will establish and maintain needed land treatment measures on 15,107 acres of cropland and 11,258 acres of grassland at an accelerated rate during the 10-year installation period in addition to the maintenance of those measures already applied. These measures will improve the hydrologic condition of both cropland and grassland. This improvement in soil condition and cover will reduce sediment delivered to floodwater retarding structures below and will effect some reduction in flooding.

The installation cost of these land treatment measures is estimated to be $692,730, of which $605,830 will be from funds other than Public Law 566. Public Law 566 funds will provide $86,900 in order to accelerate technical assistance needed for the application and maintenance of these measures.

Structural Measures

The structural measures included in the plan are 25 floodwater retarding structures, 92,015 feet of stream channel improvement, 31,320 feet of floodwater diversions, 5 grade stabilization structures, 3,850 feet of streambank protection, and 3,000 feet of dike. The total estimated cost of structural measures is $3,187,649, of which the local share is $327,647, and the Public Law 566 share is $2,860,002. The local share of the cost consists of land, easements, and rights-of-way ($309,947), and administering of contracts ($17,700). In addition, the local nonproject costs for modifying 7 floodwater retarding structures for use as county roads is estimated to be $8,744.

The structural measures will be installed during a 10-year period.

Benefits

The reduction in floodwater, sediment, flood plain scour, valley trenching, and streambank erosion damages will directly benefit the owners and operators of about 150 farms and ranches in the watershed, as well as the

DESCRIPTION OF THE WATERSHED

Physical Data

Lakeview watershed is located in the southeastern part of the Panhandle of Texas. It comprises five separate stream systems which lie to the north of Mulberry Creek and the Prairie Dog Town Fork of the Red River. These streams originate in the rough, broken lands of the High Plains escarpment in southern Donley County. The flow is southward onto the gently rolling to nearly level terrace and alluvial lands of northwestern Hall County. Two of these streams, Brushy Creek and Bitter Creek, drain the western part of the watershed and flow into Mulberry Creek slightly upstream from its confluence with Prairie Dog Town Fork of the Red River. John Mann Creek, Hogland Flat Creek, and Oak Creek drain the central and eastern parts and flow into the Prairie Dog Town Fork of the Red River. A large area of noncontributing drainage is located between Bitter and John Mann Creeks in the southwestern part of the watershed. This area drains into large gypsum sink hole lakes until the water evaporates or seeps into underground porous gypsum aquifers. Numerous intervening small streams flow directly into the Prairie Dog Town Fork of the Red River.

Lakeview is the only town in the watershed. Brice, Lesley, and Plaska are important community centers. Memphis, the county seat of Hall County, lies 7 miles east and Clarendon, the county seat of Donley County, lies 7 miles north of the watershed. The total drainage area included in this project is 237 square miles (151,680 acres). Drainage areas for each of the major streams are as follows:

Tributary	Square Miles	Acres
Brushy Creek	12.24	7,834
Bitter Creek	61.15	39,136
John Mann Creek	27.38	17,523
Hogland Flat Creek	18.58	11,891
Oak Creek	75.11	48,070
Other Areas	42.54	27,226

The topography of the watershed ranges from steeply rolling below the High Plains scarp in the northern part to almost flat on the wide alluvial valleys. Approximately 33 percent is steeply rolling; 37 percent, gently to moderately rolling; 26 percent, relatively flat; and 4 percent, hummocky. Excessively steep stream gradients of up to 200 feet per mile occur in the upper reaches where the channels are deeply entrenched in badland canyons and gullies. Flatter gradients of 25 to 40 feet per mile exist in the alluvial valleys where the incised channels give way to shallow waterways on all streams except Bitter Creek. Short reaches having steep gradients of up to 58 feet per mile occur where the streams drop off terrace deposits to the Prairie Dog Town Fork of the Red River.

Elevations above mean sea level range from 2,880 feet on the High Plains scarp to 1,860 feet at the confluence of Oak Creek and the Prairie Dog Town Fork of the Red River.

The watershed is underlain by Permian redbed materials consisting of soft siltstones, sandy siltstones and shales, and lenticular beds of gypsum. The Permian is covered by sands, clays, and gravels of the Ogallala formation (Tertiary age) in the upper portion. Quaternary terrace, alluvial, and eolian deposits, mostly silts and sands with some clays and gravels, cover much of the Permian in the lower portion.

The Ogallala formation is an important aquifer in the High Plains. Some recharge of this aquifer occurs in the outcrop area lying in the upper part of the watershed, and some water is lost through seeps and springs located in many of the canyons. Ground water also occurs in the gypsum beds of the Permian redbeds. Large sink holes resulting from the collapse of caverns formed by ground-water solution of the gypsum occur in the southwestern part of the watershed. This water contains high amounts of dissolved solids derived from gypsum but in spite of this, it is used for irrigation. The permeable sand and gravel alluvial deposits are locally important ground-water sources. This water contains low to moderate amounts of solids and is being used for irrigation. The volume available exceeds use as recharge occurs rapidly and there is very little lowering of water levels in the wells during the growing season.

A great abundance of sand and gravel deposits occur in areas surrounding the watershed. This has limited the development and use of these materials within the watershed. Some gravels in the eastern part have been used in road construction. There has been no development or uee of other geologic deposits such as the gypsum.

Soils of tbe watershed are mainly of the Central Rolling Red Plains Land Resource Area. A small area of soils of the Southern High Plains Land Resource Area occurs in the upper part. Geologic erosion has prevented deep soil development in the rough, broken, steeply rolling lands below the High Plains scarp. Loamy soils of the Mansker series occur on the smoother ridges between the canyons and gullies. Moderately deep Woodward and shallow Quinlan soils occur on the steeply rolling redbed siltstones and sandy shales. Land use on all of this area is limited to grassland and is used for grazing. Inaccessible parts of the canyons and gullied badlands are used mainly by wildlife.

Gently rolling terrace, alluvium, and eolian soils in the lower part of the watershed are intensively cultivated. These deep, fertile, and productive soils include Miles, Tipton, Yahola, Spur, Enterprise, and other associated series. The Tivoli fine sand, which is relatively low in productivity, occurs on the wind-deposited sands near the streams. Wind erosion is a problem on all cultivated soils but is most severe on the sandier types.

The over-all land use in the watershed is as follows:

Land Use	Acres	Percent
Cropland	76,700	51
Grassland	71,097	47
Miscellaneous 1/	3,883	2
Total	151,680	100

1/ Area in roads, towns, farmsteads, etc.

The average hydrologic cover condition of the grassland is fair with the range condition class being good.

The fish and wildlife habitat populations in the watershed are described by the Bureau of Sport Fisheries and Wildlife as follows:

> Fish habitat in the intermittent project streams and Deep Lake, which is an ephemeral playa, is practically nonexistent. A little fishing is done in a few farm ponds on private land by local residents.
>
> No commercial fishery exists in the watershed and none would be expected to develop in the future.
>
> Vegetation in the watershed consists of mesquite, scattered shrubs, buffalograss and grama grasses on the finer textured soils. Growing on more sandy soils are little bluestem, sideoats grama, and threeawn grasses, with sand sage and shin oak on areas of deep sand. Severely eroded areas are bare of vegetation in many places but support some patches of buffalograss, mesquite, and scattered shrubs.
>
> The principal game species in the watershed are white-tailed deer, turkey, and bobwhite.
>
> Habitat suitable for deer and turkey is scarce in the project area. Small numbers of deer and turkey are found where there is sufficient timber. Hunting for deer and turkey is light and is primarily on a lease basis. These conditions would not be expected to change without the project.
>
> Bobwhites occur over the entire watershed in good numbers. About 10 percent of the bobwhite hunting is on a lease basis. Habitat conditions affecting bobwhite populations would not change significantly in the future.
>
> The watershed lies in the former range of the lesser prairie chicken and closely borders its present known

range. The lesser prairie chicken, a species classified by the Bureau of Sport Fisheries and Wildlife as rare, does not reside in the watershed and would not be affected by the project.

No fur trapping is done in the watershed, and none would be expected to develop in the future.

Average annual rainfall is 19.91 inches. May receives the most rainfall; however, moisture is fairly well distributed throughout the summer months. Less than four inches of rain normally falls from November through March. The average date of the last killing frost in the spring is April 1 and that of the first killing frost in the fall is November 5, resulting in an average growing season of 218 days.

Economic Data

Lakeview watershed is located in an area which is dependent upon agriculture for 88 percent of its total income. Over 83 percent of the agricultural income is derived from the sale of field crops such as cotton, grain sorghum, sorghum and alfalfa hay, small grains, and soy beans. The balance of agricultural income results primarily from the sale of beef cattle.

The intensively managed flood plain lands are used as follows: cotton, 59 percent; grain sorghum, 17 percent; sorghum and alfalfa hay, 9 percent; small grains, 4 percent; pasture, 8 percent; soy beans, 1 percent; and miscellaneous uses, 2 percent. Less than 70 percent of the cotton allotment is planted at the present time. About 39 percent of the flood plain is irrigated. Water is applied primarily to cotton, alfalfa, improved pasture, and soy beans; however, small amounts are applied to the remaining crops.

It is difficult to predict trends in agricultural land uses, but many farm operators in this section of the State feel that more diversification is needed in their farming operations. The feeding of cattle has increased substantially in this section of the state, and it is quite reasonable to expect that there will be a decrease in the acreage of cotton planted and an increase in the production of feedstuffs to supply cattle feeding operations.

Farms in the watershed are becoming fewer in number, larger in size, and higher in value. In 1959 Hall County had 601 farms averaging 952 acres, with an average value of $68,137. By 1964 the total number of farms had decreased to 534 with a corresponding increase in size to 1,071 acres with an average value of $103,003. The average size of the 355 operating units in the watershed is 427 acres. About 200 of these are family-type operations with about 150 of the 200 suffering flood damage at the present. Less than 5 percent of the family-type farms are low income producing units; however, approximately 10 percent of the farm families have at least one member spending 50 percent or more of his time on an off-farm job.

The small town of Lakeview and the communities of Plaska, Brice, and Lesley lie within the watershed. Lakeview offers banking facilities, cotton ginning services, and supplies ordinarily needed in farming and ranching operations. Lakeview has recently completed installation of a water supply system and is currently developing plans for a sewage disposal plant. The communities of Plaska, Lesley, and Brice also have cotton ginning facilities and limited farm supplies. The ginning companies of these communities for years past have bought, transported, and delivered to family cisterns the entire drinking water supply for farm families of this area. This has been necessary because water from shallow wells of this area is not satisfactory for domestic use. These communities are in the process of securing Farmers Home Administration financing for development of a water supply system to serve their needs.

Memphis, with a population of 3,100, and Clarendon, with a population of 2,170, are marketing and banking centers and have processing facilities for cotton, grain, and synthetics. Good highways link these cities with other population and marketing centers, both north-south and east-west. Railway service is also available to both east-west and north-south points.

Approximately 45 miles of paved highways and 80 miles of dirt roads serve the watershed.

Land Treatment Data

Soil Conservation Service Work Units at Memphis and Clarendon serve the Hall County and the Donley County Soil and Water Conservation Districts, respectively. The Hall County Soil and Water Conservation District was organized in 1941 and the Donley County Soil and Water Conservation District was organized in 1947. Many fine examples of the quality of the planning, application, and maintenance of needed conservation measures during these early days may be observed to this day.

Leaders of both soil and water conservation districts have long recognized the need for and advocated the use of each acre of land within its capabilities and its treatment in accordance with its needs. They have worked long and diligently toward their goal of proper use and treatment of all land within their districts.

There are 355 operating units in the watershed. Basic soil and water conservation plans have been developed on 226, or 64 percent of these, representing 83 percent of the agricultural land in the watershed.

Cooperators with the soil and water conservation districts have applied approximately 63 percent of the needed practices. About 60 percent of the cropland and 65 percent of the grassland have been adequately treated. Table 1A lists the practices which have been applied. The total cost of applying these practices is estimated at $1,159,367.

WATERSHED PROBLEMS

Floodwater Damages

The principal problem in the watershed is flood damage occurring on about 18,000 acres of intensively managed agricultural land. Not all of this area will be inundated by any single flood event. During the interval between floods, minor changes in the area subject to damage, such as small dikes, road fills, irrigation ditches, or land leveling, may alter the course of flood flows. It is estimated that a flood having a 100-year recurrence interval would inundate a total of 9,137 acres within the damage area. The small town of Lakeview suffers frequent flood damage to streets, residences, low-water crossings, and commercial buildings. The communities of Plaska and Brice experience flooding of a nuisance type.

Another 4,600 acres of less intensively managed flood plain is located along the common flood plain of Mulberry Creek and the Prairie Dog Town Fork of the Red River. Flood damage in this area was not evaluated because of the frequent flooding by the river.

Floods are caused by runoff from high intensity, short duration storms, which may occur over the entire drainage area of the watershed, but ordinarily the areal extent of the storms is small. The most damaging floods result from storms occurring in the upper portion of the watershed where steep terrain causes a rapid rate of runoff. Farm owners and operators, each attempting to protect his own property, have installed over the years uncoordinated systems of dikes, levees, and diversions. This has aggravated the flooding problem considerably. Oak Creek has been completely diverted from its original course of flow. County roads often carry a majority of the flood flows because the water cannot get into a channel. Flood flows are erratic and highly unpredictable because of continuing efforts of farm operators to keep the flooding off their land.

Flooding has had a crippling effect upon the whole economy of the city of Lakeview. This small town, operating on a limited budget, has been forced to spend almost its entire revenue on cleaning sediment out of the stream channel located in the city. Flood damages to residences occur several times during years of normal rainfall unless this channel is continuously maintained. The sponsors have at times been forced to forego this channel cleanout due to its costliness.

Major floods inundating more than half the area subject to flooding from any single event occur about once every five years. Minor floods occur in some portions of the watershed whenever there is a runoff producing rain. The most recent major floods were in 1950, 1954, 1955, 1956, and 1960. The largest flood of record occurred in 1938. A large concrete bridge crossing Bitter Creek on Highway 256 was completely washed away and pieces of various sizes were deposited on cropland below. Farm operators to this day occasionally turn up pieces of this bridge during their farming operations. The most recent minor flood occurred in

September 1966, inundating portions of Bitter Creek and Oak Creek flood plains. Two minor floods occurred in the town of Lakeview during 1966.

The total acres of flood plain subject to damage and the average annual acres flooded, under nonproject conditions, by evaluation reach, are shown in the following tabulation:

Location	Evaluation Reach	Flood Plain: Total Acres	Flood Plain: Average Annual Acres Flooded
Brushy Creek	1	1,865	304
Bitter Creek	2	2,410	300
John Mann Creek	3	2,190	629
Hogland Flat Creek	4	2,445	400
Oak Creek	5	3,165	805
	6	5,080	1,520
	7	845	291
	8 (urban)	-	-
Subtotal - Oak Creek		9,090	2,616
GRAND TOTAL		18,000	4,249

Floodwaters washed out levee and devastated many acres of cropland and pastureland.

4-24606 1-66

One devastating flood washed many fertile inches of topsoil from this irrigated cropland.

Average annual damages to roads and bridges exceeds $21,000.

4-24806 1-68

Flooding causes the loss of valuable crops and results in damage to the land itself by flood plain scour and the deposition of infertile sediment upon highly productive soils. Loss of irrigation pipelines, fuel tanks, fences, terraces, and damage to irrigation pumps and wells is also quite high. Destruction of bridges and washouts of county roads during times of unusually severe flooding have a paralyzing effect upon the entire community.

Flood plain lands have been managed in a manner well below their potential as a result of flooding. Many terrace systems, needed to prevent erosion and conserve moisture, have been built during years past and then ruined by floodwaters. Flood plain land values vary from $150 to $300 or more per acre, depending upon location. The difference in value is often the direct result of flooding expected under nonproject conditions. The value of production varies from less than $5 to well over $200 per acre.

Under nonproject conditions the estimated average annual direct monetary damage resulting from floodwater is $163,084. Of this amount, $110,457 is crop and pasture; $27,643, other agricultural; $21,444, road and bridge; and $3,540, urban damage. Indirect damage, such as the interruption of travel, the inability to move agricultural products to market, the re-routing of school buses and mail routes, the disruption of livestock feeding and management regimen, losses sustained by businessmen of the area, and other losses, is estimated at $23,292 annually.

Erosion Damage

The rough, broken lands in the upper part of the watershed are highly susceptible to erosion by water. This area, comprising approximately 50,000 acres, is deeply dissected by badland type canyons and gullies ranging from 25 to more than 150 feet deep. About 25 percent, or 12,000 acres of the land, is in canyons and gullies, with estimated soil movement rates ranging from less than 5 tons to more than 300 tons per acre annually. Approximately 700 feet of the 1,000 feet of relief between the highest and lowest points in the watershed occurs in this area. Slopes on the lands lying between the canyon and gully systems range from moderate to steep and generally have a good erosion resistant cover. Overgrazing of rangeland in the past accelerated the erosion in this normally high erosional area. Present grazing management, however, has allowed the re-establishment of grasses and improvement of the rangeland to good and excellent condition.

Of the total gross erosion now occurring in the watershed, 42 percent is derived from the badland canyons and gullies, 29 percent from sheet erosion in the rough, broken lands, 10 percent from sheet erosion in the gently rolling terrace and alluvial lands, 17 percent from streambank erosion, and 2 percent from valley trenching.

Land destruction in the watershed by streambank erosion and valley trenching is occurring on 16.2 acres of alluvial lands each year.

Streambank eroeion is destroying valuable land at an average rate exceeding 15 acres annually. Road in foreground formerly went straight across this washed out area.

Streambank erosion on Bitter Creek is destroying productive irrigated cropland at the rate of 3.5 acres per year. Less productive sandy land on Oak Creek and Hogland Flat Creek is being destroyed at rates of 10.4 and 1.6 acres per year, respectively. Valley trenching is voiding 0.75 acres of productive cropland and damaging an additional 2.25 acres of land annually on Bitter Creek, lower John Mann Creek and upper Hogland Flat Creek. The average annual value of land damage and destruction by streambank erosion is $2,542 and by valley trenching is $1,288.

Increasing streambank erosion damage is expected to occur on Bitter Creek in the future. Flood flows break out in a low bank area upstream from valley section BI-2 (figure 6) and cause severe scouring and valley trenching on flood plain west of the channel. This will result in the formation of a new channel through the area being damaged by scour and valley trenching.

Flood plain scour damage is moderate in the watershed. Scouring is confined mainly to breakout points along the poorly defined channels. It also occurs at points of farm terrace breakage where the generally shallow floodwaters become concentrated. The estimated annual area damaged and damages in terms of reduced productivity by reaches is shown in the following tabulation:

Location	Evaluation Reach	Reduced Productivity 10% (acres)	20% (acres)	40% (acres)	80% (acres)	Total (acres)
Brushy Creek	1	28	22	2	-	52
Bitter Creek	2	61	29	26	10	126
John Mann Creek	3	20	12	-	-	32
Hogland Flat Creek	4	14	20	2	-	36
Oak Creek	5	16	11	2	-	29
	6	91	48	12	-	151
	7	38	26	-	-	64
	8 (urban)	-	-	-	-	-
Subtotal - Oak Creek		145	85	14	-	244
WATERSHED TOTAL		268	168	44	10	490

The average annual damage by flood plain scour is $7,088.

Sediment Damage

All streams of the watershed are carrying excessive loads of sandy and silty sediments. Most of this material is derived from the badlands-like canyons and gullied areas within the steep lands of the watershed. The sand is derived mainly from the area underlain by the Ogallala formation, while the silt is derived primarily from the Permian redbeds area. Sediment yields range from 1,320 to 3,350 tons per square mile annually for streams draining this area.

