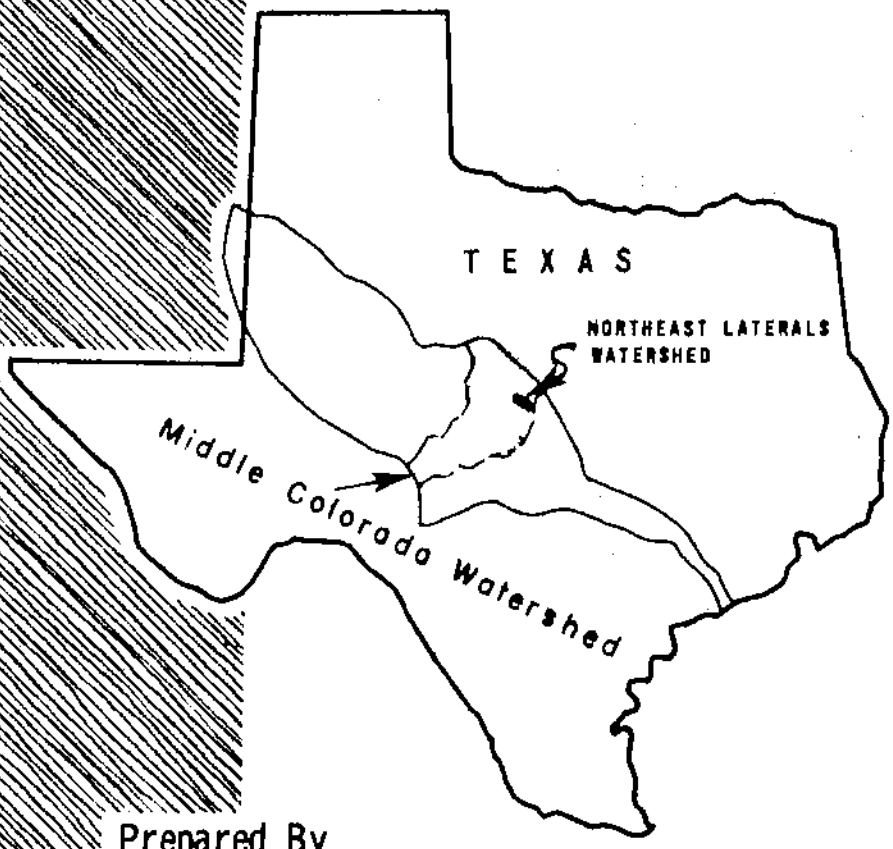
WORK PLAN

NORTHEAST LATERALS WATERSHED

OF THE MIDDLE COLORADO RIVER WATERSHED
BROWN AND MILLS COUNTIES, TEXAS



Prepared By
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Temple, Texas
February 1967

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WATERSHED WORK PLAN AGREEMENT

between the

Brown-Mills Soil and Water Conservation District
(Sponsoring Local Organization)

Brown County Commissioners Court
(Sponsoring Local Organization)

Mills County Commissioners Court
(Sponsoring Local Organization)

of the

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

and the

SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
(hereinafter referred to as the Service)

Whereas, the responsibility for administration of the Flood Prevention Program authorized by the Flood Control Act of 1936, as amended and supplemented, has been assigned by the Secretary of Agriculture to the Soil Conservation Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for said watershed, designated as the Watershed Work Plan for Northeast Laterals Watershed, State of Texas, which Watershed Work Plan is annexed to and made a part of this agreement;

Whereas, the Watershed Work Plan describes the watershed and its problems, and sets forth a plan for works of improvement including a schedule of operations, the kinds and quantities of measures to be installed, the estimated cost, cost-sharing arrangements, maintenance and other responsibilities of those participating in the project, and economic justification for installing, operating and maintaining the works of improvement;

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USDA-SCS-FORT WORTH, TEX. 1969

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 5 years.

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

1. Except as otherwise provided herein, the Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $78,734). The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Land, Easements and Rights-of-Way Cost (dollars)
Floodwater Retarding Structures and Stream Channel Improvement	100	0	1/ 78,734

1/ Includes legal fees ($7,139)

2. The Service will provide all construction costs.

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Floodwater Retarding Structures and Stream Channel Improvement	0	100	393,079

3. The Service will provide all costs and forces for installation services and contract administration.

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Floodwater Retarding Structures and Stream Channel Improvement	0	100	102,512

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

5. The Sponsoring Local Organization will obtain agreements from owners of not less than 65 percent of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

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

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

8. The Sponsoring Local Organization will be responsible for the operation and maintenance of the atructural 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.

9. 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.

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

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

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

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

Brown-Mills Soil and Water Conservation District
(Sponsoring Local Organization)

By F. Scott Lanford
F. Scott Lanford

Title Chairman

Date 12-17-68

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

adopted at a meeting held on 12-17-68

W. G. Bishop
(Secretary, Sponsoring Local Organization)
W. G. Bishop

Date 12-17-68

Brown County Commissioners Court
(Sponsoring Local Organization)

By William O. Breedlove
William O. Breedlove

Title County Judge

Date 12-31-68

The signing of this agreement was authorized by a resolution of the governing body of the Brown County Commisaioners Court
(Sponsoring Local Organization)

adopted at a meeting held on 12-16-68 Mrs. Reecie Bell

Mrs. Reecie Bell
(Secretary, Sponsoring Local Organization)

Date 12-31-68

v

Mills County Commissioners Court
(Sponsoring Local Organization)

By Cecil Egger
Cecil Egger

Title County Judge

Date 12-30-1968

The signing of this agreement was authorized by a resolution of the governing body of the Mills County Commissioners Court
(Sponsoring Local Organization)

adopted at a meeting held on December 30-1968.

H. N. Smith
(Secretary, Sponsoring Local Organization)

Date 12-30-68

Soil Conservation Service
United States Department of Agriculture

By H. N. Smith

Date 2-10-70

4-24073 (1-69)

WORK PLAN

NORTHEAST LATERALS WATERSHED
of the Middle Colorado River Watershed
Brown and Mills Counties, Texas

Plan Prepared and Works of Improvement
to be Installed Under the Authority
of the Flood Control Act of 1944
as Amended and Supplemented.

Participating Agencies:

Brown-Mills Soil and Water Conservation District

Brown County Commissioners Court

Mills County Commissioners Court

Prepared By:

Soil Conservation Service
U. S. Department of Agriculture

February 1967

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U.S.D.A. - S.C.S. FORT WORTH, TEX. 1967

WATERSHED WORK PLAN

NORTHEAST LATERALS WATERSHED
Of the Middle Colorado River Watershed
Brown and Mills Counties, Texas

February 1967

SUMMARY OF PLAN

General Summary

The work plan for watershed protection and flood prevention for the Northeast Laterals Watershed was prepared by the Soil Conservation Service, in cooperation with the Brown-Mills Soil and Water Conservation District, and the Brown and Mills County Commissioners Courts.

The primary objectives of the project are to provide flood protection to the agricultural lands subject to flood damages from Buffalo and Indian Creeks, and proper land use and treatment in the interests of soil and water conservation. Upon installation and continued maintenance of the measures set forth in this plan, a material contribution will be made toward increasing agricultural production to the maximum level consistent with the capabilities of the land.

The local sponsoring organizations determined that no organized group or individual was interested in including water storage or other works of improvement for agricultural or nonagricultural water management purposes.

The Northeast Laterals watershed comprises the drainage of that portion of the Middle Colorado River Watershed north of the Colorado River and extending from the Pecan Bayou drainage divide on the east to the Clear Creek drainage divide on the west. All of the streams in this watershed originate in the south and west portions of Brown and Mills Counties, Texas, and flow in a southerly direction, discharging into the Colorado River. The watershed has a drainage area of 130 square miles, or 83,200 acres. Approximately 77 percent of the watershed is rangeland, 22 percent is cropland, and 1 percent is in miscellaneous uses, such as roads, highways, and stream channels.

There are no Federal lands in the watershed.

The work plan proposes installing, in a 5-year period, a project for protection and development of the watershed. The cost of installing these measures, excluding work plan preparation, is estimated to be $838,408. Of this amount, $339,317 will be borne by local interests, and $499,091 by flood prevention funds. In addition, local interests will bear the entire cost of operation and maintenance.

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Land Treatment Measures

Landowners and operators will establish land treatment measures which will help accomplish the project objectives. Primarily, this treatment will consist of measures, or a combination of measures, which contribute directly to watershed protection, flood prevention, and sediment control.

Costs of land treatment measures, exclusive of expected reimbusement from Agricultural Conservation Program Service or other Federal funds, is $260,583. In addition, prior to work plan preparation, landowners and operators have established land treatment measures at an estimated non-Federal cost of $567,778. The work plan includes land treatment measures that will be installed during the 5-year installation period and those management and recurring-type practices that are necessary for the project to be successful. Remaining land treatment measures will be installed under the going programs.

Structural Measures

The structural measures included in this plan consist of 3.91 miles of stream channel improvement and six floodwater retarding structures, having a total sediment storage and floodwater detention capacity of 5,597 acre-feet. The total estimated installation cost of the structural measures is $574,325. Of this amount, $78,734 will be borne by local interests, and $495,591 by flood prevention funds. The 3.91 miles of stream channel improvement and the six floodwater retarding structures will be installed during the 5-year installation period.

Damages and Benefits

The reduction in floodwater, sediment, flood plain erosion, and indirect damages will directly benefit approximately 30 owners and operators of agricultural lands of 2,886 acres of agricultural flood plain in addition to owners of nonagricultural facilities within the watershed. Flood plain owners and operators below the project area also will benefit from reduced flooding. Processors of agricultural commodities and other businesses in the area will benefit from the project.

The estimated average annual floodwater, sediment, flood plain erosion, and indirect damages without this project total $37,118, at adjusted normalized prices. With the proposed land treatment and structural measures installed average annual damages from these sources are estimated to be $10,971, a reduction of approximately 70 percent.

The average annual benefits, excluding secondary benefits, accruing to the project total $30,464 and are distributed as follows:

Floodwater damage reduction	$23,596
Erosion damage reduction	173
Indirect damage reduction	2,378

Incidental benefits	$ 1,356
More intensive land use benefits	2,293
Benefits outside project area	668

Benefits that are incidental to the project purpose amount to $1,356 annually. They are: recreation, $594; and livestock water, $762 . No additional project installation costs or extra storage are required to produce these benefits.

Net secondary benefits will average $3,675 annually.

The total benefits of land treatment measures were not evaluated in monetary terms since experience has shown that these soil and water conservation measures produce benefits in excess of their costs.

The ratio of the total average annual benefits accruing to structural measures ($33,264) to the average annual cost of these measures ($27,744) is 1.2:1.

Provisions for Financing Local Share of Installation Costs

Funds for the local share of the project costs will come from revenue presently being collected by Brown and Mills counties. These funds will be adequate and available for financing the local share of the costs for the structural works of improvement.

Operation and Maintenance

Land treatment measures for watershed protection will be operated and maintained by landowners and operators of the farms and ranches on whioh the measures will be installed under agreements with the Brown-Mills Soil and Water Conservation District.

Structural measures will be maintained by the Brown-Mills Soil and Water Conservation District, and the Brown and Mills County Commissioners Courts. The Brown County Commissioners Court will maintain Structure Nos. 1 through 5, and the 3.91 miles of channel improvement. The Mills County Commissioners Court will maintain Structure No. 6. The value of the average annual cost of operating and maintaining the structural measures is estimated to be $888, at adjusted normalized prices.

