WORK PLAN

FOR WATERSHED PROTECTION AND FLOOD PREVENTION

MARGARET CREEK WATERSHED

Athens County, Ohio

WATERSHED WORK PLAN

MARGARET CREEK WATERSHED

Athens, County, Ohio

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

Prepared by:

Athens County Board of Commissioners

Athens Soil and Water Conservation District

Margaret Creek Conservancy District

Ohio Department of Natural Resources

Village of Albany, Ohio

With Assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

February 1965

TABLE OF CONTENTS

TABLE OF CONTENTS (Contd.)

MARGARET CREEK WATERSHED

Athens County, Ohio

February 1965

SUMMARY OF PLAN

This plan for watershed protection, flood prevention, municipal water supply and recreational development in the Margaret Creek Watershed was prepared by the Athens Soil and Water Conservation District, the Athens County Board of Commissioners, the Village of Albany, Ohio, the State of Ohio and the Margaret Creek Conservancy District as sponsoring local organizations.

The Margaret Creek Watershed consisting of 60.3 square miles (38,600 acres), is located in the southwestern portion of Athens County. Athens County is located in southeastern Ohio.

Floods, causing extensive damage to rural lands, fences and buildings, and transportation facilities occur frequently in this watershed. As recently as March, 1964, 2.7 inches of rainfall in 30 hours on saturated ground produced an estimated $40,750 damage. In March, 1963, flood damages were reported at $51,000. Again in June, 1961, an estimated 1,100 acres were inundated causing $30,600 damage to crops, pasture and transportation facilities.

The objectives of the sponsors are: 1) to provide proper land use and treatment in the watershed thereby reducing soil erosion; 2) to reduce flood damage to flood plain lands, rural properties and transportation facilities; 3) to provide water storage for the Village of Albany and surrounding community; and 4) to install water storage and basic facilities for public recreational development.

The planned works of improvement include four flood prevention impoundments, a multiple purpose-flood prevention-fish and wildlife reservoir, a multiple purpose-flood prevention-municipal water supply-recreation reservoir with basic recreational facilities and 9.8 miles of channel improvement. These recommended measures will be installed over a five year period.

The Margaret Creek Conservancy District plans to provide storage capacity in Structure No. 2 for water supply and water-based recreation. Construction of water-based recreation facilities, including a camping area, picnic area, boat docks, launching ramp and beach facilities, are planned adjacent to this proposed 137 acre lake. Water supply capacity in the amount of 380 acre feet is planned to meet the present and future needs of the of the Albany community.

Storage capacity will be incorporated in Structure No. 6 to create a 46 acre fish and wildlife reservoir which will be operated by the Ohio Department of Natural Resources.

When installed, this project will provide watershed protection by reducing soil loss, water runoff, and sedimentation; and flood prevention by reducing annual flood damages to agricultural lands, roads, bridges and railroads.

There are 256 farms in the watershed averaging 140 acres in size. Forty-nine per cent, or 127 farms, have basic farm plans with the Athens Soil and Water Conservation District. Landowners and operators will install land treatment measures under agreement with their Soil and Water Conservation District. The estimated cost of this work is $227,608. Technical assistance will be provided by PL 566 funds amounting to $21,822.

The four single-purpose flood prevention structures, the two multiple purpose reservoirs and the 9.8 miles of channel improvement will be installed through contracts administered by the Margaret Creek Conservancy District.

The cost of all structural measures is $998.632. The PL 566 share is $660,982 of which $210,592 is for recreational development and facilities. The Other than PL 566 share is $337,650. The Other funds include: $164,604 for water supply and recreation construction; $18,943 for installation services; $133,775 for lands, easements, and rights-of-way; and $20,328 for administration of contracts.

The District will be responsible for the operation and maintenance of all structural measures. Total annual cost of operation and maintenance is $25,227 which includes $20,142 for the operations and maintenance of the recreational facility at Structure No. 2.

Annual benefits due to flood prevention, water supply and recreation amount to $85,449. Redevelopment and secondary benefits total $2,065 and $8,659 respectively. Structural measures as planned will return average annual benefits of $96,173. Annual costs amount to $57,942. The benefit-cost ratio is 1.7:1.0.

DESCRIPTION OF THE WATERSHED

Physical Data:

General - Margaret Creek Watershed lies in the southwestern part of Athens County, Ohio, and is comprised of 38,600 acres (60.3 square miles). Rectangular in shape, the drainage is rock-controlled conforming to a treelike pattern. The principal valley containing Margaret Creek has a northeastern trend. Factory Creek, West Branch, North Branch and Biddle Creek, plus numerous small tributaries contribute surface flow and induce flooding along the main stem.

The topography is steep adjacent to the major stream valleys with moderately flat ridge tops comprising the upland agricultural lands. The flood plain along the main stem averages 1/8 mile wide except at the tributary entrants where it increases to 1/2 mile. The main stem has a gradient of approximately 5 feet per mile. The flood plain of Margaret Creek and the major tributaries represent a length of approximately 20 miles and covers 1,680 acres.

The maximum difference in elevation between the flood plain and the upland divide varies from 273 feet in the north to 227 feet in the southern part of the watershed. There are two villages, Albany and Hebardville, within the watershed. Two railroads, three state highways and one federal highway traverse the project area. A number of large gas transmission lines cross the watershed. Some oil or gas wells with local transmission lines are also present in the watershed.

Geology and Soils - The watershed lies, geologically, in the unglaciated Central Allegheny Plateau land resource area. Some evidence of Pleistocene glaciation is found in the alluvial valley sediments of Margaret Creek through the area from Albany to the Hocking River. Deposition of outwash materials, by large volumes of glacial melt waters coming from the north, have influenced the soils in this valley flood plain.

The upland tributary drainage ways fall predominantly in the residual complex of interbedded sandstone, shale with some limestone and coal horizons of the Pennsylvanian Conemaugh Formation.

The eastern divide of the watershed is touched by the fringe of the younger Monongahela formation of Pennsylvanian age composed of an interbedding of sandstone, shale, and coal. Some coal is being recovered by modern strip mine operations in the southeastern extreme of the watershed.

A shallow prehistoric rock valley of Teays age follows the general course of Margaret Creek and has a valley fill of approximately 30 feet.

Most soils in the upland are complex in that they are weathered from the unglaciated residual sandstone, shale and occasionally limestone. Sixty-five per cent of all upland soils fall within the Muskingum-Keene-Wellston complex and lie west of the Margaret Creek valley. The remaining 35 per cent of the upland soils, lying east of this valley, are in the Westmoreland-Muskingum complex. All upland soils are predominantly well drained.

The bottomland soils fall in the Pope series - alluviated erosional products from the surrounding residual uplands. Second bottom or terrace remnants from Pleistocene glacial outwash have given rise to the development of soils in the Chili series most of which are well drained.

Of the 1,474 acres of the soils subject to flooding within the benefited flood plain 20 per cent or 295 acres are imperfectly or poorly drained internally.

Water - Margaret Creek rises in the steep uplands near the southern watershed divide and flows northeastward to its confluence with the Hocking River in the vicinity of Athens, Ohio. The Hocking River continues southeastward and empties into the Ohio River at Hockingport, Athens County, Ohio. Three of the largest tributaries enter the main stem from the west and northwest and contribute appreciably to the flooding hazard.

The ground water potential is poor in the greater part of the watershed. The sandstone and shale including thin limestone interbeddings provide meager supplies limited to domestic use. The shallow buried valley along the main stem offers no better possibilities over most of its length. In a short spur of this flood plain extending 1 5/8 miles south from the junction with the Hocking River, water wells ranging in capacity from 5 to 25 gpm can be developed. A large water supply with a capacity as high as 500 gpm is possible from the Hocking River valley sediments east of the Watershed boundary near Athens, Ohio.

Most domestic supplies are from shallow wells and cisterns. Surface streams and farm ponds are frequently used for watering stock. Deep wells provide insufficient supplies for municipal and industrial expansion. Ground water from rock strata below 100 feet is frequently of poor quality. Salt water is encountered at 100-200 feet. The ground water supply possibilities for the town of Albany are from the shallow 30 foot fill of fine sands in the old buried valley of the prehistoric Albany Creek and the massive sandstone of the Freeport and Mahoning members at the base of the Conemaugh formation.

Climate - The watershed climate is moist temperate. The mean annual precipitation is 40 inches at the Athens weather station. The greatest monthly amounts of precipitation occur in May, June, and July. The mean annual snowfall is 17 inches with annual extremes of 3.3 and 45.5 inches.

The normal average temperature at Athens, Ohio, is 53.8 degrees Fahrenheit. The normal temperature in January is 33.5 degrees Fahrenheit and the normal July temperature is 74.7 degrees Fahrenheit.

The average date of the first killing frost in autumn is October 14th, and the last killing spring frost occurs, on the average, April 27th. An average of 170 days comprise the frost-free season.

The prevailing winds are from the west.

Land Use and Cover Conditions - General-type farming is the predominant type of agriculture within the watershed. The upland is moderately steep which limits the cropland areas. Much of the upland is used for pasture and woodland. Approximately 29 per cent of the watershed is now in cropland, 35 per cent is in pasture, 29 per cent is in woodland, and 7 per cent is in other uses.

Approximately 30 per cent of the open land is in need of adequate conservation measures for protection against sheet erosion and runoff. The woodland, as reported by the U. S. Forest Service, is poor hydrologically due, principally, to a lack of proper management.

Economic Data:

General - The watershed is predominantly rural, and agriculture provides a major source of income to the area.

There is only a small amount of off-farm employment within the watershed. Many residents commute to their jobs in the city of Athens (population 18,330), where a few industries and Ohio University are located. Other cities in the area are located a distance of forty miles, or more, and offer little in the way of employment opportunities.

Farm Data - The 1959 agricultural census shows that 81 per cent of the farms in the area are operated by the owners, 4 per cent by tenants, and 15 per cent by part owners or managers. All watershed lands are privately owned except approximately 910 acres of public road rights-of-way, 42 acres recently purchased by the Alexander Local School District, and 515 acres in farms owned by State of Ohio. Agricultural lands account for an estimated 96 per cent of the total watershed area. There are about 256 farms in the watershed averaging 140 acres in size. Forty-nine per cent, or 127 farms, have basic conservation plans with the Athens Soil and Water Conservation District. The average value of agricultural lands and buildings in the watershed is estimated to be $70 per acre. The total population of the watershed is approximately 2,860.

There are no lands under Forest Service jurisdiction in the watershed.

The main source of agricultural income is from the sale of livestock and livestock products. Corn, oats and hay are the principal crops grown. Typical yields per acre are: corn-65 bushels; oats-40 bushels' wheat-25 bushels; and hay -2½ tons.

Transportation Facilities - The major highways crossing the watershed are U. S. Highway 50 and State routes 56 and 682. The New York Central Railroad parallels the main channel through the entire length of the watershed. Most of the main channel and major tributaries are also paralleled by County and Township roads. All of the above mentioned U. S. and State highways join U. S. Highway 33 at or near the city of Athens. U. S. 33 is being reconstructed as a 4-lane highway and is a main northwest-southeast route through Ohio. U. S. Highway 50 is a principal route across southern Ohio.

Population, Trends and Future Growth - Since the turn of the century the economic activity, measured by population trends, has fluctuated in Athens County and the Village of Albany. However, the 1950 and 1960 census have both shown an increase. The city of Athens has had a steady population increase. Since 1950 the population of this city has increased 57 per cent to 18,330 people. A decline of agricultural and mining employment in the area is partially off set by the expansion of both Ohio University and manufacturing located in or near Athens.

The economic potential of the area is promising in view of its mineral and human resources and geographical location. The project proposals will provide flood protection to valley lands, roads and the railroad along with added water storage for municipal and recreation use.

WATERSHED PROBLEMS

Floodwater Damage:

During the past three years two major floods occurred in the Hocking River Basin of which Margaret Creek Watershed is a part. The storms of March 4-5, 1963, and March 9-10, 1964, caused severe flooding in this watershed.

The March 9-10, 1964, storm resulted in the highest stage (24.18 feet) at Athens since March, 1907. The rainfall, 2.7 inches in 30 hours on saturated ground, resulted in Margaret Creek overflowing its banks and inundating about 1200 acres. Flood damage to fences, buildings, roads and railroads was estimated at $40,750.

During March 4-5, 1963, rainfall measuring 4.2 inches occurred in 13 hours at Athens on saturated, frozen ground. This resulted in severe flooding to 1,350 acres of the Margaret Creek flood plain

although the storm was less intense on the major tributaries in the upper reaches of the watershed. Floodwater peaked during the night of the 5th on the lower end of the main stem with overbank depths of about 10 feet. The Athens gage on the Hocking River recorded a stage of 23.10 feet, 4th highest stage of record including the outstanding floods of March 1907, 1913 and 1964. In Margaret Creek Watershed, the 1963 flood which was higher than the most recent March floods, played havoc with private and public properties in the flood plain. The New York Central Railroad suffered two major washouts that delayed trains for a week or more while rails were straightened, ballast was replaced, and the whole line was reconditioned. Roads such as State Route No. 56 were more severely damaged by cutting due to Margaret Creek floodwater overtopping the bed than by back water inundation. Flood damages were reported at $51,000 within the watershed.

