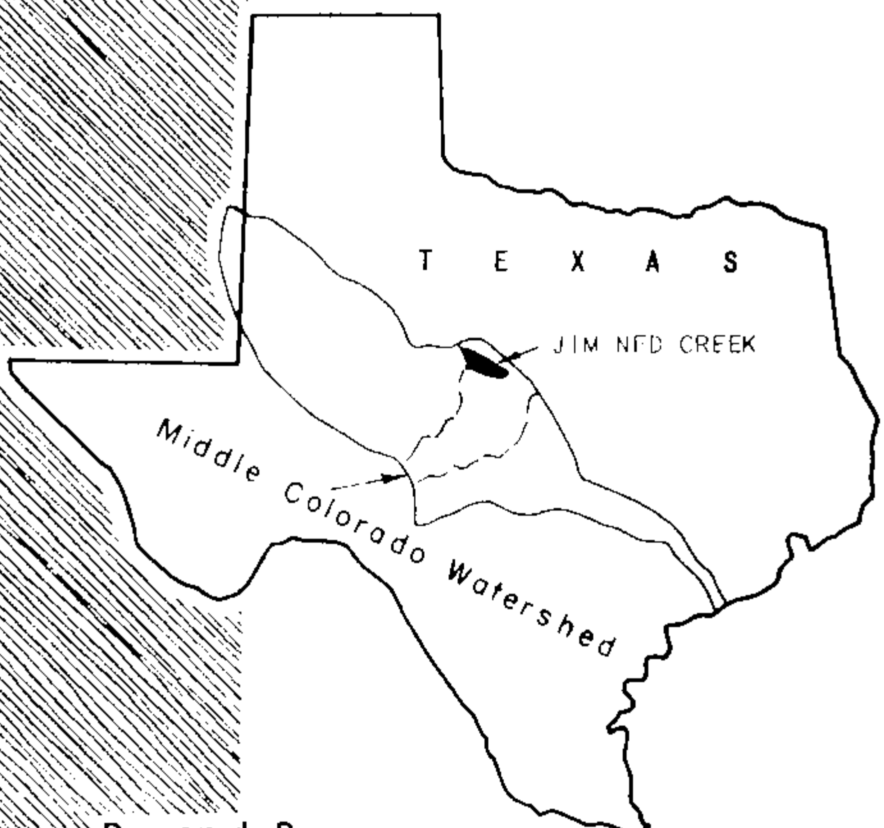
WORK PLAN

JIM NED CREEK WATERSHED

OF THE MIDDLE COLORADO RIVER WATERSHED
BROWN, COLEMAN, CALLAHAN, TAYLOR
AND RUNNELS COUNTIES, TEXAS



Prepared By
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Temple, Texas
April 1960

WATERSHED WORK PLAN AGREEMENT

between the

Brown-Mills Soil Conservation District
Local Organization
Central Colorado Soil Conservation District
Local Organization
Runnels Soil Conservation District
Local Organization
Middle Clear Fork Soil Conservation District
Local Organization

(Hereinafter referred to as the Districts)

Taylor County Commissioners Court
Local Organization
Coleman County Commissioners Court
Local Organization

(Hereinafter referred to as the Counties)

Taylor County Water Control and Improvement District No. 1
Local Organization

(Hereinafter referred to as the Water District)

In the State of Texas

and the

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

Whereas, the Soil Conservation Districts have heretofore entered into a Flood Control Supplemental Memorandum of Understanding with the Soil Conservation Service for assistance in constructing works of improvement for the prevention of floods in the Jim Ned Creek watershed, State of Texas, under the authority of the Flood Control Act of 1944 (58 Stat. 887).

Whereas, the responsibility for carrying out all or a portion of the work of the Department on the watershed has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Districts and the Service a mutually satisfactory plan for works of improvement for the Jim Ned Creek Watershed, State of Texas, hereinafter referred to as the Watershed Work Plan;

Whereas, the Water District and the Counties will benefit from the carrying out of the plan for works of improvement through the reduction of damages to property, including county roads and bridges in the counties that are located within the flood plain of the watershed, and the increase in crop yields on farm lands;

It is mutually agreed that in installing and operating and maintaining the works of improvement described in the Watershed Work Plan:

1. The Districts, Water District and the Counties 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.

2. The Districts and the Water District 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 Service will provide all construction costs and installation services applicable to works of improvement for flood prevention.

4. The Districts and Water District will obtain agreements from owners of not less than 50 percent of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

5. The Districts and Water District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the Watershed Work Plan.

6. The Districts and Water District will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

7. The Districts, Water District and the Counties 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 an Operation and Maintenance Agreement which is to be entered into.

8. 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.

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

Brown-Mills Soil Conservation District
Local Organization

By Amos Ad[illegible]

Title Chairman

Date 9-13-60

The signing of this agreement was authorized by a resolution of the governing body of the Brown-Mills Soil Conservation District
Local Organization

adopted at a meeting held on Sept. 13, 1960

D. F. Scott Lanford
(Secretary, Local Organization)

Date Sept. 13, 1960

Central Colorado Soil Conservation District
Local Organization

By Eldon M[illegible]

Title Chairman

Date 9-12-60

The signing of this agreement was authorized by a resolution of the governing body of the Central Colorado Soil Conservation District
Local Organization

adopted at a meeting held on 9-12-60

Ed Phelps Sec.
(Secretary, Local Organization)

Date 9-12-60

4-14344 3-30

Runnels Soil Conservation District
Local Organization

By [signature]

Title Member, Board of Supervisors

Date Sept 12, 1960

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

adopted at a meeting held on Sept 10, 1960

W F Minzenmayer
(Secretary, Local Organization)

Date Sept 12, 1960

Middle Clear Fork Soil Conservation District
Local Organization

By E S Brady

Title Chairman

Date 9-12-60

The signing of this agreement was authorized by a resolution of the governing body of the Middle Clear Fork Soil Conservation District
Local Organization

adopted at a meeting held on 8-17-60

[signature]
(Secretary, Local Organization)

Date Sept. 21, 1960

4.18884 8.80

Taylor County Commissioners Court
Local Organization

By [signature]

Title County Judge

Date Oct. 3, 1960

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

adopted at a meeting held on Oct. 3 - 1960

Mrs. Chester Hutcheson
(Secretary, Local Organization)

Date Oct. 3 - 1960

Coleman County Commissioners Court
Local Organization

By Frank Lewis

Title County Judge

Date September 12, 1960

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

adopted at a meeting held on September 12, 1960

[signature]
(Secretary, Local Organization)

Date September 12, 1960

4. 14884 9. 60

Taylor County Water Control and Improvement District No. 1

By Jack M Hancock

Title President

Date 9-17-60

The signing of this agreement was authorized by a resolution of the governing body of the Taylor County Water Control and Improvement District No. 1
Local Organization

adopted at a meeting held on 9-17-60

Wayne Allen
(Secretary, Local Organization)

Date 9-17-60

United States Department of Agriculture
Soil Conservation Service

By H. N. Smith
State Conservationist

Date 10-5-60

4. 14144 3. 50

WORK PLAN

JIM NED CREEK WATERSHED
Of the Middle Colorado River Watershed
Brown, Coleman, Callahan, Taylor and Runnels Counties, Texas

Plan Prepared and Works of Improvement
to be Installed Under the Authority of
the Flood Control Act of 1936 as Amended
and Supplemented.

Participating Agencies

Brown-Mills Soil Conservation District
Central Colorado Soil Conservation District
Runnels Soil Conservation District
Middle Clear Fork Soil Conservation District
Taylor County Commissioners Court
Coleman County Commissioners Court
Taylor County Water Control and Improvement
District No. 1

Prepared By:

Soil Conservation Service
U. S. Department of Agriculture
Revised April 1960

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SECTION I

WORK PLAN

JIM NED CREEK WATERSHED

Of the Middle Colorado River Watershed
Brown, Coleman, Callahan, Taylor and Runnels Counties, Texas
Revised April 1960

SUMMARY OF PLAN

Description:

Size: 477,440 acres - 746 square miles

Land Use:

Cultivation	138,030 acres
Pasture and Range	322,750 acres
Miscellaneous (roads, urban, etc.)	16,660 acres

Flood plain area: 27,118 acres

Soil Conservation Districts:

Brown-Mills	75,220 acres
Central Colorado	387,520 acres
Runnels	5,500 acres
Middle Clear Fork	9,200 acres

No Federal lands involved.

Flood Frequency:

Total of 110 floods during 20-year period of study (1923 through 1942), of which 29 inundated more than half the flood plain area.

Land Treatment:

Practice	Unit	Applied to Date	To Be Applied Installation Period
Contour Farming	Acre	102,265	14,500
Cover Cropping	Acre	12,000	4,300
Rotation Hay and Pasture	Acre	22,300	14,500
Crop Residue Utilization	Acre	72,100	51,000
Conservation Cropping System	Acre	1,500	24,500
Proper Use	Acre	151,000	88,000
Deferred Grazing	Acre	124,400	65,500
Range Seeding	Acre	4,800	4,800
Brush Control	Acre	75,350	35,100
Terracing	Mile	4,432	450
Diversion Construction	Mile	213	30
Waterway Development	Acre	34	40
Pond Construction	No.	1,470	150
Pasture Planting	Acre	-	5,000
Fertilizing	Acre	-	3,500

Structural Measures:

Floodwater Retarding Structure	No.	5	38

Total Cost:

Item	Federal (dollars)	Non-Federal (dollars)	Total (dollars)
Land Treatment	52,275	2,011,535	2,063,810
Structural Measures	3,804,462	458,782	4,263,244
Work Plan Preparation	83,228	--	83,228
Total	3,939,965	2,470,317	6,410,282

Damages and Benefits:

Item	Without Project (dollars)	With Project (dollars)	Average Annual Monetary Benefits, Structures (dollars)
Floodwater Damage	345,924	79,729	223,023
Sediment Damage	19,243	9,616	6,429
Erosion Damage	3,935	1,350	1,919
Indirect Damage	36,178	9,060	22,356
Total	405,280	99,755	253,727
Changed Land Use			5,619
More Intensive Land Use			2,266
Benefits Outside Project Area			39,700
Total			301,312

Benefit-Cost Ratio - Structural Measures

Average Annual Cost - Structures	$163,551
Average Annual Benefits - Structures	301,312
Benefit - Cost Ratio	1.8:1

Operation and Maintenance:

Land Treatment Measures:

Brown-Mills Soil Conservation District
Central Colorado Soil Conservation District
Runnels Soil Conservation District
Middle Clear Fork Soil Conservation District

Structural Measures:

Central Colorado Soil Conservation District
Coleman County Commissioners Court
Taylor County Commissioners Court
Taylor County Water Control and Improvement District No. 1

Annual Cost - $8,055

DESCRIPTION OF WATERSHED

Physical Data

Jim Ned Creek originates in southeast Taylor County, approximately 3.5 miles northwest of Tuscola, Texas, and flows in a southeasterly direction through Taylor, Coleman and Brown Counties for a distance of approximately 73 miles. It flows into Lake Brownwood about 8 miles north of Bangs, Texas. This watershed extends on downstream to the Lake Brownwood dam to include the entire drainage area of Jim Ned Creek. The major tributaries are Mud, Hords, Bachelor, Indian, Rough, Buffalo-Buck, Red Bank, South Fork of Jim Ned, Ovalo Fork of Jim Ned, Bacon Fork and Gray. Other tributaries that drain directly into Lake Brownwood are Brier, Panther, Dry, Sand and Rocky. The watershed ranges from 9 to 21 miles in width. It has an area of 477,440 acree (746 square miles), nearly all of which is in farms and ranches.

The topography of the watershed consists of a gently to moderately rolling plain bounded in the headwaters by prominently escarped erosional remnants which rise approximately 100 feet above the surrounding plain and encircle the western part of the watershed from a point near the Callahan and Taylor County line on the north to within 6 miles of the city of Coleman on the south. These remnants consist of a cap of nearly horizontal beds of hard limestones overlying sands and weak sandstones of Cretaceous age. Slightly westward dipping beds of formations of the Clear Fork and Wichita groups of Permian age are exposed on the plain and extend eastward to the outcrops of the underlying formations of Pennsylvanian age in the lower portion of the watershed. The Clear Fork group is located mostly in the Taylor County portion of the watershed and consists of redbeds and shale with alternating thin beds of limestone. Formations of the Wichita group crop out across most of the Coleman County portion of the watershed and consist of hard limestone alternating with blue shale. The limestones predominate in the upper formations, but the shales become more prominent toward the lower formations. The Pennsylvanian formations (Cisco and Canyon groups) are located mostly in the Brown County portion of the watershed and consist predominantly of shale with thin beds of limestone and sandstone. Erosion of these slightly westward dipping beds of both the Permian and Pennsylvanian formations has resulted in the formation of east-facing, cuesta-like, north and south trending ridges. Erosion resistant limestones and sandstones cap the ridges.

The flood plain is approximately 4,000 feet wide in the lower and central reaches of the watershed. It becomes much more narrow, approximately 1,500 feet wide, in the Economic Evaluation Reach 2 area of northwest Coleman County, where it is confined in a narrow escarped valley of the limestone formations of the upper Wichita group. In the upper reaches it averages about 2,000 feet wide and is hard to distinguish from the normal upland areas, especially in the extreme upper reaches.

Elevations range from 1,444 feet on the flood plain near valley section 1 above Lake Brownwood to over 2,300 feet above mean sea level on parts of the escarpment.

There are four land resource areas in the watershed. They comprise the following approximate amounts of the watershed area: 9 percent in the Edwards Plateau, 9 percent in the West Cross Timbers, 57 percent in the Rolling Plains, and 25 percent in the North Central Prairie. The soils of the Edwards Plateau consist of stony, very shallow clays on steep slopes and are used almost exclusively for rangeland. The soils of the West Cross Timbers are confined to relatively narrow bands cropping out near or on the watershed divide. The surface textures are mostly fine sandy loams with slowly permeable to moderately permeable sandy clay subsoils. Windthorst, Stephenville and Nimrod are the dominant soil series. Soils of the Rolling Plains can be divided into two groups. The first group, located in Taylor County, consists of deep, clay loam soils of the Abilene, Tillman and Valera series. This group of soils is more intensively cultivated than the second group which extends across most of Coleman County. Soils of the second group are characterized by shallow, somewhat stony, fine textured soils on hills and ridges and deep, silty clay soils on the broad valleys and flats. The dominant soil series are Valera and Abilene-like soils. Crop production in this area is confined to the deeper soils on gently sloping areas. The lower portion of the watershed consists of the varied soils of the North Central Prairie. Surface textures vary from fines, which predominate, to coarse sands. Permeability of the subsoils vary from very slow to moderately permeable. The dominant soil series of this area include the Renfrow, Kirkland, and unnamed soils. Only about 25 percent of this area is in cultivation.

The soils are generally in fair condition. Considerable amounts of small grains and high-residue producing crops are grown on the cropland and help prevent rapid deterioration of the soil. Approximately 10 percent of the cropland in the watershed is now planted to perennial type crops for soil improvement and grazing purposes. Significant amounts of cropland have been returned to grassland in the West Cross Timbers area and to a lesser amount in the North Central Prairie.

The watershed lies within the mixed prairie plant group. Hydrologic cover is mostly fair with small areas good and poor. Rangeland areas generally have made considerable improvement in cover with the improvement of moisture conditions during the last three growing seasons.

There are nine range sites in the watershed: Shallow Limestone Hills, Mixed Land, Deep Hard Land, Rolling Upland, Shaley Hard Land, Shaley Hills, Shallow Sandy Loam, Sandy Loam, and Bottomland. The natural vegetation consists of little bluestem, Indiangrass, sideoats grama, tall and hairy dropseed, sand lovegrass, purple top, vine mesquite, buffalograss, curly mesquite, Canado wildrye, Texas wintergrass, and some woody vegetation including postoak, liveoak, mesquite and shinnery oak. Invading plants and plants which have increased with the overuse of rangeland included mesquite, postoak, shinnery oak, threawn, red grama, hairy tridens, red lovegrass, and annual weeds.

The range condition classes of the watershed are as follows: 4 percent, excellent; 8 percent, good; 58 percent, fair; and 30 percent, poor.

The overall land use for the entire watershed is as follows:

Land Use	Acres	Percent
Cultivation	138,030	29
Range	322,750	68
Miscellaneous 1/	16,660	3
Total	477,440	100

1/ Includes roads, railroads, highways, towns, reservoirs, etc.

The flood plain consists of 27,118 acres, and is the area that will be inundated by the runoff from the largest storm considered in the 20-year series. This storm was a 6.29-inch rain that extended over three days and produced 3.55 inches of runoff. At the present time about 41 percent of the flood plain is in cultivation, 58 percent in pasture or range, and 1 percent in miscellaneous uses.

The mean annual weighted rainfall for the watershed is 26.25 inches. It is well distributed, with the wettest months being April, May, June, September, and October. Individual excessive rains causing serious erosion and flood damages may occur in any season, but are most frequent in the spring and fall months. The minimum recorded annual rainfall was 16.68 inches, the maximum 42.36 inches.

