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WORK PLAN CROSS CREEK WATERSHED



WASHINGTON COUNTY, PENNSYLVANIA

JULY 1971



U. S. DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Harrisburg, Penna.

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ADDENDUM NO. 1

Cross Creek Watershed, Pennsylvania

This addendum shows the project costs, benefits, and benefit-cost ratio based on a 6-7/8 percent discount rate, current construction costs, current recreation values, and current normalized prices. Annual project costs, benefits, and benefit-cost ratio are as follows:

1. Project costs are \$360,000
2. Project benefits are \$527,000
3. The project benefit-cost ratio is 1.5 to 1

The alternative selected for implementation, as contained in this work plan, is based on a careful and deliberate consideration of the environmental and economic impacts of the project. There are no known unresolved environmental issues. Comments on the draft environmental statement stressed the need for a more detailed description of resources and problems and environmental impacts. The final environmental statement has been modified in response to such comments.

December 1973

ADDENDUM NO. 2

Cross Creek Watershed Work Plan

The Project Installation section (Page 31) is to be expanded to include the following:

The Washington County Commissioners will be responsible for providing:

1. Personally or by first class mail, written notices of displacement and appropriate application forms to each displaced person, business or farm operation.
2. Assurance that decent, safe and sanitary replacement housing will be available for all displaced persons.
3. Assistance in filing applications for relocation assistance.
4. Review and processing of applications and mediating grievances in connection with displacements.
5. Each person, business, or farm operation to be displaced by the project, at least 90 days written notice prior to the day they are required to move.

The Soil Conservation Service will provide:

1. Assistance, as needed, to the Washington County Commissioners to administer Public Law 91-646.

DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL EXPERIMENT STATION

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WATERSHED WORK PLAN

Cross Creek Watershed

Washington County, Pennsylvania

Prepared under the authority of the
Watershed Protection and Flood Preven-
tion Act (Public Law 566, 83d Congress,
68 Stat. 666), as amended.

Prepared by: Washington County Soil and Water
Conservation District
Washington County
Cross Creek Township
Independence Township Municipal Authority

With assistance by:

U. S. Department of Agriculture
Soil Conservation Service
Forest Service

July 1971

CROSS CREEK
WATERSHED WORK PLAN AGREEMENT

between the

Washington County Soil and Water Conservation District
Local Organization

Washington County
Local Organization

Cross Creek Township
Local Organization

Independence Township Municipal Authority
Local Organization

(hereinafter referred to as the Sponsoring Local Organization)

Commonwealth of Pennsylvania

and the

Soil Conservation Service
United States Department of Agriculture

(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Cross Creek Watershed, Commonwealth of Pennsylvania, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666) as amended; and

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

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

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

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

1. The Washington County Commissioners, in behalf of the Sponsoring Local Organization, will acquire without cost to the federal government, such land rights as will be needed in connection with structures PA-659F, PA-660, PA-661, PA-662, and recreation facilities at PA-661. (Estimated cost \$968,800).

The Sponsoring Local Organization agrees that all land acquired or improved with PL 566 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Washington County Commissioners, in behalf of the Sponsoring Local Organization, will provide relocation advisory assistance services and make the relocation payments to displaced persons as required by the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970

(Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. Prior to July 1, 1972, the Sponsoring Local Organization will comply with the real property acquisition policies contained in said Act and Regulations to the extent that they are legally able to do so in accordance with their State law. After July 1, 1972, the real property acquisition policies contained in said Act shall be followed in all cases.

The Service will bear 100 percent of the first \$25,000 of relocation payment costs for any person, business, or farm operation displaced prior to July 1, 1972. Any such costs for a single dislocation in excess of \$25,000 and all costs for relocation payments for persons displaced after July 1, 1972, will be shared by the Sponsoring Local Organization and the Service as follows:

	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Relocation Payment Costs</u> (dollars)
Relocation Payments	53.0	47.0	\$177,000

- The Washington County Commissioners will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to Commonwealth law as may be needed in the installation and operation of structures PA-659F, PA-660, PA-661, and PA-662. They will also be responsible for securing necessary permits from the Pennsylvania Department of Environmental Resources for construction of PA-659F, PA-660, PA-661, and PA-662.
- The percentages of construction cost of structures PA-659F, PA-660, and PA-662 to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
PA-659F			
PA-660	- 0 -	100	\$730,200
PA-662			

The percentages of joint and specific construction costs of structure PA-661 to be paid by the Washington County Commissioners and the Independence Township Municipal Authority, in behalf of the Sponsoring Local Organization, and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
PA-661			
Joint Costs	Washington Co. Commissioners 35.0	62.4	\$574,800
	Independence Twp. Municipal Authority 2.6		
Specific Costs	Independence Twp. Municipal Authority 100	0	800

The percentages of construction cost of the recreational facilities to be paid by the Washington County Commissioners, in behalf of the Sponsoring Local Organization, and by the Service, are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
PA-661			
Recreation Facilities	50.0	50.0	\$610,200

5. The Service will bear engineering costs for structures PA-659F, PA-660, and PA-662. (Estimated cost \$32,400).

The percentages of joint and specific engineering costs for structure PA-661 to be paid by the Independence Township Municipal Authority, in behalf of the Sponsoring Local Organization, and by the

Service, are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Engineering Cost</u> (dollars)
PA-661			
Joint Cost	2.6	97.4	\$17,000
Specific Cost	100	0	200

The percentages of engineering costs to be incurred under an A&E contract for the recreation facilities constructed at PA-661 to be paid by the Washington County Commissioners, in behalf of the Sponsoring Local Organization, and by the Service, are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Engineering Cost</u> (dollars)
PA-661			
Recreation Facilities	50.0	50.0	\$91,600

6. The Sponsoring Local Organization and the Service will each bear the costs of Project Administration which it incurs, estimated to be \$23,000 and \$259,000, respectively.
7. The Washington County Soil and Water Conservation District will obtain agreements from owners of not

less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation plans on their land.

8. The Washington County Soil and Water Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
9. The Washington County Soil and Water Conservation District will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
10. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

The Washington County Commissioners will be responsible for operation and maintenance of Structures PA-659F, PA-660, PA-661, recreational facilities, and PA-662. (Estimated annual cost \$45,400).

The Independence Township Municipal Authority will be responsible for operation and maintenance of PA-661 assigned to water supply. (Estimated annual cost - \$100).

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is

contingent on the appropriation of funds for this purpose.

A separate agreement will be entered into between the Service and the Sponsoring Local Organization before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7 C.F.R. Sec. 15.1-15.12) which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving federal financial assistance.

Washington County Commissioners
Local Organization

By /s/ A. V. Capano

Title Acting Chairman

Address Court House

Washington, Pa. 15301

Date September 2, 1971

The signing of this agreement was authorized by a resolution of the governing body of the Washington County Commissioners adopted at a meeting held on September 2, 1971.

Minute #181

/s/ J. V. Murphy

Chief Clerk

Address Court House

Washington, Pa. 15301

Date September 2, 1971

Washington County Soil & Water
Conservation District
Local Organization

By /s/ R. L. Adamson

Title Chairman

Address 37 Highland Avenue

Washington, Pa. 15301

Date September 3, 1971

The signing of this agreement was authorized by a resolution of the governing body of the Washington County Soil & Water Conservation District adopted at a meeting held on

September 3, 1971

/s/ Paul Onopiuk

Secretary

Address 37 Highland Avenue

Washington, Pa. 15301

Date September 3, 1971

Independence Township Municipal Authority
Local Organization

By /s/ Patsy De Filippis

Title Chairman

Address R. D. #3, Avella, Pa. 15312

Date August 27, 1971

The signing of this agreement was authorized by a resolution of the governing body of the Independence Township Municipal Authority adopted at a meeting held on _____

August 27, 1971

/s/ Paul J. Bukarnsky
Secretary

Address P. O. Box 391

Avella, Pa.

Date August 27, 1971

Cross Creek Township Supervisors
Local Organization

By /s/ Lee Adamson

Title Chairman

Address R. D. #2, Avella, Pa. 15312

Date August 23, 1971

The signing of this agreement was authorized by a resolution of the governing body of the Cross Creek Township Supervisors adopted at a meeting held on August 23, 1971

/s/ Josephine Mucci
Secretary

Address R. D. #3, Avella, Pa.

Date August 23, 1971

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

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WATERSHED WORK PLAN

CROSS CREEK WATERSHED

Washington County, Pennsylvania

July 1971

Summary of Plan

This plan for the conservation of water and related land resources was prepared by the Washington County Soil and Water Conservation District, Washington County, Cross Creek Township, and Independence Township Municipal Authority. Technical assistance was provided by the Soil Conservation Service and the Forest Service of the U. S. Department of Agriculture and various state and local organizations.

Cross Creek Watershed is a drainage area of about 54.8 square miles. It is located entirely in Washington County which is in southwestern Pennsylvania. Its downstream boundary is at Coal Hollow just above the Pennsylvania - West Virginia State Line. Easy access to the area is provided by a railroad and numerous highways. Although only 4,400 people reside within the watershed, over 2,000,000 people live within a 50-mile radius.

This plan was formulated to alleviate floodwater damage, to furnish a dependable water supply for present and future demands, and provide an opportunity for satisfying the water-oriented recreational requirements of the people. These needs will be fulfilled by conservation land treatment measures, three single purpose flood prevention structures (PA-659F, PA-660, and PA-662), one multiple purpose flood prevention - recreation - municipal water supply structure (PA-661), and recreation facilities. These works of improvement are to be installed within a seven-year period.

Several major floods have occurred over the last 100 years. The flood of record or key flood occurred September 1 and 2, 1912. Discharges from this flood are larger than those from a 100-year recurrence interval flood.

An analysis indicates with present conditions, that is without the project, the estimated average annual floodwater damage would be \$89,360. With the project features installed the average annual damage will be reduced to \$7,210. The \$82,150 difference between with and without project conditions is the flood damage reduction benefit.

Of this benefit, \$3,220 is attributable to land treatment measures and \$78,930 to the structural measures.

Additional benefits realized because of the project are \$3,440 for changed land use, \$177,750 for recreation, \$7,900 for water supply, \$16,600 for redevelopment, and \$26,980 for secondary local effects. Enhancement type benefits, although not evaluated, will add significantly to the effects.

Average annual costs for the structural measures are \$225,300. This includes \$165,300 for installation, \$14,500 for project administration, and \$45,500 for recreational facilities replacements and all operation and maintenance.

The ratio of average annual structural benefits, \$311,600, to average annual costs, \$225,300, is 1.4 to 1.0.