DESCRIPTION OF WATERSHED

Physical Data

The Northeast Laterals watershed comprises the drainage of that portion of the Middle Colorado River Watershed north of the Colorado River, and extending from the Pecan Bayou drainage divide on the east to the Clear Creek drainage divide on the west. The principal tributaries, from east to west, are: Flatrock, Hog, Rough, Buffalo, Rocky, and Indian Creeks. All of these

streams originate in the south and west portions of Brown and Mills counties, Texas, and flow in a southerly direction, discharging directly into the Colorado River. The watershed drains a total of 83,200 acres (130 square milee), and is served by the towns of Brownwood and Goldthwaite, located about 10 miles north and east, respectively, of the area.

The topography of the watershed ranges from gently rolling in the central reaches to moderately rolling near the headwaters on the north and along the Colorado River on the south. Most of the watershed is underlain by interbedded soft shales and hard sandstones of the Strawn group of Pennsylvanian age. A small area along the northern watershed divide is underlain by impure limeetones, soft sandstones, and siltstones of the Trinity group of Lower Cretaceoue age. Narrow belts of alluvium of Quaternary age occur along the major tributaries of the Colorado River.

The alluvial valleys of the major tributaries range in width from about 200 feet in the lower reaches near the Colorado River to about 1,000 feet in the central reaches. Elevations above mean sea level range from 1,580 feet on the watershed divide to 1,250 feet at the Colorado River.

The watershed lies within the Grand Prairie and Central Rolling Red Prairie land reeource areas. The Grand Prairie, which lies in the northern portion of the watershed, consists mainly of rangeland soils of the Denton and Tarrant series. The Central Rolling Red Prairie soils include the Owens, Darnell, Bonti, Exray, and other similar series. The major land use is rangeland, with cultivated lands being confined to the deeper soils.

The hydrologic cover conditions of the rangeland is fair. The natural vegetation consists of the mixed prairie plant group. It is composed of buffalograss, little bluestem, Texas wintergrass, Texas bluestem, vine mesquite, sideoats grama, curly mesquite, purple top, and Arizona cotton top. Invading plants, and plante which have increased with overuse of rangeland include: mesquite, catclaw, tasajillo, hood windmill, and sorubby post oak.

The overall land use is:

Land Uee	Acres	Percent
Cultivated	18,470	22
Range	64,061	77
Miscellaneous 1/	669	1
Total	83,200	100

1/ Includes roads, highways, stream channels, and farmsteade.

The mean annual weighted rainfall for the watershed is 27.28 inches. The minimum recorded weighted rainfall was 15.39 inchee, and the maximum 39.60 inches. Rainfall is fairly well dietributed. The wettest months are April,

May, September, and October. Individual excessive rains may occur in any season, but are most frequent in the spring and fall months.

Mean monthly temperatures range from 33 degrees Fahrenheit in January to 96 degrees in July. The normal frost-free season of 242 days extends from March 22 to November 19.

Wells and farm ponds supply a majority of the farmers and ranchers with adequate water for domestic and livestock use.

Economic Data

The watershed economy depends to a large extent on agriculture. Most of the agricultural activities are associated with diversified livestock operations and with small grain production. The average value per farm of all products sold in 1964 was $6,174. Eighty-one percent of this agricultural income is derived from livestock and poultry. Livestock and livestock products provide 57 percent; poultry and poultry products, 18 percent; and dairy products, 6 percent; of the total farm income. The remaining 19 percent of farm income is from sale of crops, such as oats, wheat, barley, grain sorghum, hay, and pecans.

The flood plain of the watershed is used primarily for grazing and for production of feed crops. Crops in excess of the operators requirements for livestock feed are sold.

Present flood plain land use is as follows: Oats (for grain and temporary winter grazing) 15 percent; wheat (for grain and temporary winter grazing) 12 percent; sudan, 5 percent; barley (for grain and temporary winter grazing) 2 percent; hayland, 1 percent; pasture and rangeland, 64 percent; and miscellaneous uses, 1 percent. Future trends are toward increased production of grain and pasture for livestock production. It is not expected that crops subject to acreage allotments will be increased as a result of the project.

The changes in farm operations and farm enterprises in Brown County are typical of those which have occurred in the watershed.

Listed below are selected census data for Brown County that indicates the magnitude of these changes:

Item	Year 1949	Year 1964
Cropland harvested, acres	105,989	59,834
Corn, acres harvested for grain	6,758	130
Oats, acres harvested	16,846	19,255
Wheat, acres harvested	23,021	15,035
Barley, acres harvested	1,361	544
Grain sorghum, acres harvested for grain	12,483	3,770

Cotton, acres harvested	12,110	1,263
Cattle and calves, number	36,948	43,965
Sheep and lambs, number	61,058	45,750

The change from a general type of farming to livestock farming is almost complete for the watershed. In the future, it is expected that more emphasis will be placed on growing row crops that can be grazed. Oats and other small grains are well suited to the soils and climate, and are important to supplement range when native grasses are dormant. These crops will continue to be planted in the alluvial valleys and on the deeper upland soils. The size of the operating units will continue to expand, with a gradual decrease in the number of farm units. Urban population should remain about the same. The watershed is not an economically depressed area.

The Northeast Lateral watershed has approximately 125 operating farm units, averaging 666 acres in size. The current market price of upland is $75 to $100 per acre, with flood plain lands ranging from $150 to $200 per acre. Agricultural land is largely owner-operated, with about 13 percent being leased or rented. Usually, the leased land is operated by a neighboring landowner.

The cities of Brownwood and Goldthwaite are the principal market centers serving the watershed. Modern up-to-date transportation facilities consisting of bus, motor freight, and the Gulf, Colorado and Santa Fe Railway, provide service to the area. The watershed is served adequately by Farm-to-Market roads 45, 574, and 586. These roads, and other county roads, provide all-weather travel within the watershed.

Land Treatment Data

The Brown-Mills Soil and Water Conservation District has been very active in establishing land treatment measures and initiating flood prevention work. It has obtained a high degree of participation in this program from farmers, ranchers, and other interested parties in the watershed.

The watershed is served by the Soil Conservation Service work units at Brownwood and Goldthwaite, which are assisting the Brown-Mills Soil and Water Conservation District. These work units have assisted farmers and ranchers in preparing 102 soil and water conservation plans on 48,240 acres (58 percent of the total agricultural land) within the watershed. Of these, 90 are basic conservation plans.

Technical guidance has been furnished in establishing and maintaining planned land treatment measures. There are 35 conservation plans in need of current revision. About 60 percent of the needed measures have been applied. Where these measures have been applied for as long as three years, average crop and pasture yields have increased about one-fifth.

Satisfactory soil surveys have been completed on 36,500 acres. Surveys needed on the remaining agricultural lands will be accomplished during the

5-year installation period. Land treatment measures installed before the development of this flood prevention work plan are shown in table 1a.

WATERSHED PROBLEMS

Floodwater Damage

The total flood plain area in the Northeast Laterals watershed consists of approximately 5,000 acres along its tributaries and the north side of the Colorado River. Very little of the flood plain area along the Colorado River is inundated by runoff from the Northeast Laterals watershed. It was determined that structural measures were not feasible on tributaries other than Buffalo and Indian Creeks, either because of insufficient damage or the lack of economical structure sites.

The flood plain lands of Buffalo and Indian Creeks consists of 2,886 acres, excluding 219 acres of stream channels (figure 1). This flood plain land comprises the areas that will be inunda ed by runoff from the largest storm considered in the 42-year evaluation series. The runoff from this storm approximates a two percent chance of occurrence storm.

At the present time, about 35 percent of the flood plain is in cultivation; 64 percent is in pasture or range; and one percent is in miscellaneous uses.

Some farmers and ranchers, on an individual basis, have attempted to enlarge, straighten, and levee some streams with very little reduction of flood damage. The adverse economic and physical effect of flooding has been felt throughout the entire watershed, and will prompt local participation in the alleviation of the flood problem.

Flooding along Buffalo and Indian Creeks occurs frequently, covering an average of 2,618 acres annually, including areas flooded more than once per year. This causes severe damage to growing crops and to other agricultural and nonagricultural properties. Small overflows occur at least once or twice annually, causing some damage to crops, fences, roads, and bridges. In addition, severe erosion takes place, especially on recently plowed land. Productivity has been reduced, causing some cropland to be converted from cash crops to pasture.

The largest recent damaging flood occurred October 4-5, 1959, when approximately 2,600 acres were flooded in the Buffalo and Indian Creek tributaries. Information obtained from farmers and ranchers showed damage in these reaches to be in excess of $30,000. Damage to crops and pasture was approximately $9,700, and livestock losses and damages to fences were estimated to be $15,400. Nonagricultural damages to roads and bridges were estimated at $5,000.

Spring floods damage seedbeds, growing row crops, and maturing small grains, and, conversely, fall floods damage maturing grain sorghums and growing small grain. Other agricultural damages are high in this watershed. Some

fences have to be completely reconstructed as often as every five years. Interviews with farmers and ranchers indicate that livestock losses of cattle and sheep are heavy from the larger floods.

For floods expected to occur during the evaluation period, the total direct average annual floodwater damage is estimated to be $33,480, at adjusted normalized prices (table 5). This includes crop and pasture damages ($17,991), and other agricultural damages ($10,830), and nonagricultural damages to roads and bridges ($4,659).

Indirect damages, such as interruption of travel to and from school and work, and interruption of community activities, are estimated to average $3,375, annually.

Erosion Damages

Upland erosion rates in the watershed are low. Rangeland with a generally fair vegetative cover is the predominant land use. In addition, the area of cropland has been reduced considerably by conversion to grassland in recent years. Of the total gross erosion in the watershed, 83 percent is derived from sheet erosion; 15 percent from flood plain scour; and 2 percent from gully and streambank erosion.

About 112 acres of flood plain land is damaged moderately by scour. Soil losses have reduced the productivity as follows: 75 acres by 10 percent; 36 acres by 20 percent; and one acres by 40 percent. The average annual value of this damage in terms of loss of production is $263 (table 5).

Sediment Damage

Sediment loads carried by streams of the watershed are low. Overbank deposits of clay loams and other loamy sediment ranging from 0.5 to 2.0 feet occur in very small areas of the flood plain near the channels. Damage to the productivity of the soils is low, and monetary losses are negligible. However, sediment derived from the watershed and deposited in Lake Buchanan is estimated to average 25 acre-feet per year. The average annual monetary value of this loss in storage capacity is estimated to be $736.

PROJECTS OF OTHER AGENCIES

In evaluating this plan, consideration was given to the proposed U. S. Corps of Engineers' Fox Crossing Reservoir, located just downstream from the mouth of Pecan Bayou on the Colorado River. While no Federal funds have been authorized for advance planning or construction of the reservoir, benefits to the Northeast Laterals watershed project reflect the facility in place by 2010.

The works of improvement included in this and similar plans in the Colorado River Basin will have significant effect, none of which are detrimental, on

existing and proposed downstream works of improvement included in the water resource development plan for this basin.

BASIS FOR PROJECT FORMULATION

After a reconnaissance of the watershed was made by specialists of the watershed planning staff, meetings were held with the local sponsoring organizations to discuss existing problems and to formulate objectives for a watershed protection and flood prevention program. This watershed depends almost entirely on agricultural enterprises for its income. Livestock farming is the major type of operation. Moderate to severe flooding causes extensive damage to flood plain lands, crops, pastures, and other agricultural properties.

It was recognized by the local sponsoring organizations and planning personnel that development of a sound watershed protection and flood prevention project will present many problems due to the wide variation of soil types and treatment needs and the topography of the structure site locations.

The opportunities for including storage capacities for purposes other than flood prevention were explained, as were the local responsibilities in connection with completing a project. The sponsors determined that a project for watershed protection and flood prevention would most nearly meet their needs, and that no group or individual was interested in additional storage for other purposes.

In addition to expressing the desire for the establishment of a complete program for soil and water conservation on the watershed, the following specific objectives were named by the local interests:

1. Establish the remaining land treatment measures which contribute directly to watershed protection and flood prevention, based on current needs.

