

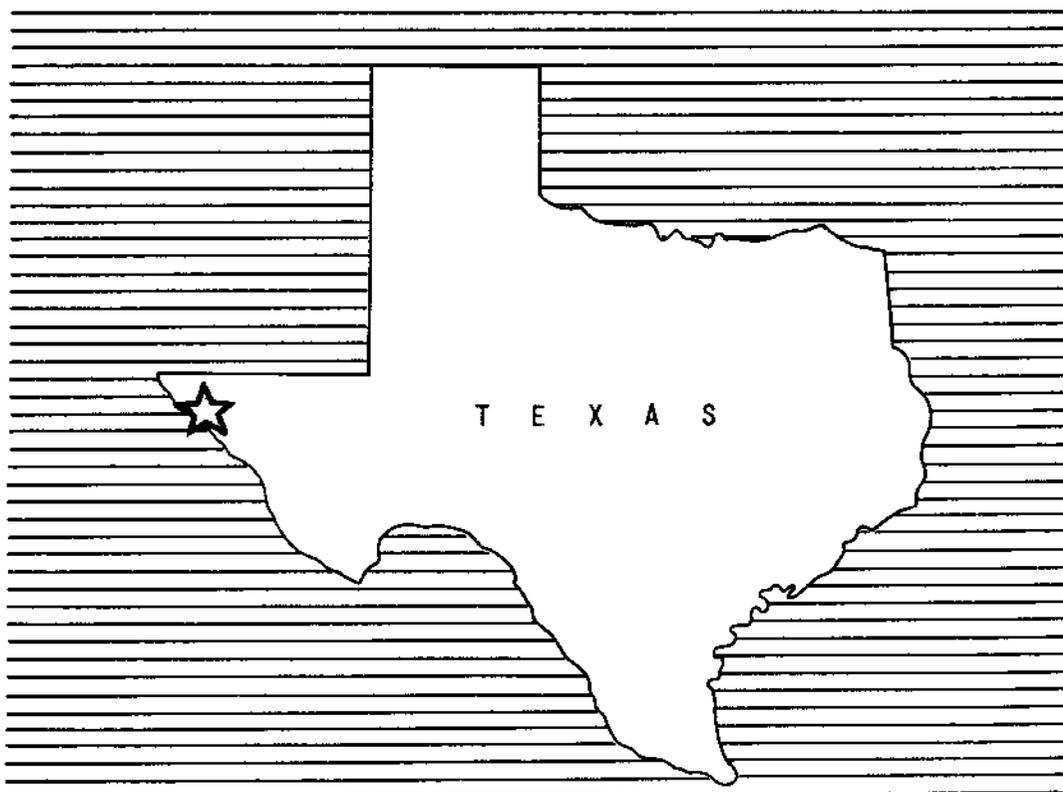
WORK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION

MACHO ARROYO

WATERSHED

HUDSPETH COUNTY, TEXAS



July 1960

WATERSHED WORK PLAN AGREEMENT

between the

El Paso-Hudspeth Soil Conservation District

Local Organization

Hudspeth County Conservation and Reclamation District No. 1

Local Organization

Hudspeth 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, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Macho Arroyo Watershed, State of Texas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended by the Act of August 7, 1956 (Public Law 1018, 84th Congress; 70 Stat. 1088); and

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

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

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 will be installed, within one years, and operated and maintained substantially in accordance with the terms, conditions, and stipulations provided for therein.

It is mutually agreed that in installing and operating and maintaining the works of improvement described in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost \$ 803 .)
2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
3. The percentages of construction costs of structural measures and land treatment measures for flood prevention 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 Cost</u> (dollars)
1 Floodwater Retarding Structure	0	100	162,795

The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The Service will bear the cost of all installation services applicable to works of improvement for flood prevention. (Estimated cost \$ 41,981.)

The Service will bear - percent of the cost of installation services applicable to works of improvement for agricultural water management and the Sponsoring Local Organization will bear - percent of the cost of such services. (Estimated cost \$ -.)

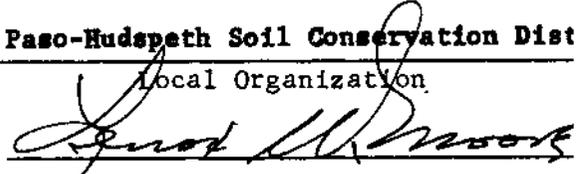
The Sponsoring Local Organization will bear the cost of all installation services applicable to works of improvement for nonagricultural water management. (Estimated cost \$ -.)

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost \$ 500.)
6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

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

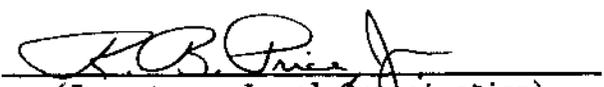
Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will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

- 12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
- 13. No member of or delegate to Congress, or resident commissioner shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

El Paso-Hudspeth Soil Conservation Dist
Local Organization
 By 
 Title Chairman
 Date January 26, 1961

The signing of this agreement was authorized by a resolution of the governing body of the El Paso-Hudspeth Soil Conservation Dist
Local Organization

adopted at a meeting held on January 3, 1961.


 (Secretary, Local Organization)
 Date January 26, 1961.

Hudspeth County Conservation and Reclamation District No.

Local Organization

By *W. F. Hargrove*

Title President

Date January 26, 1961

The signing of this agreement was authorized by a resolution of the governing body of the **Hudspeth County Conservation and Reclamation District No.**

Local Organization

adopted at a meeting held on January 26, 1961.

Buddy E. Miller
(Secretary, Local Organization)

Date January 26, 1961.

Hudspeth County Commissioners Court

Local Organization

By *Tom H. Reely*

Title County Judge

Date January 26, 1961

The signing of this agreement was authorized by a resolution of the governing body of the **Hudspeth County Commissioners Court**

Local Organization

adopted at a meeting held on January 26, 1961.

J. A. Pease
Secretary, Local Organization)*

Date January 26, 1961.

* County Commissioner, Precinct #1, Huds

Soil Conservation Service
United States Department of Agriculture

By _____
State Conservationist

Date _____

WORK PLAN
FOR
WATERSHED PROTECTION AND FLOOD PREVENTION

MACHO ARROYO WATERSHED
Hudspeth County, 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: El Paso-Hudspeth Soil Conservation District
(Cosponsor)

Hudspeth County Conservation and Reclamation
District No. 1
(Cosponsor)

Hudspeth County Commissioners Court
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
July 1960

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SECTION 1

WATERSHED WORK PLAN

MACHO ARROYO WATERSHED
Hudspeth County, Texas
July 1960

SUMMARY OF PLAN

General Summary

The work plan for watershed protection and flood prevention for Macho Arroyo watershed was prepared by the El Paso-Hudspeth Soil Conservation District, the Hudspeth County Conservation and Reclamation District No. 1, and the Commissioners Court of Hudspeth County, as cosponsoring local organization. Technical assistance was provided by the Soil Conservation Service of the United States Department of Agriculture.

The primary objective of the project is to provide flood protection to agricultural lands subject to flood and sediment damage from Macho Arroyo. The local sponsoring organizations considered all possibilities of including agricultural and nonagricultural water management measures and determined that the watershed protection and flood prevention program most nearly met their needs.

The watershed covers an area of 18.62 square miles, or 11,917 acres in Hudspeth County, Texas. Approximately 10.6 percent of the watershed is irrigated cropland, 87.2 percent rangeland, and 2.2 percent is in miscellaneous uses, such as roads, highways, railroads, irrigation canals and drains and Macho Ponding Area.

There are no Federal lands in the watershed.

The work plan proposes installing in a 1-year period, a project for the protection and development of the watershed at a total estimated installation cost of \$206,079. The share of this cost to be borne by Public Law 566 funds is \$204,776. The share to be borne by other than Public Law 566 funds is \$1,303. In addition, the local interests will bear the entire cost of operations and maintenance.

Land Treatment Measures

There are no costs associated with land treatment measures.

Structural Measures

The Structural measures included in the plan consists of one floodwater retarding structure having a total sediment storage and floodwater detenti-

capacity of 1,914 acre-feet. The total cost of structural measures is \$206,079 of which the local share is \$1,303 and the Public Law 566 share is \$204,776. The local share of the costs of structural measures includes easements, and rights-of-way, 62 percent and administering contracts, 38 percent. The one floodwater retarding structure will be installed during 1-year period.

Damages and Benefits

The reduction in floodwater, sediment, and indirect damages will directly benefit the 12 landowners in the damage area. In addition, approximately 90 landowners in the Hudspeth County Conservation and Reclamation District No. 1 will receive significant benefits through the reduction of damages to district maintained irrigation and drainage facilities.

The estimated average annual floodwater, sediment, and indirect damages without the project total \$11,029 at long-term price levels. The estimated average annual floodwater, sediment, and indirect damages with the project installed amount to \$468, a reduction of approximately 96 percent.

The average annual primary benefits accruing to structural measures are \$10,561, which are distributed as follows:

Floodwater damage reduction	\$8,786
Sediment damage reduction	\$ 815
Indirect damage reduction	\$ 960

The ratio of the average annual benefits (\$10,561) to the average annual cost of structural measures (\$7,798) is 1.4:1.

The economy of the entire surrounding area is dependent to an unusual extent upon the productivity of the limited area in the Rio Grande Valley that can be irrigated. All of the available cropland is concentrated here. Consequently, protection to this area, of which the project is a part, will have an influence extending far beyond the watershed boundaries.

Provisions for Financing Construction

The Hudspeth County Conservation and Reclamation District No. 1 has powers of taxation under applicable State laws. Funds for the local share of the project will come from revenue presently being collected and are adequate available for financing the local share of the structural costs.

Operation and Maintenance

The Hudspeth County Conservation and Reclamation District No. 1 will be responsible for the operation of the floodwater retarding structure. Revenue from the District operation and maintenance tax will be available and adequate for this purpose. The estimated average annual cost of operation and maintenance of this structure is \$350.