Average temperatures range from 83 degrees Fahrenheit in the summer to 43 degrees in the winter. The normal frost-free season of 232 days extends from March 25 to November 12.

Surface runoff is the principal source of water for all purposes, due to the low water table and poor quality of underground water. Farm ponds supply a majority of the farmers and ranchers with water for domestic and livestock uses. Jim Ned Creek and several of its main tributaries have numerous water holes, some created by low water dams, which supply stock water throughout the major part of the year. There are a few scattered areas where well water is used for domestic purposes. However, the water has a high mineral content, and in many cases the wells do not provide an adequate supply throughout the entire year.

Six storage reservoirs in this watershed furnish water for municipal and industrial uses. Lake Scarborough and Hords Creek Lake furnish Coleman an adequate supply for present needs but will not support additional expansion. Old and New Lakes Santa Anna, supplemented by a pipeline from Lake Brownwood, furnish Santa Anna with an adequate and dependable supply. Lake Novice, supplemented with poor quality well water, supplies Novice. Lake Brownwood supplies Bangs and Brownwood adequately, in addition to providing water for irrigation purposes. Lawn, Tuscola and Ovalo obtain their water from shallow wells, located in the flood plain area of Jim Ned Creek. Although of poor quality, these are adequate except during periods of extreme drought.

Economic Data

The economy of the watershed depends largely upon its farms and ranches. The watershed, excepting the Taylor County part, is characterized by a predominance of ranching and livestock farming. In this area oats and wheat, which are grazed during the winter months and harvested for grain in June, are the predominant crops. The Taylor County portion of the watershed is more diversified. Cash cropping, mostly in the form of cotton and livestock production, including sheep and cattle, are the most important agricultural enterprises in this area.

Crude oil and natural gas production is important to the economy of the watershed. Oil and gas leases and royalties are furnishing income to supplement that from agriculture,and many local residents are employed by oil companies operating in the area.

The average size farm in the watershed is 460 acres. The average value of land and buildings per farm is $28,990 (1954 agricultural census). The most common form of land tenure is the part-owner type--that is, most farmers and ranchers own a portion of the land they operate and rent or lease the other part. This type tenure makes establishment of land treatment measures difficult on the rented land.

Coleman, population 6,800, is the county seat of Coleman County and is the principal banking, commercial and shipping point in the watershed. This town has excellent highway and rail connections and produces brick, leather goods, clothing and cottonseed oil. The cities of Brownwood and Abilene, which lie outside and on opposite ends of the watershed, furnish additional marketing facilities. The numerous small towns and villages in the watershed such as Tuscola, Ovalo, Novice, Lawn and Oplin provide markets and processing plants for farm products. These urban areas are supported largely by agricultural enterprises in the watershed.

The watershed is adequately served by approximately 726 miles of roads, of which 190 miles are paved. Two railroads provide ample loading facilities for carload lot shipments. The Santa Fe Railroad traverses the full length of the watershed, while the Texas and Pacific crosses the upper end through Ovalo and Tuscola.

Status of Conservation Work in Watershed

The watershed is served by Soil Conservation Service work units at Abilene, Ballinger, Coleman and Brownwood, which are assisting the Brown-Mills, Central Colorado, Runnels and Middle Clear Fork Soil Conservation Districts. These work units have assisted farmers and ranchers in preparing 756 soil and water conservation plans on 343,752 acres (75 percent of the agricultural land) within the watershed and in giving technical guidance in establishing and maintaining planned measures. Sixty percent of the needed land treatment measures in the watershed have been applied. Where land treatment measures have been applied and maintained as long as three years, average crop and pasture yields have increased by about one-fifth. Land treatment measures installedbefore the revision of this flood prevention work plan are listed in table 1A.

WATERSHED PROBLEMS

Floodwater Damage

Floods occur frequently on Jim Ned Creek and cause severe damage (figure 1). Major floods (floods inundating more than one-half of the flood plain) have occurred on an average of about three every two years, the latest being in May 1957. During the 20-year period 1923-1942, there were 29 major floods and 81 minor floods. Fifty-six of the floods occurred in the spring, causing severe damage to growing row crops and to maturing small grains. Twenty-seven of the floods occurred in September and October, causing severe damage to growing small grain and to maturing row crops. The largest storm in the flood series occurred July 1-3, 1932, and inundated 27,118 acres of flood plain.

For the floods experienced during the 20-year period studied, the total direct agricultural and nonagricultural floodwater damages under present conditions were estimated to average $345,924 annually at long-term price levels, of which $147,160 is crop and pasture damage, $152,846 is other agricultural damage, and $45,918 is nonagricultural damage such as damage to roads, railroads, bridges and oil field equipment. Indirect damages such as interruption of travel, extra travel over re-routed school bus and mail routes, losses sustained by dealers and industries in the area, and similar losses are estimated to average $36,178. The average annual monetary flood damages are summarized in table 5.

Erosion Damage

Upland erosion rates in this watershed are low. About 29 percent of the area is in cultivation and 68 percent in rangeland. The rangeland is generally in fair condition with smaller areas of excellent, good and poor conditions. The cropland has had approximately 60 percent of the needed conservation practices applied. The use of small grains on 60 percent and the use of perennial type crops on an additional 10 percent of the cropland have reduced erosion rates considerably. Of the total estimated upland sediment production under present conditions, 95 percent is derived from sheet erosion and 5 percent from gully and streambank erosion.

Flood plain scour damages an average of 1,040 acres annually, with damages ranging from 10 to 80 percent of the productive capacity of the soil. The average annual amount of this damage is estimated to be $3,935 under present conditions. Total land damage from streambank erosion is minor and consists mostly of small isolated areas throughout the watershed.

Sediment Damage

Sediment damages to the flood plain are minor. Approximately 96 acres have been damaged by deposits up to 3 feet in depth of material ranging from sandy loams to coarse sand. Damage in terms of reduced soil productivity are estimated to range from 10 to 50 percent. Because of the small area damaged, the total annual damage in dollars is not significant.

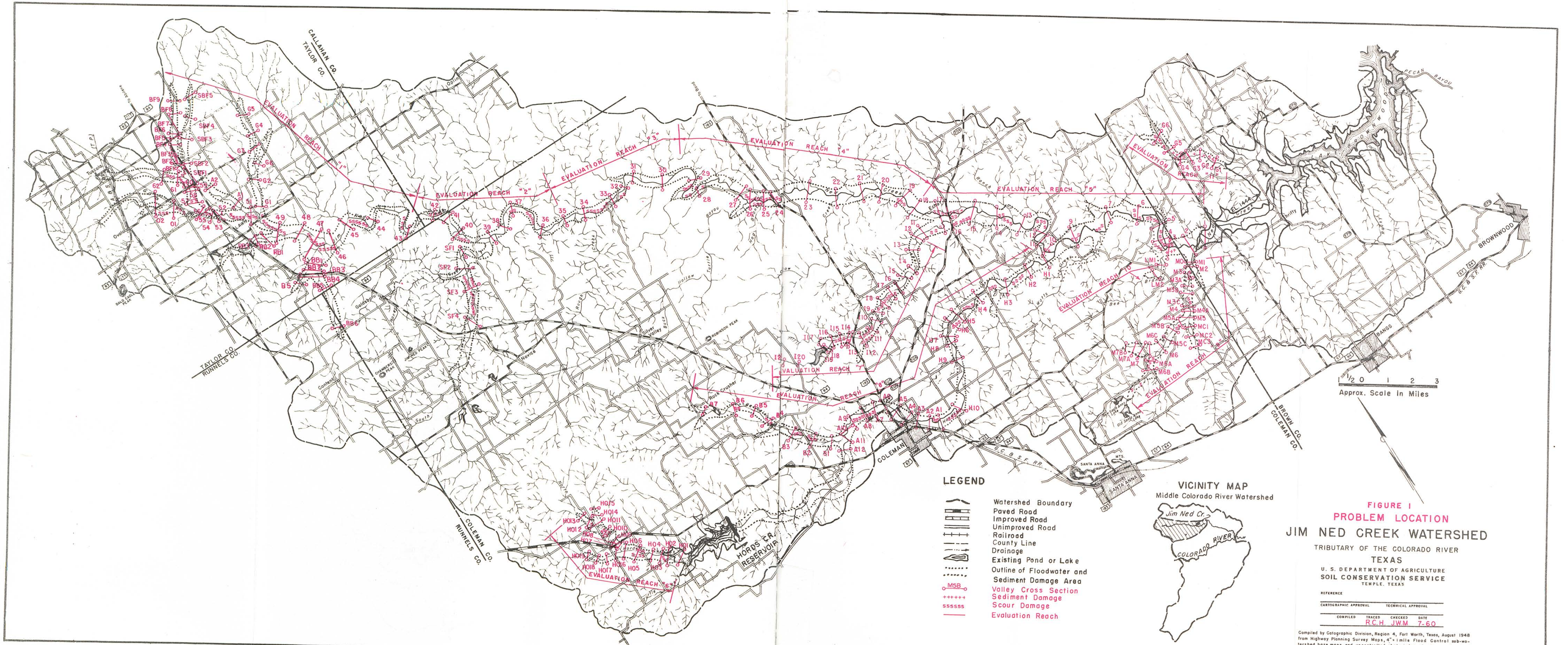


FIGURE I
PROBLEM LOCATION
JIM NED CREEK WATERSHED
TRIBUTARY OF THE COLORADO RIVER
TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

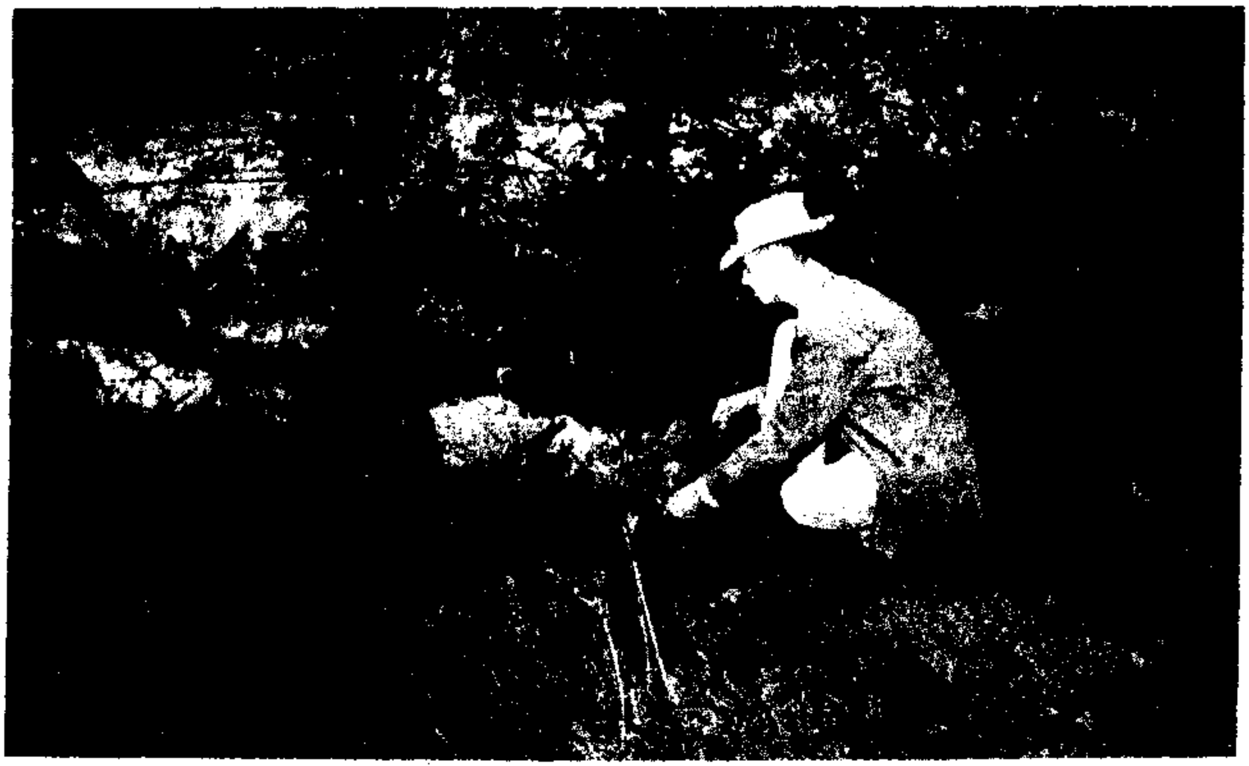
REFERENCE
CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL

COMPILED	TRACED	CHECKED	DATE
	R.C.H.	J.W.M.	7-60

Compiled by Catographic Division, Region 4, Fort Worth, Texas, August 1948 from Highway Planning Survey Maps, 4" = 1 mile Flood Control sub-watershed base maps, and uncontrolled photo index sheets supplimented by some stereoscopic examination of individual aerial photographs.

4-R-14320
Revised 7-60 Base 4-R-6812

USDA-SCS-FORT WORTH, TEX. 1974



Loss of livestock and destruction of fences is a major floodwater damage in this watershed.

Annual floodwater damages on Jim Ned Creek averages about $346,000.

Deposition of sediment such as this has destroyed approximately 10 percent of the storage in Lake Brownwood. Most of it came from unprotected cropland and poor grassland areas.

Flood of April 30 and May 1, 1956 caused high crop loss and scour damage.

4-14264 6-44

The most significant sediment damage in the watershed is the loss of storage in existing reservoirs because of sediment deposition. There are nine large reservoirs and numerous farm and ranch ponds located within the watershed. In addition, the watershed comprises about 48 percent of the drainage area of Lake Brownwood. Detailed reservoir sedimentation surveys were made by the Soil Conservation Service on a number of reservoirs in the watershed, including Lake Scarborough and Lake Brownwood, in 1940-41. Analysis of data from these surveys indicated that the average sediment yield to Lake Scarborough is 4.74 acre-feet annually and 214.8 acre-feet to Lake Brownwood. The average annual monetary value of this damage is estimated to be $19,243.

Problems Relating to Water Management

There is no need for drainage and very little activity relative to irrigation in the watershed. At the present time there is no local interest in providing additional storage in any of the structures for irrigation, fish and wildlife development or recreation. The City of Coleman's present water supply is inadequate for future needs according to their consulting engineer's report.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

Efforts to prevent or reduce flooding on agricultural lands in the watershed have been minor. The farmers and ranchers on the headwaters and in the lower reaches have made some attempts at enlarging, straightening and leveeing of stream channels on an individual basis, with very little effect on the reduction of flood damages.

The Central Colorado River Authority, operating in Coleman County, has constructed a number of stock ponds and reservoirs for municipal water supplies which contribute to a limited reduction in damages from small floods within the immediate vicinity of the structures. However, due to their low detention storage capacity and small drainage areas, they do not materially contribute to reduction of flood damage on the entire watershed.

Lake Brownwood, located on Pecan Bayou just below its confluence with Jim Ned Creek, was constructed in 1932 (figure 1). There is no provision for floodwater detention storage in this structure. However, the spillway storage will have an appreciable dampening effect on the peak flows below the dam.

Hords Creek Reservoir, located seven miles west of Coleman, Texas, is a dual purpose structure constructed by the Corps of Engineers to serve as a flood control structure and as a municipal water supply for Coleman. Also, in their "Review of Reports on Pecan Bayou, Texas" dated September 3, 1948, a reservoir is proposed on Pecan Bayou immediately below Lake Brownwood to provide flood storage for the control of floods on the mainstem below the dam. A re-evaluation of this report is in progress. In the evaluation of the project on the Jim Ned Creek watershed, only sediment reduction benefits were claimed below the elevation of the 25-year frequency storage requirement for the proposed structure. Lake Brownwood lies below this elevation. The effect of the Hords Creek Reservoir was considered in the "without project" condition; therefore, no benefits accruing to it were considered.

The Brown-Mills, Central Colorado, Runnels and Middle Clear Fork Soil Conservation Districts have been very active in establishing land treatment measures and in initiating flood prevention work. The districts have exerted their influence toward a high degree of participation in this program on the part of the farmers, ranchers and other interested parties in the watershed.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as is now being carried out by the four soil conservstion districts serving the watershed, is essential for a sound flood prevention program on the watershed. Basic to reaching this objective is the establishment and maintenance of all applicable soil and water conservation and management practices necessary to proper land use. Emphasis will be placed on accelerating the establishment of land treatment measures which have a measurable effect on reducing floodwater and sediment damages.

Of the total watershed area of 477,440 acres, 210,438 lie above 5 constructed and 38 proposed floodwater retarding structures. There are 31,000 acres above the Hords Creek Reservoir, none of which lie above floodwater retarding structures. This constitutes a total of 241,438 acres controlled by the Hords Creek Reservoir and the floodwater retarding structures. Land treatment is especially important to support and supplement the control of these measures. There are another 210,246 acres of upland in the watershed for which no structural control has been planned and for which establishment of land treatment constitute the only planned measures in this plan. Land treatment measures on the 27,118 acres of flood plain, 1379 acres of which are above floodwater retarding structures, are also important in reducing floodwater, sediment and flood plain scour damages.