No major growing season storm-producing stage over 20 feet has occurred on the Hocking River since April, 1948. Summer floods on Margaret Creek, usually caused by a high-intensity cloud burst, occur frequently without a major backup from the Hocking River. On June 9, 1961, a series of cloud burst hit the watershed. Athens recorded 2.35" of rainfall in 24 hours. The resultant flood inundated an estimated 1,100 acres and caused $30,600 damage to crops, pastures, and transportation facilities. The stream gage on the Hocking River only reached a maximum stage of 14.4 feet on June 11. Historically, floods of somewhat smaller magnitude have been experienced one or more times a year. The existing channel is clogged with vegetation and is incapable of handling the rapid runoff from the upstream watershed area. The meandering character of the stream results in overland flood flows causing prolonged inundation of the lands along the channel. Railroad and road embankments have created valley restrictions that trap surface runoff and when overtopped cause extensive damage to these facilities.

A total of 1,474 acres adjacent to the channel are directly affected by a 100-year frequenty flood. Floods that occur more frequently during the growing season (April to November) create the greatest damage within the watershed.

Flood Frequency (Growing Season)	Acres Inundated
10 yr.	1,096
5 yr.	943
2 yr.	563

The average annual damage to crops is estimated to be $10,475. This damage results from flooding during the growing season and frequently occurs more than once a year on the main flood plain.

Other agricultural damages to farmsteads, fences, farm roads and bridges; livestock losses; and the extra cost of debris removal is estimated at $883 yearly.

An estimated 4.5 miles of public roads in the flood plain are inundated by floodwaters. State Route 56 has been damaged by flooding. Numerous secondary roads that cross and parallel the valley have received damage. The average annual damage to highways is estimated to be $3,939.

The New York Central Railroad parallels the channel the length of the valley. An estimated 3.7 miles of the railroad are subject to floodwater damage. Ballast washout and buckled rails caused directly by flooding have resulted in disrupted traffic, large repair costs, and loss of revenue. Saturation of the road bed also leads to pumping and deterioration of the ties and loosening of the rails. This causes high maintenance costs, much of which can be attributed to flooding. Average annual damages to the railroad by floodwater were estimated to be $4,625.

Erosion and Sediment Damage:

Sheet and Gully Erosion - Comparison of aerial photos, and field examinations of the upland areas of the watershed indicate that cropland on the slopes has undergone severe sheet and gully erosion in the past. Gradual changes in land use and the application of some improved farm practices have reduced gully erosion. It was found that this type of erosion is not serious enough at present to warrant detailed studies.

Road bank erosion is active in some parts of the watershed. In determining sediment storage requirements for reservoirs, consideration was given to this type of erosion. Many road banks have been cut back or are eroded to residual rock. Sloughing was observed in some local areas above the rock, however, this is not considered serious enough to evaluate.

Sheet erosion is severe on 6 per cent of the upland cropland and moderate on the balance. Improved land treatment and farm practices are needed for watershed protection on many of the sloping farm lands.

Channel Erosion - Channel erosion is not excessive in the watershed. Much of the main channel is tree-lined particularly at the lower end. In some areas along unprotected meander curves adjacent to cropland active channel erosion is taking place to a minor degree. Field observations made to check the evidence shown on aerial photos indicate that detailed studies in these areas are not needed. Channel erosion is taking place slowly in the major tributaries where farming is being done close to cleared channel banks. This type of erosion is confined to the meander curves advancing stream migration slowly. Consideration of this type of erosion has been given to channels above all planned flood retarding structures.

Flood Plain Scour - The flood plain contains some shallow scour areas at the lower end of the main stem where the degree of stream meandering increases. The channel banks are tree-lined and over bank stages spread out on the flat flood plain with only minor local degradation. In view of no damage, as indicated by the land owners, no special studies were warranted.

Sediment Damage - There are no significant areas of infertile overwash on the flood plains. Accumulations of streambed materials are found as occasional shoals in the main stem caught by fallen trees or trash. These are predominantly coarse materials from the eroding weathered sandstone and sandy shale residual rocks exposed in the steep side draws. Small shoal deposits are also found at some tributary junctions. Considering the entire main stem the amount of these bed materials is not significant.

Infertile overwash from the strip mine spoils, near the watershed divide, is confined to idle or wooded areas close to the spoils themselves. Field observation revealed traces of yellow sand and iron-bearing waters in two tributaries below strip mines. No detrimental quantities of sediment were observed in the bottom lands.

Swamping produced by extensive channel deposits or otherwise is not a problem in this watershed.

Problems Relating to Water Management:

Water Supply Problems - The water supply for the village of Albany is rapidly diminishing. Six wells combine to furnish 38 gpm. This supply does not meet present demands, particularly for fire protection. Mineral deposits in the aquifer are sealing the screens. The quality of the water is such that iron and manganese removal are mandatory. The local officials and consultants are of the opinion that the life of the present water supply system is two years. Recent explorations for extra water, by the village, have not been successful. Two wells drilled in 1962, which produced 3,000 to 4,000 gallons per hour have already stopped functioning. There is no apparent solution for re-opening these wells.

The newly created consolidated Alexander school district has purchased land in the vicinity to build their new high school building. In addition to the permanent residents there are 550 students in the present school at Albany who are not residents of the village. There is an urgent need for adequate water supply facilities in the Albany community.

Need for Recreational Development - Located at the mouth of Margaret Creek is the city of Athens, Ohio, with a population of 18,330. Athens is also the home of Ohio University with 11,808

students. The Hocking River Valley in which Margaret Creek Watershed is located is known as one of the most scenic areas in Ohio. Thousands of people from Central Ohio flock to this general area for family outings.

Recreation facilities in the area are inadequate. The nearest State park is Strouds Run where the only facility provided is picnicking. Boating is permitted but no facilities are available. Burr Oak Park, located in the northern part of the county, is used extensively. Lake Hope, located in Vinton County, is used to the point of being overcrowded.

Socio-economic Problems:

Both unemployment and underemployment are basic problems in the area. In some parts of the watershed, agriculture is marginal in nature. There are no industries located within the watershed. The city of Athens, located adjacent to the watershed, has had little industrial growth during the past few years, however, the Ohio University is growing rapidly. Younger people, unable to find employment at home, have migrated out of the area. Population growth has not kept pace with that of the state or nation. Because of the employment situation the U. S. Department of Commerce has designated Athens and all adjacent counties an Area Redevelopment Area.

Fish and Wildlife:

The populations of such wildlife species as rabbit, squirrel, woodchuck, raccoon, and muskrat are relatively high within the watershed. Quail, grouse and waterfowl species are seldom found. Frequent flooding of nests in spring reduce the rabbit and quail populations.

Most streams in the Margaret Creek system are intermittent, and therefore, are not valuable for fishing. The main stem has a low gradient and a high population of suckers and bullheads. Near the mouth of the stream there is a medium population of channel cats, croppies, and a low population of spotted bass. The mixed sunfish population is high. Largemouth bass are medium in the backwaters.

PROJECTS OF OTHER AGENCIES

The Hocking Valley Conservancy District was organized in 1964 to study and carry out plans for flood prevention and water resource development throughout a major portion of the Hocking River basin.

The U. S. Army Engineer District, at Huntington, West Virginia, is engaged in authorized surveys and investigations of the Hocking

River Basin. This survey will include studies for the local protection of Athens. It is anticipated that the proposed improvements to the Hocking River will lower the present backwater situation on Margaret Creek. This work plan will add to the total river basin developments.

BASIS FOR PROJECT FORMULATION

The sponsors requested that a plan for watershed protection and flood prevention be developed recommending works of improvement to reduce soil erosion; to prevent flood damage to agricultural lands and transportation facilities; to provide for water supply needs and to develop water-based recreation within the watershed.

In order to accomplish these objectives it was agreed by the sponsors that a combination of the following measures should be included in the plan.

1. Land Treatment measures to reduce soil erosion and sedimentation.
2. Installation of floodwater retarding structures on major tributaries to store floodwater during periods of high runoff, and release it slowly over a period of time.
3. Improve channels where needed to increase their carrying capacity and provide an economic level of flood protection.
4. Incorporate extra water storage for water supply and public recreation at one of the floodwater retarding structures near Albany.
5. Include additional water storage on West Branch for a public recreation development.

A 3-year level of protection was considered desirable for flooded lands devoted to agricultural production. Factory and Little Factory Creek, which enter Margaret Creek near its confluence with the Hocking River, occupy the northern one-fifth of the watershed. Two other major tributaries, West Branch and North Branch enter Margaret Creek from the West and a third major tributary, Biddle Creek enters Margaret Creek from the southeast. These three tributaries account for 56 per cent of the total drainage area on Margaret Creek above its junction with Factory Creek. What is considered to be some of the best potential agricultural land in the county is located on the flood plains of these three laterals and the main channel. The policy to control as much drainage area as possible above the main damage areas resulted in an original selection of 8 potential floodwater retarding sites. All of these sites were located on the three major tributaries and on the upper end of the main stem.

Careful analysis was made of the engineering, geologic, hydrologic and economic phases of each site. After due consideration of all the aspects involved, 6 sites controlling 32 per cent of the total watershed were selected. The floodwater retarding effect of the structures must be supplemented by some channel improvement in order to achieve the level of flood protection desired by the sponsors.

A 3-year growing season channel capacity was determined to provide the maximum net benefits by restoring former productivity to the flooded lands devoted to agriculture. This will permit needed land use adjustments between cropped hill lands subject to erosion and the bottomlands.

Three additional structure sites were studied on Factory and Little Factory Creeks as potential multiple purpose flood prevention recreation and/or water supply sites. Due to the limited flood damage on these tributaries and their location with respect to damage areas along the main stem of Margaret Creek no structural measures are recommended for Factory Creek in this plan.

The Conservancy District Directors recognized the need for recreational developments in the watershed. The Ohio Department of Natural Resources, Division of Wildlife, desires to add water storage to floodwater retarding Structure No. 6 for use as a public fish and wildlife facility.

The Village of Albany has determined that Site No. 2 is the best suited for water supply storage. This will provide water for the village, the new consolidated school district and surrounding land owners.

The Conservancy District Directors determined that Site No. 2 would be the most desirable location for a complete recreational development. This is to be accomplished by the inclusion of additional water storage with adjacent recreational facilities.

The sponsors expect that the combination of works of improvement proposed in this plan will accomplish their objectives and provide an opportunity for over-all economic growth in the area.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures:

The installation of land treatment measures to reduce erosion and sedimentation is an essential part of this plan. In the upland areas of the watershed, grasses and legumes will be increased in the rotations on cropland. Acreages of permanent pasture and woodland will also be increased. Pasture and hayland areas will be improved

by renovating and increased by planting. In addition to agronomic changes in land use, mechanical practices such as contour strip cropping, diversion ditches, and grassed waterways will be installed on cropland in order to control erosion.

Since the flood plain contains pratically all of the land suitable for intensive crop production in the watershed, some areas now in pasture or idle because of frequent flooding will be brought into economic agricultural use by this project. Surface field ditches will need to be installed to carry surface water to outlet channels. Diversion ditches will be used to divert hill runoff from the flood plain lands.

It is expected that changes brought about by the land treatment program will result in a small decrease in total cropland in the watershed.

The land treatment program will increase soil fertility and productivity, improve soil structure, bring land use in balance with the soil capabilities, reduce surface runoff and erosion.

The Soil Conservation Service will provide technical assistance for installing the above land treatment measures.

Land treatment measures for the woodland will include such practices as tree planting (forestation), improved forestry practices, livestock exclusion, sustained yield and cultural practices. These measures will improve the forest hydrologic cover, soil conditions, water infiltration and retention, and thereby reduce storm flow. Technical assistance for the forestry measures will be furnished by the Ohio Department of Natural Resources, Division of Forestry, in cooperation with the U. S. Forest Service.

The total estimated cost of installing land treatment measures is $249,430 (PL 566 cost - $21,822, other than PL 566 cost - $227,608) as shown in Table 1.

Structural Measures:

General - A total of four single purpose flood prevention reservoirs, one multiple purpose flood prevention-water supply-recreation and one flood prevention-fish and wildlife reservoir, are planned for this watershed. In addition 9.8 miles of channel improvement are required for flood prevention. Basic water and related park recreational facilities are planned in connection with the multiple-purpose reservoirs.

Flood Detention Structures - All structures are designed to store the sediment accumulation for a 100-year period. Total sediment storage for the six structures is 868 acre feet. The total floodwater detention capacity provided is 2,152 acre feet. These structures control 19.35 square miles of drainage area, or 32 per cent of the total watershed.

Single purpose structures No. 1, 3, 4 and 5 will provide flood protection in the flood plain downstream. A permanent water impoundment is equivalent in volume to the estimated 50-year sediment accumulation. The combined water surface area of the 50 year sediment pools is 55.5 acres. Design data for individual structures is given in Table 3.

The total estimated cost for installing structures 1, 3, 4 and 5 is $370,127. The total annual cost is $15,048 of which $923 is for operations and maintenance.

Multiple Purpose Structures - Structure No. 2, a multiple purpose structure, is designed for flood prevention, water supply and recreation. Storage capacity of 380 acre feet for municipal water supply will be available, plus 1,573 acre feet for recreation, 569 acre feet for floodwater, and 178 acre feet for sediment accumulation.

The water supply is for the use of the village of Albany, In order to use the impounded water, a water supply intake structure with a discharge pipeline will be installed. The intake structure will be located within the impoundment and will consist of a tower with gated openings at key elevations to permit controlled entrance of water from the impoundment. A pipeline will be laid from the base of the intake structure under the dam. This installation will permit controlled use of the stored water. The surface area of the water supply and recreation pool is 137 acres at elevation 735. The minimum recreation pool, after maximum evaporation and maximum allowable water use will be 105 acres at elevation 729.5.