To achieve adequate protection of the watershed, conservation land treatment will be applied to 4,500 acres of cropland, 4,300 acres of woodland, and 6,000 acres of grassland. Accelerated technical assistance for planning and application of conservation measures will be needed to realize these goals. The costs of conservation land treatment measures utilizing cost sharing assistance available through going and accelerated conservation programs are \$460,000. Technical assistance necessary for the installation of these measures will be \$100,000. Of this amount, regular going programs will bear \$28,000 and \$72,000 of PL 566 funds will be used to accelerate technical assistance. These measures will be operated and maintained by the landowners under agreements with the Washington County Soil and Water Conservation District.

Altogether, the four structural measures proposed in this project will control approximately 21 square miles. They will be constructed to provide 3,825 acre-feet of flood-water detention storage, 395 acre-feet for sediment accumulation, 5,435 acre-feet for recreation, and 196 acre-feet for water supply. Storage capacity will be included in the multiple purpose site to allow for evaporation losses and releases required by the Pennsylvania Department of Environmental Resources.

Structure PA-661 will provide a 228-acre permanent lake for recreation. In conjunction with the lake, facilities for fishing, boating, picnicking, and hiking will be installed with cost sharing assistance from PL 566 funds. Additional facilities, including those for swimming, camping, conservation demonstrations, athletics, etc., will be installed at local expense at a later date.

Financial responsibility for land rights, relocation payments, project administration, engineering, and construction of the dams and recreational facilities will be borne by funds provided by or through the Washington County Commissioners, Independence Township Municipal Authority, and PL 566. The total installation cost for structural measures is estimated to be \$3,485,000. The sponsors will provide \$1,654,400 and PL 566 funds will bear \$1,830,600.

Washington County Commissioners will provide an estimated \$968,800 or 100 percent of the land rights cost and \$94,000 or 53 percent of the relocation payments necessary for all structures and the recreational development. Land rights for PA-661 are \$445,200, for the recreational facilities \$219,200, with the remaining \$304,400 required for the three single purpose sites. The relocation payments for Site PA-661 are \$16,000 local, \$14,000 PL 566; for Site PA-659, \$2,300 local and \$2,000 PL 566; for Site PA-660, \$35,200 local and \$31,200 PL 566; and for Site PA-662, \$18,800 local and \$16,600 PL 566. Recreational facilities, \$21,700 local and \$19,200 PL 566.

Engineering and construction costs, estimated at \$32,400 and \$730,200, for the three single purpose sites will be borne 100 percent by PL 566 funds. Engineering and construction costs associated with PA-661 are estimated at \$17,200 and \$575,600 respectively. These were separated into joint costs for flood prevention - recreation - water supply and specific costs for water supply. Joint engineering costs of \$17,000 will be borne 2.6 percent by Independence Township Municipal Authority and 97.4 percent by PL 566 funds. Joint construction costs of \$574,800 will be furnished 35.0 percent by Washington County Commissioners, 2.6 percent by the Independence Township Municipal Authority, and 62.4 percent by PL 566 funds. Specific engineering and construction costs of \$200 and \$800 will be borne 100 percent by Independence Township Municipal Authority.

The costs of engineering to be performed by an Architectural and Engineering (A&E) contract and construction of the recreation facilities at PA-661 are estimated at \$91,600 and \$610,200 respectively. The Washington County Commissioners and PL 566 funds will share these costs equally.

Operation and maintenance of the structural measures and the recreational facilities will be the responsibility of local sponsoring organizations. Replacement of the recreation facilities will be provided by the sponsors.

The Sponsoring Local Organizations and the Service will each bear the costs for Project Administration which it incurs, estimated to be \$23,000 and \$259,000 respectively.

The total costs for the works of improvement set forth in this "Cross Creek Watershed Work Plan" are estimated to be \$4,045,000. Local interests will provide \$2,142,400 and PL 566 funds will provide \$1,902,600.

DESCRIPTION OF WATERSHED

Physical Data

Cross Creek Watershed is located in Washington County in southwestern Pennsylvania. Land and water area encompassed by the watershed perimeter is 35,000 acres or 54.8 square miles. The downstream boundary is at the confluence of Cross Creek and Coal Hollow, less than one mile east of the Pennsylvania-West Virginia State Line. It is located within 20 miles of the urban centers of Pittsburgh and Washington, Pennsylvania, Wheeling and Weirton, West Virginia, and Steubenville, Ohio. In the watershed, rural communities are Avella, Browntown, Cross Creek, and Studa.

The principal soil series of the watershed are Guernsey, Weikert, and Westmoreland, with minor amounts of Brooke, Clarksburg, Lindside, and Melvin.

Guernsey, Weikert, and Westmoreland are well to moderately well drained soils occupying uplands with slopes up to 50 percent. Guernsey is a deep, gently sloping soil formed in shale and limestone. Weikert and Westmoreland are shaly soils formed in interbedded shale, sandstone, and some limestone. They occupy areas of hilly terrain with moderate to steep slopes. Weikert soils have shale bedrock within 20 inches.

Brooke and Clarksburg are deep, well to moderately well drained soils. Brooke has a sticky and plastic subsoil formed in limestone and calcareous shale. It is found on gentle slopes. Clarksburg, formed in gently to steeply sloping colluvium from shale, siltstone and limestone, are common on the footslopes.

Lindside and Melvin are soils formed in alluvial deposits on the flood plains. These soils are subject to flooding and have seasonable high water tables.

This watershed lies entirely within the Pittsburgh Plateau physiographic province. It is underlain by sandstone, siltstone, shale, limestone, and coal of the Monongahela and Conemaugh formations of the Pennsylvanian and Permian Age. These rocks have been folded gently downward along

an axis which crosses the eastern one-third of the watershed in a northerly direction. West of the axis the rocks dip shallowly to the southeast while east of the axis a low angle northwesterly dip occurs. The bedrock has been eroded into rolling uplands with an average relief of 250 feet. The range in elevation varies from 750 feet MSL at the Pennsylvania-West Virginia State Line to 1,400 feet MSL in the northern part of the watershed.

The Pittsburgh coal seam at the base of the Monongahela formation has been extensively mined in the western portion of the watershed; however, little or no mining has occurred east of the North Fork of Cross Creek. Several lesser coal seams underlie the area but are uneconomical to mine on a large scale.

Cross Creek flows in a westerly direction emptying into the Ohio River north of Wellsburg, West Virginia. The steep gradient headwater tributaries of Cross Creek have their sources in the hills of central Washington County. Cross Creek and its major tributaries of North, Middle, and South Forks have an average gradient of four-tenths of one percent. South Fork joins the main stem east of Avella while Middle and North Forks empty into Cross Creek at Avella.

Except for about 15 ponds, the only water bodies are two small lakes along the main stem of Cross Creek. The lake closest to Avella is presently being used by Independence Township Municipal Authority as an emergency water supply source.

Precipitation averages 40 inches annually with about 22 inches falling during a growing season. The yearly temperature averages 51°F. with extremes ranging from -20°F. to 94°F. The frost free growing season averages 150 days.

Economic Data

The watershed, comprising 6 1/2 percent of the county area, is rural in character and typical of the county. Avella, including Browntown, is the largest community and the center of economic activity. Population is estimated to be 4,400 with approximately 2,000 residing in communities, 650 living on farms, and the remaining 1,750 living throughout the watershed.

The only public land in the watershed is the 3,500 acres to be used for the county park in which PA-661 is to be located.

The highway system consists of secondary state routes and

includes Pennsylvania Routes 18, 844, 50 and 231. These highways provide easy access and crisscross the watershed making an average farm-to-market distance of 15 miles. The Norfolk and Western Railroad provides service to Avella and vicinity.

There are about 160 farms averaging 170 acres and valued at approximately \$100 to \$300 per acre. Although agriculture is important to the watershed economy, most residents work at industrial plants located outside the watershed.

The annual value of agricultural production in the county is estimated to be \$11,700,000. Receipts, in order of importance, are from dairy, other livestock, crops and poultry. Washington County ranks 23rd in farm cash receipts even though it ranks 10th in the state for land in farms. This indicates that agricultural productivity for the county is lower than the state average. The agricultural census indicates that 50 percent of the county's 2,400 farm operators work off the farm with 43 percent working off the farm more than 100 days. Income from off-farm work exceeds the value of farm products sold on 48 percent of Washington County farms. Most farms in the county are operating as family farm units and only 18 hire farm managers. Census figures also indicate that family workers comprise 90 percent of the farm labor force. One hundred sixty-five farms reported having regular hired workers with 65 farms reporting more than one.

In recent years records show there has been an increase in total farm acreage as well as a slight increase in the average size of farms. Land use adjustment centered on the production of crops for livestock enterprises has resulted in an increase in forage crops with a resulting decrease in small grain crops. The greatest changes have occurred in reduction of wheat acreage and increase in alfalfa acreage in the last ten years.

Forest stands are mainly mixed hardwoods such as elm, ash, mixed oaks, hickories, red maple, sugar maple, beech, black walnut, and black cherry. White pine, Austrian pine, Norway spruce, and Japanese larch have been planted on some of the spoil banks and abandoned fields. About 30 percent of the forest stand is of sawtimber size, having more than 1,500 board feet per acre, 60 percent in pole size, and 10 percent in seedling and sapling size. The forest land within the watershed is in private ownership except for the forested portions of the planned 3,500 acre county park. There is a good demand for quality hardwood sawlogs and veneer logs. A fair market exists for block-ing and pallets. The pulpwood market is poor.

The watershed lies within the Ohio River Basin and was studied within the framework of that basin study and also under the Development of Water Resources in Appalachia authorized by the Appalachia Regional Development Act of 1965 (PL 89-4 as amended by PL 90-103).

Land Treatment Data

Cover and land use complex consists of 45 percent cropland, 20 percent pasture, 23 percent forest land, with the remaining 12 percent in idle, streams, roads, urban, or strip mines.

Cropland amounting to 15,700 acres is utilized for general farm crops and forage crops to support the livestock enterprises. The trend in the upland farms is to convert cropland to hay and pasture. This additional acreage added to the present 7,000 acres of grassland is being developed into a good grassland program. About 320 acres of agricultural land are located on the flood plain and are restricted in use because of the flood hazard.

Approximately 200 acres of the watershed is in mine spoil located downstream from the proposed floodwater retarding structures. These spoil areas have been undisturbed for many years and are becoming stabilized by natural vegetation.

