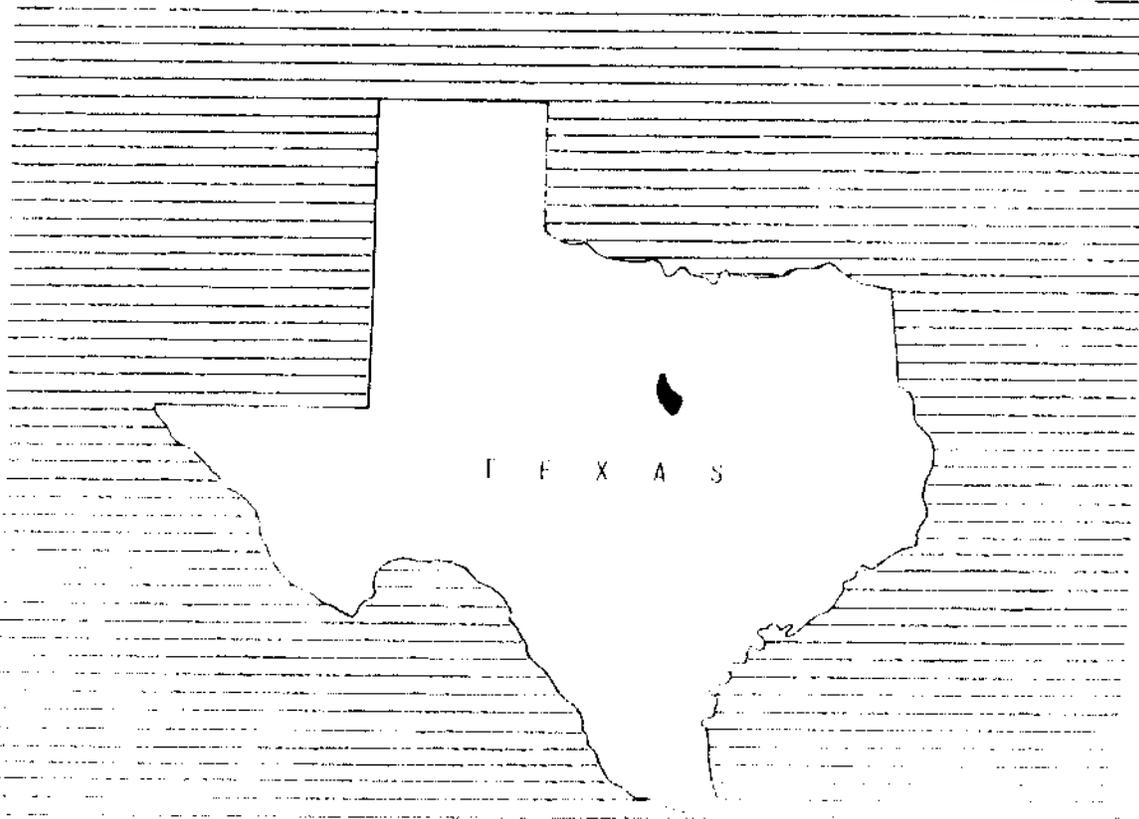


SUPPLEMENTAL WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

NORTHEAST TRIBUTARIES OF
THE LEON RIVER WATERSHED

Cow-Armstrong, Resley and Walnut Creeks
Comanche, Erath, and Eastland Counties, Texas



JULY 1967

TABLE OF CONTENTS

	<u>Page</u>
PURPOSE OF THE SUPPLEMENTAL WORK PLAN	1
SUMMARY OF PLAN	1
DESCRIPTION OF THE WATERSHED	3
WATERSHED PROBLEMS	3
Floodwater Damages	3
Sediment Damage	4
Erosion Damage	4
Problems Relating to Water Management	5
EXISTING OR PROPOSED WORKS OF IMPROVEMENT	5
WORKS OF IMPROVEMENT TO BE INSTALLED	5
Land Treatment Measures for Watershed Protection	5
Structural Measures	6
BENEFITS FROM WORKS OF IMPROVEMENT	6
Tables of Damage Reduction	7-8
COMPARISON OF BENEFITS AND COSTS	10
ACCOMPLISHING THE PLAN	11
Land Treatment Measures	11
Structural Measures for Flood Prevention	11
PROVISIONS FOR OPERATION AND MAINTENANCE	12
Land Treatment Measures	12
Structural Measures for Flood Prevention	13
COST-SHARING	13
CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS	13
TABLES	
Revised Table 1 - Estimated Project Installation Cost	14
Revised Table 2 - Estimated Structure Cost Distribution	15
Revised Table 3 - Structure Data - Floodwater Retarding Structures	16
Revised Table 4 - Summary of Physical Data	18
Revised Table 5 - Summary of Plan Data	19
Revised Table 6 - Annual Cost	20
Revised Table 7 - Monetary Benefits from Structural Measures	21
Table 7D - Monetary Benefits from Structural Measures - Walnut Creek	22
Revised Table 8 - Benefit-Cost Analysis	23
SECTION 2 - REVISED STATISTICAL SUMMARY, INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES	
STATISTICAL SUMMARY	24
The Watershed	24
Land Use Changes	24
Structural Measures	24
Cost of Project	25
Damages and Benefits	25
INVESTIGATIONS AND ANALYSES	25
Project Formulation	25
Hydrologic Investigations	26
Sedimentation Investigations	27
Geologic Investigations	28
Economic Investigations	28
FIGURES	
Figure 1 - Section of a Typical Floodwater Retarding Structure	
Figure 2 - Project Map	
Figure 3 - Location of Problem Areas and Structure Site Investigation	
Figure 4 - Typical Floodwater Retarding Structure - General Plan and Profile	
Figure 4A - Typical Floodwater Retarding Structure - Plan and Section	

REVISED TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Northeast Tributaries of Leon River Watershed, Texas

Item	Unit	STRUCTURE NO. 25	Total
Drainage Area	Sq. Mi.	3.09	104.54
Storage Capacity			
Sediment Pool (200 acre-feet or less)	Ac. Ft.	99	2,977
Sediment Reserve (Below riser)	Ac. Ft.	0	711
Sediment in Detention Pool	Ac. Ft.	16	582
Floodwater Pool	Ac. Ft.	785	28,324
Total	Ac. Ft.	900	32,594
Surface Area			
Sediment Pool <u>1/</u>	Acre	20	709
Floodwater Pool	Acre	85	2,837
Volume of Fill	Cu. Yd.	116,500	3,532,700
Elevation Top of Dam <u>5/</u>	Foot	1364.9	xxx
Maximum Height of Dam <u>2/</u>	Foot	39	xxx
Emergency Spillway			
Crest Elevation	Foot	1359.1	xxx
Bottom Width	Foot	200	xxx
Type	Veg.		xxx
Percent Chance of Use		2	xxx
Average Curve No. - Condition II		79	xxx
Emergency Spillway Hydrograph			
Storm Rainfall (6-hour) <u>3/</u>	Inch	9.50	xxx
Storm Runoff	Inch	6.90	xxx
Velocity of Flow (VC) <u>4/</u>	Ft./Sec.	5.6	xxx
Discharge Rate <u>5/</u>	C.F.S.	1,090	xxx
Maximum Water Surface Elevation <u>5/</u>	Foot	1361.0	xxx
Freeboard Hydrograph			
Storm Rainfall (6-hour) <u>3/</u>	Inch	20.70	xxx
Storm Runoff	Inch	17.80	xxx
Velocity of Flow (VC) <u>4/</u>	Ft./Sec.	10.8	xxx
Discharge Rate <u>5/</u>	C.F.S.	7,655	xxx
Maximum Water Surface Elevation <u>5/</u>	Foot	1364.9	xxx
Principal Spillway			
Capacity (Maximum)	C.F.S.	62	xxx
Capacity Equivalents			
Sediment Volume	Inch	0.60	xxx
Sediment Reserve Volume (Below riser)	Inch	0	xxx
Sediment in Detention Pool	Inch	0.10	xxx
Detention Volume	Inch	4.76	xxx
Spillway Storage	Inch	3.64	xxx
Class of Structure		B	xxx

Revised August 1968

SUPPLEMENTAL WATERSHED WORK PLAN AGREEMENT

between the

Upper Leon Soil and Water Conservation District
(Formerly Upper Leon Soil Conservation District)
(Local Organization)

Palo Pinto Soil and Water Conservation District
(Formerly Palo Pinto Soil Conservation District)
(Local Organization)

Erath County Commissioners Court
(Local Organization)

Comanche County Commissioners Court
(Local Organization)

. In the State of Texas

(Hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, the Watershed Work Plan Agreement for the Northeast Tributaries of the Leon River Watershed, State of Texas, executed by the Sponsoring Local Organizations named therein and the Service, became effective on the 8th day of June 1962; and

Whereas, it has been found necessary to modify the Watershed Work Plan to increase the scope of the project by providing flood protection to the flood plain of Walnut Creek; and

Whereas, a Supplemental Watershed Work Plan, which modifies the Watershed Work Plan dated March 1961 for said Watershed, has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service, which plan is annexed to and made a part of this agreement;

Now, therefore, the Sponsoring Local Organization and the Service hereby agree upon the following modification of the terms, conditions, and stipulations of said Watershed Bank Plan Agreement:

1. Paragraph numbered 1 is modified to read as follows:

The Sponsoring Local Organization will acquire without cost to the Federal Government all land, easements, or rights-of-way needed for installation of structural works of improvement. (Estimated cost \$228,672.) The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Land, Easements, and Rights-of-Way Costs</u> (dollars)
26 Floodwater Retarding Structures	100	0	228,672

2. Paragraph numbered 3 is modified to read as follows:

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

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Costs</u> (dollars)
26 Floodwater Retarding Structures	0	100	1,757,473

3. Paragraph numbered 4 is modified to read as follows:

The Service will provide the necessary engineering forces for installation services. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Installation Service Cost</u> (dollars)
26 Floodwater Retarding Structures	0	100	534,974

4. Paragraph numbered 5 is modified to read as follows:

The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost \$13,000.)