It is significant that the entire cost of developing the work plan for watershed protection and flood prevention was borne by the sponsoring local organizations.

A summary of work plan statistical data is included in Section 2.

DESCRIPTION OF WATERSHED

Physical Data

Macho Arroyo heads just beneath the Finlay Mountains in the southwestern part of Hudspeth County, approximately $3\frac{1}{2}$ miles north of Finlay, Texas. It flows $11\frac{1}{2}$ miles toward the southwest where it enters Macho Pounding Area just above the alluvial valley of the Rio Grande. Valuable irrigated cropland lies between this ponding area and the river. Macho Arroyo has no direct outlet to the Rio Grande. The drainage area of the watershed is 18.62 square miles (11,917 acres).

The topography of the watershed may be divided into four major categories: (1) the gently sloping upper portion broken by occasional mountainous area (2) the rolling middle portion of deep wind blown sand; (3) the gravelly, rough broken lower portion; and (4) the Rio Grande alluvial plain. Elevations range from 4,220 feet above mean sea level along the watershed divide to 3,480 feet near the Rio Grande.

All of the watershed lies within the Trans-Pecos Land Resource Area. It is within an intermontane valley which has received deep deposition. In general the soils are: (1) moderately permeable, gravelly, fine textured soils and (2) deep, rapidly permeable, medium to coarse grained sands. The fine textured soils, which generally contain caliche, are mostly shallow to very shallow in the upper portion of the watershed and deep in the lower portion. The Rio Grande alluvial soils, all of which are irrigated, are of fine to medium textured and generally moderately permeable. The evaporative of saline irrigation water presents a serious problem of controlling the high salt content of these soils. Overgrazing of rangeland in this arid region has resulted in little good forage producing vegetation on upland areas.

Most of the watershed is underlain by coarse-grained unconsolidated material of Pleistocene terraces and Recent alluvium. In places however, there are rock outcrops, chiefly Jurassic Malone sandstone and limestone.

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

<u>Land Use</u>	<u>Acres</u>	<u>Percent</u>
Cultivation <u>1/</u>	1,268	10.6
Range	10,391	87.2
Miscellaneous <u>2/</u>	258	2.2
Total	11,917	100.0

1/ All cultivated land in the watershed is irrigated.

2/ Includes roads, highways, railroads, irrigation drains and canals, and Macho Pounding Area.

The average annual rainfall is 8.00 inches for the 44 years studied (1915-1958) as recorded at U. S. Weather Bureau gage at El Paso, Texas. The monthly average ranges from 0.27 inch in April to 1.32 inches in July and August. September is also one of the higher rainfall months with an average of 1.1 inches.

Average temperatures range from 81 degrees Fahrenheit in the summer to 43 degrees in winter. The normal frost-free season of 242 days extends from March 19 to November 16.

The Rio Grande is normally the source of irrigation water. Well water, which is of relatively poor quality, is used during times when the supply of river water is inadequate. Water for livestock on the range is obtained from surface ponds and wells. Water for household use is hauled.

Economic Data

The economy of the watershed is almost entirely agricultural, and is dependent upon the crops produced on the highly developed irrigated land. This irrigated land comprises the majority of the area being damaged. Although the capacity of the Macho Ponding Area is being depleted by the deposition of sediment, it is not included as a part of the "damage area" considered in this work plan, because its only use is to prevent sediment and floodwater damage to the irrigated land and damage to it was not computed. The 1,268 acres of cropland are all irrigated and are in the Hudspeth County Conservation and Reclamation District No. 1. Typical land use, crops grown, and average yields of the 1,393 acres subject to damage by overflow are as follows:

<u>Crop or Land Use</u>	<u>Acres</u>	<u>Yield</u>
Upland Cotton	446	985 Lbs. lint
Long Staple Cotton	84	735 lbs. lint
Alfalfa	167	5.0 tons
Silage Crops	98	15.0 tons
Sudan for Temporary Pasture and Hay	167	6.0 AUM grazing plus 2.0 tons Hay
Temporarily Idle	306	
Miscellaneous Land Use <u>1/</u>	<u>125</u>	
Total	1,393	

1/ Includes Canals, Drainage Ditches, Roads, Farmsteads, etc.

Some cropland is always idle because of normal crop rotations, shortages of water, temporary salt concentrations or occasional crop failures. This area may range from as low as 50 acres to as high as 900 acres as a result of the prolonged water shortages such as occurred in 1952 to 1958. Cotton grown in the watershed is uniform in grade, extremely high in quality, and brings a premium price. It is ginned locally and is usually marketed in Fabens or El Paso through local cotton marketing cooperatives. Dairies around El Paso

provide a good market for alfalfa and other feed crops grown in the area. At present there is a decided trend toward incorporating livestock feeding into the farm operations. A large quantity of the hay and feed crops produced are now being utilized on the farms on which they are grown.

The farmers in the irrigated area are performing conservation measures for soil improvement and irrigation water management. They are using advanced methods and techniques of conservation irrigation. These measures are necessary to maintain the continued efficient utilization of the irrigated land. The average size of an irrigated farm unit is approximately 230 acres which is more than sufficient for an economic unit.

The rangeland located above the irrigated section is largely owned by the State of Texas or the Texas and Pacific Land Trust with some small private holdings to be found throughout the watershed. Almost all of the rangeland is under lease and is grazed on a seasonal basis in accordance with cooperative agreements with the soil conservation district.

There are no towns or communities located wholly within the watershed. The small community of Esperanza is located at the edge of the irrigated section and provides post office and ginning facilities. It is 20 miles to Sierra Blanca, population 850, 32 miles to Fabens, population 3,100, and 67 miles to El Paso, population 271,000. These three centers provide adequate markets for financial, educational, medical and cultural facilities for the area.

The irrigated section is served adequately by Federal, State, county and private roads. Access to the rangeland area is provided by county and private ranch roads.

The Texas and Pacific and the Southern Pacific Railroads, both of which have loading facilities near the watershed, adequately serve the agriculture of the watershed.

WATERSHED PROBLEMS

Macho Arroyo is a tributary of the Rio Grande. Formerly it discharged directly into the river but gradual building up of the alluvial fan and the shifting of the river channel produced lateral spreading of the runoff over larger areas of the valley bottom. At present the channel of the Rio Grande is higher than the irrigated lands adjacent to it and the only outlet for runoff from Macho Arroyo is through the system of drainage ditches and irrigation canals serving the lands in the Hudspeth County Conservation and Reclamation District No. 1.

Floodwater Damage

Nearly all rains of high intensity occur during the summer growing season. Prior to the installation of the ponding area by the local people, approximately 20 years ago, damage from floodwater was an annual occurrence. Since the ponding area was constructed damaging floods have occurred on an average of once every two or three years. Recent floods that caused severe damage to crop irrigation facilities occurred in 1948, 1950, 1953 and 1958.

An estimated 1,393 acres of land is subject to floodwater and sediment damage. However, not all of this area will be inundated by any single flood event. During the interval between floods minor changes in the area subject to damage, such as small dikes, road fills, irrigation ditches or land leveling, may alter the course of flood flows.

With the gradual loss of capacity in the ponding area, due to deposition of sediment, it is evident that the incidence of flooding will increase to a point where small flows from the arroyo again will cause flooding on an annual basis.

Analysis of the flooding under present conditions and the increased frequency in the future indicate that, during the project life, the total direct floodwater damage will average \$9,139 annually without the project. Of this amount \$7,044 is crop and pasture damage and \$2,095 other agricultural damages primarily to irrigation and drainage facilities and the necessary re-leveling of irrigated lands following flood flows.

Indirect damages, such as interruption of travel and irrigation services are high. The total annual value of such damages is estimated to be \$1,003.

Sediment Damage

Floodwater frequently overflows the Macho Ponding Area, located just above the damage area, but the resulting sediment damage to irrigated cropland has been insignificant. Irrigation ditches and canals transport from the watershed a considerable amount of the sediment which passes the ponding area. Sediment which has been deposited on the irrigated cropland has been incorporated into the soil by mechanical means to such an extent that, to date, very little damage can be recognized.

The estimated average annual sediment yield to the ponding area is 5.5 acre-feet under present conditions. Deposition of this sediment will deplete the storage capacity of the ponding area, which has an estimated 70 percent trapping efficiency, within 24 years. As sedimentation continues to deplete the storage capacity, the resulting increase in flooding will result in increased sedimentation below the ponding area. Without a project installed it is estimated that, during the next 24 years, the productive capacity of 37 acres of irrigated cropland would be reduced an average of 10 percent due to deposition of clay and sand. During the next 26 years, after depletion of the ponding area storage capacity, the rate of sediment deposition will be increased until at the end of the 50-year evaluation period, it is estimated that the productive capacity of 194 acres of irrigated cropland would be reduced an average of 15 percent. This damage at long-term price levels, when discounted to present worth, would represent an average annual monetary damage of \$887.

The estimated average annual rate of sediment production for the watershed is 0.34 acre-foot per square mile.

Erosion Damage

Erosion rates in the upland areas are moderate due to the limitation of water available for erosive action, the gravelly nature of the soils which protect steeper slopes from rapid erosion, the gently sloping topography of most of the watershed, and a large area of deep sand from which runoff is very slow.

Sheet erosion accounts for 67 percent of the annual gross erosion and channel erosion 33 percent. Because the most severe channel erosion occurs in the lower reaches of the watershed a high percent of the sediment derived from this source is delivered to the ponding area.

Very little scour damage is occurring on the irrigated overflow area due to the nearly level topography and low velocity of floodwaters.