2. Attain a 65 to 70 percent reduction in average annual flood damages on tributaries where structural measures could be used to supplement land treatment to insure sustained agricultural production on flood plain lands and to maintain the economy of the watershed.

The Soil Conservation Service agreed that the desired level of flood protection and watershed improvement was reasonable. Although some reduction in flooding would result from application of 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. It was recognized that a complete watershed program would result in a reduction of land devoted to crop production and in acreages of crops now in surplus supply.

Structural measures for watershed protection and flood prevention which would be feasible to install to meet the objectives of the local sponsoring organizations were then determined.

In selecting the sites for floodwater retarding structures, consideration was given to locations which would provide the desired level of protection for the areas subject to flood damage. The size, number, design, and cost of the structures was influenced by the location of the damaged areas, the complex topography, and the geologic conditions of the watershed, together with the availability of embankment fill material.

The proposed works of improvement, including both land treatment and structural measures, most nearly meets projectives in providing the desired level of protection for agricultural enterprises and satisfying the needs of the watershed at least cost.

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 Brown-Mills Soil and Water Conservation District, is essential for a sound flood prevention program for the watershed. The establishment and maintenance of all applicable soil and water conservation and management practices necessary to proper land use is basic to this objective.

The acreages to be treated in each major land use and the estimated cost of the needed land treatment measures to be installed by landowners and operators during the 5-year installation period are shown in table 1. The installation and maintenance of land treatment measures needed after the installation period will be carried out under the going programs. Remaining standard soil surveys on 21,740 acres of agricultural land will be completed during the installation period. Flood prevention funds in the amount of $3,500 will be provided to assist in completing these surveys.

There is a trend toward conversion of small fields of rolling, eroded cropland to hay or pasture usage. Most of the cropland in the watershed has a high productive capability, and, in recent years, the trend has been toward better management and fertilization to increase cover and residues. Also, the use of small grains is increasing considerably.

Most of the land treatment measures will function principally to decrease erosion damages to crop and pasture lands by improving soil-cover conditions. These include conservation cropping systems and crop residue use for the cropland, and range seeding to establish good cover on grassland. They also include brush control to allow grass stands to improve and replace the poor brush cover on grassland; construction of farm ponds to provide adequate watering places to prevent cover-destroying concentrations of

Proper range use and deferred grazing increase cover and species of better grasses by allowing ranges to seed. Note the seed crop of little bluestem and Indiangrass and the good cover being provided.

Brush control on rangeland allows better species of forage grasses to increase thereby improving cover conditions of the ranges.

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livestock; and proper use and deferred grazing of rangeland to provide improvement, protection, and maintenance of grass stands. These measures also effectively improve soil conditions which allow rainfall to soak into the soil at a more rapid rate.

Other beneficial land treatment measures include contour farming, terracing, diversions, and irrigation and water management practices, all of which have a measurable effect in reducing peak discharges by slowing runoff. These measures also reduce erosion and sediment damage. The total benefits of land treatment measures were not evaluated in monetary terms since experience has shown that these soil and water conservation measures produce benefits in excess of their costs.

Structural Measures

A system of six floodwater retarding structures and 3.91 miles of stream channel improvement will be installed to provide the needed protection to the flood plain lands of Buffalo and Indian Creeks that cannot be provided by land treatment measures alone. The total storage capacity of the six floodwater retarding structures will be 5,597 acre-feet. The 100-year accumulation of sediment will eventually reduce this capacity 794 acre-feet. The remaining detention storage capacity of 4,803 acre-feet will be sufficient to detain an average of 4.39 inches of runoff from 30 percent of the drainage area of Buffalo and Indian Creeks.

The total area of the sediment pools, including the reserve pools, is 134 acres, of which 50 acres are flood plain. The detention pools will temporarily inundate an additional 378 acres, of which 154 acres are flood plain.

Sufficient detention storage can be developed at all structure sites to make possible the use of natural rock or vegetative emergency spillways, thereby effecting a substantial reduction in cost over a concrete or similar type spillway.

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

The 3.91 miles of channel improvement will provide the needed flood protection to the flood plain lands along the West Fork of Rough Branch, a tributary to Indian Creek, that cannot be provided by land treatment or other structural measures. This flood protection will be equal to the peak discharge of the 10-year frequency storm event. Inlets will be installed to conduct local runoff into the improved channel. The local sponsors will assume responsibility for modifying two county road bridges and one bridge on Farm-to-Market road No. 586, in connection with the channel improvement work.

The details on quantities, costs, and design features of the floodwater retarding structures and the stream channel improvement are shown in tables 2, 3, and 3a.

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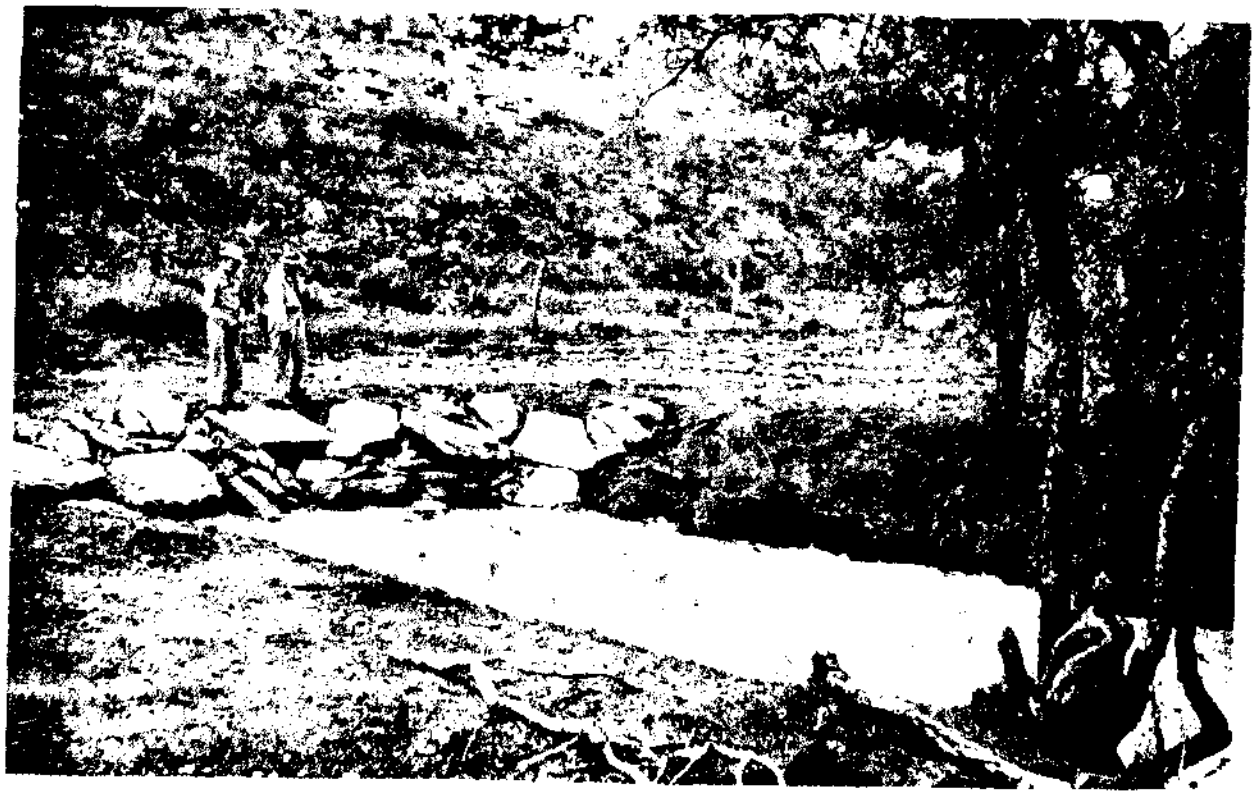
Runoff from heavy rains being controlled by floodwater retarding structures in a nearby watershed.



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

EXPLANATION OF INSTALLATION COSTS

The estimated cost of planning and installing land treatment measures, exclusive of Federal funds, is $260,583, based on current program criteria (table 1). In addition, prior to work plan preparation, landowners and operators have established land treatment measures at an estimated non-Federal cost of $567,778 (table 1a).

Land treatment costs are based on present prices being paid by landowners or operators to establish the individual measures in the area. The land treatment measures to be applied and the unit cost of each measures was estimated by the Brown-Mills Soil and Water Conservation District. Technical assistance in the amount of $3,500 will be provided from flood prevention funds to assure timely completion of standard soil surveys for the watershed.

The estimated cost of installing the six floodwater retarding structures and the 3.91 miles of stream channel improvement is $574,325. Of this amount, $78,734 will be borne by local interests, and $495,591 by flood prevention funds, of which $393,079 is construction costs, and $102,512 is installation services.

Land, easements, and rights-of-way, and relocation of roads, bridges, utilities, and other improvements for the floodwater retarding structures and the stream channel improvement will be provided by local interests at no cost to the Federal government. The value of these is estimated to be $71,575, based on current market value estimated by local organizations. An additional $7,159 of non-Federal funds will be provided for legal and other services required in obtaining land, easements, and rights-of-way.

Construction costs include both the engineers' estimates and the contingencies. The engineers' estimates were based on the unit costs of floodwater retarding structures in similar areas, modified by specific conditions peculiar to each individual site location. They include such items as rock excavation, permeable foundation conditions, and site preparation. Ten percent of the engineers' estimates was added as a contingency to provide for unpredictable costs.

Installation services include engineering and administrative costs. These estimates were based on an analysis of previous work in this area.

The tentative schedule of obligations for the complete 5-year project installation period, including installation of both land treatment and structural measures, is as follows:

SCHEDULE OF OBLIGATIONS

Fiscal Year	Measures	Federal Funds	Non-Federal Funds	Total
		(dollars)	(dollars)	(dollars)
First	Land Treatment	700	48,200	48,900
	Structure No. 6	98,498	16,088	114,586
Second	Land Treatment	700	50,100	50,800
	Structure Nos. 2 and 3	109,041	11,633	120,674
Third	Land Treatment	700	52,000	52,700
	Structure Nos. 1 and 4	152,530	21,698	174,228
Fourth	Land Treatment	700	54,100	54,800
	Structure No. 5	82,942	5,940	88,882
Fifth	Land Treatment	700	56,183	56,883
	Channel Improvement	52,580	23,375	75,955
TOTAL		499,091	339,317	838,408

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 light of appropriations and accomplishments actually made.

EFFECTS OF WORKS OF IMPROVEMENT

After installation of the combined programs of land treatment and structural measures described above, average annual flooding will be reduced from 2,618 acres to 1,117 acres. This project will benefit directly approximately 30 owners and operators of 2,886 acres of agricultural flood plain lands.

The owners and operators of flood plain lands reported that they would restore 341 acres now in low-yield pastures to production of higher value crops when adequate flood protection is provided. This land was formerly cultivated, but is now used only for grazing. It will be used primarily for the production of oats for grain and temporary grazing. Some small grains now grown on upland soils will be shifted to the more productive bottomlands.

It was estimated from discussions with farmers and other agricultural technicians that about 305 acres of flood plain lands would be farmed more intensively with flooding reduced. The timeliness of farm operations and a more secure feeling with the project installed will result in the application of better farming techniques. More fertilizer will be used, more insecticides will be applied, and the use of certified and treated seed will more common.

Shifts in upland land use will reduce the total acreage of cropland in the watershed during the project installation period. Allotment crops of cotton and wheat will be reduced to some extent. Decreases in cropland will

result from the conversions of cropland to grassland and grassed waterways as a result of the planned land treatment program.