The amounts and estimated cost of establishing the needed measures that will be installed by landowners and operators during the 5-year installation period are shown on table 1. The estimated cost of planning and installing these measures, exclusive of expected reimbursement from ACPS or other Federal funds, is $460,405, based on current program criteria. In addition, prior to work plan revision, landowners and operators have established land treatment measures at an estimated non-Federal cost of $1,551,130 (table 1A). Also prior to work plan revision, $29,575 of Federal funds were used for the acceleration of technical assistance by the Soil Conservation Service to landowners and operators. This acceleration of technical assistance will be continued during the period of installation at a cost of $22,700.

Most of the land treatment meesures will function principally to decrease erosion damage to fields and pastures by providing improved soil-cover conditions. These measures include cover cropping, conservation cropping

Brush covered rangeland after root plowing and overseeding with blue panic grass.

Native grasses recover rapidly when proper use of rangeland is practiced.

4-14224 3-40

system, use of rotation hay and pasture, crop residue use for croplands and proper use and deferred grazing to provide improvement, protection and good maintenance of grass stands on the rangelands. They also include brush control to allow grass stands to improve for replacement of the poor cover afforded by brushy pastures; the construction of farm ponds, to provide adequate numbers and locations of watering places to prevent cover-destroying, seasonal concentrations of livestock; and range seeding and pasture planning to establish good cover of grasses. These measures, especially the cropland measures and range seeding, also effectively improve soil conditions which allow larger amounts of rainfall to soak into the soil.

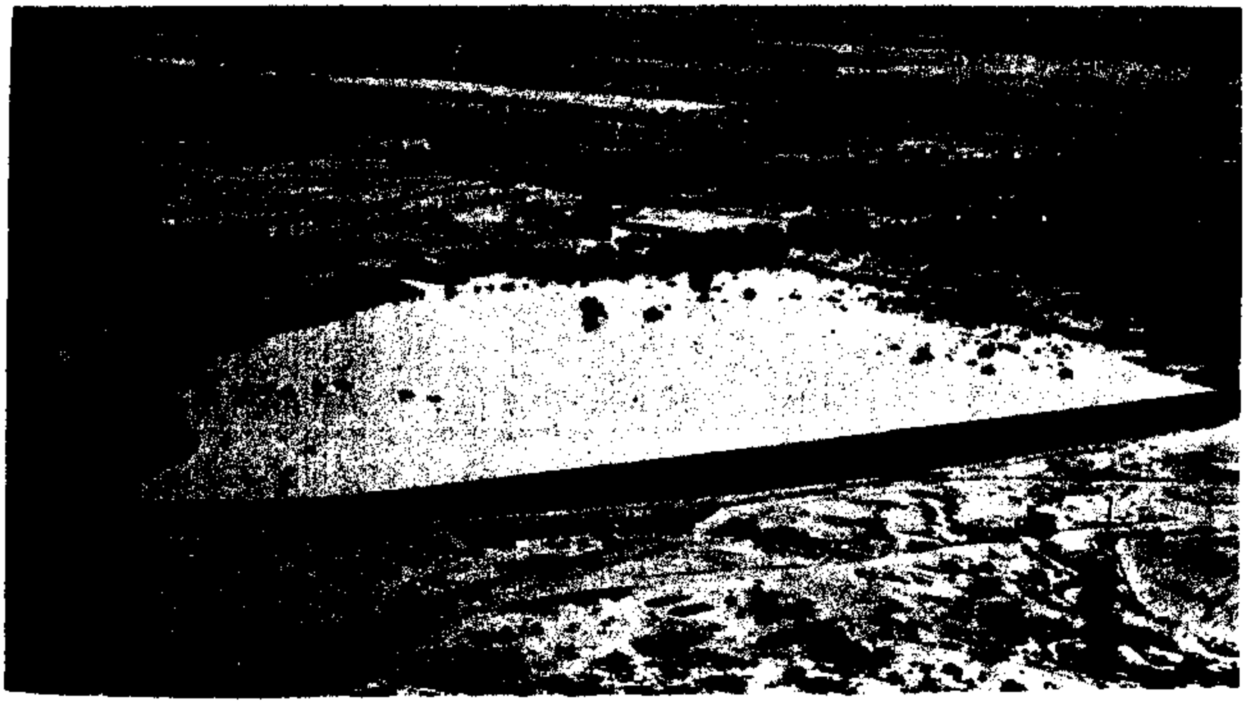
In addition to the above soil improvement and cover measures, land treatment includes fertilizing, contour farming, terracing, diversion construction and waterway development to serve these measures, all of which have a measurable effect in reducing the velocity of runoff water from fields. These measures also help the soil improvement and cover measures reduce erosion damage and sediment yield.

Structural Measures

A system of 43 floodwater retarding structures will be required in the watershed to afford the degree protection to flood plain lands desired by the local people that cannot be provided by land treatment measures alone. Storage in these sites will range from 2.53 to 5.78 inches of runoff depending on local conditions. Five of the structures, Sites 15, 16, 17, 19 and 20, have been installed. In addition, the Corps of Engineers' Hords Creek Reservoir has a flood control capacity of 6.46 inches. The following table reflects the degree of control by each project and a combination of both:

Item	Floodwater Retarding Structures	Hords Creek Reservoir	Combined Programs
Drainage Area - Square Miles	328.81	48.44	377.25
Control - Percent	44.08	6.49	50.57
Flood Storage - Acre Feet	80,001	16,678	96,679
Storage From Drainage Area of Structures - Inch	4.56	6.46	4.83
Equivalent Storage Entire Watershed - Inch	2.00	0.42	2.42

In order to develop the required storage for Site 12-E it was necessary to locate Site 12-D in series above Site 12-E. Site 25-A and 25-B were located in series above 25 and Site 17-B located in series above 17-A to give protection to the intervening flood plain lands.



Runoff from heavy rains being controlled by floodwater retarding structures.

Floodwater retarding structures releasing water slowly through the principal spillway following heavy rains.

4-14104 5-60

Figure 2 shows a section of a typical floodwater retarding structure. The location of the structural measures is shown on Figure 3.

There are 15 low-water crossings on county roads and numerous private intra-farm low-water crossings on Jim Ned Creek and its tributaries, that will be affected by the release flow from the principal spillways of the floodwater retarding structures. Under present conditions water flows over these crossings for relative short periods following rains. After the structures are installed, the flow will be reduced in peak but flow will be greatly prolonged. The Commissioners Courts of Coleman and Taylor Counties will install culverts or other improvements needed to keep the crossings on county roads passable during periods of floodwater release at no cost to the Federal Government. Individual landowners will be responsible for the improvement of their crossings. The cost of these improvements are included in the estimated cost of land rights.

Land rights for the floodwater retarding structures will be provided by local interests at no cost to the Federal Government. The value of these sites, together with the cost of relocating roads, utilities and other improvements, is estimated to be $417,076, based on current market values furnished by the local organizations. It is estimated that an additional $41,706 of non-Federal funds will be expended for legal services required in the securing of land rights. The total area of the sediment pools is 1,153 acres, of which 207 acres are flood plain lands. In addition, the detention pools will temporarily inundate 5,391 acres of which 145 acres is flood plain.

The estimated cost of establishing these works of improvement is $4,263,244 of which $458,782 will be borne by local interests and $3,804,462 by flood prevention funds.

The estimated annual equivalent cost of installation, $155,496, with an estimated annual operation and maintenance cost of $8,055, makes a total annual cost of $163,551.

Sufficient detention storage can be developed at all structure sites to make possible use of rock and vegetative spillways, thereby effecting a substantial reduction in cost over concrete or similar type of spillway. All applicable state water laws will be complied with in the design and construction of the floodwater retarding structures.

The City of Coleman has developed preliminary plans for a municipal water supply structure on Jim Ned Creek located at the lower end of Evaluation Reach 3 (figure 1). The reservoir would have 7,500 acre-feet of sediment storage, 32,500 acre-feet of municipal water storage and 24,000 acre-feet of floodwater detention storage. The floodwater detention storage is included to reduce structure cost rather than for the purpose of flood prevention. These plans are very indefinite, however, if this reservoir is constructed, the work plan will be revised to omit Sites 2, 3, 4, 9, 10, 11, 12A and 22 (figure 3). These sites are in the fourth and fifth year of the tentative schedule of obligations.

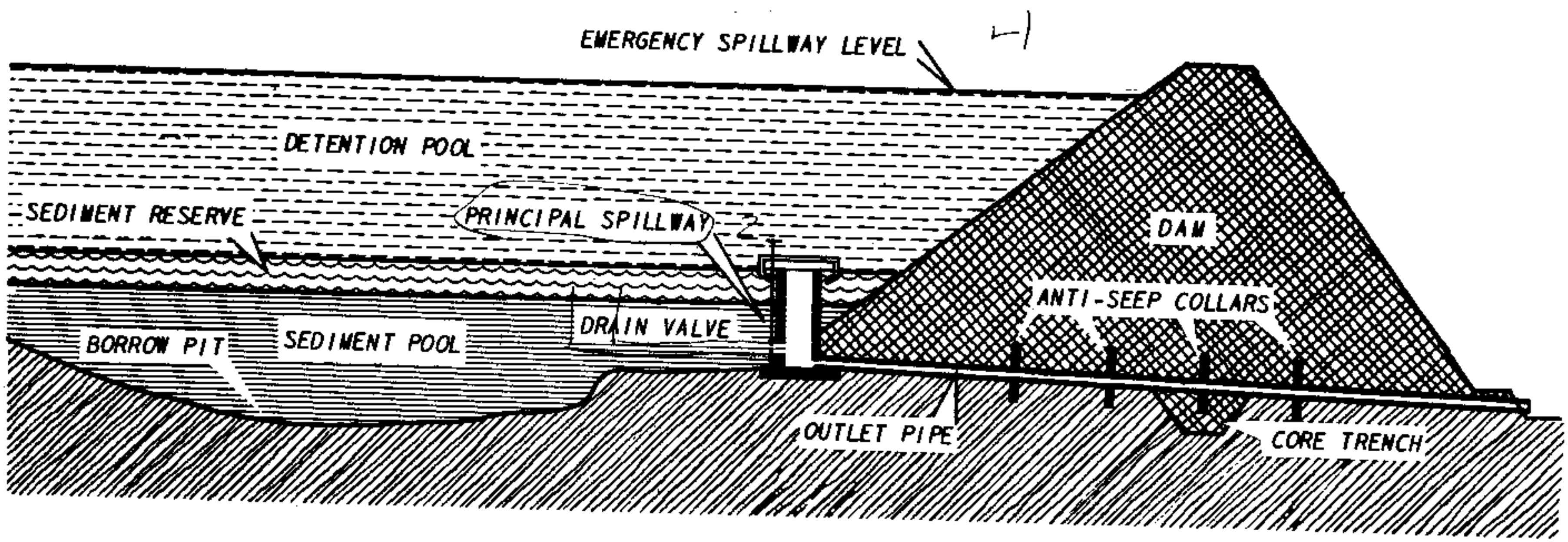


Figure 2
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

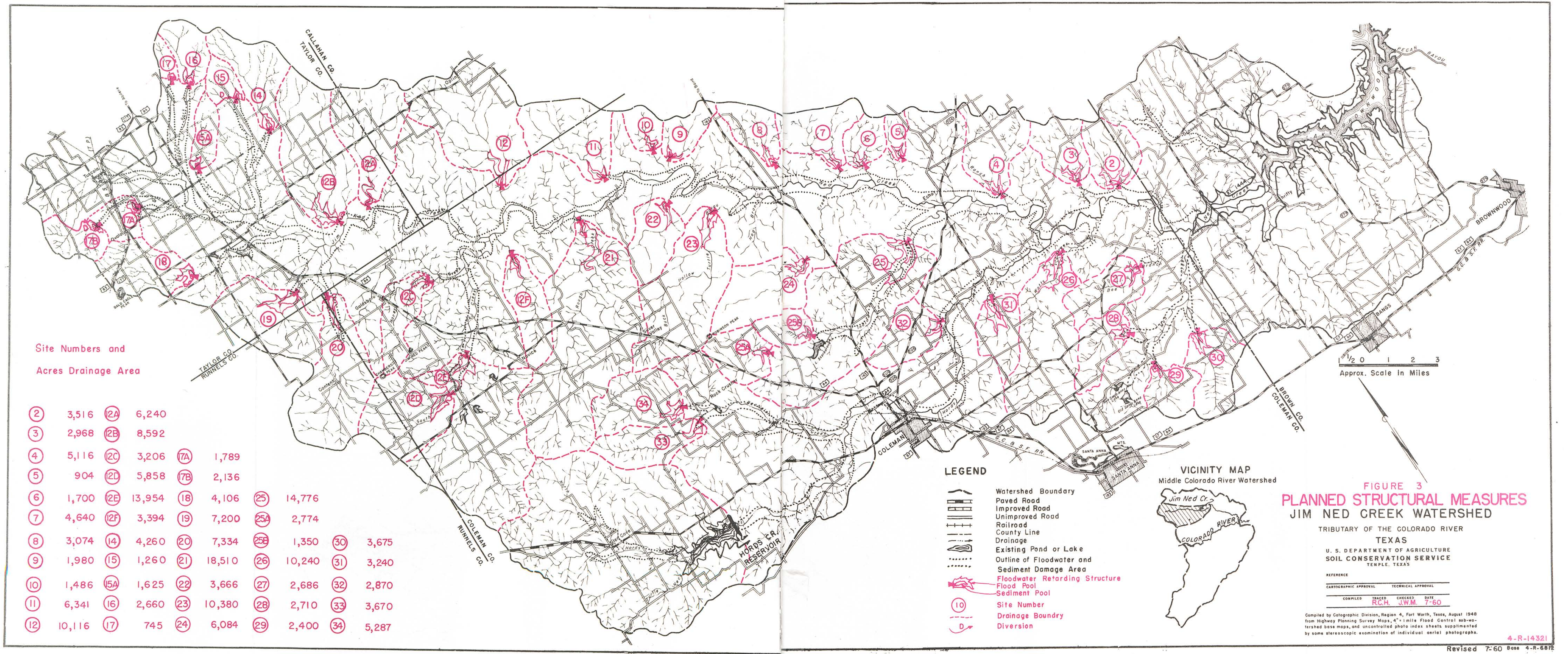


FIGURE 3

PLANNED STRUCTURAL MEASURES
JIM NED CREEK WATERSHED

TRIBUTARY OF THE COLORADO RIVER

TEXAS

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

REFERENCE

CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL

COMPILED TRACED R.C.H. CHECKED J.W.M. DATE 7-60

Compiled by Catographic Division, Region 4, Fort Worth, Texas, August 1948 from Highway Planning Survey Maps, 4" = 1 mile Flood Control sub-watershed base maps, and uncontrolled photo index sheets supplimented by some stereoscopic examination of individual aerial photographs.

4-R-14321

Revised 7-60 Base 4-R-6812

Site Numbers and Acres Drainage Area

2	3,516	12A	6,240						
3	2,968	12B	8,592						
4	5,116	12C	3,206	17A	1,789				
5	904	12D	5,858	17B	2,136				
6	1,700	12E	13,954	18	4,106	25	14,776		
7	4,640	12F	3,394	19	7,200	25A	2,774		
8	3,074	14	4,260	20	7,334	25B	1,350	30	3,675
9	1,980	15	1,260	21	18,510	26	10,240	31	3,240
10	1,486	15A	1,625	22	3,666	27	2,686	32	2,870
11	6,341	16	2,660	23	10,380	28	2,710	33	3,670
12	10,116	17	745	24	6,084	29	2,400	34	5,287

USDA-SCS-FORT WORTH, TEX. 1974

BENEFITS FROM WORKS OF IMPROVEMENT

The evaluation storm series for the period 1923 through 1942 contained 110 storms which would cause flooding under present conditions. The effect the combined program of land treatment and structural measures, by evaluation reaches, would have on such storms is shown in Table A.

Under present conditions 27,118 acres of floodplain would be flooded by runoff from the largest storm which occurred during the 20-year period 1923-1942 (3.55 inches runoff). If such a rain were to occur after land treatment measures had been applied, it is estimated that the area inundated would be reduced to 26,327 acres. With land treatment measures applied and structural measures for flood prevention in operation, 17,116 acres would be flooded.

The land treatment measures will reduce the present average annual sediment yield, 0.35 acre-foot per square mile, from the watershed of the proposed 43 floodwater retarding structures by 22 percent. It is estimated that land treatment measures have reduced sediment yields by 38 percent since the detailed sediment surveys were made in 1940 and 1941 on existing reservoir. Application of the additional planned land treatment measures will reduce present sediment yields to these reservoirs an additional 20 percent. The effect of the combined program of land treatment and structural measuras on sediment being delivered to Lake Scarborough and Lake Brownwood is shown in the following table:

Reservoir	Without Project		With Land Treatment		With Structures and Land Treatment	
	(Ac. Ft.)	(Dollars)	(Ac. Ft.)	(Dollars)	(Ac. Ft.)	(Dollars)
Lake Scarborough	4.74	1,304	4.04	1,111	2.79	767
Lake Brownwood	214.80	17,939	178.58	14,934	104.95	8,849

Other sediment damages, such as damages to recreational facilities and to fish and wildlife, are recognized but monetary evaluations of these damages were not made.