A recreational development of 305 acres is planned. This includes 185 acres for the structure, lake and shoreline access and 120 acres for recreational facilities. The recreational facilities will include a camping-picnic area and a beach-boat dock area. The camping area will have 100 camping lots, 2 latrines, 2 waste drains, 1 bath and laundry building, and 1 water system (15 taps). Each camp lot will be equipped with a picnic table, fire ring and trash disposal facilities. The picnic area will contain 150 picnic tables, 75 fire rings, 2 latrines, 1 shelter house, parking and trash disposal facilities.

The beach-boat dock area will contain a swimming beach, change booths and bath house, 2 latrines, 1 drinking and shower water system, 1 boat launching ramp, 25 boat docks, and parking facilities for 250 automobiles.

The total estimated cost for installing Structure No. 2 is $468,106 which includes $150,465 for the basic recreational facilities. The annual cost is $36,028 of which $20,692 is for operation and maintenance. Figure 3 shows the layout of the recreational development.

Structure No. 6 is designed as a flood prevention, public fish and wildlife reservoir with a permanent surface area of 46 acres. Storage capacity for fish and wildlife is 330 acre feet. The 100-year sediment storage amounts to 160 acre feet. The structure includes capacity for 400 acre feet of floodwater storage. The surface area of the floodwater pool is 70 acres.

The total estimated cost for installing Structure No. 6 is $134,873. The total annual cost is $4,728 of which $310 is for operation and maintenance.

The locations of the structure sites are shown on the Project Map, Figure 2. A typical cross section of the earth fill and concrete drop inlet is shown in Figure 1. Design data for the individual structures are given in Table 3 with costs in Tables 1 and 2.

Channel Improvement - Channel improvement of 9.8 miles will supplement the 6 retarding structures to approach the desired level of protection.

Improvement on the main stem of Margaret Creek consisting of channel clearing will extend from the New York Central railroad bridge upstream to the junction of Margaret Creek and the North Branch. (Station 724+00 to 268+00).

Channel measures on West Branch of Margaret Creek will extend from the confluence of Margaret Creek to the junction of Dirty Creek. (Station 590+00 to 525+00). A seeded berm is planned along each bank. Spoil will be piled or spread. Openings will be left at intervals in the spoil to allow surface water to enter the channel.

Location of all channel measures are shown on the Project Map Figure 2. Table 3B, Channel Data, and Figure 4, Profile of Channel Improvement show design details by reaches. The estimated cost of channel measures is shown in Table 1 and 2.

The total estimated cost of channel improvement is $25,526. The annual cost is $4,138 of which $3,302 is for operation and maintenance.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Costs:

The unit costs for installation of land treatment measures were based on current costs of farm labor, equipment and materials. The cost of technical assistance for the installation of land treatment measures was based upon Soil Conservation Service expenditures and Soil Conservation District accomplishments for the past several years. Costs for standard soil surveys are included in the technical assistance cost estimates.

The costs of forestry measures are based upon unit costs prevailing in the locality. The cost of technical assistance for installation of forestry measures is based upon costs of the going Cooperative Forest Management Program.

Structural Measures Costs:

Explanation of Costs - Construction costs for structural measures include the engineer's estimate and contingencies. The engineer's estimates were derived by applying current unit costs to detailed material estimates. Unit costs were based on bid schedules of similar projects in Ohio and adjusted to the 1965 price level. Fifteen per cent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs.

Installation services cost is the sum of the costs of engineering and of other installation services including all overhead costs for structural measures as well as direct cost for installation services provided by other than engineers and geologists. Engineering Services include construction surveys, site investigations (boring and laboratory tests), designs, necessary inspections, preparation and interpretation of plans and specifications, and similar services in carrying out construction.

The estimated expenditure for acquiring land, easements, and rights-of-way; removal or salvage of buildings; changes in public utilities; changes in or relocation of roads and bridges and relocation or reconstruction of fences is a land, easement, and rights-of-way cost. Land values for determining land easement and rights-of-way costs were estimated taking into consideration land use, frequency of flooding, buildings affected, other improvements and current land values. The cost of land used for fill site, emergency spillways, borrow areas, and the cost of land placed permanently under water was estimated on the basis of fee-simple acquisition.

The following is a list of roads and utilities that will be affected by construction of the works of improvement and proposed alterations:

1. County Road 12. Abandon portion affected by Structure No. 2.
2. County Road 80. Relocate road around fill of Structure No. 3.
3. County Road 17. Raise road in pool area behind Structure No. 4.
4. Tennessee Gas Transmission Co. Weight two piplelines at Structure No. 6.
5. Texas Eastern Transmission Co. Raise three pipeline valves at Structure No. 4.

Administration of contracts includes all local costs for administrative, legal and clerical services incurred in carrying out contracts.

The detail of costs by individual structural measure is shown in Table 2.

Allocation of Costs - The cost of the two multiple-purpose structures were allocated to purpose by the "Use of Facilities Method". The joint costs, of Structure No. 2 including construction cost, installation services and administration of contracts was estimated at $255,261. This amount was allocated 27.7 per cent for flood prevention, 58.2 per cent for recreation and 14.1 per cent for water supply. The cost of land, easements and rights-of-way were allocated at $48,915 for recreation and $5,085 for water supply. This allocation was based on reservoir surface area with water supply at the top increment. The specific cost, including construction cost, installation services and administration of contracts for installing a water intake tower, valves and pipeline under the dam, amounts to $8,380 and was allocated to water supply.

At Structure No. 6 joint costs amounting to $134,873, including construction cost, installation services, land costs and administration of contracts were allocated 62.9 per cent to flood prevention and 37.1 per cent to recreation.

The cost of minimum basic recreation facilities and associated land was allocated to recreation. Detail of cost allocation is shown in Table 2A.

Cost Sharing - At Structure No. 2 fifty per cent of the cost of the land required for the water resource development and allocated to the purpose of recreation will be a Public Law 566 cost.

Public Law 566 funds will not bear any of the cost of providing storage allocated to water supply.

Public Law 566 will bear 50 per cent of the construction cost of basic recreational facilities and associated land.

The construction cost and installation services for installing flood prevention measures are borne by PL 566. At Structure No. 2 and No. 6, 50 per cent of that portion of the construction cost, attributed to installing the water storage impoundment and allocated to recreation, will be paid by PL 566.

Public Law 566 will not bear any of the installation service cost for installing recreational facilities.

At Structure No. 6, Public Law 566 will not bear any of the cost of land, easements or rights-of-way.

The Public Law 566 share of lands, easements, and rights-of-way will be based on actual payments made by the sponsors or the fair market value as jointly determined by the sponsors and the Soil Conservation Service.

Public Law 566 funds will not bear any of the costs for administering contracts or legal fees, and engineering services needed to obtain land, easements, or rights-of-way.

The details of cost allocation and cost sharing are shown in Table 2 and 2A.

Fund Obligation - The following is the estimated obligation of total project funds including land treatment and structural measures for each fiscal year during the installation period.

Fiscal Year	PL 566		Other Than PL 566	
	Land Treatment (Dollar)	Structural Measures (Dollar)	Land Treatment (Dollar)	Structural Measures (Dollar)
First	2,180	205,790	22,760	159,027
Second	6,442	165,915	68,280	97,116
Third	7,090	162,282	72,838	4,728
Fourth	4,360	104,470	45,520	73,777
Fifth	1,750	22,525	18,210	3,002
Total	21,822	660,982	227,608	337,650

Cost Tabulation may be found in Tables 1, 2 and 4.

EFFECTS OF WORKS OF IMPROVEMENT

The installation of both the land treatment and structural measures recommended in this plan will fulfill the sponsor's objective for flood prevention, water supply and recreation, and will produce the benefits described in this work plan.

Flood Prevention:

The Margaret Creek Watershed project will provide essentially a 3-year economic level of protection to the agricultural flood plain areas of the watershed. The areas on tributaries immediately below floodwater retarding structures will benefit by a 50-year level of protection. The main stem above North Branch, North Branch, Biddle Creek and West Branch flood plains will be provided with 3 to 10-year growing season level of protection. The main stem between North Branch and SR #56 will be afforded on the average between a 2 and 3-year level of protection in the growing season. The lower portion of Margaret Creek below State Route 56 is affected

by backwater from the Hocking River. During the growing season this reach will be provided a 2-year level of protection by the works of improvement.

With installation of the project, runoff from flood-producing storms will be trapped in floodwater storage basins provided behind the structures. This storage will be released through conduits at controlled rates that can be safely handled by the downstream channels. In addition, the water carrying capacity of the main channel will be increased so that the remaining uncontrolled runoff will be contained at lower overbank stages for the same storm magnitude. The effect of the project on various size floods is tabulated below:

Flood Frequency (Growing Season)	Acres Flooded Without Project	Acres Flooded With Project	Percent Reduction of Acres	Av. Stage Reduction in feet
2 yr.	563	34	94	1.8
5 yr.	943	582	38	2.1
10 yr.	1,096	749	32	2.3
50 yr.	1,319	891	32	2.8

Figure 4 shows graphically on the channel profiles the stage reduction for the 3-year and 100-year growing season evaluation storms.

The structural measures, in providing this level of flood protection to agricultural lands, will reduce the average annual agricultural damages by 70 per cent.

In the total 1,474 acres benefited, which were subject to or affected by overflow from the 100-year flood, there are approximately 290 beneficiaries.

The highways and railroads in the watershed will greatly benefit from the reduction in floodwater stages. The average annual damage will be reduced an estimated 67 per cent to the railroad and 79 per cent to highways.

Future bridge replacement may be made with structures of reduced size consequent to the retarding effect of the flood prevention structures on peak flows.

It is expected that more intensive agricultural use of floodplain land will occur due to the level of protection provided. About 49 per cent of the flood plain is now in cropland. Changed land use benefits are anticipatedon approximately 7 acres. The more intensive use of cropland will be reflected throughout the flood plain by the higher crop yields and an increase in the acreage of grain crops grown. An estimated 93 acres will be restored to their former productivity.

Water Supply:

The Village of Albany plans to impound 380 acre feet of water in Structure No. 2. This includes 300 acre feet for municipal supply plus additional storage for evaporation losses. Studies indicate this development will make water available for home and public use to the 1180 residents and school pupils of the Albany community. Water will also be available for the Consolidated Local High School to be built on land already purchased near Albany. It is estimated that the 380 acre feet of water will provide a safe water yield of 200,000 gallons per day for 2,000 people.

Recreation:

The 137 acre recreation-water supply pool and adjacent recreational facilities at Structure No. 2 will provide such activities as swimming, boating, fishing, camping and picnicking. Busy U. S. Highway Route 50 borders the development on the east. This route intersects U. S. Route 33, a main northeast-southwest highway, at the city of Athens. Many travelers and vacationers using these routes will find it convenient to stop and use the facilities provided at this site. An annual visitor day use of 33,000 is anticipated after completion of the project. The peak monthly use is expected during the months of June, July, and August. The peak daily use will occur on weekends and holidays. The Margaret Creek Conservancy District is planning to operate the facility.

Site No. 6, a multiple purpose flood prevention-fish and wildlife reservoir will be operated by the State of Ohio, Department of Natural Resources, Division of Wildlife, as a fishing lake. It is estimated that 7,438 annual visitor days will be provided at this site which is located approximately four miles from the city of of Athens and one mile from State Highway Route 56.

An estimated 4,120 visitor days will be provided by the conservation pools, which total 55.5 surface acres at site No. 1, 3, 4 and 5. Public access to these pools will be provided.

PROJECT BENEFITS

Installation of structural works of improvement recommended in this work plan will produce average annual monetary benefits of $96,173. It is anticipated that these benefits will result from the reduction of flood damage to agricultural land and transportation facilities; enhancement of agricultural lands; reduction in the future design capacity of bridges; water storage for municipal use; storage of recreational water coupled with installation of recreation facilities; incidental recreational use of conservation pool areas; reduced soil erosion; and improved local economic conditions.

Benefits accruing from the reduction of damage to crop and pasture lands are estimated at $5,474 and to the restoration of former productivity at $1,843 annually. Those attributable to a reduction in other agricultural damages including farm roads, bridges, fences, culverts, and debris removal amount to $595.

A substantial portion of the farming operations, in the area now subject to flooding, reflect the risks of farming such lands. It is anticipated that improved cropping methods and land use conversion will occur where flood reductions are significant. Benefits of $5,712 will accrue on the more frequently flooded cropland acres that will be protected by the planned works of improvement.

Average annual benefits of $6,207 are anticipated from floodwater damage reduction to transportation facilities. The transportation benefits include $3,108 annually from roads and bridges, and $3,099 annually from railroads.

Indirect benefits amount to $1,537 or 11 per cent of the direct benefits.

The permanent water supply storage, provided at Structure No. 2 for the Albany community, will provide annual benefits estimated at $5,538.

Recreation benefits at Site No. 2 were evaluated at $47,025 annually - based on a per unit visitor-day rate of $1.50 for this highly developed facility. Annual benefits of $7,438 were estimated at Site No. 6 where the State of Ohio is developing a fish and wildlife facility. A per unit visitor-day rate of $1.00 was used in evaluating the benefits on this site. Incidental recreation benefits were estimated at $2,060 annually at Sites No. 1, 3, 4, and 5 - based on a per unit visitor-day rate of $0.50.