Problems Relating to Water Management

All of the cropland in the watershed is irrigated and is located within the Hudspeth County Conservation and Reclamation District No. 1, which was organized in 1923. Water for irrigation originates from Elephant Butte reservoir and reaches the Hudspeth County Conservation and Reclamation District No. 1 as return flow from other irrigation districts above it in the Rio Grande Valley. Except for the period from 1952 to 1958 this source has provided an adequate supply of irrigation water for the district. During this period a water shortage, brought about by drought and subnormal snow packs, affected all irrigation districts, and there was little or no return flow available. Many irrigation wells were developed as a source of water but due to both poor quality and small quantity of water, they were inadequate to meet the needs of prolonged irrigation. At the height of the water shortage operators were only able to adequately irrigate approximately 30 percent of the irrigable land in the watershed. Since the return of water to the District in 1958, recovery has been rapid and at the present time operations are approaching normal. The wells drilled during the water shortage now furnish a considerable amount of supplemental irrigation water.

Storage for irrigation water could not be accomplished due to climatic conditions and limited available storage space in the structure. Most of the rains occur in the summer growing season when all of the storage in the reservoir and ponding area will be needed to prevent damage to crops.

The Hudspeth County Conservation and Reclamation District No. 1 operates and maintains all irrigation water distribution canals and drainage ditches within the watershed. Both the distribution and drainage facilities are adequate for efficient continued operations and no additional facilities are considered necessary by the district.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

The watershed is served by the Soil Conservation Service Work Unit at El Paso assisting the El Paso-Hudspeth Soil Conservation District. The work unit assisted farmers and ranchers in preparing 13 soil and water conservation

plans on all of the irrigated land and 9,751 acres (94 percent) of the rangeland (including the leased rangeland) within the watershed and has given technical assistance in establishing and maintaining planned measures. Approximately 65 percent of the planned practices have been applied.

The Hudspeth County Conservation and Reclamation District No. 1 and the individual landowners have long recognized the severe flood problem in the watershed and have made every effort within their capabilities to control or prevent flooding of the productive cropland. Approximately 20 years ago the district constructed a ponding area to trap sediment and to temporarily detain small flows from Macho Arroyo for safe disposal through drainage ditches into the rectified channel of the Rio Grande. This ponding area has materially reduced floodwater and sediment damages from small flows, and has had measurable beneficial effect on the larger more infrequent flows. Efforts have been made to maintain the capacity of the ponding area by increasing the height of the fill. However, due to the topography, this is no longer feasible and gradually its effectiveness in reducing damage is decreasing. It is estimated that under present conditions the capacity for sediment and floodwater will be completely depleted in 24 years.

The Bureau of Reclamation built and operates the Rio Grande Project, which includes Elephant Butte Reservoir. A secondary water right from this project is the primary source of irrigation water in the Hudspeth County Conservation and Reclamation District No. 1.

The rectified channel of the Rio Grande is operated and maintained by the International Boundary and Water Commission. All flood flows and irrigation drain water ultimately discharge into its channel.

The works of improvement to be installed in Macho Arroyo Watershed will have no detrimental effects on any existing or future works of improvement of other agencies, conversely it will complement the works of improvement of the International Boundary and Water Commission by reducing sediment delivery into the rectified channel of the Rio Grande.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures for Watershed Protection

Except for the 1,268 acres of irrigated cropland located along the Rio Grande and the 258 acres in miscellaneous uses, the rest of the watershed, 10,391 acres, is rangeland. Nearly all the rangeland is owned by the State of Texas or the Texas and Pacific Land Trust, and is leased for grazing. Approximately 94 percent of the land in the watershed is under cooperative agreement with the El Paso-Hudspeth Soil Conservation District. The present management programs for these lands will result in improved vegetative cover within climatic limitation on these range sites. Because of limited rainfall and therefore slow rate of recovery, together with unfavorable topography of the watershed, other land treatment measures are not feasible. Present grazing use of watershed rangelands is on a seasonal basis. Grazing management to

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/

Macho Arroyo Watershed, Texas
Price Base: 1960

Installation Cost Item	Unit	Number to be: Applied	Estimated Cost		
			Non-Federal Land	Public Law: Funds	Other: Funds
			(dollars) (dollars)(d		
<u>LAND TREATMENT FOR</u>					
Watershed Protection					
Soil Conservation Service					
Proper Use	Acre	10,391	-		NC
Deferred Grazing	Acre	10,391	-		NC
SCS Subtotal			-		-
<u>TOTAL LAND TREATMENT</u>			-		-
<u>STRUCTURAL MEASURES</u>					
Soil Conservation Service					
Floodwater Retarding					
Structure	No.	1	162,795	-	16
SCS Subtotal			162,795	-	16
Subtotal - Construction			162,795	-	16
<u>Installation Services</u>					
Soil Conservation Service					
Engineering Services					
			29,303	-	2
Other					
			12,678	-	1
SCS Subtotal			41,981	-	4
Subtotal - Installation Services			41,981	-	4
<u>Other Costs</u>					
Land, Easements and Rights-of-Way					
			-	803	
Administration of Contracts					
			-	500	
Subtotal - Other			-	1,303	
<u>TOTAL STRUCTURAL MEASURES</u>			204,776	1,303	20
<u>TOTAL PROJECT</u>			204,776	1,303	20
<u>SUMMARY</u>					
Subtotal SCS			204,776	1,303	20
<u>TOTAL PROJECT</u>			204,776	1,303	20

1/ No Federal lands involved.

July 1960

allow for maximum vegetative recovery under environmental conditions existing in this locality is a fundamental part of the plan, and will allow vegetation to make its maximum contribution in reducing erosion and sediment movement.

The absence of extensive rangeland treatment measures will not adversely affect operation and maintenance of the floodwater retarding structure to be installed. The major vegetative cover of the watershed will remain the same since rainfall is the limiting factor in changing the vegetation. The structure is designed to be fully effective for 50 years under present watershed conditions; any cover improvement which may be experienced resulting from more favorable climatic conditions, will serve merely to lengthen the useful life of the structure. No costs have been included in the plan for accompanying management since it represents merely a continuation of present efforts.

Structural Measures for Flood Prevention

One floodwater retarding structure will be installed to afford the needed protection for the irrigated cropland and the irrigation and drainage facilities in the damage area.

Figure 1 shows a section of a typical floodwater retarding structure.

The location of the floodwater retarding structure is shown on the Project Map, Figure 2.

This structure will temporarily detain runoff from approximately 80 percent of the entire watershed and 90 percent of the 10,524 acres above the benefited area which contribute damaging floodwater and sediment. The floodwater retarding structure will have a floodwater detention capacity of 1,661 acre-feet and will detain temporarily 2.10 inches of runoff from its drainage area. This is equivalent to 1.89 inches of runoff from the area contributing damaging floodwater.

The total estimated cost of establishing the structural measure is \$206,070 (table 1). The average annual equivalent cost is estimated to be \$7,448 for installation and \$350 for operation and maintenance, making a total annual cost of \$7,798 (table 6).

Sufficient detention storage can be developed at this structure site to make possible the use of an earthen spillway, thereby effecting a substantial reduction in cost over concrete or similar types of spillways.

All applicable State water laws will be complied with in design and construction of the floodwater retarding structure.

BENEFITS FROM WORKS OF IMPROVEMENT

After the installation of the floodwater retarding structure described above, the estimated average annual monetary floodwater, sediment, and indirect damage within the watershed will be reduced from \$11,029 to \$468, a 96 percent reduction.