Owners and operators of flood plain lands say that if adequate flood protection is provided, they will restore 404 acres of land now idla or in poor pasture to cultivation. This land will ba usad to produce grain sorghum, small grain and forage crops. All of this land was in cultivation at one time, but is now used chiefly for pasture because of frequency of flooding. It is estimated that average net income from such rastoration will amount to $7,795 (long-term price levels) annually. This loss from the original production has been considered a crop and pasture damage, and its restoration a benefit in Table 5.

Table A - General Location of Benefits

	Evaluation Reach (Figure 1)					
	1	2	3	4	5	6 1/
Average Annual Acre Flooded						
Without Project - Acres	19,363 2/	2,948	1,646	6,065	8,487	471
With Project - Acres	6,405	1,136	421	1,836	2,830	398
Percent Reduction	67	61	74	70	67	15
Area Flooded by Largest Storm						
Without Project - Acres	9,441 3/	1,730	1,100	4,000	5,500	670
With Project - Acres	4,334	1,091	1,006	2,868	4,066	630
Percent Reduction	54	42	9	28	26	6
Average Annual Floodwater Damage						
Without Project - Dollars	138,476	19,467	14,399	45,861	86,665	2,936
With Project - Dollars	31,182	4,440	2,355	7,894	18,351	2,437
Percent Reduction	85	77	84	83	79	17
Number of Major Floods in Evaluation Series						
Without Project	32	31	32	33	32	6
With Project	0	6	6	6	6	6

1/ No structural measures to be installed due to lack of economic justification.

2/ Does not include 2,509 acres flooded by overland flow, 925 of which will flood after the project is installed.

3/ Does not include 5,591 acres flooded by overland flow, 3,800 of which will flood with the project.

April 1960

Table A - General Location of Benefits - Continued

	Evaluation Reach (Figure 1)					
	7	8	9	10	11 1/	Total
Average Annual Acre Flooded						
Without Project - Acres	815	747	2,343	542	1,167	44,594 2/
With Project - Acres	397	292	581	40	956	15,292
Percent Reduction	51	74	75	93	18	66
Area Flooded by Largest Storm						
Without Project - Acres	610	1,950	1,415	252	450	27,118 3/
With Project - Acres	490	1,124	862	200	445	17,116
Percent Reduction	20	42	39	21	1	37
Average Annual Floodwater Damage						
Without Project - Dollars	5,901	8,037	12,621	3,095	8,466	345,924
With Project - Dollars	2,207	1,297	2,437	67	7,062	79,729
Percent Reduction	63	84	81	98	17	77
Number of Major Floods in Evaluation Series						
Without Project	19	3	32	41	58	
With Project	5	1	3	1	41	

1/ No structural measures to be installed due to lack of economic justification.
2/ Does not include 2,509 acres flooded by overland flow, 925 of which will flood after the project is installed.
3/ Does not include 5,591 acres flooded by overland flow, 3,800 of which will flood with the project.

It is expected that landowners will convert 647 acres of pastureland to cropland which will result in an additional $5,619 increase in net average annual income and that more intensive use of land on 3,503 acres will produce average annual benefits in the amount of $2,266. The land being converted to cropland will be used to produce grain sorghum, small grains and forage crops. The more intensively used lands will consist of increasing the grazing capacity of rangeland.

Average annual benefits of $39,700 will accrue to the planned structural measures in the watershed from reduction of damages on the mainstem of Pecan Bayou below Lake Brownwood.

The estimated average annual floodwater, sediment, erosion and indirect damage within the watershed will be reduced from $405,280 to $99,755, a 75 percent reduction. Approximately 83 percent, $253,727, of the expected reduction in the average annual damage will result from the system of floodwater retarding structures.

The total flood prevention benefits resulting from structural measures are estimated to be $301,312 annually.

COMPARISON OF BENEFITS AND COSTS

The annual equivalent cost of structural measures (converted from total installation cost) plus the annual operation and maintenance cost is estimated to be $163,551. When the project is completely installed, it is expected to produce average annual benefits of $301,312. The project, therefore, will produce $1.84 for each dollar of cost. Other substantial values will accrue from the project, such as increased opportunity for recreation, improved wildlife habitat and a sense of security, none of which has been used for project justification.

ACCOMPLISHING THE PLAN

Federal assistance for carrying out the works of improvement as described in this plan will be provided under the Flood Control Act of 1936, as amended and supplemented.

Land Treatment Measures

Land treatment measures itemized in table 1 will be established by farmers and ranchers in cooperation with the Brown-Mills, Central Colorado, Runnels and Middle Clear Fork Soil Conservation Districts during the 5-year project installation period. The cost of applying these measures will be borne by the owners and operators of the land. It is expected that the owners and operators will be reimbursed for a portion of this cost through the existing Agricultural Conservation Program or other Federal programs. The amount of reimbursement to be expected has been estimated, based on current program criteria, and this amount has not been included in the total estimated non-Federal cost for land treatment listed in table 1. The soil conservation districts are giving assistance in the planning and application of these measures under their going programs. This assistance will be continued to assure application of the planned measures within the 5-year installation period of the project.

The governing bodies of the soil conservation districts will arrange for meetings according to definite schedules. By this means and by individual contacts they will encourage the landowners and operators within the watershed to adopt and carry out soil and water conservation plans on their farms. District-owned equipment will be made available to the landowners in accordance with the existing arrangements for equipment usage in the district. Each district governing body will make periodic inspections of the completed conservation measures within its district and follow through to see that needed maintenance is performed.

The Soil Conservation Service work units will assist landowners and operators cooperating with districts in accelerating the preparation of soil and water conservation plans and the application of conservation practices.

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

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

The Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings, preparing radio, television and press releases and using other methods of getting information to landowners and operators in the watershed. This activity will help to get the land treatment practices and the structural measures for flood prevention carried out.

Structural Measures for Flood Prevention

The Soil Conservation Service has contracted for and supervised the construction of 5 of the floodwater retarding structures and, likewise, will contract for the construction of the remaining 38. It also will provide technical specialists to prepare plans and specifications, supervise construction, prepare contract payment estimates, make contract payments, make final inspections, certify completion, and perform related duties for the installation of these structural measures.

Taylor and Coleman Counties, in cooperation with the Central Colorado Soil Conservation District and the Taylor County Water Control and Improvement District No. 1, will furnish the land rights and arrange for road, utility and improvement changes for all the structural measures at no cost to the Federal Government.

The following is a grouping of structures for construction purposes, each group of which has a favorable benefit-cost ratio, based on those benefits that will accrue within the boundary of each construction unit:

Construction Unit Number	Structure Numbers	Annual Benefits	Annual Costs	Benefit Cost - Ratio
1	14, 15, 15-A, 16, 17, 17-A, 17-B, 18, 19, 20	102,730	33,759	3.0:1
2	28, 29, 30	10,606	9,488	1.1:1

All necessary land rights will be obtained for each construction unit before Federal financial assistance is made available for installation of any part of that construction unit. All necessary land rights, including the relocation of roads, utilities and improvements, will be obtained for all structural measures before construction is started on any of the structures not included in the two construction units.

The cooperating parties have agreed on a 5-year installation period. The tentative schedule of obligations for the complete project installation period, including installation of both land treatment and structural measures, is as follows:

Fiscal Year	Structure Numbers	Federal Cost (dollars)	Non-Federal Cost (dollars)	Total Cost (dollars)
Completed	15, 16, 17, 19, 20	397,110	1,608,055	2,005,165
First	14, 15-A, 17-A, 17-B, 18, 27, 28, 29, 30	664,284	139,816	804,100
Second	12, 12-B, 12-D, 12-E, 12-F	601,547	166,895	768,442
Third	23, 24, 25, 25-A 25-B, 33, 34	714,148	225,173	939,321
Fourth	2, 3, 4, 5, 6, 7, 8, 21, 26	757,425	234,973	992,398
Fifth	9, 10, 11, 12-A 12-C, 22, 31, 32	722,223	95,405	817,628
Total		3,856,737	2,470,317	6,327,054

This schedule will be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desired, and in the light of appropriations and accomplishments actually made.

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

1. The required land treatment in the drainage area above structures has been installed or is in the process of being installed.

2. All land rights have been secured.

3. Operation and maintenance agreements have been executed.

4. Flood prevention funds are available.

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

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be operated and maintained by the owners and operators of the farms and ranches on which the measures are installed, under agreements with the Brown-Mills, Central Colorado, Runnels and Middle Clear Fork Soil Conservation Districts. Representatives of these soil conservation districts will make periodic inspections of the land treatment measures to determine maintenance needs and to encourage landowners and operators to perform maintenance. They will make district-owned equipment available for this purpose.

Structural Measures

Structure Nos. 12-A, 12-B, 14, 15, 15-A, 16, 17, 17-A, 17-B, 18, and 19 will be operated and maintained jointly by the Central Colorado Soil Conservation District, the Taylor County Commissioners Court and Taylor County Water Control and Improvement District No. 1. The Coleman County Commissioners Court and Central Colorado Soil Conservation District will assume operation and maintenance of the remaining structural measures.

The estimated operation and maintenance cost is $8,055 annually, based on long-term price levels. The necessary maintenance work will be accomplished through the use of contributed labor and equipment, by contract, by force account, or a combination of these methods. Funds for this work will be provided by Taylor and Coleman County Commissioners Courts.

All floodwater retarding structures will be inspected by representatives of all cosponsoring organizations at least annually and after each heavy rain. A Soil Conservation Service representative will participate in these inspections at least annually. Items of inspection will include, but will not be limited to, the condition of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and emergency spillway and fences and gates installed as part of the floodwater retarding structures. The sponsoring local organizations will maintain a record of the inspection and maintenance work performed and have it available for review by Soil Conservation Service personnel.

Provisions will be made for free access of representatives of the cosponsoring organizations and the Federal Government to inspect the floodwater retarding structures and their appurtenances at any time.

The cosponsoring local organizations fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of any invitation to bid.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

The installation of the watershed protection and flood prevention project on the Jim Ned Creek Watershed will make a substantial contribution to the objectives of the overall Middle Colorado River development program.

This project conforms to all Federal laws and regulations and will have no known detrimental effects on existing downstream projects or any that might be constructed in the future.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Project Objectives

Flood problems, needed land treatment measures, and the degree of protection desired by the local people were discussed with the local sponsoring organizations and the following project objectives reached:

1. That, in accordance with present policies and criteria, a revision of the Jim Ned Creek Watershed work plan developed in 1950 is needed.

2. That more land treatment measures which contribute directly to flood prevention, based on current needs, are requirsd.

3. That a minimum of 75 percent reduction in average annual floodwater damage will be required to insure sustained agricultural production on flood plain lands and to maintain the economy of the watershed.

4. That the proposed Coleman reservoir be considered in revising the plan.

Land Treatment

Soil Conditions, Land Use and Treatment Needs

Soil conditions and land use on the upland were determined by expanding a 10 percent random sample of the watershed to the entire upland area. The land use of the flood plain was determined by planimetering the flood plain strip map which was developed during the hydrologic and economic investigations.

The status of land treatment measures and practices effectively applied and the current conservation needs were secured from the records of the Brown-Mills, Central Colorado, Middle Clear Fork, and the Runnels Soil Conservation Districts. This information was expanded, with assistance from personnel of the Soil Conservation Service work units at Brownwood, Coleman, Abilene, and Ballinger, to estimate the amount of various practices that will be applied during the 5-year installation period for the entire watershed.

Cover Conditions and Range Sites

Cover conditions and range sites were determined from available range surveys and other cover information secured from the records of the soil conservation districts, and expanded with assistance of the work units involved to the entire watershed.

Project Formulation

The needed land treatment measures which contribute directly to flood prevention remaining to be done in the watershed, based on range condition classes and land capability classes developed from soil surveys were first determined. The hydraulic, hydrologic, sedimentation and economic investigations provided data on the effect these measures would have on the reduction of sediment and flood damages. Although significant benefits would result from application of these needed land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of watershed protection and flood damage reduction desired by the local people.

In collaboration with the concerned members of the State staff and the Engineering and Watershed Planning Unit, a study of the surveys, investigations, data, and analyses used in the original work plan was made. It was decided that, in the revision of the Jim Ned Creek Watershed Work Plan in accordance with present policies and criteria, additional surveys, investigations and analyses to supplement the original data would be made. However, the original methods of analysis would be used.

Structural measures for watershed protection and flood prevention which would be feasible to install to meet the objectives of the sponsoring local organizations were then determined. The study made and the procedures used in that determination were as follows:

1. A base map of the watershed had been prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. This map was adjusted and brought up to date. A stereoscopic study of 4-inch consecutive aerial photographs had been made to locate all probable floodwater retarding structure sites, the limits and the area of the flood plain, and points where valley cross sections should be taken for the determination of hydraulic characteristics and for flood routing purposes. These studies were re-examined to determine the availability of additional new and alternate site locations and the necessity for, and location of, additional valley cross sections. This information was placed on the watershed base map for use in field surveys.

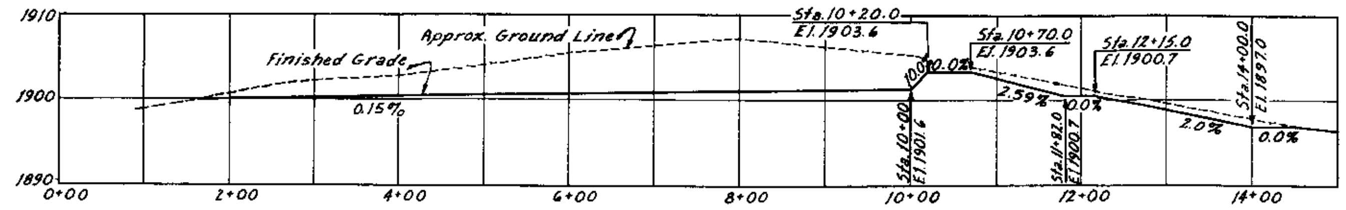
2. The cross sections of the flood plain, previously located stereoscopically, had been examined in the field, adjusted to give the best representation of hydraulic characteristics and surveyed at the selected locations. These were re-examined on a sample basis. The needed additional cross sections were examined in the field and surveyed at the selected locations. Data developed from these cross sections permitted the computation of peak discharge-stage-damage relationships for various flood flows. The map that had been prepared of the flood plain showing land use, cross section locations, and other pertinent information was brought up to date.

3. A field examination was made of all probable floodwater retarding structure sites, including additional new and alternate sites previously located stereoscopically as well as those included in the original plan. Sites which did not show good storage possibilities or which would inundate highways or improvements for which the cost of relocating could not be economically justified were dropped from further consideration. From the remaining sites a system of floodwater retarding structures was selected, based on the degree of control desired, for further consideration and detailed survey. Plans of a floodwater retarding structure, typical of those planned for this watershed, are illustrated by figures 4 and 4A.

4. To obtain the desired degree of protection needed, give adequate protection to flood plain lands, and develop the storage necessary for this protection, it was necessary to locate Site 12-E in series with 12-D, Site 17-A in series with Site 17-B, and Site 25 in series with Sites 25-A and 25-B (figure 3).

5. A topographic map with 4-foot contour intervals was made of the pool area of each of the proposed sites to determine the storage capacity of the site, the estimated cost of the dam and the areas of flood plain and upland that would be inundated by the sediment and flood pools. Sediment storage requirements were determined for each site through a study of the physical and vegetative conditions of the drainage area above that site. Spillway widths, depths of flow, embankment yardage, and volume of rock excavation in spillways were computed for each structure starting with the storage volume needed to temporarily detain the minimum runoff as determined from criteria as set forth in Soil Conservation Service, Washington Engineering Memorandum No. 27, Hydrology Memorandum EWP-2 (Revised), Technical Release No. 2, and Section 2441, Texas State Manual. The runoff to be stored was then increased by increments to determine the amount of storage that would result in the most economical structure.

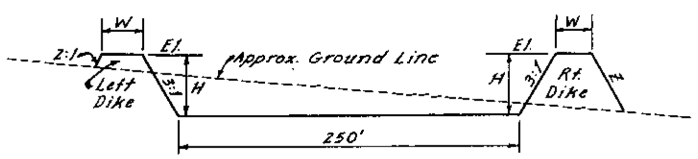
6. The limits of the flood pools and sediment pools of all satisfactory sites and the flood plain of the stream were drawn to scale on a copy of the base map. Structure date tables ware developed to show, for each structure, the drainage area, the storage capacity needed for floodwater detention and sediment, storage in acre-feet and in inches of runoff from the drainage areas, the release rate of the principal spillway, the emergency spillway widths and depths of flow, maximum height of dams, the acres inundated by the sediment and detention pools, the volume of fill in the dams, and the estimated cost of the structures (tables 2 and 3).