Forest land amounting to 8,200 acres is approximately 20 percent in poor hydrologic condition, 40 percent in fair, and 40 percent in good hydrologic condition. With protection and management most of the forest should be in good to very good condition within the project evaluation period. Adequate forest fire protection is provided by the Pennsylvania Department of Environmental Resources in cooperation with the U. S. Forest Service through the Clarke-McNary Cooperative Fire Control Program. The average annual burn during the past five years (0.02 percent) has not exceeded the fire loss index goal of 0.10 percent. Neither present nor expected future fire occurrence justifies additional measures beyond the going program. Other state-federal cooperative forestry programs include Cooperative Forest Management, Cooperative Forestation, and Cooperative Insect and Disease Control.

The Washington County Soil and Water Conservation District has been in operation 22 years. An active program is being carried out throughout the district. In the watershed area, 62 farmers have developed conservation farm plans on 9,300 acres of farm land. This comprises 27 percent of the private land in the watershed. Table 1A indicates the type and amount of land treatment measures installed on

these farms. A survey of agricultural land indicates that approximately 10 percent of the cropland and 30 percent of the grassland acreage has received adequate land treatment.

Fish and Wildlife Resource Data

The common species of wildlife in the watershed are white-tailed deer, cottontail rabbits, gray squirrels, ring-necked pheasants, and bobwhite quail. Populations of all listed species are medium, except for quail which is low.

The watershed is primarily hayland and pasture land. Most of the farms have some corn or other small grain and a wood lot. This results in good interspersion of cover types and rather even distribution of all of the wildlife species. The large proportion of grassland is responsible for lower than desired game populations. Populations could be increased by planting hedgerows and establishing cutback borders.

The watershed receives hunting pressure of medium to high intensity. There are two private hunting preserves totaling 200 acres along with 100 Farm Game Cooperatives covering 3,000 acres. There is a 3,000 acre State Game Land adjacent to the watershed.

Smallmouth bass, suckers, bluegills and sunfish are present in Cross Creek and its tributaries in medium numbers. Water quality in all of the streams is good. The main factors limiting fish production and fishing are low water during the summer, poor cover, and stream-bank erosion.

There are no impounded fisheries. There is a 92 acre lake in the adjacent watershed that furnishes fishing for 35,000 fishermen per year. There is a demand for additional impoundment fishing in the area. The structures planned as part of this project, and the installation of additional farm ponds along with good pond management, will help to satisfy the unfilled demands.

WATERSHED PROBLEMS

Land Treatment

There is a need for land treatment measures. Low fertility, slope, and land being used beyond its capability are all problems which need correcting. Approximately 3,000 acres of Class II, 5,500 acres of Class III, and 3,500

acres of Class IV land need some degree of conservation treatment.

Improved management practices, along with conservation measures, will in large part correct these inadequacies. This in turn will increase agricultural receipts. Presently, income from agricultural enterprises is low. If a viable land treatment program is expected to be installed, continued cost sharing for practices will be necessary to ease the initial cost to the landowners. The Agricultural Stabilization and Conservation Service records indicate that an average of \$15,500 per year in cost sharing funds is being utilized by farmers.

Floodwater Damage

Flooding along Cross Creek has long been a serious problem with floods occurring in 1912, 1920, 1928, 1954, 1960, and 1963. The greatest flood in terms of damage occurred September 1 and 2, 1912. This flood has been selected as the key flood for the damage analysis. The flood resulted from thunderstorms which deluged the watershed with rainfall varying in amounts from four inches to approximately 10 inches over a four-hour period. The soil moisture content was below average prior to the storm occurrence. The resulting flood was larger than that which would be expected from a 100-year recurrence interval flood. In the watershed and along Cross Creek the key flood took the lives of seven people and caused damages to residences, commercial properties, the railroad, highways, and bridges.

There were 19 highway bridges and numerous sections of roads damaged or destroyed by the 1912 flood. The bridges replaced since 1912 are designed to carry the heavier traffic vehicles; however, should the 1912 flood recur, most of these bridges would be washed out or severely damaged.

An east-west main line railroad is located on the Cross Creek flood plain. During the 1912 flood the railroad embankment washed out in several locations, damaging bridge approaches, bridges, tracks, telephone lines, switches, buildings, a railroad engine, and several freight cars. Furthermore, the railroad suffered the loss of use of its main line during the reconstruction period which resulted in loss of business and increased costs due to the rerouting of traffic.

The use of 320 acres of agricultural land on the flood plain is restricted because of flooding. Flooding affects only a limited number of farm buildings with most of the agricultural damage occurring as a decrease in

crop and pasture production.

If the key storm were to recur today, it would cause damages of \$320,000 to 102 residences, \$490,000 to commercial establishments, over \$1,000,000 to the railroad, \$650,000 to roads and bridges, and inundate 450 acres of land.

The average annual direct and indirect damages to residences are \$15,660 and \$28,970 to commercial properties. These properties have a market value in excess of \$2,000,000. Damages to these types of improvements are concentrated in Avella and Browntown, Reaches C, Cl and G.

Average annual direct and indirect damages to the railroad will be \$20,360. This will occur primarily in Reaches A, B and F. Average annual damages to roads and bridges will amount to \$24,090. Most of this damage will occur in Reach C, although damage will take place in all reaches. Land along the streams in Reaches A, D, F, F-1, and I will experience scour and overwash damage. Crops grown on some of this land will be damaged by floodwater inundation. Damages to land and crops will amount to \$280 annually.

Indirect damages were estimated to be 10 percent of the agricultural direct damage, 15 percent of residential, 20 percent of industrial and commercial, and 25 percent of road, bridge and railroad direct damages. These damages include delaying shipment of materials and products, loss of wages to employees, increased costs due to rerouting traffic, and interruption of public utilities and similar services.

Erosion and Sediment Damage

The principal source areas for sediment derived through sheet erosion include cropland, pasture land, and mine spoil. At present, mine spoil areas contribute significant amounts of sediment only during flood flow. These areas are located downstream from the proposed structures and the sediment thus derived will not affect the structures.

Evaluation was made of land damage in the valleys due to streambank erosion, overwash, and flood plain scour. The damage was found to be insignificant, occurring mainly in wooded or idle areas, and does not contribute appreciable quantities of sediment to the stream. In the past, however, extensive erosion damage occurred to the Norfolk and Western Railroad fill downstream from Avella.

Problems Relating to Water Management

Water Supply: Water supply systems are servicing customers in the communities of Avella, Browntown, and Studa. In the Avella-Browntown area there are about 300 customers. Residents of smaller villages and farm and rural residents obtain their water from wells and springs.

Independence Township Municipal Authority has indicated a need for expansion of its present water supply system. Their present demands are about 100,000 gallons per day. A consulting firm retained by the Authority anticipates that future demands will be 200,000 gallons per day. This additional demand will be created by approximately 200 additional residential customers, plus the supplying of the recreational facilities of PA-661, and a reserve for future industrial development. Present facilities are not adequate to provide for this future demand and ground water, though available, is not of sufficient quantity nor quality to satisfy expected future expansion.

Recreation: Cross Creek Watershed is located within the nine county Pittsburgh State Park Planning Area. In 1968 the population exceeded 2.8 million and is increasing. Approximately 93 county and local parks and playgrounds are available for public use. By 1980 it is estimated there will be a total demand in the Pittsburgh State Park Planning Area for 50,000,000 activity days of swimming, picnicking, boating and fishing, and camping.

An analysis indicated there is a lack of outdoor recreation facilities southwest of Pittsburgh. This is particularly true of parks with water impoundments. The region has been heavily strip mined, so that unspoiled areas containing unpolluted water are scarce. A goal of the State-Wide Outdoor Recreation Plan is to develop major recreational complexes south of Pittsburgh in Washington County. The development of the recreation facilities within the Cross Creek Watershed ideally meets these needs and goals.

Fish and Wildlife: Wildlife population is limited because of a lack of appropriate cover. The land use is primarily grassland. There are few hedgerows and borders to furnish the edge effect that is conducive to game abundance.

Fishing is adversely affected by shallow, slow-moving streams with very little cover and severe streambank erosion. In addition, there are no impoundments to satisfy the demands of lake fishermen.

Water Quality: At present there are no public sewage treatment facilities. Septic tanks are widely used as a method of household sewage disposal. If these conditions are allowed to continue and increase, the water quality in Cross Creek will be degraded.

PROJECTS OF OTHER AGENCIES

The Agricultural Stabilization and Conservation Service, through the Rural Environmental Assistance Program, will assist eligible landowners with the installation costs of approved land treatment practices.

Minor stream clearing projects have been completed by the Pennsylvania Department of Environmental Resources and the Pennsylvania Department of Transportation. These improvements are located downstream from the structures. Developments proposed in this plan are compatible with the stream clearing projects.

PROJECT FORMULATION

The Washington County Soil and Water Conservation District has developed a long-range program to aid expansion of the economy in the county. This plan encourages proper land use and treatment and desirable adjustments in present land use. Public parks and recreation areas are included in this plan. Emphasis is being placed on the development of water impoundment areas, both public and private, and the establishment of income-producing recreation enterprises based at these developments. Proper land use and treatment, flood prevention, water supply, and water-oriented recreational opportunities, the major objectives of the plan, were developed by the sponsors with the assistance of the Soil Conservation Service and the Forest Service.

The Soil and Water Conservation District Directors have goals which will enable landowners to install this land treatment program within seven years. They will work closely with farmers as land is converted from crop to pasture. It is estimated that during the seven year installation period 2,300 acres of cropland will be converted to pasture. The land treatment program will reduce erosion, streambank, channel and floodplain scour by 28 percent or 25,770 tons. The directors are prepared to assist in the conservation treatment to be applied to 4,500 acres of cropland, 6,000 acres of grassland, and 4,300 acres of woodland. These goals have been coordinated with the County Planning Commission.

The flood prevention objectives of the sponsors are to reduce by approximately 80 percent the damages expected to occur by a repeat of the 1912 flood. In all reaches which include the communities of Browntown, Avella, and Studa, the aim is to reduce residential, commercial, road and bridge damage. Where improvements were built too low on the flood plain to completely protect, the desire is to prevent structural damage and maintain service. In rural reaches the objective is to protect crop and pasture lands from inundation. At two areas along Reaches F and G the goal is to protect lands that are expected to be developed for residential use.

The water supply needs in Independence, Cross Creek, and Jefferson Townships, and the Avella area will be satisfied by including 54,000,000 gallons of municipal and industrial water supply in structure PA-661. A report concerning the water supply facilities was prepared by a consultant retained by the Independence Township Municipal Authority. The water supply features incorporated in PA-661 were based on this report and the sponsor's concurrence of storage required to provide an adequate supply to meet all anticipated future needs.

The water quality problems are recognized by the Washington County Planning Commission. They have prepared a sewage treatment plan for Avella and the surrounding area as required by the Pennsylvania "Sewage Facilities Act 527."