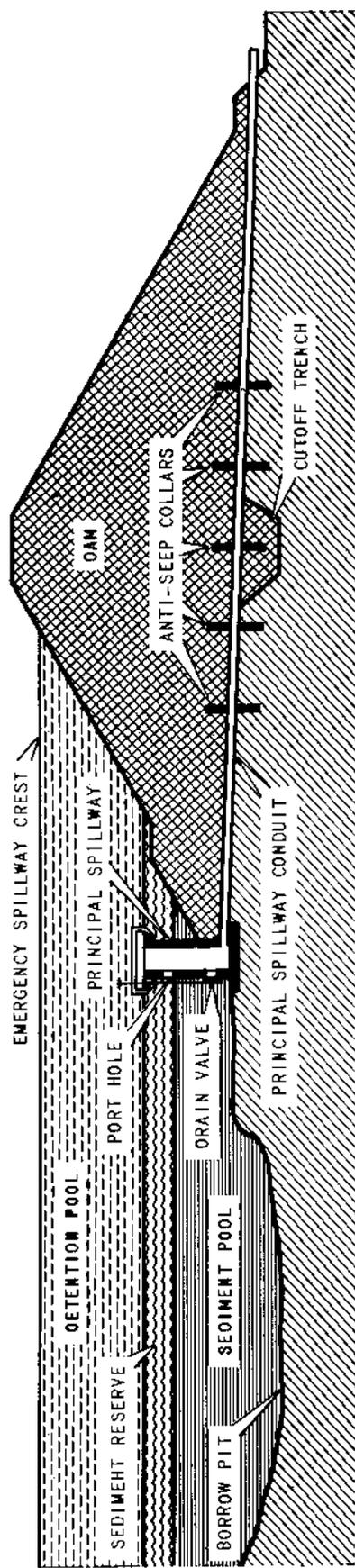


Figure 1
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

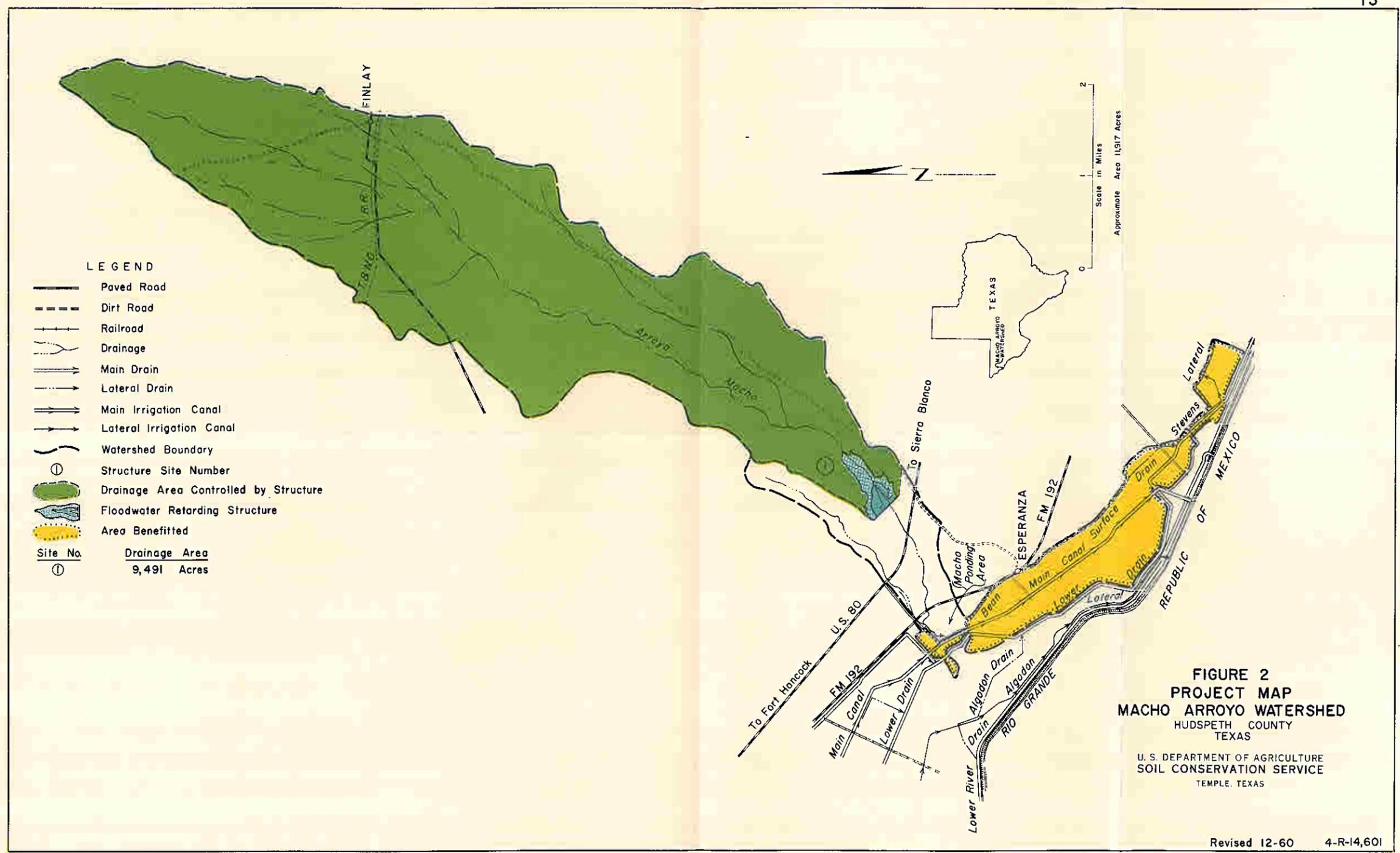


FIGURE 2
PROJECT MAP
MACHO ARROYO WATERSHED
 HUDSPETH COUNTY
 TEXAS

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

Revised 12-60 4-R-14,601
 5-60 4-R-14,553

The estimated average annual sediment yield to the Macho Ponding Area will be reduced from 5.5 acre-feet to 1.8 acre-feet. With this reduction the expected 24-year useful life of the existing ponding area will be extended beyond the 50-year project evaluation period.

The effects of the project on reduction in area inundated and direct monetary floodwater damages are shown in the following tables:

AVERAGE ANNUAL AREA INUNDATED

Condition	Area (Acres)
Without Project and With Present Capacity in Ponding Area	69
With Project and With Present Capacity in Ponding Area	0
Without Project and With Capacity in Ponding Area Depleted	132
With Project and With Capacity in Ponding Area Depleted	12

AREA INUNDATED BY AVERAGE RECURRENCE INTERVAL

Condition	Average Recurrence Interval					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)
Without Project-With Present Capacity in Ponding Area	0	109	226	415	576	772
With Project-With Present Capacity in Ponding Area	0	0	0	0	0	12
Without Project-With Capacity in Ponding Area Depleted	53	213	330	530	680	876
With Project-With Capacity in Ponding Area Depleted	0	18	47	71	96	128

DIRECT MONETARY FLOODWATER DAMAGE BY AVERAGE RECURRENCE INTERVAL

Condition	Average Recurrence Interval					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	(dollar)	(dollar)	(dollar)	(dollar)	(dollar)	(dollar)
Without Project-With Present Capacity in Ponding Area	0	9,065	19,155	34,878	50,580	68,700
With Project-With Present Capacity in Ponding Area	0	0	0	0	0	9,000
Without Project-With Capacity in Ponding Area Depleted	4,734	18,000	28,391	46,437	60,296	78,500
With Project-With Capacity in Ponding Area Depleted	0	1,401	3,789	5,807	7,910	10,600

The area on which sediment damage from overbank deposition is expected to occur will be reduced from 194 acres to 16 acres by the project, a reduction of 92 percent.

The structural works of improvement also will produce significant benefit reducing the cost of removing the sediment derived from Macho Arroyo and deposited in the rectified channel of the Rio Grande. Because of uncertainties as to the proportion of the deposition from the arroyo that will be deposited in the rectified channel, an estimate of the monetary benefits from this source was not attempted.

The economy of the entire surrounding area is dependent to an unusual extent upon the productivity of the limited area in the Rio Grande Valley that can be irrigated. All of the available cropland is concentrated here. Consequently, protection to this area, of which the project is a part, will have an influence extending far beyond the watershed boundaries.

The total flood prevention benefits as a result of the floodwater retarding structure are estimated to be \$10,561 annually. In addition to the direct monetary benefits, there are other substantial benefits which will accrue from the project such as an increased sense of economic security, better living conditions, and improved wildlife conditions, none of which have been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of the floodwater retarding structure is estimated to be \$7,798. The floodwater retarding structure is expected to produce average annual benefits of \$10,561, or \$1.35 for each dollar of cost.

ACCOMPLISHING THE PLAN

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

Land Treatment Measures

Land treatment measures will be established by farmers and ranchers in cooperation with the El Paso-Hudspeth Soil Conservation District, which is giving technical assistance in the planning and application of these measures under its ongoing program.

The El Paso-Hudspeth Soil Conservation District with the assistance of the Hudspeth County Conservation and Reclamation District No. 1 will assume aggressive leadership in the land treatment program. The landowners within the watershed will be encouraged to continue the management program now being carried out under their cooperative agreements with the soil conservation district. The Soil Conservation Service will provide technical assistance

to the El Paso-Hudspeth Soil Conservation District to assist landowners cooperating with the district.

The Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings, prepare radio, television and press releases, and use other methods of informing landowners and operators in the watershed. This activity will help to get the project for watershed protection and flood prevention carried out.

Structural Measures for Flood Prevention

The Hudspeth County Conservation and Reclamation District No. 1 will obtain the necessary land, easements, and rights-of-way; provide necessary legal, administrative and clerical personnel, facilities, supplies and equipment; advertise, award, and administer contracts; determine the legal adequacy of the easements and permits for construction of the floodwater retarding structure. No relocation of roads, utilities or improvements will be necessary. Funds for the local share of the project cost including land, easements, rights-of-way, and administration of contracts are available from existing funds which are created by a district tax and are adequate for these purposes.

The easements will be dedicated jointly to the Hudspeth County Conservation and Reclamation District No. 1 and the El Paso-Hudspeth Soil Conservation District.

All land, easements, and rights-of-way will be obtained before Public Law 566 funds are made available for construction.

The structural measure will be constructed during a 1-year installation period pursuant to the following conditions:

1. The required land treatment in the drainage area above the structure has been applied.
2. The necessary land, easements, rights-of-way, and permits have been obtained.
3. The contracting agency is prepared to discharge its responsibilities.
4. Operation and maintenance agreements have been executed.
5. The project agreements have been executed.
6. Public Law 566 funds are available.

Technical assistance will be provided by the Soil Conservation Service in 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 measure for flood prevention.

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

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by landowners or operators of farms and ranches on which the measures are installed under agreements with the El Paso-Hudspeth Soil Conservation District. Representatives of the soil conservation district will make periodic inspections of the land treatment measures to determine maintenance needs and encourage landowners and operators to perform maintenance.

Structural Measure for Flood Prevention

The floodwater retarding structure will be operated and maintained by the Hudspeth County Conservation and Reclamation District No. 1. The estimated average annual operation and maintenance cost of the structural measure is \$350 based on long-term prices. Funds for this purpose will come from district tax funds which are available and adequate for this purpose. The district will establish a reserve fund of \$1,000. When it becomes necessary to use any of the reserve fund for maintenance expenditures, the district will take appropriate action to replenish the fund in a reasonable period of time.

The floodwater retarding structure will be inspected at least annually and after each heavy rain by representatives of the Hudspeth County Conservation and Reclamation District No. 1 and the El Paso-Hudspeth Soil Conservation District. A Soil Conservation Service representative will participate in these inspections at least annually. Items of inspection will include, but will not be limited to, the condition of the principal spillway and its appurtenances, the emergency spillway, the earth fill and fences and gates installed as a part of the floodwater retarding structure.

The Soil Conservation Service, through the El Paso-Hudspeth Soil Conservation District, will participate in operation and maintenance activities only to the extent of furnishing technical assistance.

Provisions will be made for free access of representatives of the sponsoring local organizations and Federal agencies to inspect and provide maintenance for the structural measure and its appurtenance at any time.

The sponsoring local organizations will maintain a record of all maintenance inspections made and maintenance performed and have it available for inspection by Soil Conservation Service personnel.