PROFILE ON R/L OF EMERGENCY SPILLWAY

Elevation	Surface Acres	Storage	
		Acre Feet	Inches
1886	16	40	0.07
1890	43	158	0.26
1890.9	50	200	0.33
1893.3	103	384	0.64
1894	115	460	0.77
1898	211	1112	1.85
1902	318	2170	3.62
1903.6	373	2723	4.54
1906	458	3720	6.20
1910	612	5860	9.77

Top of Dam (Effective) Elev.	1908.8
Emergency Spillway Crest Elev.	1903.6
Principal Spillway Crest Elev.	1893.3
Sediment Pool Elev.	1890.9
Drainage Area, Acres	7200
Sediment Storage, Acre Feet	384
Floodwater Storage, Acre Feet	2339
Max. Emergency Spillway Cap., c.f.s.	4850

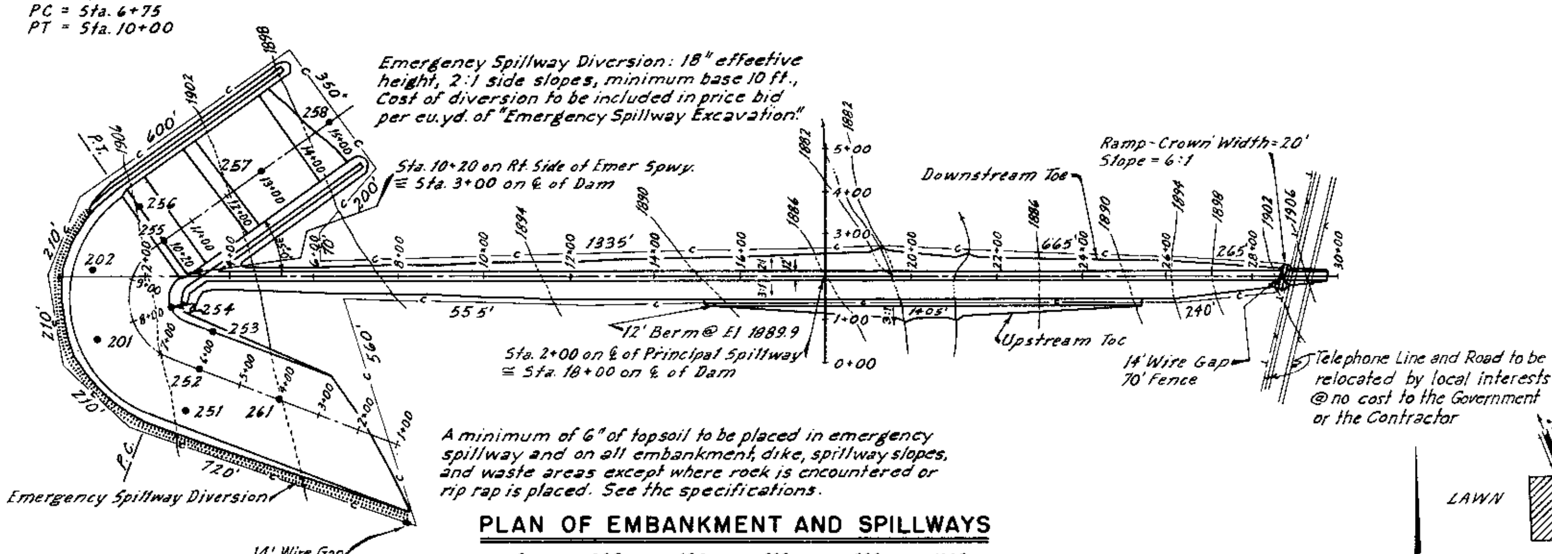


Left Dike – From Approx. Sta. 9+50 to Sta. 10+70 El. = 1908.8, W = 12'. Sta. 10+70 to Sta. 11+00, Transition Section. Sta. 11+00 to Sta. 15+00, W = 8'; H = 4' above Spillway Grade.

Right Dike – From Sta. 8+00 to Sta. 10+70, W = 12'; Z = 3:1; El. = 1908.8. Sta. 10+70 to Sta. 11+00, Transition Section. Sta. 11+00 to Sta. 15+00, W = 8'; Z = 2:1; H = 4' above Spillway Grade.

TYPICAL SECTION — EMERGENCY SPILLWAY

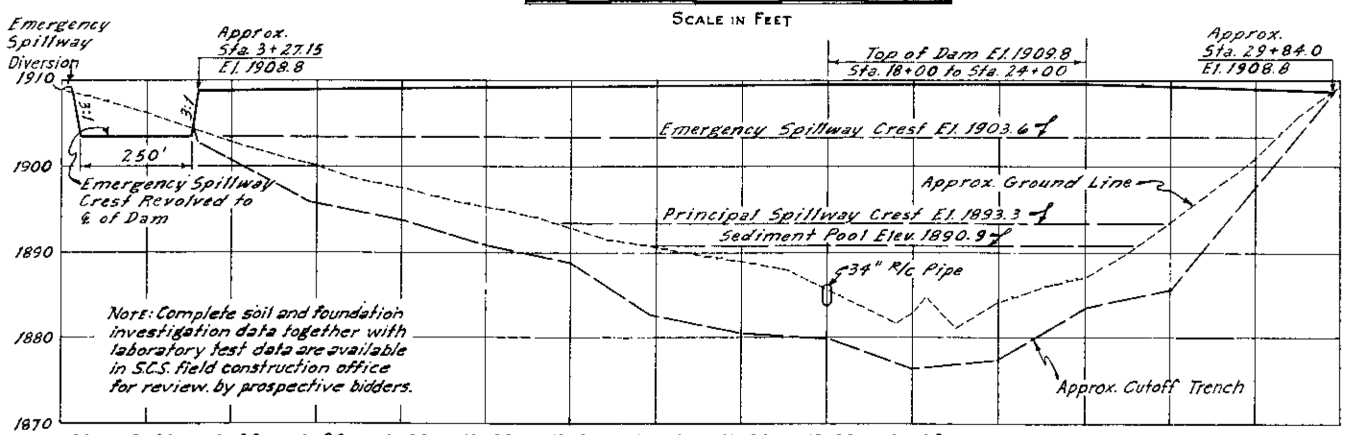
Emergency Spillway Base Line Curve Data
Δ = 124° - 08'
D = 38° - 12'
R = 150'
L = 325'
PC = Sta. 6+75
PT = Sta. 10+00



A minimum of 6" of topsoil to be placed in emergency spillway and on all embankment, dike, spillway slopes, and waste areas except where rock is encountered or rip rap is placed. See the specifications.

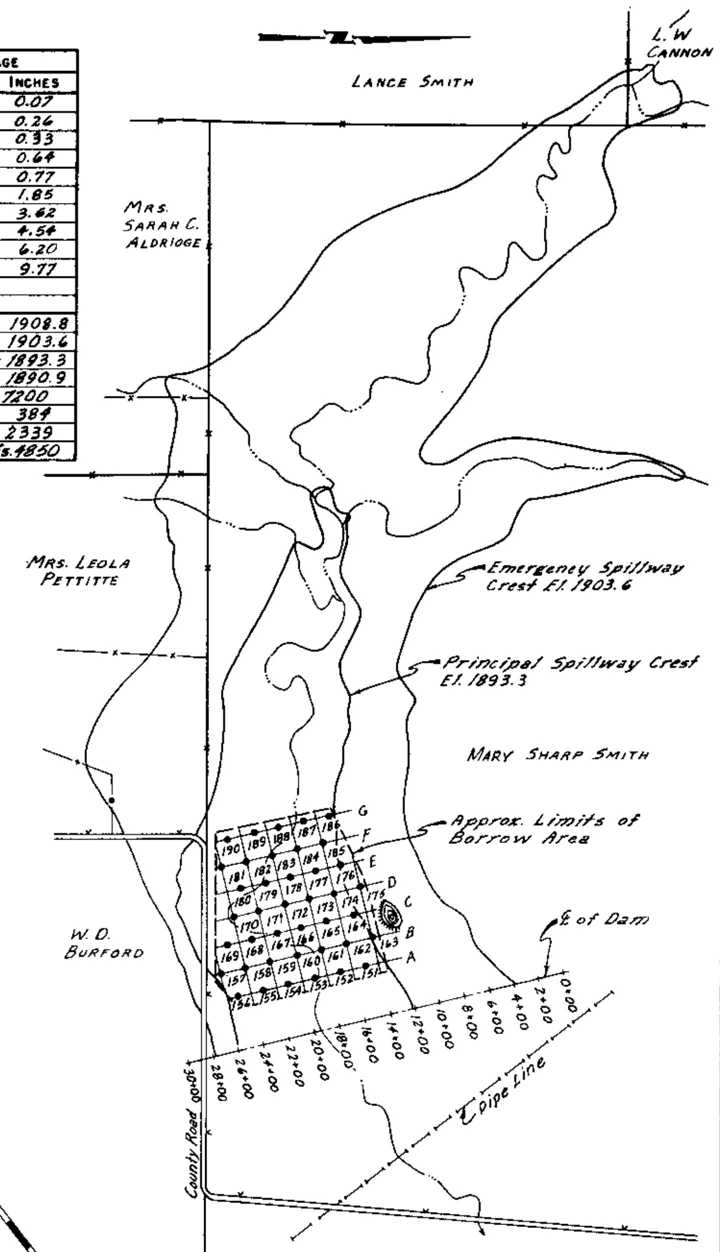
PLAN OF EMBANKMENT AND SPILLWAYS

0 200 400 600 800 1000
SCALE IN FEET



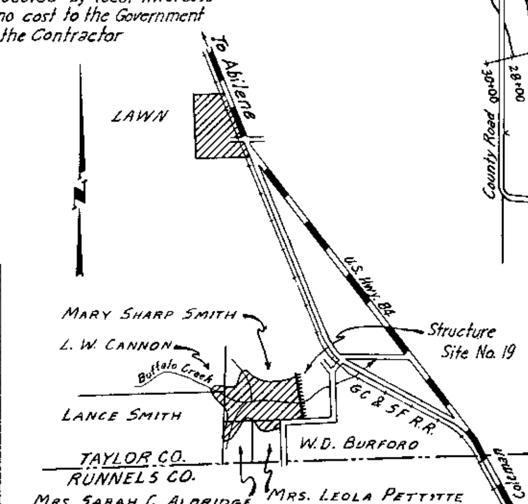
Note: Complete soil and foundation investigation data together with laboratory test data are available in SCS field construction office for review by prospective bidders.

PROFILE ON ℄ OF DAM



GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640
SCALE IN FEET



Located 3.5 miles Southwest of Lawn, Taylor County, Texas.

VICINITY MAP

0 1 2 3 4
SCALE IN MILES

Figure 4
TYPICAL
FLOODWATER RETARDING STRUCTURE
PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	L.L.	4-59
Drawn	L.L. & J.E.L.	4-59
Traced	J.E.L.	4-59
Checked	L.L. & G.W.T.	5-59

Sheet No. 2 of 7 — Drawing No. 4-E-13,361

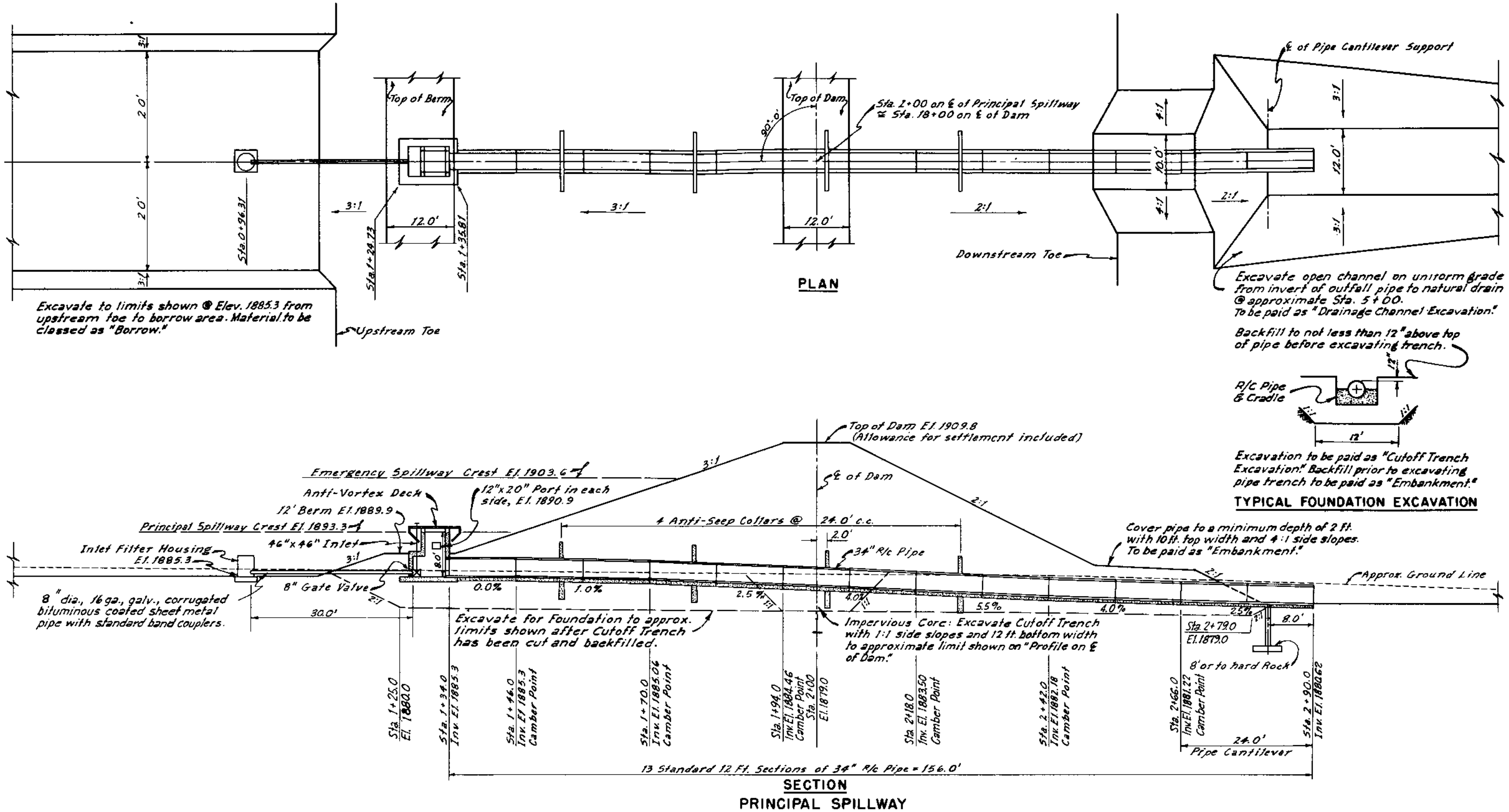


TABLE OF MATERIALS

LAB TEST		COMPACTION REQUIREMENTS			Lab. Curve
Modified		Min. Dry Density	Moisture Range		
Max. Dry Den.	Opt'm Moist	Lbs. Per Cu. Ft.	Percent From	To	No
115.5	15.0	104.0	15.0	Up	1
125.0	10.5	113.0	10.0	"	2
117.5	13.5	106.0	13.0	"	3
126.5	10.0	114.0	10.0	"	4
122.5	12.5	110.0	14.0	15.0	5
133.0	7.5	120.0	7.0	Up	6
115.5	13.5	104.0	13.0	"	7
129.0	9.5	116.0	9.0	"	8

Note: No sectional zoning of the embankment is required. Minimum dry density required is 90% of maximum dry density as obtained by AASHO modified compaction procedures. Placement moisture range for the structure backfill from Curve 5 will be as indicated in tabulation. The remainder of the embankment will be placed with a moisture content from optimum upward.

Figure 4A
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	L.L.	4-59	Approved by
Drawn	L.L. & J.E.L.	4-59	
Traced	J.E.L.	4-59	Sheet No. 3 of 7
Checked	L.L. & G.W.T.	5-59	Drawing No. 4-E-13,361

7. Data on the proposed Coleman municipal water supply structure on Jim Ned Creek as obtained from the "Report on the Jim Ned Creek Dam and Reservoir for the City of Coleman, Texas", by Forrest and Cotton, Consulting Engineers, dated November 1957, was tabulated and analyzed. The effect of the flood prevention program on this reservoir and its effect on the flood prevention program was determined by flood routings and evaluated.

8. Damages resulting from floodwater, sediment and erosion were determined from damage schedules and survey of sample areas. Reduction in these damages resulting from the proposed works of improvements were estimated on the basis of reduction of peak discharges, stages, and volumes of runoff in inches for various frequency storms, as determined by flood routings. These flood routings were made for conditions without the project, with land treatment, and for future conditions assuming that all proposed works of improvement has been installed. Benefits so determined were allocated to individual measures or groups of interrelated measures on the basis of the effect of each on reduction of damages. In this manner it was determined that floodwater retarding structures could be economically justified. By further analysis those individual floodwater retarding structures and interrelated structures which had favorable benefit-cost ratios were determined. Those which were unfavorable were dropped from further consideration, and where replacements were found to be necessary to effect the needed control, alternate sites were investigated until a system of floodwater retarding structures was developed which would give maximum net benefits for the degree of control desired. These works were included in the plan.