5. 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 participating in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.
6. The Sponsoring Local Organization and the Service further agree to all other terms, conditions, and stipulations of said Watershed Work Plan Agreement not modified herein.

Upper Leon Soil and Water Conservation District
(Local Organization)

By Ray Beatty

Title Vice Chairman

Date April 5, 1968

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

adopted at a meeting held on April 5, 1968

Gene Silbaugh
(Secretary, Local Organization)

Date April 5, 1968

Comanche County Commissioners Court
(Local Organization)

By *W. H. Lawrence*

Title *County Judge*

Date *4-8-68*

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

meeting held on *4-8-68*

Fred Hall
(Secretary, Local Organization)

Date *4-8-68*

Soil Conservation Service
United States Department of Agriculture

By *A. N. Smith*

Date *5/29/68*

SUPPLEMENTAL
WORK PLAN
FOR
WATERSHED PROTECTION AND FLOOD PREVENTION

NORTHEAST TRIBUTARIES OF THE LEON RIVER WATERSHED
Cow-Armstrong, Resley, and Walnut Creeks
Comanche, Erath, and Eastland Counties, Texas

Prepared Under the Authority of the Watershed
Protection and Flood Prevention Act, (Public
Law 566, 83rd Congress; 68 Stat. 666), as
amended.

Prepared By:

Upper Leon Soil and Water Conservation District

Palo Pinto Soil and Water Conservation District

Erath-County Commissioners Court

Comanche County Commissioners Court

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service

July 1967

SUPPLEMENTAL WATERSHED WORK PLAN

NORTHEAST TRIBUTARIES OF THE LEON RIVER WATERSHED
Comanche, Erath, and Eastland Counties, Texas
July 1967

PURPOSE OF THE SUPPLEMENTAL WORK PLAN

The work plan for the Northeast Tributaries of the Leon River watershed was approved for operations June 8, 1962. Construction has been completed or is under way on the 24 floodwater retarding structures planned for this project.

During the development of the work plan, only limited information was available concerning flood damages on the flood plain of Walnut Creek and there was a question of justification of flood prevention measures for this portion of the flood plain. On September 20-21, 1964, heavy rains fell on the watershed of Walnut Creek, resulting in significant flood damages to the flood plain.

This supplement to the work plan provides for the installation of 2 additional floodwater retarding structures to provide needed flood protection to the flood plain of Walnut Creek.

The following are changes and modifications that are to be made in appropriate parts of the work plan.

SUMMARY OF PLAN

The summary of the plan is modified to read:

"The work plan for watershed protection and flood prevention for the Northeast Tributaries of the Leon River watershed, Texas, was prepared by the Upper Leon and Palo Pinto Soil and Water Conservation Districts, Erath County Commissioners Court and the Comanche County Commissioners Court as the local sponsoring organizations. Technical assistance was provided by the Soil Conservation Service of the United States Department of Agriculture.

"The watershed covers an area of 317 square miles (202,880 acres) in Comanche, Erath, and Eastland Counties, Texas.

"The only Federal lands in the watershed are located in the Proctor Reservoir.

"The supplemental work plan proposes installing, during a 1-year installation period, 2 additional floodwater retarding structures for the protection and development of the Walnut Creek portion of the watershed at an installation cost of \$141,432. The share of

the additional cost to be borne by Public Law 566 funds will be \$128,207. The remaining \$13,225 will be borne by local and other funds. The total estimated installation cost of the entire project is estimated to be \$2,997,635. The cost is divided as follows: land treatment, \$463,516; structural measures, \$2,534,119. The share of the project cost to be borne by Public Law 566 funds will be \$2,324,289. The remaining \$673,346 will be borne by local and other funds.

"During the 22-year evaluation period (1936 through 1957), there were 12 major floods which inundated more than half of the flood plain. A total of 65 floods occurred in the 22 years, an average of 3 floods per year.

"This project will reduce average annual damages in Northeast Tributaries of the Leon River watershed by 74 percent. With this project installed, damages from 12 of the 65 evaluation period floods would have been eliminated. Approximately 79 percent of the flood plain area below floodwater retarding structures will flood less often than once in three years on the average and most of the major floods will be reduced to minor floods.

"Benefits from reduction in sediment delivered to the Proctor Reservoir by the structural measures planned in this watershed are estimated to average \$861 annually.

"The economy of the watershed is largely agricultural. Installation of the project will promote agricultural progress in the area and will improve the prosperity of towns such as Dublin, which is primarily dependent upon agriculture. In addition, the scenic and recreational resources of this region will be substantially enhanced. The watershed protection provided by this project will provide the basis whereby the natural resources of this watershed can be developed to their full potential.

"The estimated average annual damages within the watershed, including an allowance for restoration of former productivity, will be reduced from \$145,651 to \$37,911.

"The ratio of average annual benefits from planned structural measures for flood prevention (\$108,657) to the average annual equivalent cost (\$96,221) is 1.13 to 1.0.

"The Erath and Comanche Counties Commissioners Courts are legal subdivisions of the State of Texas with the powers of taxation and eminent domain. They will contract for the construction of all the structural measures and will be responsible for the operation and maintenance of the 26 floodwater retarding structures. The estimated annual operation and maintenance cost is \$3,987. The Erath and Comanche Counties Commissioners Courts will raise

the local share of the project costs. The 2 additional floodwater retarding structures will be installed during a 1-year period.

"The Federal share of installation of structural measures will be \$2,292,447. Local cost of easements, rights-of-way, and administration of contracts will be \$241,672, of which about \$50,000 is anticipated to be out-of-pocket costs to the local organization. The sponsors do not plan to apply for an FHA loan.

"A statistical summary can be found at the beginning of Section 2."

DESCRIPTION OF THE WATERSHED

No change.

WATERSHED PROBLEMS

Floodwater Damages

Modify the first paragraph to read:

"Floods that have occurred since the development of the work plan indicated that damages to the flood plain of Walnut Creek are much more serious than were originally estimated. A re-evaluation of the damages occurring in this portion of the flood plain indicated that installation of flood prevention measures would be economically feasible; hence all references to damages and benefits in this supplemental work plan will include those found on Walnut Creek."

Modify the third paragraph to read:

"During the 22-year period (1936-1957), 12 major floods inundated more than half of the flood plain in the Northeast Tributaries of the Leon River watershed (revised figure 3). An additional 53 minor floods inundated less than half of the flood plain. Ten of the major floods and 43 of the minor floods occurred during the growing season, causing heavy damage to growing crops. Less damaging floods occur during the winter months. The adverse economic and physical effect of these floods has been felt throughout the entire watershed community and has prompted local participation in the alleviation of the flood problem. For the floods experienced during the period studied, the total direct agricultural and nonagricultural floodwater damages under present conditions are estimated to average \$104,736 annually (revised table 7), of which \$68,033 is crop and pasture damage, \$21,258 is other agricultural damage, and \$15,445 is nonagricultural damage such as damage to urban property, roads, bridges, and railroads. Indirect damages such as interruption of travel, re-routing of school bus and mail routes, losses sustained by businessmen in the area, and similar losses are estimated to average \$13,970 annually."

Sediment Damage

Modify the narrative on sediment damage to read:

"Damage by overbank deposition is moderate in the watershed. Erosion in the upland areas has resulted in deposition of fine textured silty clays and clays, and fine and coarse textured sands, sandy silts, silty sands and sandy clays on flood plain land. This damaging sediment is low in organic matter, crusts and puddles readily, and is generally low in productivity. The productive capacity has been reduced from 10 to 40 percent on an estimated 4,392 acres of flood plain by this process. The areas affected by overbank deposition are as follows:

Acres Damaged (Figure 3)					
Evaluation	: 10	: 20	: 30	: 40	:
Reach	: Percent	: Percent	: Percent	: Percent	: Total
B	24	74	94	28	220
C	68	28	12	6	114
D	66	94	70	0	230
E	266	396	408	0	1,070
F	79	209	189	0	477
G	26	179	73	0	278
H	14	111	101	0	226
I	186	386	274	0	846
J	72	136	89	0	297
K	53	190	104	0	347
L	0	88	33	0	121
M-1	24	6	4	0	34
M-2	72	32	28	0	132
Total	950	1,929	1,479	34	4,392

"The estimated average annual monetary damage by overbank deposition is \$23,306 (revised table 7)."