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

The necessary maintenance work will be accomplished either by contract, f account, or through the use of equipment available to, or owned by, the Hudspeth County Conservation and Reclamation District No. 1.

COST SHARING

There are no costs associated with land treatment measures since they are continuation of existing management practices.

The required local costs for installing the structural measure, consistin the value of the land, easements, and rights-of-way (\$803) and the cost o administering contracts (\$500) are estimated at \$1,303.

The entire construction costs for the floodwater retarding structure, amo to \$162,795 will be borne by Public Law 566 funds. In addition, the inst tion services costs for \$41,981 will be a Public Law 566 expense. The to Public Law 566 cost is \$204,776 for the installation of the structural me.

The total project cost of \$206,079 will be shared 99.4 percent (\$204,776) Public Law 566 funds and 0.6 percent (\$1,303) by other than Public Law 566 funds.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

This project plan conforms to all Federal laws and regulations and will ha no known detrimental effects on any downstream projects which are now in existence or that might be constructed in the future.

SECTION 2

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

Drainage Area: 18.62 square miles or 11,917 a
 Area Subject to Floodwater Damage: 1,393 a
 Benefited Area: 1,393 a
 Area of land below retarding structure that will be flooded:
 (By once in 100-year storm on average)

Without Project: 876 acres
 With Project: 128 acres

Number of owners of land benefited from structural measure . . 12
 in the damage area and all of the approximately 90 landowners in the
 Hudspeth County Conservation and Reclamation District No. 1.
 Range in benefited acreage owned: 13 acres to 340 a
 Estimated current market price of land in benefited area: . . \$600/a
 Estimated current market price of agricultural upland: . . . \$ 10/a

Land Use in Watershed

Land Use	: <u>Damage Area (Acres)</u> :		<u>Upland (Acres)</u>	
	: Without :	With :	Without :	With :
	: Project :	Project :	Project :	Project :
Irrigated Cropland	1,268	1,268	0	0
Rangeland	0	0	10,391	10,364
Miscellaneous Uses (Canals, drainage ditches, roads, farmsteads, etc.)	125	125	133	160

Structural Measures

Floodwater Retarding Structures: 1
 Floodwater detention capacity: 1,661 acre feet
 Sediment storage capacity: 253 acre feet
 Percent watershed control by structure: 80

<u>Cost of Project</u>	<u>P. L. 566 Funds</u> (dollars)	<u>Other Funds</u> (dollars)	<u>Total</u> (dollars)
Land Treatment Measures	0	0	0
Structural Measures	204,776	1,303	206,079
Total Project	204,776	1,303	206,079

Damages and Benefits

Present average annual flood damages:	\$11,
Crop and Pasture:	\$7,044
Other Agricultural:	\$2,095
Sediment:	\$ 887
Indirect:	\$1,003
Reduction in average annual damage by project: (percent)	
Total average annual benefits expected from structural measures	\$10,
Total average annual costs of structural measures:	\$ 7,
Annual equivalent cost of project installation	\$7,448
Annual operation and maintenance	\$ 350
Benefit-cost ratio:	1.

INVESTIGATIONS AND ANALYSES

Project Formulation

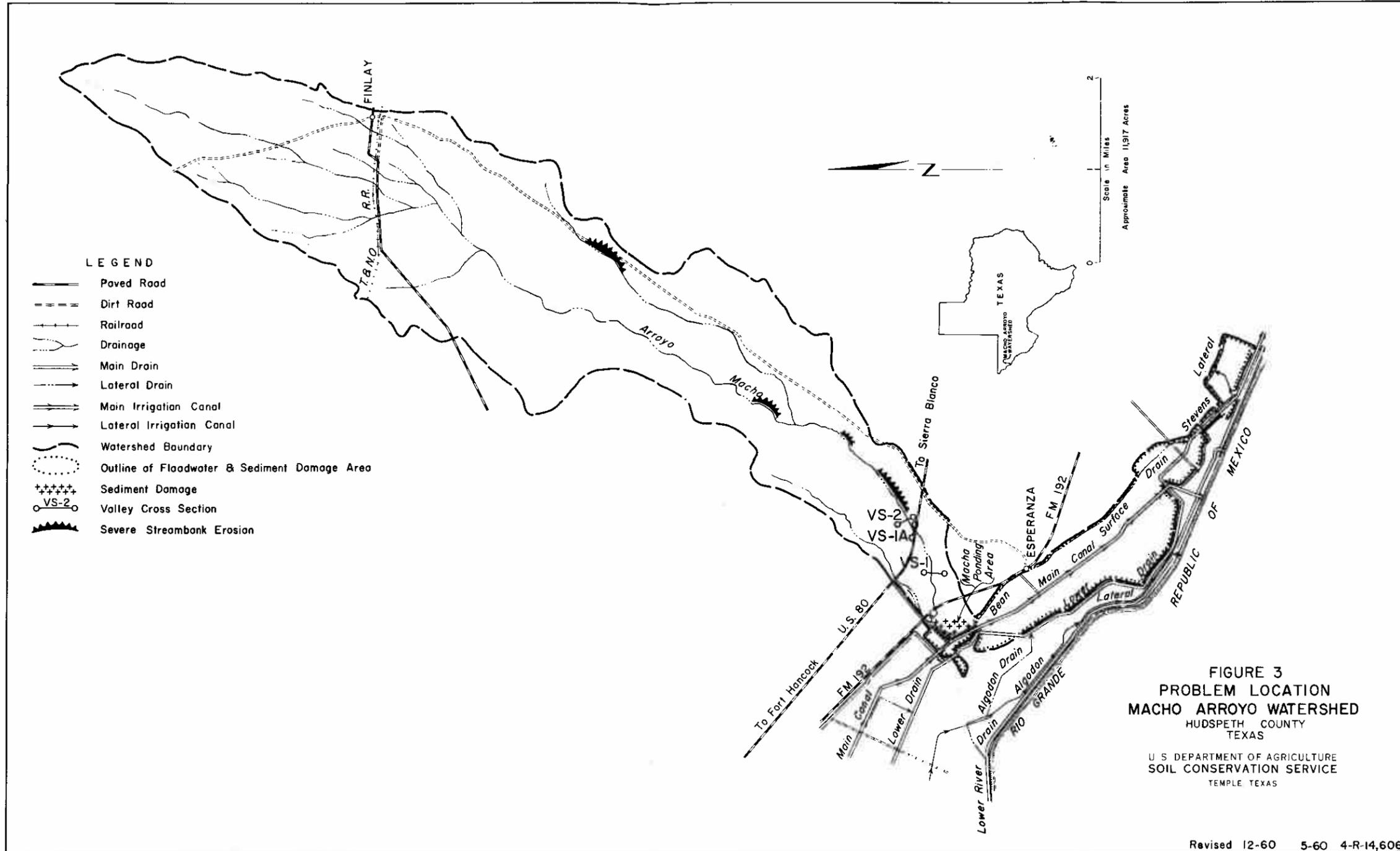
Project Objectives

Flood problems and project objectives were discussed with representatives of the Hudspeth County Conservation and Reclamation District No. 1, El Paso-Hudspeth Soil Conservation District, and the Hudspeth County Commissioner's Court. The project objectives desired by the sponsoring local organizations were to provide a degree of flood protection that would result in a reduction of at least 75 percent in existing damages. A further objective was to provide for the anticipated increase in damages due to depletion of floodwater and sediment capacity in the Macho Ponding Area.

The local sponsors considered the possibility of incorporating storage for agricultural water management and fish and wildlife development in any floodwater retarding structure that might be included in the plan. They decided that neither of these purposes should be included because of the low and uncertain water yield from the watershed.

Land Treatment Measures

The needed and feasible land treatment for the watershed, as shown in Table 1, was developed by the soil conservation district assisted by personnel of the Soil Conservation Service at Fabens. Conservation needs data were compiled from existing conservation plans within the watershed for each land treatment practice which contributes directly to flood prevention to be applied and maintained during the project life. The hydraulic, hydrologic, sedimentation and economic investigations provided data on the effect of these measures related to sediment and floodwater damages. These investigations showed that due to climatic, geologic and economic conditions that prevail in the watershed, the establishment of needed land treatment measures on the rangeland would be too slow to effect a significant benefit within a reasonable length of time. 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.