When the land treatment measures and the structural measures for flood prevention had been determined, a table was developed to show the total cost of each type of measure. The summation of the total costs of all needed measures represented the estimated cost of the planned watershed protection and flood prevention project, as revised (table 1). A second cost table was developed to show separately the annual installation cost, annual maintenance cost and total annual cost of the structural measures (table 4).

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from Climatological Bulletins, United States Weather Bureau and Water Supply Papers, United States Geological Survey, and local records and analyzed to determine average precipitation, depth-duration relationships, seasonal distribution of precipitation, the frequency of occurrence of meteorological

events and the historical flood series to be used in the evaluation of the project, rainfall-runoff relationships, runoff-peak discharge relationships, and the relationship of geology, soils and climate to runoff depth for single storm events.

2. In the development of the original work plan, engineering surveys were made to collect information on selected stream reaches, including valley cross sections, channel capacities, high water elevations of selected storms, bridge capacities, and other hydraulic characteristics. From a study of these surveys, it was determined that surveys of additional stream reaches and cross sections were needed. Engineering surveys were also made on all proposed structure sites to collect data used in design. These cross sections and evaluation reaches were selected on the ground in conference with the economist and sedimentation specialist.

3. Present hydrologic conditions of the watershed were determined, taking into consideration such features as soils, land use, topography, cover and climate. Future hydrologic conditions were determined by obtaining from the work unit conservationist and landowners estimates of the changes in land use and cover conditions that could be expected during the installation period of the project. Runoff curve numbers were computed from soil-cover complex data obtained from the drainage area of 16 representative structure sites, 36 percent of the drainage area of all sites, and used with figure 3.10-1, Soil Conservation Service, National Engineering Handbook, Section 4, Supplement A, to determine depth of runoff from individual storms in the evaluation series and design storms.

4. Rainfall-runoff relationship was determined and compared to nearby actual gaged runoff on similar watersheds. The frequency of meteorological events was determined by computing the plotting positions of historical series taken from Climatological Papers and Water Supply Bulletins and plotting rainfall, runoff and peak discharges against their respective plotting positions on Hazen probability paper. The relationships of runoff peak discharges and damages were determined for various frequencies. (Pages 3.18-1-24, NEH, Section 4, Supplement A).

5. Rating curves for the cross sections were computed by Mannings formula and concordant flow (Pages 4.2-1-9, NEH, Section 4, Supplement A), and were checked at selected sections by water surface profiles for various selected discharges. (Doubt method, Pages 3.14-7-13, NEH, Section 4, Supplement A and NEH, Section 5, Supplement A). Stage-area inundated curves were developed for each cross section, and from these composite runoff-area inundated curves for each evaluation reach were developed.

6. Determination was made of peak discharges, area inundated and damages caused by various amounts of runoff which would exist due to:

    a. Present conditions.

    b. Effect of land treatment measures.

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

    d. Consideration of alternative measures.

7. Structure classifications were determined and emergency spillway design storm inflow hydrographs were developed for all structure sites. Spillway widths and depths of flow were determined by the Goodrich graphical routing method in accordance with procedures set forth in Washington Engineering Memorandum No. 27; NEH, Section 4, Hydrology, Supplement A; NEH, Section 5, Hydraulics; Technical Release No. 2; Hydrology Memorandum EWP-2 (Revised); Section 2441, Texas State Manual.

From a graph showing cumulative departures from normal precipitation, the rainfall for the period 1923 to 1942, inclusive, was selected as most representative of normal rainfall for this watershed. Rainfall information for the historical series used in these studies was obtained by applying the Thiessen polygon method of weighting to the rainfall data tabulated for the Brownwood, Coleman, Echo, Burkett, Abilene and Winters stations. (NEH, Section 4, Hydrology).

The largest rain which occurred during the 20-year period was a storm of 6.29 inches. An average rain of this magnitude would produce the equivalent of 3.55 inches of runoff at section No. 1, after adjustment for transmission loss.

It was determined that 0.01 inch of runoff was the minimum volume that would cause flooding to a depth of six inches at the smallest valley section. Therefore, no storms producing less than 0.01 inch of runoff were considered for flood-routing purposes. Runoff of 0.01 inch would produce a discharge of 30 cubic feet per second at the minimum valley section (No. SBF-2) and 269 cubic feet per second at the reference section (No. 1). The minimum valley section is located about 3 miles north of Lawn, Texas. The reference cross section is located approximately 8 miles north of Bangs, Texas (figure 1).

The channel capacity at the reference section is 16,100 cubic feet per second. The peak discharge at this point for a 6.29-inch rain under present conditions is estimated to be 95,000 cubic feet per second. After installation and full functioning of all the planned measures on the Jim Ned Creek Watershed, the discharge at the same point would have been reduced to 39,700 cubic feet per second.

The 6-hour design storm rainfall was taken from figure 3.21-1, NEH, Section 4, Supplement A. The emergency spillway and freeboard storm hydrographs were computed using 0.5P and P, as determined by Hydrology Memorandum EWP-3, and adjusted to the drainage area of each site. Routing the emergency spillway hydrographs resulted in no flow through the emergency spillways. Therefore, the dimensions of the emergency spillways were determined by graphically routing the freeboard hydrographs. Composite hydrographs were developed for those sites in series using the storage indication method to flood route between the structures. The criteria and procedures used are set forth in Washington Engineering Memorandum SCS-No. 27, Technical Release No. 2; Hydrology Memoranda EWP-1, EWP-2, EWP-3, and EWP-4; NEH, Section 4, Supplement A, NEH, Section 5; and Section 2441, Texas State Manual.

Frequency of use of emergency spillways was based on regional analysis of gaged runoff from this and similar watersheds. Detention storage, spillway depth and width, embankment yardage, rock excavation and spillway alignment were balanced to give the most economical structure, which was included in the watershed plan.

These studies were based on a release rate of 47 cubic feet per second per square mile for the Hords Creek reservoir, as set forth in the U. S. Army Corps of Engineer's report, and a maximum release of 10 cubic feet per second per square mile for all proposed detention structures.

Sediment investigations were made in accordance with methods and procedures contained in Watershed Memorandum EWP-7, "Sediment Investigations in Work Plan Development".

Sedimentation Investigations

Sediment Source Areas

Sediment source studies to determine the 50-year sediment storage requirements were made in the drainage areas of the 43 planned floodwater retarding structures according to the following procedures:

1. Detailed investigations were made in the drainage areas above 16 of the planned floodwater retarding structures. These investigations included: mapping soil units by slope in percent; slope length in feet; present land use; present land treatment on cultivated land; present cover condition classes on rangeland and pasture; land capability classes; lengths, widths, and depths of all gullies; lengths, widths, and depths of all stream channels affected by erosion; and the estimated annual lateral erosion of gullies and stream channels in feet.

2. Office computation included summarizing erosion by sources (sheet erosion, gully erosion, and streambank erosion) in order to fit these date into formulas for computation of gross annual erosion in tons for conversion to acre-feet.

The following formula was used for computing sheet erosion:

E = A x F x SF x CF x RF, where
E = Sheet erosion in tons per year
A = Area in acres
F = Basic erosion rate of soil unit in tons per year
SF = Slope factor, based on percent and length of slope
CF = Cover factor, based on present cover and land treatment
RF = Rainfall factor, based on maximum 2-year, 30-minute rainfall intensity

The following formula was used for computing gully and streambank erosion:

E = N x L x P x H x LE ÷ 43,560 x W, where
E = Erosion in tons per year
N = Number of banks affected
L = Length of gully or streambank in feet
P = Percent of gully or streambank affect by erosion
H = Average height of bank in feet
LE = Estimated annual lateral erosion in feet
W = Weight in tons per acre-foot of soil material being eroded.

3. Field surveys and office computations to determine the estimated sediment rates for the remaining 27 structures under present conditions consisted of mapping the land use and arranging the sites into homogeneous groups and the preparation of sediment source summary sheets based on the homogeneous grouping of the sites and the detailed investigations.

4. The sediment rates were then adjusted to reflect the effect of expected land treatment on the drainage areas of the planned floodwater retarding structures. The computed sediment storage requirement for each site is based on a gradual improvement of watershed conditions as a result of the installation of needed land treatment measures expected to be installed during the first ten years and maintaining these measures at 75 percent effectiveness during the next 40 years.

5. The ratio of sediment storage volume in the pools to soil in place was estimated to range from 1.2 to 1.8 depending on the texture of the eroding soil.

6. The allocation of sediment to the structure pools was based on a range of 15 to 30 percent deposition in the detention pools and 70 to 85 percent deposition in the sediment pool. This allocation was determined on the basis of topography and texture of sediment.

The sediment source studies indicated that the erosion rates in the watershed are low. A summation of the annual sediment yields above the 43 planned floodwater retarding structures was found to be 116.9 acre-feet or an average of

0.35 acre-foot per square mile.

Flood Plain Sedimentation and Scour

The following sedimentation and scour damage investigations were made to evaluate the nature and extent of physical damage to flood plain land, giving due consideration to agronomic and other land treatment practices, soils, crop yields, and land capabilities:

1. Field examinations were made along each of the valley cross sections (figure 1) making note of depth and texture of deposits, scour channels, sheet scour areas, stream channel aggradation or degradation and other important factors.

2. Estimates of past physical flood plain damages were obtained through interviews with the landowners and operators.

3. A damage table was developed to show percent damage by texture and depth increment for deposition and percent damage by depth and width for scour.

4. The sedimentation and scour damages were summarized by evaluation reaches for the entire flood plain and adjusted for recoverability of productive capacity. Estimates for recoverability of productive capacity were developed as a result of field studies and interviews with farmers.

5. The present annual damages from overbank deposition in the watershed were found to be negligible in terms of monetary loss and were not further evaluated. The reduction of scour damage due to installation of the complete project is based on reduction of depth and area inundated.

Reservoir Sedimentation

Sediment source studies were made in the drainage areas of all reservoirs now being used for municipal water supply. These studies were similar to those made above the planned floodwater retarding structures. Estimated sediment yields and deposition was based on existing delivery rates and measured rates of accumulation from detailed reservoir sedimentation surveys made by the Soil Conservation Service in 1940-41. These measured rates were available for Lake Scarborough, the Santa Anna Lakes, Lake Brownwood, and other reservoirs in the watershed which are not now being used for municipal water supply. In addition preliminary data was used from a recently completed re-survey of Lake Brownwood by the Soil Conservation Service.

Geological Investigations

Preliminary geologic dam site investigations were made at each of the 38 planned floodwater retarding structure sites and detailed geologic dam site investigations were made at 5 constructed floodwater retarding structures prior to their construction. The preliminary investigations included studies of valley slopes, alluvium, channel banks, and exposed geologic formations. Borings with a hand auger were made to determine nature of foundation material and extent of available fill material. The detailed investigations were made with core-drilling equipment and necessary laboratory tests made prior to construction.

Description of Problems

All of the sites can be grouped into one of four geologic areas on the basis of similarity of problems. These areas are as follows:

1. The Trinity sand formation.
2. The formations of the Clear Fork group.
3. The Clyde and Lueders limestone formation of the Wichita group (upper formations).
4. The lower formations of the Wichita group and formations of the Cisco group.

Only two sites, 16 and 17, are located entirely within the Trinity sand formatation. Both of these sites have been constructed.

Planned Sites 14, 15-A, 17-A, 17-B, and 18 in addition to constructed Sites 15 and 19 are located in formations of the Clear Fork group. Shale, separated by thin beds of hard limestone, predominates in the formations. Very little or no rock is expected in spillway excavation. Few if any other problems in construction are expected. Soils suitable for embankment purposes are adequate and are classified as CL, CH, and SC in accordance with the Unified Soil Classification System.

Ten planned sites, 12, 12-A, 12-B, 12-C, 12-D, 12-E, 12-F, 21, 33 and 34, and constructed Site 20 are located in the Lueders limestone and Clyde formations of the Wichita group. These formations consist of regular beds of hard limestone alternating with shale or marl of about the same thickness. The limestones probably predominate. Problems include the possibility of leakage occurring through the limestone beds at some of the sites which will necessitate toe drains in the embankment. Shaping of some steep bluffs may be necessary to avoid differential settlement. Excavation of appreciable volumes of rock in the emergency spillways will be necessary on Sites 12, 12-A, 12-B, 12-E, 21. Smaller volumes are expected on Sites 12-C and 12-D. This rock is satisfactory for use as riprap. Sufficient material for embankment purposes will not be available from within the generally small sediment pool areas of a majority of these sites. Adequate material, however, can be obtained above all sites except Site 12 by extending the borrow areas into the detention pool areas. Adequate material for Site 12 can be obtained in the valley immediately below the proposed dam. The soils of this group are classified predominantly as CL, CH, GC, and SC, often with cobbles and boulders.

Twenty-three planned sites, Sites 2 through 11 and 22 through 32, are located in the lower formations of the Wichita group and the Thrifty formation of the Cisco group. These formations consist of alternating beds of shale, limestone, and some sandstone, with the shale predominating. Problems in construction of sites in this area are expected to be few. Only two sites, Sites 11 and 26, are expected to have significant volumes of rock excavation in the emergency spillway. Adequate material suitable for embankment purposes is available above all sites, but it is doubtful that all of the needed material can be obtained from the generally small sediment pool areas at many sites. The sites with known inadequate sediment pool borrow areas and those in the doubtful borderline class include Sites 4, 5, 9, 10, 11, 22, 23, 24, 25-A, 25-B, 32, and 33. The soils can be classified as predominantly CL, CH, SC, GC, and SM.

Detailed investigations, including exploration with core-drilling equipment will be made at all floodwater retarding structure sites prior to their construction. Laboratory tests will be made to determine the suitability and placement of the available embankment materials and to evaluate foundation problems.

Economic Investigations

Basic methods used in the economic investigations and analysis are outlined in the Economics Guide issued December 8, 1958.

Determination of Annual Benefits from Reduction in Damages

Agricultural damage estimates were based upon schedules obtained in the field covering approximately 60 percent of the flood plain of Jim Ned Creek and its tributaries. These schedules covered land use, crop distribution under normal conditions, crop yields and historical data on flooding and flood damage.

In Evaluation Reach 1 the flood plain is not as well defined as it is in the other evaluation reaches. During storm periods, floodwater will leave the main course of the stream and overland flow occurs. Because of this it was decided to use the Overland Flow method of analysis as outlined in Chapter 3 of the Economics Guide. Based on information obtained from the local people it was estimated that there would be one acre flooded for each acre-foot of floodwater that flows overland.

Most of the flood damage information obtained was for floods which occurred in 1956 and 1957.

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

The proper rates of damage were applied, flood by flood, to the floods which occurred during the period 1923 to 1942, and an adjustment was made to take into account the effect of recurrent flooding when several floods occurred within one year. The flood plain land use was mapped in the field. Normal yields were based on data obtained from landowners and operators and other agricultural workers in the area.

Significant differences in land use, frequency of flooding and degree of future use were sufficient to divide the flood plain into eleven evaluation reaches. A different damageable value was used for each reach. The location of the evaluation reaches are shown in figure 1.

Estimates of damages to other agricultural property such as fences, livestock, and farm equipment were made from analysis of flood damage schedules.

The estimated monetary value of the physical damage to the flood plain from erosion was based on the value of the production lost, taking into account the lag in recovery of productivity and for the cost of farm operations to speed recovery. Damage from erosion was related to depth of flooding, giving greater weight to deeper flows.

Estimates of damages to roads, bridges, railroads, and oil field equipment were obtained from local residents, county commissioners, state highway officials, oil company officials and supplemented by information obtained in developing the original work plan.

Indirect damages involve such items as disruption of travel to markets, extra costs of purchasing feed for livestock and losses in business sustained by dealers and industry in the area. Based on information obtained and data for watersheds previously analyzed, it was determined these damages are slightly less than 10 percent of the direct damage for all evaluation reaches.

Farmers in the flood plain were asked to state changes made in land use as a result of past flooding. This information, together with landowners and operators estimates of future changes in land use and crop distribution as a result of reduction in flood extent and frequency was the basis for estimating benefits from changed land use, more intensive use of land and restoration of productivity. Benefits from restoration are included as crop and pasture benefits. Among the factors considered in this analysis were the size and location of the areas affected, land capability, acreage allotment restrictions, existence of available markets and reduction in frequency of flooding. It is not expected that the acreage of crops under allotments will be increased in the watershed as a result of the project.

All benefits from flood plain land use changes, restoration of productivity and increased productivity are net benefits remaining after production and harvest costs, additional costs for taxes and overhead, clearing costs where applicable and added damages were deducted. All such benefits were discounted to provide for a five-year lag in accomplishment.

The straight-line depreciation method was used in evaluating the benefits that are derived from reduction of sediment damage to Lakes Brownwood and Scarborough.