A need for and interest in recreational opportunities by county officials has resulted in the planning of PA-661 as a multiple purpose structure to include recreation. Washington County Commissioners are planning to acquire approximately 3,500 acres of land encompassing PA-661 for development of a county park. A goal for the initial stage of development is to provide facilities for a peak daily use of 1,800 for picnicking and 900 for boating and fishing. It is estimated that structure PA-661 will have an annual use of 71,000 fishermen days.

The sponsor's desire for improved fish and wildlife resources will be provided for by both land treatment and structural measures. An increase in wildlife population will result from the improved conditions afforded by the land treatment measures such as wildlife habitat improvement, cut back borders, and hedgerow planting. Fish habitat will be increased by the reservoir at PA-661 and the three single purpose structures.

The watershed lies within the Ohio River Basin and was studied within the framework of that basin study and also under the Development of Water Resources in Appalachia authorized by the Appalachia Regional Development Act of

1965 (PL 89-4 as amended by PL 90-103). Information about the improvements proposed in this work plan was made available for these studies. This project is included in the Ohio River Basin Study.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Washington County Soil and Water Conservation District program and the technical assistance programs made available through the district all emphasize use of the land within its capabilities. The soil survey for the watershed area has been completed and will be included in the county report to be published in 1974. The district program places emphasis on the production of forage crops with a resultant decrease in acreage of grain crops and will have a beneficial effect on land use adjustment.

Land treatment measures will be installed for both watershed protection and flood prevention. More than 20 soil and water conservation practices are used to treat land according to its conservation needs. Normally, a combination of several land treatment practices is required in any given situation to achieve the best results. In each instance the land treatment practices applied must be tailor-made to fit the specific circumstances involved. The kinds of practices used vary depending upon the type of land, topography, use, soil properties, and the management ability of the land user. The more common land treatment practices to be applied on cropland are conservation cropping systems, diversions, stripcropping, drains, and grassed waterways. Pasture and hayland planting and management, farm ponds, spring developments, wildlife habitat improvements, and forest land management which includes forest fire control, tree planting, hydrologic cultural operations, and woodland grazing controls are also important practices to be applied. Other applicable and alternative land treatment measures are indicated and described in technical guides.

Structural Measures

The structural works of improvement are three single purpose floodwater retarding dams, one multiple purpose (flood prevention, recreation, water supply) dam and a recreation facility (Figure 2). The four dams, PA-659F, PA-660, PA-661 and PA-662, control 46 percent of the drainage area above Avella.

Drainage areas, allocation of developed storage, surface

areas, structural data and hydraulic data for each structure are found on Table 3.

The basic flood prevention features common to the four structures are as follows:

1. Sufficient capacity will be developed to store the volume of sediment expected to accumulate during a 100-year period from the individual drainage areas.
2. The floodwater retarding storages indicated in Table 3 are larger than the minimum 100-year flood storages. The larger storages will provide protection against runoff similar to that of the key storm.
3. The principal spillway will be non-gated and self-operating.

The basic structural design features of all the dams are as follows:

1. Each dam will be an earth or rock fill structure, with a design life of 100 years.
2. The principal spillway system will consist of a reinforced concrete intake structure, a 30-inch reinforced concrete pipe under the fill, (36-inch for PA-661), and a suitable energy dissipator.

The principal spillways on Sites PA-660 and PA-661 will be designed for and constructed on non-yielding foundations, and the principal spillways on Sites PA-659F and PA-662 will be on yielding foundations.

3. The emergency spillway will pass the flow in excess of detention storage and pipe release resulting from a 6-hour storm producing approximately 23 inches of runoff.
4. Embankment and foundation drainage will be designed for structural stability.

Special design features for the multiple purpose dam, PA-661, are as follows:

1. Storage will be provided for recreation and municipal and industrial water supply purposes. Additional storage to offset the anticipated losses to evaporation and seepage and to meet the Pennsylvania required release of .15 cubic feet per second per square mile (CSM) will be included.

This storage is added to make sure that the water supply and recreation storages are not used for other than their intended purpose.

2. The amount of municipal and industrial water supply storage needed was determined by consultants for the Independence Township Municipal Authority. This storage will be released into the principal spillway system through a separate device on the intake structure which will not permit drawdown of the reservoir below elevation (MSL) 1021.7, the elevation of the recreation pool. A provision to take off future water supply from the energy dissipator will be included in the final design of the principal spillway system.

The Washington County Planning Commission has plans for a 3,500 acre county park to include the reservoir created by PA-661 and the associated recreation development. They have acquired fee title to approximately 2,000 acres of land. Stage I recreation facilities, developed in conjunction with the lake, and cost shared with PL 566 funds, will provide for a comprehensive water-oriented recreational development. This development will have facilities for picnicking, fishing, pleasure driving, boating, and sightseeing. Facility details for these activities are shown on Table 2B. Installation, operation and maintenance of all planned features will meet the requirements of the Commonwealth and public health agencies.

Design features for the recreation development at PA-661 are:

1. Facilities will be located in areas where the soils and topography are suitable for that use.
2. Facilities will be designed and constructed so the handicapped can use them.
3. All aspects of the recreational development will meet local, state, and federal health and safety standards.

Pertinent information common to all dams is as follows:

The flood plain at all sites is covered with terrace and alluvium deposits ranging in thickness from four to twelve feet. This alluvium is underlain by siltstone, limestone, sandstone, and shale. All dams will be constructed with the fine grain soils in the center and the weathered shale and sandstone on the outside. Cutoffs

will be constructed of fine grain soils along the center-line of the dam and extend to firm bedrock across the flood plain.

The Pittsburgh coal is present 75 feet below the flood plain at Site PA-659F, 55 feet at PA-660, 240 feet at PA-661, and 205 feet at PA-662. Mineral rights will be purchased to provide a support area for all dams. This area has been determined by projecting downward and outward from the base of the dam at an angle 30° from the vertical to the level of the mineral. No minerals shall be removed or access entries driven for any mineral which lies within 200 feet of the ground surface. In the areas beyond 200 feet of the ground surface, 40 percent extraction of the coal will be allowed provided that the remaining 60 percent is left in uniformly distributed pillars. The pillars shall have a minimum width of 30 feet and openings between the pillars shall have a maximum width of 20 feet. A factor of safety of at least 2.5 shall be provided. The factor shall be determined as outlined on page 15 of "Coal Support for Dams - Cross Creek Watershed," by General Analytics, Inc. This publication is on file with the Soil Conservation Service office. If any mining is to be done of minerals which lie greater than 200 feet below the surface, the mining shall be approved by a qualified engineer experienced in mine subsidence problems and by the USDA, Soil Conservation Service.

Buildings within the flood pool area and the area where the dam will be constructed will be acquired or protected.

Other pertinent information on each structure is as follows:

PA-659F - This structure is located on a tributary of North Fork, approximately 2.5 miles northeast of Avella. It will control 1.84 square miles of drainage area and will store 298 acre-feet of floodwater and 45 acre-feet of sediment. The volume of submerged sediment (22 acre-feet) expected in the first 50 years will be provided for below the principal spillway crest. This storage will create a five acre sediment pool.

The lower portion of the alluvium deposits at this site have sufficient strength to support the embankment and will not require removal. A zone of vertical fractures and minor faulting is present at the right side of the flood plain, but this is not expected to cause any major problems in the construction of the structure. Minor leakage through the joints and fractures is expected. The abutments consist of residual and colluvial soils underlain by sandstone, shale and limestone. A

vegetated emergency spillway 350 feet wide will be excavated in the right abutment.

The dam will be 35 feet high, 630 feet long, and will consist of 70,000 cubic yards of earth fill. About 85 percent of this material will be excavated from the emergency spillway.

The principal spillway will have a restricted 30-inch pipe. A section of legislative route 62185 will be raised and a Bell Telephone Company line will be relocated.

Relocations include one single unit tenant-occupied dwelling.

PA-660 - This structure is located on Middle Fork approximately 1.5 miles northeast of Avella. It will control 4.39 square miles of drainage area and will store 982 acre-feet of floodwater and 89 acre-feet of sediment. The volume of submerged sediment (43 acre-feet) that is expected in the first 50 years will be provided for below the principal spillway crest. This storage will create an 8 acre sediment pool.

The alluvium at this site has a low bearing capacity and most of it will be removed in order to provide a suitable foundation for the embankment. The bedrock profile is very steep on the left abutment just above the valley floor. The profile of the abutment will be flattened to prevent differential settlement in the embankment. The abutments consist of approximately four feet of residual soil underlain by siltstone and shales.

The dam will be 61 feet high, 650 feet long, and will consist of 158,000 cubic yards of earth and rock fill. A vegetated emergency spillway 135 feet wide will be constructed on the right abutment.

Farm lanes in the flood pool area will be raised to ensure that no one is marooned by floodwater stored at the dam.

Legislative route 62024 will be raised and relocated. Bell Telephone Company and West Penn Power Company lines will be relocated.

Relocations include three single unit owner-occupied dwellings and two farm operations.

PA-661 - This structure is a multiple purpose flood control, recreation development, water supply dam, located on the main stem of Cross Creek, approximately 2.5 miles

southeast of Avella. It will control 11.0 square miles of drainage area.

The reservoir will provide 1,950 acre-feet of floodwater retarding storage, 182 acre-feet of sediment storage, 166 acre-feet of water supply storage, 4,567 acre-feet of recreation water storage, and 898 acre-feet of storage to meet reservoir losses and state required releases. The water supply pool will have a maximum surface area of 258 acres. The operating range of the reservoir (fluctuation of water surface elevation due to water supply needs and reservoir losses) during periods of severe droughts will be between elevations 1026.0 and 1021.7 feet MSL. The normal operating range that could be expected in years similar to the period of 1961-1967 is between elevation 1026.0 and 1023.0 feet MSL. The shale and sandstone are highly weathered to a depth of approximately 15 feet and have high permeability rates in this zone.

The right abutment is covered with a thin mantle of residual soil and underlain by alternating layers of sandstone, shale, and limestone. The bedrock is weathered and has zones of high permeability to a depth of 20 to 60 feet. Some grouting will be necessary to minimize the water loss through these zones.

The left abutment consists of terrace material up to 40 feet thick. Laboratory analysis of this material indicates that it is stable and will not require removal.

The dam will be 74 feet high, 780 feet long, and will consist of 340,000 cubic yards of earth and rock fill. A vegetated emergency spillway 240 feet wide will be constructed on the right abutment. Modifications will be made on the riser and energy dissipator to accommodate the water supply and low flow releases.