Erosion Damage

The second and third paragraphs are modified to read:

"Flood plain erosion ranges from low to high in the watershed. It is estimated that 317 acres are presently being damaged annually by this process, with a resultant loss in productive capacity of 10 to 80 percent. It is not expected that there will be any significant increase in the acreage damaged in the future. However, the degree of damage is expected to increase for an estimated period of 10-15 years before a state of equilibrium is reached. During this period

it is estimated that damage on 60 acres of cropland will increase to a point that crop production will no longer be possible. The following tabulation shows flood plain erosion damage by evaluation reaches:

Acres Damaged (Figure 3)						
Evaluation:	10	20	30	40	80	
Reach	Percent	Percent	Percent	Percent	Percent	Total
B	6	5	0	0	0	11
C	3	0	0	0	0	3
D	10	3	0	3	0	16
E	41	10	14	0	0	65
F	5	13	3	0	0	21
G	9	0	0	6	0	15
H	3	0	1	1	0	5
I	29	8	0	15	0	52
J	12	4	2	0	0	18
K	0	6	1	0	0	7
L	0	0	0	0	0	0
M-1	28	17	0	23	14	82
M-2	14	5	0	3	0	22
Total	160	71	21	51	14	317

"The estimated average annual monetary damage by flood plain scour is \$3,639 (revised table 7).

Problems Relating to Water Management

No change.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

Modify the second paragraph to read:

"Proctor Dam, a Corps of Engineers multiple-purpose structure, has been built on the Leon River at Proctor. The flood control pool of this reservoir will inundate the lower portion of the Cow and Armstrong Creek flood plain (revised figure 2)."

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures for Watershed Protection

Modify the second paragraph to read:

"Approximately 66,907 acres of the total watershed area of 202,880 acres lie above the planned floodwater retarding structures. Land

treatment is especially important for protection of these watershed lands to support and supplement the structural measures. Land treatment constitutes the only planned measures on the remaining upland area. Land treatment measures on the 8,455 acres of flood plain lands not within the pools of proposed structures are also important in reducing floodwater and erosion damages."

Structural Measures

The first and second paragraphs are modified to read:

"A system of 26 floodwater retarding structures will be installed to provide needed protection for flood plain land that cannot be attained by the land treatment measures described above. Of these 26 structures, 9 are located in Armstrong Creek, 3 are in Cow Creek, 12 are in Resley Creek, and 2 are located in Walnut Creek.

"This system of structures will temporarily detain runoff from 53.6 percent of Armstrong Creek, 43.4 percent of Cow Creek, 51.1 percent of Resley Creek, 19.4 percent of Walnut Creek, and 33.0 percent of the entire watershed. The 26 structures will have floodwater detention capacity to detain an average of 5.12 inches of runoff for Armstrong Creek, 5.02 inches for Cow Creek, 5.10 inches for Resley Creek, and 4.65 inches for Walnut Creek above structures. This is the equivalent of 2.74 inches of runoff from the entire 55,232 acres of Armstrong Creek, 2.17 inches of runoff from the 15,232 acres of Cow Creek, 2.60 inches of runoff from the 54,720 acres of Resley Creek, and .90 inches of runoff from the 14,214 acres of Walnut Creek."

The fourth paragraph is modified to read:

"The total estimated cost of installing the structural works of improvement is \$2,534,119. The estimated annual equivalent cost of installation, \$92,234, with an estimated annual operation and maintenance value of \$3,987, makes a total annual cost of \$96,221."

BENEFITS FROM WORKS OF IMPROVEMENT

The first, second, third, and fourth paragraphs are modified to read:

"With the installation of the land treatment and structural measures described in this work plan, damages from 12 of the 65 evaluation period floods would have been eliminated. Most of the 12 major floods would have been reduced to minor floods and approximately 79 percent of the flood plain area below floodwater retarding structures would have flooded less often than once in 3 years on the average.

"The location of the areas to which the benefits from the combined program of land treatment and structural measures will accrue is presented in the following tables:

Reach	Average Annual Acres Flooded		Damage Reduction	
	Without Project (acres)	With Project (acres)	Reduction in Acres Flooded (percent)	Damage Reduction ^{2/} (percent)
Resley Creek				
A ^{1/}	-	-	-	60
B	312	172	45	59
C	267	108	60	77
D	396	140	65	78
E	1,779	727	59	74
Total	2,754	1,147	58	73
Cow Creek				
F	359	104	71	83
Total	359	104	71	83
Armstrong Creek				
G	292	83	72	73
H	207	42	80	90
I	709	199	72	76
J	254	39	85	89
K	962	597	38	52
L	311	213	32	46
Total	2,735	1,173	57	73
Walnut Creek				
M-1	139	28	80	85
M-2	141	101	28	49
Total	280	129	54	77
GRAND TOTAL	6,128	2,553	58	74

^{1/} Urban reach - City of Dublin. The 40 percent remaining damages result from inadequate drainage facilities for runoff originating within the city of Dublin.

^{2/} By land treatment and floodwater retarding structures.

Acres Flooded and Floodwater Damage for 3-Year and 25-Year Frequency Floods

4-15560

Reach	3-Year Frequency Flood				25-Year Frequency Flood			
	Without Project	With Project	Without Project	With Project	Without Project	With Project	Without Project	With Project
	Acres : Dollars	Acres : Dollars	Percent : Reduction	Percent : Reduction	Acres : Dollars	Acres : Dollars	Percent : Reduction	Percent : Reduction
	Flooded : Damage	Flooded : Damage	Flooded : Reduction	Flooded : Reduction	Flooded : Damage	Flooded : Damage	Flooded : Reduction	Flooded : Reduction
Resley Creek								
A	0	0	0	0	17,700	-	-	7,080
B	241	2,985	139	42.3	1,420	391	333	14.8
C	177	3,015	87	50.8	1,030	423	283	33.1
D	380	5,465	545	86.8	545	619	470	24.1
E	1,625	24,150	498	69.4	5,300	2,566	1,972	23.1
Total	2,423	35,615	774	68.1	8,295	3,999	3,058	23.5
Cow Creek								
F	343	3,655	64	81.3	620	740	452	38.9
Total	343	3,655	64	81.3	620	740	452	38.9
Armstrong Creek								
G	225	2,580	54	76.0	450	457	294	35.7
H	200	1,397	19	90.5	85	367	207	43.6
I	510	8,540	145	71.6	1,855	1,249	723	42.1
J	260	2,597	0	100.0	0	570	273	52.1
K	514	5,930	448	12.8	3,885	599	540	9.8
L	156	1,569	149	4.5	1,290	166	159	4.2
Total	1,865	22,713	815	56.3	7,565	3,408	2,196	35.6
Mainut Creek								
M-1	107	1,077	11	89.7	138	260	150	40.0
M-2	150	790	104	30.7	499	329	286	11.7
Total	257	1,867	115	55.3	637	589	436	24.0
GRAND TOTAL	4,888	63,850	1,768	63.8	17,117	8,736	244,591	6,142
								29.6
								100,345
								59.8
								31.0
								49.8

1/ Spring flood. Floodwater damage only.

2/ Urban reach - city of Dublin. The \$7,080 remaining damages result from inadequate drainage facilities for runoff originating within the city of Dublin.

"After protection from flooding is provided and adequate soil improving crop rotations have been put into effect, 4,258 acres of the 4,392 acres damaged by overbank deposition and 266 acres of the 317 acres damaged by flood plain scour can be fully productive again under flood-free conditions. Sixty acres of cropland, destined to revert to poor quality pastureland as the result of severe scouring under nonproject conditions, will be kept productive and capable of meeting the needs of future generations. The remaining acres damaged are not fully recoverable. A monetary reduction of 53.6 percent in sediment damages will occur after the installation of the complete project, with 22.0 percent resulting from land treatment measures and the remaining 31.6 percent from structural measures. A monetary reduction of 80.2 percent in scour damage will occur after the installation of the project, with 10.0 percent due to land treatment and the remaining 70.2 percent attributable to structural measures (revised table 5). The installation of the planned land treatment program can be expected to reduce the total annual upland gross erosion in the watershed from 791 acre-feet to 483 acre-feet, a reduction of 39 percent.

"The estimated average annual floodwater, sediment, erosion, and indirect damages (revised table 7) within the watershed, including an allowance for restoration of former productivity, will be reduced from \$145,651 to \$37,911, a reduction of 74.0 percent. Approximately 90 percent, \$97,104, of the expected reduction in the average annual damage will result from the system of floodwater retarding structures."

The sixth, seventh, and eighth paragraphs are modified to read:

"Owners and operators of flood plain lands say that if adequate flood protection is provided, they will restore some land now in pasture or meadow to production of cotton, corn, and grain sorghum. All of this land was in cultivation at one time, but is now chiefly used for hay or pasture because of the frequency of flooding. None of the benefits claimed come from an increase in the acreage of allotment crops in the watershed; however, it is expected that 176 acres of cotton will be shifted from the upland to more productive flood plain land as a result of the project. The upland cotton will be replaced by better adapted upland crops. It is estimated that net income from such restoration of land to former productivity will amount to \$27,130 (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 revised table 7.

"A smaller acreage, now largely in woods, will be cleared and used for improved pasture and crops. The average annual benefit from

this change in land use, after deduction of associated costs, and discounting for time needed for development, is estimated to be \$8,494.

"The total flood prevention benefits as a result of structural measures are estimated to average \$108,657 annually."