Redevelopment benefits stemming from project installation as a result of the employment of the unemployed and underemployed are evaluated at $1,453. Benefits attributable to the cost of operation and maintenance of the structural improvements are estimated to be $612.

Benefits accruing because of a reduction in bridge replacement costs are estimated to be $2,630.

Local secondary benefits stemming from the project were considered to be equal to 10 per cent of the direct primary project benefits and were computed at $8,659 Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

The installation of this project would have substantially reduced the floodwater damage caused by the three recent floods

of March 1964, March 1963, and June 1961. The March 1964 and 1963, flood damage would have been reduced by $28,200 and $34,800 respectively (69 and 68 per cent reduction). The June 1961, growing season, flood damage would have been reduced 60 per cent with an estimated benefit of $18,500.

COMPARISON OF BENEFITS AND COSTS

The total estimated structural installation costs (Table 2) when amortized over the evaluation period, as shown in Table 4, give an average annual equivalent cost of $32,715. The average annual cost of operation and maintenance of structural works of improvement is estimated at $25,227. The total annual cost is $57,942 (Table 4). When the project is completed and operating, the estimated average annual benefits from structural measures will be $96,173.

The ratio of the total annual benefit, without the inclusion of $8,659 local secondary benefits, to the total annual cost is 1.5:1.0. The ratio of the annual benefit including local secondary benefits, to the total annual cost is 1.7:1.0.

PROJECT INSTALLATION

The period of time necessary to install all land treatment and structural measures shown in Table 1 is estimated to be 5 years.

In order to accomplish construction with a minimum amount of danger, delay, and inconvenience the following items should be used as a guide in determining the sequence of events:

1. Channel improvement is designed with structures in place.
2. The Present water supply at Albany is now critically low.

Using these guides the following sequence of installation is recommended:

Fiscal Year	Structural Measures
1	Multiple Purpose Structure No. 2.
2	Multiple Purpose Structure No. 6.
	Structure No. 3.
3	Structure No. 4 and No. 5.
4	Structure No. 1.
	Recreational Facilities.
5	Improvement West Branch and Main Stem.

Prior to initiating construction on any single structure, the sponsoring organizations will agree to use all the powers at their command to secure the necessary land, easements and rights-of-way for all structures. The Margaret Creek Conservancy District has

the power of eminent domain to acquire necessary lands, to raise needed funds, to enter into contracts, to construct works of improvement, and to maintain such works. All power and facilities vested in the District by law will be used as needed to complete the project.

It will be the duty of the Conservancy District to secure all land, easements and rights-of-way for construction and maintenance of all structural works of improvement, and to be responsible for construction and administering contracts of all structural measures. Other sponsoring local organizations will assist the Conservancy District where practical.

The Village of Albany, Ohio, will enter into agreement with the Margaret Creek Conservancy District for the inclusion of water supply storage at multiple purpose flood prevention-water supply-recreation Structure No. 2.

The Soil Conservation Service will assist the sponsoring organizations in developing engineering plans and specifications, in preparing contracts for construction and will provide construction inspection for installation of structural measures.

The officials of Athens County will coordinate their respective road work with the construction schedule of the Conservancy District.

The Margaret Creek Conservancy District will enter into agreement with the Ohio Department of Natural Resources to construct and maintain the fishing and wildlife facilities at Structure No. 6.

Land treatment measures will be applied by the landowners in cooperation with Athens Soil and Water Conservation District, Technical assistance on open lands will be provided by the Soil Conservation Service. Financial assistance will be provided for the installation of land treatment measures from the Agricultural Conservation Program, with educational assistance from the Ohio Cooperative Extension Service.

Table 1 shows the amount of land needing treatment and the cost of technical assistance for forestry to be furnished by the Ohio Department of Natural Resources, Division of Forestry, in cooperation with the U. S. Forest Service. The technical assistance for installing the forestry measures will cost $22,580. This includes the going Cooperative Forest Management Program costing $970 and accelerated technical assistance costing $21,610. The accelerated technical assistance costs consist of $11,120 under authority of Public Law 566 which will be matched with $10,490 from the Ohio Department of Natural Resources, Division of Forestry.

FINANCING PROJECT INSTALLATION

The Athens Soil and Water Conservation District will carry out a program to accelerate the installation of the land treatment measures contained in this plan. The estimated total cost of installing land treatment measures is $249,430. The cost to the landowners is estimated at $198,905. Part of this cost may be shared through the Agricultural Conservation Program or paid from other going programs.

The present level of technical assistance will be supplemented by $21,822 of PL 566 funds. Table 1 shows the area of land needing treatment and the cost of technical assistance for forestry to be furnished by the Ohio Department of Natural Resources, Division of Forestry. In addition, technical assistance valued at $970 will be provided under the going Cooperative Forestry Management Program by the Ohio Division of Forestry in cooperation with the U. S. Forest Service. It is expected that the Agricultural Conservation Program cost-sharing will be available to qualified landowners for installing forest land treatment measures.

The Margaret Creek Conservancy District will be financially responsible for the local share of the costs involved in constructing and maintaining all structural works of improvement. Funds for which the District is obligated may be raised by assessments to benefited properties under authority of the Ohio Revised Code covering the Conservancy District, or by other means.

The Margaret Creek Conservancy District has made application to the Farmers Home Administration for a loan, as provided in the act, to finance the other than Public Law 566 share of the recreational development at Structure No. 2. This includes the District's share of both the water resource development and the basic recreational facilities. Loan repayment will be made from charges to the users of the facilities.

It is anticipated that the Farmers Home Administration will will make a loan to finance the water supply portion of the project as provided for in the act.

The Ohio Department of Natural Resources has agreed with the Margaret Creek Conservancy District to finance the Other than Public Law 566 cost incurred by the addition of the fish and wildlife purpose at Structure No. 6.

The total cost of all structural measures to be paid by "Other" funds is estimated to be $337,650 as shown in Table 2.

When legal requirements have been met, the Soil Conservation Service will make available an estimated $660,982 of PL 566 funds. These funds will be furnished as needed and as they become available.

An estimated $158,418 of PL 566 funds for installation services will be utilized by the Soil Conservation Service as shown in Table 2.

Federal assistance for carrying out 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 (PL 566-83d Congress; 68 Stat. 666) as amended.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures for watershed protection on privately owned land will be installed, operated and maintained by landowners under cooperative agreements with their Soil and Water Conservation District. Technical assistance of the Soil Conservation Service will be provided upon request by the landowners and operators to determine maintenance needs and to encourage them to perform the needed maintenance. After completion of the PL 566 project, forestry program measures will be maintained by the landowners and operators with technical assistance provided by the Ohio Department of Natural Resources, Division of Forestry, in cooperation with the U. S. Forest Service under the going Cooperative Forest Management Program.

Operation and maintenance agreements will be executed for all structural measures prior to issuing the invitation to bid on construction contracts. These agreements will be made between the Soil Conservation Service and the Margaret Creek Conservancy District. The District will assume responsibility for operation and maintenance immediately upon acceptance of construction from the Contractor.. Funds needed for maintenance will be raised by the District through normal legal procedures, or by other means.

The Margaret Creek Conservancy District will enter into an agreement with the Village of Albany for the operation and maintenance of the water supply portion of Structure No. 2. A charge will be made for use of the recreational facilities in order to defray the expense of operation and maintenance.

Inspection of the individual structures and channels will be made annually and following major storms. The inspection will be made by a committee composed of representatives of the sponsoring organizations, the Soil Conservation Service, and other local, county, state or federal agencies. Authorized representatives will have free access to inspect structural works of improvement.

Items of inspection will include, but not be limited to, the condition and proper functioning of the concrete work, earth fills, principal and emergency spillways, vegetative growth, channel banks, capacities and appurtenances, bridge abutments, and accumulation of sediment and debris.

Reports will be prepared after the inspection stating maintenance needed. The reports together with a record of the action taken will be kept on file by the Conservancy District.

Vegetative growth in the channels and on the berms will be controlled by a spraying and mowing program.

All private bridges and facilities of public utilities will be maintained by the respective owners. All other bridge maintenance will be handled by officials responsible for such maintenance from funds appropriated for that purpose.

The annual operation and maintenace cost for the recreational development at Structure No. 2 is estimated to be $20,142. This includes $5,820 for maintenance and replacement of recreational facilities and $14,320 for personnel to manage and maintain the development. Planned personnel include one full-time park manager and nine part-time employees to help during the peak use months. Custodial, sanitation, safety and operational services will be the responsibility of the sponsor and be under the direct supervision of the park manager. Charges made for admission to the recreational area will be based on the cost of operation and maintenance of the recreational development and retirement of the Other than Public Law 566 portion of the original investment.

The operation and maintenance cost for the fish and wildlife development at Structure No. 6 is estimated to be $310 annually.

Operation and maintenance may be accomplished either by contract or by force account. The total annual operation and maintenance cost is estimated to be $25,227 including the recreational development.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Margaret Creek Watershed, Ohio

Sheet 1 of 2

Installation Cost Item	Acres to be Treated 2/	Estimated Cost (Dollars) 1/ P.L. 566	Other	Total
LAND TREATMENT				
Soil Conservation Service				
Cropland	11,228		22,985	22,985
Grassland	13,510		111,910	111,910
Miscellaneous Land	2,702		17,160	17,160
Technical Assistance		10,702	17,243	27,945
SCS Subtotal		10,702	169,298	180,000
Forest Service				
Woodland	10,065		46,850	46,850
Technical Assistance		11,120	11,460	22,580
FS Subtotal		11,120	58,310	69,430
TOTAL LAND TREATMENT		21,822	227,608	249,430

1/ Price Base 1965

2/ Non-Federal Land

February 1965

TABLE 1 - ESTIMATED PROJECT INSTALLATION COSTS

Installation Cost Item	Unit Number 2/	Estimated Cost (Dollars) 1/ P.L. 566	Other	Total
STRUCTURAL MEASURES				
Floodwater Retarding Structures	4	214,034		214,034
Stream Channel Improvements	9.8	17,599		17,599
Multiple Purpose Structures	2	177,995	104,641	282,636
Recreational Facilities	1	59,962	59,963	119,925
Subtotal - Construction		469,590	164,604	634,194
INSTALLATION SERVICES				
Engineering		117,682	18,943	136,625
Other		40,736		40,736
Subtotal - Installation Services		158,418	18,943	177,361
OTHER COSTS				
Land, Easements & R/W		32,974	133,775	166,749
Administration of Contracts			20,328	20,328
Subtotal - Other		32,974	154,103	187,077
TOTAL STRUCTURAL MEASURES		660,982	337,650	998,632
TOTAL PROJECT		682,804	565,258	1,248,062
SUMMARY				
Subtotal S.C.S.		671,684	506,948	1,178,632
Subtotal F. S.		11,120	58,310	69,430
TOTAL PROJECT		682,804	565,258	1,248,062

1/ Price Base 1965

2/ Non-Federal Land

February 1965

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan Preparation)
Margaret Creek Watershed, Ohio

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Brush Control	Ac.	2,500	35,000
Conservation Cropping System	Ac.	1,222	1,122
Cover & Green Manure Crop	Ac.	66	264
Diversion	Ft.	13,060	3,918
Drainage Field Ditch	Ft.	9,488	2,372
Drainage Main or Lateral	Ft.	1,970	1,379
Farm Pond	No.	106	42,400
Fish Pond Management	No.	76	760
Grassed Waterway or Outlet	Ac.	24	3,240
Hedgerow Planting	Ft.	26,700	1,602
Pasture & Hayland Planting	Ac.	552	27,600
Pasture & Hayland Renovation	Ac.	2,065	82,600
Spring Development	No.	21	4,200
Strip Cropping, Contour	Ac.	1,318	10,544
Terrace, Gradient	Ft.	2,112	528
Tile Drain	Ft.	21,949	4,390
Wildlife Habitat Development	Ac.	195	7,800
Wildlife Habitat Preservation	Ac.	46	46
Fire Control	Ac.	11,160	33,480
Livestock Exclusion	Ac.	1,338	5,350
Cultural Practices	Ac.	298	2,980
Harvest Cutting	Ac.	14	70
Forestation	Ac.	234	8,190
TOTAL			279,835

1/ Price Base 1965

February 1965

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Margaret Creek Watershed, Ohio

(Dollars) [1]

Structure Site No. or Name	Installation Cost - P.L. 566 Funds				Installation Cost - Other Funds					
	Construction	Instal. Services	Land Easement & R/W	Total P.L. 566	Construction	Installation Services	Admin. of Contracts	Land Easements & R/W	Total Other	Total Inst. Cost
Floodwater Retarding Structures:										
No. 1	44,508	14,687		59,195			1,775	17,391	19,166	78,361
No. 3	51,033	17,573		68,606			2,125	13,370	15,495	84,101
No. 4	58,311	19,242		77,553			2,327	30,667	32,994	110,547
No. 5	60,182	19,860		80,042			2,401	14,675	17,076	97,118
Subtotal	214,034	71,362		285,396			8,628	76,103	84,731	370,127
Multiple Purpose Structure No. 6	71,386	28,923		100,309	16,258		2,630	15,676	34,564	134,873
Multiple Purpose Structure No. 2										
Joint Costs [2]	106,609	53,205	23,974	183,788	81,083	8,733	5,631	30,026 [4]	125,473	309,261
Specific Costs [3]					7,300	730	350		8,380	8,380
Basic Facilities [5]	59,962		9,000	68,962	59,963	9,480	2,560	9,500 [6]	81,503	150,465
Subtotal	166,571	53,205	32,974	252,750	148,346	18,943	8,541	39,526	215,356	468,106
Channel Improvement	17,599	4,928		22,527			529	2,470	2,999	25,526
Grand Total	469,590	158,418	32,974	660,982	164,604	18,943	20,328	133,775	337,650	998,632

1/ Price Base 1965.
2/ Joint Installation Costs. Includes Construction Cost, Installation Services, Land Cost & Administration of Contracts.
3/ Water Supply Appurtenances. Includes water intake tower, valves and pipe under dam.
4/ Includes $1200 Survey, legal fee and other costs. 5/ Recerational facilities. Includes a camping-picnic area & a beach-boat-dock area. 6/ Includes $500 survey, legal fee & other costs.