The support area under the reservoir has been determined by projecting downward and outward from the elevation of the emergency spillway crest (elevation 1033.0) at an angle of 15° from the vertical to the level of the mineral. Fifty percent extraction under the reservoir will be allowed providing pillars are left in a uniform pattern throughout the area as mentioned above.

Thirty-five hundred acres surrounding PA-661 and the recreation facilities will be purchased by Washington County.

Buildings and other structures will be removed from the area to be used for the recreation facilities, dam and reservoir. An area of 443 acres is required for the dam and reservoir. Of this, 413 acres are allotted for

recreation and 30 acres for water supply. Legislative routes 62133 and 62022 will be relocated. West Penn Power and Bell Telephone lines will be relocated and Taylorstown Telephone line will be removed.

Relocations for both PA-661 and the recreation facility include three single unit owner-occupied dwellings and one single unit tenant-occupied dwelling. Two farm operations will be included.

The Chester Engineers were hired by Independence Township Municipal Authority to determine the water supply needs and the capability of PA-661 to meet these needs. The Chester Engineers found:

1. That providing water supply storage in PA-661 is the least costly alternative.
2. Present and future municipal and industrial water supply needs can be met by providing 166 acre-feet of water supply storage at PA-661.
3. The watershed yield above PA-661 is sufficient to meet the water storage requirements.
4. The water quality is adequate to meet municipal standards.

Recreation Facility - This development complements the recreation pool formed by PA-661. Boating facilities, including launching ramps, loading docks and mooring lines, will be provided. Picnic facilities, nature and sightseeing walks and trails will also be provided.

At some future date as the need arises, Washington County plans to expand the facilities. Increased quantities of the same type facilities will be installed in addition to facilities for other types of recreation. When finally completed, the total park will contain 3,500 acres which includes the 1,140 acres used for PA-661 and the PL 566 cost shared recreational facility.

The master development plan for Cross Creek County Park proposes a sewage collection and treatment system. Soils are unsuitable for septic tank or subsurface disposal. Sanitary facilities to be installed as a part of this plan are the concrete vault type. These will be constructed so they can be converted to permanent flush type and connected to the sewage treatment system.

PA-662 - This structure is located on a tributary of South Fork less than a mile northeast of Rea. It will control 3.72 square miles of drainage area and will store 595

acre-feet of floodwater and 79 acre-feet of sediment. The volume of submerged sediment (38 acre-feet) expected in the first 50 years will be provided for below the principal spillway crest. This storage will result in an 8 acre sediment pool.

The terrace and alluvial materials at this site have adequate strength to support the structure and very little of this material will require removal.

The abutments consist of approximately four feet of residual and colluvial soils underlain by shale and limestone, with sandstone high in the abutments.

The dam will be 46 feet high, 450 feet long, and will consist of 78,000 cubic yards of earth and rock fill.

Some leakage is expected through the limestone and shale. However, this can be picked up in a foundation drainage system.

This structure will have two vegetated emergency spillways, one on the left abutment 50 feet wide and one on the right abutment 100 feet wide. The two emergency spillways are required in order to reduce the amount of rock excavation.

Legislative route 62035 will be relocated. A culvert will be installed at the intersection of township route 773 and the relocated legislative route 62035. The Hickory and Woodrow telephone line will be removed.

Relocations include one single unit owner-occupied dwelling, one farm operation, and one business (sportsmen's club).

Associated Measures

The Pennsylvania Fish Commission has the responsibility for fishery management of public waters within the Commonwealth. It is anticipated that the Fish Commission will stock the reservoir at PA-661 at an initial cost estimated to be \$45,000. This cost is for warm water species which will be stocked over a two-year period. Management of the fishery will require an estimated \$5,700 annually. If the water quality in the reservoir proves to be satisfactory for two-story management, trout will be stocked at an additional cost. Enforcement of the Water Safety and Boating Regulations, as well as enforcement of the Fishing Regulations, will be the responsibility of the Pennsylvania Fish Commission also. It is estimated that this cost will be \$3,400 annually.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Measures

The costs for installation of open land treatment measures and technical assistance were based on analysis of costs for this type of expenditure and Soil and Water Conservation Districts' accomplishments for the past several years. Costs for the installation of forest land treatment measures are based on current costs of supervision, labor, equipment, and materials needed to perform the particular measures. Costs of technical assistance are based on actual expenditures and accomplishments of the Pennsylvania Department of Environmental Resources. An analysis of costs against accomplishments was made for each measure to determine unit costs for technical assistance.

The total cost of installing land treatment measures is estimated to be \$560,000. Technical assistance to private landowners for the installation of these measures will cost \$100,000.

Structural Measures

Land rights costs for structures are based upon information prepared by the sponsors and are estimated to be \$968,800. Of this amount, \$502,000 is for land and buildings, and \$108,800 for mineral rights. The costs for relocation of utilities and roads were made by the utility companies involved and the Pennsylvania Department of Transportation. Estimated costs for utility relocations and alterations are \$37,200 and for road relocations are \$320,800. All land rights costs were reviewed by the Soil Conservation Service. Federal funds will not be used for land rights costs.

Relocation costs are estimated at \$177,000. Of this amount, \$94,000 or 53 percent will be borne by Washington County with the remaining \$83,000 or 47 percent to be borne by PL 566 funds. The cost sharing percentages shown will be applicable after July 1, 1972, and are based upon the ratio of PL 566 funds and other funds to the total project costs less relocation payments. For displacements prior to July 1, 1972, the Service will provide the first \$25,000 for each displacement. A detailed description of these costs by site is shown in the "Works of Improvement to be Installed" section.

Construction costs are based upon unit prices from recent contracts for comparable work. These items include clearing, grubbing, common excavation, compacted earth fill, drainage material, rock excavation, reinforced

concrete pipe, concrete, seeding and mulching. Estimates include 20 percent of construction costs for contingencies, which include costs for minor or unforeseen items that turn up during the construction phase of the project.

Public Law 566 funds will bear 100 percent of the construction cost for Sites PA-659F, PA-660, and PA-662 estimated to be \$730,200 and 62.4 percent of the estimated \$574,800 joint construction cost of PA-661.

The Washington County Commissioners and the Independence Township Municipal Authority will bear 35.0 percent and 2.6 percent, respectively, of the joint construction cost for PA-661. The Independence Township Municipal Authority will bear 100 percent of the specific construction costs for water supply, estimated at \$800.

The estimated construction costs for recreation facilities to be built in conjunction with PA-661 were provided by the Washington County Planning Commission and were based on Commonwealth and federal criteria used in the construction of similar facilities. Public Law 566 funds will provide 50 percent of the construction cost of these facilities. The Washington County Commissioners will be responsible for the local share of this construction cost. Estimated total construction cost of the recreation facilities is \$610,200.

Engineering costs were estimated as a percentage of the construction cost based on previous experience for similar work. Due to extensive mining in the area, the detailed geologic investigation and soil mechanics testing were completed during planning in order to determine the suitability of each of the four proposed sites. Nevertheless, engineering costs include \$400 per site as contingency to cover any additional geologic investigation that may be necessary. Public Law 566 funds will bear 100 percent of the engineering costs for structures PA-659F, PA-660, and PA-662, estimated to be \$32,400 and 97.4 percent of the \$17,000 joint engineering cost of PA-661. The Independence Township Municipal Authority will bear 2.6 percent of the joint engineering costs of PA-661 and 100 percent of the specific engineering cost for water supply, estimated at \$200.

Engineering for the recreational facilities at PA-661 will be performed under an A&E contract. Public Law 566 funds will bear 50 percent of the estimated \$91,600 cost of the contract. The Washington County Commissioners will be responsible for the local share of this cost.

Project administration costs include the cost* of contract administration, review of engineering plans, government

representatives, construction surveys, inspection, relocation assistance advisory services, and administration of relocation payments. The Service will perform construction surveys and inspection of all structures, including specific cost items with respect to their effect on the total structure. The Service will also bear the costs it incurs in assisting Washington County in serving notice of displacement, providing appropriate application forms, assisting in filing applications, hearing and resolving grievances, and in making relocation payments. Together with the local sponsors the Service will review engineering plans and specifications for the recreation facilities

The local sponsors will be responsible for the inspection of the water supply features and secure such assistance as they may need to assure themselves that the plans and specifications for these facilities are being followed. At their own option they may inspect the installation of any portion of the works of improvements. Washington County will be responsible for the administration of relocation payments. The County will also provide, without PL 566 cost sharing, all relocation assistance advisory services estimated to be \$3,000. These consist of: determination of need for assistance, provide current information on availability, prices, and rentals of comparable housing, assure availability of replacement dwellings, assist in establishment in replacement location and provide persons with data outlining benefits to which they may be entitled.

The Service and the sponsors will each pay their own costs for project administration. The joint construction and engineering costs of Structure PA-661 estimated to be \$591,800 were allocated by the use of facilities method. Land rights of 1,140 acres are necessary for PA-661 and the recreational facilities. Of this amount, 443 acres estimated to cost \$445,200 are needed for the dam and reservoir. This figure was determined as that land area encompassed by the top of dam contour (MSL 1043.6), plus that necessary for construction of the dam and emergency spillway. These 443 acres were allocated on the same ratio as the reservoir surface area (413 acres to recreation and 30 acres to water supply).

Total allocated costs for PA-661 are \$170,200 for flood prevention, \$850,200 for recreation, and \$47,600 for water supply (includes specific costs of \$1,000 allocated to the water supply purpose).

The following summarizes the construction schedule and obligation of estimated installation costs:

<u>Year</u>		<u>Structural Measures</u>	<u>Land Treatment</u>	<u>Total</u>
1st	PL 566	\$ 169,300	\$ 9,000	\$ 178,300
	Other	820,700	63,000	883,700
	Yearly Total	\$ 990,000	\$ 72,000	\$1,062,000
2nd	PL 566	\$ 395,800	\$ 12,000	\$ 407,800
	Other	482,800	64,000	546,800
	Yearly Total	\$ 878,600	\$ 76,000	\$ 954,600
3rd	PL 566	\$ 356,800	\$ 13,000	\$ 369,800
	Other	45,800	69,000	114,800
	Yearly Total	\$ 402,600	\$ 82,000	\$ 484,600
4th	PL 566	\$ 651,700	\$ 13,000	\$ 664,700
	Other	305,100	69,000	374,100
	Yearly Total	\$ 956,800	\$ 82,000	\$1,038,800
5th	PL 566	\$ 257,000	\$ 12,000	\$ 269,000
	Other	--	75,000	75,000
	Yearly Total	\$ 257,000	\$ 87,000	\$ 344,000
6th	PL 566	--	\$ 8,000	\$ 8,000
	Other	--	73,000	73,000
	Yearly Total	\$ --	\$ 81,000	\$ 81,000
7th	PL 566	--	\$ 5,000	\$ 5,000
	Other	--	75,000	75,000
	Yearly Total	\$ --	\$ 80,000	\$ 80,000
Project]	PL 566	\$1,830,600	\$ 72,000	\$1,902,600
Period]	Other	1,654,400	488,000	2,142,400
Total]	Total	\$3,485,000	\$560,000	\$4,045,000

EFFECTS OF WORKS OF IMPROVEMENT

Land Treatment

The recommended land treatment program will conserve and improve natural resources and aesthetics, and reduce the hazards of flooding.