Sediment deposition on the intensively cultivated alluvial and terrace soils is severe. Swift flows in the steep uplands enable the streams to carry high bedloads and suspended sediment, but this energy is rapidly dissipated in the wide flat alluvial valleys, resulting in the deposition of large fanlike deposits. Productive loam, clay loam, and fine sandy loam alluvial and terrace soils are covered by less fertile materials. The damages from these deposits range from low for textural classes similar to the original soil to high for the infertile cleaner sands and gravels. Depths range from less than one foot to more than six feet. A total of 2,135 acres of flood plain land has been damaged. Areas damaged in terms of reduced productivity by reaches are shown in the following tabulation:

Location	Evaluation Reach	Reduced Productivity 10% (acres)	25% (acres)	50% (acres)	75% (acres)	90% (acres)	Total (acres)
Brushy Creek	1	69	55	88	67	-	279
Bitter Creek	2	60	36	3	2	1	102
John Mann Creek	3	95	111	65	46	30	347
Hogland Flat Creek	4	152	46	22	16	22	258
Oak Creek	5	23	18	30	22	11	104
	6	396	339	139	78	33	985
	7	50	10	-	-	-	60
	8 (urban)	-	-	-	-	-	-
Subtotal - Oak Creek		469	367	169	100	44	1,149
WATERSHED TOTAL		845	615	347	231	97	2,135

Increasing damage due to sediment deposition and accumulation is also occurring. Overbank deposition damage on Bitter Creek is increasing as channel aggradation becomes more serious. This condition is also occurring on the other streams. A more severe type of damage associated with sediment accumulation is occurring along the present channel of Oak Creek. Here channel filling and overbank deposition are causing swamping damage by creating a high water table problem on approximately 950 acres in the central reach of Oak Creek. This damage had its beginning shortly after 1920, the approximate date of the diversion of Oak Creek from the old to the present channel downstream from Lakeview. The concentration of flows in the new channel resulted in delivery and deposition of enormously large sand bedloads at breakout points along the channel. More than 1,000 acres of productive terrace soils have been covered by deposits ranging from 1 to 5 feet in depth. Higher local recharge due to the greater permeability of the sandy sediments, increased flooding due to sediment filled channels, and changed local drainage patterns have raised the water table levels within 2 feet of the surface in some areas. Evaporation and transpiration result in salt accumulations in the plant root zone. The high water table prevents effective leaching of these salts from the soil profile by rainfall. Studies indicate that the natural ground-water level prior to the 1920's was well below the plant root zone. A hand-dug well west of Plaska on the southwest side of Oak Creek had a water level 20 feet below the surface in 1911. The water level is now 5 feet below the surface. Studies also show that the area of wet soils lying in this area has almost doubled in size since 1956. Flood plain scouring associated with the inadequate channel capacities has also contributed to this damage. Removal of several feet of topsoil has reduced the effective soil profile depth above the ground-water level in parts of the area.

Overbank deposition damage to the flood plain soils amounts to $45,030 annually. Swamping damages are occurring at the rate of $13,887 annually.

Sediment delivery to the Prairie Dog Town Fork of the Red River is high from Bitter Creek. This is the only major stream which has an incised natural channel with appreciable capacity along its entire course to the

river. The estimated sediment yield is 1,600 tons per square mile annually. Sediment yields from the other streams are low.

Sand dune soils, derived from exposed reaches of sand-bedded stream channels, occur in many areas of the watershed. Strong,gusting winds, usually from the southwest and the northwest, remove fine sand from the channel and deposit it above the channel banks. Most of these areas are adequately vegetated and the encroachment upon surrounding productive soils is at a very slow rate.

Problems Relating to Water Management

There are presently about 12,000 acres of land being irrigated from underground sources. These areas are fairly well distributed throughout the lower portion of the watershed. The alluvium and terrace deposits supply ground water in parts of all of the major streams. The wells, however, are confined to the clean, coarse bedload sands of the old buried channels. Seasonal lowering of the water tables is minor because of recharge from the large surrounding areas of water-bearing fine sand and silty sand deposits. A significant area of soils in the southwestern part of the watershed is being irrigated from wells located in cavernous gypsum beds of the Permian redbeds.

The water quality is generally fair. The ground water from the alluvium and terrace contains low to moderate amounts of salts derived from gypsum. High amounts of these salts are contained in the ground water obtained from the Permian redbeds. However, the generally permeable sandy soils of the watershed are not detrimentally affected by use of this water. Some detrimental effect to a small area of soils being irrigated with ground water containing sodium salts is occurring on lower Oak Creek near the Prairie Dog Town Fork of the Red River.

Lakeview has an adequate water supply. Other residents of the watershed, lacking a suitable underground water supply, are forced to obtain drinking water from the ginning companies. However, this problem is being solved by the development of a water system serving the communities of Lesley, Brice, and Plaska.

Opportunities for water-based recreation are very limited in this area. Some fishing and swimming are done at lakes formed by gypsum sink holes but these lakes have lost much of their capacity by filling with sediment. The nearest large lake is Lake Greenbelt near Clarendon. Interest was high among residents of the area in developing a much needed lake for water-based recreation.

Sediment is the only known source of pollution in the watershed. Sediment produced in the upper portion of the watershed not only causes problems within the watershed, but also contributes to the sediment problems on the Red River.

PROJECTS OF OTHER AGENCIES

There are no projects of other agencies for water resource development which will affect or be affected by the works of improvement included in the plan. Several of the farm communities within the watershed are developing ground-water supplies with financial assistance from the Farmers Home Administration.

BASIS FOR PROJECT FORMULATION

A reconnaissance and preliminary investigation of the watershed was made by representatives of the Soil Conservation Service and the Hall and Donley Counties Water Control and Improvement District No. 1 to determine the location and severity of watershed problems. A map was prepared to show the location of the land being damaged by floodwater, erosion, and sediment.

Meetings were held with the sponsors to discuss their problems, possible solutions, watershed resource development needs, and the formulation of project objectives. Initially the sponsors listed the following objectives:

1. Establishment and maintenance of land treatment measures which contribute directly to watershed protection.

2. Prevention of flood damages from all storms up to and including the 10 percent chance event in the agricultural flood plain.

3. Prevention of flood damages in the town of Lakeview.

4. Development of a multiple-purpose structure to include water storage for recreational use.

The high level of protection to the agricultural flood plain was requested because of the intensive land use, the extensive damage to the land itself, and the need for protection of planned water conservation and land treatment measures. Much of the flood plain is being irrigated and more is expected to be irrigated after installation of the project.

It was agreed that the following steps would be taken in order that these objectives be reached:

1. The establishment and maintenance of at least 80 percent of the needed land treatment measures by the end of the installation period.

2. The installation of those structural measures needed for detention, orderly release, and disposal of floodwaters.

The location, number, design, and cost of structural measures were determined by the physical, topographic, and geologic conditions in the watershed. Other influencing factors were improvements, land use, and the location of the damage areas. Most of the upper portion of the watershed is in rangeland and the topography is suitable for floodwater retarding structures. The lower portion of the watershed is cultivated and the topography is generally unsuitable for floodwater retarding structures. This necessitated the planning of most of the floodwater retarding structures in the upper portion of the watershed. Stream channel improvement and floodwater diversions are planned to remove the excess runoff from the remainder of the watershed.

The sponsors requested that the 12-foot crown width of structures 101, 103, 104, 105E, 105W, 107, and 108 be widened to 16 feet so that they can be used as county roads. This modification will eliminate the need for construction of dams on cultivated land and for culverts under the road to carry release flows, and will reduce the total maintenance needs of the structures and roads. Hall County will pay for the cost of modifying the structures.

The project will meet the flood prevention objectives of the sponsors except in the lower end of Hogland Flat, where the creek passes through a gypsum sink lake. The lake has been drained and is being used for improved pasture. It is not feasible to provide structural measures to carry floodwater through this area.

The sponsors were interested in two specific locations for the development of recreation in conjunction with a floodwater retarding structure. Both locations had good access roads nearby and the land was to be donated for the reservoir and basic recreation facilities. Geologic and hydrologic studies indicated that neither of these structures would provide a satisfactory impoundment of water required for a recreation development. The development of recreation as a project purpose was therefore dropped from further consideration in development of the plan. The sponsors plan on taking advantage of recreational opportunities offered by the sediment pools of some of the floodwater retarding structures.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The use of each acre of land within its capabilities and its treatment in accordance with its needs has long been accepted as the foundation for the building of a strong and free community, state, or nation. Sponsors of this project are keenly aware of this concept and deem the installation and maintenance of needed land treatment measures as essential.

A soil survey for Hall County has been published. This survey covers the bulk of the cropland in the watershed; therefore, planning and application of needed land treatment measures can be achieved without interruption and on schedule.

This system of parallel terraces (center of picture) helps to control erosion and also conserves valuable moisture for crop production. This conservation measure is gaining in popularity. Project installation will enable many landowners to install these needed systems on land now flooded so frequently that installation is impractical.

This excellent condition rangeland is typical of much of the upper portion of the watershed. Dominant grasses are sideoats grama, sand bluestem, little bluestem, and Indiangrass. A good cover of these grasses holds sedimentation of floodwater retarding structures to a minimum, thus assuring proper functioning of these structures for the entire evaluation period.

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In addition to effectively maintaining those land treatment measures already established (table 1A), additional soil and water conservation measures or combinations of measures to be applied on cropland include conservation cropping system, contour farming, crop residue use, terraces, and diversions. The controlling of invading brush will improve the productivity of what is now low quality rangeland. Rangeland will be seeded with adapted native or introduced grasses where the native seed source is deemed inadequate to permit natural revegetation within a reasonable period. Proper range management, including deferred grazing and proper use, will enable treated areas and all other rangeland to produce large quantities of good quality grasses on a sustained yield basis. Marginal cropland will be converted to pasture by sodding or seeding adapted grasses and will be managed so as to achieve high production.

These planned land treatment measures will improve soil cover and condition. This improvement will reduce soil and water losses, will assure proper functioning of floodwater retarding structures and stream channel improvement, will reduce flooding, and will increase the incomes of the operators of agricultural lands in harmony with a prosperous and expanding economy.

Structural Measures

A system of 25 floodwater retarding structures, 3,850 feet of streambank protection, 5 grade stabilization structures, 92,015 feet of stream channel improvement, 31,320 feet of floodwater diversions and 3,000 feet of dike will be installed to provide protection to the flood plain lands of Lakeview watershed. The locations of the planned structural measures are shown on the project map (figure 8).

Runoff from 41 percent of the watershed will be controlled by floodwater retarding structures. This figure represents 54 percent of Brushy Creek, 62 percent of Bitter Creek, 55 percent of John Mann Creek, 42 percent of Hogland Flat Creek, and 41 percent of Oak Creek. The storage capacity of the floodwater retarding structures is 22,522 acre-feet, of which 9,250 acre-feet is sediment storage and 13,272 acre-feet is floodwater detention storage.

The floodwater retarding structures will detain an average of 2.54 inches of runoff from the 62,669 acres above them. In addition, an average of 1.77 inches of storage has been allocated for the expected 100-year accumulation of sediment from the controlled drainage area. The principal spillway crest elevation for 17 of the structures will be set at the 50-year sediment capacity. Structures 101, 103, 104, 105E, 105W, 106, 107, and 108 will have principal spillway crest elevations below natural ground. The landowners involved have requested that these structures have dry pools. Structures having a 50-year sediment capacity greater than 200 acre-feet will have the principal spillway ported at the 200 acre-feet elevation.

All structures will be located on soft sedimentary rocks of Permian and Quaternary age. The Permian consists of redbed siltstones, sandy shales, and lenticular beds of gypsum. The gypsum is moderately hard and occurs in beds less than 3 feet thick. It weathers into a soft, earthy material to depths of 10 or 15 feet below the surface. The weathered soil materials are classified as ML, SM-ML, MH, and CL and contain some horizons with high concentrations of disseminated gypsum. The Quaternary terrace and alluvial deposits are dominantly noncohesive silty and sandy materials of low plasticity (SM, SM-SP, SC, and CL). The permeabilities range from slow in clayey sediments to rapid in clean bedload sands. These materials occur to depths of 100 feet over the Permian bedrock at some sites. Sites 2, 4, 5, and 14 have deep accumulations of freely permeable bedload sands in the foundations and redbeds bedrock in the abutments. Sites 1, 3, 6, 7, 8, 13, 15, 101, 102, 103, 105E, 105W, 106, 107, and 108 have alluvial materials in the foundations and redbeds in one or both abutments. Sites 9, 10, 11, 12, 16, and 104 are located completely on terrace and alluvial materials.

The streambank protection structures to be installed in the Bitter Creek channel will prevent further destruction of valuable flood plain land by streambank erosion. It is recognized that these structures will deteriorate before the end of the evaluation period; however, it is anticipated that by the end of their useful life natural revegetation will assure the continued stability of the streambank. Funds designated for maintenance of these structures will be used for maintenance of vegetation after the deterioration of the structures.

The improved stream channels will have the capacity to carry the peak discharge of the 10 percent chance of recurrence flood. Approximately 4 grade stabilization structures per mile will be installed as appurtenances to the stream channel improvement to prevent erosion and headcutting where local inflow enters the improved channel. These structures will be designed and installed in accordance with standards and specifications contained in the Work Unit Technical Guide. Two earth dam grade stabilization structures will be installed in the improved channel of Brushy Creek to stabilize the channel. A concrete weir drop type grade stabilization structure will be installed at the lower end of John Mann stream channel improvement to stabilize the channel outlet.

Four of the five floodwater diversions will have the capacity to carry the peak discharge of the 10 percent chance of recurrence flood. Floodwater diversion No. I, which is located above Lakeview, will have the capacity to carry the peak discharge of the 1 percent chance of recurrence flood. A concrete weir grade stabilization structure will be installed at the lower end of this floodwater diversion to stabilize the outlet.

The dike below floodwater retarding structure No. 12 is designed to divert the runoff from the 1 percent chance into floodwater retarding structure No. 16.

A concrete weir type grade stabilization structure, No. 203, will be installed on a tributary of Bitter Creek to prevent valley trenching below floodwater retarding structure No. 3.

It will be necessary to alter or relocate a number of county roads and a pipeline in order to install the structural measures. County roads in the reservoir areas of structures Nos. 6, 9, 101, and 105E will be temporarily flooded. An alternate route will be designated for traffic. The county roads crossing the embankments of structures 101, 103, 104, 105E, 105W, 107, and 108 will be modified. The top of the dams will be widened from 12 feet to 16 feet so that they may be used as county roads. County roads crossing the improved stream channels and floodwater diversions will be altered. The sponsors plan to install low-water crossings where the roads cross improved stream channels and floodwater diversions. The pipeline affected by floodwater diversion V will be modified.

Figures 1, 2, 2A, 3, 4, and 5 show structures which are typical of those planned for this watershed. Tables 3, 3A, 3B, 3C, and 3D show details on quantities and design features.

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

EXPLANATION OF INSTALLATION COSTS

Land treatment measures listed in table 1 will be applied by local interests at an estimated cost of $692,730. This includes funds for Public Law 46 and Public Law 566 technical assistance to be provided by the Soil Conservation Service and cost sharing in the establishment of approved conservation measures under the Great Plains Conservation Program of the Soil Conservation Service and the Agricultural Conservation Program as administered by the Agricultural Stabilization and Conservation Service. Included in the above sum is $86,900 of Public Law 566 funds to accelerate technical assistance in order that application of needed land treatment measures may be completed by the end of the 10-year installation period.

The costs of application of the various measures are based on present prices being paid by landowners and operators in the area.

The total installation cost of the structural measures is estimated to be $3,187,649. Public Law 566 fill provide $2,308,334 for construction and $551,668 for installation services. The local sponsors' cost is estimated to be $309,947 for land, easements, and rights-of-way, and $17,700 for contract administration. The estimated value of land, easements, and rights-of-way includes $4,300 for legal fees, $274,818 for value of easements, and $30,829 for modification or relocation of roads and utilities.

The sponsors requested that floodwater retarding structures 101, 103, 104, 105E, 105W, 107, and 108 be modified to permit their use as a roadway.

The total nonproject cost for these modifications is estimated to be $8,744. This is the increased cost for construction and installation services necessary to modify the structures for use as roadways.

The construction cost includes the engineer's estimate and contingencies. The engineer's estimate was based on the unit cost of construction items planned for each structural measure. The unit cost was based on actual cost of structural measures in similar areas modified to conditions found in this watershed. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction cost. Installation services consist of engineering and administrative costs and are based on analysis of previous work in similar areas. The engineering portion of these costs consists of, but is not limited to, detailed surveys, geological investigations, laboratory reports, designs, cartographic services, and inspection services.

Value of land, easements, and rights-of-way was estimated by representatives of the local sponsors and concurred in by the Soil Conservation Service. The estimated cost for altering or re-routing roads, utility, and pipelines was furnished by the Hall County Commissioners Court and the utility and pipeline companies, respectively.

The estimated schedule of obligations for the 10-year installation period, covering installation of land treatment and structural measures, is as follows:

Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Total Other (dollars)	Total (dollars)
1st	Land Treatment	8,690	60,583	69,273
2nd	Land Treatment and Structures 4 and 5	460,194	95,833	556,027
3rd	Land Treatment; Structures 1, 2, 3, 201, 202, 203, and 301 through 308; and Brushy and Bitter Creeks Stream Channel Improvement	535,755	99,858	635,613
4th	Land Treatment; Structures 6, 7, 8, 101, and 204; and John Mann Creek Stream Channel Improvement	463,648	100,246	563,894
5th	Land Treatment and Structures 9, 10, 11, 102, 103, 104, 105E, 105W, 106, and 107	399,499	131,008	530,507
6th	Land Treatment; Structures 13 and 14; and Oak Creek Stream Channel Improvement	567,577	132,169	699,746
7th	Land Treatment; Structures 12, 15, 16, 108, 205, I through V, and Dike	485,469	132,031	617,500
8th	Land Treatment	8,690	60,583	69,273
9th	Land Treatment	8,690	60,583	69,273
10th	Land Treatment	8,690	60,583	69,273
Total		2,946,902	933,477	3,880,379

EFFECTS OF WORKS OF IMPROVEMENT

The installation of all measures, both land treatment and structural, will benefit to some degree approximately 355 farms and ranches in the watershed. Approximately 150 farms, most of which are family type, will benefit

from reduced flooding as the result of installation of structural measures. Approximately 17,900 acres of the intensively managed flood plain will receive flood protection benefits. Another 3,300 acres of grassland located in the common bottom with Mulberry Creek and the Prairie Dog Town Fork of the Red River will benefit by a reduction in flooding and deposition of sediment. Benefits to this 3,300 acres, although real, have not been evaluated or used for project justification because of frequent flooding of the larger streams.

The combined program of land treatment and waterflow control measures will eliminate flooding in the town of Lakeview and the communities of Plaska and Brice. Flood damages occurring from all storms up to the 10 percent chance recurrence event will be eliminated on the agricultural land except for 172 acres of flood plain located in the old gypsum sink lake at the lower end of Hogland Flat Creek. The major cause of present damage in this area is the deposition of infertile sediment upon fertile land. With the project installed, these damages will be greatly reduced since flooding will generally be of a nondamaging nature.

Average annual flooding will be reduced from 4,249 acres to 253 acres, a reduction of 94 percent. This reduction in flooding will result in a 96 percent reduction in crop and pasture damages, 96 percent reduction in other agricultural damages, 98 percent reduction in road and bridge damages, and elimination of urban damages.

Sheet erosion rates in the watershed will be reduced by an average of 10 percent after application of needed land treatment measures. Most of this reduction will occur in the gently rolling cultivated portions of the watershed. The steeply rolling grazing land in the upper part has good treatment applied on all areas except the canyon and gullied badlands. The structural measures will provide stable outlets for the lower reaches of these badlands. Sediment accumulation in and above the pool areas will cause this stabilizing effect to extend upstream well above the structures.

Flood plain land damages by streambank erosion, valley trenching, and scour will be reduced or eliminated by installation of the structural measures. Streambank erosion on Bitter Creek will be stabilized with the installation of streambank protection measures. Stabilization by natural vegetation and a high degree of control will greatly reduce or eliminate streambank erosion on Oak and Hogland Flat Creeks. All areas of valley trenching will be eliminated by installation of grade stabilization structures. Scour damages will be reduced by 86 percent in the watershed.

The structural measures will trap the excessive sediment loads now being deposited on the flood plain. Damaging overbank deposition will be reduced by 76 percent in the watershed.

Increasing damages resulting from channel aggradation and the deposition of infertile sand deposits on fertile soils will be eliminated. The

annual sediment load carried into the Prairie Dog Town Fork of the Red River by Bitter Creek will be reduced by 80 percent.

Ground-water recharge will occur in the terrace and alluvium aquifer from the structural measures. No monetary benefits have been claimed for this recharge since there is a surplus of ground water available under present conditions; however, the replenishing of the underground supply of this valuable resource can be nothing less than beneficial to the nation as a whole.