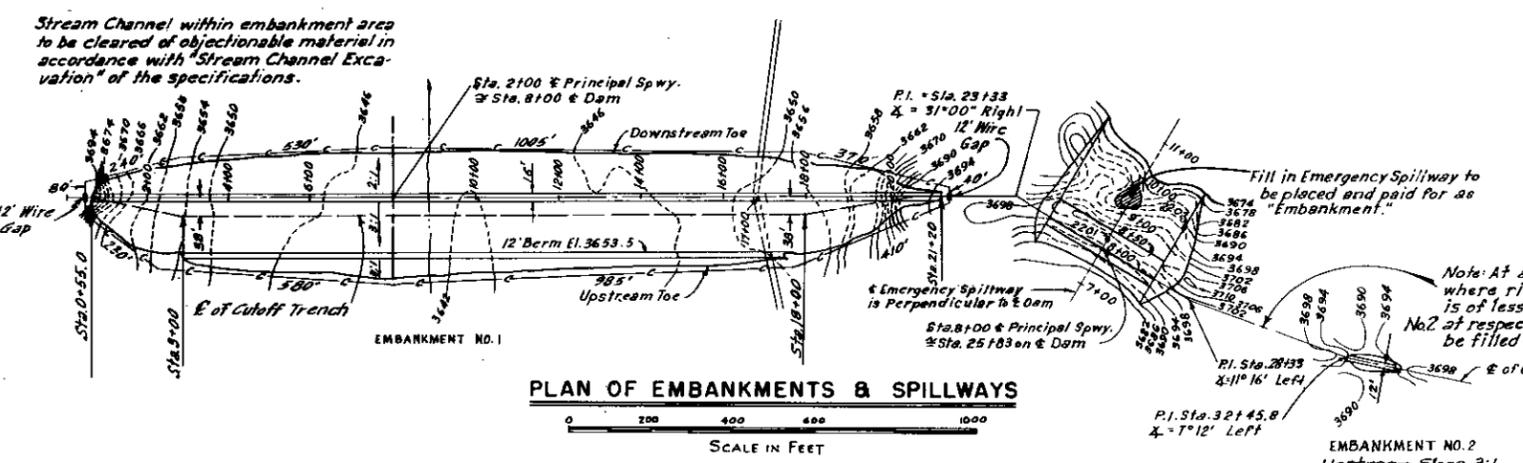
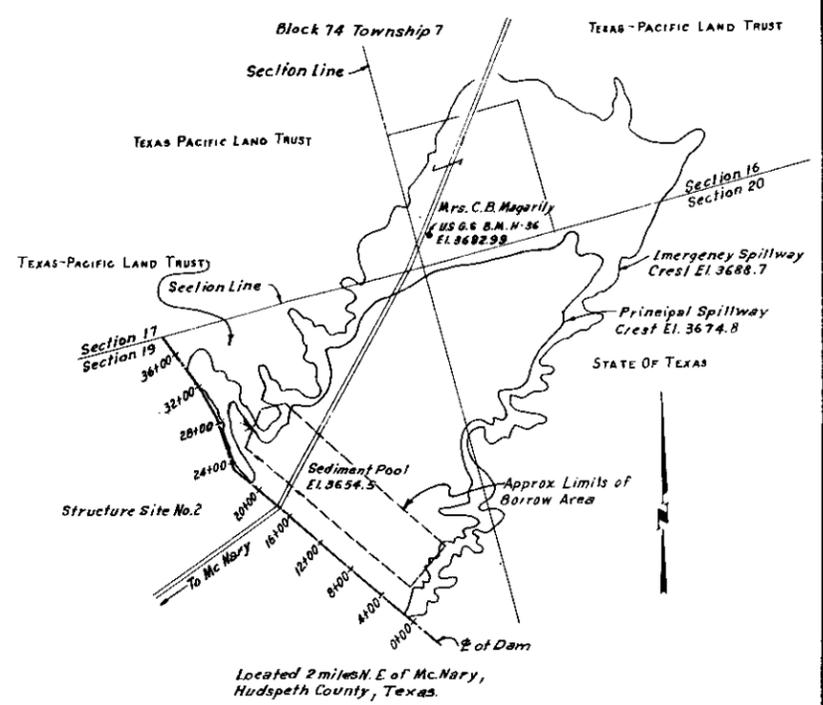
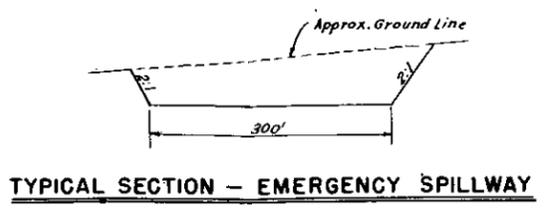
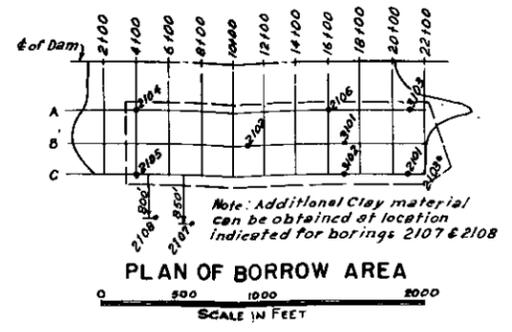
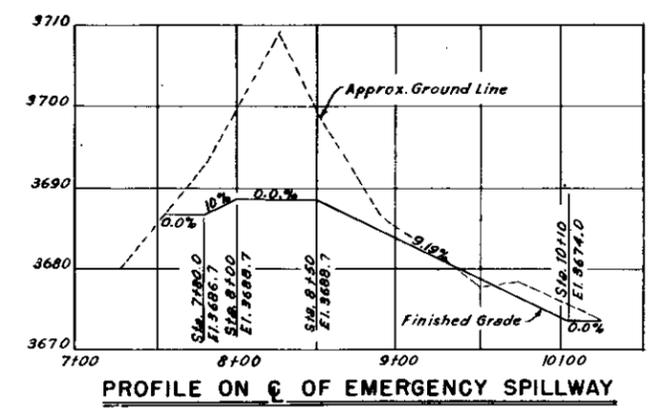
Structural Measures

Structural measures for flood prevention needed to attain the project objectives were then determined. The study made and the procedures used in the determination were as follows:

1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads and railroads, and other pertinent information. Three probable floodwater retarding structure sites were located by field inspection and stereoscopic study of 4-inch consecutive aerial photographs. Valley cross sections were selected to represent adequately the hydraulic characteristics of the flood plain and stream channel. Surveys were made of the valley cross sections at these selected locations. Data developed from these valley cross sections permitted the computation of stage-discharge relationships for various flows. A map was prepared of the flood plain on which land use, valley cross section locations and other pertinent information were recorded.
2. Three sites were selected for detailed study. Plans of a floodwater retarding structure, typical of the one planned for the watershed, are illustrated by Figures 4 and 4A.
3. Sufficient surveys were made to determine which of these three probable sites would be the most economical and feasible to install. A topographic map was made of the pool, dam, and spillway areas of this site to determine the storage capacity of the site, the estimated cost of the dam including spillway, the pool areas, and the area involved in the dam and spillway. The height of the dam and the size of the pools were determined by criteria outlines in Washington Engineering Memorandum SCS-27, and Texas State Manual Supplement 2441. The limits of the detention and sediment pools of the proposed floodwater retarding structure and the flood plain of the stream were drawn to scale on a copy of the base map.

Structure data tables were developed to show for the proposed structure, the drainage area, the capacity needed for floodwater detention and for sediment storage in acre-feet and in inches of runoff from the drainage area, the release rate of the principal spillway, the area inundated by the sediment and detention pools, the volume of fill in the dam, the estimated cost of the structure, and other pertinent data (tables 2, 3, and 5).

4. Preliminary investigations of streambed materials and stream gradients indicated the possibility of stream channel degradation occurring from the prolonged release flows from the



GENERAL PLAN OF RESERVOIR AND VICINITY MAP
SCALE IN FEET

ELEVATION	SURFACE ACRES	STORAGE	
		ACRE FEET	INCHES
3654	37	179	.14
3654.5	40	198	.15
3658	58	369	.28
3662	77	639	.49
3666	99	991	.76
3670	126	1441	1.10
3674	142	1977	1.52
3674.8	147	2093	1.60
3678	168	2597	1.99
3680.2	182	2982	2.29
3682	194	3320	2.54
3686	237	4182	3.20
3688.7	263	4857	3.72
3690	276	5207	3.99

Top of Dam (Effective) Elev.	3694.3
Emergency Spillway Crest Elev.	3688.7
Principal Spillway Crest Elev.	3674.8
Sediment Pool Elev.	3654.5
Drainage Area, Acres	156.60
Sediment Storage, Acre Feet	2982
Floodwater Storage, Acre Feet	1875
Max Emergency Spillway Cap., cfs	8480

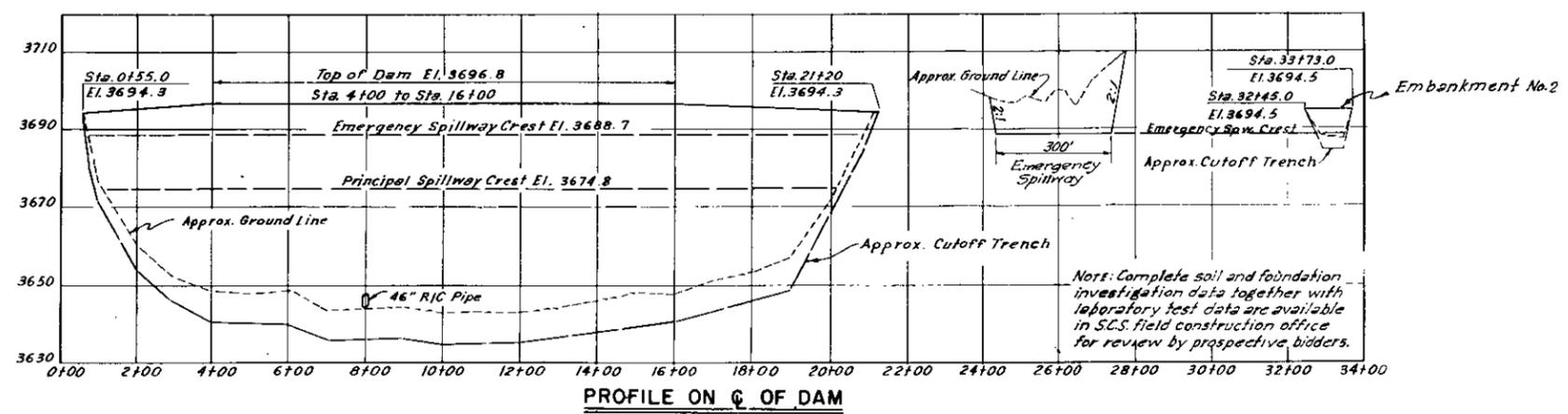


Figure 4
TYPICAL
FLOODWATER RETARDING STRUCTURE
PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	J. L. & M. G. C.	Date	12-58	Approved by	[Signature]
Drawn	L. L. & M. G. C.	Date	12-58	Checked	[Signature]
Traced	M. G. C.	Date	12-58	Sheet	No. 2 of 7
Checked	L. L. & M. G. C.	Date	12-58	Drawing No.	4-E-12,893

proposed floodwater retarding structure. Detailed investigations were then made of channel gradients, hydraulic characteristics of the channel and the channel bed material. These investigations determined that no significant channel degradation will result from the installation of the proposed floodwater retarding structure.