Establishment of diversions and grassed waterways will have a measurable effect in reducing peak discharge by slowing runoff and will augment the soil cover improvement measures in reducing erosion and sediment damage. Installation of drainage measures on the poorly drained,

more level soils will result in beneficial adjustments in land use by permitting retirement of upland soils which have a greater erodibility potential. The establishment of farm ponds and spring developments will make more livestock water available and permit improved pasture management which will result in less overgrazing, higher infiltration capacities, and a reduction in the erosion hazard.

Forestry practices will improve hydrologic conditions which will reduce flood peaks, sedimentation, and facilitate ground water recharge. Manipulation of stand composition through approved cultural operations improves hydrologic condition by producing a good humus layer which in turn improves soil structure. The control of woodland grazing protects forest cover from browsing and prevents soil compaction from trampling. Diverting water from skid trails and logging roads by simple structural measures reduces runoff velocity and soil erosion is retarded. Stabilization and decreased sedimentation are further attained by planting shrubs and trees.

Damage Reduction

This combined program of land treatment and structural measures will have a pronounced effect on the reduction of floodwater damages. The project was planned to reduce future flooding in the watershed from peak discharges similar to the one of September 1 and 2, 1912. This peak discharge was larger than that which would be expected from a 100-year recurrence interval flood. For example, the discharge from the 1912 flood through the Avella area was 16,000 cubic feet per second (cfs) and the 100-year flood would be 13,000 cfs. With this project installed these discharges would be reduced to 8,000 and 6,000 cfs, respectively.

The average annual direct and indirect floodwater damages will be reduced to \$7,210 with the project in place, or a 92 percent reduction of damages.

Sixty-three residences will be completely protected from a recurrence of the 1912 storm. Thirty-two residences would still have basement and/or nuisance type damage. First floor damage would occur to seven properties varying in inundations from just over the floor on four properties to approximately one foot on the remaining three houses. The total amount of remaining average annual damage is estimated to be \$1,240.

Twenty-two commercial properties will be completely protected after project installation. First floor damage would still occur to five enterprises varying from about

two feet over the floor of a gas station to approximately one-foot inundation on four other establishments. Basement and ground damage would result at sixteen properties. The estimated remaining average annual damage is \$2,530.

Other remaining damages are \$1,190 to the railroad, \$2,220 to road and bridges, and \$30 to land.

These remaining damages are distributed through the watershed and along Cross Creek as follows: Reach A1 - \$570; Reach A2 - \$90; Reach A - \$20; Reach C - \$2,970; Reach C1 - \$2,210; Reach D - \$50; Reach F - \$50; Reach G - \$330; and Reach I - \$920. (See Figure 5 for reach locations).

The goal for flood damage reduction is to provide complete protection to urban areas. In this watershed the elimination of all damages would require reduction of the flow which can be expected to occur annually. From an engineering and economic standpoint it is impractical to attain this degree of protection. The areas which will not receive complete protection from the 100-year flood will be publicized at least once annually by the local sponsors. Also, the sponsors will discourage misuse of unprotected flood plain lands.

There will be 210 acres of agricultural flood plain protected by the structures. This, along with the land treatment planned for other lands, will substantially reduce sediment and erosion damage. Agriculture will experience other beneficial effects of this program. The land treatment phase will permit proper land use, increase efficiency, and raise net income.

Changed Land Use

There are about 45 acres in Reaches F and G which could be developed into residential housing if the threat of flooding were removed. With the installation of this watershed project this land will become flood-free and it is anticipated this development will take place in the next 20 years.

Fish and Wildlife

The project will produce a good warm water fishery in the 228 acre lake created by PA-661. This lake will be stocked with muskellunge, northern pike, walleye, largemouth bass, black crappie, channel catfish and yellow perch by the Pennsylvania Fish Commission. And depending on water quality studies, it may be stocked with trout to provide a two-story type fishery.

PA-660 and PA-662 are too small for the Fish Commission to stock and manage. However, the water is suitable for stocking and management of bass and bluegills by the local sponsors. PA-659F appears to be too shallow for fish, but water quality studies after completion may indicate that it will support warm water fish. In addition, farm ponds constructed as part of the land treatment program will be stocked with adapted species of fish. In all, the project will create about 250 acres of warm water fishing and should provide at least 75,000 man-days of fishing and boating per year.

Field borders, hedgerow planting, and habitat management are also part of the project. These practices will improve food and cover conditions for upland game. This can be expected to increase the populations of wildlife and to improve the quality of the hunting. In addition, bird watching and nature study should be expected to increase due to the development of the county park at PA-661. The Soil Conservation Service, the Pennsylvania Game Commission, and the Pennsylvania Fish Commission will also encourage and work with interested individuals on other practices beneficial to fish and wildlife.

Recreation

The construction of PA-661 will greatly increase opportunity for water-oriented recreation. Picnicking, hunting, fishing, and boating opportunities will be provided for residents in the watershed and surrounding areas including Washington, Waynesburg, and the Northern Panhandle of West Virginia, and the greater Pittsburgh area. The lake and recreational facilities at PA-661 will be used throughout the year with major picnicking use anticipated in the 14-week summer season and boating and fishing use during a 25-week period. A value of \$1.50 per visitor day was used to determine benefits. Design capacity peak daily use and annual use of the evaluated activities are estimated to be:

<u>Activity</u>	<u>Visitor Days</u>		
	<u>Design Capacity</u>	<u>Peak Daily Use</u>	<u>Annual Use</u>
Picnicking	1,200	1,800	78,800
Boating, Fishing]	900	900	71,200
			<u>150,000</u>

Shoreline fishing, hiking, sightseeing, ice-skating, etc., are interspersed type activities and were not evaluated.

Water quality is suitable for fish at the single purpose sites. In addition, these sites will provide a potential for incidental recreational activities of fishing, boating, picnicking, etc. In the event these sites are used for recreation, the sponsors will provide sanitary facilities to avoid the degradation of the water quality.

Water Supply

The construction of PA-661, a multiple purpose structure to include 166 acre-feet of storage for municipal and industrial water supply, will provide 54 million gallons (200,000) gallons per day for 270 days) of water to meet current and anticipated future needs. This additional supply will provide the Water Authority with enough water to service approximately 500 families, supply the recreational development at PA-661, and have adequate reserves available to service planned industrial expansion. The quality of the water will be the same as the present supply which has been approved by the Pennsylvania Department of Health as an acceptable supply.

Environmental Quality

All works of improvement will be designed in such a manner to minimize any detrimental effects to the environment. During construction, steps will be taken to control air and water pollution, as well as sedimentation from the construction area. Upon completion, the works of improvement and surrounding areas will be restored to original quality or improved.

The planned recreational area will afford watershed residents, plus those living within a commuting distance, many days of enjoyment and relaxation. Water supply features will allow the Avella area to plan for an orderly residential and industrial expansion program. Security, along with freeing financial resources for more productive endeavors, will result from floodwater damage reduction. Increased productivity on farm and forest lands will result from land use capability adjustment and the land treatment program. Conservation measures will also abate water pollution by reducing surface runoff, thereby lessening sediment and agricultural pollutant deposition in streams. Other significant benefits, classified as secondary effects, will be realized.

All these benefits will enhance the present environmental quality, but more importantly, they will conserve natural

resources so that they will be available when needed, allowing the freedom of choice by future generations.

PROJECT BENEFITS

The total average annual project benefits accruing to the structural measure are \$311,600 and to the land treatment measures are \$3,220.

Average annual floodwater damage without the project is estimated to be \$89,360. With the project installed the average annual damage is reduced to \$7,210 for a benefit of \$82,150. Average annual flood prevention benefits accruing to structures are \$78,930 for damage reduction and \$3,440 for changed land use. Land treatment measures will bring about in damage reduction benefits of \$3,220.

Flood prevention benefits accrue 19 percent to residences, 32 percent to businesses and industry, 26 percent to roads and bridges, 23 percent to railroads.

Average annual benefits of \$7,900 were assigned to municipal and industrial water supply based on a water supply study by a consultant retained by the Independence Township Municipal Authority.

Recreation benefits were assigned to the recreational facilities to be developed at Site PA-661. The facilities at PA-661 were designed to permit 150,000 recreation days of use annually at a benefit of \$177,750.

Additional benefits to fish and wildlife will result by increasing the amounts of habitat. Land treatment measures planned will also improve existing habitat by providing better food and cover conditions. These benefits were not included in the evaluation.

The proposed land treatment measures will improve the hydrologic condition of the land. This will have the effect of reducing sediment and retarding water runoff. Also, proper management and continued fire protection will increase the productivity of the forest land.

Redevelopment benefits resulting from increased labor resources required for project construction and operation and maintenance have been included. Evaluation of benefits from operation and maintenance is limited to the first 20-year period of the project. The redevelopment benefits stemming from increased labor use are \$16,600. Because of unemployed labor resources in the area, each added unit of employment is important.

Secondary benefits were evaluated in monetary terms and included in the economic evaluation of the project. The value of local secondary benefits stemming from the project was considered to be equal to ten percent of the direct primary benefits, \$26,980. They included the proposed expansion of residential development and the establishment of private service industries in conjunction with the recreation development. Secondary benefits from the national viewpoint were not considered pertinent to the economic evaluation.

COMPARISON OF BENEFITS AND COSTS

The structural measures described in this work plan are economically justified. The ratio of the average annual structural benefits, \$284,620 without the inclusion of local secondary benefits, to the estimated average annual costs, \$225,300, is 1.3 to 1.0.

The total average annual benefits, including local secondary benefits of \$26,980, are \$311,600. The benefit cost ratio is 1.4 to 1.0. Table 6 shows a comparison of annual costs to annual benefits.

PROJECT INSTALLATION

The installation period for accomplishing this plan will be seven years. Structure PA-661 will be built first. However, the sponsors will provide assurance to the Soil Conservation Service that land rights for all structures will have been acquired prior to starting the construction of PA-661.