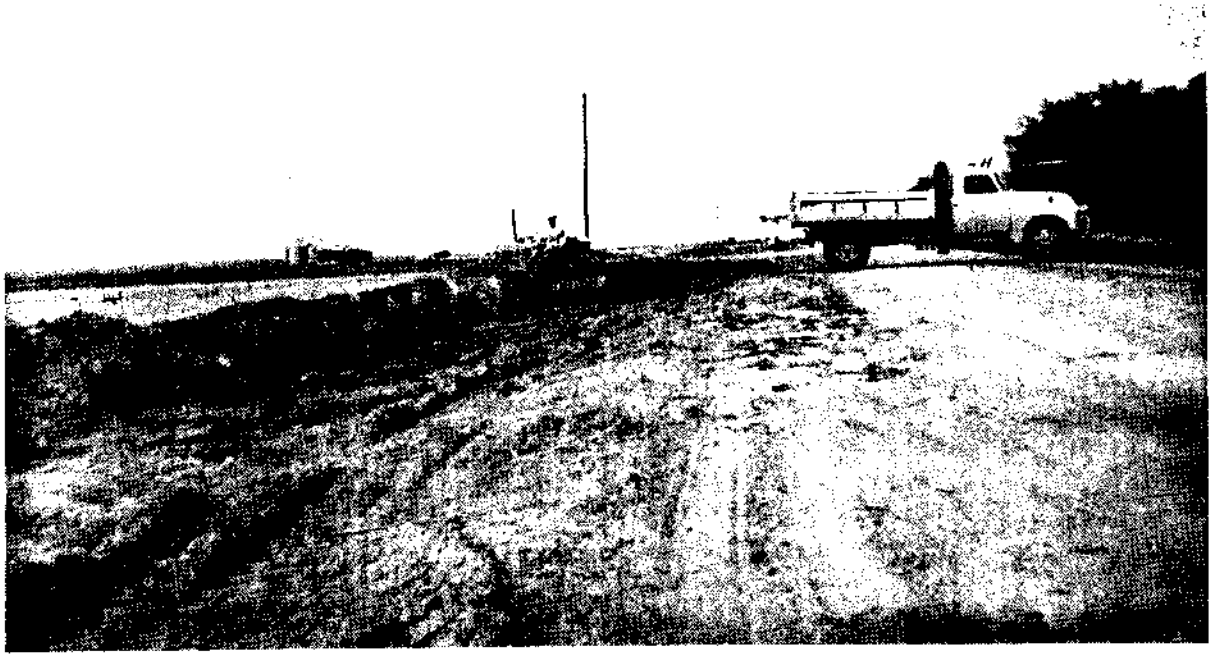
Swamping damages on Oak Creek will be reduced 94 percent by the installation of the project. It is expected that approximately 850 acres of land now suffering this damage will again produce at or near its true potential.

It is expected that project installation will result in the conversion of approximately 1,000 acres of cropland to pastureland. This land, largely marginal cropland, can be expected to yield a more dependable income when converted to this usage.

The effects of the works of improvement on fish and wildlife habitat are described by the Bureau of Sport Fisheries and Wildlife as follows:

> The proposed floodwater retarding reservoirs would create important fish habitat in the watershed. Moderate to heavy fishing is expected in the impoundments. With the project, there would be no commercial fishery in the watershed.
>
> With the project, cover cropping and stubble mulching would benefit bobwhites. The stirring of soils would stimulate weed production and would benefit turkeys as well as bobwhites. Flood protection below the floodwater retarding reservoirs would benefit wildlife, particularly ground-nesting species. The floodwater retarding reservoirs would provide drinking water for wildlife. Migrating waterfowl would use the impoundments as resting areas.
>
> An excellent opportunity exists in the watershed to develop some good quality sport fishing. The addition of a few economical measures during the construction of the floodwater retarding structures would improve fish habitat.

Excellent opportunities for the development of on-farm income producing recreation facilities will become available at and in the vicinity of the sediment pools of 5 floodwater retarding structures expected to retain water during period of normal rainfall. Landowners have indicated to the sponsors that they will develop on-farm income producing recreational facilities, including needed sanitary facilities, at these structures. They are expected to be available for use by the general public either on a free or fee basis. They will provide opportunities for water-based recreation such as fishing, hunting, picnicking, and camping. Such facilities are used quite



Project installation will reduce road and bridge damage (shown above) from an estimated average annual $21,444 to $500.

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frequently by youth organizations such as Boy Scouts, Girl Scouts, church groups, etc. These facilities are expected to furnish 13,040 visitor-days of recreation annually. Most of the usage will occur from April through September, but use will be made of these facilities to a limited extent throughout the remainder of the year. These incidental recreation benefits will be a boon to surrounding residents of all ages since there is a dearth of such facilities in this section of the State. Many children and even adults in this area have never had the opportunity to "wet a hook," while other residents of the area travel many hundreds of miles to enjoy facilities such as these will provide.

In addition to the incidental recreation benefits evaluated above, it is expected that sediment pools of an additional 12 floodwater retarding atructures will furnish some incidental recreation during periods of above normal rainfall. This recreation may be in the form of picnicking, camping, or water skiing. No monetary benefits are claimed for the recreation expected from these 12 sediment pools.

The high level of flood protection afforded by this project will enable farm owners and operators to install needed land treatment measures on 17,900 acres of agricultural land. These measures will result in maximum utilization of rainfall for both soil conservation and crop production

instead of letting the water run off to cause damage to crops, improvements, and land below.

Savings effected by the reduction of other agricultural losses will enable residents to afford conveniences in their homes which heretofore they have done without. This improved standard of living will also be reflected in their support of schools and churches, both so essential to the well-being of present and future generations.

County funds formerly used to repair roads and replace bridges may be used to provide good all-weather surfaces for all roads in the watershed.

Savings to the city of Lakeview from urban damage elimination may be used constructively to provide other needed services, beautification projects, etc.

In summation, residents of the watershed will be able to plan and manage more efficiently, secure in the knowledge that their investment of both time and capital is not so likely to be swept away at a moment's notice by a whim of Mother Nature.

Secondary benefits will accrue to the trade area as a result of increased business to those who supply farm equipment, petroleum products, seeds, feeds, fertilizers, and the various services associated with a farming and ranching community.

PROJECT BENEFITS

The estimated total average annual monetary damages (table 5) within the watershed will be reduced from $256,211 to $20,807, a reduction of 92 percent. Crop and pasture damages, excluding indirect damages, will be reduced from $110,457 to $4,384, a reduction of 96 percent. Other agricultural damages, such as losses of fences, irrigation pipe, and fuel tanks, and damages to irrigation pumps and wells, will be reduced from $27,643 to $1,119, or 96 percent. Nonagricultural damage to roads, bridges, and urban property will be reduced from $24,984 to $500, a reduction of 98 percent. Damages from overbank deposition of infertile sediment upon fertile flood plain soils will be reduced from $45,030 to $10,978, or 76 percent. Swamping damage, now occurring at the rate of $13,887 annually, will be reduced to $889, or 94 percent. Flood plain scour damages to fertile flood plain soils are expected to be reduced from $7,088 to $973, or 86 percent. Valley trenching damages, now occurring at an average rate of $1,288 annually, will be eliminated. Streambank erosion damages, averaging $2,542 annually under without project conditions, can be expected to amount to only $73 after project installation, for a reduction of 97 percent. Indirect damages resulting from re-routing of traffic, disruption of agricultural regimen, and financial losses to those furnishing supplies and services to the populace, will be reduced from $23,292 to $1,891, or 92 percent.

The use of those sediment pools of floodwater retarding structures open to the public is expected to produce incidental recreation benefits of $8,756 annually after deduction of associated costs for cleanup, repair, and replacement of recreation and sanitary facilities, and liability insurance. The pools are expected to be used heavily for fishing, picnicking, hunting, and campouts by Boy Scouts, Girl Scouts, and church groups. A gross value of $1 per visitor-day was used for evaluation. Benefits, expected to accrue at full level for the first 40 years of the project, diminish to zero by the end of the 50th year and be nonexistent for the balance of the 100-year evaluation period, are discounted accordingly.

Secondary benefits, although not considered pertinent from a national viewpoint, will amount to $21,943 annually in the immediate locale. This amount, excluding indirect benefits in any form, results from $20,911 in benefits stemming from the project and $1,032 in benefits induced by the project.

Other substantial benefits will accrue to the project, such as an increased sense of security, a more satisfying environment in which to work and rear a family, and a deeper sense of well-being, secure in the knowledge that at least some of the hazards involved in wresting a livelihood from the land have been alleviated. These benefits, although extremely important, have not been evaluated in monetary terms, nor have they been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures (amortized total installation and replacement cost, plus operation and maintenance) is $119,625. These measures are expected to produce average annual primary benefits of $233,233. The benefit-cost ratio without secondary benefits is 1.9 to 1.0. The ratio of total average annual project benefits accruing to structural measures, $255,176, to the average annual cost of structural measures, $119,625, is 2.1 to 1.0 (table 6).

PROJECT INSTALLATION

Planned land treatment (table 1) will be accomplished by farm and ranch operators in cooperation with the Hall County and Donley County Soil and Water Conservation Districts during a 10-year installation period. The goal is the adequate treatment of 80 percent of the agricultural land by or before the end of the project installation period. This treatment is expected to be accomplished as follows:

Land Use	FISCAL YEAR 1st (acres)	2nd (acres)	3rd (acres)	4th (acres)	5th (acres)	6th (acres)
Cropland	1,511	1,511	1,511	1,511	1,511	1,511
Grassland	1,126	1,126	1,126	1,126	1,126	1,126
Total	2,637	2,637	2,637	2,637	2,637	2,637

Land Use	FISCAL YEAR (Continued) 7th (acres)	8th (acres)	9th (acres)	10th (acres)	Total (acres)
Cropland	1,511	1,510	1,510	1,510	15,107
Grassland	1,126	1,126	1,125	1,125	11,258
Total	2,637	2,636	2,635	2,635	26,365

The governing bodies of the soil and water conservation districts will assume aggressive leadership in the acceleration of the land treatment program now being applied. The Soil Conservation Service will provide additional technical assistance to the soil and water conservation districts, as needed, in order to accelerate the planning, application, and maintenance of soil, water, and plant conservation measures.

The Hall County and Donley County ASCS County Committee will cooperate with the governing bodies of the soil and water conservation districts and the Hall and Donley Counties Water Control and Improvement District No. 1 in selecting for financial assistance those practices which will accomplish the conservation objectives in the shortest possible time. The Extension Service will assist in the educational phase of the program by holding local farm meetings, preparing press, radio, and television releases, and using other methods of getting information to the landowners and operators in the watershed. Soil and water conservation loans available through the Farmers Home Administration will be given special emphasis. Present FHA clients in the watershed will be encouraged to cooperate in the program.

The structural measures will be installed during a 10-year installation period.

The Hall and Donley Counties Water Control and Improvement District No. 1 will act as the contracting local organization to administer the contracts for the construction of all planned structural measures. The district will

make arrangements for necessary legal, administrative, and clerical personnel, facilities, supplies, and equipment to advertise, award and administer the contracts. The district will select and appoint a contracting officer.

Land,easements, and rights-of-way, including utility, pipeline, road, and improvement changes, will be acquired for all of the planned structural measures by the Hall and Donley Counties Water Control and Improvement District No. 1 and/or the Hall and Donley Counties Commissioners Courts. The commissioners courts will assume prime responsibility for acquisition of such land, easements, or rights-of-way as will be needed for construction of planned works of improvement in their respective counties upon specific request of the water control and improvement district. All of floodwater retarding structures Nos. 1 and 2 and portions of the reservoir areas of floodwater retarding structures Nos. 4 and 5 are located in Donley County. The remainder of the structural works of improvement are located in Hall County. The Hall and Donley Counties Commissioners Courts have the authority under applicable State law to exercise the right of eminent domain in their respective counties, if necessary, to acquire such land, easements, or right-of-way, including utility, pipeline, road and improvement changes, as will be needed in connection with the works of improvement to be installed with Federal assistance. The legal adequacy of easements, permits, etc., for construction of the planned structural measures will be determined by the Hall and Donley Counties Water Control and Improvement No. 1.

The structural measures will be installed pursuant to the following conditions:

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

2. All land, easements, rights-of-way, and permits have been obtained for all structural measures, or the Hall and Donley Counties Water Control and Improvement No. 1 has furnished a written statement (or statements) to the effect that it has the means to secure easements and giving a schedule for remaining non-cleared sites, by site number, and the exact date by which all land rights therefor will be obtained.

   The schedule, by 6-month periods, for obtaining needed land, easements, and rights-of-way is as follows:

1st 6-Month Period	Floodwater Retarding Structures 1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 102, 103, 104 and 107; Grade Stabilization Structure 203; Streambank Protection Structures 301, 302, 303, 304, 305, 306, 307, and 308; and 2,000 feet of Stream Channel Improvement on Bitter Creek.

2nd 6-Month Period	Floodwater Retarding Structures 8, 13, 16, 105E, and 105W; Grade Stabilization Structures 201 and 202; and 14,800 feet of Stream Channel Improvement on Brushy Creek
3rd 6-Month Period	Floodwater Retarding Structures 9, 14, 15, 101, and 106; Grade Stabilization Structure 204; and 13,150 feet of Stream Channel Improvement on John Mann Creek
4th 6-Month Period	Floodwater Diversions III and IV
5th 6-Month Period	Floodwater Retarding Structure 108 and 3,000 feet of Dike
6th 6-Month Period	Floodwater Diversions I, II, and V, and 62,065 feet of Stream Channel Improvement on Oak Creek

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

4. Court orders have been obtained from the Hall County Commissioners Court stating that all county and private road crossings that are affected by stream channel improvement will be modified or replaced, if needed, concurrently with or prior to the construction of the improved stream channel.

5. Flowage easements have been obtained for release flows of floodwater retarding structures through a former gypsum sink lake, which is used for improved pasture in the lower portion of Hogland Flat Creek.

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

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

8. Public Law 566 funds are available.

The watershed has been divided into five construction units, which are synonymous with the five evaluation units (table 6). Each of the five units has a favorable benefit-cost ratio and construction

may start with any construction unit; however, all necessary land, easements, and rights-of-way will be obtained for each construction unit before construction in that unit will start.

The sequence of construction within a construction unit is very important because the stream channel improvement, floodwater diversions, grade stabilization structures, floodwater retarding structures, and dikes were designed considering the structural measures above them to be in place.

Floodwater retarding structures in series with and above other structural measures will be installed before or concurrently with the lower structural measure. Installation of floodwater retarding structures before stream channel improvement commences may cause prolonged flooding where the existing stream channel is inadequate; therefore, stream channel improvement will commence concurrently with or soon after the construction of floodwater retarding structures.

The general sequence of construction is shown in the tabulation under schedule of obligations, "EXPLANATION OF INSTALLATION COSTS."

FINANCING PROJECT INSTALLATION

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

The cost of installing the needed land treatment measures during the 10-year installation period will be borne by the landowners and operators of the land on which these measures are installed.

The Agricultural Stabilization and Conservation Service will provide financial assistance for the installation of those land treatment measures which are eligible for this assistance. The Farmers Home Administration, local banks, and other lending institutions can arrange financing for the landowners and operators' share of this cost.

The Soil Conservation Service will provide funds in the amount of $229,680 to finance the cost of technical assistance in planning and application of the land treatment measures. This consists of $86,900 of Public Law 566 funds and $142,780 to be provided from Public Law 46 funds (table 1).

Out-of-pocket costs, consisting of the cost of acquiring the land, easements, and rights-of-way that are not donated, the cost of modification or relocation of roads and utilities, and contract administration, are expected to be $75,000.

Funds for the local share of the cost of installing the structural measures will be provided by the commissioners court of the county in which the structural measures are located.

The Donley County Commissioners Court will exercise its right of eminent domain, if necessary, to acquire needed land, easements, and rights-of-way for floodwater retarding structures Nos. 1 and 2 and that portion of the reservoir areas of floodwater retarding structures Nos. 4 and 5 which are in Donley County.

The Hall County Commissioners Court will exercise its right of eminent domain, if necessary, to acquire the remainder of the needed land, easements, and rights-of-way.

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

PROVISIONS FOR OPERATION AND MAINTENANCE

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

The Hall and Donley Counties Water Control and Improvement District No. 1 will have operation, maintenance, inspection, and coordination responsibility for all structural measures, but accomplishment and financing will be the responsibility of the commissioners court of the county in which the structure is located. Donley County will be responsible for floodwater retarding structures Nos. 1 and 2. Hall County will be responsible for all other structural measures. An operation and maintenance agreement will be executed by the parties hereto prior to the signing of the initial project agreement and the issuance of invitations to bid on construction of the structural measures. The agreement will set forth specific details on procedure in line with recognized assignments of responsibility.

The estimated average annual value of operation, maintenance, and replacement is $11,626, based on adjusted normalized prices. This consists of $4,325 for the floodwater retarding structures, $5,162 for the stream channel improvement, $1,186 for the floodwater diversions, $683 for the grade stabilization structures, $100 for streambank protection measures, and $170 for the dike. The estimated average annual value of operation, maintenance, and replacement is $375 for those structural measures located in Donley County and is $11,251 for those measures located in Hall County.

The Service and the sponsors will make a joint inspection annually, or after unusually severe floods, or in the event of other unusual conditions that may adversely affect the works of improvement, for three years

following installation of each structure. Inspections after the third year will be made annually by the sponsors. The Service will participate in annual inspections as often as it elects to do so after the third year. Inspection items are those items which may need maintenance. These include, but will not be limited to, the condition of the principal spillway, earth fills or embankments, vegetative cover of the earth fills and emergency spillways; the need for removal of woody vegetation, sediment bars, and debris from improved channels; the need for corrective measures to prevent bank cutting in the improved channel; and the condition of fences, gates, and other appurtenances installed as a part of the structural measures.

Maintenance needs for all structural measures noted by the representative of the water control and improvement district, or those called to his attention by others and confirmed by him, will be referred to the respective commissioners courts. The representative of the water control and improvement district will prepare a report of all maintenance inspections. A copy of this report will be submitted to the Service representative. The water district representative will keep summary control records in support of proper maintenance having been performed on these works of improvement for the entire watershed.