Some loss of wildlife habitat will result from the clearing of sediment pools at a few of the structural sites, but these losses will be off-set by fish production and habitat for wild fowl. Wildlife habitat in the flood plain areas will be improved by reduction of frequency, depth, and duration of flooding.

Incidental benefits will result from the use of the sediment pools of the floodwater retarding structures. It was indicated that these six structures, with a combined total of 90 surface-acres in sediment pools, will be open to the general public for recreation on a fee basis, or with the permission of the landowners. Recreation, such as camping, picnicking, fishing and hunting, will be available to local people throughout the year. Based on the use of existing nearby structures, it is expected that the project will have an average use of approximately 1350 visitor days annually. Recreational use of sediment pools will continue for 40 years, and diminish to zero after 50 years because of sediment deposition.

Sediment pools of the six floodwater retarding structures also will provide a more dependable water supply for livestock.

Benefits will accrue to the project from some reduction in floodwater and sediment damages outside the project area. These benefits will occur on the Colorado River main stem immediately below the watershed, and to Lake Buchanan. It was recognized that these benefits will cease with installation of the proposed Fox Crossing Reservoir (2010). Benefits from reduction of sediment to Fox Crossing Reservoir will accrue to the upstream project when that facility is in place. These benefits will be at least equal to those estimated for Lake Buchanan and the Colorado River main stem.

Secondary benefits stemming from, and induced by, the project will accrue in the local area. The increased net income of farm families resulting from reduced flood damages and increased efficiency in farm operations will stimulate economic activities. As the farm family standard of living improves, sales of consumer goods can be expected to increase. Sales and services in connection with recreational activities will be increased. In addition, there are intangible benefits, such as increased sense of security, and the opportunity to plan farm operations without consideration of frequent flooding.

Land treatment measures will reduce the present average annual sediment yield to the six floodwater retarding structure sites from .56 to .48 acre-feet per square mile of drainage area, a reduction of 15 percent. Similar reductions are expected in other portions of the watershed.

The annual flood plain scour damage is expected to be reduced about 61 percent. Six percent will be attributable to land treatment, and 55 percent to the structural measures.

The annual sediment yield to the mouth of the watershed is expected to be reduced from 153,250 tons to 85,750 tons with the project installed. With the complete program installed, the loss of capacity in Lake Buchanan will be reduced by 10 acre-feet annually.

The flood prevention program will result in minor reduction in average annual runoff from the watershed. Reduction in average annual runoff at the floodwater retarding structure sites is 11 percent. This is an equivalent reduction of 3 percent over the watershed. This reduction will decrease as the sediment pools are filled with sediment.

PROJECT BENEFITS

The estimated average annual monetary damages (table 5) for Buffalo and Indian Creeks will be reduced from $37,118 to $10,971, a reduction of 70 percent.

Crop and pasture damage will be reduced from $17,991 to $4,632, or 74 percent. Other agricultural damages, such as loss of fences, farm equipment, livestock, and other property, will be reduced from $10,830 to $3,481, or 68 percent. Road and bridge damage will be reduced from $4,659 to $1,771, or 62 percent. Flood plain scour damages will be reduced from $263 to $90, or 66 percent.

Of the $26,147 damage reduction benefits attributable to the project, $25,272, or 97 percent, are the result of structural measures, with the remaining 3 percent reduction the result of land treatment.

The estimated net increase in farm income due to the restoration of former productivity will amount to $6,284, annually, at adjusted normalized price levels. The loss of the original productivity of this land has been included in the crop and pasture damage and its restoration a benefit in table 5.

Benefits incidental to project purposes will amount to $1,356 annually. These will include $594 for recreation and $762 for livestock water.

The net increase in income due to more intensive use of flood plain lands will amount to $2,293, annually.

No increase in allotted crops is expected to result from the project.

Benefits from reduction of floodwater and sediment damages outside the project area are estimated to average $668 annually. These reductions will occur along the Colorado River main stem below the watershed and to Lake Buchanan.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluations. The project will, however, provide a higher level of income to farmers and stimulate business in towns and marketing

oenters adjacent to the watershed. The monetary value of secondary benefits is estimated to be $3,675 annually.

Consideration was given to decreased production in pool areas, resulting from the project installation. The amortized value of land in pool areas ($1,649) exceeded the net loss in pool area production plus associated secondary losses ($1,557). Consequently, the higher value was used to assure a conservative evaluation.

The total average annual benefits from structural works of improvement are estimated to be $33,264.

Other benefits not evaluated in monetary terms are an increased sense of security for farmers, and improved wildlife habitat.

Brown and Mills counties have not been designated as areas eligible for assistance under the Area Redevelopment Act. Consequently, no redevelopment benefits were considered.

Comparison of Benefits and Costs

The total average annual cost of structural measures is $27,744. These measures are expected to produoe average annual benefits, excluding secondary benefits, of $29,589, resulting in a benefit-cost ratio of 1.1:1.

The ratio of total average annual project benefits, including secondary benefits accruing to structural measures, is estimated to be $33,264, giving a benefit-cost ratio of 1.2:1. (table 6).

PROJECT INSTALLATION

The land treatment measures needed to protect both the cropland and rangeland as shown in table 1 will be established by farmers and ranchers in cooperation with the Brown-Mills Soil and Water Conservation District during their 5-year installation period. The district is giving assistance in the planning and application of these measures under its going programs.

In reaching the gcal for establishing land treatment measures during the installation period, it was agreed that accomplishments would be as follows:

Land Use	FISCAL YEAR					Total
	1st	2nd	3rd	4th	5th	
	(acres)	(acres)	(aores)	(acres)	(acres)	(acres)
Cropland	770	804	837	871	904	4,186
Rangeland	3,384	3,531	3,678	3,826	3,973	18,392
TOTAL	4,154	4,335	4,515	4,697	4,877	22,578

The governing body of the soil and water conservation district will arrange for meetings in accordance with definite schedules. By this means, and by

individual contacts, they will encourage 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 landowners in accordance with existing arrangements for equipment usage in the district.

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

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

The county Agricultural Stabilization and Conservation committees will cooperate with the governing body of the soil and water conservation district by selecting and recommending financial assistance for those ACPS practices that 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, preparation of radio, television, and press releases, and using other methods of getting information to landowners and operators in the watershed. This activity will help get the land treatment practices and structural measures for flood prevention established.

The Soil Conservation Service will contract for the construction of six floodwater retarding structures and the 3.91 miles of stream channel improvement. 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 the structural measures.

The Brown and Mills County Commissioners Court, in cooperation with the Brown-Mills Soil and Water Conservation District, will furnish the land, easements, and rights-of-way, and arrange for road, utility, and improvement changes for all structural measures. They will install culverts and make other needed improvements to keep crossings on public roads passable, while the floodwater retarding structures are operating. Local sponsors will be responsible for the improvement of individually-owned crossings, where required. The cost of these improvements is included in the estimated cost of land, easements, and rights-of-way.

Construction may start with any structure in the watershed. All necessary land, easements, and rights-of-way, including relocation of roads, utilities, and other improvements, or adequate assurance that they will be pro-

vided in a timely manner, will be obtained for all structures in the watershed before Federal financial assistance is made available.

The six floodwater retarding structures will be constructed during the 5-year installation periods in the general sequence of Sites 6, 2, 3, 1, 4, and 5. The 3.91 miles of stream channel improvement may be constructed at any time.

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

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement as described in this plan will be provided under the Flood Control Act of 1944, as amended and supplemented.

The cost of establishing land treatment 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 Service, Great Plains 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.

Based on experience in this area, the local sponsors have estimated that more than 90 percent of the needed land, easements, and rights-of-way for the floodwater retarding structures and stream channel improvement will be donated. Sufficient funds will be made available from taxes now being collected to meet all local obligations in completing the project.

Federal assistance will be made available pursuant to the following conditions:

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

2. All required land, easements, and rights-of-way have been obtained.

3. Operation and maintenance agreements have been executed.

4. Flood prevention funds are available.

County assistance will be made available 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. At least 90 percent of the land, easements, and rights-of-way have been obtained as set out above.

3. Flood prevention funds are available.

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 Soil and Water Conservation District. Representatives of this district will make periodic inspections of the land treatment measures to determine maintenance needs and to encourance landowners and operators to perform maintenance. District-owned equipment will be made available for this purpose in accordance with existing arrangements for equipment usage.

Structural Measures

All six of the proposed floodwater retarding structures and the 3.91 miles of channel improvement will be operated and maintained by the Brown and Mills County Commissioners Courts and the Brown-Mills Soil and Water Conservation District. The Brown County Commissioners Court will maintain Structure Nos. 1 through 5, and the 3.91 miles of channel improvement. The Mills County Commissioners Court will maintain Structure No. 6.

The estimated average annual operation and maintenance cost is $888, based on adjusted normalized prices. 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 the Brown and Mills County Commissioners Courts.

All floodwater retarding structures and stream channel improvement will be inspected by representatives of the local sponsoring organizations after each heavy rain, or at least annually. A Soil Conservation Service representative will participate in these inspections at least annually, for a period of three years following completion of each work of improvement. The Service may make other inspections thereafter as it elects to do so. Items of inspection for the floodwater retarding structures 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 the emergency spillway, and fences and gates installed as part of the structures. Items of inspection for the stream channel improvement will include the degree of scour, sediment deposition, and bank erosion; obstruction to flow caused by debris lodged against fences, and water gates; excessive brush and tree growth within the chennel, and the condition of side inlets and appurtenances.

The sponsoring local organizations will maintain a record of the inspections and maintenance work performed and have it available for review by the Soil Conservation Service.

Provisions will be made for free access of representatives of the sponsoring organizations and the Federal government to inspect the floodwater retarding structures and the stream channel improvement and their appurtenances at any time.

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

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

Installation Cost Item	Unit	Number	Estimated Cost 2/ Federal	Non-Federal	Total
			(dollars)	(dollars)	(dollars)
Land Treatment					
Soil Conservation Service					
Cropland	Acre	4,186	-	69,180	69,180
Grassland	Acre	18,392	-	191,403	191,403
Technical Assistance (Accel.)			3,500	-	3,500
SCS Subtotal			3,500	260,583	264,083
TOTAL LAND TREATMENT			3,500	260,583	264,083
Structural Measures					
Soil Conservation Service					
Floodwater Retarding Structures	No.	6	353,173	-	353,173
Stream Channel Improvement	Mile	3.91	39,906	-	39,906
SCS Subtotal			393,079	-	393,079
Subtotal - Construction			393,079	-	393,079
Installation Services					
Soil Conservation Service					
Engineering Services			65,802	-	65,802
Other			36,710	-	36,710
SCS Subtotal			102,512	-	102,512
Subtotal - Installation Services			102,512	-	102,512
Other Costs					
Land, Easements, and Rights-of-Way			-	71,575	71,575
Legal Fees			-	7,159	7,159
Subtotal - Other			-	78,734	78,734
TOTAL STRUCTURAL MEASURES			495,591	78,734	574,325
Work Plan Preparation			31,100	-	31,100
TOTAL PROJECT			530,191	339,317	869,508
SUMMARY					
Subtotal - SCS			530,191	339,317	869,508
TOTAL PROJECT			530,191	339,317	869,508

1/ Price Base: 1966.

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

TABLE 1a - STATUS OF WATERSHED WORKS OF IMPROVEMENT 1/
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

Measures	Unit	Applied To Date	Total Cost 2/
			(dollars)
LAND TREATMENT			
Conservation Cropping System	Acre	3/ 9,765	194,160
Range Proper Use	Acre	3/ 34,628	91,890
Range Seeding	Acre	2,306	11,530
Brush Control	Acre	17,100	85,500
Terraces	Foot	1,146,600	57,330
Diversions	Foot	186,400	22,368
Farm Ponds	No.	350	105,000
TOTAL			567,778

1/ At time of work plan preparation. Price Base: 1966.