The tenth paragraph is modified to read:

"The project will increase the level of economic activity in the watershed and in neighboring communities by providing greater purchasing power and an increased flow of agricultural products for processing, transportation, and consumption. Restoration of former productivity and changed land use as a result of project installation will pump an additional annual net income to the farmers in excess of \$27,000. In addition, the increased farm production will provide an additional outlet for labor and for sale of products used in farm production. The protection afforded by the project should bring land values to a figure that more nearly approaches the potential worth of the land. Sediment pools of floodwater retarding structures are expected to be used heavily by the general public and by organized groups such as Boy Scouts, Girl Scouts, and church youth groups for camping, fishing, and picnicking. Some use will also be made of these facilities for dove and duck hunting. These pools are expected to provide 1,920 visitor-days of recreation annually with peak usage during summer holidays and weekends. Incidental recreation benefits from this usage are estimated to have a net value of \$1,255 annually from structures 25 and 26 only. Benefits were based on a gross value of \$1 per visitor-day less associated costs. No estimate was made for those structures either completed or under construction. Secondary benefits from structures 25 and 26 are estimated to amount to \$943 annually. In addition, there are other unevaluated benefits, such as a greater sense of security, diminished hazards to life, and the opportunity to plan farm operations without serious risk of flooding, that will follow installation of the proposed measures."

COMPARISON OF BENEFITS AND COSTS

The narrative is modified to read:

"The total average annual cost of structural measures (amortized total installation plus operation and maintenance) is \$96,221. These measures are expected to produce average annual primary benefits of \$107,714. The benefit-cost ratio without secondary benefits is 1.12 to 1.00. The ratio of total average annual project benefits accruing to structural measures, \$108,657, to the average annual cost of structural measures, \$96,221, is 1.13

to 1.00 (revised table 8). The fact that the benefit to cost ratio is less than 1.2 to 1.0 indicates a need for re-examination of damages, benefits, and structure cost estimates. This has been done and indications are that the project can be installed with a favorable benefit-cost ratio."

ACCOMPLISHING THE PLAN

Land Treatment Measures

No change.

Structural Measures for Flood Prevention

The narrative is revised to read:

"All of the 24 floodwater retarding structures proposed in the work plan have been completed or they are under construction at the present time.

"The Erath and Comanche Counties Commissioners Courts have the right of eminent domain and taxing authority under applicable State law and will obtain the necessary land, easements, and rights-of-way, including utility, road, and improvement changes; will provide necessary legal, administrative, and clerical personnel, facilities, supplies, and equipment to advertise, award, and administer contracts, and will determine the legal adequacy of easements, permits, etc., for the construction of the 2 additional floodwater retarding structures included in the supplement.

"Funds for the local share of the project costs, including land, easements, rights-of-way, and administration of contracts, are available in the general funds of the counties and will be supported by tax revenue. It is anticipated that 95 percent of the easements will be donated. The out-of-pocket costs of easements which will not be donated, legal services, and administration of contracts are estimated to be \$1,650. The sponsors do not plan to borrow money from private sources or from the Farmers Home Administration.

"All necessary land, easements, and rights-of-way will be obtained for Sites 25 and 26 before Federal financial assistance will be made available for construction.

"The 2 floodwater retarding structures will be constructed during a 1-year installation period 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, easements, and rights-of-way have been secured or a written statement is furnished by the Erath and Comanche Counties Commissioners Courts that their right of eminent domain will be used, if needed, to secure any remaining easements within the project installation period and that sufficient funds are available for paying for those easements, permits, and rights-of-way.
- "3. Only public road adverse situations caused by installation of the project have been shown on the Project Map (figure 2). Other similar situations may exist on private ownerships the entire length of the stream channels. The sponsoring local organizations have been advised of this condition and an allowance has been made for them in determining the feasibility of the project. Action to be taken for the protection of the sponsors' interest is for the determination of and the responsibility of the co-sponsors.
- "4. The contracting agency is prepared to discharge its responsibilities.
- "5. Project and operation and maintenance agreements have been executed.
- "6. Public Law 566 funds are available.

"Technical assistance will be provided by the Soil Conservation Service to assist in the design, preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificate of completion and related tasks necessary to establish the planned structural measures for flood prevention.

"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

No change.

Structural Measures for Flood Prevention

Modify the first paragraph to read:

"The Erath County Commissioners Court will be responsible for the operation and maintenance of the 21 floodwater retarding structures, Sites 1 through 20 and 25, located in Erath County, and the Comanche County Commissioners Court for the 5 structures, Sites 21 through 24 and 26, located in Comanche County. The estimated average annual operation and maintenance cost of the structural measures is \$3,987, based on long-term prices. This cost will be approximately \$3,221 for the Erath County Commissioners Court and \$766 for the Comanche County Commissioners Court. Funds for this purpose will come from existing county tax revenue which is available and adequate for this purpose in each county. This \$3,987 represents the cost of equipment and material to carry out operation and maintenance of the project. Necessary maintenance will be accomplished by contributed labor and equipment, by force account, by contract, or by a combination of these."

COST-SHARING

The second, third, and fourth paragraphs are modified to read:

"The installation cost of the 26 floodwater retarding structures, \$2,534,119, will be shared \$2,292,447 (construction \$1,757,473, and installation services \$534,974) by Public Law 566 funds; and \$241,672 (easements, \$189,397; changes in utilities, roads, and improvements, \$34,725; legal fees, \$4,550; and administration of contracts, \$13,000) by other than Public Law 566 funds.

"The total cost of structural measures, \$2,534,119, will be shared 90.5 percent, \$2,292,447, by Public Law 566 funds and 9.5 percent, \$241,672, by other than Public Law 566 funds.

"The total project cost of \$2,997,635 will be shared 77.5 percent, \$2,324,289, by Public Law 566 funds and 22.5 percent, \$673,346, by other than Public Law 566 funds. In addition, the cost of operation and maintenance (\$3,987 annually) will be borne by local interests."

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

No change.

REVISED TABLE 1 - ESTIMATED PROJECT INSTALLATION COST ^{1/}
Northeast Tributaries of Leon River Watershed, Texas

Installation Cost Item	:	:	Number :	Estimated Cost (Dollars) ^{2/}		
Unit	:	:	To Be	Public Law	Other	Total
Applied	:	:	566	Funds	Funds	Total
<u>LAND TREATMENT</u>						
SCS Subtotal				31,842	431,674	463,516
TOTAL LAND TREATMENT				31,842	431,674	463,516
<u>STRUCTURAL MEASURES</u>						
Soil Conservation Service						
Floodwater Retarding						
Structures	No.	26		1,757,473	-	1,757,473
SCS Subtotal				1,757,473	-	1,757,473
Subtotal - Construction				1,757,473	-	1,757,473
<u>Installation Services</u>						
Soil Conservation Service						
Engineering Services				338,379	-	338,379
Other				196,595	-	196,595
SCS Subtotal				534,974	-	534,974
Subtotal - Installation Services				534,974	-	534,974
<u>Other Costs</u>						
Land, Easements, and						
Rights-of-Way				-	228,672	228,672
Administration of Contracts				-	13,000	13,000
Subtotal - Other				-	241,672	241,672
TOTAL STRUCTURAL MEASURES				2,292,447	241,672	2,534,119
TOTAL PROJECT				2,324,289	673,346	2,997,635
<u>SUMMARY</u>						
Subtotal SCS				2,324,289	673,346	2,997,635
TOTAL PROJECT				2,324,289	673,346	2,997,635

1/ No Federal lands involved.

2/ Price Base: 1966 for floodwater retarding structures Nos. 25 and 26.
All other structure costs based on actual obligations.

July 1967

REVISED TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION
 Northeast Tributaries of Leon River Watershed, Texas
 (Dollars) 1/

Structure Site Number	Installation Cost - Public Law 566 Funds			Instal. Cost - Other Funds			Total Installation & R/W Cost		
	Construction Engineer's Estimate	Installation Engineer's Other	Public Law 566	Adm. of Contracts	Ease- ments & R/W	Other			
1 thru 24	1,504,520	150,452	321,756	187,512	2,164,240	12,000	216,447	228,447	2,392,687
25	55,381	5,538	9,138	5,342	75,399	500	8,300	8,800	84,199
26	37,802	3,780	7,485	3,741	52,808	500	3,925	4,425	57,233
GRAND TOTAL	1,597,703	159,770	338,379	196,595	2,292,447	13,000	228,672	241,672	2,534,119

1/ Price Base: 1966 costs for floodwater retarding structures 25 and 26. Actual costs obligated for all other structures.

July 1967

* See minor work plan revision
relative to changing width of
the emer. sp. lwy. etc.