The Soil Conservation Service, through the Hall County and the Donley County Soil and Water Conservation Districts, will participate in operation and maintenance by furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

Provisions will be made to provide for free access of representatives of the Hall and Donley Counties Water Control and Improvement District No. 1, the Hall and Donley Counties Commissioners Courts, and the Soil Conservation Service to inspect and provide for maintenance of all structural measures and their appurtenances at any time.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Lakeview Watershed, Texas

Installation Cost Item	Unit	Number To Be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	15,107	-	287,767	287,767
Grassland	Acre	11,258	-	175,283	175,283
Technical Assistance			86,900	142,780	229,680
SCS Subtotal			86,900	605,830	692,730
TOTAL LAND TREATMENT			86,900	605,830	692,730
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	25	1,795,439	-	1,795,439
Stream Channel Improvement	Foot	92,015	317,106	-	317,106
Grade Stabilization Structures	No.	5	111,377	-	111,377
Floodwater Diversions	Foot	31,320	60,798	-	60,798
Dike	Foot	3,000	2,439	-	2,439
Streambank Protection	Foot	3,850	21,175	-	21,175
SCS Subtotal			2,308,334	-	2,308,334
Subtotal - Construction			2,308,334	-	2,308,334
Installation Services					
Soil Conservation Service					
Engineering Services			349,102	-	349,102
Other			202,566	-	202,566
SCS Subtotal			551,668	-	551,668
Subtotal - Installation Services			551,668	-	551,668
Other Costs					
Land, Easements, and Rights-of-Way			-	309,947	309,947
Administration of Contracts			-	17,700	17,700
Subtotal - Other Costs			-	327,647	327,647
TOTAL STRUCTURAL MEASURES			2,860,002	327,647	3,187,649
TOTAL PROJECT			2,946,902	933,477	3,880,379
SUMMARY					
Subtotal SCS			2,946,902	933,477	3,880,379
TOTAL PROJECT			2,946,902	933,477	3,880,379

1/ Price Base: 1966

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Lakeview Watershed, Texas

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Cropland			
Conservation Cropping System	Acre	45,253	90,506
Contour Farming	Acre	49,371	-
Crop Residue Use	Acre	37,967	75,934
Diversion	Foot	84,480	8,448
Terraces	Foot	10,443,840	824,826
Grassland			
Range Deferred Grazing	Acre	7,369	7,369
Range Seeding	Acre	2,565	33,345
Pasture and Hayland Planting	Acre	2,434	43,812
Pasture and Hayland Management	Acre	2,599	25,990
Brush Control	Acre	700	5,600
Range Proper Use	Acre	43,537	43,537
TOTAL LAND TREATMENT			1,159,367

1/ Price Base: 1966

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Lakeview Watershed, Texas

(Dollars) 1/

Structure Site Number or Name	Installation Cost - Public Law 566 Funds				Installation Cost - Other Funds						
	Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566	Construction	Installation Services: Engineering	Installation Services: Other	Adm. of Contracts	Easements & Rights-of-Way	Total Other	Total Installation Cost
Floodwater Retarding Structures											
1	63,357	9,504	5,556	78,417	-	-	-	500	4,425	4,925	83,342
2	129,052	16,777	11,119	156,948	-	-	-	500	9,125	9,625	166,573
3	88,411	13,262	7,753	109,426	-	-	-	500	9,150	9,650	119,076
4	230,142	23,014	19,303	272,459	-	-	-	500	19,875	20,375	292,834
5	147,221	19,139	12,685	179,045	-	-	-	500	14,375	14,875	193,920
6	92,118	13,818	8,078	114,014	-	-	-	500	9,975	10,475	124,489
7	70,857	10,629	6,213	87,699	-	-	-	500	3,525	4,025	91,724
8	114,415	14,874	9,858	139,147	-	-	-	500	7,475	7,975	147,122
9	73,843	11,076	6,475	91,394	-	-	-	500	6,275	6,775	98,169
10	33,776	7,431	3,142	44,349	-	-	-	500	1,675	2,175	46,524
11	37,688	8,291	3,506	49,485	-	-	-	500	1,150	1,650	51,135
12	60,924	9,139	5,342	75,405	-	-	-	500	3,275	3,775	79,180
13	63,528	9,529	5,571	78,628	-	-	-	500	3,900	4,400	83,028
14	180,618	19,868	15,287	215,773	-	-	-	500	17,125	17,625	233,398
15	70,562	10,584	6,187	87,333	-	-	-	500	13,325	13,825	101,158
16	136,542	17,750	11,765	166,057	-	-	-	500	15,700	16,200	182,257
101	21,693	5,423	2,068	29,184	-	-	-	500	5,375	5,875	35,059
					2/ (510)	(163)	(52)			(725)	(725)
102	9,677	3,097	974	13,748	-	-	-	500	3,950	4,450	18,198
103	16,166	5,173	1,627	22,966	-	-	-	500	4,425	4,925	27,891
					(711)	(228)	(72)			(1,011)	(1,011)
104	15,871	5,079	1,598	22,548	-	-	-	500	5,225	5,725	28,273
					(720)	(230)	(73)			(1,023)	(1,023)
105E	23,329	5,832	2,223	31,384	-	-	-	500	11,200	11,700	43,084
					(1,110)	(352)	(111)			(1,573)	(1,573)
105W	29,361	7,340	2,798	39,499	-	-	-	500	11,350	11,850	51,349
					(1,125)	(360)	(113)			(1,598)	(1,598)
106	28,525	7,131	2,719	38,375	-	-	-	500	13,250	13,750	52,125
107	27,548	6,887	2,626	37,061	-	-	-	500	6,925	7,425	44,486
					(480)	(154)	(49)			(683)	(683)
[redacted]	30,215	6,647	2,811	39,673	-	-	-	500	10,625	11,125	50,798
					(1,500)	(480)	(151)			(2,131)	(2,131)
Subtotal	1,795,439	267,294	157,284	2,220,017	-	-	-	12,500	212,675	225,175	2,445,192
Total - Nonproject Costs					(6,156)	(1,967)	(621)			(8,744)	(8,744)

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION - Continued
Lakeview Watershed, Texas
(Dollars) 1/

Structure Site Number or Name	Installation Cost - Public Law 566 Funds				Installation Cost - Other Funds						
	Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566	Construction	Installation Services: Engineering	Installation Services: Other	Adm. of Contracts	Easements & Rights-of-Way	Total Other	Total Installation Cost
Stream Channel Improvement											
Brushy Creek	46,667	8,400	4,198	59,265	-	-	-	500	9,060	9,560	68,825
Bitter Creek	7,104	2,273	715	10,092	-	-	-	500	890	1,390	11,482
John Mann Creek	39,875	8,773	3,709	52,357	-	-	-	500	9,963	10,463	62,820
Oak Creek	223,460	22,346	18,680	264,486	-	-	-	500	49,061	49,561	314,047
Subtotal	317,106	41,792	27,302	386,200	-	-	-	2,000	68,974	70,974	457,174
Grade Stabilization Structures											
201 and 202	43,177	7,772	3,884	54,833	-	-	-	200	2,400	2,600	57,433
203	22,000	5,500	2,097	29,597	-	-	-	500	325	825	30,422
204	24,200	6,050	2,307	32,557	-	-	-	500	350	850	33,407
205	22,000	5,500	2,097	29,597	-	-	-	500	250	750	30,347
Subtotal	111,377	24,822	10,385	146,584	-	-	-	1,700	3,325	5,025	151,609
Floodwater Diversions I-V	60,798	9,120	5,331	75,249	-	-	-	500	23,733	24,233	99,482
Dike	2,439	780	246	3,465	-	-	-	500	1,040	1,540	5,005
Streambank Protection 301-308	21,175	5,294	2,018	28,487	-	-	-	500	200	700	29,187
GRAND TOTAL	2,308,334	349,102	202,566	2,860,002	-	-	-	17,700	309,947	327,647	3,187,649

1/ Price Base: 1966
2/ All costs in parentheses are nonproject costs.

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Lakeview Watershed, Texas

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9
Drainage Area	Sq. Mi.	1.75	4.93	4.63	17.84	15.28	4.87	1.58	3.57	1/ 2.09
Storage Capacity										
Sediment Submerged - 1st 50 Years	Ac. Ft.	130	2/ 297	2/ 272	2/ 790	2/ 497	2/ 260	107	2/ 259	96
Sediment Submerged - 2nd 50 Years	At. Ft.	126	289	261	770	481	252	104	253	96
Sediment Aerated	Ac. Ft.	89	240	186	590	367	179	79	191	67
Floodwater Pool	At. Ft.	297	794	753	2,398	1,955	753	252	523	464
Total	Ac. Ft.	642	1,620	1,472	4,548	3,300	1,444	542	1,226	723
Surface Area										
Sediment Pool (Lowest Ungated Outlet)	Acre	20	28	36	40	37	33	18	23	19
Sediment Pool - 1st 50 Years	Acre	20	37	40	80	61	40	18	26	19
Sediment Pool - 2nd 50 Years	Acre	30	58	52	133	92	62	24	50	32
Floodwater Pool	Acre	52	114	104	246	180	124	42	87	81
Volume of Fill	Cu. Yd.	94,500	240,000	164,000	505,000	290,800	160,530	114,100	191,680	91,330
Elevation Top of Dam	Foot	2389.8	2447.9	2231.3	2333.0	2331.1	2207.7	2320.0	2323.1	2239.1
Maximum Height of Dam	Foot	35.3	45.4	53.1	53.1	49.8	47.8	40.5	43.1	35.6
Emergency Spillway										
Crest Elevation	Foot	2386.0	2442.0	2225.5	2327.7	2325.7	2203.0	2314.0	2317.5	2234.0
Bottom Width	Foot	50	250	100	400	400	100	50	140	260
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use		2.6	1.2	1.6	1.2	1.8	2.1	3.1	1.6	1.0
Average Curve No. - Condition II		77	75	77	75	75	77	77	75	75
Emergency Spillway Hydrograph										
Storm Rainfall 3/	Inch	5.30	8.10	5.30	5.04	5.10	5.30	5.30	5.30	8.10
Storm Runoff	Inch	2.90	5.10	2.90	2.50	2.50	2.90	2.90	2.90	5.10
Velocity of Flow (VC)	Ft./Sec.	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	1,342.0
Distharge Rate	C.F.S.	0.0	1,631.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
Maximum Water Surface Elevation	Foot	-	2444.2	-	-	-	-	-	-	2236.0
Freeboard Hydrograph										
Storm Rainfall 3/	Inch	10.50	16.80	10.50	9.98	10.20	10.50	14.50	14.50	14.50
Storm Runoff	Inch	7.60	13.40	7.60	6.90	7.05	7.60	11.40	11.40	11.10
Velocity of Flow (VC)	Ft./Sec.	8.4	10.4	10.2	9.8	10.0	9.3	10.5	8.0	8.3
Distharge Rate	C.F.S.	905	8,839	3,415	11,785	12,353	2,525	1,822	4,601	7,371
Maximum Water Surface Elevation	Foot	2389.8	2447.9	2231.3	2333.0	2331.1	2207.7	2320.0	2323.1	2239.1
Principal Spillway										
Capacity (Maximum)	C.F.S.	18	79	68	200	210	49	16	36	120
Capacity Equivalents										
Sediment Volume	Inch	3.70	3.14	2.91	2.26	1.65	2.66	3.44	3.69	2.32
Detention Volume	Inch	3.18	3.02	3.05	2.52	2.40	2.90	2.99	2.75	4.16
Spillway Storage	Inth	2.40	2.89	3.34	1.52	1.34	2.49	3.40	3.01	4.42
Class of Structure		A	B	A	A	A	A	A	A	B

(See footnotes at end of table)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Lakeview Watershed, Texas

Item	Unit	STRUCTURE NUMBER 10	11	12	13	14	15	16	101	102
Drainage Area	Sq. Mi.	1.07	0.43	1.06	1.38	19.37	3.54	4.00	1.28	0.90
Storage Capacity										
Sediment Submerged - 1st 50 Years	Ac. Ft.	18	8	21	46	2/455	30	34	0	9
Sediment Submerged - 2nd 50 Years	Ac. Ft.	18	7	21	45	444	30	34	0	8
Sediment Aerated	Ac. Pt.	14	5	15	33	330	23	24	4/35	6
Floodwater Pool	Ac. Ft.	158	63	159	212	2,407	525	578	123	80
Total	Ac. Ft.	208	83	216	336	3,636	608	670	158	103
Surface Area										
Sediment Pool (Lowest Ungated Outlet)	Acre	5	2	5	10	42	9	16	0	5
Sediment Pool - 1st 50 Years	Acre	5	2	5	10	72	9	16	9	5
Sediment Pool - 2nd 50 Years	Acre	8	5	12	15	103	14	24	14	8
Floodwater Pool	Acre	21	15	34	33	216	77	88	32	22
Volume of Fill	Cu. Yd.	51,370	29,350	71,500	90,900	356,400	96,200	211,700	47,500	12,800
Elevation Top of Dam	Foot	2356.2	2299.2	2301.1	2286.4	2265.5	2169.1	2107.9	2188.6	2164.8
Maximum Height of Dam	Foot	27.2	16.2	24.8	33.3	56.0	32.1	22.5	13.6	17.8
Emergency Spillway										
Crest Elevation	Foot	2352.5	2297.0	2298.0	2282.5	2260.0	2165.0	2104.0	2186.6	2162.8
Bottom Width	Foot	50	50	50	50	350	100	150	30	30
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use		2.5	1.6	1.6	2.3	1.2	1.4	1.2	4.0	4.0
Average Curve No. - Condition II		75	73	74	75	74	74	74	74	74
Emergency Spillway Hydrograph										
Storm Rainfall 3/	Inch	5.30	5.30	5.30	5.30	4.96	5.30	5.30	5.70	5.70
Storm Runoff	Inch	2.70	2.50	2.60	2.70	2.30	2.60	2.60	2.94	2.94
Velocity of Flow (VC)	Ft./Sec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Discharge Rate	C.F.S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maximum Water Surface Elevation	Foot	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph										
Storm Rainfall 3/	Inch	10.50	10.50	10.50	10.50	9.82	10.50	10.50	7.10	7.10
Storm Runoff	Inch	7.30	7.10	7.20	7.30	6.60	7.20	7.20	4.14	4.14
Velocity of Flow (VC)	Ft./Sec.	8.2	5.9	7.3	8.4	10.0	8.8	8.4	3.6	3.4
Discharge Rate	C.F.S.	839	312	602	911	10,864	2,095	2,730	44	36
Maximum Water Surface Elevation	Foot	2356.2	2299.2	2301.1	2286.4	2265.5	2169.1	2107.9	2187.6	2163.7
Principal Spillway Capacity (Maximum)	C.F.S.	16	14	16	14	205	35	63	55	98
Capacity Equivalents										
Sediment Volume	Inch	0.87	0.88	1.01	1.68	1.19	0.44	0.43	0.51	0.48
Detention Volume	Inch	2.77	2.76	2.81	2.89	2.33	2.78	2.71	1.81	1.67
Spillway Storage	Inch	1.58	1.49	2.08	1.97	1.31	2.01	1.86	1.00	1.10
Class of Structure		A	A	A	A	A	A	A	A	A

(See footnotes at end of table)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued
Lakeview Watershed, Texas

Item	Unit	STRUCTURE NUMBER 103	104	105E	105W	106	107	108	Total
Drainage Area	Sq. Mi.	0.80	0.68	1.55	1.58	1.08	1.34	1.32	97.92
Storage Capacity									
Sediment Submerged - 1st 50 Years	Ac. Ft.	0	0	0	0	0	0	0	5/ 3,329
Sediment Submerged - 2nd 50 Years	Ac. Ft.	0	0	0	0	0	0	0	3,239
Sediment Aerated	Ac. Ft.	4/ 16	4/ 20	4/ 36	4/ 36	4/ 23	4/ 34	4/ 44	2,682
Floodwater Pool	Ac. Ft.	75	63	145	142	101	123	129	13,272
Total	Ac. Ft.	91	83	181	178	124	157	173	22,522
Surface Area									
Sediment Pool (Lowest Ungated Outlet)	Acre	0	0	0	0	0	0	0	353
Sediment Pool - 1st 50 Years	Acre	3	6	11	9	11	6	11	531
Sediment Pool - 2nd 50 Years	Acre	6	9	17	15	16	9	18	1,286
Floodwater Pool	Acre	23	20	48	45	53	36	46	1,839
Volume of Fill	Cu. Yd.	33,870	32,400	49,800	57,770	50,920	61,510	67,400	3,173,330
Elevation Top of Dam	Foot	2175.1	2254.4	2210.5	2211.4	2165.0	2066.0	2020.0	xxx
Maximum Height of Dam	Foot	14.7	13.2	14.5	17.1	19.3	15.6	12.1	xxx
Emergency Spillway									
Crest Elevation	Foot	2173.1	2252.4	2208.5	2209.4	2163.0	2064.0	2018.0	xxx
Bottom Width	Foot	30	30	30	30	30	30	30	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use		4.0	4.0	4.0	4.0	4.0	4.0	4.0	xxx
Average Curve No. - Condition II		74	74	74	74	74	74	74	xxx
Emergency Spillway Hydrograph									
Storm Rainfall 3/	Inch	5.70	5.70	5.70	5.70	5.70	5.70	5.70	xxx
Storm Runoff	Inch	2.94	2.94	2.94	2.94	2.94	2.94	2.94	xxx
Velocity of Flow (VC)	Ft./Sec.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Discharge Rate	C.F.S.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	xxx
Maximum Water Surface Elevation	Foot	-	-	-	-	-	-	-	xxx
Freeboard Hydrograph									
Storm Rainfall 3/	Inch	7.10	7.10	7.10	7.10	7.10	7.10	7.10	xxx
Storm Runoff	Inch	4.14	4.14	4.14	4.14	4.14	4.14	4.14	xxx
Velocity of Flow (VC)	Ft./Sec.	3.4	3.2	3.4	5.2	5.0	3.6	3.1	xxx
Discharge Rate	C.F.S.	36	30	36	130	121	44	29	xxx
Maximum Water Surface Elevation	Foot	2174.0	2253.2	2209.4	2211.3	2164.8	2165.0	2118.8	xxx
Principal Spillway									
Capacity (Maximum)	C.F.S.	34	30	83	116	143	60	62	xxx
Capacity Equivalents									
Sediment Volume	Inch	0.37	0.55	0.43	0.43	0.40	0.48	0.62	xxx
Detention Volume	Inch	1.76	1.75	1.76	1.68	1.75	1.71	1.84	xxx
Spillway Storage	Inch	1.22	1.20	1.38	1.26	2.24	1.14	1.45	xxx
Class of Structure		A	A	A	A	A	A	A	xxx

1/ Exclusive of area controlled by other structures.

2/ Principal spillway ported at 200 acre-foot elevation, or less.

3/ The hydrologic design criteria for structures Nos. 1 through 16 are based on Engineering Memorandum-27 (Rev.) and Engineering-Hydrology Memorandum TX-1. The hydrologic design criteria for structures Nos. 101 through 108 are based on Chapter 1, Section 17, Texas Engineering Handbook.

4/ "Dry" pool.

5/ Includes 1,891 acre-feet of sediment storage at elevation of lowest ungated outlet.

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TABLE 3A - STRUCTURE DATA

CHANNELS

Lakeview Watershed, Texas

Channel Designation	Scacion Numbering for Reach: Scacion (100 ft.)	Scacion Numbering for Reach: Station (100 ft.)	Watershed Area: Total (sq. mi.)	Watershed Area: Uncontrolled (sq. mi.)	Channel Capacity: Existing (c.f.s.)	Channel Capacity: Planned (c.f.s.)	Average Bottom Width (ft.)	Average Side Slope	Average Depth (ft.)	Average Grade (pct.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu. yds.)
Brushy Creek												
BR-1	38+50	90+00	11.05	4.37	200	875	32	1.5:1	4.0	.48	5.67	
	90+00	92+00			Transition Section							
BR-2	92+00	152+50	11.71	5.03	800	1,030	40	1.5:1	4.2	.37	5.18	
BR-3	152+50	175+00			No Channel Improvement Planned							
	175+00	177+00			Transicion Section							
BR-4	177+00	218+50	11.90	5.22	150	1,086	40	1.5:1	4.0	.50	5.90	143
Bitter Creek												
B1-1	587+28	607+28	41.06	8.41	0	1,956	22	1.5:1	6.0	.92	10.70	19
John Mann Creek												
JM-1	156+50	170+00	22.40	3.73	500	904	100	1.5:1	2.0	.55	4.39	
	170+00	172+00			Transition Seccion							
JM-2	172+00	186+00	22.99	7.87	200	1,253	140	1.5:1	2.0	.55	4.38	
	186+00	189+00			Transition Section							
JM-3	189+00	244+00	23.85	8.73	200	1,342	50	1.5:1	4.0	.50	5.99	
	244+00	246+00			Transition Section							
JM-4	246+00	280+00	26.69	11.57	400	1,692	60	1.5:1	4.0	.55	6.41	
	280+00	282+00			Transition Section							
	282+00	-			Grade Stabilization Structure No. 204 (80' weir length)							
	282+00	284+00			Transition Section							
JM-5	284+00	288+00	26.69	11.57	400	1,692	60	1.5:1	4.0	.55	6.41	121
Oak Creek - Mainstem												
O-1	367+75	412+00	29.44	11.00	1,100	2,162	50	1.5:1	5.0	.60	7.52	
	412+00	414+00			Transition Section							
O-2	414+00	513+00	31.81	15.65	1,020	2,575	60	1.5:1	5.0	.60	7.63	
	513+00	515+00			Transition Section							
O-3	515+00	540+00	37.03	24.93	1,120	3,208	60	1.5:1	6.0	.50	7.75	
	540+00	542+00			Transition Section							
O-4	542+00	580+00	37.32	25.29	810	3,394	60	1.5:1	6.2	.50	7.90	
O-5	580+00	600+00	42.31	30.28	535	3,038	60	1.5:1	6.2	.40	7.07	
	600+00	602+00			Transicion Section							
O-6	602+00	688+00	43.13	31.40	500	3,736	60	1.5:1	7.0	.40	7.57	
O-7	688+00	780+00	75.11	40.32	500	4,180	60	1.5:1	7.0	.50	8.47	616

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TABLE 3A - STRUCTURE DATA - Continued