5. A topographic map was made of the Macho Ponding Area to determine the present storage capacity. Necessary surveys were made of outlets and drainage ditches to determine the peak flows that could be discharged safely.
6. The sponsoring local organizations or other interests did not desire to incorporate additional water storage for any agricultural or nonagricultural purposes due to the inadequacy of firm water yield.
7. Damages resulting from floodwater and sediment were determined from damage schedules, surveys of sample areas, and routings of flood volumes under present conditions. Reductions in these damages resulting from the proposed works of improvement were estimated on the basis of reduction of flood volumes as determined by flood routings under future conditions for which it was assumed that the proposed works of improvement had been installed. In this manner it was determined that the floodwater retarding structure would be justified economically.

When the structural measure for flood prevention had been determined, a table was developed to show the cost of the measure (table 2). The sum of the total costs for all works of improvement 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 measure (table 6).

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from Climatological Bulletins, U. S. Weather Bureau and Water Supply Papers, U. S. Geological Survey. These data were analyzed to determine average precipitation depth-duration relationships, seasonal distribution of precipitation, runoff-peak discharge relationship and the relationship of geology, soils and climate to runoff depth for single storm events.
2. Engineering surveys were made to collect information, including valley cross sections, channel capacities, bridge capacities

and other hydraulic characteristics, on selected stream reaches, and on the proposed floodwater retarding structure site.

3. Hydrologic conditions of the watershed were determined by considering such factors as climate, geology, topography, soils, land use and cover. From this, soil-cover complex data were assembled, and rainfall-runoff relationships were computed for use in determining depth of runoff. These data were compared to the best available gaged runoff data.
4. The period 1915 through 1958 was selected as the most representative of normal precipitation in the watershed, and is the period from which the annual runoff frequency line for evaluation was developed.
5. At the present time the floodwaters from the hill areas are directed into a ponding area from which they overflow onto the relatively flat and broad flood plain. The magnitude of the area inundated can be determined but the location cannot be predicted for any single flood event. It was determined that the area flooded is not a direct function of peak discharge, but is directly related to flood volume. Therefore the "overland flow" method was used to determine the area that would be inundated by the volumes of runoff for selected frequencies used in the evaluation for each of the following conditions:
 - a. Without project and with present capacity in ponding area.
 - b. Without project and with capacity in ponding area depleted.
 - c. With project and with present capacity in ponding area.
 - d. With project and with capacity in ponding area depleted.
6. The appropriate design storm and storm pattern was selected from figures 3.21-1 and 3.21-4, National Engineering Handbook, Section 4, Supplement A, in accordance with criteria contained in Washington Engineering Memorandum SCS-27, and Texas State Manual Supplement 2441.
7. Spillway design hydrographs were developed for the floodwater retarding structure by the distribution graph method. The emergency spillway depth and width was determined by using the Goodrich flood routing method described on page 5, 8-12, NEH, Section 5.

8. Emergency spillway capacities were determined in accordance with Technical Release No. 2 (Tentative) Washington Design Section dated October 1, 1956; Supplement A to Tentative Technical Release No. 2 dated May 13, 1957; Section 3.21, NEH, Section 4, Supplement A; and Texas State Manual Supplement 2441.
9. In determining the maximum release rate for the principal spillway of the floodwater retarding structure primary consideration was given to the effect of the release flow on the stability of the stream channel and the peak flows that could be discharged safely into the existing drainage system. The maximum release rate will be 3 c.s.m. for this site.

The structure classification, minimum storage required and actual floodwa storage planned for the structure is shown in the following table:

Structure Number	Classification	Minimum Floodwater Detention Required <u>1/</u> (inches)	Actual Floodwa Detention Planne (inches)
1	B	0.74	2.10

1/ For Class B structure - 50-year frequency based on regional analysis gaged runoff.

Detention volume in excess of the minimum established by the criteria in Texas State Manual Supplement 2441 was used for the site to decrease the chance of use of the emergency spillway because of the extremely erosive soils in the exit channel.

Sedimentation Investigations

Sedimentation investigations for the work plan were made in accordance with procedures in Watershed Memorandum EWP-7, "Sedimentation Investigations in Work Plan Development," August 21, 1959, Fort Worth, Texas.

Sediment Source Studies

A detailed investigation of sediment sources to determine the sediment storage requirement for a 50-year period was made in the drainage area of the plan floodwater retarding structure according to the following procedures:

1. The field survey included:
 - a. Mapping soil units by slope in percent, slope length, present land use, present cover condition classes on range land, and land capability classes.
 - b. Determining the lengths, widths, depths and estimating the average annual lateral erosion of all stream channels and gullies affected by erosion.

2. Office computations included summarizing erosion by sources (sheet and channel) in order to fit these data into formulas for computation of the annual gross erosion in tons. The sediment rate to the structure was determined by adjusting annual gross erosion for estimated delivery rates, transportation of bedload material due to channel degradation, trap efficiency, and the ratio of sediment storage volume in the sediment pool to soil in place. The allocation of sediment to the structure pools is estimated to be 70 percent deposition in the sediment pool and 30 percent in the detention pool.
3. Detailed sedimentation surveys of floodwater retarding structures in the San Felipe watershed located in El Paso County, the use of aerial photographs, and interviews with local people provided important information in this study.

Flood Plain and Ponding Area Sedimentation

The type of investigation described under Sediment Source Studies was made both above and below the planned floodwater retarding structure. This investigation was made in order to estimate the amount of sediment deposition on irrigated cropland and the rate of depletion of the storage capacity of the Macho Ponding Area with and without the project installed.

The estimated volume of sediment was adjusted for trap efficiency of the ponding area and sediment transported out of the watershed by irrigation canals and drainage ditches. The texture of expected deposition was also considered in assigning damage categories both before and after depletion of the ponding area.

A brief field study was made of existing deposition on the irrigated crop below the ponding area, but due to the slight thickness of deposits, little damage was observed.

Channel Stability and Bedload Transport Studies

The following studies were made to predict channel behavior and bedload transport after installation of the floodwater retarding structure:

1. Channel Stability

Two equally spaced cross sections were selected for sampling below the floodwater retarding structure site. Dozer pits were dug along each cross section, and samples were taken for each 2-foot increment down to a total depth of 10 feet. Samples were composited at each 2-foot increment and submitted for laboratory analyses. Grain size distribution graphs were then plotted for each 2-foot increment of depth showing the median particle size.

A plan map of the channel below the structure site was prepared showing valley cross sections and slope of the channel. Data from rating curve computation work sheets were used to plot release flow velocity curves.

For the purpose of this study a 30-year period of annual maximum 24-hour rainfall was tabulated. From this a frequency analysis was made and annual runoff was computed to be 0.25 inch based on existing cover conditions and soil characteristics. The analysis further showed that with the release rate of 3 c.s.m. to be used, significant flows will have an average duration of 2.2 days per year.

Mean and maximum velocities were computed for each valley section below the structure site. These were compared with permissible velocities, as shown in "Design of Stable Channels" by Emory Lane, American Society of Civil Engineers Transactions, 1955, Paper Number 2776, Volume 120. Table 2 of the above paper shows permissible velocities of the median size diameter of noncohesive materials ranging in texture from clay to pebbles. Based on these comparisons it was determined that velocities, using a 3 c.s.m. release rate, are not critical for the median size bed material.

2. Bedload Transport

The Meyer-Peter equation as defined in the review draft of the unnumbered Technical Release "Guide to Field Investigations and Computations of Channel Stability", U. S. Department of Agriculture, Soil Conservation Service, Engineering Division, Washington D. C., was used in computing the total annual bedload transport of the gravelly materials below the structure site to the ponding area. This computation showed this volume to be 0.001 acre-foot annually which is negligible. This estimate is based upon an average channel width of 193 feet, discharge duration of 2.2 days annually, and with the bed material having a dry weight of 120 pounds per cubic foot.

Geologic Investigations

A preliminary geologic investigation was made at the planned floodwater retarding structure site. This investigation included lithologic and stratigraphic studies of the valley slopes, alluvium, channel banks, and exposed geologic formations. Hand auger borings were made to collect information on the nature and extent of embankment material, emergency spillway excavation, and possible problems that might be encountered in construction.

Description of Problems

The structure site is located on coarse grained sediments of Pleistocene

terraces and Recent alluvium underlain by clay with some apparent degree dispersion. Selective placement of embankment materials may be necessary if this clay is used. Soils available for construction, as classified in accordance with the Unified Soil Classification System, are SP, SC, SM and CL. There will be no rock encountered in emergency spillway excavation.

Detailed investigations, including exploration with core-drilling equipment will be made at the floodwater retarding structure site prior to construction. Laboratory tests will be made to determine the suitability and method of handling the materials to be used in the embankment and the stability foundation strata.

Economic Investigations

Determination of Annual Benefits from Reduction in Damages

Damage schedules covering approximately 75 percent of the area subject to floodwater damage were obtained from landowners or operators. These schedules covered land use and crop distribution, yields and historical data on flooding and flood damages. Most of the flood damage information obtained was from floods which occurred in 1953 and 1958. Analysis of the information contained therein formed the basis for determining damage rates for various seasons and depths of flooding.

In the calculation of crop and pasture damage the expenses saved, such as cost of harvesting and other production inputs, were deducted from the gross value of the damage. The land use in the area subject to damage was obtained by field mapping and from analysis of annual crop reports prepared by the Hudspeth County Conservation and Reclamation District No. 1. Estimates of normal flood-free yields were based on data obtained from schedules and from the annual crop reports of the district. Information on other agricultural damages to "on farm" facilities, such as damage to field laterals, farm equipment and buildings, and necessary land re-leveling due to overflow, was obtained from analysis of schedules. Damages to the district operated and maintained facilities such as irrigation canals and appurtenances, drainage ditches, and bridges were obtained from files of the district and correlated with size of flood. Information was obtained from railroad, county and State Highway officials and others concerning nonagricultural damages. From this information it was determined that nonagricultural damages in the watershed are negligible.