16

REVISED TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES

Northeast Tributaries of Leon River Watershed, Texas

Item	Unit	STRUCTURE NUMBER		Total
		25	26	
Drainage Area	Sq. Mi.	3.09	1.21	104.54
Storage Capacity				
Sediment Pool (200 acre-feet or less)	Ac. Ft.	99	45	2,977
Sediment Reserve (Below riser)	Ac. Ft.	0	0	711
Sediment in Detention Pool	Ac. Ft.	16	8	582
Floodwater Pool	Ac. Ft.	785	281	28,324
Total	Ac. Ft.	900	334	32,594
Surface Area				
Sediment Pool <u>1/</u>	Acre	20	12	709
Floodwater Pool	Acre	85	40	2,837
Volume of Fill	Cu. Yd.	114,400	97,300	3,530,600
Elevation Top of Dam <u>5/</u>	Foot	1364.7	1315.5	xxx
Maximum Height of Dam <u>2/</u>	Foot	39	32	xxx
Emergency Spillway				
Crest Elevation	Foot	1359.1	1311.4	xxx
Bottom Width	Foot	250	50	xxx
Type		Veg.	Veg.	xxx
Percent Chance of Use		2	4	xxx
Average Curve No. - Condition II		79	79	xxx
Emergency Spillway Hydrograph				
Storm Rainfall (6-hour) <u>3/</u>	Inch	9.50	6.60	xxx
Storm Runoff	Inch	6.90	4.20	xxx
Velocity of Flow (VC) <u>4/</u>	Ft./Sec.	5.2	0	xxx
Discharge Rate <u>5/</u>	C.F.S.	1,137	0	xxx
Maximum Water Surface Elevation <u>5/</u>	Foot	1360.9	-	xxx
Freeboard Hydrograph				
Storm Rainfall (6-hour) <u>3/</u>	Inch	20.70	13.60	xxx
Storm Runoff	Inch	17.80	10.90	xxx
Velocity of Flow (VC) <u>4/</u>	Ft./Sec.	10.1	8.8	xxx
Discharge Rate <u>5/</u>	C.F.S.	8,183	1,076	xxx
Maximum Water Surface Elevation <u>5/</u>	Foot	1364.7	1315.5	xxx
Principal Spillway				
Capacity (Maximum)	C.F.S.	62	18	xxx
Capacity Equivalents				
Sediment Volume	Inch	0.60	0.70	xxx
Sediment Reserve Volume (Below riser)	Inch	0	0	xxx
Sediment in Detention Pool	Inch	0.10	0.12	xxx
Detention Volume	Inch	4.76	4.36	xxx
Spillway Storage	Inch	3.54	3.00	xxx
Class of Structure		B ₁ ✓	A	xxx

July 1967

- 1/ Surface area to the top of the riser.
- 2/ Difference in elevation between the top of the settled dam and the bottom of the stream channel.
- 3/ Based on Engineering-Hydrology Memorandum TX-1, "Emergency Spillway and Freeboard Hydrograph Development," August 16, 1965.
- 4/ Obtained from curves drawn from figure 4-R-11472 revised March 1959 and ES-98, dated April 27, 1955, based on flows obtained from routing of hydrographs.
- 5/ Values obtained from routing.

July 1967

REVISED TABLE 4 - SUMMARY OF PHYSICAL DATA
 Northeast Tributaries of Leon River Watershed, Texas

Item	: Unit :	Quantity : Without Project :	Quantity : With Project
Watershed Area	Sq. Mi.	317.0	xxx
Watershed Area	Acre	202,880	xxx
Area of Cropland	Acre	43,680	43,870
Area of Pastureland	Acre	8,358	8,473
Area of Rangeland	Acre	144,756	143,923
Miscellaneous Area	Acre	6,086	<u>1/</u> 6,614
Overflow Area Subject to Damage	Acre	<u>2/</u> 8,736	<u>2/</u> 6,142
Area Damaged By:			
Overbank Deposition	Acre	4,226	<u>4/</u> 1,521
Flood Plain Scour	Acre	<u>3/</u> 213	<u>4/</u> 79
Annual Rate of Erosion:			
Sheet	Ac. Ft.	680.50	394.69
Gully	Ac. Ft.	91.17	65.64
Streambank	Ac. Ft.	19.54	19.54
Scour	Ac. Ft.	15.21	5.62
Sediment Delivered to Proctor Reservoir	Ac.Ft./Yr.	78	38
Average Annual Rainfall	Inch	30.80	xxx

- 1/ Includes area inundated by sediment pools of the planned structures.
2/ Area inundated by the 25-year frequency storm, based on gaged runoff excluding 845 acres of stream channel.
3/ Acreage on which some production loss occurs each year.
4/ The acreage on which production loss will occur each year after all recovery has taken place. Applies to all flooding up to the area inundated by the largest storm in the 22-year series.

July 1967

REVISED TABLE 5 - SUMMARY OF PLAN DATA
 Northeast Tributaries of Leon River Watershed, Texas

Item	Unit	Quantity
Years to Complete Project	Year	7
Total Installation Cost		
Public Law 566 Funds	Dollar	2,324,289
Other	Dollar	673,346
Annual O and M Cost		
Public Law 566 Funds	Dollar	0
Other	Dollar	3,987
Average Annual Monetary Benefits ^{1/}	Dollar	108,657
Agricultural	Percent	88.1
Nonagricultural	Percent	11.9
Structural Measures		
Floodwater Retarding Structures	Each	26
Area Inundated by Structures		
<u>Flood Plain</u>		
Sediment Pool	Acre	140
Detention Pool	Acre	141
<u>Upland</u>		
Sediment Pool	Acre	569
Detention Pool	Acre	1,987
Watershed Area above Structures	Acre	66,907
Reduction of Floodwater Damage	Dollar	81,994
By Land Treatment Measures		
Watershed Protection	Percent	4.0
By Structural Measures	Percent	74.3
Reduction of Sediment Damage	Dollar	12,483
By Land Treatment Measures		
Watershed Protection	Percent	22.0
By Structural Measures	Percent	31.6
Reduction of Erosion Damage	Dollar	2,917
By Land Treatment Measures		
Watershed Protection	Percent	10.0
By Structural Measures	Percent	70.2
Flood Prevention Benefit from Changed Land Use	Dollar	8,494
Benefits Outside of Watershed	Dollar	861

^{1/} From structural measures.

July 1967

REVISED TABLE 6 - ANNUAL COST
Northeast Tributaries of Leon River Watershed, Texas

Measure	: Amortization : of : Installation : Costs <u>1/</u> (dollars)	: Operation and Maintenance : Cost <u>2/</u> : Other (dollars)	: Total (dollars)	: Total (dollars)
Floodwater Retarding Structures				
1 through 24	86,474	3,681	3,681	90,155
25 and 26 <u>3/</u>	5,760	306	306	6,066
TOTAL	92,234	3,987	3,987	96,221

1/ Price Base: 1966 prices for floodwater retarding structures 25 and 26 amortized for 50 years at 3.25 percent. Actual costs obligated for all other structures amortized for 50 years at 2.625 percent.

2/ Adjusted normalized prices for structures Nos. 25 and 26; long-term prices projected by ARS, September 1957, for all other structures.

3/ Interrelated measures.

July 1967

REVISED TABLE 7 - MONETARY BENEFITS FROM STRUCTURAL MEASURES ^{1/}
 Northeast Tributaries of Leon River Watershed, Texas
 (Dollars) ^{2/}

Item	: Estimated Average Annual Damage :			: Average : Annual : Monetary : Benefits
	: Without : Project	: After Land : Treatment : for W/S : Protection	: With : Project	
Floodwater Damage				
Crop and Pasture	68,033	65,789	15,334	50,455
Other Agricultural	21,258	20,063	4,990	15,073
Nonagricultural (Road, Bridge, Railroad, Urban)	15,445	14,735	2,418	12,317
Subtotal	104,736	100,587	22,742	77,845
Sediment Damage				
Overbank Deposition	23,306	18,171	10,823	7,348
Subtotal	23,306	18,171	10,823	7,348
Erosion Damage				
Flood Plain Scour	3,639	3,274	722	2,552
Subtotal	3,639	3,274	722	2,552
Indirect Damage	13,970	12,983	3,624	9,359
Total, All Damages	145,651	135,015	37,911	97,104
Changed Land Use to				
Crop Production	xxx	xxx	xxx	8,494
Incidental Recreation Benefits (Structures 25 and 26)	xxx	xxx	xxx	1,255
Benefits Outside Project Area ^{3/}	xxx	xxx	xxx	861
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	107,714
TOTAL NET PRIMARY BENEFITS	xxx	xxx	xxx	107,714
SECONDARY BENEFITS FROM STRUCTURES 25 and 26	xxx	xxx	xxx	943
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	108,657

1/ Sums of tables 7A, 7B, 7C, and 7D.

2/ As projected by ARS, September 1957, for Armstrong Creek, Cow Creek, and Resley Creed. Adjusted normalized prices used for Walnut Creek.

3/ Reduction of sediment yield to Proctor Reservoir.

July 1967

TABLE 7D - MONETARY BENEFITS FROM STRUCTURAL MEASURES
 Northeast Tributaries of Leon River Watershed, Texas
 (Dollars) ^{1/}

Walnut Creek

Item	: Estimated Average Annual Damage :			
	: Without Project :	: After Land Treatment for W/S Protection :	: With Project :	: Average Annual Monetary Benefits :
Floodwater Damage				
Crop and Pasture	2,593	2,463	534	1,929
Other Agricultural	503	478	126	352
Nonagricultural (Road, Bridge, Railroad)	310	295	5	290
Subtotal	3,406	3,236	665	2,571
Sediment Damage				
Overbank Deposition	1,025	917	582	335
Subtotal	1,025	917	582	335
Erosion Damage				
Flood Plain Scour	2,650	2,331	353	1,978
Subtotal	2,650	2,331	353	1,978
Indirect Damage	708	648	160	488
Total, All Damages	7,789	7,132	1,760	5,372
Changed Land Use to Crop Production	xxx	xxx	xxx	1,035
Incidental Recreation Benefits	xxx	xxx	xxx	1,255
Benefits Outside Project Area	xxx	xxx	xxx	xxx
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	7,662
TOTAL NET PRIMARY BENEFITS	xxx	xxx	xxx	7,662
SECONDARY BENEFITS	xxx	xxx	xxx	943
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	8,605

^{1/} Adjusted normalized prices.