CHANNELS

Lakeview Watershed, Texas

Channel Designation	Station Numbering for Reach: Station (100 ft.)	Station (100 ft.)	Watershed Area: Total (sq. mi.)	Uncontrolled (sq. mi.)	Channel Capacity: Existing (c.f.s.)	Planned (c.f.s.)	Average Bottom Width (ft.)	Average Side Slope	Average Depth (ft.)	Average Grade (pct.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu. yds.)
Oak Creek - Tributary												
	98+00	100+00			Transition Section from Existing Stream Channel							
0-8	100+00	132+00	16.50	4.25	110	650	24	1.5:1	4.0	.33	5.12	
	132+00	134+00			Transition Section							
0-9	134+00	206+00	18.86	4.71	110	860	30	1.5:1	4.0	.40	5.88	
	206+00	208+00			Transition Section							
0-10	208+00	235+00	20.95	4.99	110	950	50	1.5:1	4.0	.20	4.36	91
	235+00	240+90			Transition Section into Mainstem, Oak Creek							
Oak Creek - Tributary												
0-11	316+00	381+50	5.00	0	0	50	12	1.5:1	1.5	.25	2.44	5
											Total Excavation	995

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TABLE 3B - STRUCTURE DATA
FLOODWATER DIVERSIONS
Lakeview Watershed, Texas

Channel Designation	Station Numbering for Reach: Station (100 ft.)	Station (100 ft.)	Watershed Area: Uncontrolled (sq. mi.)	Channel Capacity: Planned (c.f.s.)	Average Bottom Width (ft.)	Average Side Slope	Average Depth (ft.)	Average Grade (pct.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu. yds.)
Oak Creek										
Diversion I										
	5+50	8+50			Transition Section					
I-1	8+50	10+00	0.94	194	20	4:1	2.4	.25	2.73	
I-2	10+00	25+00	1.23	260	20	4:1	2.8	.25	2.98	
I-3	25+00	30+00	1.68	378	20	4:1	3.4	.25	3.31	
I-4	30+00	44+00	2.17	521	20	4:1	4.0	.25	3.62	
I-5	44+00	47+00			Transition Section					11
Diversion II										
	47+00	49+00			Transition Section					
II-1	49+00	I32+00	1.96	352	26	4:1	4.0	.10	2.09	
	132+00	134+00			Transition Section					
II-2	134+00	140+00	4.42	438	10	4:1	4.0	.50	4.21	
	140+00	142+00			Transition Section					74
Diversion III										
	13+50	14+50			Transition Section					
III-1	14+50	20+00	3.28	840	34	4:1	4.0	.30	4.20	
	20+00	22+50			Transition Section					
III-2	22+50	73+00	4.34	924	38	4:1	4.0	.30	4.28	
	73+00	75+70			Transition Section					73
Diversion IV										
	1+50	4+00			Transition Section					
IV-1	4+00	11+00	0.44	277	30	4:1	2.0	.50	3.64	
	11+00	13+00			Transition Section					
IV-2	13+00	45+00	0.83	284	26	4:1	2.5	.30	3.15	
	45+00	48+00			Transition Section					19
Diversion V										
	0+00	2+00			Transition Section					
V-1	2+00	40+00	2.99	716	54	4:1	4.0	.10	2.56	
	40+00	42+00			Transition Section					
V-2	42+00	66+00	5.68	787	56	4:1	4.4	.08	2.43	
	66+00	68+00			Transition Section					38
									Total Excavation	215

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TABLE 3C - STRUCTURE DATA

STREAMBANK PROTECTION

Lakeview Watershed, Texas

Stream Name	Structure Number	Length of Streambank Protection (ft.)	Station Numbering: Station (100 ft.)	Station Numbering: Station (100 ft.)	Bank Designation 1/	Average Height of Bank (ft.)
Bitter Creek	301	600	700+00	706+00	Left	17
	302	200	709+00	711+00	Right	17
	303	400	734+00	738+00	Left	17
	304	700	751+50	758+50	Left	15
	305	300	774+00	777+00	Left	15
	306	600	782+50	788+50	Right	15
	307	250	799+00	801+50	Left	15
	308	800	883+00	891+00	Left	15

1/ Downstream view.

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TABLE 3D - STRUCTURE DATA

DIKE

Lakeview Watershed, Texas

Structure Number	Station Numbering for Reach: Station (ft.)	Station Numbering for Reach: Station (ft.)	Top Width (ft.)	Side Slopes	Average Height (ft.)	Volume of Fill 1/ (cu. yds.)
401	200+00	230+00	10	3:1	3	6,300

1/ Fill will be semi-compacted.

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TABLE 3E - STRUCTURE DATA
GRADE STABILIZATION STRUCTURES
Lakeview Watershed, Texas

Structure Number	Drainage Area (acre) 1/	Principal Spillway (m.s.l.)	Emergency Spillway (m.s.l.)	Top of Dam (m.s.l.)	Principal Spillway Capacity (Maximum) (c.f.s.)	Volume of Fill (cu. yd.)
201	2,694	2266.0	2272.0	2275.0	690	2,600
202	3,200	2205.0	2212.0	2215.0	690	2,600
					Total	5,200

Structure Number	Station (feet)	Drainage Area (acre) 1/	Drop (feet)	Concrete (cu. yd.)	Type Structure
203	0+00	1,478	10.0	128	Weir Type "C" 2/ Drop Spillway
204	282+00	7,405	5.0	140	Weir Type "C" 2/ Drop Spillway
205	47+00	1,389	14.0	118	Weir Type "C" 2/ Drop Spillway

1/ Does not include area controlled by floodwater retarding structures.

2/ As set forth in National Engineering Handbook, Section 11.

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TABLE 4 - ANNUAL COST
Lakeview Watershed, Texas
(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Brushy Creek 2 Floodwater Retarding Structures, 2 Grade Stabilization Structures, and 14,800 feet of Stream Channel Improvement	12,745	1,748	14,493
Ritter Creek 3 Floodwater Retarding Structures, 1 Grade Stabilization Structure, 2,000 feet of Stream Channel Improvement, and 3,850 feet of Streambank Protection	22,934	696	23,630
John Mann Creek 7 Floodwater Retarding Structures, 1 Grade Stabilization Structure, and 13,150 feet of Stream Channel Improvement	21,646	2,014	23,660
Hogland Flat Creek 7 Floodwater Retarding Structures	10,739	1,171	11,910
Oak Creek 6 Floodwater Retarding Structures, 1 Grade Stabilization Structure, 62,065 feet of Stream Channel Improvement, 31,320 feet of Floodwater Diversion, and 3,000 feet of Dike	39,935	5,997	45,932
TOTAL	107,999	3/ 11,626	119,625

1/ Price Base: 1966 prices amortized for 100 years at 3.25 percent.
2/ Adjusted normalized prices.
3/ Includes costs of $760 for replacement of structures or appurtenances having a life expectancy shorter than the 100-year evaluation period.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Lakeview Watershed, Texas
(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop and Pasture	110,457	4,384	106,073
Other Agricultural	27,643	1,119	26,524
Non-Agricultural			
Road and Bridge	21,444	500	20,944
Urban	3,540	0	3,540
Subtotal	163,084	6,003	157,081
Sediment			
Overbank Deposition	45,030	10,978	34,052
Swamping	13,887	889	12,998
Subtotal	58,917	11,867	47,050
Erosion			
Flood Plain Scour	7,088	973	6,115
Valley Trenching	1,288	0	1,288
Streambank	2,542	73	2,469
Subtotal	10,918	1,046	9,872
Indirect	23,292	1,891	21,401
TOTAL	256,211	20,807	235,404

1/ Price Base: Adjusted normalized prices.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Lakeview Watershed, Texas

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS				Average Annual Cost	Benefit-Cost Ratio
	Flood Prevention					
	Damage Reduction	Incidental Recreation	Secondary	Total		
Brushy Creek 2 Floodwater Retarding Structures, 2 Grade Stabilization Structures, and 14,800 feet of Stream Channel Improvement 2/	20,284	1,333	2,068	23,685	14,493	1.6:1
Bitter Creek 2 Floodwater Retarding Structures, 1 Grade Stabilization Structure, 2,000 feet of Stream Channel Improvement, and 3,850 feet of Streambank Protection 2/	23,884	3,424	2,333	29,641	23,630	1.3:1
John Mann Creek 7 Floodwater Retarding Structures, 1 Grade Stabilization Structure, and 13,150 feet of Stream Channel Improvement 2/	34,415	3,399	3,531	41,345	23,660	1.7:1
Hogland Flat Creek 7 Floodwater Retarding Structures	15,093	-	1,524	16,617	11,910	1.4:1
Oak Creek 6 Floodwater Retarding Structures, 1 Grade Stabilization Structure, 62,065 feet of Stream Channel Improvement, 31,320 feet of Floodwater Diversion, and 3,000 feet of Dike 2/	130,801	600	12,487	143,888	45,932	3.1:1
GRAND TOTAL	224,477	8,756	21,943	255,176	119,625	2.1:1

1/ Average annual benefits and operation and maintenance costs based on adjusted normalized prices; construction costs based on 1966 prices.

2/ Interrelated measures.

3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of 10,927 annually.

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INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment measures for the watershed was developed by supervisors of the Hall County and Donley County Soil and Water Conservation Districts with assistance from personnel of the Soil Conservation Service Work Units at Clarendon and Memphis, Texas. Basic soil and water conservation plans have been developed on all of the acreage of the watershed lying in Donley County. All of these plans, 14 in number, were analyzed to determine land use and needs. Forty-one basic soil and water conservation plans, representing 12 percent of the operating units, were analyzed for that portion of the watershed lying in Hall County. These figures were expanded to represent the total acreage involved for that portion of the watershed.

This analysis provided pertinent data on total conservation needs, accomplishments to date, and remaining needs, and was useful in the establishment of priorities for planning and application of needed land treatment measures.

The need for funds for accelerated assistance represents the difference in the amount of funds now being expended and those which will be required in order to meet the project goal of the application of 80 percent of all needed land treatment by the end of the 10-year installation period.

Engineering Investigations

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

1. A base map of the watershed was prepared. Possible structural measures that would accomplish the project objectives were then located on the map. The map was then reviewed with the local sponsors. It was agreed that a system of structural measures including floodwater retarding structures, stream channel improvement, floodwater diversions, dikes, grade stabilization structures, and streambank protection would be investigated.

2. Engineering surveys for the 25 floodwater retarding structures were made in accordance with Watersheds Memorandum TX-2. Reservoir pool topography was mapped on aerial photographs with a scale of 8 inches equals 1 mile. Engineering surveys for the stream channel improvement, grade stabilization structures, floodwater diversions, and dikes were made in accordance with Watersheds Memorandum TX-1. Surveys were made using aerial photographs with a scale of 8 inches equal 1 mile.

3. Floodwater retarding structures 1 through 16 were designed in accordance with criteria outlined in Engineering Memorandum-27 (Rev.), March 19, 1965, and Texas State Manual Supplement 2441. Structures 101 through 108 are small dams for which the product of storage times the height of the dam is less than 3,000. These structures were designed in accordance with Conservation Practices Specifications No. TX-5, "Small Earthen Dams or Reservoirs," August 1965, and No. TX-10, "Pipe Drop Inlets, Hood Inlets, and Pipe Drops," June 1964.

4. The stream channel improvement designs were based on the procedures outlined in USDA Technical Release No. 25, "Planning and Design of Open Channels," December 15, 1964.

5. The earth dam grade stabilization structures were designed in accordance with Section 17, Texas Engineering Handbook. The type "C" concrete grade stabilization structures were designed in accordance with Section 11, National Engineering Handbook.

6. The floodwater diversions were designed in accordance with Conservation Practices Specifications No. TX-3, "Diversions or Spreader Terraces," February 1962, and the Engineering Handbook for Work Unit Staffs.

7. The streambank protection structures were designed in accordance with the Engineering Handbook for Work Unit Staffs.

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from U. S. Weather Bureau Climatological Bulletins for the gages at Memphis and Brice, Texas. Rainfall frequency data for the watershed were obtained from U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas for the United States."

2. The present hydrologic conditions were determined from a 10 percent sampling of soil and cover conditions. Four sub-land resource areas showing significant variations in hydrologic soil groupings as well as land use and cover conditions were delineated on a watershed base map. The with project hydrologic conditions were determined by considering the effect of changes in land use and treatment that are expected during the installation period.

3. The area subject to damage from flooding was determined by stereoscopic photo study, field surveys, and interviews with residents of the watershed.

These studies indicated that the areas subject to flooding were originally natural water spreading areas with no defined channel or water courses. However, because of the favorable topographic and soil characteristics, these areas developed into highly productive farming lands. Manmade diversions and erosion tend to concentrate flood flows and make the paths of smaller floods predictable. However, the paths of large floods are very unpredictable. Overtopping of diversions and dikes and construction of new diversions determine the path of the next flood.

The surveys of the flood plain were used to evaluate typical floods assuming one set of conditions. Average annual acres flooded were determined by using this approach. Interviews with flood plain residents indicated that the results are reasonable, although conservative.

4. Engineering surveys were made of the stream channels, flood plain, and roads to represent the stream hydraulics and flood plain area. Preliminary locations were made on aerial photographs, giving due consideration to the needs of the geologist and the economist. The final locations were selected on the ground.

5. Stage-discharge relationships for the valley cross sections were developed by use of Manning's formula.

6. The relationships of peak discharges and flow durations for the drainage area above each valley cross section were determined by routing the peak discharge from runoff of the 24-hour, 25-year frequency rainfall, using antecedent moisture condition No. II.

7. Stage-area inundated curves were developed for each portion of the agricultural flood plain represented by a single cross section. Area inundated depths of 0-1, 1-3, and 3 feet plus depth increments were determined for selected frequency storm events of 1, 2, 5, 10, 25, 50, and 100-year frequency, 24-hour rainfall. Composite runoff-area inundated curves were developed for each reach and for the entire watershed to reflect the without project conditions and to reflect the effect of the planned works of improvement.

8. Determinations were made of the area that would be flooded by the selected frequency floods under each of the following conditions:

   a. The present condition, using the present soil-cover complex number.

   b. The installation of the various systems of floodwater retarding structures, stream channel improvement, and floodwater diversions, using the future soil-cover complex number.

9. Reservoir operation studies were completed to determine the feasibility of meeting recreation demands in two of the proposed floodwater retarding structures. The results of the studies indicated that the recreation demands could not be met because of excessive evaporation and seepage from the structures. The procedure for making these studies is contained in Texas Engineering Handbook, Section 4, Hydrology, Chapter 2. Reservoir evaporation rates were obtained from the Texas Board of Water Engineers Bulletin 6006, "Monthly Reservoir Evaporation Rates for Texas," and were adjusted to reflect the effect of solar radiation, wind, dew point, and air temperature in accordance with U. S. Weather Bureau Technical Paper No. 37. Rainfall records for the Weather Bureau gages at Brice and Memphis, Texas, were used for the studies.

10. Detention volumes for floodwater retarding structures Nos. 1 through 16 were determined by using the procedures outlined in Engineering-Hydrology Memorandum TX-2, "Detention Storage Requirements for Floodwater Retarding Structures," November 5, 1965, and Engineering Memorandum-27 (Rev.), March 19, 1965.

11. The emergency spillway and freeboard hydrographs were developed for floodwater retarding structures Nos. 1 through 16 in accordance with procedures outlined in Engineering-Hydrology Memorandum TX-1, "Emergency and Freeboard Hydrograph Development," August 16, 1965, and Engineering Memorandum-27 (Rev.), March 19, 1965. The dimensions of the emergency spillways were determined by flood routing the freeboard hydrograph.

12. Detention volumes, pipe drop inlets, and emergency spillways for floodwater retarding structures 101 through 108 were proportioned in accordance with the design criteria and procedures for earth dams given in Texas Engineering Handbook, Section 17, Chapter 1, Erosion Control Structures.

13. In determining the release rates of the principal spillways of the floodwater retarding structures, primary consideration was given to the effect of the release flows on the stability of the downstream channel and the effect of duration of flooding in the reservoir pools.

14. The required capacities for stream channel improvement, floodwater diversions, and the dike below floodwater retarding structure No. 12 were determined from routings described in item 6.

15. The earth dam grade stabilization structures were proportioned to carry the 10-year frequency peak discharges through the pipe drop inlets. The 100-year frequency peak discharges were used to determine the required size of the emergency spillways.

16. The concrete weir type grade stabilization structures were proportioned to carry the peak discharge from the 100-year flood without overtopping.

17. The dike was designed as class II in accordance with "National Engineering Standard and Specification Guide for Dike and Levee (Classes II and III)," with 2 feet of freeboard above the 100-year frequency event hydraulic gradient.

Sedimentation Investigations

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

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

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

   b. The appropriate sediment delivery ratios and trap efficiency adjustments were made in accordance with Chapter VIII. The relief-length method for estimating the delivery ratio was used. Trap efficiencies of 90 percent and 80 percent were estimated for floodwater retarding structures and dry pool floodwater retarding structures, respectively.

   c. Allowances for differences in soil and sediment densities were based on the following volume weights by textural classes:

Texture	Soil in Place (lbs./cu.ft.)	Sediment (lbs./cu. ft.)
Clays	80	60
Loams	85	68
Fine Sandy Loam	90	79
Loamy Fine Sand	95	90

d. Sediment allocation to pools was made as follows:

Period of Deposition	Pool	Condition of Sediment	Allocation (percent)
First 50 years	Sediment	Submerged 1/	35
Second 50 years	Sediment	Submerged 1/	35
	Detention	Aerated	30

1/ Sediment will be aerated in structures planned with dry pools.

2. Sedimentation and scour damage investigations were made by the field mapping method as explained in chapter XI of the guide. Damage categories, measurements, and summaries of all physical flood plain damages were made in accordance with suggested procedures. Land destruction by streambank erosion and valley trenching was substantiated by studies of aerial photos made in 1950 and 1964.

Channel Stability Studies

Technical Release No. 25, "Planning and Design of Open Channels," USDA, SCS, December 15, 1964, was used as a guide in making channel investigations for stability studies. These investigations included study of the general geology and soils of the drainage basin, depth and nature of the alluvium, thickness and types of modern alluvial deposits, types of bedload carried, relative stability under present conditions, and nature of the underlying bedrock.

A power soils auger was used in making necessary field investigations. All soil horizons were logged and representative samples collected for laboratory analysis. Tests were made on 14 samples.

All stream channel improvement is located in alluvial and terrace deposits. These materials range from highly plastic (P.I. greater than 20), cohesive clays (CH) in small areas to low plasticity (P.I. 10 or less) and nonplastic sandy and silty materials (SM, SM-SP, ML, and SC-CL) over large areas. Deep accumulations of coarse sand bed materials (d50 = 0.3 to 0.7 m.m.) occur in most existing natural channels. Sand deposits also occur under the wide alluvial valleys along old buried stream channels. The finer textured materials (d50 = 0.02 to 0.15 m.m.) occur outward from the stream channels. Silts deposited by wind and water predominate in these deposits. The alluvial deposits occur to depths of 125 feet in the underlying Permian redbeds bedrock.

Design of the improved channels in cohesive soils is based on suggested velocities in Technical Release No. 25. Designs in the noncohesive soils

are based on bedload studies (Schoklitch Equation) in which design velocities are adjusted on the basis of expected incoming bedload. The types of soil materials on which the channels are located and the basis for design are shown in the following tabulation:

Channel Designation	Channel Reach	Cohesive Soils P.I. = 20+	Cohesive Soils P.I. = 10-20	Noncohesive Soils
Brushy Creek	BR-1			X
	BR-2			X
	BR-3		X	
Bitter Creek	BI-1			X
John Mann Creek	JM-1		X	
	JM-2			X
	JM-3		X	
	JM-4	X		
	JM-5	X		
Oak Creek	O-1		X	
	O-2		X	
	O-3			X
	O-4			X
	O-5		X	
	O-6	X		
	O-7	X		
	O-8	X		
	O-9	X		
	O-10	X		
	O-11			X

Geologic Investigations

Preliminary geologic dam site investigations were made at each of the 25 floodwater retarding structure sites and reports prepared in accordance with procedures shown in chapter 6, "Guide to Geologic Site Exploration," South Regional Technical Service Area, EWP Technical Guide No. 4, USDA, SCS, June 1967. These investigations included studies of valley slopes, alluvium, channel banks, and exposed geologic formations. Core drill equipment was used to make more detailed investigations of foundation conditions at Sites 3, 4, and 14.

Site 14 was investigated as a multiple-purpose structure to include recreational development. Foundation conditions indicate that high water losses would occur through the 60 feet or more of SM and SP materials occurring under the valley. A suitable cutoff for water storage cannot be attained at this site at a reasonable cost.