February 1965

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Margaret Creek Watershed, Ohio
(Dollars) 1/

	Purpose				
	Flood Prevention	Recre-ation	Fish & Wildlife	Water Supply	Total
	Cost Allocation				
Single Purpose Floodwater Retarding Structures	370,127				370,127
Channel Improvement	25,526				25,526
Recreation Facilities		150,465			150,465
Water Supply Appurtenances				8,380	8,380
Multiple Purpose Floodwater Retarding-Water Supply-Recreation	70,707	197,478		41,076	309,261
Floodwater Retarding-Fish & Wildlife	84,834		50,039		134,873
TOTAL	551,194	347,943	50,039	49,456	998,632
	Cost Sharing				
P.L. 566	450,390	185,573	25,019		660,982
Other	100,804	162,370	25,020	49,456	337,650
TOTAL	551,194	347,943	50,039	49,456	998,632

1/ Price Base 1965

February 1965

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS
Margaret Creek Watershed, Ohio

ITEM	UNIT	1	2	3	4	5	6	TOTAL
Drainage Area								
Uncontrolled	Sq. Miles	3.49	4.04	1.95	4.20	1.66	4.01	19.35
Storage Capacity								
Sediment								
Total 1/	Ac.Ft.	148	178	82	204	96	160	868
Submerged 2/	Ac.Ft.	(75)	-	(43)	(105)	(48)	-	(271)
Floodwater	Ac.Ft.	353	569	205	456	169	400	2,152
Between High & Low Stages	Ac.Ft.	(300)	(280)	(150)	(252)	(94)	(240)	
Water Supply	Ac.Ft.	-	380 4/	-	-	-	-	380
Recreation	Ac.Ft.	-	1,573	-	-	-	330 5/	1,903
Total	Ac.Ft.	501	2,700	287	660	265	890	5,303
Surface Area								
Submerged Sediment 2/	Acres	16.0	-	7.5	24.0	8.0	-	55.5
Floodwater Pool	Acres	57.0	163.0	35.0	83.0	26.5	70.0	434.5
Recreation Pool	Acres	-	120.0	-	-	-	46.0 5/	166.0
Recreation-Water Supply Pool	Acres	-	137.0	-	-	-	-	137.0
Elevations								
Top of Dam	Ft.	719.5	745.0	722.0	719.0	736.2	708.0	
Crest of Emergency Spillway	Ft.	713.5	739.0	717.0	712.8	730.0	701.0	
Crest Principal Spillway								
High Stage	Ft.	705.0	737.0	714.0	710.0	727.0	698.5	
Low Stage	Ft.	701.5	735.0	707.0	705.0	720.0	694.0	
Max. Height of Dam	Ft.	27.0	53.3	32.0	34.6	31.5	41.6	
Volume of Fill	Cu.Yds.	22,570	189,724	34,154	47,116	47,383	65,026	405,973
Principal Spillway								
Design Storm Duration	Hrs.	6	6	6	6	6	6	
Design Storm Rainfall	Inch	3.65	3.65	3.65	3.65	3.65	3.65	
Runoff Curve No. (AMC II)		77	81	78	78	78	76	
Storm Runoff (AMC II½)	Inch	2.16	2.40	2.23	2.23	2.23	2.07	
Capacity (low stage)	c.f.s.	38	40	18	37.2	25	62	
Capacity (high stage)	c.f.s.	134	135	102	158	100	124	
% Chance of Use, High Stage		20	20	20	20	20	20	
Time of Concentration	Hrs.	1.10	0.95	0.92	0.75	0.65	1.40	

TABLE 3 - STRUCTURE D

FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS

Margaret Creek Watershed, Ohio

ITEM	UNIT	STRUCTURE NUMBER 1	2	3	4	5	6
Emergency Spillway							
Type		Earth	Earth	Earth	Earth	Earth	Earth
Bottom Width	Feet	120	100	124	120	50	64
% Chance of Use		2	2	2	2	2	2
Emergency Spillway Hydrograph							
Storm Rainfall (6 hr.)	Inches	6.75	6.75	6.75	6.75	6.75	6.75
Storm Runoff (AMC II)	Inches	4.14	4.57	4.27	4.27	4.27	4.04
Velocity of Flow (V_c) 3/	Ft/Sec.	6.65	5.6	5.95	6.35	6.5	7.65
Discharge Rate	c.f.s.	1,310	558	576	1,114	474	960
Max. W. S. Elev. 3/		716.2	740.9	718.9	715.4	732.5	704.6
Freeboard Hydrograph							
Storm Rainfall (6-hr.)	Inches	13.00	13.00	13.00	13.00	13.00	13.00
Storm Runoff (AMC II) 3/	Inches	10.00	10.55	10.15	10.15	10.15	9.85
Velocity of Flow (V_c)	Ft/Sec	10.35	10.50	9.7	10.9	10.4	10.5
Discharge Rate	c.f.s.	5,002	3,600	3,697	5,247	2,090	3,265
Max. W. S. Elev. 3/	Ft.	719.5	744.6	722.0	719.0	736.2	707.8
Capacity Equivalents							
Sediment Volume 1/	Inches		00.83	0.72	.91	1.08	.75
Water Supply Volume	Inches	-	1.76 4/	-	-	-	-
Recreation Volume	Inches	-	7.30 5/	-	-	-	-
Fish & Wildlife Volume	Inches	-	-	-	-	-	1.54 6/
Detention Volume	Inches	1.89	2.64		1.92	1.91	1.87
Spillway Storage	Inches	2.25	4.31		2.88	2.71	2.85
Class of Structure		b	b		b	b	b

1/ Accumulation Volume for 100 years.
2/ 50-year sediment storage.
3/ Maximum during passage of hydrograph.
4/ Water Supply for Albany
5/ For recreational development
6/ For public Fish & Wildlife development

TABLE 3B - STRUCTURE DATA

CHANNELS
Margaret Creek Watershed, Ohio

Sta.	to Sta.	Watershed Area	Types of Impr.	Req'd. Channel Capacity	"n" Value	Hydr. Grad. Slope	Bottom Grade	Des. Chnl. Area	Ave. Design Depth	Bot. Width	Side Slopes	Design Vel. in Channel	Volume of Excavation
		sq.mi.	1/	c.f.s.		ft/ft	%	sq.ft.	ft.	ft.		ft/sec.	1000cu. yds.
West Branch Margaret Creek													
525+00	590+00	10.8	C.E.	670	.035	.0017	.17	164	6.2	14	2:1	4.35	10.5
Margaret Creek													
268+00	424+00	18.6	C.C.	400 2/	.045							2.25 3/	
424+00	590+00	33.4	C.C.	510 2/	.04							2.4 3/	
590+00	724+00	47.2	C.C.	840 2/	.04							2.0 3/	

1/ C. E. Channel Enlargement
C. C. Channel Clearing

2/ Average Bankfull Capacity

3/ Average Bankfull Velocity

February 1965

TABLE 4 - ANNUAL COSTS

Margaret Creek Watershed, Ohio

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 1/	Total
One Unit:			
Floodwater Retarding Structures (4) 2/	12,125	923	13,048
Multiple-Purpose Structure (2) 2/	19,754	21,002 3/	40,756
9.8 Miles of Channel Improvement 2/	836	3,302	4,138
TOTAL	32,715	25,227	57,942

1/ Long term projected prices.

2/ Price base 1965 amortized at 3 1/8 per cent interest for 100 years.

3/ Includes $20,142 for annual operation and maintenance of the recreational facility.

February 1965

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Margaret Creek Watershed, Ohio
(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit 2/
	Without Project	With Project	
Floodwater			
Crop and Pasture	10,475	3,158	7,317
Other Agricultural	883	288	595
Non-agricultural			
Transportation	8,564	2,357	6,207
Subtotal	19,922	5,803	14,119
Indirect	2,236	699	1,537
TOTAL	22,158	6,502	15,656

1/ Price Base - Projected Long-Term

2/ Includes Flood Damage Reduction Benefits of $610 for Land Treatment Measures.

February 1965

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Margaret Creek Watershed, Ohio

(Dollars) 1/

Evaluation Unit	Average Annual Benefits									Average Annual Cost	Benefit Cost Ratio
	Damage Reduction	More Intensive Use	Changed Land Use Agr.	Savings in Bridge Costs	Municipal Water Supply	Redevelopment	Other 3/	Secondary	Total		
One Unit:	15,046	5,488	224	2,630	5,538	2,065	56,523	8,659	96,173	57,942	1.7:1.0
Floodwater Retarding Structures (4)											
Multiple Purpose Structures											
Floodwater Municipal Water & Recreation (1)											
Floodwater & Fish and Wildlife (1)											
Channel Improvement (9.8 Mi.)											
GRAND TOTAL	15,046 2/	5,488	224	2,630	5,538	2,065	56,523	8,659	96,173	57,942	1.7:1.0

1/ Price Base 1965 for Installation Costs and Projected Long-Term for Benefits and O&M Costs.

2/ In addition, Land Treatment Measures will provide Annual Flood Damage Reduction Benefits of $610.

3/ Site No. 2 Recerational Development - $47,025; Site No. 6 Fish & Wildlife - $7,438; and Sites No. 1, 3, 4 & 5 Incidental Recreation - $2,060

February 1965

INVESTIGATION AND ANALYSIS

The Soil Conservation Service, in assisting the sponsoring local organizations, employed the following data, sources, methods and procedures in the preparation of this plan.

Standard methods and information contained in prepared handbooks, are referred to by name rather than described here.

LAND USE AND TREATMENT NEEDS

Land use and treatment programs proposed in this watershed were planned by the Board of Supervisors of the Athens Soil and Water Conservation District. Technical assistance was provided by the U. S. Soil Conservation Service, U. S. Forest Service, and the Ohio Division of Forestry.

The Conservation Needs Inventory and basic farm plans within the watershed were used to arrive at the present land use and total conservation needs as outlined in AN-W 748 and supplements. The U. S. Forest Service and the Ohio Division of Forestry made a detailed study of the woodland aspects to determine the woodland needs and amounts of forestry practices to be applied.

The above data were used by the Boards of Supervisors in determining land treatment needs to be met during the project period.

HYDROLOGIC AND HYDRAULIC INVESTIGATIONS

The following physical data and procedures were used for the design of the proposed structural measures and to determine their effect in reducing present floodwater damages. The procedures used, if not referenced, are described in the Soil Conservation Service National Engineering Handbook, Section 4, Hydrology.

Floodwater Damage Evaluation:

Hydrologic Studies - Rainfall-frequency curves for the watershed were developed using data and methods described in the U. S. Weather Bureau Technical Paper No. 40 for 6-hour and 12-hour duration storms. There are no stream gaging stations with adequate records or similar flood peak producing characteristics located within or near the watershed to use in predicting frequency of discharge occurrences.

The backwater condition affecting Margaret Creek was analyzed by the study of 39 years of concurrent record of a stream gage at Athens on the Hocking River ($3\frac{1}{2}$ miles downstream from Margaret Creek) and a standard rain gage at Athens which was used to indicate potential floods on Margaret Creek. Altogether 46 years of record at the Hocking River stream gage were used to establish annual and growing season flood frequency curves. A frequency curve was also calculated for the largest annual 24-hour growing season rainfall

amounts at the Athens rain gage. This curve was very similar to U. S. Weather Bureau Technical Paper #40 6-hour duration frequency curve. The backwater study of the lower reaches on Margaret Creek indicated that coincident flooding and the flooding due to the Hocking River alone were not significant factors in the growing season evaluation.

The hydrologic curve number for the watershed was developed utilizing land use estimates, provided by the Work Unit Conservationist, and hydrologic soil groups from soil surveys. The runoff-frequency curve for non-agricultural damage evaluation was obtained by use of this curve number and the annual rainfall-frequency curve.

A growing season discharge-frequency relation was obtained from previous studies of gaged records in other watersheds. The growing season runoff-frequency curves for agricultural damage evaluations were developed using this data.

The discharge-runoff relationships for the watershed were obtained by flood routing. In the main stem and tributary reaches, flood routing was based on Soil Conservation Service Central Technical Unit hydrograph peak discharges developed from time of concentration relationships. Routing reach travel times were determined for one inch of runoff from storage-discharge data.

The following flood routings were carried out:

1. Natural (present) conditions: 2 and 5-year growing season and 50-year frequency.

2. Modified (with project) condition including land treatment, floodwater retarding structures and channel improvements: 3 and 10-year growing season and 100-year frequency.

In the modified condition routings, the hydrographs were adjusted to reflect the area under control by the structures. Reach travel times were recomputed using the increased capacity of the channel improvements.