2/ Excludes costs that were reimbursed from other Federal funds.

3/ The level of application of the management and recurring-type practices reached at the time of work plan preparation and are not cumulative.

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TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

(Dollars) 1/

Structure Number or Name	Federal Installation Cost				Non-Federal Installation Cost			Total Installation Cost
		Installation Services						
	Construction	Engineering	Other	Total Federal	Easements and Rights-of-Way	Legal Fees and Other	Total Non-Federal	
1	49,368	8,886	4,660	62,914	12,225	1,223	13,448	76,362
2	43,772	7,879	4,132	55,783	5,700	570	6,270	62,053
3	41,791	7,522	3,945	53,258	4,875	488	5,363	58,621
4	72,155	10,823	6,638	89,616	7,500	750	8,250	97,866
5	66,781	10,017	6,144	82,942	5,400	540	5,940	88,882
6	79,306	11,896	7,296	98,498	14,625	1,463	16,088	114,586
Subtotal	353,173	57,023	32,815	443,011	50,325	5,034	55,359	498,370
Channel Improvement	39,906	8,779	3,895	52,580	21,250	2,125	23,375	75,955
GRAND TOTAL	393,079	65,802	36,710	495,591	71,575	7,159	78,734	574,325

1/ Price Base: 1966

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	Total
Drainage Area	Sq.Mi.	3.29	1.90	1.65	2.92	3.42	7.58	20.76
Storage Capacity								
Sediment Pool (50-year)	Ac.Ft.	68	35	31	54	46	117	351
Sediment Reserve Pool	Ac.Ft.	65	34	29	53	43	109	333
Sediment in Detention Pool	Ac.Ft.	20	11	10	18	15	36	110
Floodwater Detention	Ac.Ft.	667	424	374	615	721	2,002	4,803
Total	Ac.Ft.	820	504	444	740	825	2,264	5,597
Surface Area								
Sediment Pool	Acre	23	10	10	12	9	26	90
Sediment Reserve Pool	Acre	43	15	14	19	12	38	141
Floodwater Detention Pool	Acre	118	57	47	78	57	155	512
Volume of Fill	Cu.Yds.	84,500	66,600	70,600	145,000	98,000	129,300	594,000
Elevation Top of Dam	Foot	1,469.9	1,470.4	1,483.6	1,442.3	1,424.7	1,400.5	xxx
Maximum Height of Dam	Foot	26	31	29	37	51	56	xxx
Emergency Spillway								
Crest Elevation	Foot	1,464.7	1,466.0	1,478.5	1,436.2	1,419.0	1,394.0	xxx
Bottom Width	Foot	100	100	50	70	150	150	xxx
Type	----	Veg.	Veg.	Rock	Veg.	Rock	Rock	xxx
Percent Chance of Use 1/	----	4	4	4	4	4	1.1	xxx
Average Curve No. Condition II	----	80	80	80	80	80	79	xxx
Emergency Spillway Hydrograph								
Storm Rainfall (6-hour)	Inch	6.5	6.5	6.5	6.5	6.5	6.6	xxx
Storm Runoff	Inch	4.2	4.2	4.2	4.2	4.2	4.2	xxx
Velocity of Flow (Vc) 2/	Ft./Sec.	3.0	-	-	-	-	-	xxx
Discharge Rate 2/	c.f.s.	100	-	-	-	-	-	xxx
Maximum Water Surface Elevation 2/	Foot	1,465.5	-	-	-	-	-	xxx
Freeboard Hydrograph								
Storm Rainfall (6-hour)	Inch	13.5	13.5	13.5	13.5	13.5	13.6	xxx
Storm Runoff 2/	Inch	10.9	10.9	10.9	10.9	10.9	10.9	xxx
Velocity of Flow (Vc) 2/	Ft./Sec.	9.6	9.0	9.9	10.1	10.0	11.0	xxx
Discharge Rate 2/	c.f.s.	3,200	2,260	1,440	2,810	4,800	6,160	xxx
Maximum Water Surface Elevation 2/	Foot	1,469.9	1,470.4	1,483.6	1,442.3	1,424.7	1,400.5	xxx
Principal Spillway Capacity	c.f.s.	50	65	64	68	79	136	xxx
Capacity Equivalents								
Sediment Volume	Inch	0.87	0.79	0.79	0.80	0.57	0.65	xxx
Detention Volume	Inch	3.80	4.18	4.25	3.95	3.95	4.95	xxx
Spillway Storage	Inch	4.31	2.83	3.31	3.58	2.03	2.81	xxx
Class of Structure	----	A	A	A	A	A	A	xxx

1/ Based on Engineering-Hydrology Memorandum TX-2.

2/ Maximum during passage of hydrograph.

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TABLE 3a - STRUCTURE DATA - STREAM CHANNEL IMPROVEMENT

Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

Channel Designation	Station Numbering For Reach: Station	Station	Watershed Area	Required Channel Capacity	Planned Channel Capacity	Average Bottom Width	Average Side Slope	Average Depth	Average Grade	Average Velocity at Design Section	Volume of Excavation
	(100 ft.)	(100 ft.)	(acres)	(c.f.s.)	(c.f.s.)	(ft.)	(H:V)	(ft.)	(ft./ft.)	(ft./sec.)	(cu.yds.)
West Fork	100+00	112+60	826	620	628	28	1:1	3.8	.0054	5.18	10,710
	112+60	125+60	896	670	680	28	1:1	4.0	.0054	5.12	8,710
	125+60	139+80	979	710	740	28	1:1	4.2	.0054	5.25	7,384
	139+80	181+70	1,082	750	730	28	1:1	4.4	.0046	4.96	24,396
										Subtotal	51,200
East Fork	126+20	156+40	147	230	246	16	1:1	3.0	.0056	4.32	7,744
	156+40	181+70	506	500	500	22	1:1	3.8	.0054	5.06	9,176
										Subtotal	16,920
Main Stem and Tributaries	181+70	198+80	1,907	1,010	1,040	40	1:1	4.8	.0034	4.85	9,170
	198+80	222+10	2,125	1,150	1,175	40	1:1	4.8	.0046	5.64	22,824
	222+10	242+40	2,387	1,200	1,240	40	1:1	5.0	.0042	5.52	23,443
	242+40	260+80	2,560	1,220	1,240	40	1:1	4.8	.0048	5.76	17,831
										Subtotal	73,268
										Total	141,388

TABLE 4 - ANNUAL COST 1/
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

(Dollars)

Evaluation Unit	Amortization of Installation Costs 2/	Operation and Maintenance Cost 3/	Total
Floodwater Retarding Structure Numbers 1, 2, 3, 4, 5, and Stream Channel Improvement	21,498	762	22,260
Floodwater Retarding Structure Number 6	5,358	126	5,484
Total	26,856	888	27,744

1/ Does not include work plan preparation cost

2/ 1966 prices amortizad for 100 years at 4-5/8 percent.

3/ Adjusted normalized priees.

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	17,991	4,632	13,359
Other Agricultural	10,830	3,481	7,349
Roads and Bridges	4,659	1,771	2,888
Subtotal	33,480	9,884	23,596
Erosion			
Flood Plain Scour	263	90	173
Indirect	3,375	997	2,378
TOTAL	37,118	10,971	26,147

1/ Price Base: Adjusted normalized prices.

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Northeast Laterals Watershed, Texas
Middle Colorado River Watershed
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost	Benefit-Cost Ratio
	Flood Prevention							
	Damage Reduction	Intensification	Incidental 2/	Secondary	Outside Watershed 3/	Total		
Floodwater Retarding Structure Numbers 1, 2, 3, 4, 5, and Stream Channel Improvement	21,317	825	1,057	2,888	399	26,486	22,260	1.2:1
Floodwater Retarding Structure Number 6	3,955	1,468	299	787	269	6,778	5,484	1.2:1
GRAND TOTAL	4/ 25,272	2,293	1,356	3,675	668	33,264	27,744	1.2:1

1/ Price Base: Adjusted normalized prices.

2/ Includes $762 benefits from livestock water and $594 benefits from recreation.

3/ Includes $432 benefits from reduction of flood damage to the mainstem of the Colorado River, and $236 benefits from reduction of sediment damage to Lake Buchanan.

4/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $875, annually.

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment for the watershed was developed by supervisors of the Brown-Mills Soil and Water Conservation District, with assistance from personnel of the Soil Conservation Service work units at Brownwood and Goldthwaite, Texas. A 50 percent sample of current basic conservation plans of the watershed was analyzed to develop conservation needs data for the entire watershed. Acres to be treated by land use during the 5-year installation period were based on a study of total conservation needs, accomplishments to date, remaining needs, and the priority of planning and servicing established by the Soil and Water Conservation District.

Engineering Investigations

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

1. A base map of the watershed was prepared to show the drainage pattern, road system, and other pertinent information.

2. All probable floodwater retarding structure sites and the approximate limits of the flood plain subject to flood damages were located by stereoscope studies of aerial photographs and field examinations. Based on these examinations, a structural system consisting of six floodwater retarding structure sites and approximately 3.91 miles of channel improvement was presented to the local sponsors for their consideration and approval.

3. With the approval of local sponsors, engineering surveys of the floodwater retarding structure sites were made in accord nce with Watersheds Memorandum TX-2 dated June 3, 1959. Channel surveys were made in accordance with Watersheds Memorandum TX-1, dated March 5, 1964.

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

5. The stream channel improvement designs were based on procedures outlined in U.S.D.A. Technical Release No. 25, Planning and Design of Open Channels", December 15, 1964.

When the most economical system of structural measures for flood prevention had been determined, a table was developed to show the cost distribution of

structural measures (table 2). The summation of the total costs of all needed land treatment and structural measures represented the estimated cost of the planned watershed protection and flood prevention project (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 meteorological and hydrologic data were tabulated from Climatological Bulletins, United States Weather Bureau and Water Supply Papers, United States Geological Survey, and local records. These data were analyzed to determine average precipitation, depth-duration relationships, seasonal distribution of precipitation, the frequency of occurrence of meteorological events, the historical flood series, rainfall-runoff peak discharge relationships, and the relationship of geology, soils, and climate to runoff depth for single storm events.

2. Engineering surveys were made to collect information on selected stream reaches, including valley cross-sections, channel capacities, highwater elevations of selected storms, bridge capacities, and other hydraulic characteristics, and on proposed structure sites to collect data used in design. Cross-sections and evaluation reaches were selected on the ground in collaboration with the economist and geologist.

3. Present hydrologic conditions of the watershed were determined, taking into consideration such factors as soils, land use, topography, cover, and climate. Future hydrologic conditions were determined by obtaining from work unit conservationists and local 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 representative structure sites and a 10 percent random sample of the uncontrolled drainage area (about 25 percent of the drainage area of the watershed) and used with figures 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 the design storms.

4. Rainfall-runoff relationships were determined and compared with nearby gaged runoff on similar watersheds. The percent chance of occurrence of meteorological events was determined

by computing the plotting of values 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 (3-10-1-24, NEH, Section 4, Supplement A).

5. Rating curves for the cross-sections were computed by Mannings formula (4.2-1-9, NEH, Section 4, Supplement A). Stage-area inundated curves were developed for each cross-section. From these, composite runoff-area inundated curves were developed for each evaluation reach.

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

   a. Present conditions of the watershed.

   b. Effect of land treatment measures.

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

   d. Consideration of alternative and various combinations of measures.

The 6-hour design storm rainfall and the emergency spillway and freeboard hydrographs were computed for each site in accordance with Section 2441, Texas State Manual. The dimensions of the emergency spillways were determined by graphically routing the freeboard hydrographs. The criteria and procedures used are set forth in Engineering Memorandum SCS-27; Technical Release No. 2; NEH, Section 4, Hydrology, Supplement A; NEH, Section 5, Hydraulics, and Section 2441, Texas State Manual.