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

Economic Investigations

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention," U. S. Department of Agriculture, Soil Conservation Service, March 1964. Eight reaches were evaluated because of the diversity of damageable values and flood plain characteristcs. Seven of these, each with its own damageable value, are agricultural reaches and one is an urban reach involving the town of Lakeview. An adjustment was made in the damageable value of the flood plain of Oak Creek to reflect the effect of increasing swamping under nonproject conditions.

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

The monetary value of the physical damage from flood plain scour and overbank deposition was based upon production lost and the net loss to the farm operator. The value of recovery from this damage was discounted in accordance with the time required for and the extent of recovery. The

monetary value of the expected future damage from valley trenching and streambank erosion was estimated by using the procedures outlined in chapter 5 of the Economics Guide.

Road and bridge damage estimates for without project conditions were based on interviews with State highway officials and county commissioners concerning damages to roads and bridges from specific flood events. Estimated benefits were based upon expected reduction of flooding as a result of project installation. Indirect damages were estimated to approximate 10 percent of direct damages.

Incidental recreation benefits were evaluated for sediment pools of those floodwater retarding structures expected to retain water and to be open to the general public on either a free or fee basis. A value of $1 per visitor-day was used for evaluation in accordance with recommendations in Watersheds Memorandum-57, October 3, 1962. Associated costs of development, including liability insurance, operations, and maintenance, were deducted from the gross value of benefits. Benefits were calculated allowing for full level of use for 40 years, with a gradual diminishing of use and attractiveness during the next 10 years to zero by the end of 50 years and for the balance of the evaluation period. Restoration of former productivity is expected on approximately 850 acres of formerly productive land now plagued by a high water table.

Secondary benefits stemming from the project were estimated to amount to 10 percent of damage reduction benefits, incidental recreation, and restoration of former productivity as outlined in chapter 11 of the Economics Guide. Secondary benefits induced by the project were estimated to amount to 10 percent of increased expenditures associated with restoration of former productivity and recreation development.

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

A comparison of the value of agricultural production lost in the pool areas as a result of the project to the amortized value of the easements showed the latter to be greater. The value of easements was therefore used to be conservative in the economic evaluation.

Fish and Wildlife Investigations

The Bureau of Sport Fisheries and Wildlife, in cooperation with the Texas Parks and Wildlife Department, has completed a reconnaissance survey of the Lakeview watershed. This report was invaluable in preparing the fish and wildlife phase of the sections of this work plan on "DESCRIPTION OF THE WATERSHED" and "EFFECTS OF WORKS OF IMPROVEMENT." In addition, the following recommendations are reproduced from the report:

> The basins of the floodwater retarding reservoirs should be disked and planted to a grain adaptable to the area upon

completion of the reservoirs and prior to impoundment. These plantings would improve fish habitat by decreasing turbidity and improving the initial fertility of the reservoir waters.

Lands adjacent to the periphery of floodwater retarding reservoirs should be sowed to grass to prevent soil erosion and sediment deposition into the basins of the impoundments.

When practicable, the floodwater retarding reservoirs should be fenced to prevent muddying of the water by livestock. If required, watering devices should be installed below the dams and outside of the enclosures.

The floodwater retarding reservoirs should be stocked with fish species and at rates recommended by the Texas Parks and Wildlife Department in order to achieve the best possible fishery.

We do not know whether or not the project planners have considered the possibility of adding conservation storage in one or more of the proposed floodwater retarding reservoirs. Under certain conditions, Federal aid is available to finance up to 50 percent of the incremental cost to modify a structure or structures for conservation storage. Usually, the incremental cost to include such storage is a small part of the total cost of the structure; and cities, sportsmen's clubs, or interested groups can often benefit from development of conservation storage in small watershed projects at modest cost.

During the process of stream channel enlargement and construction of floodwater retarding structures and debris basins, clearing of woody vegetation should be kept to a minimum. Standing timber is at a premium for deer and turkey along watercourses and should be preserved when practicable.

Wildlife habitat could be improved by the planting of wildlife food and cover plants. These plantings could be made in eroded and barren areas, gullies, impoundment enclosures, and along fencerows and driveways. Such plantings also would add to the esthetic value of the area.

In view of the above, it is recommended that:

1. The basins of the floodwater retarding reservoirs be planted to a grain adaptable to the area upon completion and prior to impoundment.

2. Lands adjacent to the periphery of the floodwater retarding reservoirs be sowed to grass.

3. When practicable, the floodwater retarding reservoirs be fenced and, if necessary, a livestock watering device be installed outside of each fenced enclosure.

4. The floodwater retarding reservoirs be stocked with fish species and at rates recommended by the Texas Parks and Wildlife Department.

5. The project planners consider the possibility of conservation storage in one or more of the proposed floodwater retarding reservoirs.

6. The clearing of woody vegetation be kept at a minimum during stream channel enlargement and construction of floodwater retarding structures and debris basins.

7. Wildlife food and cover plants be planted in eroded and barren areas, gullies, impoundment enclosures, along fencerows, and driveways.

The above recommendations are in conformance with U.S.D.A. Soil Conservation Service Biology Memorandum-7 (Rev. 1), National Standards for Biology Practices. If adopted as a part of the plan of development, losses of wildlife habitat would be mitigated and, additionally, fish and wildlife benefits would accrue to the project.

A detailed study of the watershed by the Bureau of Sport Fisheries and Wildlife is not considered necessary at this time. Should the sponsors desire, our Bureau, in cooperation with the Texas Parks and Wildlife Department, would be happy to be of further assistance in developing plans for fish and wildlife.

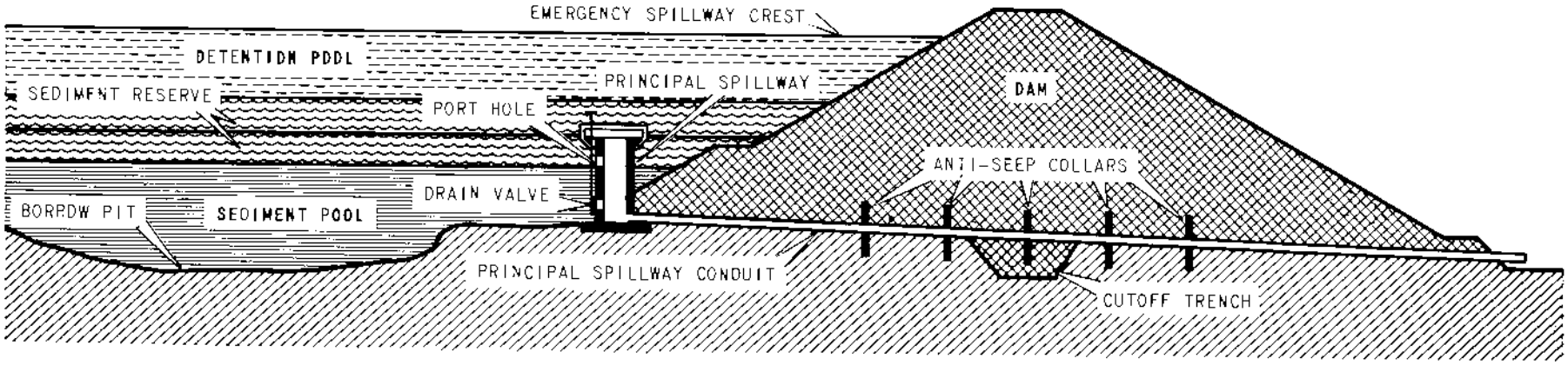
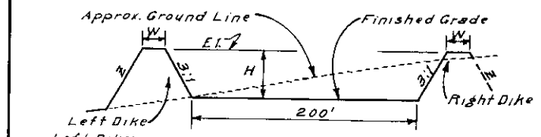


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

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



Left Dike:
From Sta. 4+30 to Sta. 5+00-El.= 1962.2, W=16.0', Z= 2.5:1
From Sta. 5+00 to Sta. 5+50 - a transition section.
From Sta. 5+50 to approx. Sta. 6+30-W=10.0', Z=3:1, H=4.5'.
Right Dike:
From Sta. 4+30 to Sta. 5+00-El.= 1962.2, W=16.0', Z= 2.5:1
From Sta. 5+00 to Sta. 5+50 - transition to W=10.0', Z=3:1, H=4.5'.
Material forming dikes shall be placed and paid as "Earth Fill, Embankment".

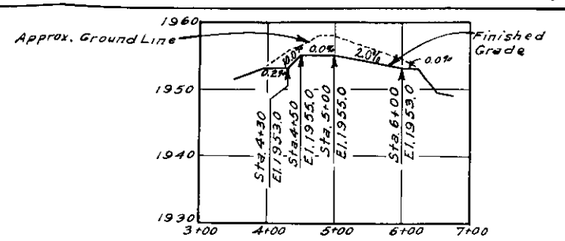
TYPICAL SECTION — EMERGENCY SPILLWAY

Emergency Spillway Diversions and Stub Diversions (S.D.): 18" effective height, 3:1 side slopes and 13 ft., minimum base, shall be constructed at the approximate locations shown on the plans. Final locations of the Stub Diversions shall be determined by the Engineer (See Construction Specification 5).

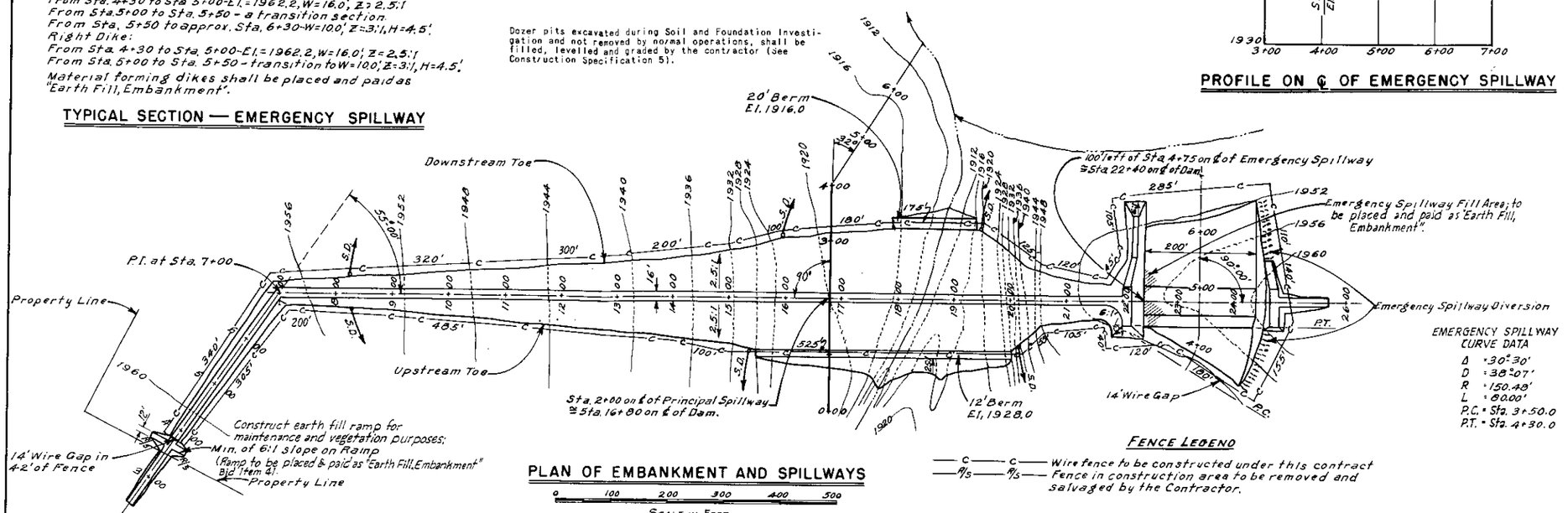
A minimum of 6" topsoil shall be placed in Emergency Spillway and on all Earth Fill Areas (See Construction Specification 20C).

Stream Channel within embankment area shall be shaped and cleared of objectionable material (see sheet 12 and Construction Specification 4).

Dozer pits excavated during Soil and Foundation Investigation and not removed by normal operations, shall be filled, levelled and graded by the contractor (See Construction Specification 5).



PROFILE ON ℄ OF EMERGENCY SPILLWAY

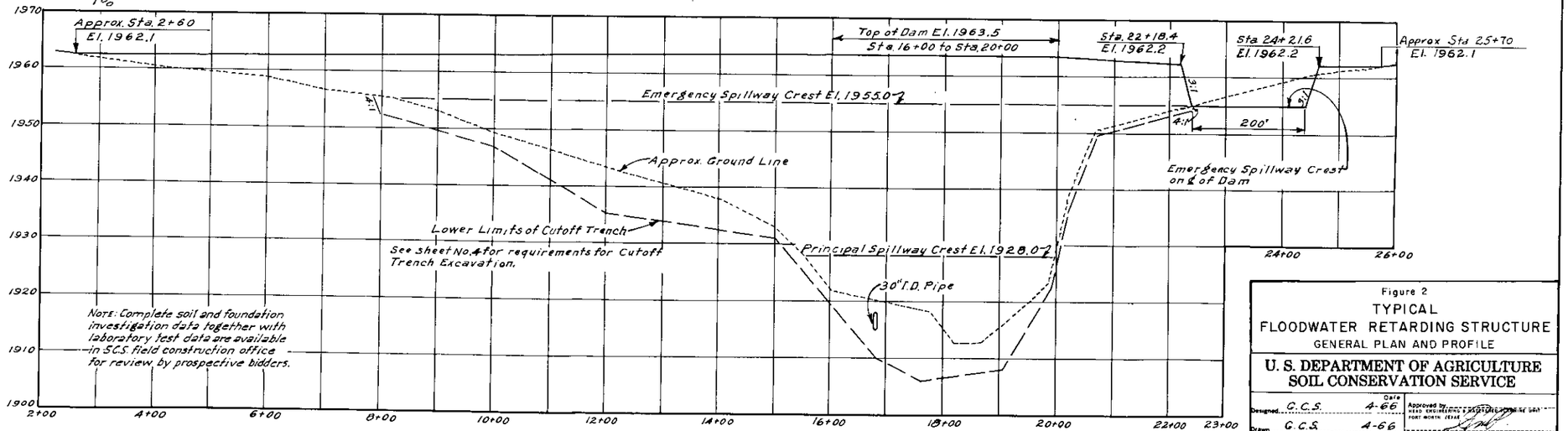


PLAN OF EMBANKMENT AND SPILLWAYS

0 100 200 300 400 500
SCALE IN FEET

FENCE LEGEND

—— C —— C —— Wire fence to be constructed under this contract
—— R/S —— R/S —— Fence in construction area to be removed and salvaged by the Contractor.



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

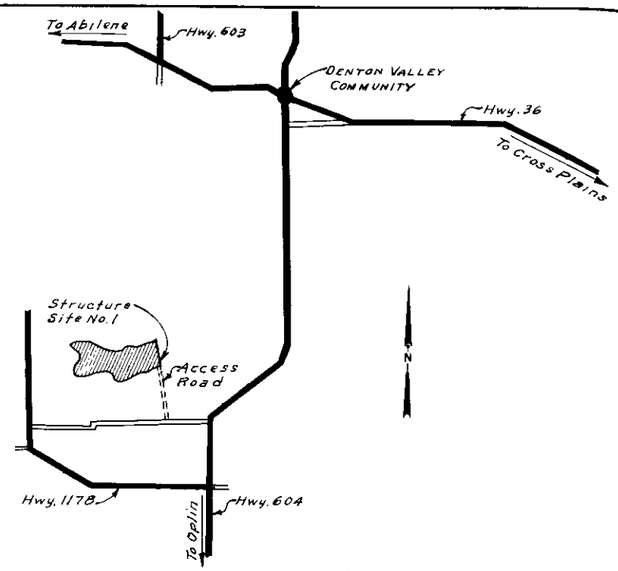
PROFILE ON ℄ OF DAM

Figure 2
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	C.C.S.	4-66
Drawn	C.C.S.	4-66
Traced	T.F.R.	5-66
Checked	C.C.S.	5-66

Approved by: ACTING AREA CONSERVATIONIST
FORT WORTH, TEXAS
STATE CONSERVATION ENGINEER
TEMPLE, TEXAS
Sheet No. 12 of 13
Drawing No. 4-E-21,594



Structure site is located approx. 7 miles southwest of Denton Valley Community, Callahan County, Texas.

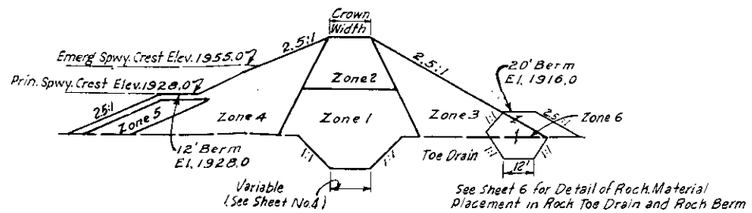
VICINITY MAP

0 1 2 3 4
SCALE IN MILES

Note: For limits of clearing and clearing and grubbing see Construction Specifications 1 and 2.

GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640
SCALE IN FEET



See Sheet 6 for Detail of Rock Material Placement in Rock Toe Drain and Rock Berm

TYPICAL SECTION - ZONED EMBANKMENT

MATERIALS PLACEMENT DATA

Embankment Zone No. 1/	Source of Fill Materials: Material Location 2/	Source of Fill Materials: Average Depth, feet: From	Source of Fill Materials: Average Depth, feet: To	Type or Unified Classification	Field Control Test: ASTM Test: Number	Field Control Test: ASTM Test: Method	Placement and Compaction Requirements: Max. Allowable Particle Size	Placement and Compaction Requirements: Max. Uncompacted Layer Thickness	Placement and Compaction Requirements: Specified Compaction Class	Placement and Compaction Requirements: Min. Dry Density, Percent of Field Test Max. Dry Density	Placement and Compaction Requirements: Moisture Limits, Relative to Field Test Optimum: From	Placement and Compaction Requirements: Moisture Limits, Relative to Field Test Optimum: To	Laboratory Test Data: ASTM Test: Number	Laboratory Test Data: ASTM Test: Method	Laboratory Test Data: Curve No.	Laboratory Test Data: Max. Dry Density, p.c.f.	Laboratory Test Data: Optimum Moisture, %
1	Borrow	0	3	CL	D698	A or B	6"	9"	A	95	-2	+4	D698	A	5	101.5	20.5
	Borrow	0	6	CL	D698	A or B	6"	9"	A	95	-2	+3	D698	A	6	113.0	14.0
	Borrow	0	4	SC	D698	A or B	6"	9"	A	95	-1	+3	D698	A	3	116.5	13.0
2 & 3	Borrow	4	12	GC	D698	D	6"	9"	A	95	Opt.	+4	D698	C	2	130.0	7.0
4	Borrow	0	7	SM	D698	A or B	6"	9"	A	95	-1	+4	D698	A	4	121.5	11.0
5	Borrow	0	4	SM	D698	A or B	6"	9"	A	95	Opt.	+4	D698	A	1	116.0	11.5
2 & 3	Emerg. Spwy.	0	Grade	GC	D698	D	6"	9"	A	95	Opt	4	Not Tested				
6	3/	Durable Rock					24"	36"									

1/ The zone boundaries shown in the typical section are approximate. Adjustments will be made by the Engineer to permit the use, within the neat lines of the embankment, of all suitable materials from the required excavations.

2/ Materials from the required excavations that are not tabulated in the table above and that are suitable and acceptable for earth fill shall have the same placement and control requirements as that specified for like materials under Materials Placement Data.

3/ Rock Material to be used for the Rock Toe Drain, Berm, and Channel Liner shall be procured from required excavations.

Additional rock materials required in excess of that obtained from specified excavations shall be combed, raked or otherwise harvested from the sediment pool, detention pool, or surrounding areas. (See Construction Specification 5).

ZONED EMBANKMENT DATA

All usable material from within the sediment pool shall be used prior to enlarging borrow area outside these limits. Borrow from outside the sediment pool shall be obtained only as directed by the Engineer.

Elevation	Surface Acres	Storage: Acre Feet	Storage: Inches
1918	1	3	.0
1920	9	11	.82
1924	9	35	.05
1928	13	79	.12
1932	22	149	.23
1934.1	27	207	.32
1936	32	257	.40
1940	47	415	.165
1944	71	651	1.01
1948	96	985	1.53
1952	130	1437	2.24
1955	155	1864	2.90
1956	163	2023	3.15
1960	197	2743	4.27
1962.1	221	3182	4.95
1964	243	3623	5.64

Top of Dam (Effective) Elev.	1962.1
Emergency Spillway Crest Elev.	1955.0
Principal Spillway Crest Elev.	1928.0
Sediment Pool Elev.	1928.0
Drainage Area, Acres	7706.
Sediment Storage, Acre Feet	207.
Floodwater Storage, Acre Feet	1651.
Max. Emergency Spillway Cap., c.f.s.	14820.