In order to relate discharge to frequency, curves were plotted for each reach showing the relation to routed peak flows (natural and modified) and runoff in inches.

Hydraulic Studies - Engineering field surveys were tied to mean sea level datum in the Hocking River backwater area and on the West Branch channel improvement reach. In the upper reaches of the Margaret Creek valley the channel survey data are based on assumed mean sea level datum in areas where it was inconvenient to tie into existing vertical control. The surveys consisted of 9 valley sections, 18 additional channel sections and 2 bridge sections. Approximately 16 highwater marks of the March, 1963 flood were obtained. Additional engineering data were obtained from the advance prints of the new 7½ min. U. S. Geological Survey topographic maps, the 1941 flood

survey report on the Hocking River by the U. S. Army, Corp of Engineers and the March, 1963 flood profile of the Hocking River by the Division of Water, Ohio Department of Natural Resources.

Discharge rating curves were prepared at the surveyed cross sections by the development of water surface profiles under natural and modified conditions. Water surface profiles were developed by the Leach step method for Margaret Creek from the backwater on the Hocking River to the restricted valley flow section along the railroad just upstream from the new U. S. Route 50 bridge and for the West Branch of Margaret Creek. On the upper reaches of the main stem, the discharge rating curves were developed using Manning formula with the slope based on available high-water data. On the other major tributaries valley discharge rating curves were snythesized from the state-discharge relation from other valley sections with similar flow characteristics. High-water marks served as checks on the methods. In the modified condition, the discharge rating curves reflect the improved channel capacity due to the planned improvements.

The natural condition backwater from the Hocking River was determined by relating the rating curve at the Athens stream gage to the elevations above the White's Mill Dam, just below the Margaret Creek confluence. The average annual growing season discharge frequency (2.33 year) was selected as the starting elevation for the agricultural evaluation flood series.

Elevation-acres flooded curves were developed from the natural condition water surface profiles in each reach using valley section overbank top widths and representative lengths. Adjustment factors, to correlate computed with actual flooded area, were determined from the high-water marks and U.S.G.S. topographic maps. The acres flooded for each reach were related to the elevations of a key section within the reach. Using the stage-discharge curve for this section and the runoff-frequency-discharge relationship for the reach, frequency-acres flooded data were tabulated. The resultant area and depths inundated for the selected growing season and annual frequency storms were calculated for both natural and modified conditions to use in the evaluation of the works of improvement.

Structural Measures Design Hydrologic Criteria:

Floodwater Retarding Structures - For the principal spillway design, the 6-hour design storm rainfall amounts were obtained from the U. S. Weather Bureau Technical Paper No. 40 for this watershed. The low stage spillways were designed on a 5-year rainfall to give greater agricultural protection for the more frequent storms. The high stages were designed for 50-year rainfalls. Depth-duration curves, following the method given in Soil Conservation Service Technical Release No. 10, were used as checks on the structures.

This was to insure that longer duration storms would not cause the emergency spillways to operate more frequently than desired.

Individual runoff curve numbers were developed for each of the structure sites by a detailed evaluation of their hydrologic soil cover conditions. Future land use changes were used in the development of the curve numbers to determine the runoff from the design storm rainfall. These curve numbers are suitable for final structure design.

Release rates for the low stage spillways range from 8 to 15 cubic feet per second per square mile depending primarily on location within the watershed and on drainage area size. These accumulated discharges were checked in the main damage areas to assure that they will not impair drainage flow. High stage release rates were checked to be sure that bank-full channel capacities were not exceeded below the individual structures.

Design storm rainfall criteria for the emergency spillway and freeboard hydrographs were obtained from figures 21.5 - 21.9 1/ These criteria are based upon 6-hour 100-year frequency and 6-hour maximum probable precipitation maps from U. S. Weather Bureau Technical Paper No. 40. Design hydrographs for the detailed flood routing of the structure sites were computed by the Soil Conservation Service Central Technical Unit method.

Channels - The same runoff-frequency procedures developed in the floodwater damage evaluation were used to determine the discharge-frequency for design of the channel improvements. The channel design discharges on the West Branch of Margaret Creek were developed by flood routing the 3-year growing season design storm discharge, modified by the retarding structures, through the proposed channel improvements. The design discharges computed on the main stem of Margaret Creek are the result of the modified flood routing, which considers the reduction in flow from the retarding structures along with revised Manning's ("n") roughness coefficients. These "n" values are based on the scope of channel work considered practical in each reach. Therefore, the design frequency used varies by reaches similar to the present channel capacity.

GEOLOGIC INVESTIGATIONS

Upland Erosion Investigations:

Conservation survey maps, photos, farm plans and field observation of the land areas above structures and intervening areas were used to determine the representative soils, slopes, erosion

1/ Soil Conservation Service National Engineering Handbook, Sec. 4, Hydrology, Supplement A (Revised)

and vegetative cover in the watershed. A geologic map was prepared to show the contact of the major geologic formations and soil relationships.

Sheet erosion was found to be moderate over most of the watershed. Approximately 6 per cent of the sloping cropland was found to have severe erosion.

A number of the actively eroding gullies shown on the old aerial photos have been stabilized by natural revegetation. Gully erosion is no longer a problem in the watershed as a whole.

Estimates based on aerial photos and field checks were made of rock banks and channels above all retarding structures. Channel erosion in the tributaries was found to be moderate to slight.

Local areas of unprotected strip mine spoils are severely eroded, however these are confined in remote, rugged upland areas and are not affecting the farm lands in the watershed.

Aerial photos, farm plans, and field observation were used to evaluate sheet erosion above all impounding structures. Land characteristics relative to the delivery of the products of erosion were observed. Sediment from all sources that will be delivered to each structure site under present and future conditions was calculated. Sediment storage requirements were determined in accordance with the Soil Conservation Service Engineering Memo #16, Revised, and Technical Release #12. Measured reservoirs in the same land resource area were used for comparison. The sediment storage figures shown in Table 3 will be used for final design.

Sedimentation Investigations:

Infertile overwash is not a problem on the flood plains. Field observation showed that infertile deposits are confined to occasional channel shoals $1\frac{1}{2}$-2 feet thick mainly of fragmented sandstone in varying stages of transit or which are temporarily stabilized. Most fine textured soils are carried through the watershed during high stream stages. Overwash of fines during out-of-bank flood flows were found imperceptible by hand auger checks except in the depressional areas where 1-2 inches maximum were measured in two pasture fields immediately after flooding. These deposits are not detrimental from a fertility standpoint. However, occasional reduction in quality of farm crops results from deposition of thin films of fine sediments on bottom land crops. It is anticipated that this damage will be reduced by improved land treatment measures and flood reduction with the structural works of improvement installed. No significant build-up of natural levees leading to bottom land swamping was observed.

Overwash of sometimes toxic colluvium from erosion and slipping o· strip mine spoil bank materials is confined to the perimeter of the spoils. These are idle or forested lands. Some runoff and debreital material is trapped in the high wall pools left after stripping.

The maximum advance of sediments from this source was found to be limited to short advances in several wooded ravines. Very small amounts of yellow sand, considered as traces, can be found in the tributaries above Structure Sites No. 4 and No. 5. Iron-bearing waters with their yellow oxidation deposits are apparent on rocks and vegetation in these tributary channels. These are minor and do not appear to be toxic to the native vegetation.

Structure Site Investigations:

Of 8 possible sites located on the U.S.G.S. topographic maps, six were found to be feasible from economic, geologic and hydrologic aspects.

Preliminary investigations were made on the above 6 sites for work plan purposes. Geologic information, surficial observation and limited hand borings were used to arrive at the pertinent physical data for engineering purposes, and which are summarized below.

In general, all sites lie in rock-controlled tributary valleys within the dissected Conemaugh formation of residual Pennsylvanian rocks. The weathered, unconsolidated upland surface mantel as well as the valley alluvium varies in depth from several feet to 12 feet.

Site # 1 (FWR) (Margaret Creek)

The foundation at this site is normally stable with 10 feet of CL material over sandstone bedrock. The proposed reservoir bottom appears impermeable. The left abutment will tie into unconsolidated material, however, interbedded sandstone and shale will be encountered at 2-3 feet in the right abutment. Soil slumping is present in the colluvial areas. The rock tie-in on the right abutment, is rippable with heavy equipment through its weathered surface.

The emergency tentatively planned on the left uplands will entail some weathered rock excavation in an estimated amount of 10 per cent.

Borrow of acceptable CL quality is available on both uplands near the proposed dam, and in the tributary bottom upstream from the fill.

This appears to be a good site with no complex geologic problems. A very small area of strip mine spoils at the eastern divide will not contribute infertile or toxic products to this impoundment.

Site # 2 (M.P.) (Tributary Margaret Creek)

The foundation is non-yielding below 10 feet where shale bedrock occurs. The present channel bottom is on shale in some places.

The long fill across this valley will tie into 8 feet of unconsolidated CL material at the right abutment. Soft shale was found be low 8 feet. Interbedded sandstone and shale were found at 2 feet from the surface in the left abutment.

The emergency has been tentatively planned on the right upland where soil materials are 8 feet deep to weathered, soft shale.

Borrow in ample quantity is available on both uplands near fill centerline, and from the emergency spillway excavation.

The proposed reservoir bottom alluvium is silty and sandy clay with sandstone fragments. Positive cut off by a core into the soft impervious shale bedrock will be needed, pending further detailed investigation.

Site # 3 (FWR) (North Branch)

The foundation is silty alluvium to bedrock at 3.5 feet. The right abutment consists of an exposed precipitous face of interbedded sandstone, shale, and limestone. The left tie-in is shallow (2.5 ft.) to bedrock with a minimum vertical fracture pattern.

The emergency on the right abutment is unconsolidated to 6.5 feet below which soft shale was encountered.

Borrow of CL quality is available on both uplands at the proposed center line. The reservoir bottom materials are unacceptable as borrow material and positive cut off into the bedrock will be necessary. Depths of this trench will be determined during detailed subsurface explorations.

Site # 4 (FWR) (Biddle Creek)

Bedrock was not reached by hand borings in the foundation. Rather dense CL alluvial material, which is impervious, covers the valley bottom at this site to a depth of at least 10 feet. Some thinly-bedded rippable shale was found in the left abutment. The right abutment is unconsolidated to 3 feet, to the thinly bedded, soft shale.

No rock was found in the emergency area proposed on the right upland. Ten feet of very stiff, silty clay were encountered in hand borings. All material from this cut, as well as an area on the right upland is of ggod quality for embankment construction. Additional material of acceptable borrow quality may be taken from the high parts of the proposed reservoir bottom. These have been deposited from the adjacent uplands.

A limited amount of strip mine water will pass through this site. Most of the run off from the spoils above is trapped within the mined area. Approximately 4,000 feet of the last cut against the highwall contain impounded pools. The total area disturbed by strip mining, including the spoils, covers an area approximately 10,000 feet long and 700 feet wide on the contour near the sub-watershed divide. This is a small part of the total sub-watershed. Effluents will be transported through wooded ravines of two tributaries, and will empty into the upper end of the proposed impoundment.

Three 30 inch pipelines traverse the upper end of the flood pool which should be weighted.

Site # 5 (FWR) (Trib. of Biddle Creek)

Very much like Site No. 4, no rock was encountered in the foundation borings to 10 feet. The alluvium was found to be very stiff CL material. Both abutments were composed of ledges of alternating sandstone and shale. Stream-cut benches occur above the ledges.

Some thin limestone interbeddings were found within the sandstone and shale at 7 feet from the surface in the emergency area on the right upland. All unconsolidated material from this excavation and a possible borrow area on both uplands is of acceptable quality CL material. It appears that rock excavation in the emergency area will not be a major problem.

Both abutments will be tied into rippable rock to a firm unweathered surface.

In that this site is also below a strip mined area some pollution by mine effluents or spoil bank run-off would be anticipated. The strip mined area is small in terms of the total subwatershed area. Following the contour near the divide the disturbed area is approximately 4,500 feet long by 500 feet wide. The width increases to 1,000 ft. in one cove. There are pools adjacent to the high wall which trap most of the run-off. Transport of effluents from this operation are through a wooded ravine on one tributary emptying into the proposed dam. There are several gas wells at elevation 740 on the right upland near the above mentioned tributary confluence. It is not anticipated that the wells or their collection lines will be affected by this project. These wells are approximately 4 ft. higher than the top of the proposed dam. No sustained pollution from brines is anticipated.

Site # 6 (FWR) (West Branch, Margaret Creek)

The foundation at this site is 10-12 feet of silty clay alluvium over sandstone and shale. A water table was measured at 7 feet.

The left abutment is unconsolidated to 10 feet, and is silty clay material. The right abutment tie-in will be cut into steep, interbedded shale and sandstone. The stream flowing near the right valley wall had sandstone bedrock 1 foot below the channel bottom.

The emergency spillway on the left upland was found to be unconsolidated to 7 feet where gray, clay shale was found.

Borrow from the emergency excavation, the left upland, and colluvial material at the left valley slope is of silty clay texture. An average of 5 feet can be taken from these areas. Some silty clay borrow may be taken from the sloping bottom of a tributary valley just upstream from the left abutment.

Two pieplines cross the West Branch valley. The easternmost, designated as No. 2 in the field surveys, falls within the flood pool of this proposed impoundment and should be weighted.

Detailed subsurface explorations will be needed to determine the bedrock profile at the fill site.