Flood plain areas which will be inundated by the sediment and detention pools were excluded from the damage and benefit calculations. An estimate was made, however, of the value of the production lost in these areas after installation of the program. In this appraisal it was considered that there would be no production in the sediment pools, and that the land covered by the detention pools would be used as pasture after installation of the program.

The cost of land rights for the 43 floodwater retarding structures was determined by individual appraisal. This evaluation was based on estimates by local interests.

The average annual loss in production within the structure sites was compared with amortized value of easements. The easement value was found to be the greater, and, therefore was used in economic justification to assure a conservative benefit-cost analysis.

Determination of Benefits Outside of the Watershed

Benefits from the reduction of damage on the mainstem of Pecan Bayou below Lake Brownwood were determined by comparison with evaluation reaches in Jim Ned Creek watershed which have similar flood plain land use and valley sections. The dampening effect of spillway storage of Lake Brownwood on reduction of peak flows was given consideration in estimating the benefits to structural measures.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: 1959

Installation Period April 1960-April 1965

Item	Unit	Number to be Applied	Estimated Cost 2/ Federal (dollars)	Non-Federal (dollars)	Total (dollars)
LAND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	14,500	-	14,500	14,500
Cover Cropping	Acre	4,300	-	17,200	17,200
Rotation Hay and Pasture	Acre	14,500	-	38,500	38,500
Crop Residue Use	Acre	51,000	-	21,000	21,000
Conservation Cropping System	Acre	24,500	-	31,200	31,200
Proper Use	Acre	88,000	-	19,200	19,200
Deferred Grazing	Acre	65,500	-	16,700	16,700
Range Seeding	Acre	4,800	-	15,000	15,000
Brush Control	Acre	35,100	-	180,500	180,500
Terracing	Mile	450	-	21,630	21,630
Diversion Construction	Mile	30	-	3,400	3,400
Waterway Development	Acre	40	-	1,375	1,375
Pond Construction	No.	150	-	55,000	55,000
Pasture Planting	Acre	5,000	-	15,000	15,000
Fertilizing	Acre	3,500	-	10,200	10,200
Technical Assistance (Accel.)			22,700	-	22,700
SCS Subtotal			22,700	460,405	483,105
TOTAL LAND TREATMENT			22,700	460,405	483,105
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	38	2,800,455	-	2,800,455
SCS Subtotal			2,800,455	-	2,800,455
Subtotal - Construction			2,800,455	-	2,800,455
Installation Services					
Soil Conservation Service					
Engineering Services			381,883	-	381,883
Other			254,589	-	254,589
SCS Subtotal			636,472	-	636,472
Subtotal - Installation Services			636,472	-	636,472
Other Costs					
Land Rights			-	365,326	365,326
Legal Fees			-	36,531	36,531
Subtotal - Other			-	401,857	401,857
TOTAL STRUCTURAL MEASURES			3,436,927	401,857	3,838,784
WORK PLAN PREPARATION COST			65,439	-	65,439
TOTAL PROJECT			3,525,066	862,262	4,387,328
SUMMARY					
Subtotal SCS			3,525,066	862,262	4,387,328
TOTAL PROJECT			3,525,066	862,262	4,387,328

1/ Does not include prior expenditures of flood prevention funds or accomplishments resulting therefrom. (see table 1A).

2/ Excludes cost that will be reimbursed from other Federal funds.

NOTE: There are no Federal lands in this watershed.

April 1960

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT 1/
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: 1959

Item	Unit	Number Applied	Prior to April 1960 Estimated Cost Federal 2/	Non-Federal 3/	Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	102,265	-	102,265	102,265
Cover Cropping	Acre	12,000	-	48,000	48,000
Rotation Hay and Pasture	Acre	22,300	-	65,100	65,100
Crop Residue Use	Acre	72,100	-	60,100	60,100
Conservation Cropping System	Acre	1,500	-	2,400	2,400
Proper Use	Acre	151,000	-	52,400	52,400
Deferred Grazing	Acre	124,400	-	45,200	45,200
Range Seeding	Acre	4,800	-	19,500	19,500
Brush Control	Acre	75,350	-	387,250	387,250
Terracing	Mile	4,432	-	236,320	236,320
Diversion Construction	Mile	213	-	26,120	26,120
Waterway Development	Acre	34	-	1,175	1,175
Pond Construction	No.	1,470	-	505,300	505,300
Pasture Planting	Acre	-	-	-	-
Fertilizing	Acre	-	-	-	-
Technical Assistance (Accel.)			29,575	-	29,575
SCS Subtotal			29,575	1,551,130	1,580,705
TOTAL LAND TREATMENT			29,575	1,551,130	1,580,705
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	5	299,473	-	299,473
SCS Subtotal			299,473	-	299,473
Subtotal - Construction			299,473	-	299,473
Installation Services					
Soil Conservation Service					
Engineering Services			40,838	-	40,838
Other			27,224	-	27,224
SCS Subtotal			68,062	-	68,062
Subtotal - Installation Services			68,062	-	68,062
Other Costs					
Land Rights			-	51,750	51,750
Legal Fees			-	5,175	5,175
Subtotal - Other			-	56,925	56,925
TOTAL STRUCTURAL MEASURES			367,535	56,925	424,460
WORK PLAN PREPARATION COST			17,789	-	17,789
TOTAL PROJECT			414,899	1,608,055	2,022,954
SUMMARY					
Subtotal - SCS			414,899	1,608,055	2,022,954
TOTAL PROJECT			414,899	1,608,055	2,022,954

1/ At time of work plan revision
2/ Flood prevention funds, including accelerated funds.
3/ Excludes costs that will be reimbursed from other Federal funds.

April 1960

TABLE 1B - TOTAL ESTIMATED INSTALLATION COSTS 1/

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: 1959

Item	Unit	Number	Total Project 1/ Estimated Cost: Federal 2/	Non-Federal 3/	Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	116,765	-	116,765	116,765
Cover Cropping	Acre	16,300	-	65,200	65,200
Rotation Hay and Pasture	Acre	36,800	-	103,600	103,600
Crop Residue Use	Acre	123,100	-	81,100	81,100
Conservation Cropping System	Acre	26,000	-	33,600	33,600
Proper Use	Acre	239,000	-	71,600	71,600
Deferred Grazing	Acre	189,900	-	61,900	61,900
Range Seeding	Acre	9,600	-	34,500	34,500
Brush Control	Acre	108,450	-	567,750	567,750
Terracing	Mile	4,882	-	257,950	257,950
Diversion Construction	Mile	243	-	29,520	29,520
Waterway Development	Acre	74	-	2,550	2,550
Pond Construction	No.	1,620	-	560,300	560,300
Pasture Planting	Acre	5,000	-	15,000	15,000
Fertilizing	Acre	3,500	-	10,200	10,200
Technical Assistance (Accel.)			52,275	-	52,275
SCS Subtotal			52,275	2,011,535	2,063,810
TOTAL LAND TREATMENT			52,275	2,011,535	2,063,810
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	43	3,099,928	-	3,099,928
SCS Subtotal			3,099,928	-	3,099,928
Subtotal - Construction			3,099,928	-	3,099,928
Installation Services					
Soil Conservation Service					
Engineering Services			422,721	-	422,721
Other			281,813	-	281,813
SCS Subtotal			704,534	-	704,534
Subtotal - Installation Services			704,534	-	704,534
Other Costs					
Land Rights			-	417,076	417,076
Legal Fees			-	41,706	41,706
Subtotal - Other			-	458,782	458,782
TOTAL STRUCTURAL MEASURES			3,804,462	458,782	4,263,244
WORK PLAN PREPARATION COST			83,228	-	83,228
TOTAL PROJECT			3,939,965	2,470,317	6,410,282
SUMMARY					
Subtotal SCS			3,939,965	2,470,317	6,410,282
TOTAL PROJECT			3,939,965	2,470,317	6,410,282

1/ Table 1, plus table 1A.
2/ Flood prevention funds, including acceleration funds.
3/ Excludes costs that will be reimbursed from other Federal funds. April 1960

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: 1959

Structure Site Number	Federal Installation Costs: Construction: Engineers Estimate (dollars)	Federal Installation Costs: Construction: Contingencies (dollars)	Federal Installation Costs: Installation Service: Engineering (dollars)	Federal Installation Costs: Installation Service: Other (dollars)	Total Federal (dollars)	Non-Federal Installation Costs: Land Rights (dollars)	Non-Federal Installation Costs: Legal Fees and Other (dollars)	Non-Federal Installation Costs: Total Non-Federal (dollars)	Total Installation Cost (dollars)
2	44,169	4,417	6,625	4,417	59,628	8,150	815	8,965	68,593
3	27,700	2,770	4,155	2,770	37,395	6,825	682	7,507	44,902
4	61,120	6,112	9,168	6,112	82,512	17,650	1,765	19,415	101,927
5	24,190	2,419	3,629	2,419	32,657	1,575	157	1,732	34,389
6	23,940	2,394	3,591	2,394	32,319	2,962	296	3,258	35,577
7	33,327	3,333	5,000	3,333	44,993	7,850	785	8,635	53,628
8	51,940	5,194	7,791	5,194	70,119	4,987	498	5,485	75,604
9	40,050	4,005	6,008	4,005	54,068	2,475	248	2,723	56,791
10	31,584	3,158	4,738	3,158	42,638	2,400	240	2,640	45,278
11	140,000	14,000	21,000	14,000	189,000	6,750	675	7,425	196,425
12	172,195	17,220	25,829	17,220	232,464	8,700	870	9,570	242,034
12-A	126,025	12,603	18,904	12,603	170,135	7,338	734	8,072	178,207
12-B	80,270	8,027	12,041	8,027	108,365	12,863	1,286	14,149	122,514
12-C	64,158	6,416	9,624	6,416	86,614	4,613	461	5,074	91,688
12-D	53,477	5,348	8,022	5,348	72,195	20,800	2,080	22,880	95,075
12-E	89,457	8,946	13,418	8,946	120,767	22,350	2,235	24,585	145,352
12-F	46,826	4,683	7,024	4,683	63,216	3,300	330	3,630	66,846
14	73,970	7,397	11,096	7,397	99,860	8,300	830	9,130	108,990
15 1/	36,913	3,691	5,537	3,691	49,832	2,050	205	2,255	52,087
15-A	38,190	3,819	5,729	3,819	51,557	9,375	937	10,312	61,869
16 1/	48,617	4,862	7,293	4,862	65,634	6,950	695	7,645	73,279
17 1/	24,713	2,471	3,707	2,471	33,362	2,550	255	2,805	36,167
17-A	50,326	5,033	7,549	5,033	67,941	11,175	1,118	12,293	80,234
17-B	78,683	7,868	11,802	7,868	106,221	9,600	960	10,560	116,781

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION (continued)
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: 1959

Structure Site Number	Federal Installation Costs: Construction: Engineers Estimate (dollars)	Construction: Contingencies (dollars)	Installation Service: Engineering (dollars)	Installation Service: Other (dollars)	Total Federal (dollars)	Non-Federal Installation Cost: Land Rights (dollars)	Legal Fees and Other (dollars)	Total Non-Federal (dollars)	Total Installation Cost (dollars)
18	43,042	4,304	6,456	4,304	58,106	14,900	1,490	16,390	74,496
19 1/	46,852	4,685	7,028	4,685	63,250	25,000	2,500	27,500	90,750
20 1/	115,154	11,515	17,273	11,515	155,457	15,200	1,520	16,720	172,177
21	193,930	19,393	29,090	19,393	261,806	13,550	1,355	14,905	276,711
22	60,280	6,028	9,042	6,028	81,378	3,900	390	4,290	85,668
23	132,600	13,260	19,890	13,260	179,010	10,838	1,084	11,922	190,932
24	109,402	10,940	16,410	10,940	147,692	6,525	653	7,178	154,870
25	83,600	8,360	12,540	8,360	112,860	32,700	3,270	35,970	148,830
25-A	39,216	3,922	5,882	3,922	52,942	4,100	410	4,510	57,452
25-B	38,280	3,828	5,742	3,828	51,678	3,425	342	3,767	55,445
26	95,694	9,569	14,354	9,569	129,186	24,500	2,450	26,950	156,136
27	45,320	4,532	6,798	4,532	61,182	5,800	580	6,380	67,562
28	42,311	4,231	6,347	4,231	57,120	7,250	725	7,975	65,095
29	60,659	6,066	9,099	6,066	81,890	7,100	710	7,810	89,700
30	57,879	5,788	8,682	5,788	78,137	11,750	1,175	12,925	91,062
31	30,400	3,040	4,560	3,040	41,040	9,700	970	10,670	51,710
32	40,800	4,080	6,120	4,080	55,080	7,700	770	8,470	63,550
33	51,296	5,130	7,694	5,130	69,250	7,200	720	7,920	77,170
34	69,560	6,956	10,434	6,956	93,906	14,350	1,435	15,785	109,691
GRAND TOTAL	2,818,115	281,813	422,721	281,813	3,804,462	417,076	41,706	458,782	4,263,244

1/ Constructed prior to April 1960.