Figure 2

TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	G.C.S.	4-66
Drawn	G.C.S.	4-66
Traced	T.F.R.	5-66
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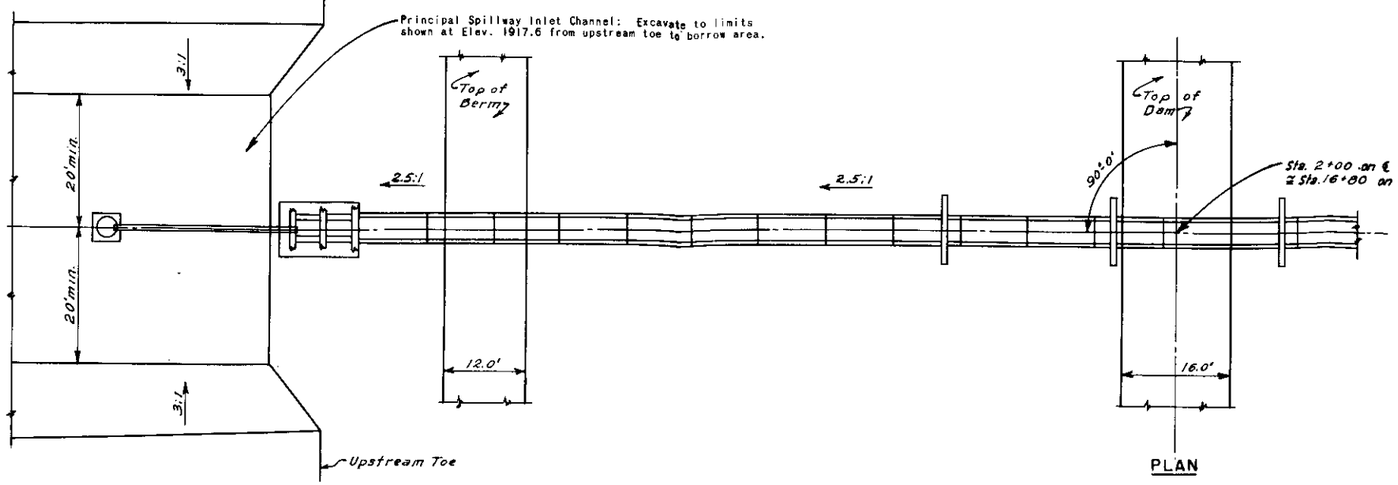
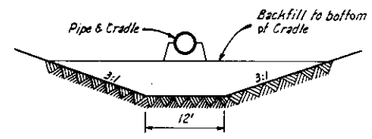
Approved by: Head, Engineering Unit, Post, Texas; State Conservationist, S.C.S.

Temple, Texas
Sheet No. 3 of 13
Drawing No. 4-E-21,594

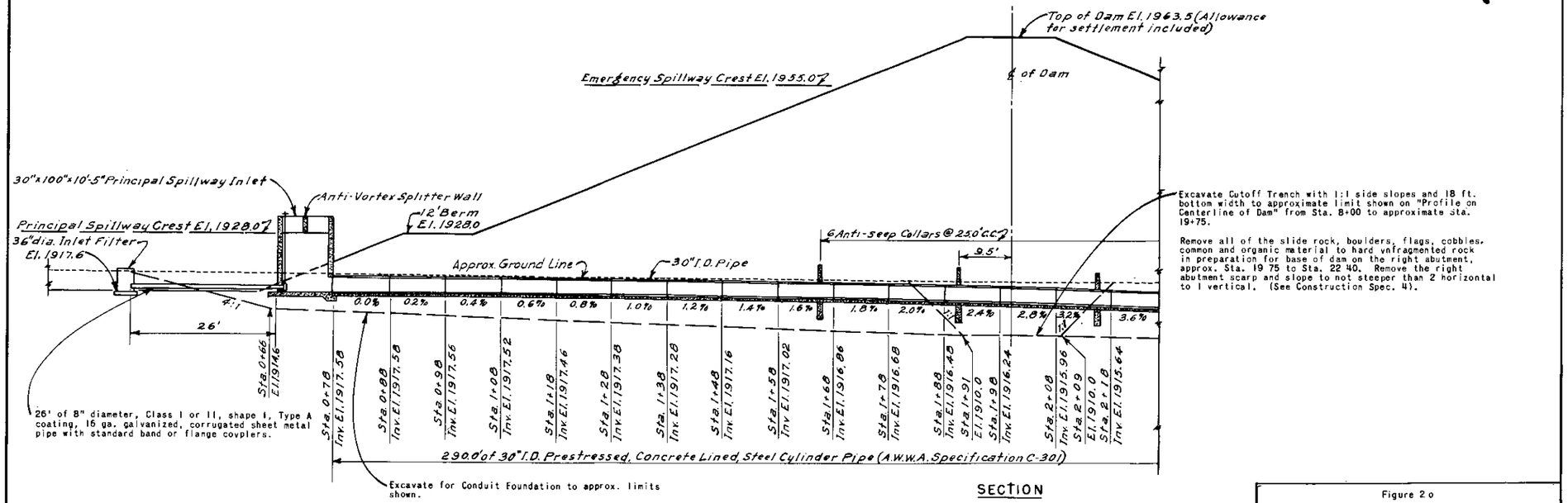




Excavation to be paid as "Excavation, Unclassified".

Prior to placing backfill around the structure, the surface layer of the in-place fill material shall be reworked as necessary, and to the depth necessary, to restore and satisfy the density and moisture requirements specified for that fill material.

TYPICAL CONDUIT FOUNDATION EXCAVATION



Excavate Cutoff Trench with 1:1 side slopes and 18 ft. bottom width to approximate limit shown on "Profile on Centerline of Dam" from Sta. 8+00 to approximate Sta. 19+75.

Remove all of the slide rock, boulders, flags, cobbles, common and organic material to hard unfragmented rock in preparation for base of dam on the right abutment, approx. Sta. 19 75 to Sta. 22 40. Remove the right abutment scarp and slope to not steeper than 2 horizontal to 1 vertical. (See Construction Spec. 4).

SECTION

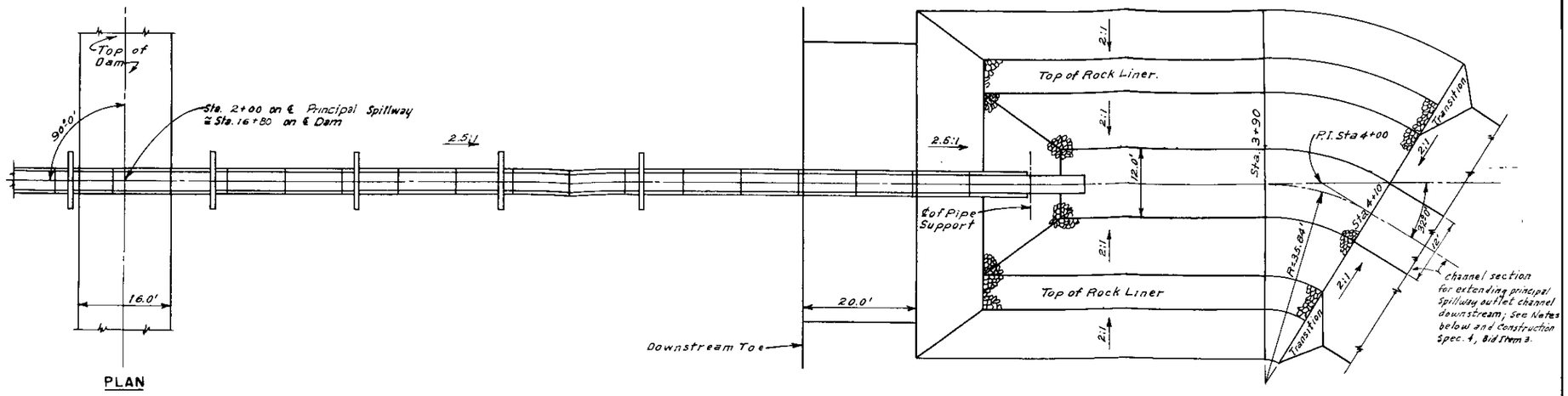
PRINCIPAL SPILLWAY

Figure 2 o

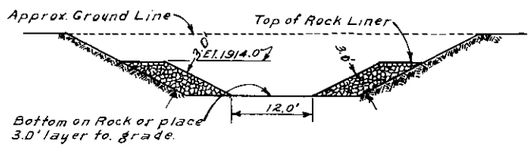
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	G. C. S.	4-66	Approved by ... HEAD ENGINEERING & SURVEYING WORK UNIT FORT WORTH, TEXAS
Drawn	G. C. S.	4-66	STATE CONSERVATION ENGINEER
Traced	T. F. R.	5-66	TEMPLE, TEXAS
Checked	G. C. S.	5-66	Sheet No. 4 of 13 — Drawing No. 4-E-21,594

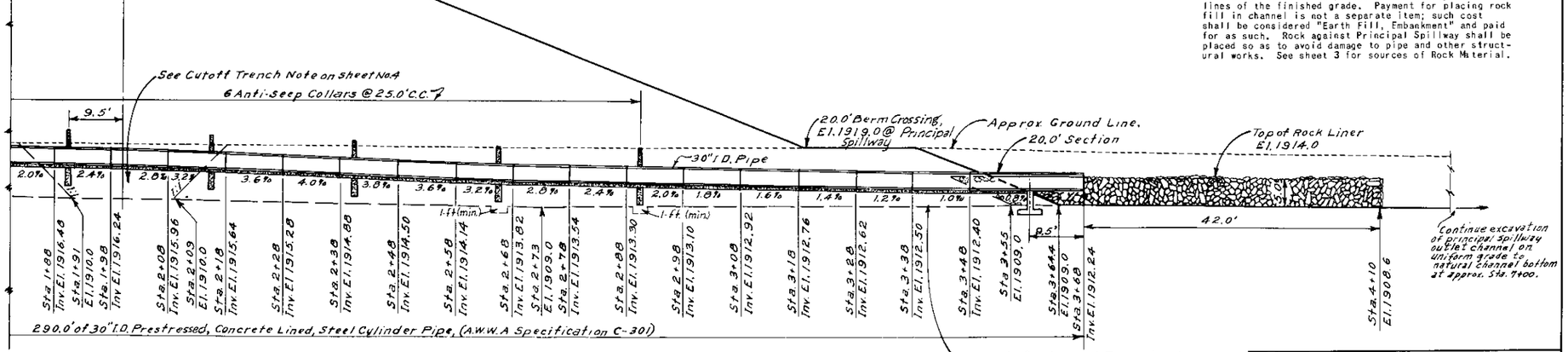


PLAN



SECTION

NOTE: Excavation for the Rock lined Channel shall be paid as "Excavation, Unclassified". Place a 3.0 ft. thickness of dumped rock to dimensions shown in the drawings with rock size grading from small at subgrade to large at finished grade. Placement of spalls and cobbles shall precede dumping of boulders. Rock material shall be placed to reasonably neat lines of the finished grade. Payment for placing rock fill in channel is not a separate item; such cost shall be considered "Earth Fill, Embankment" and paid for as such. Rock against Principal Spillway shall be placed so as to avoid damage to pipe and other structural works. See sheet 3 for sources of Rock Material.



SECTION

PRINCIPAL SPILLWAY

Figure 2d

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed G.C.S.	4-66	Approved by: AREA ENGINEERING & WATERSHED PLANNING UNIT FORT WORTH TEXAS
Drawn G.C.S.	4-66	STATE CONSERVATION ENGINEER U. S. S. C. TEMPLE, TEXAS
Traced T.F.R.	5-66	Sheet No. 5 of 13
Checked G.C.S.	5-66	Drawing No. 4-E-21,594

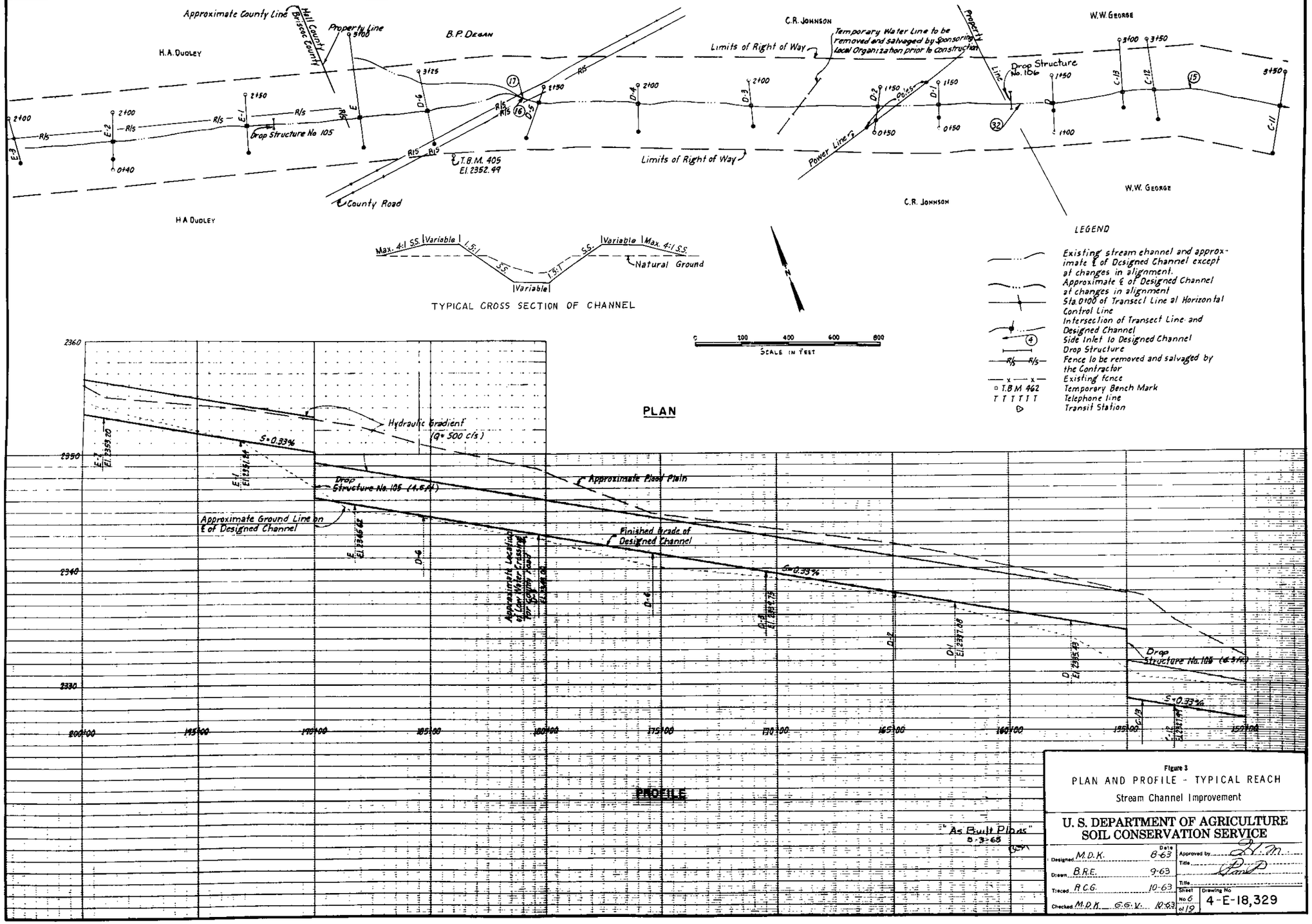


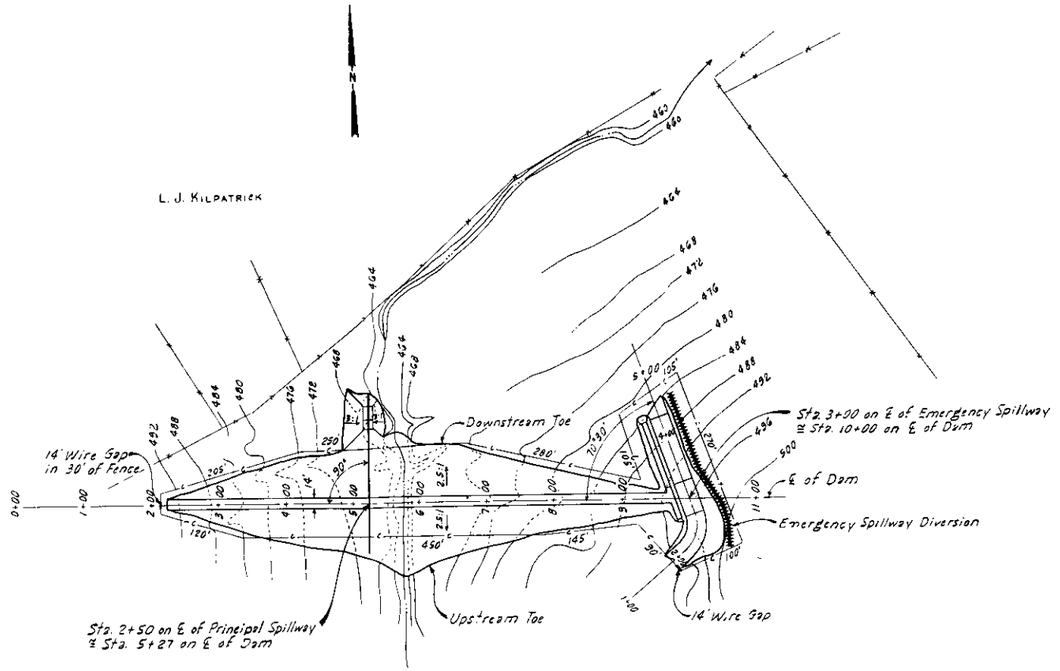
Figure 3

PLAN AND PROFILE - TYPICAL REACH

Stream Channel Improvement

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed M.D.K.	Date 8-63	Approved by	
Drawn B.R.E.	9-63	Title	
Traced R.C.G.	10-63	Title	
Checked M.D.K. G.G.V.	10-63	Sheet No. 6 of 19	Drawing No. 4-E-18,329

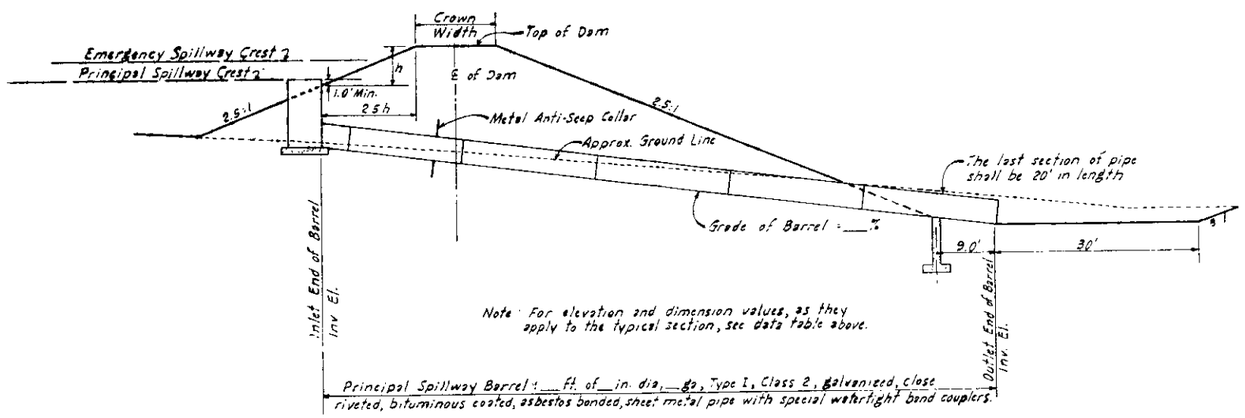


SITE 1

PLAN OF EMBANKMENTS AND SPILLWAYS

0 50 100 200 300 400 500

SCALE IN FEET



TYPICAL SECTION - PRINCIPAL SPILLWAY

Figure 4
TYPICAL
GRADE STABILIZATION STRUCTURE
STRUCTURE - PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed J.A.B.	4-65	Approved by ___
Drawn J.A.B.	4-65	HERD ENGINEERING & WATERSHED PLANNING UNIT FORT WORTH, TEXAS
Traced C.V.C.	5-65	STATE CONSERVATIONIST
Checked J.A.B. & G.M.T.	5-65	TEXAS Sheet No. 5 of 14 — Drawing No. 4-E-21,303