The Washington County Soil and Water Conservation District will be responsible for working with landowners and operators to carry out the land treatment measures to be established within the next seven years. The Soil and Water Conservation District, with technical assistance from the Soil Conservation Service and the Pennsylvania Department of Environmental Resources in cooperation with the Forest Service, will assist landowners and operators with the preparation and application of farm conservation plans.

Fifty percent of the farm land in the drainage area above each flood retarding structure will be under cooperative agreement with the Soil and Water Conservation District before construction of the dams can be initiated. The Washington County Soil and Water Conservation District has agreed that an intensive program of assisting farmers in the drainage areas above the structural works of

improvement is of the highest priority.

Technical assistance to all district cooperators will be accelerated under the Public Law 566 program as set forth in this work plan. Provisions for carrying out this accelerated program will be included in the annual work plans of the Soil and Water Conservation District. The annual work plans will include goals for the establishment of land treatment practices, land use adjustments, and other conservation activities to be met within the program period.

The Cooperative Extension Service of The Pennsylvania State University, through the County Agricultural Extension agents, will assist the Soil and Water Conservation District in developing and carrying out an information and educational program to stimulate interest in watershed activities.

The Washington County Commissioners will:

1. Be responsible for acquiring all land rights.
2. Be responsible for making relocation payments to displaced persons.
3. Be responsible for 53.0 percent of any relocation payments for a single dislocation after July 1, 1972, and 53.0 percent of any costs for a single dislocation in excess of \$25,000 before July 1, 1972.
4. Enter into agreements with the Pennsylvania Department of Transportation, townships, and appropriate utility companies for the relocation, flooding easements, and abandonment of roads and utilities affected by the structures.
5. Be responsible for building a proposed county park road.
6. Be responsible for 35 percent of the joint construction cost of PA-661 and 50 percent of construction and engineering costs for the recreational facilities to be constructed at PA-661.
7. Acquire or provide assurance that landowners or water users have acquired such water rights as may be needed in the installation and operation of PA-659F, PA-660, PA-661, and PA-662.

8. Be responsible for securing the necessary permits from the Department of Environmental Resources for construction of structures.
9. Use their project administration funds to perform their duties as local sponsors and assure themselves that the works of improvement are being installed as planned by performing such inspections as they may deem necessary.
10. Bear the cost of their own project administration, including relocation assistance advisory service.
11. With the Soil Conservation Service, review and approve the plans, designs and specifications prepared by a consultant for the recreational facilities at PA-661.
12. Be responsible for coordination and communication between the sponsors and the Soil Conservation Service during construction.

The Independence Township Municipal Authority will:

1. Be responsible for 2.6 percent of the joint construction and engineering costs of PA-661.
2. Be responsible for all specific costs for the water supply purpose.
3. Be responsible for inspection of water supply features at PA-661.
4. Bear the cost of its own project administration.

The Soil Conservation Service will:

1. Do all the engineering for the single purpose flood prevention sites.
2. At the request of the Sponsoring Local Organization, do the engineering for, and design of, multiple purpose Site PA-661.
3. Be responsible for its share of the construction and engineering costs associated with PA-659F, PA-660, PA-661, Recreation Facility, and PA-662.
4. At the formal request of the Sponsoring Local

Organization, perform the administration of contracts.

5. Provide a government representative.
6. Do the inspection during construction, including those water supply features which have a bearing on the stability of the dam.
7. With the Washington County Commissioners, review and approve the plans, designs, and specifications prepared by a consultant for the recreational facilities at PA-661.
8. Initiate specific guidelines and requirements to be met by the contractors for abatement of sediment and other forms of water and air pollution during construction.
9. Bear its cost of project administration, including assisting sponsors in the administration of relocation payments.
10. Be responsible for 100 percent of the first \$25,000 of relocation payment costs for any person, business or farm operation displaced prior to July 1, 1972, and 47 percent of any such costs for a single dislocation in excess of \$25,000. Be responsible for 47.0 percent of any payments for a single dislocation after July 1, 1972.

The Washington County Commissioners and the Independence Township Municipal Authority have the power of eminent domain and will exercise it, if necessary, for the acquisition of land rights for all structural measures.

FINANCING PROJECT INSTALLATION

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

PL 566 funds will not be used for land rights, specific water supply, nor the installation of land treatment measures.

The sponsors have analyzed their financial needs in consideration of the scheduled installation of works of

improvement so that funds will be available when needed.

The Washington County Commissioners will provide funds for carrying out its responsibilities from its general funds or taxation. They will also secure financial assistance from state and federal agencies to aid them in carrying out their responsibilities in the installation of the watershed project and the projects to be installed in conjunction with it. The Independence Township Municipal Authority has filed a letter of intent with the State Director of Farmers Home Administration seeking funds for credit assistance to finance their water storage and release costs at PA-661, estimated to be \$17,000.

The local sponsors will pay their share of costs for a particular structural measure by either depositing the required amount in an escrow account at the time of signing a project agreement, or by other arrangements satisfactory to the sponsors and the Soil Conservation Service.

The Washington County Agricultural Stabilization and Conservation Committee in administering the Rural Environmental Assistance Program will assist in the land treatment program through cost sharing. It is estimated that \$30,000 of Rural Environmental Assistance Program cost sharing funds will be needed annually for this purpose. The actual determination of how much assistance can be provided will be made on an annual basis and will be influenced by the needs and desires of the landowners. The Sponsoring Local Organizations, the County Agricultural Stabilization and Conservation Service, the Pennsylvania Department of Environmental Resources, the Forest Service, and the Soil Conservation Service will, on an annual basis, determine how each can best contribute in carrying out an accelerated land treatment program in the watershed.

Financial and other assistance to be furnished by the Soil Conservation Service in carrying out the watershed work plan is contingent on the availability of funds for this purpose.

PROVISIONS FOR OPERATION & MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained by the owners or operators of the land on which these measures are installed. Technical assistance will be furnished by the Soil Conservation Service and the Pennsylvania Department of Environmental Resources in cooperation with the Forest Service.

Structural Measures

The Independence Township Municipal Authority will be responsible for the operation and maintenance costs connected with water supply at PA-661 at an estimated annual cost of \$100.

The Washington County Commissioners will be responsible for operation and maintenance of PA-659F, PA-660, PA-661, Recreation Facility, and PA-662, at an estimated annual cost of \$45,400. The annual operation and maintenance costs of PA-661 and the associated recreation facilities are estimated to be \$44,400. Of this amount, \$700 is for the Structure PA-661, \$41,100 for operation and maintenance of recreational facilities, and \$2,600 for replacement of recreation facilities. Operation and maintenance costs for PA-659F, PA-660, and PA-662 are estimated at \$1,100.

The Washington County Commissioners will maintain the recreation area at PA-661 as a county park and will provide custodial, sanitation, safety, and other operational services necessary for public safety, health and welfare as required by the Commonwealth of Pennsylvania.

The sponsors are aware of their responsibilities and will work with the County Planning Commission to prevent areas adjacent to the permanent pools from becoming a source of sediment production and water pollution. They will take the necessary steps to reduce sedimentation and alleviate any pollution problem that may develop to the impounded waters.

The 228 acre recreation lake to be created at PA-661 will be maintained as a permanent lake and will not be used for water supply. This will be accomplished by a modification at the principal spillway intake structure which will prevent lowering the pool elevation below that of the 228 acre lake.

Representatives of the Sponsoring Local Organizations, responsible for operation and maintenance, and the Soil Conservation Service will jointly inspect the structures and facilities annually, after unusually severe rainfalls, and after the occurrence of other conditions that might adversely affect the structural measures. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made by the sponsors. A report including recommendations for repairs, improvements, and replacement will be prepared and filed for each inspection.

The structural works of improvement will be operated in

such a manner that they will serve the purpose, both as to function and time, for which they are installed.

The maintenance will consist of, but not be limited to, the following:

1. Maintain good sod covers by mowing, liming, fertilizing, and reseeding where and when necessary.
2. Remove and dispose of debris.
3. Refill, smooth and vegetate rilling on embankments, spillways, and drainage-ways.
4. Realign disposal channels.
5. Repair damaged riprap, concrete, or other works.
6. Repair fences and gates.

Specific maintenance agreements will be entered into prior to the execution of the project agreement for works of improvement.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Cross Creek Watershed, Pennsylvania

Installation Cost Item	Unit	To be Treated		Estimated Cost Dollars ^{1/}		
		Non-federal Land	PL 566	Other	Total	
<u>Land Treatment</u>						
Soil Conservation Service						
Cropland		4,500	--	99,000	99,000	
Grassland	Acres	6,000	--	337,000	337,000	
Technical Assistance			49,000	23,000	72,000	
SCS Subtotal			49,000	459,000	508,000	
Forest Service						
Forest Land	Acres	4,300	--	24,000	24,000	
Technical Assistance			23,000	5,000	28,000	
FS Subtotal			23,000	29,000	52,000	
TOTAL LAND TREATMENT			72,000	488,000	560,000	
<u>STRUCTURAL MEASURES</u>						
<u>Construction</u>						
Floodwater Retarding Structures	Each	3	730,200	--	730,200	
Multiple Purpose Structures	Each	1	358,600	217,000	575,600	
Recreation Facilities	Each	1	305,100	305,100	610,200	
Subtotal-Construction			1,393,900	522,100	1,916,000	
<u>Engineering</u>						
Investigation, Survey and Design			94,700	46,500	141,200	
Subtotal-Engineering			94,700	46,500	141,200	
<u>Relocation Payments</u>						
Moving Expense and Replacement Housing			83,000	94,000	177,000	
Subtotal-Relocation			83,000	94,000	177,000	
<u>Project Administration</u>						
Relocation Assistance Advisory Services			--	3,000	3,000	
Construction Inspection			106,400	500	106,900	
Other			146,600	19,500	166,100	
Review of Designs and Specifications ^{2/}			6,000	--	6,000	
Subtotal-Administration			259,000	23,000	282,000	
<u>Other Costs</u>						
Land Rights			--	968,800	968,800	
Subtotal-Other			--	968,800	968,800	
TOTAL STRUCTURAL MEASURES			1,830,600	1,654,400	3,485,000	
TOTAL PROJECT			1,902,600	2,142,400	4,045,000	
SUMMARY						
Subtotal - SCS			1,879,600	2,113,400	3,993,000	
Subtotal - FS			23,000	29,000	52,000	
TOTAL PROJECT			1,902,600	2,142,400	4,045,000	

^{1/} Price Base: 1970^{2/} Review of design and specifications for the recreational facility which will be prepared by others.