Frequency of use of emergency spillways was based on Engineering-Hydrology Memorandum TX-2. Detention storage, embankment yardage, rock excavation, and spillway depth, width, and alignment were balanced to give the most economical structure, which was included in the watershed plan.

The rainfall for the period 1922 to 1963, inclusive, was selected for evaluating damages in this watershed. Rainfall information for the historical evaluation series used in these studies was obtained by applying the Thiessen polygon method of weighting to the rainfall data tabulated for the Goldthwaite, Mullin, and Brownwood Stations.

Sedimentation Investigations

Sedimentation investigations were made in accordance with procedures outlined in "Guide to Sedimentation Investigations", South Regional Technical

Service Area, March 1965:

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

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

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

   c. Allowances for differencee in density were baeed on the following volume weighte:

      Soil in Place ..... 95 lbs./cu.ft.
      Submerged Sediment ..... 60 lbs./cu.ft.

   d. The sediment was allocated to the pools as follows:

Period of Depoeition	Pool	Condition	Per-oent
First 50 years	Sediment	Submerged	40
Seoond 50 years	Sediment	Submerged	1/ 40
100 years	Detention	Aerated	20

1/ Includes aerated sediment volume expected to be deposited in this pool during first 50 year period.

2. Sedimentation and ecour damage inveetigations were made by the valley crose-eection method on applicable reaches. Damage categories, measurements, and summariee of all phyeical damage were made in accordance with procedures euggeeted in Chapter XI of the Guide.

3. Sediment damage to Lake Buchanan was baeed on adjuetment of the groes eroeion volume from the watershed (without and with project conditions) for expected delivery, trap efficiency, and volume weight change for sediment in the reservoir.

Channel Stability Studies

Channel investigations for stability studies were made in accordance with the suggested procedures in Technical Release No. 25, "Planning and Design of Open Channels", USDA, SCS, December 15, 1964. These investigations included studies of the general geology and soils of the drainage basin, depth and nature of the alluvium, types of bedload carried, relative stability of present channel, and the nature of the underlying bedrock.

The alluvium along all streams is dominantly a cohesive, clayey material, classified as CL and CH. Gravelly materials (GC) with some cobbles and small boulders occur in the lower horizons. The bedrock consists of interbedded soft clay shales and moderately hard sandstones. Channel filling with sandy and silty clay sediment and some sandy bedload materials has caused moderate amounts of capacity loss on many streams and severe capacity loss on Rough Creek. Landowners have attempted to straighten and enlarge segments of the Rough Creek channel, but these attempts have been largely ineffective.

The improved channel on Rough Creek will be approximately the same depth as the present channel in the less severely filled reaches. Maximum depth of excavation in straightened reaches will not exceed nine feet. Most of the improvement consists of widening the present channel. The non-scouring velocities for the soil materials along the channel range from 4.0 feet per second, clear water, to 5.5 feet per second, suspended load.

Geologic Investigations

Preliminary geologic dam site investigations were made at each of the six floodwater retarding structure sites and reports prepared in accordance with procedures shown in Chapter 6 of "Guide to Geologic Site Exploration", South Regional Technical Service Area, July 1966. These investigations included making studies of valley slopes, alluvium, channel banks, and exposed geologic formations. Seismic equipment was used at Site 5 to test depth of the alluvium and interpret bedrock conditions.

All of the sites are located on sedimentary rocks of the Strawn group of Pennsylvanian age. The structure of these formations is simple, with some localized small anticlines and synclines. The dip is northwesterly at less than 50 feet per mile. Soft shales of the Brownwood shale member of the Watt formation occur at Site 1. Interbedded soft shales and hard sandstones of the Lone Camp formation occur at Sites 2, 3, 4, 5, and 6. The shales predominate in the foundation and lower abutments of Sites 2, 3, and 4, with the sandstones occurring in the upper abutments and emergency spillway areas. Sandstone predominates at Sites 5 and 6, occurring in the foundations, abutments, and in the emergency spillway areas.

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

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Economic Investigations

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guids for Watershed Protection and Flood Prevention", U. S. Department of Agriculture, Soil Conservation Service, March 1964.

The flood plain was divided into two evaluation reaches, due to the difference in damageabls values and flood plain characteristics.

Agricultural damage calculations were based upon information obtained in interviews with landowners and operators of approximately 60 percent of the acreage of the flood plain land. Schedules covered past, present, and intended future use; crop dietribution under normal conditions; planting dates; yields; historical data on flooding and resultant damages to crops and pastures, as well as other agricultural property. Information from these schedules was supplemented with information from local agricultural technicians. Eetimates of damages to roads and bridges were obtained from county commissioners, State highway officials, and local farmers. Current flood plain land use was mapped in the field.

Monetary values of physical damage to flood plain lands from scour was based on the net value of production loet, taking into acoount the time for recovery, and discounted.

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

Average annual damages within the watershed were calculated for conditions without a project, with land treatment installed, and after installation of the complete project. The difference between the damage at the time of the initiation of each project increment and that expected after its installation constituted the benefits brought about by that increment through reduction in damages.

Installation of this project will provide benefits from reduction of floodwater and sediment damages outside the project area. These reductions will occur along the Colorado River mainstem below the watershed and to Lake Buchanan. These benefits were evaluated and included as a project benefit.

Farmers in the watershed were asked what changes in cropping eystems and land use had been made as a result of frequent flooding, and what changes in land use and cropping practices might be expected in the future with these floods reduced in extent and frequency. Using their predictions as a guide, it wae estimated that 341 acres of formerly cultivated land now in low-yielding pasture would be returned to more productive cash crops. Added damage to higher damageable values from the remaining floods was calculated and subtracted.

Field studies indicated that 305 acres of flood plain would be farmed more intensively with flooding reduced. The timeliness of farm operations with

flooding reduced will result in the use of better farming techniques. More fertilizers will be applied and wider use will be made of insecticides and weed control measures. The use of certified and treated seed is expected to become more common.

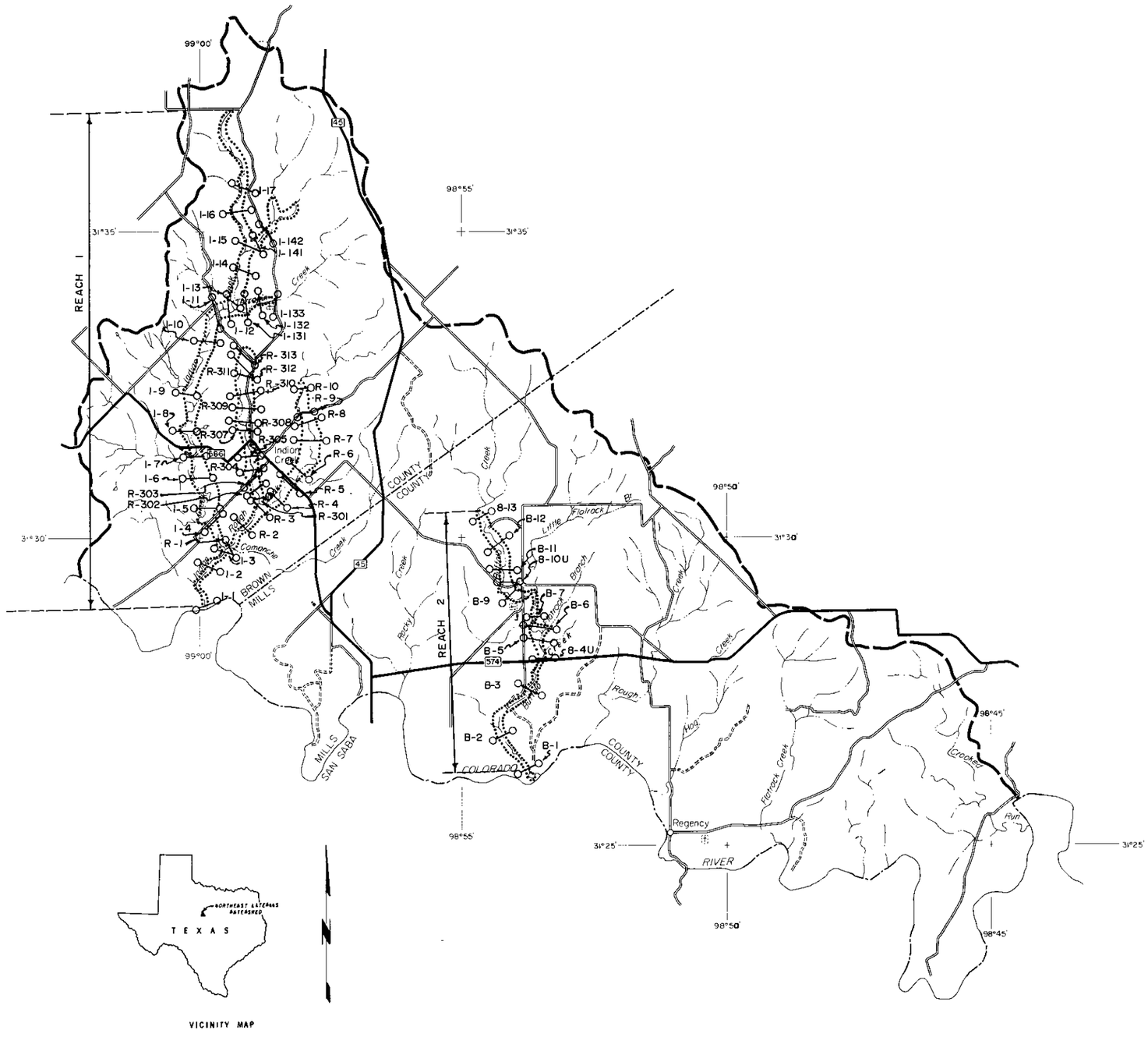
Incidental recreation benefits were evaluated for sediment pools of floodwater retarding structures using a net value of $0.50 per visitor day. Benefits were calculated, allowing for full level of use and attractiveness for 40 years, with a gradual diminishing of attractiveness during the next 10 years to zero at the end of 50 years and thereafter.

Benefits accruing from the use of sediment pools for livestock water were based on studies made on watersheds where structures have been installed for several years.

The value of local secondary benefits induced by, or stemming from, the project were estimated to be equal to 10 percent of the direct primary benefits plus 10 percent of the cost of the additional agricultural production and associated costs incurred as the result of increased production.