April 1960

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Item	Unit	STRUCTURE NUMBER 2	3	4	5	6	7	8	9	10	11	12
Drainage Area	Sq.Mi.	5.49	4.64	7.99	1.41	2.66	7.25	4.80	3.09	2.12	9.90	15.81
Storage Capacity												
Sediment Pool	Ac.Ft.	71	44	129	28	50	106	87	51	15	51	143
Sediment in Detention Pool	Ac.Ft.	21	8	18	4	7	15	13	7	5	10	41
Floodwater Detention	Ac.Ft.	1,556	1,105	1,940	269	556	1,453	912	678	440	2,621	4,800
Total	Ac.Ft.	1,650	1,157	2,087	301	613	1,574	1,012	738	480	2,684	4,984
Surface Area												
Sediment Pool	Acre	16	11	27	8	14	30	21	10	11	12	23
Floodwater Detention Pool	Acre	147	91	177	16	65	182	110	56	53	148	209
Volume of Fill	Cu.Yd	100,384	54,300	152,800	48,380	51,200	83,317	116,681	89,000	70,186	337,000	403,700
Elevation Top of Dam (MSL)	Foot	1,511.0	1,542.7	1,571.9	1,656.4	1,615.2	1,614.0	1,664.2	1,727.2	1,748.7	1,761.4	1,837.8
Maximum Height of Dam	Foot	61	46	41	30	34	35	11	17	22	49	61
Emergency Spillway												
Crest Elevation (MSL)	Foot	1,506.0	1,517.5	1,568.6	1,651.2	1,610.0	1,609.0	1,659.0	1,722.0	1,741.6	1,758.0	1,812.0
Bottom Width	Foot	100	150	200	60	100	200	150	125	100	270	250
Type	-	Rock	Rock	Rock	Veg.	Rock	Veg.	Veg.	Rock	Veg.	Veg.	Rock
Percent Chance of Use 2/	-	1.2	1.7	1.6	1.2	2.1	2.1	2.5	1.9	2.5	1.1	1.0
Average Curve No. Condition II	-	76	77	78	76	76	76	76	78	76	75	75
Emergency Spillway Hydrograph												
Storm Rainfall 6-hour	Inch	6.10	6.16	5.91	6.15	6.21	5.87	6.07	6.15	6.20	5.81	5.56
Storm Runoff	Inch	1.50	3.60	1.50	1.70	1.60	3.30	3.45	1.76	1.45	1.15	2.95
Velocity of Flow (Vc)	Ft./Sec.	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
Maximum Water Surface Elevation (MSL)	Foot	-	-	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph												
Storm Rainfall 6-hour	Inch	14.25	14.38	11.81	14.85	14.52	11.80	14.15	14.42	14.59	11.52	13.01
Storm Runoff	Inch	11.06	11.11	10.91	11.64	11.32	10.62	10.96	11.52	11.38	10.20	9.71
Velocity of Flow (Vc)	Ft./Sec.	9.8	10.0	10.1	10.0	10.0	9.7	10.0	10.0	9.8	10.1	10.5
Discharge Rate	c.f.s.	2,945	4,629	6,220	1,811	1,123	5,488	4,477	1,770	2,857	8,550	8,842
Maximum Water Surface Elevation (MSL)	Foot	1,511.0	1,542.7	1,573.9	1,656.4	1,615.2	1,614.0	1,664.2	1,727.2	1,748.7	1,761.4	1,837.8
Principal Spillway												
Capacity - Maximum	c.f.s.	55	46	80	14	27	72	48	11	23	100	158
Capacity Equivalents												
Sediment Volume	Inch	.25	.18	.30	.37	.35	.27	.34	.12	.28	.10	.17
Sediment in Detention Pool	Inch	.07	.03	.04	.05	.05	.04	.05	.04	.04	.02	.05
Detention Storage	Inch	5.30	4.47	4.55	3.58	1.91	1.76	1.64	4.11	1.56	4.96	5.69
Spillway Storage	Inch	3.58	2.62	2.54	2.97	2.90	2.91	2.61	1.81	2.62	1.07	1.58
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes on last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Item	Unit	STRUCTURE NUMBER										
		12A	12B	12C	12D	12E	12F	14	15	15A	16	17
Drainage Area	Sq.Mi.	9.75	13.43	5.01	9.15	1/21.80	5.30	6.65	1.97	2.54	4.16	1.16
Storage Capacity												
Sediment Pool	Ac.Ft.	213	184	93	112	151	34	180	59	89	104	31
Sediment in Detention Pool	Ac.Ft.	57	50	24	29	12	6	35	9	16	0	0
Floodwater Detention	Ac.Ft.	3,006	2,515	1,303	1,718	5,000	1,468	1,123	312	507	674	157
Total	Ac.Ft.	3,276	2,749	1,420	1,859	5,163	1,508	1,338	380	612	778	188
Surface Area												
Sediment Pool	Acre	25	35	19	24	32	9	36	14	25	26	13
Floodwater Detention Pool	Acre	140	273	104	207	315	88	130	50	101	93	38
Volume of Fill	Cu.Yd.	299,500	187,200	148,140	117,101	192,445	93,652	168,113	104,480	95,476	150,222	68,640
Elevation Top of Dam (MSL)	Foot	1,897.5	1,885.4	1,889.4	1,954.6	1,924.0	1,841.3	2,011.0	2,037.1	1,951.3	2,077.8	2,061.7
Maximum Height of Dam	Foot	70	46	48	46	61	55	36	26	20	33	22
Emergency Spillway												
Crest Elevation (MSL)	Foot	1,892.0	1,879.9	1,884.0	1,849.0	1,917.9	1,836.0	2,006.0	2,032.0	1,948.0	2,072.8	2,056.7
Bottom Width	Foot	200	300	100	150	500	130	200	100	200	180	50
Type	-	Rock	Rock	Rock	Rock	Rock	Rock	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 2/	-	1.0	2.1	1.3	2.5	1.4	1.1	3.2	3.3	2.9	3.3	4.1
Average Curve No. Condition II	-	75	75	74	76	75	75	77	77	79	72	72
Emergency Spillway Hydrograph												
Storm Rainfall 6-hour	Inch	5.80	5.64	6.07	5.88	5.40	6.07	5.82	6.30	6.36	6.07	6.38
Storm Runoff	Inch	3.20	3.00	3.30	3.30	2.80	3.40	3.30	3.70	4.08	3.30	3.30
Velocity of Flow (Vc)	Ft./Sec.	0	0	0	0	0	0	0	0	0	0	4.0
Discharge Rate	c.f.s.	0	0	0	0	0	0	0	0	0	0	94
Maximum Water Surface Elevation (MSL)	Foot	-	-	-	-	-	-	-	-	-	-	1,957.9
Freeboard Hydrograph												
Storm Rainfall 6-hour	Inch	13.57	13.20	14.12	13.71	12.27	14.07	13.45	12.60	14.68	12.15	12.76
Storm Runoff	Inch	10.25	9.89	10.64	10.53	9.01	10.73	10.42	9.70	11.91	8.50	9.00
Velocity of Flow (Vc)	Ft./Sec.	10.2	10.1	10.1	11.5	10.9	10.2	9.8	9.7	7.8	9.7	9.3
Discharge Rate	c.f.s.	6,630	9,466	3,275	7,159	20,200	4,197	5,783	2,820	2,934	4,959	1,270
Maximum Water Surface Elevation (MSL)	Foot	1,897.5	1,885.4	1,889.4	1,954.6	1,924.0	1,841.3	2,011.0	2,037.1	1,951.3	2,077.8	2,061.7
Principal Spillway												
Capacity - Maximum	c.f.s.	100	134	50	91	300	53	66	20	26	41	10
Capacity Equivalents												
Sediment Volume	Inch	.41	.26	.35	.23	.13	.12	.50	.56	.66	.47	.50
Sediment in Detention Pool	Inch	.11	.07	.09	.06	.01	.02	.10	.09	.12	0	0
Detention Storage	Inch	5.78	3.51	4.87	3.52	4.30	5.19	3.16	2.97	3.74	3.03	2.53
Spillway Storage	Inch	1.68	2.79	2.90	3.16	1.87	1.77	1.76	3.04	2.78	2.44	5.02
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes on last page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Item	Unit	17A	17B	18	19	20	21	22	23	24	25	25A
		STRUCTURE NUMBER										
Drainage Area	Sq.Mi.	1/ 2.70	3.34	6.42	11.25	11.46	28.92	5.73	16.22	9.51	1/23.09	4.33
Storage Capacity												
Sediment Pool	Ac.Ft.	101	124	225	383	291	185	70	190	146	357	90
Sediment in Detention Pool	Ac.Ft.	17	22	39	67	51	46	6	26	20	49	14
Floodwater Detention	Ac.Ft.	505	624	1,040	2,273	2,478	5,000	1,533	5,000	1,950	5,000	831
Total	Ac.Ft.	623	770	1,304	2,723	2,820	5,231	1,609	5,216	2,116	5,406	935
Surface Area												
Sediment Pool	Acre	32	27	54	103	48	26	11	30	24	69	15
Floodwater Detention Pool	Acre	90	81	186	373	227	202	93	255	150	485	67
Volume of Fill	Cu.Yd.	125,815	173,458	107,604	113,890	205,420	489,800	137,000	331,500	245,000	220,000	89,128
Elevation Top of Dam (MSL)	Foot	1,972.7	2,051.6	1,949.8	1,908.8	1,932.6	1,796.7	1,723.1	1,720.7	1,705.4	1,603.2	1,814.9
Maximum Height of Dam	Foot	24	30	26	23	35	81	49	59	44	36	43
Emergency Spillway												
Crest Elevation (MSL)	Foot	1,967.6	2,046.7	1,945.2	1,903.6	1,927.5	1,787.0	1,718.0	1,715.0	1,700.0	1,598.1	1,809.0
Bottom Width	Foot	200	150	200	250	300	250	180	250	350	400	150
Type	-	Veg.	Veg.	Veg.	Veg.	Veg.	Rock	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 2/	-	2.9	2.9	3.6	2.9	1.9	2.4	1.3	0.9	2.3	1.9	2.7
Average Curve No. Condition II	-	77	77	77	77	77	75	76	76	78	78	77
Emergency Spillway Hydrograph												
Storm Rainfall 6-hour	Inch	6.08	6.04	5.86	5.74	5.70	5.28	6.00	5.60	5.83	5.42	6.12
Storm Runoff	Inch	3.50	3.50	3.37	3.20	3.20	2.67	3.45	3.00	3.40	3.00	3.50
Velocity of Flow (Vc)	Ft./Sec.	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
Maximum Water Surface Elevation (MSL)	Foot	-	-	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph												
Storm Rainfall 6-hour	Inch	13.50	13.94	13.59	11.48	11.41	12.35	14.03	13.11	13.65	12.70	14.32
Storm Runoff	Inch	10.47	10.90	10.56	8.60	8.52	9.09	10.84	9.96	10.78	9.86	11.27
Velocity of Flow (Vc)	Ft./Sec.	9.8	9.7	9.4	9.5	10.0	15.7	9.4	10.2	10.2	9.9	10.5
Discharge Rate	c.f.s.	5,839	4,197	5,156	6,888	9,486	30,160	4,643	8,228	11,605	11,670	5,457
Maximum Water Surface Elevation (MSL)	Foot	1,972.7	2,051.6	1,949.8	1,908.8	1,932.6	1,796.7	1,723.1	1,720.7	1,705.4	1,603.2	1,814.9
Principal Spillway												
Capacity - Maximum	c.f.s.	61	33	64	110	114	290	57	162	95	230	43
Capacity Equivalents												
Sediment Volume	Inch	.70	.70	.66	.64	.48	.12	.23	.22	.29	.29	.39
Sediment in Detention Pool	Inch	.12	.12	.11	.11	.08	.03	.02	.03	.04	.04	.06
Detention Storage	Inch	3.50	3.52	3.04	3.79	4.05	3.24	5.02	5.78	3.84	4.06	3.59
Spillway Storage	Inch	3.63	2.51	3.02	4.16	2.22	1.44	1.65	1.77	1.74	2.36	1.81
Class of Structure		A	A	A	A	A	A	A	A	A	A	A

(Footnotes on next page)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Item	Unit	25B	26	27	28	29	30	31	32	33	34	Total
		STRUCTURE NUMBER										
Drainage Area	Sq.Mi.	2.11	16.00	4.20	4.23	3.75	5.74	5.06	4.48	5.73	8.26	328.81
Storage Capacity												
Sediment Pool	Ac.Ft.	68	324	95	126	143	191	119	93	67	88	5,527
Sediment in Detention Pool	Ac.Ft.	10	43	17	22	25	33	19	14	18	22	967
Floodwater Detention	Ac.Ft.	446	4,217	784	792	724	1,292	945	838	1,150	1,952	73,507
Total	Ac.Ft.	524	4,584	896	940	892	1,516	1,083	945	1,235	2,062	80,001
Surface Area												
Sediment Pool	Acre	10	52	24	30	40	44	26	14	13	20	1,153
Floodwater Detention Pool	Acre	44	398	92	115	102	191	168	100	131	181	6,544
Volume of Fill	Cu.Yd.	87,000	241,200	103,000	96,162	137,861	131,543	76,000	102,000	128,240	173,900	6,669,440
Elevation Top of Dam (MSL)	Foot	1,763.7	1,562.3	1,522.2	1,577.4	1,562.7	1,520.7	1,597.6	1,633.1	1,932.5	1,943.4	xxx
Maximum Height of Dam	Foot	47	41	27	25	23	24	21	35	29	39	xxx
Emergency Spillway												
Crest Elevation (MSL)	Foot	1,758.0	1,556.0	1,517.1	1,572.5	1,558.0	1,516.0	1,592.9	1,628.1	1,927.5	1,938.0	xxx
Bottom Width	Foot	75	100	200	200	200	200	150	175	150	150	xxx
Type	-	Rock	Rock	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 2/	-	2.2	1.3	3.1	3.1	3.0	2.2	2.9	2.9	2.1	1.1	xxx
Average Curve No. Condition II	-	79	78	79	80	80	80	78	78	70	71	xxx
Emergency Spillway Hydrograph												
Storm Rainfall 6-hour	Inch	6.32	5.61	6.30	6.30	6.30	6.23	6.10	6.16	6.05	5.91	xxx
Storm Runoff	Inch	3.80	3.30	3.90	4.00	4.00	3.95	3.70	3.75	2.80	2.80	xxx
Velocity of Flow (Vc)	Ft./Sec.	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	xxx
Maximum Water Surface Elevation (MSL)	Foot	-	-	-	-	-	-	-	-	-	-	xxx
Freeboard Hydrograph												
Storm Rainfall 6-hour	Inch	14.77	13.19	14.90	14.88	14.97	14.64	14.30	14.39	14.13	13.80	xxx
Storm Runoff	Inch	12.00	10.33	12.13	12.26	12.34	12.02	11.40	11.49	10.04	9.88	xxx
Velocity of Flow (Vc)	Ft./Sec.	10.5	11.0	9.9	9.7	9.6	9.4	9.5	9.8	9.8	10.0	xxx
Discharge Rate	c.f.s.	2,694	3,940	6,053	5,633	5,273	5,143	3,889	5,055	4,243	4,777	xxx
Maximum Water Surface Elevation (MSL)	Foot	1,763.7	1,562.3	1,522.2	1,577.4	1,562.7	1,520.7	1,597.6	1,633.1	1,932.5	1,943.4	xxx
Principal Spillway												
Capacity - Maximum	c.f.s.	21	160	42	42	37	57	51	45	57	82	xxx
Capacity Equivalents												
Sediment Volume	Inch	.60	.38	.42	.56	.72	.63	.44	.39	.22	.20	xxx
Sediment in Detention Pool	Inch	.09	.05	.08	.10	.13	.11	.07	.06	.06	.05	xxx
Detention Storage	Inch	3.96	4.94	3.50	3.50	3.62	4.21	3.50	3.50	3.76	4.43	xxx
Spillway Storage	Inch	2.95	3.47	2.65	2.50	2.78	3.54	4.04	2.47	2.50	2.40	xxx
Class of Structure		A	A	A	A	A	A	A	A	A	A	xxx

1/ Exclusive of watershed from which runoff is controlled by other structures in series. Entire drainage area considered in the design of the emergency spillway.
2/ Based on regional analysis of gaged runoff.

TABLE 4 - ANNUAL COSTS 1/

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Measures	Amortization of Installation Cost 2/			Operation and Maintenance Costs 3/		Total
	Federal	Non-Federal	Total	Non-Federal	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures						
2 through 12, 12-A, 12-B, 12-C, 12-D, 12-E, 12-F, 14, 15, 15-A, 16, 17, 17-A, 17-B, 18 through 25, 25-A, 25-B and 26 through 34 4/	134,137	21,359	155,496	8,055	8,055	163,551
TOTAL	134,137	21,359	155,496	8,055	8,055	163,551

1/ Does not include work plan preparation cost.

2/ Prices amortized for 50 years at 2.5 percent for Federal and 4.0 percent for non-Federal cost.

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

4/ Interrelated measures.

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TABLE 5 - MONETARY BENEFITS FROM STRUCTURAL MEASURES
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)
Price Base: Long-Term 1/

Item	Estimated Average Annual Damage: Without Project	Estimated Average Annual Damage: After Land Treatment for W/S Protection	Estimated Average Annual Damage: With Project	Average Annual Monetary Benefits
	(dollars)	(dollars)	(dollars)	(dollars)
oodwater Damage				
rop and Pasture	147,160	134,739	52,135	82,604
ther Agricultural	152,846	128,989	22,449	106,540
onagricultural				
Road, Bridge, Railroad	45,918	39,024	5,145	33,879
Subtotal	345,924	302,752	79,729	223,023
diment Damage				
eservoirs	19,243	16,045	9,616	6,429
osion Damage				
lood Plain Scour	3,935	3,269	1,350	1,919
direct Damages	36,178	31,416	9,060	22,356
tal, All Damages	405,280	353,482	99,755	253,727
anged Land Use				
To Crop Production	xxx	xxx	xxx	5,619
re Intensive Use of Land	xxx	xxx	xxx	2,266
nefits Outside of Project Area 2/	xxx	xxx	xxx	39,700
TAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	301,312
TAL MONETARY BENEFITS	xxx	xxx	xxx	301,312

As projected by ARS, September 1957.
Damage reduction on Pecan Bayou below Lake Brownwood.

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TABLE 6 - BENEFIT COST ANALYSIS
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 1/ Flood Prevention							Average Annual Cost 3/	Benefit-Cost Ratio
	Floodwater	Sediment	Erosion	Indirect	Change of Land Use	Other 2/	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures									
2 through 12, 12-A, 12-B, 12-C, 12-D, 12-E, 12-F, 14, 15, 15-A 16, 17, 17-A, 17-B, 18 through 25, 25-A, 25-B, and 26 through 34 4/	223,023	6,429	1,919	22,356	5,619	41,966	301,312	163,551	1.8:1
GRAND TOTAL	223,023	6,429	1,919	22,356	5,619	41,966	301,312	163,551	1.8:1

1/ Long-term price levels, as projected by ARS, September 1957.
2/ Includes $2,266 intensification benefits and $39,700 benefits accruing outside project area.
3/ Installation costs based on 1959 prices; operation and maintenance on long-term prices as projected by ARS, September 1957.
4/ Interrelated measures.

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ADDENDUM

TABLE 6 - BENEFIT COST ANALYSIS 1/

Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 2/ Flood Prevention: Floodwater	Sediment	Erosion	Indirect	Change of: Land Use	Other 3/	Total	Average Annual Cost 4/	Benefit-Cost Ratio
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures									
2 through 12, 12A, 12B, 12C, 12D, 12D, 12F, 14, 15, 15A, 16, 17, 17A, 17B, 18 through 25, 25A, 25B, and 26 through 34 5/	223,023	6,429	1,919	22,356	5,619	41,966	301,312	162,128	1.9:1
GRAND TOTAL	223,023	6,429	1,919	22,356	5,619	41,966	301,312	162,128	1.9:1

1/ Revised to show benefit-cost comparison on 2-5/8 percent interest rate for amortization of both Federal and non-Federal costs.
2/ Long-term price levels, as projected by ARS, September, 1957.
3/ Includes $2,266 intensification benefits and $39,700 benefits accruing outside project area.
4/ Installation costs based on 1959 prices; operation and maintenance on long-term prices as projected by ARS, September, 1957.
5/ Interrelated measures.

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TABLE 6A - Benefits and Costs by Construction Units
Jim Ned Creek Watershed, Texas
(Middle Colorado River Watershed)

Construction Unit and Structures	Annual Benefits 1/	Annual Cost 2/
	(dollars)	(dollars)
1. Sites 14, 15, 15-A, 16, 17, 17-A, 17-B, 18, 19 and 20	102,730	33,759
2. Sites 28, 29, and 30	10,606	9,488

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

2/ Installation costs based on 1959 prices and operation and maintenance on long-term prices as projected by ARS, September 1957.

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