July 1967

REVISED TABLE 8 - BENEFIT-COST ANALYSIS

Northeast Tributaries of Leon River Watershed, Texas

Measure	AVERAGE ANNUAL BENEFITS 1/					Total	Average Annual Cost	Benefit: Cost Ratio
	Flood Prevention	Erosion	Indirect	Other 2/	Secondary 3/			
Floodwater Retarding Structures								
1 through 24 5/	75,274	7,013	574	8,871	8,320	xxx	100,052	90,155 1.11:1
25 and 26 5/	2,571	335	1,978	488	2,290	943	8,605	6,066 1.42:1
GRAND TOTAL	77,845	7,348	2,552	9,359	10,610	943	108,657	96,221 1.13:1

1/ Price Base: Adjusted normalized prices for structures 25 and 26. All other benefits based upon long-term prices as projected by ARS, September 1957.

2/ Changed land use benefits and benefits outside the watershed. Also includes incidental recreation benefits for structures 25 and 26 only.

3/ Estimated for structures 25 and 26 only.

4/ From table 6.

5/ Interrelated measures.

July 1967

SECTION 2

REVISED STATISTICAL SUMMARY, INVESTIGATIONS, ANALYSES,
AND SUPPORTING TABLESSTATISTICAL SUMMARYThe Watershed

Drainage Area 317.0 square miles or 202,880 acres
 Total Flood Plain 9,581 acres
 Area Benefited 8,440 acres
 Owners of Land Benefited from Structural Measures (number) . . 227
 Range in Benefited Acreage Owned City Lot to 350 acres
 Estimated Current Market Price of Land in Benefited
 Area (per acre) \$75 to \$150
 Estimated Current Market Price of Agricultural
 Upland in Watershed (per acre) \$50 to \$125

Land Use Changes

Land Use	: Flood Plain (Acres) :		: Upland (Acres)	
	: Without :	With :	: Without :	With :
	: Project :	Project :	: Project :	Project :
Cropland	4,228	5,973	39,452	37,897
Pastureland	4,412	2,527	3,946	5,946
Rangeland	0	0	144,756	143,923
Miscellaneous ^{1/}	941	1,081	5,145	5,533

^{1/} Includes urban, roads, railroads, sediment pools, stream channels, etc.

Structural Measures

Floodwater Retarding Structures 26
 Floodwater Detention Capacity 28,324 acre-feet
 Sediment Storage Capacity 4,270 acre-feet

Watershed Control by Structures (percent)

Armstrong Creek 53.6
 Cow Creek 43.4
 Resley Creek 51.1
 Walnut Creek 19.4

Cost of Project

Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
Land Treatment Measures	31,842	431,674	463,516
Structural	2,292,447	241,672	2,534,119
Total	2,324,289	673,346	2,997,635

Damages and Benefits

Present Average Annual Flood Damages	\$145,651
Crop and Pasture	\$68,033
Other Agricultural	\$21,258
Nonagricultural	\$15,445
Sediment and Erosion	\$26,945
Indirect	\$13,970
Reduction in Average Annual Damage by Project (percent)	74.0
Total Average Annual Benefits Expected from Structural Measures	\$108,657
Total Average Annual Cost of Structural Measures	\$96,221
Annual Equivalent Cost of Project Installation	\$92,234
Annual Cost of Operation and Maintenance	\$ 3,987
Benefit-Cost Ratio	1.13:1

INVESTIGATIONS AND ANALYSESProject FormulationProject Objectives

No change.

Land Treatment Measures

Change the fifth sentence to read:

"Estimates were made of practices that would be applied during the 7-year installation period for the entire watershed."

Structural Measures

Modify item 8 to read:

"Data obtained in land treatment needs studies for the watershed, as well as hydraulic, hydrologic, geologic, sedimentation, and economic investigations, provided the necessary means for evaluating various combinations and locations of floodwater retarding structures. As a result of this analysis, it was determined that 26 floodwater retarding structures would be the most economical system to install that would provide a level of protection acceptable to the cosponsoring organizations. Original estimates indicated that the cost of installing structural measures for flood prevention on Walnut Creek exceeded the benefits that could be derived therefrom. More detailed information on flood damages indicates that a favorable benefit-cost ratio can be obtained in this reach. Plans of a floodwater retarding structure, typical of those planned for the watershed, are illustrated by figures 4 and 4A."

Modify item 12 to read:

"The entire watershed was divided into four construction units. Armstrong Creek, Cow Creek, Resley Creek, and Walnut Creek are designated as separate construction units because they are independent drainages into the Leon River."

Hydrologic Investigations

Modify item 10 to read:

"The minimum floodwater detention volume in floodwater retarding structures Nos. 1 through 24, as determined in accordance with Engineering Memorandum-27 using Yarnell's 6-hour 25, 50, and 100-year frequency rainfall amounts, revised to conform to Technical Paper No. 25, is 2.98, 3.67, and 4.91 inches, respectively. In accordance with Texas State Manual Supplement 2441, the recommended detention storage volume for this watershed varies from 4.55 inches for Class A structures, 6.45 inches for Class B structures, and 8.95 inches for Class C structures, depending on size of drainage area. The recommended detention storage volume for Class A, B, and C structures less the volume which will be released through the principal spillway during a 2-day period was used as the minimum detention storage volume for all floodwater retarding structures. Detention volumes in excess of those recommended in accordance with Texas State Manual Supplement 2441 were used in a number of sites to obtain a more economical or desirable emergency spillway or structure design. Percent chance of use of emergency spillways, based on regional analysis of gaged runoff from similar watersheds, was determined by

adding to the actual detention storage the volume which would be released by the principal spillways during a 2-day period. Detention volumes for floodwater retarding structures Nos. 25 and 26 were determined using Engineering-Hydrology TX-2, "Detention Storage Requirements for Floodwater Retarding Structures," November 5, 1965, and Engineering Memorandum-27 (Rev.), March 19, 1965."

Modify item 11 to read:

"Average principal spillway release rates range from 8 to 16 csm with 9 csm being the average for all sites in the watershed. The higher rates were used in some structures to decrease the period of time valuable cultivated land would be inundated or to provide less frequent use of emergency spillways."

Add the following to item 13:

"The emergency spillway and freeboard hydrographs for floodwater retarding structures Nos. 25 and 26 were developed, using Engineering-Hydrology Memorandum TX-1, "Emergency Spillway and Freeboard Hydrograph Development," August 16, 1965, and Engineering Memorandum-27 (Rev.), March 19, 1965. The dimensions of the emergency spillway were determined by flood routing the freeboard hydrograph."

Sedimentation Investigations

Sediment Source Studies

Modify the first sentence of third paragraph to read:

"The annual gross erosion in the drainage areas above the 26 planned structures is 249 acre-feet or an average annual rate of 2.40 acre-feet per square mile of watershed area."

Critical Sediment Source Areas

No change.

Flood Plain Sedimentation and Scour

No change.

Geologic Investigations

Description of Problems

Modify last sentence of third paragraph to read:

"Sites 1, 4, 5, 7 - 12, and 16 - 26 are located either wholly or partially within the Glen Rose outcrop."

Economic Investigations

Determination of Annual Benefits from Reduction in Damages

Modify the third paragraph to read:

"It was found that significant differences in land use, frequency of flooding, and future land use changes existed. The flood plain was therefore divided into 14 evaluation reaches, each with its own damageable value. The evaluation reaches (figure 3) are:

"Reach A - From valley section R-1 downstream to a point halfway between valley sections R-9 and R-10. (Urban area within the city of Dublin).

"Reach B - From a point halfway between valley sections R-9 and R-10 downstream to a point halfway between valley sections R-14 and R-15.

"Reach C - From a point halfway between valley sections R-14 and R-15 downstream to a point halfway between valley sections R-18 and R-19.

"Reach D - From a point halfway between valley sections R-18 and R-19 downstream to a point halfway between valley sections R-22 and R-23.

"Reach E - From a point halfway between valley sections R-22 and R-23 downstream to the mouth of Resley Creek.

"Reach F - Cow Creek to its confluence with Armstrong Creek.

"Reach G - From valley section AW1 downstream to a point halfway between valley sections AW5 and A1.

"Reach H - From valley section AE1 downstream to a point halfway between valley sections AE5 and A1.

- "Reach I - From a point halfway between valley sections AW5, AE5, and A1 downstream to a point halfway between valley sections A-8 and A-9.
- "Reach J - Hackberry and Henning Creeks to their confluence with Armstrong Creek.
- "Reach K - From a point halfway between valley section A-8 and A-9 downstream to a point halfway between valley sections A-13 and A-14.
- "Reach L - From a point halfway between valley sections A-13 and A-14 downstream to the confluence of Armstrong Creek with the Leon River. (Within the flood pool of the Proctor Reservoir).
- "Reach M-1 - From Site 25 to a point halfway between valley sections W-2 and W-3.
- "Reach M-2 - From a point halfway between valley sections W-2 and W-3 to the mouth of Walnut Creek."