Detailed geologic investigations will be made at all sites in the operations phase of this program. Cost estimates for these and laboratory sample analyses are included in this work plan. It appears that all sites will have some rock excavation either for core trench, abutment preparation, or emergency construction. The thin bedding and character of the rock will allow these preparations to be made by heavy rock ripping equipment through the weathered zones (2-3 ft. thick) and into firm material. The additional costs of this type of excavation have been considered for each proposed site, and are included in this work plan. Detailed geologic reports will be furnished to the design engineer, as well as, collaboration by the geologist with the project engineer on principal spillway foundations or physical conditions affecting other appurtenances.

Channel Investigations:

Channel stability investigations were made using hand auger borings and surficial observation of channel characteristics on 6,500 feet of the West Branch channel. The textural composition of the stream banks was studied and found to be light silty clays and clayey silts in this reach. In view of the gradual transitions between these textures and the lack of widespread horizons of coarse sediments it is anticipated that stability can be maintained at 2:1 slopes. The project involves widening for increased capacity with no significant deepening. Some shoals and numerous boulders and rock slabs will be removed from the bottom at the upper end of the bridge within this reach. No problems are anticipated under sustained flow conditions. This investigation will be adequate for the operations phase of this project.

DESIGN ANALYSES FOR STRUCTURAL MEASURES

Design Standards and Procedures for Retarding Structures:

Designs for the floodwater retarding structures and the floodwater retarding aspects of the multiple purpose structures are based upon criteria as established in Soil Conservation Service Memoranda 16, 27, 31, 40, 42, 43, and 47 and Technical Releases 2 and 10.

Cross-section surveys were made along the proposed centerlines of fill. Profile surveys were also made at the lower elevations in the impoundment areas to determine the extent of road and building inundation. All elevations were tied into mean sea level datum. U. S. Geological Survey $7\frac{1}{2}$ minute quadrangle topographic maps and aerial photographs were used extensively.

In developing the area-capacity curves, U. S. Geological Survey Topographic maps were checked with the cross-section survey data noted above.

All the floodwater retarding structures were designed with 100 year sediment storage. A permanent wet conservation pool is planned at the 50 year sediment level except at Structure No. 2 and No. 6. Structure No. 2 contains additional storage for municipal water supply and recreation. No. 6 contains additional storage for fish and wildlife development. Flood routings were started at the elevations of the 100 year sediment volume at Structures 1, 3, 4 and 5. At Structure No. 2 and No. 6 flood routings were started at the permanent pool elevations.

In the design of the structures for floodwater storage the following criteria were used:

1. A port in the principal spillway riser set at the permanent pool elevation to control the normal lake elevation for 5-year runoff volume with antecedent moisture condition II$\frac{1}{2}$.

2. A high stage opening in the principal spillway at the top of the 5-year frequency design storage or two feet above the low stage port whichever is greater.

3. An emergency spillway crest set at or above (a) the peak of maximum flood storage required for the principal spillway design frequency runoff with antecedent moisture condition II$\frac{1}{2}$ or (b) two feet of minimum stage above the crest of the high stage riser, whichever is greater.

4. Freeboard and emergency spillway dimension to be determined by flood routing the freeboard and emergency spillway hydrographs respectively.

The principal spillway design storms were flood routed by the Beta method. Technical Release No. 10 procedure was used. The emergency spillway and freeboard design hydrographs were routed by the Upper Darby method of reservoir flood routing.

For estimating cost, the structure design was based on side slopes of the dam being $2\frac{1}{2}$:1 downstream and 3:1 upstream and minimum top width of fill being 14 feet. Berms of 8 foot width were used on all structures. These dimensions may change in final design following recommendation of the Soil Mechanics Laboratory.

Structure No. 6 is planned as a flood prevention-fish and wildlife multiple purpose structure, utilizing a conventional type principal spillway as shown in Figure 1. An upstream level berm is planned at the permanent waterline of the fish and wildlife pool. The Upper Darby method reservoir routing was used to proportion the emergency spillway.

Structure No. 2 which is planned as a flood prevention-Recreation-Water Supply multiple purpose structure utilizes a conventional type principal spillway as shown in Figure 1 with a flat top inlet and reinforced concrete pipe conduit. A berm is planned across the upstream slope but protection of dumped stone riprap is provided from the point of maximum drawdown to a few feet above the permanent water line. The Upper Darby method of reservoir routing was used to proportion the emergency spillway.

The recreation facilities adjacent to Structure No. 2 will be planned by the Margaret Creek Conservancy District. The following table shows an itemized construction cost estimate of the recreational facilities:

ESTIMATED CONSTRUCTION COST OF RECREATIONAL FACILITIES

Item	No.	Estimated Unit Cost (Dollars)	Construction Cost (Dollars)
Boat Dock - Beach Area			
Floating Boat Docks	25	100	2,500
Latrine	2	2,500	5,000
Water System (15 taps)	1	5,000	5,000
Launching Ramp	1	1,100	1,100
Bath House & Change Booths	1	15,000	15,000
Beach (75,000 sq. ft.)	1	15,000	15,000
Roads & Parking	1800 ft.	6	10,800
Subtotal			54,400
Camp & Picnic Area			
Latrine	4	2,500	10,000
Electrical Hookup	28	25	700
Waste Drain	2	600	1,200
Water System	1	5,000	5,000
Picnic Tables	250	25	6,250
Fire Rings	175	5	875
Bath & Laundry Bldg.	1	8,000	8,000
Roads & Parking	4,200 ft.	6	25,200
Shelter House	1	5,000	5,000
Fencing	6,600 ft.	.50	3,300
Subtotal			65,525
Total Cost			119,925

Design Standards and Procedures for Channel Improvement:

Soil Conservation Service "Standards and Specifications for Open Ditches" in Ohio, National Engineering Handbook 16 (Drainage) and pertinent engineering memoranda were used as criteria and guides for the design of channel works of improvement.

Field surveys made by Soil Conservation personnel and other field data from U. S. Geological Survey and aerial photographs were used. These data, were used to develop the profiles for channel design and cross sections for quantity determinations.

ECONOMIC INVESTIGATIONS

General:

Damages and benefits were calculated from basic economic information obtained from various reports and field investigations. Interviews with flood plain operators and local agricultural technicians were made to determine the type, extent and location of agricultural damages. Other damage data were obtained from local people and officials.

Damages and benefits were computed at long-term levels by use of indexes and projections in the Agricultural Price and Cost Projection Pamphlet, by the Agricultural Research Service and Agricultural Marketing Service, September 1957.

The costs of planned works of improvement are based on current construction costs for southeastern Ohio. Estimated land, easements, and rights-of-way values were based on recent local transactions. For lands having 100 per cent loss of present use, costs were computed for fee simple title acquisition. The costs of lands used for temporary pool areas and channel construction were based on easement values. The estimated economic life of the structural measures is 100 years. Annual installation costs were computed by the application of an interest rate of 3 1/8 per cent for amortization based on the estimated economic life of the improvements.

Agricultural Floodwater and Sediment Damage:

Floodwater and sediment damage to crops and pasture constitute the majority of the damages computed as agricultural. Farmer interviews with more than 20 flood plain operators plus consultation with the agricultural technicians and correlation with recent crop damage history provided a basis to establish a damegeable value per acre for the principal crops in the flood plain area. Loss of expected normal yields, lost production costs and extra tillage operations were taken into account in establishing these damageable values. The season of expected flood occurrence, depth and duration of the flooding waters were correlated and weighed into the over-all damage estimate to obtain a composite-acre damage and stage-damage value for each reach.

Hydrologic data provided area flooded-frequency of occurrence relationships. With this information and composite-acre-damage data, existing average annual damages by reaches were computed for the inundated areas.

Utilizing the flood damage-frequency of occurrence relationship for "without" and "with" project installations, it was possible to determine the average annual flood damages prevented. These reductions are considered as benefits to the projects and summarized in Table 5.

Other agricultural floodwater damages involving farm flood gates, farm buildings, urban homes, farm lanes, culverts, livestock loss, and debris pickup were obtained by interviews and related data from similar watersheds. The average annual damages "without" and "with" project were computed by use of the stage-damage-frequency relationships.

Transportation Facilities Damages:

Public road and bridge floodwater damage data were obtained from local residents, and responsible state, county and township road officials.

These data were used to develop stage-damage-frequency relationships per mile of inundated road for use in computing existing annual damages and remaining damages "with" project. The damages prevented constitute the public road transportation benefits. All reaches were separately evaluated for flood water damages to roads.

Railroad floodwater damage data were obtained from local residents and officials. Due to the rebuilding of the roadbed, following the most recent flood, accurate damage values based on the repair of floodwater damage alone were not available. However, recent detailed data was available on a railroad in a nearby watershed. These data were conservatively projected to establish the damage values for this railroad. Stage-damage-frequency relationships per mile of damaged road bed were established, for use in computing the existing annual damages and remaining damages "with" project. The damages prevented constitute the railroad benefits.

Indirect Damage:

All indirect damages were estimated as a percentage of direct floodwater and sediment damages. Ten per cent was used for such agricultural losses as the inability to market livestock in a timely manner, market milk, etc.

Indirect damages resulting from direct damages to public roads, bridges and culverts were estimated at 15 per cent. Excessive travel costs are incurred from re-routing traffic around flooded and washed out roads. Extra travel and expense is incurred due to the closing of normal bus routes for transporting school children. During flooding many people in the watershed are faced with extra travel and expense to secure needed goods and services, and to get to their place of employment.

Inundated railroad tracks cause train delays of a week or more, disrupting traffic patterns and causing shipping delays and re-routing of cargo. No loss of perishables due to such delays were reported. These indirect damages were evaluated at 25 per cent.

Other Flood Prevention Benefits to Agriculture:

Benefits were based on the reduction in flood stages which will permit greater land utilization. Data and information from farmer interviews, local agricultural technicians, and other sources provided the basis for determining cropping patterns, yields, crop production costs and associated costs "without" and "with" project.

An estimated 93 acres were determined to have productivity restored to former levels. The evaluated benefits were reported as damage reduction benefits.

There are 7 acres subject to changed land use in the additional area provided by the 5-year level of protection.

The more intensive use of existing cropland will occur on most of the flood plain where a substantial portion of a field is protected during a 2 to 5-year flood. Although there will be some shifting from low to high value crops, most of these benefits are reflected in higher yields of existing crops due to improved farming practices which will be economically justified with the level of protection provided by the project.

Monetary benefits, due to the enhancement of agriculture lands, were derived from the difference in net returns "without" and "with" project. Allowances were made for added floodwater damage to the higher value crops, the associated costs necessary to produce these crops, and the reduced net income in the upland due to the shifting of crops. The benefits were discounted to provide for the time lag in their accrual.

Redevelopment Benefits:

Data for determining benefits from employment stemming from project installation were obtained from engineer's estimates, the Ohio Bureau of Unemployment, and the Ohio Department of Development.

Labor costs involved in the project structural measures were determined with consideration given to wage rates, types and classes of labor. The extent of the unemployed or underemployed was determined for the project area. Applicable data were obtained from experienced contractors showing what portion of their labor costs were spent for local labor. Labor will come primarily from counties designated as Area Redevelopment Areas. The practice of contractors in use of labor and the potential supply of unemployed or underemployed local labor assures reasonableness to the project redevelopment benefits claimed (Table 6).

The labor portion of the average annual operation and maintenance costs for the structural measures was estimated. Evaluations were made, as described above, to determine that portion of the labor costs which will benefit the unemployed and the underemployed.

Secondary Benefits:

Local secondary benefits stemming from the project were evaluated at 10 per cent of the direct primary project benefits.

Secondary benefits occurring outside the project area were not evaluated.

Recreation Benefits:

Structure No. 2 is a multiple purpose flood prevention-recreation-water supply reservoir. A statewide inventory, showing the visitor-day use of similar public recreational areas, was used as the basis for estimating the use of this highly developed recreational facility. The visitor-days were appropriately discounted to reflect the expected lag in the development and use of the facility.