A study of the flood history and physical features of the area subject to damage indicated that damages could best be appraised by the "overland flow method," as outlined in Chapter 3 of the Economics Guide. Information was obtained from the local people and correlated with specific flood events. It was estimated that each acre-foot of floodwater discharged onto the dam area would inundate 1.12 acres.

Floodwater volume was calculated, by frequency of occurrence, and converted to acres inundated for each of the following conditions:

1. Without project and with the present capacity in the ponding area available for flood prevention.
2. Without project and with the capacity in the ponding area depleted.
3. With project and with the present capacity in the ponding area available for flood prevention.
4. With project and with capacity in the ponding area depleted.

Average annual floodwater damages were calculated for all of the above conditions. A summary of damages for "Without Project" and "With Project" conditions was developed by adding to the existing damages the appropriately discounted additional damages expected to occur because of the depletion capacity in the ponding area.

The monetary value of the physical damage to irrigated cropland from deposition of sediment was based on the discounted net value of the expected production loss during the life of the project.

Indirect damages in the watershed primarily involve extra travel to field production and related losses when irrigation and drainage services are disrupted, and losses sustained by businesses and dealers in the area. Upon analysis it appears that these damages are about 10 percent of the direct damage.

Farmers and ranchers in the area subject to damage were asked to state changes made in land use as a result of past flooding. Operators also were asked what changes they would make in their use of the land if flooding were reduced. Their responses indicated that the land was presently being operated as intensively as available irrigation water and good conservation rotations allowed. Consequently no benefits were calculated from restoration of former productivity or changed land use of agricultural land.

An estimate was made of the value of production lost in the pool areas of floodwater retarding structure after installation of the project. In this appraisal it was considered that there would be no production in the sediment pool. The land covered by the detention pool is rangeland and it is assumed that it will so remain. The cost of land, easements, and rights-of-way for the floodwater retarding structure was determined by appraisals in cooperation with representatives of the sponsoring local organizations. The structure site cost was based on an appraisal of the value of the land with consideration given to the value that will remain after the land is devoted to project purposes. The average annual net loss in production, based on long term prices, within the site was calculated and this value compared with the amortized cost of the structure site. The larger amount was used in the economic evaluation of the project to assure a conservative estimate.

Details of Methodology

Details of the procedures used in the investigations are described in the Conservation Service Economic Guide for Watershed Protection and Flood Prevention, December, 1958.

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Macho Arroyo Watershed, Texas
Price Base: 1960

Structure Number	Installation Cost - Public Law 566 Funds		Installation Service		Installation Cost - Other Funds		Total Installation Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
	Construction	Engineer's Estimate	Engineer's Estimate	Other	Adm. of Contracts	Easements and R/W	Total
	14,800	14,800	29,303	12,678	204,776	500	206,079
	147,995	14,800	29,303	12,678	204,776	500	206,079
	147,995	14,800	29,303	12,678	204,776	500	206,079

Floodwater Retarding Structure

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURE

Macho Arroyo Watershed, Texas

Item	Unit	Structure Number	Total
Drainage Area	Sq. Mi.	14.83	14.
Storage Capacity			
Sediment Pool	Ac. Ft.	190	1
Sediment Reserve Below Riser	Ac. Ft.	0	
Sediment in Detention Pool	Ac. Ft.	63	
Floodwater Detention	Ac. Ft.	1,661	1,6
Total	Ac. Ft.	1,914	1,9
Surface Area			
Sediment Pool	Acre	27	
Floodwater Detention Pool	Acre	107	1
Volume of Fill	Cu. Yd	295,990	295,9
Elevation Top of Dam	Foot	3,629.4	xx
Maximum Height of Dam	Foot	49	xx
Emergency Spillway			
Crest Elevation	Foot	3,625.3	xx
Bottom Width	Foot	300	xx
Type	-	Earth	xx
Percent Chance of Use <u>1/</u>	-	1.0	xx
Average Curve Number - Condition II	-	77	xx
Emergency Spillway Hydrograph			
Storm Rainfall (6-Hour) x 0.75 P	Inch	4.36	xx
Storm Runoff	Inch	2.10	xx
Velocity of Flow (Vc) <u>2/</u>	Ft./Sec.	0	xx
Discharge Rate <u>2/</u>	c. f. s.	0	xx
Maximum Water Surface Elevation <u>2/</u>	Foot	-	xx
Freeboard Hydrograph			
Storm Rainfall (6-Hour) x 1.3 P	Inch	7.55	xx
Storm Runoff	Inch	4.86	xx
Velocity of Flow <u>2/</u>	Ft./Sec.	8.8	xx
Discharge Rate <u>2/</u>	c. f. s.	6,555	xx
Maximum Water Surface Elevation <u>2/</u>	Foot	3,629.4	xx
Principal Spillway			
Capacity (Maximum)	c. f. s.	45	xx
Capacity Equivalents			
Sediment Volume	Inch	0.32	xx
Detention Volume	Inch	2.10	xx
Spillway Storage	Inch	0.59	xx
Class of Structure	-	B	xx

1/ Based on regional analysis of gaged runoff.

2/ Maximum during passage of hydrograph.

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TABLE 4 - SUMMARY OF PHYSICAL DATA

Macho Arroyo Watershed, Texas

Item	: : Unit :	: Quantity : Without : Project	: : Quantity : With : Project
Watershed Area	Sq.Mi.	18.62	-
Watershed Area	Acre	11,917	-
Area of Cropland	Acre	1,268	1,268
Area of Rangeland	Acre	10,391	10,364
Area of Miscellaneous Use	Acre	258	285
Overflow Area Subject to Damage	Acre	876 <u>1/</u>	128 <u>1</u>
Overflow Area Damaged By:			
Flood Plain Sedimentation	Acre	194 <u>2/</u>	16 <u>2</u>
Annual Rate of Erosion			
Sheet	Ac. Ft.	7.6	7.6
Gully	Ac.Ft.	0.2	0.2
Stream Channel	Ac.Ft.	3.5	3.5
Sediment Deposition in Ponding Area	Ac.Ft./Yr.	3.9	1.2
Average Annual Rainfall	Inch	8.00	-

1/ Area inundated by the runoff from a 1 percent chance storm event and may occur anywhere within the 1,393 acre irrigated area subject to flood damage.

2/ Area on which some annual loss of production will occur by the end of the project evaluation period.

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TABLE 5 - SUMMARY OF PLAN DATA

Macho Arroyo Watershed, Texas

Item	:	Unit	:	Quantity
Years to Complete Project		Year		1
Total Installation Cost				
Public Law 566 Funds		Dollar		204,776
Other		Dollar		1,303
Annual O and M Cost				
Public Law 566 Funds		Dollar		0
Other		Dollar		350
Average Annual Monetary Benefits <u>1/</u>		Dollar		10,561
Agricultural		Percent		100.0
Nonagricultural		Percent		0.0
Structural Measure				
Floodwater Retarding Structure		Each		1
Area Inundated by Structure				
Flood Plain				
Sediment Pool		Acre		0
Detention Pool		Acre		0
Upland				
Sediment Pool		Acre		27
Detention Pool		Acre		80
Watershed Area Above Structure		Acre		9,491
Reduction of Floodwater Damages		Dollar		8,786
By Land Treatment Measures				
Watershed Protection		Percent		0.0
By Structural Measure		Percent		96.1
Reduction of Sediment Damage		Dollar		815
By Land Treatment Measures				
Watershed Protection		Percent		0.0
By Structural Measure		Percent		91.9

1/ From Structural Measure.

TABLE 6 - ANNUAL COST

Macho Arroyo Watershed, Texas

Measures	Operation and Maintenance Costs ^{2/}				Total Annual Costs (dollars)
	Amortization of Installation Cost ^{1/} (dollars)	Public Law 566 (dollars)	Other (dollars)	Total (dollars)	
Floodwater Retarding Structure					
1	7,448	0	350	350	7,798
TOTAL	7,448	0	350	350	7,798

^{1/} Price Base: 1960 prices amortized for 50 years at 2.5/8 percent.

^{2/} Long-term prices as projected by ARS, September 1957.

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TABLE 7 - MONETARY BENEFITS FROM STRUCTURAL MEASURES

Macho Arroyo Watershed, Texas
Price Base: Long-Term 1/

Item	Estimated Average Annual Damage			
	Without Project	After Land Treatment for W/S Protection	With Project	Average Annual Monetary Benefit
	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Damage				
Crop and Pasture	7,044	7,044	289	6,755
Other Agricultural	2,095	2,095	64	2,031
Subtotal	9,139	9,139	353	8,786
Sediment Damage				
Overbank Deposition	887	887	72	815
Subtotal	887	887	72	815
Indirect Damage	1,003	1,003	43	960
Total, All Damages	11,029	11,029	468	10,561
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	10,561
TOTAL PRIMARY BENEFITS	xxx	xxx	xxx	10,561
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	10,561

1/ As projected by ARS, September 1957.

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TABLE 8 - BENEFIT COST ANALYSIS

Macho Arroyo Watershed, Texas

Measures	AVERAGE ANNUAL BENEFITS ^{1/}		Average		Benefit Cost Ratio
	Floodwater (dollars)	Sediment : Indirect : Total : (dollars)	Annual Cost <u>2/</u> (dollars)	Annual Cost (dollars)	
Floodwater Retarding Structure					
1	8,786	815 960	10,561	7,798	1.4:1
GRAND TOTAL	8,786	815 960	10,561	7,798	1.4:1

^{1/} Price Base: Long-term prices as projected by ARS, September 1957.

^{2/} Derived from installation costs based on 1960 price level and operation and maintenance cost based on long-term price levels as projected by ARS, September 1957.

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