Modify the eighth paragraph to read:

"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 changes in land use and crop distribution as a result of reduction in flood extent and frequency, was the basis for estimating benefits from restoration of productivity. Benefits from restoration of productivity are included as crop and pasture benefits. Consideration was given to increased damage after restoration of productivity and net benefits remaining after production, harvesting, and all other allied costs were deducted. All benefits from restoration of productivity were discounted to provide for a 5-year lag in accomplishment and totaled \$27,130 annually."

Insert the following two paragraphs between the eighth and ninth paragraphs:

"Incidental recreation benefits were estimated for the sediment pools of structures 25 and 26. A gross value of \$1 per visitor-day, either upon a fee or invitational basis, was used in accordance with Watersheds Memorandum-57, dated October 3, 1962. The value of maintenance, insurance, and replacement of facilities was deducted from gross benefits. Benefits are expected to accrue at full level for 40 years and gradually diminish to zero by the end of 50 years and thereafter. Annual benefits were discounted accordingly.

"Secondary benefits of \$943 were estimated for structures 25 and 26. Benefits stemming from these structures as the result of the reduction of floodwater, overbank deposition, and flood plain erosion damages, and from incidental recreation are expected to be \$674 annually. Benefits induced by these same structures, as the result of increased production costs resulting from changed land use and restoration of former productivity, will amount to \$269 annually."

Modify the ninth paragraph to read:

"Analysis of the schedules, the degree of protection and the physical capabilities of the flood plain indicated that about 705 additional acres of flood plain now in wooded pasture would be cleared and put into more productive use as open pasture or cropland after installation of the project. The average annual benefit from this source, after deduction of additional damage, associated cost and added overhead, and discounting for the lag in accrual, is estimated at \$9,753. Neither the restoration in productivity nor this change in flood plain land use will involve an increase in the acreage of cotton or peanuts in the watershed, since increases in cotton and peanut acreage in the flood plain will be compensated by decreases in the upland."

Delete the table on page 39.

Determination of Annual Benefits Outside Watershed Resulting from Project

No change.

Details of Methodology

No change.

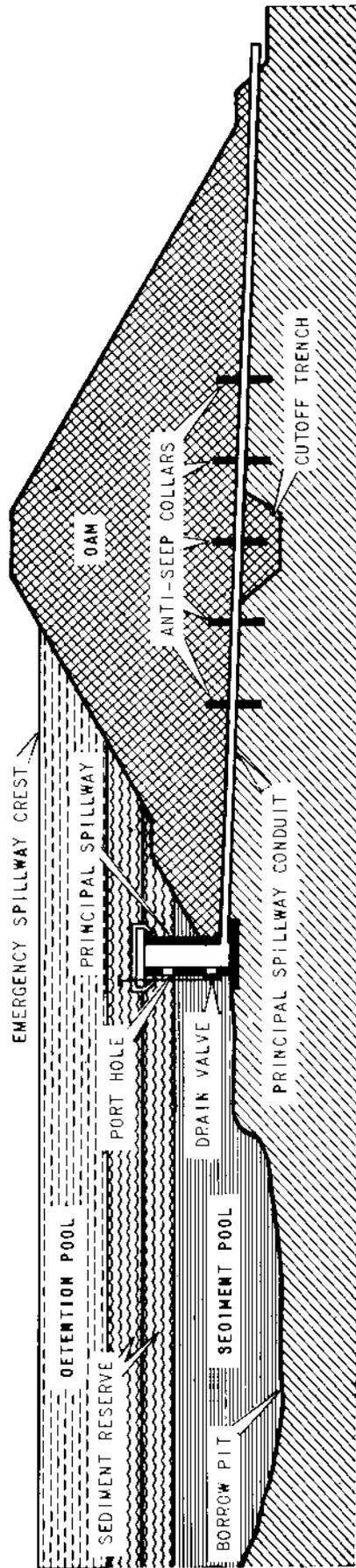
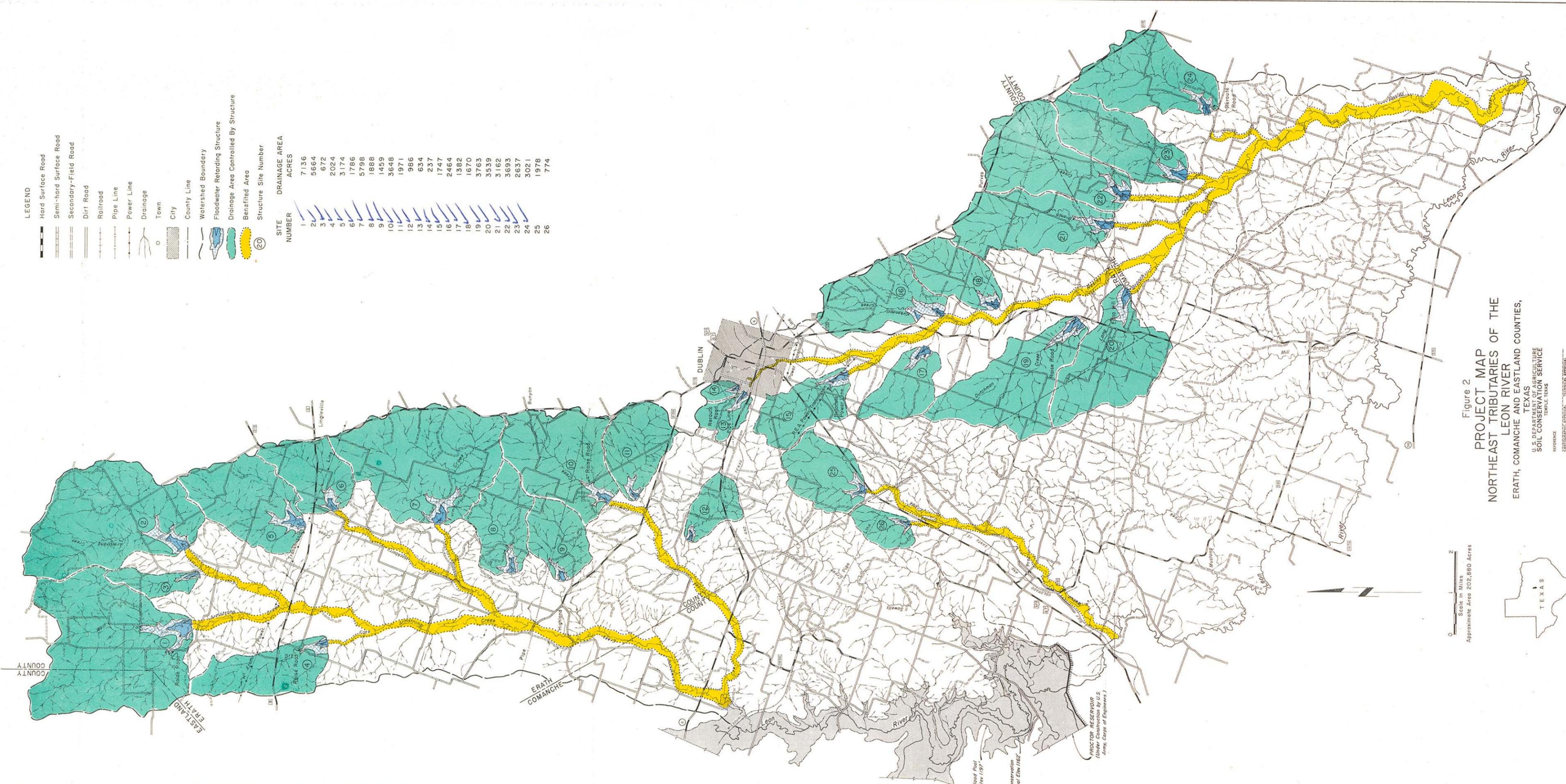


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE



- LEGEND**
- Hard Surface Road
 - Semi-hard Surface Road
 - Secondary-Field Road
 - Dirt Road
 - Railroad
 - Pipe Line
 - Power Line
 - Drainage
 - Town
 - City
 - County Line
 - Watershed Boundary
 - Detailed Investigation
 - Detailed Investigation Land Stabilization Measures
 - Reconnaissance Investigation
 - Drainage Area Controlled By Structure
 - Outline Of Floodwater And Sediment Damage Area
 - Valley Cross Section
 - Evaluation Reach
 - Sediment Damage Each + Represents 25 Acres
 - Scour Damage Each S Represents 5 Acres
 - Structure Site Number



Figure 3
**LOCATION
 OF
 PROBLEM AREAS
 AND
 STRUCTURE SITE INVESTIGATION**
 NORTHEAST TRIBUTARIES OF THE
 LEON RIVER
 ERATH, COMANCHE AND EASTLAND COUNTIES,
 TEXAS