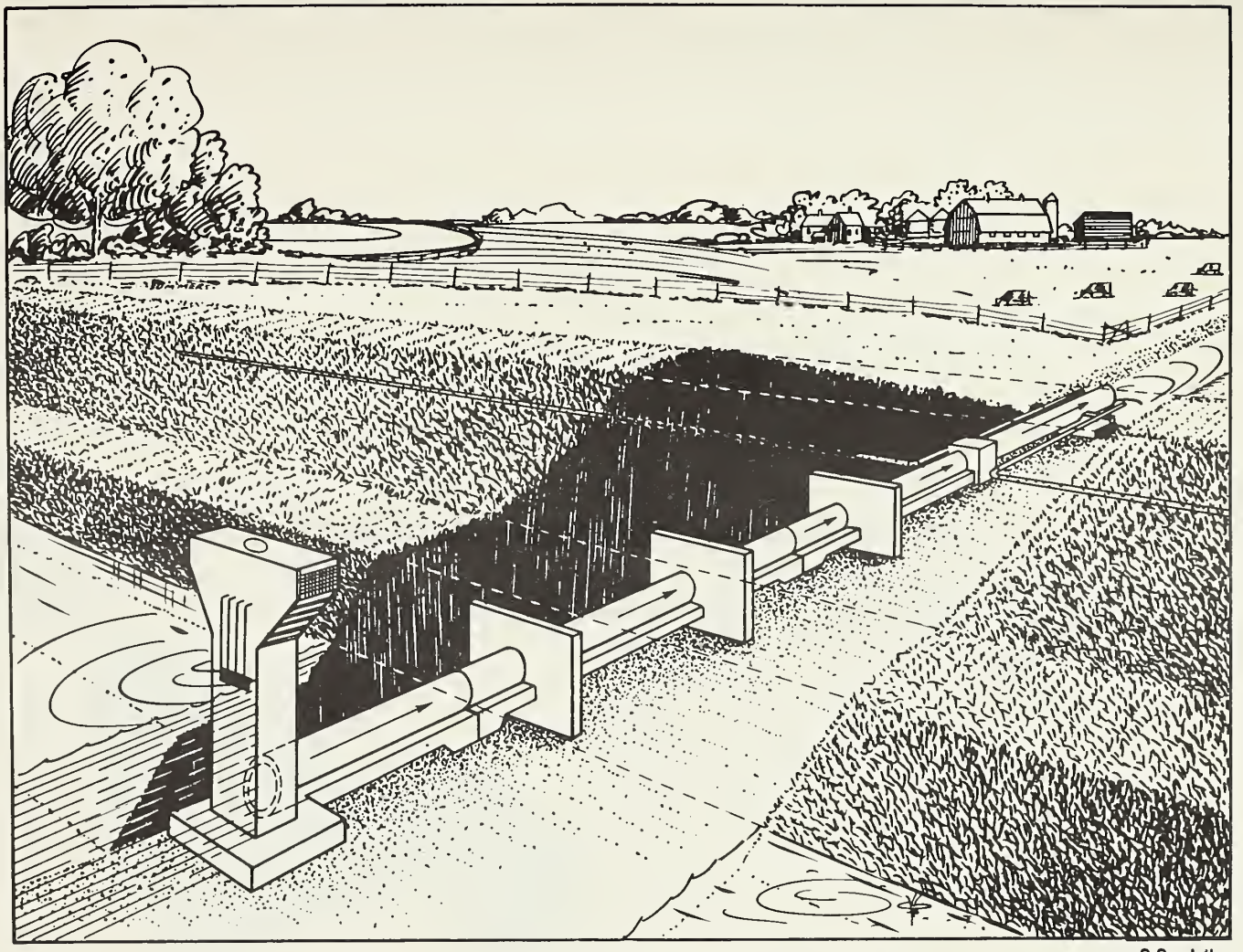
The use of the State-sponsored fish and wildlife recreation facility at multiple purpose flood prevention-recreation Structure No. 6 was evaluated in the same manner as described for Structure No. 2 above.

Incidental recreational use of the conservation pools at Structure No. 1, 3, 4 and 5 was evaluated with appropriate discounting for the development of the aquatic aspects and the future loss of the pool areas by siltation. The above mentioned State-wide inventory was again used as the basis for estimating the visitor-day use of these pools.

The Federal cost sharing for the construction costs of the water resource improvement at Sturcture Nos. 2 and 6, and the minimum basic facilities of the recreational development at Structure No. 2, do not exceed 50 per cent. The costs were allocated by the Use of Facilities method.

Water Supply Benefits:

Municipal water supply has been incorporated into the multiple purpose Structure No. 2 as shown in the cost allocation. Local interest estimated that the benefits from the non-agricultural water storage were at least equal to the cost of the cheapest alternative source of equivalent water supply. This was the cost of a single purpose-municipal water storage reservoir at each structure site or other suitable location in the general area. The costs were allocated by the Use of Facilities method as shown above in the cost allocation of Structure No. 2.



SS-14

Reinforced concrete pipe with flat top inlet.

FIGURE 1

U. S. DEPARTMENT OF AGRICULTURE

PROJECT MAP
MARGARET CREEK WATERSHED
ATHENS AND MEIGS COUNTIES, OHIO

SOIL CONSERVATION SERVICE

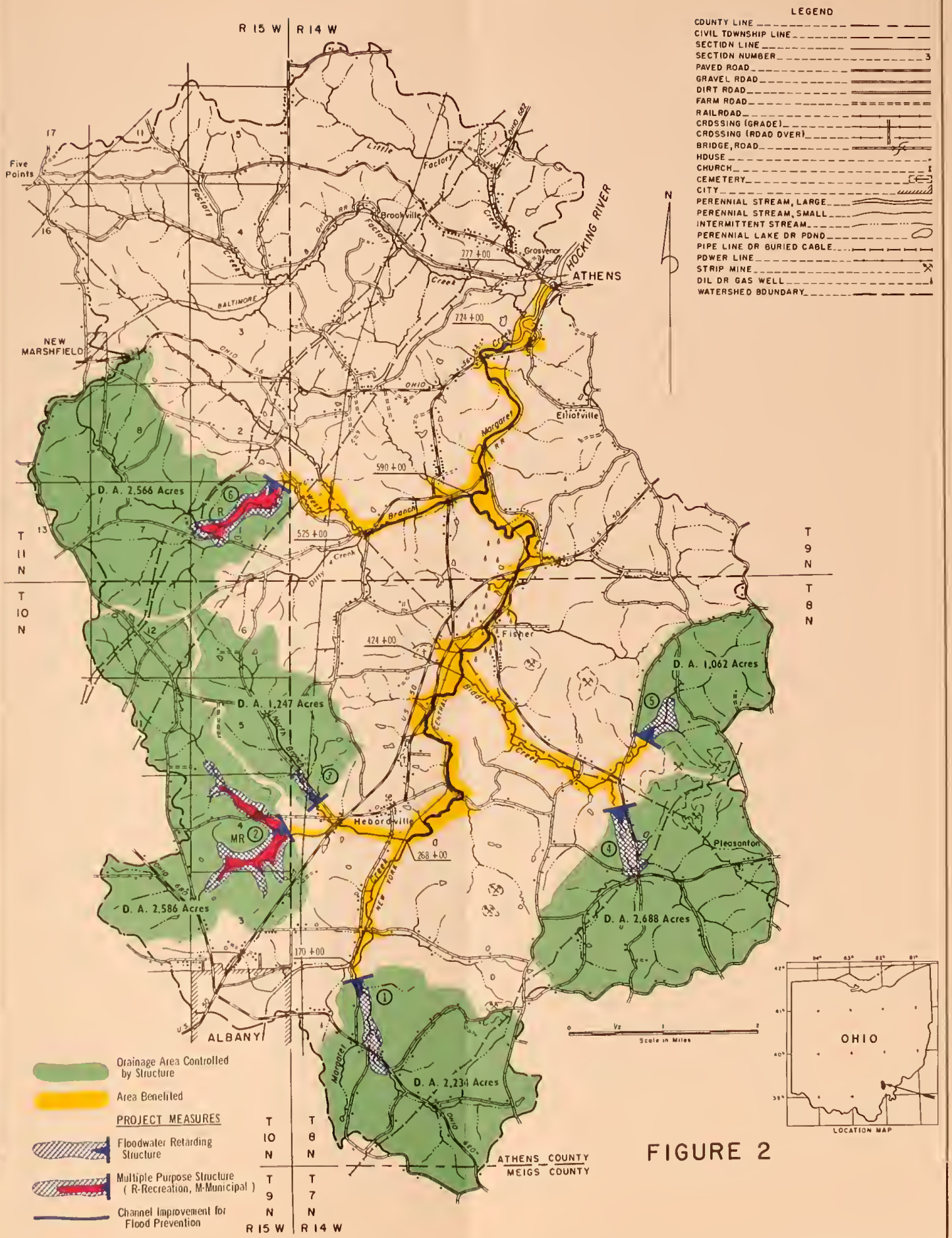


FIGURE 2

USDA-SCS-HYATTSVILLE, MD. 1965

N

TO ATHENS
U.S. ROUTE 50

DAM

Camping Area

TOILET

BATH & LAUNDRY

TOILETS

PICNIC AREA

Shelter House

Pond

Bath House

Beach Area

Pond

Park Entrance

Sediment Pool
Elev 710.0

Recreation Pool
Elev 732.2

Water Supply Pool
Elev 735.0

Spillway Crest plus
2 Feet Vertical
Elev 741.0

COUNTY ROAD 12

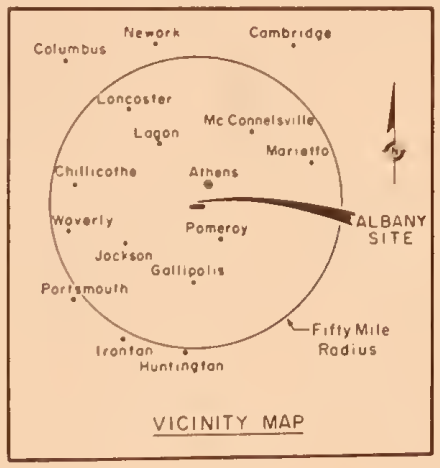
Boat Marina

Parking Area

Recreation Area
Boundary

TO ALBANY

400' 0 400' 800' 1200' 1600' FEET



VICINITY MAP

FIGURE 3
RECREATIONAL DEVELOPMENT
STRUCTURE SITE NO. 2
MARGARET CREEK WATERSHED
Athens County, Ohio

USDA-SCS-HYATTSVILLE, MD 1965

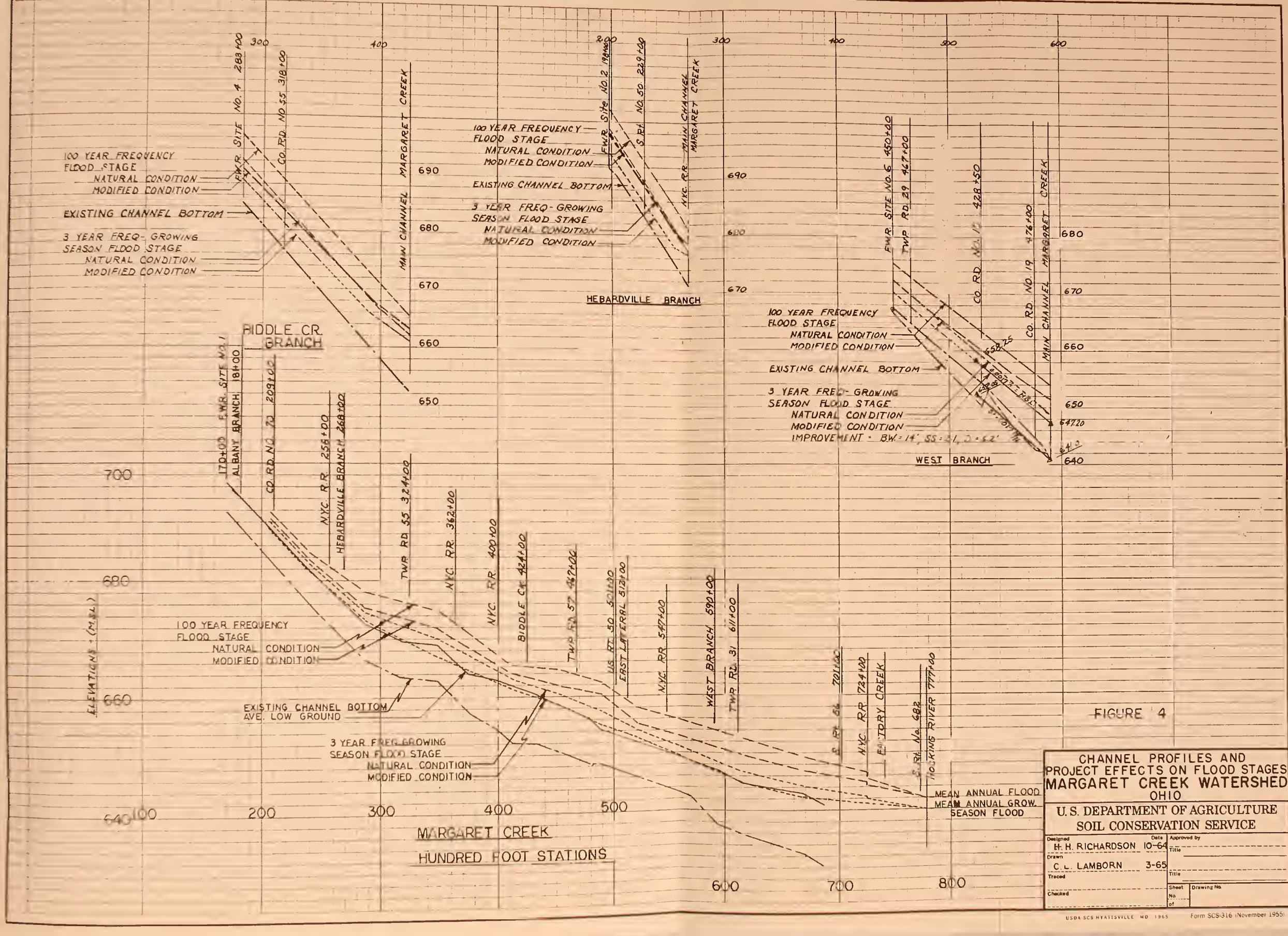


FIGURE 4

CHANNEL PROFILES AND PROJECT EFFECTS ON FLOOD STAGES
MARGARET CREEK WATERSHED
OHIO

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed H. H. RICHARDSON	Date 10-64	Approved by	
Drawn C. L. LAMBORN	3-65	Title	
Traced		Title	
Checked		Sheet No. of	Drawing No.

USDA-SCS HYATTSVILLE MD 1965 Form SCS-316 (November 1955)