USDA SCS FORT WORTH, TEX. 1666

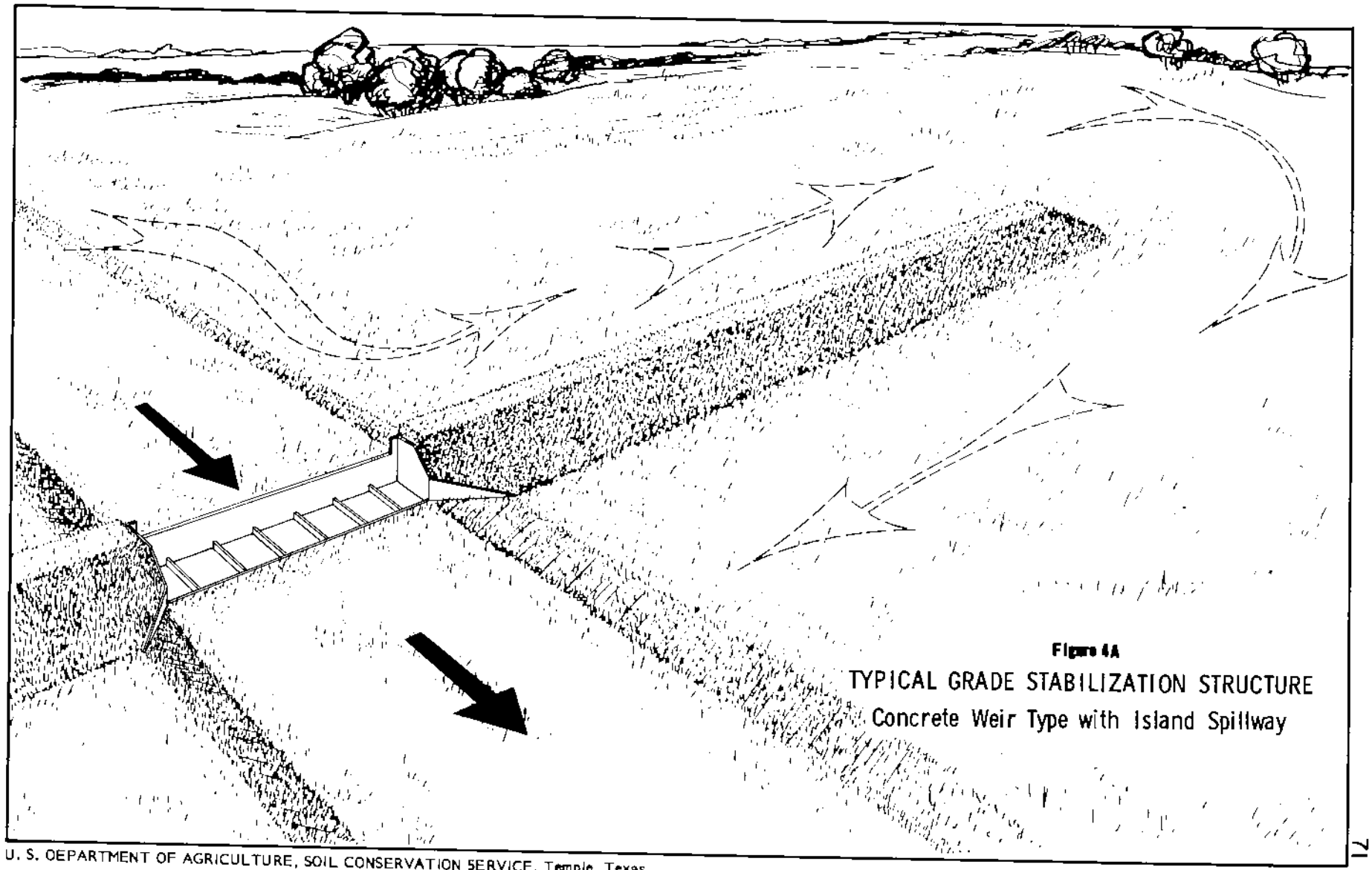
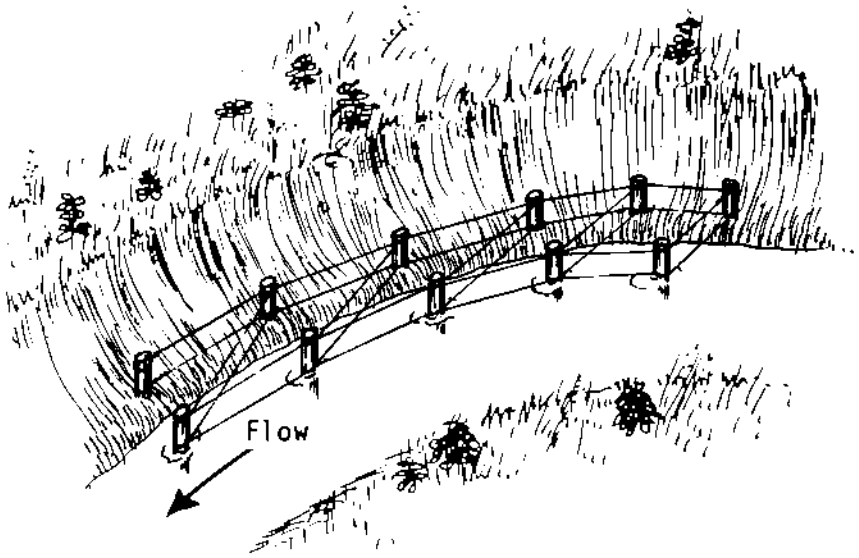
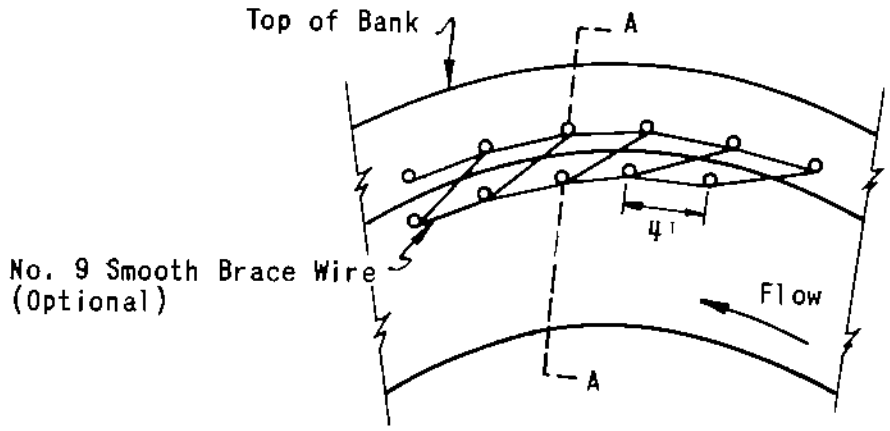


Figure 4A

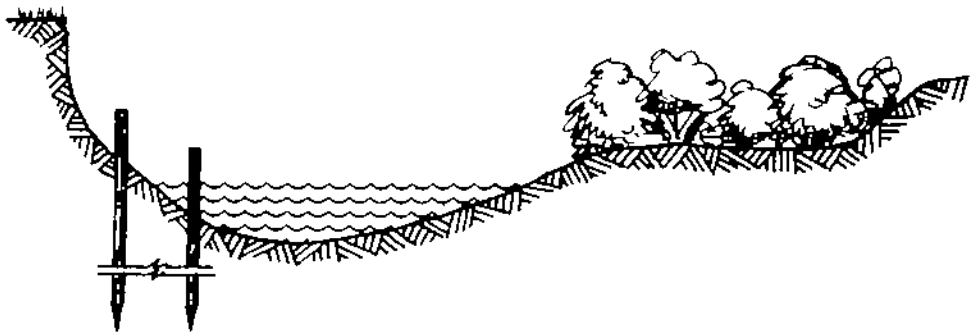
TYPICAL GRADE STABILIZATION STRUCTURE

Concrete Weir Type with Island Spillway





PLAN



SECTION A-A

Figure 5

STRUCTURE FOR STREAMBANK PROTECTION

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, Temple, Texas 12-64 4-L-19604
DEAD-ACE-FORT WORTH, TEX. (895

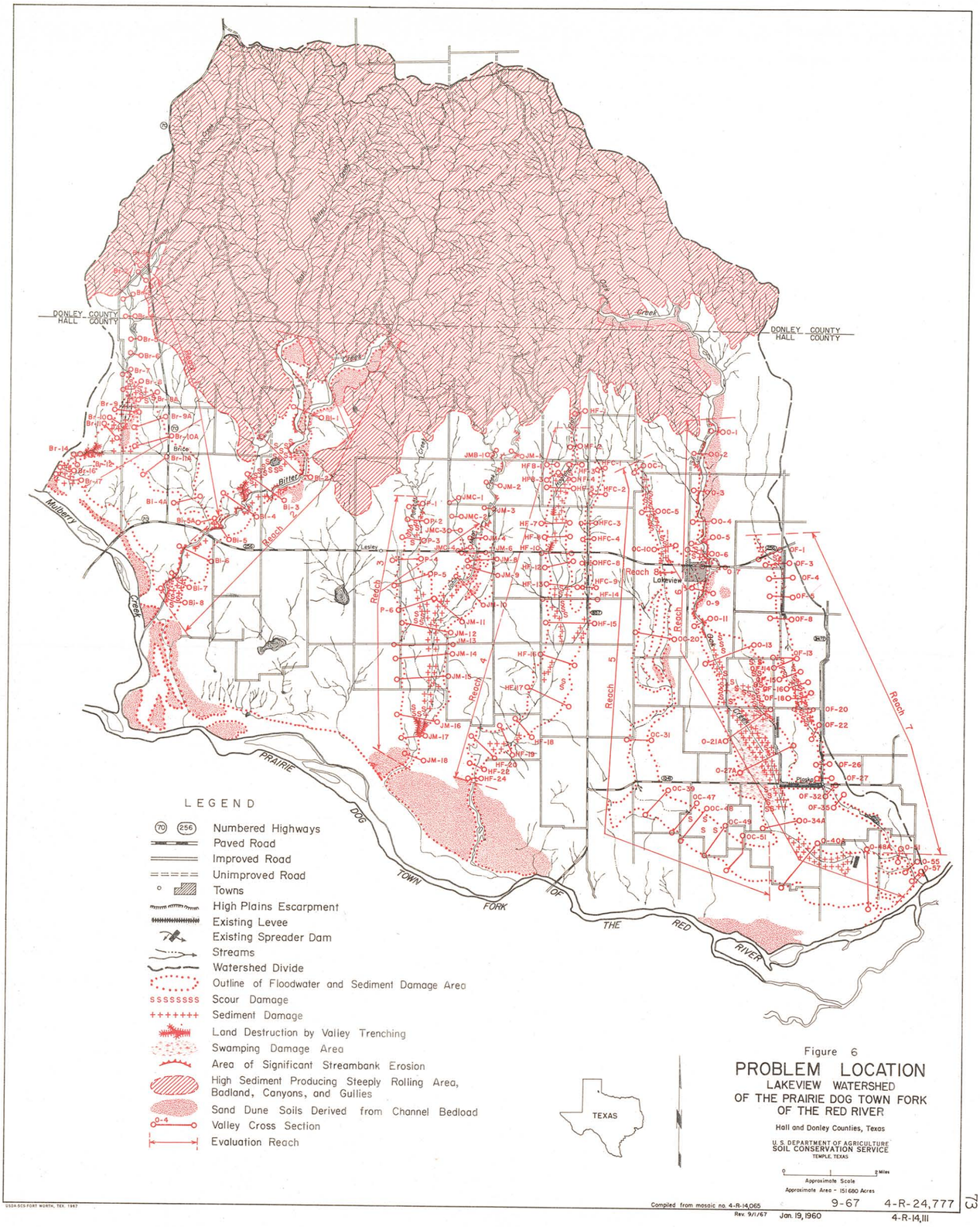


Figure 6

PROBLEM LOCATION

LAKEVIEW WATERSHED OF THE PRAIRIE DOG TOWN FORK OF THE RED RIVER

Hall and Donley Counties, Texas

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

Approximate Scale
Approximate Area - 151,680 Acres

Compiled from mosaic no. 4-R-14,065
Rev. 9/1/67 Jan. 19, 1960

9-67 4-R-24,777
4-R-14,111

USDA-SCS-FORT WORTH, TEX. 1967

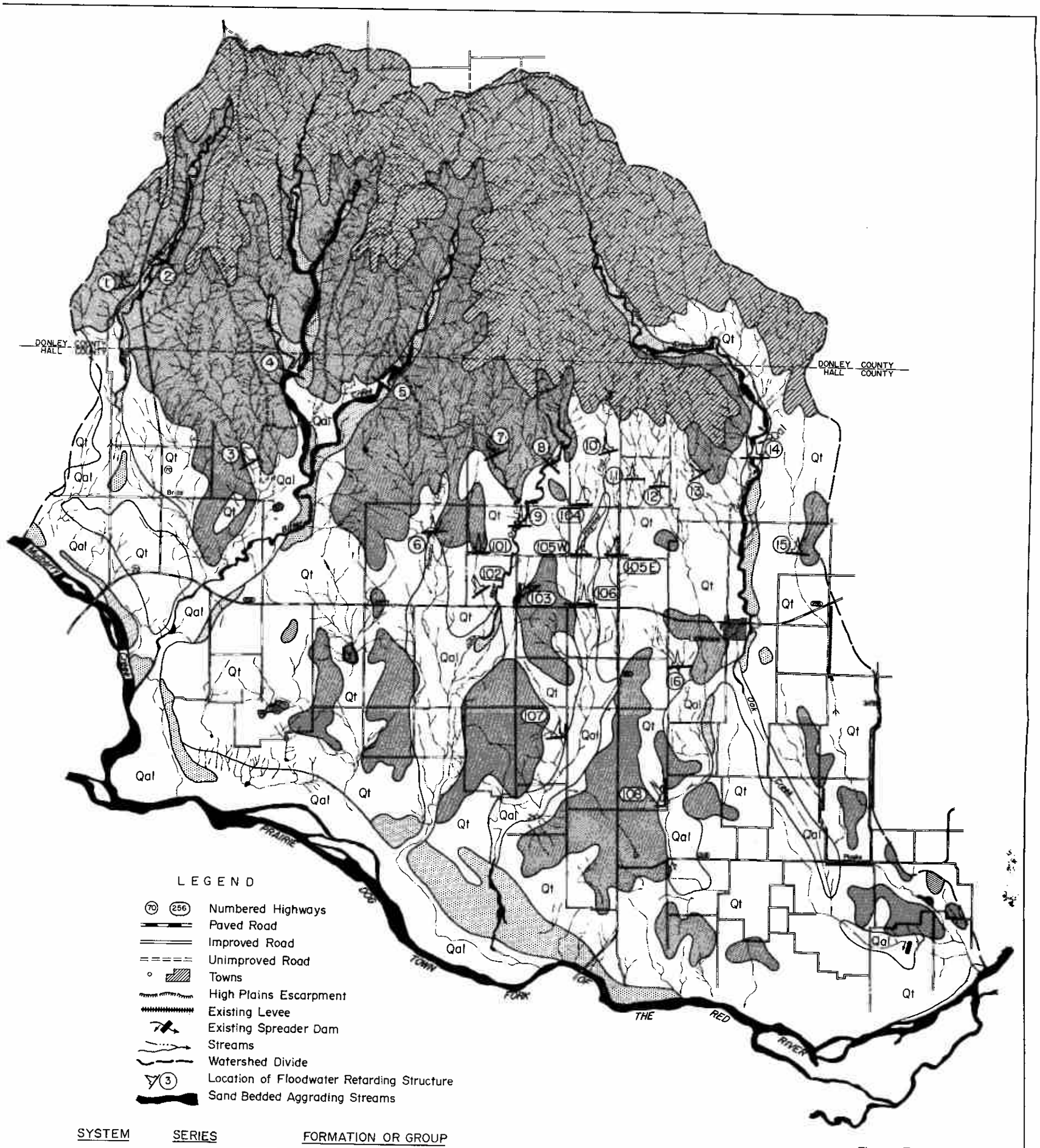


Figure 7
GENERALIZED GEOLOGIC MAP

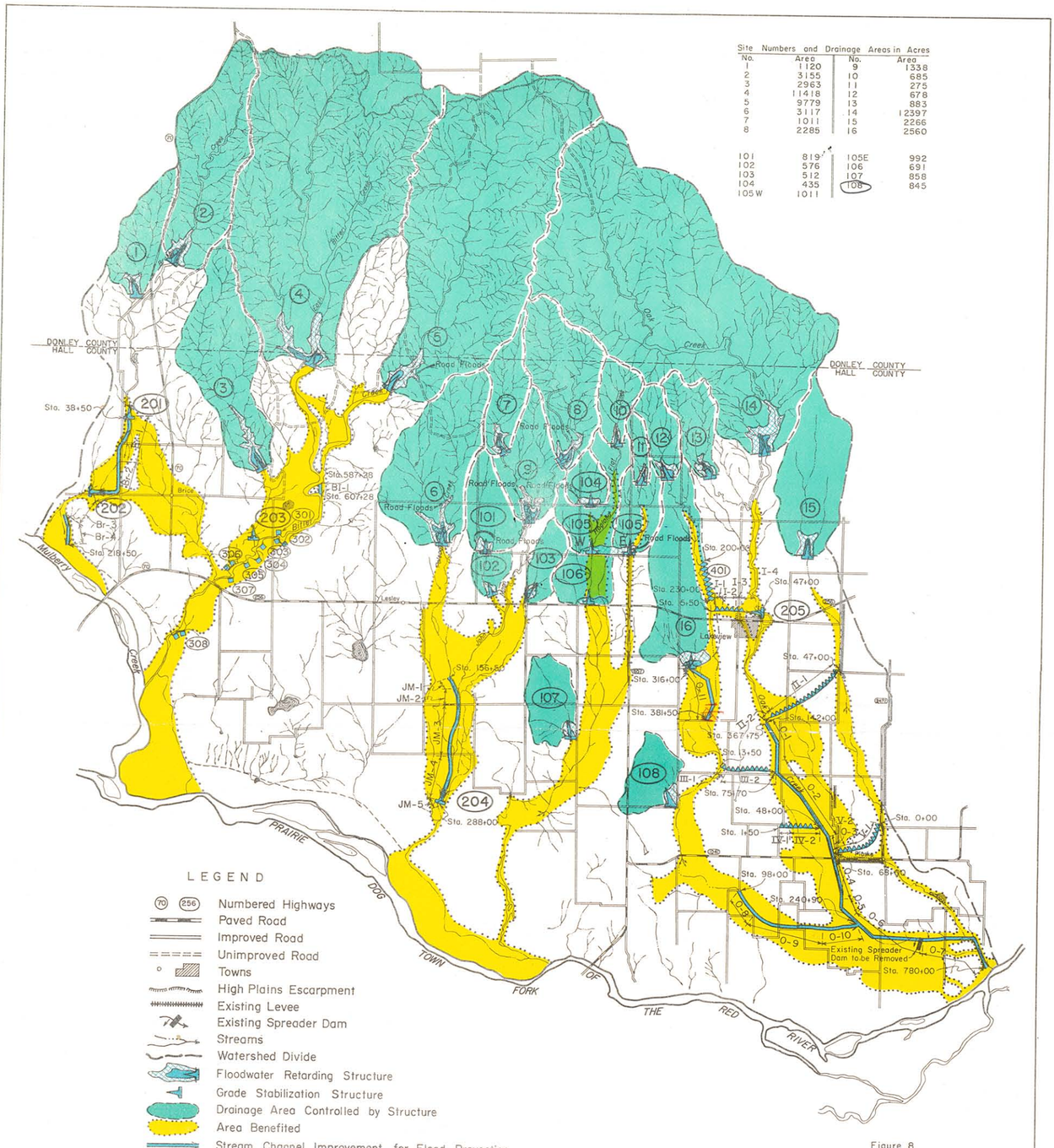


Figure 8

PROJECT MAP

LAKEVIEW WATERSHED OF THE PRAIRIE DOG TOWN FORK OF THE RED RIVER

Hall and Donley Counties, Texas

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

Compiled from mosaic no. 4-R-14,065
Rev. 9/1/67

Rev. 2-68 9-67 4-R-24,781
Jan. 19, 1960 4-R-14,111