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

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



VICINITY MAP

LEGEND

- Paved Road
- Dirt Road
- Private Road
- County Line
- Drainage
- Town or Community
- Watershed Boundary
- Benefited Area
- R-4 Valley Cross Section
- Evaluation Reach

Figure 1

PROBLEM LOCATION MAP

NORTHEAST LATERALS WATERSHED

BROWN AND MILLS COUNTIES

TEXAS

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

0 1 2 4 Miles
APPROXIMATE SCALE

Base compiled from USGS Quads and County Highway Maps

USDA SCS FORT WORTH TEX. 1967

I-67 4-R-23469

Rev. 7-66 May 1966 4-R-21652

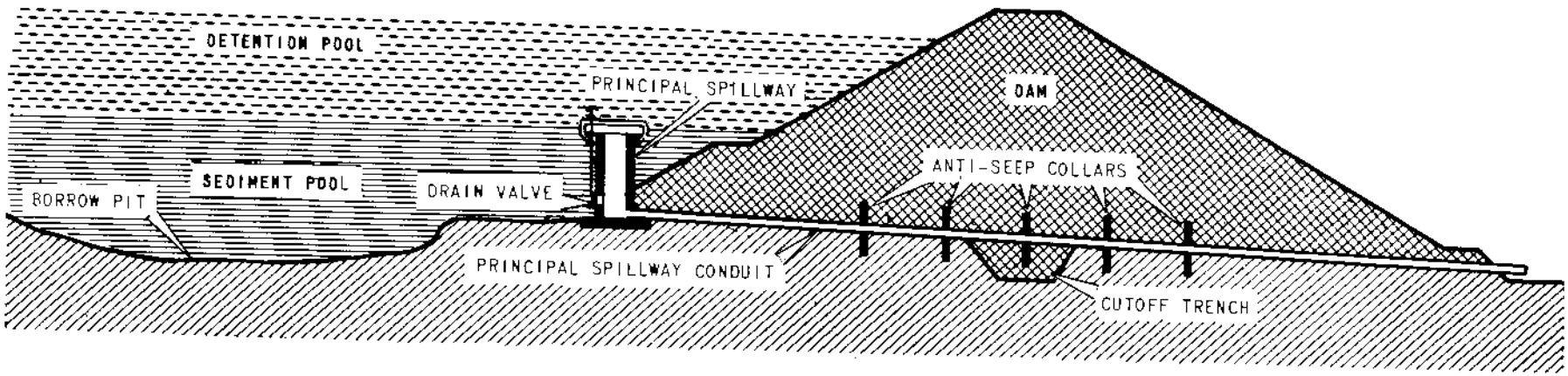


Figure 2

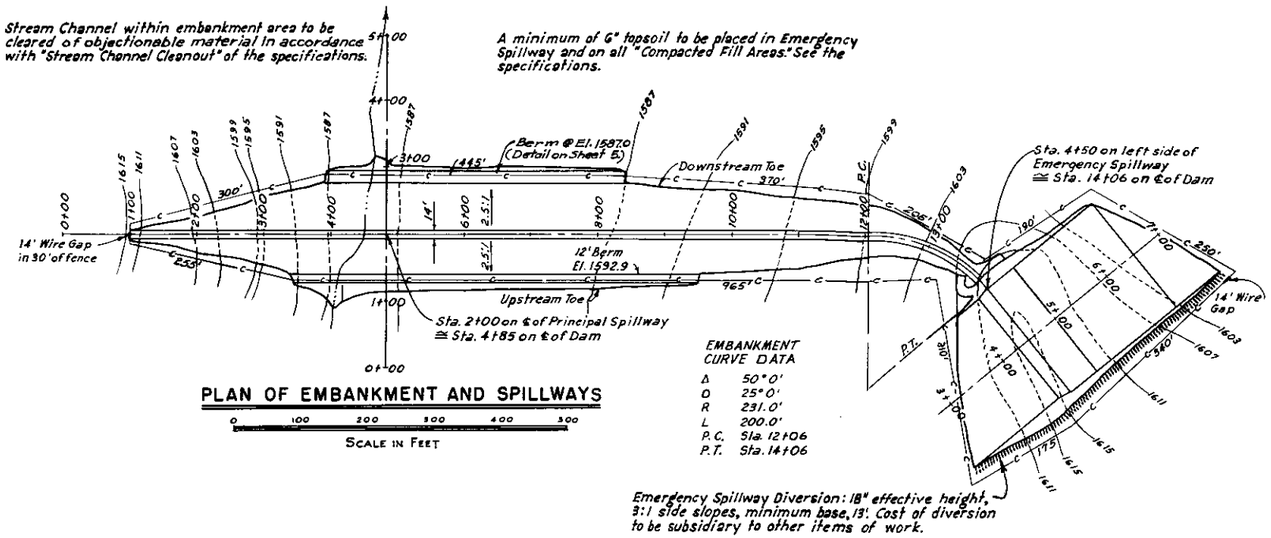
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Revised 10-66 4-L-10,071-A

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

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



PLAN OF EMBANKMENT AND SPILLWAYS

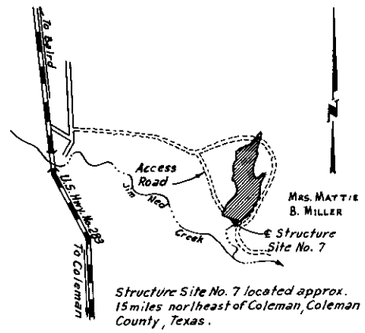
0 100 200 300 400 500

SCALE IN FEET

EMBANKMENT CURVE DATA

Δ	50°0'
D	25°0'
R	231.0'
L	200.0'
P.C.	Sta. 12+06
P.T.	Sta. 14+06

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

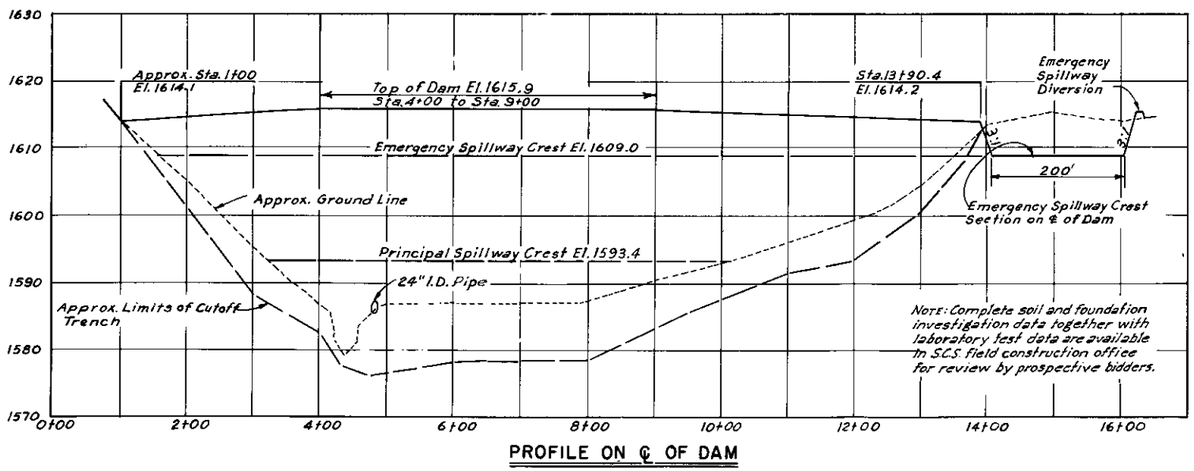


Structure Site No. 7 located approx. 15 miles northeast of Coleman, Coleman County, Texas.

VICINITY MAP

0 1 2 3 4

SCALE IN MILES

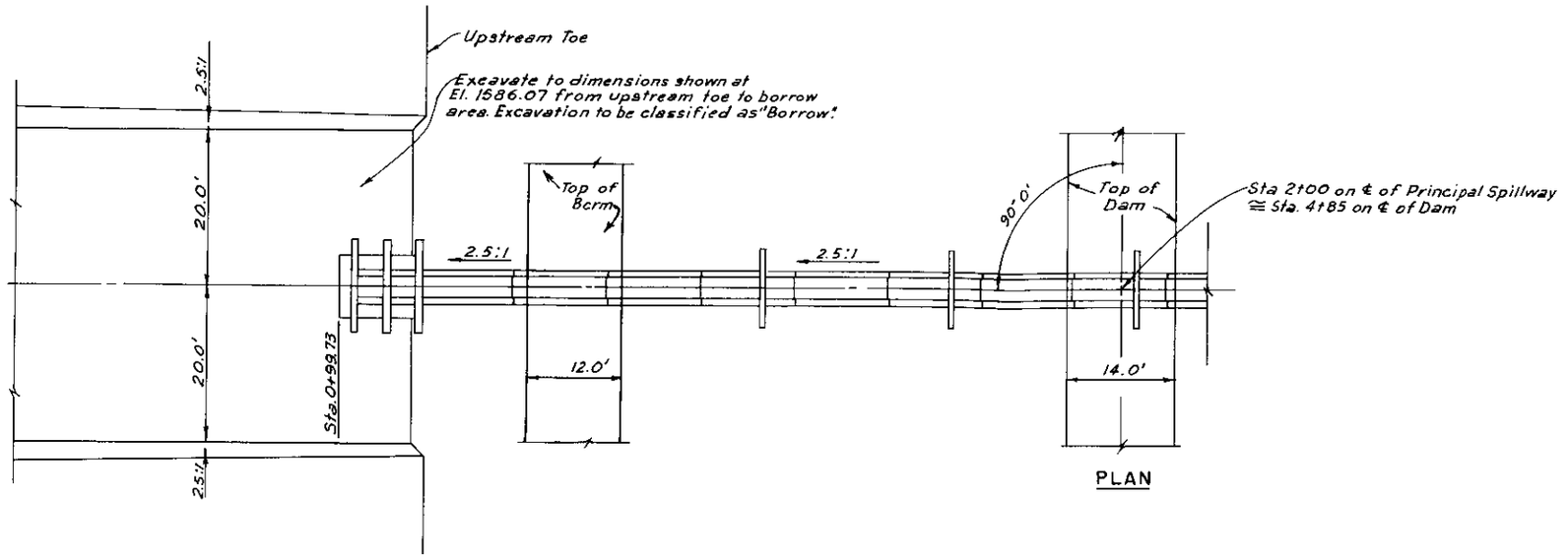


PROFILE ON ℄ OF DAM

Figure 3
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Data	
Designed	M.O.K.	3-61	Approved by ... HEAD ENGINEERING & WATERSHED PLANNING UNIT FORT WORTH, TEXAS
Drawn	M.O.K. & M.G.C.	3-61	STATE CONSERVATIONIST TEMPLE, TEXAS
Traced	M.G.C.	3-61	Sheet No. 2 of 10 — Drawing No. 4-E-15,400
Checked	M.D.K. & G.W.T.	4-61	



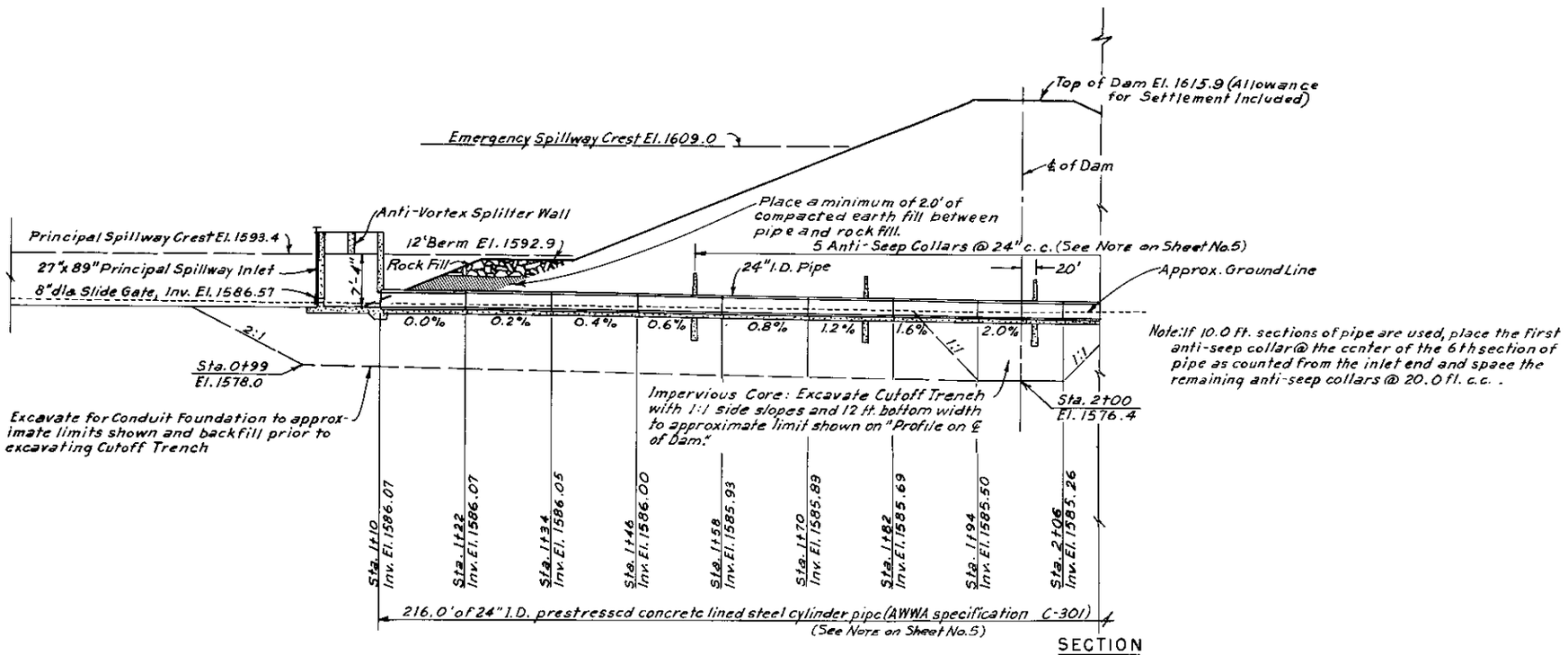
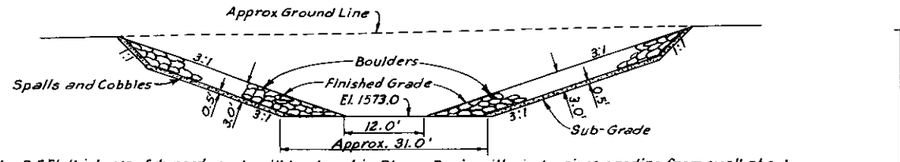