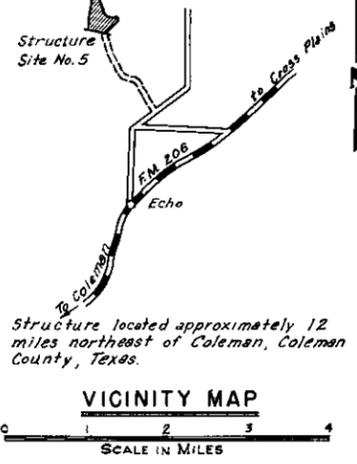
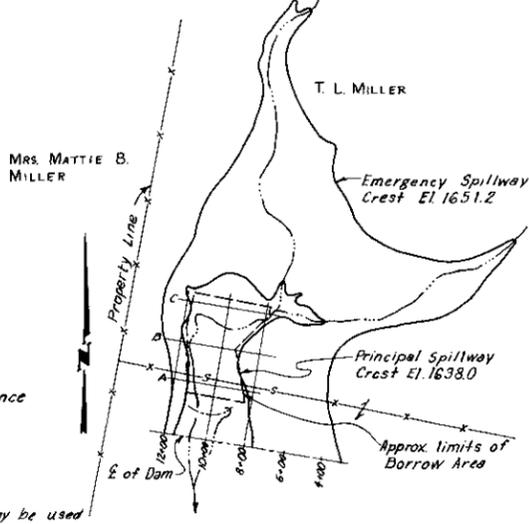
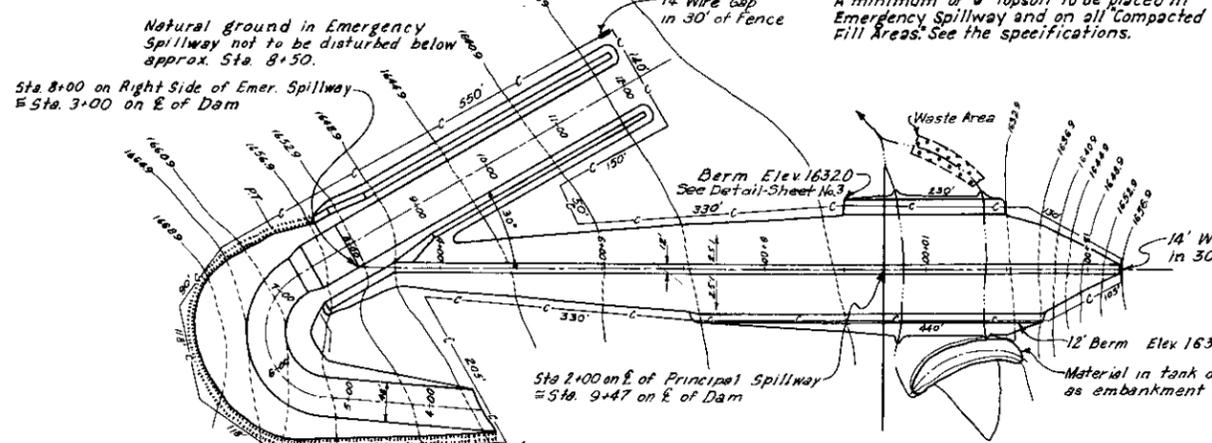
U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE
 TEMPLE, TEXAS

REFERENCE
 CARTOGRAPHIC APPROVAL TECHNICAL APPROVAL
 COMPILED TRACED CHECKED DATE
 J.E.L. J.W.M. 3-24-61

Rev. 12-67
 Revised June 8, 1960 H.T. & R.M. 4-R-15352
 Base 4-R-13846

Base compiled from uncontrolled mosaic 4-R-14378

FENCE LEGEND
 -C- Fence to be constructed under contract
 -X- Existing Fence
 -S- Fence in the construction area to be removed and salvaged by contractor.



EMERGENCY SPILLWAY CURVE DATA
 Δ = 144°00'
 D = 71'37"
 R = 80.35'
 L = 201.0'
 P.C. = Sta. 5+29
 P.T. = Sta. 7+30

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

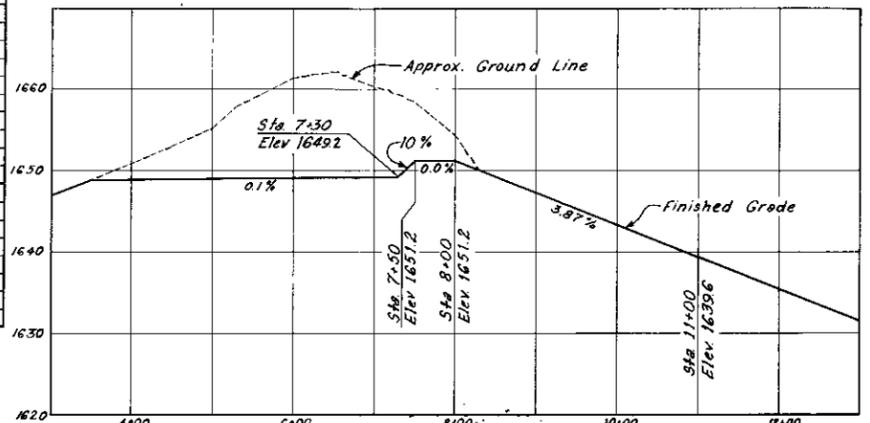
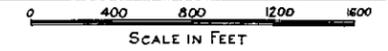
PLAN OF EMBANKMENT AND SPILLWAYS



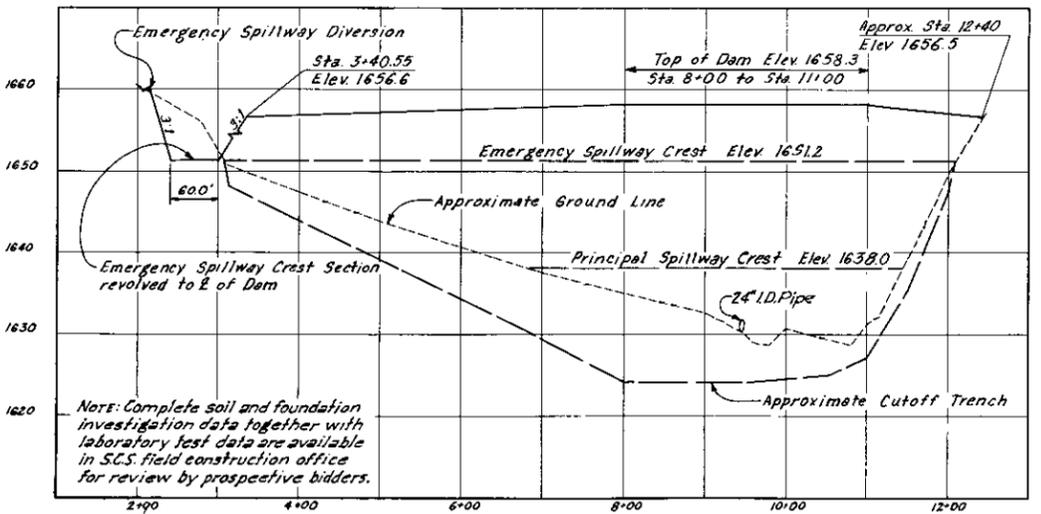
ELEVATION	SURFACE ACRES	STORAGE	
		ACRE FEET	INCHES
1632.9	2	4	0.05
1636.9	6	20	0.27
1638.0	8	28	0.37
1640.9	14	60	0.80
1644.9	20	128	1.70
1648.9	29	226	3.00
1651.2	36.4	301	3.99
1652.9	42	368	4.88
1656.9	53	558	7.40
1660.9	64	792	10.51

Top of Dam (Effective) Elev. 1656.5
 Emergency Spillway Crest Elev. 1651.2
 Principal Spillway Crest Elev. 1638.0
 Sediment Pool Elev. 1638.0
 Drainage Area, Acres 904
 Sediment Storage, Acre Feet 32
 Floodwater Storage, Acre Feet 269
 Max. Emergency Spillway Cap., c.f.s. 1830

GENERAL PLAN OF RESERVOIR

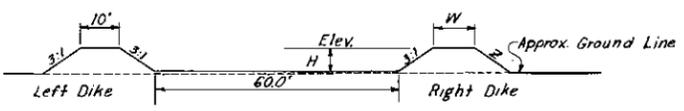


PROFILE ON C OF EMERGENCY SPILLWAY



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

PROFILE ON C OF DAM



Left Dike:
 Approx. Sta. 7+75 to Sta. 8+00 Elev. 1656.6 From Sta. 8+00 to Sta. 8+50, grade uniformly to H+30'. From Sta. 8+50 to 12+00, H+30'.

Right Dike:
 Approx. Sta. 7+40 to Embankment Elev. 1656.6, W=14.0', Z=2.5:1. From Embankment to Sta. 9+00 Transition Section, Sta. 9+00 to Sta. 12+00 H+30', W=10.0', Z=3:1.

NOTE:
 Material forming both dikes to be placed and paid for as "Compacted Fill".
 Natural ground in Emergency Spillway not to be disturbed below approx. Sta. 8+50

TYPICAL SECTION -- EMERGENCY SPILLWAY

Figure 4

TYPICAL FLOODWATER RETARDING STRUCTURE
 GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

Designed by W.E.C. Date 3-61
 Drawn by W.E.C. & H.R.T. 3-61
 Traced by H.R.T. 3-61
 Checked by W.E.C. & G.W.T. 4-61

Approved by [Signature] Date 3-61
 STATE ENGINEER IN CHARGE
 SOIL CONSERVATION SERVICE
 DRAINAGE DISTRICT NO. 2
 DRAWING NO. 4-E-15,357