Figure 14

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

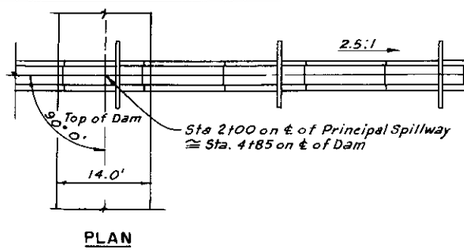
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed M.D.K.	3-61	Approved by	
Drawn M.D.K. & M.G.C.	3-61		
Traced M.G.C.	3-61		
Checked M.D.K. & G.W.T.	4-61	Sheet No. 4 of 70	Drawing No. 4-E-15,400

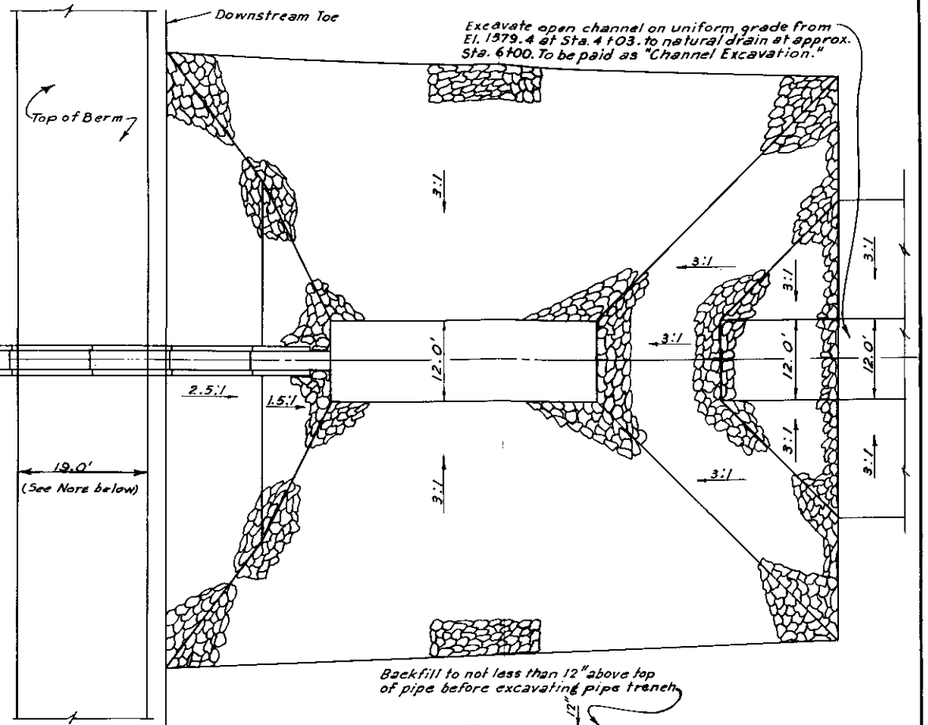


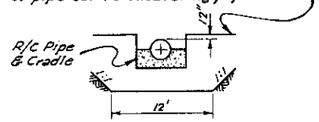
The 2.5 Ft. thickness of dumped rock will be placed in Plunge Basin with rock sizes grading from small at sub-grade to large at finished grade. Placement of spalls and cobbles will precede dumping and placement of boulders. Boulders will be placed to reasonable neat lines of the finished grades, as shown on drawings. Cost of excavating and preparing Plunge Basin for placement of rock will be paid as "Channel Excavation". Rock against Principal Spillway will be hand placed to avoid damage to pipe or other structural works. Any damage to pipe or other structural works caused by the Contractor during construction of the Plunge Basin shall be repaired by the Contractor without compensation. Source of rock will be from the Emergency Spillway Excavation. Rock shall be quarry-run size. Placement of the rock in the Plunge Basin is not a direct pay item; such cost is to be considered subsidiary to other items of work. Approximately 560 cu.yd. of rock will be required to construct the Plunge Basin.

TYPICAL SECTION – PLUNGE BASIN



PLAN





Excavation to be paid as "Cutoff Trench Excavation." Backfill prior to excavating pipe trench to be paid as "Compacted Fill"

TYPICAL FOUNDATION EXCAVATION

Impervious Core: Excavate Cutoff Trench with 1:1 side slopes and 12 ft. bottom width to approximate limit shown on "Profile on ℄ of Dam."

Excavate for Conduit Foundation to approximate limits shown and backfill prior to excavating Cutoff Trench

Note: If 10.0 ft. sections of pipe are used, place the first anti-seep collar at the center of the 6th section of pipe as counted from the inlet end and space the remaining anti-seep collars @ 20.0 ft. c.c.

Plunge Basin shall bottom on rock at approx. El. 1573.0 Excavate for plunge so that overall length, width and finished slopes will be as shown on the drawing.

Note; Add 4 ft. to all Station points shown for plunge basin if 10.0 ft. sections of pipe are used.

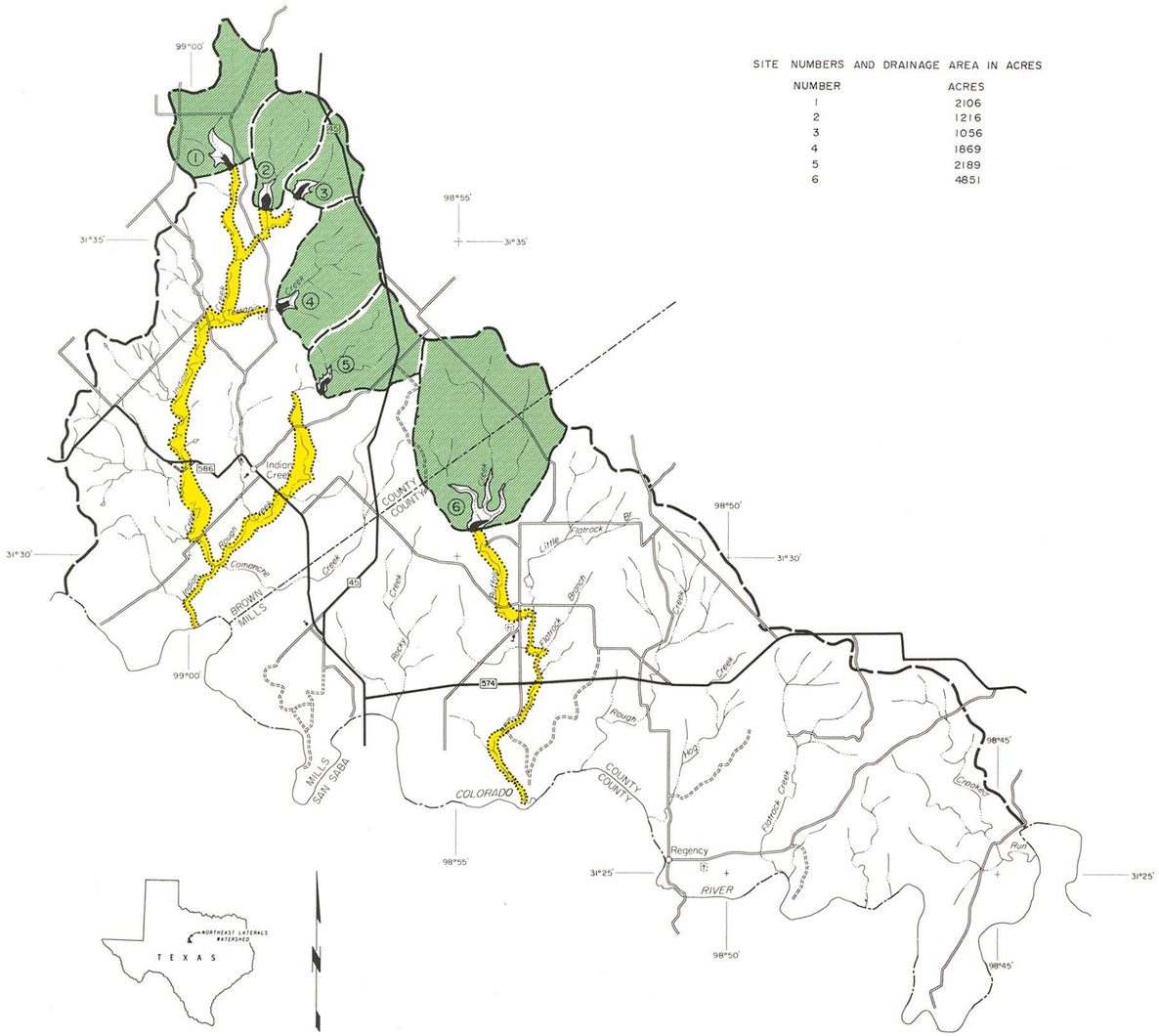
SECTION
PRINCIPAL SPILLWAY

Note: The detail above is planned for 12.0 ft. sections of pipe. Section lengths of 10.0 ft. may be used with invert of joints set on grade line as established above, utilizing 220.0 ft. of pipe, ending at station 3+30. Section lengths in excess of 12.0 ft. will not be permited.

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed M.D.K.	3-61	Approved by:	
Drawn M.D.K. & M.G.C.	3-61		
Traced M.G.C.	3-61	Temple, Texas	Drawing No.
Checked M.D.K. & G.W.T.	4-61	No. 5 of 10	4-E-15,400



SITE NUMBERS AND DRAINAGE AREA IN ACRES

NUMBER	ACRES
1	2106
2	1216
3	1056
4	1869
5	2189
6	4851

LEGEND

- Paved Road
- Dirt Road
- Private Road
- County Line
- Drainage
- Town or Community
- Watershed Boundary
- Floodwater Retarding Structure (Existing)
- ③ Structure Site Number
- Drainage Area Controlled By Structure
- Benefited Area

VICINITY MAP

FIGURE 4

PROJECT MAP

NORTHEAST LATERALS WATERSHED

BROWN AND MILLS COUNTIES
TEXAS

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

0 1 2 3 Miles
APPROXIMATE SCALE
1:145,000

Base compiled from USGS Quads and County Highway Maps

USDA-SCS-FORT WORTH, TEX. 1971

Rev. 12-71 4-R-23470

Rev. 7-66 May 1966 4-R-21652