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Cross Creek Watershed, Pennsylvania

Measures	Unit	Applied to Date	Total Cost (Dollars) ^{1/}
<u>Land Treatment</u>			
Contour Strips Conservation	Acres	2,000	8,700
Cropping System	Acres	1,300	19,400
Diversions	Feet	28,000	10,000
Tile Drains	Feet	23,000	56,500
Grassed Waterways	Acres	12	3,700
Pasture and Hayland Planting	Acres	280	19,700
Pasture and Hayland Management	Acres	1,460	65,800
Wildlife Habitat Management	Acres	310	6,200
Livestock Exclusion	Acres	670	16,800
Farm Pond	No.	8	7,100
Spring Development	No.	52	14,400
Land Clearing	Acres	210	9,000
Hedgerow Planting	Feet	44,950	4,500
Fire Control	Acres	8,200	11,500
Tree Planting	Acres	150	8,900
Hydrologic Cultural Operations	Acres	10	100
Woodland Grazing Control	Acres	40	700
TOTAL LAND TREATMENT			263,000

^{1/} Price Base: 1970

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Cross Creek Watershed, Pennsylvania

(Dollars) ^{1/}

ITEM	Installation Cost - PL 566 Funds			Installation Cost - Other Funds			Total Installation Cost	
	Construction	Engineering	Relocation Payments ^{2/}	Construction	Engineering	Land Rights		Relocation Payments ^{2/}
PA-659F	175,600	8,800	2,000	--	--	40,600 ^{3/}	2,300	42,900
PA-660	297,600	12,600	31,200	--	--	85,800 ^{4/}	35,200	121,000
PA-661	358,600	16,500	14,000	216,200	500	445,200 ^{5/}	16,000	677,900
Joint Costs	--	--	--	800	200	--	--	1,000
Specific Costs ^{6/}	305,100	45,800 ^{7/}	19,200	305,100	45,800 ^{7/}	219,200	21,700	591,800
Rec. Facility	257,000	11,000	16,600	--	--	178,000 ^{8/}	18,800	196,800
PA-662	1,393,900	94,700	83,000	522,100	46,500	968,800 ^{9/}	94,000	1,631,400
SUBTOTAL	1,393,900	94,700	83,000	1,571,600	46,500	968,800 ^{9/}	94,000	1,631,400
Project Admin.	--	--	--	259,000	--	--	--	23,000
GRAND TOTAL	1,393,900	94,700	83,000	1,830,600	46,500	968,800	94,000	1,654,400

1/ Price Base: 1970
 2/ Relocation payments for displacements prior to July 1, 1972 will be shared as provided in PL 91-646 and paragraph numbered 2 of the Agreement.
 3/ Includes \$27,000 to raise LR 62185; \$4,200 to relocate Bell Telephone lines.
 4/ Includes \$23,800 to raise and relocate LR 62024; \$4,000 to raise farm access lanes; \$7,000 to relocate Bell Telephone lines; and \$400 to relocate West Penn Power line.
 5/ Includes \$110,000 to relocate LR 62133 and LR 62022; \$16,000 to relocate West Penn Power line; \$9,000 to relocate Bell Telephone lines; and \$200 to remove Taylorstown Telephone line.
 6/ Water supply outlet pipe and impact basin outlet.
 7/ A&E contract cost to be borne \$45,800 by PL 566 funds and \$45,800 by Other funds.
 8/ Includes \$155,000 to relocate LR 62035; \$1,000 to replace culvert to township road (T-773); and \$400 to remove Hickory & Woodrow Telephone line.
 9/ Includes \$26,400 for survey, legal fees and other costs; \$108,800 for mineral (coal) rights.

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Cross Creek Watershed, Pennsylvania

(Dollars) ^{1/}

Item	COST ALLOCATION				COST SHARING				Total	Water Supply	Total		
	PURPOSE				PUBLIC LAW 566							OTHER	
	Flood Prevention	Recreation	Water Supply	Total	Flood Prevention	Recreation	Water Supply ^{2/}	Total				Flood Prevention	Recreation
PA-659F	229,300	--	--	229,300	186,400	--	--	186,400	42,900	--	--	42,900	
PA-660	462,400	--	--	462,400	341,400	--	--	341,400	121,000	--	--	121,000	
PA-661	170,200	850,200	47,600	1,068,000	165,800	222,900	400	389,100	4,400	627,300	47,200	678,900	
Rec. Fac.	--	961,900	--	961,900	--	370,100	--	370,100	--	591,800	--	591,800	
PA-662	481,400	---	--	481,400	284,600	--	--	284,600	196,800	--	--	196,800	
GRAND TOTAL	1,343,300	1,812,100	47,600	3,203,000	978,200	593,000	400	1,571,600	365,100	1,219,100	47,200	1,631,400	

^{1/} Price Base: 1970.

^{2/} PL 566 costs for Water Supply reflects the federal portion of relocation payments as required by PL 91-646.

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TABLE 2B - RECREATIONAL FACILITIES ESTIMATED CONSTRUCTION COSTS

PA-661, Cross Creek Watershed, Pennsylvania

Facility and Area	Unit	Quantity	Estimated Cost (Dollars) ^{1/}	
			Unit	Total
Access Roads, Two-Lane Blk. Top	1.f		22	
GP-1, P-4, P-5		6,200 ^{2/}		136,400
BF-1		3,000 ^{2/}		66,000
Access Road, Two-Lane, Gravel	1.f.		15	
GP-1		1,800 ^{2/}		27,000
P-4		1,000 ^{2/}		15,000
P-5		200 ^{2/}		3,000
BF-1		1,000 ^{2/}		15,000
Parking Spaces, Car, 350 Square Feet, Gravel	ea.		170	
GP-1		90		15,300
P-4		80		13,600
P-5		110		18,700
BF-1		100		17,000
Parking Spaces, Trailer 400 Square Feet, Gravel	ea.		192	
BF-1		20		3,900
Picnic Tables	ea.		240	
GP-1		90 ^{2/}		21,600
P-4		60 ^{2/}		14,400
P-5		90 ^{2/}		21,600
Grills	ea.		180	
GP-1		30 ^{2/}		5,400
P-4		20 ^{2/}		3,600
P-5		30 ^{2/}		5,400
Trash Can Holders	ea.		100	
GP-1		30 ^{2/}		3,000
P-4		20 ^{2/}		2,000
P-5		30 ^{2/}		3,000
Water Drilled Wells with Pitcher Pump	ea.		900	
GP-1		2		1,800
P-4		2		1,800
P-5		2		1,800
BF-1		1		900
Comfort Stations, Concrete Vault, 6 seats, 2 urinals	ea.		19,800	
GP-1		2		39,600
P-4		2		39,600
P-5		2		39,600
BF-1		1		19,800
Signs, Identification, location and directional	set	1	1,900	1,900
Fishing Piers	ea.	4	3,000	12,000
Boating Facilities				
Launching ramp 40' x 80'	ea.	1	6,000	6,000
Loading Dock 6' x 20'	ea.	1	1,500	1,500
Boat Mooring Line	1.f.	200	12	2,400
Boat Parks, including Bulkhead	ea.	10	2,160	21,600
Trails 4' width	1.f.		1.20	
P-4, P-5		7,500 ^{2/}		9,000
TOTAL				610,200

^{1/} Price Base: 1970

^{2/} Estimated quantity.

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TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY

Cross Creek Watershed, Pennsylvania

ITEM	UNIT	PA-659F	PA-660	PA-661	PA-662	TOTAL
Class of Structure		c	c	c	c	
Drainage Area	Sq. Mi.	1.84	4.39	11.0	3.72	20.95
Curve No. (1-day)(AMC II)		77	79	77	77	
Tc	Hrs.	1.13	1.76	2.81	1.25	
Elevation						
Top of Dam	Ft.	1050.8	1028.6	1043.6	1083.5	
Crest Em. Spillway	Ft.	1045.5	1017.0	1033.0	1072.5	
Crest Low Stage Inlet	Ft.	1024.0	981.0	1026.0	1048.0	
Maximum Height of Dam	Ft.	35	61	74	46.5	
Volume of Fill	Cu. Yds.	70,000	158,400	340,500	77,800	646,700
Total Capacity	Ac. Ft.	343	1,071	7,763	674	9,851
Sediment Submerged						
1st 50 years	Ac. Ft.	22	43	169 ^{1/}	38	272
2nd 50 years	Ac. Ft.	21	42	--	37	100
Sediment Aerated	Ac. Ft.	2	4	13	4	23
Benefit Use						
Recreation	Ac. Ft.	--	--	5,435 ^{2/}	--	5,435
Water Supply	Ac. Ft.	--	--	196 ^{3/}	--	196
Retarding	Ac. Ft.	298	982	1,950	595	3,825
Surface Area						
Sediment Pool	Ac.	5	8	--	8	21
Beneficial Use						
Recreation Pool	Ac.	--	--	228	--	228
Water Supply Pool	Ac.	--	--	258	--	258
Retarding Pool	Ac.	27	57	311	52	447
Principal Spillway						
Rainfall Volume (areal)						
(1 day)	In.	5.1	5.1	5.1	5.1	
(10 day)	In.	9.0	9.0	9.0	9.0	
Runoff Volume (10 day)	In.	4.22	4.59	4.22	4.22	
Capacity of Low Stage (Max.)	cfs.	32	119	386	113	
Size of Conduit	Dia. - In.	30-R ^{4/}	30	36	30	
Emergency Spillway						
Rainfall Volume						
(ESH)(areal)	In.	9.5	9.5	9.5	9.6	
Runoff Volume (ESH)	In.	6.66	6.92	6.66	6.76	
Frequency of Operation	% chance	1	1	1	1	
Type	Veg.		Veg.	Veg.	Veg.	
Bottom Width	Ft.	350	135	240	150 ^{5/}	
Velocity of Flow (Ve)	Ft./Sec.	5.60	8.75	8.20	8.0	
Slope of Exit Channel	Ft./Ft.	0.025	0.025	0.025	0.025	
Max. Water Surface Elev.	Ft.	1047.3	1020.6	1036.2	1076.0	
Freeboard						
Rainfall Volume (FH)(areal)	In.	25.5	25.5	25.5	25.6	
Runoff Volume (FH)	In.	22.24	22.56	22.24	22.34	
Max. Water Surface Elev.	Ft.	1050.8	1028.6	1043.6	1083.5	
Capacity Equivalents						
Sediment Volume	In.	0.46	0.38	0.31	0.40	
Retarding Volume	In.	3.40	4.19	3.32	2.99	

^{1/} 100-Year Submerged Sediment.^{2/} Includes 868 acre-feet for reservoir losses and state required release.^{3/} Includes 30 acre-feet for reservoir losses and state required release.^{4/} Restricted.^{5/} 50 feet on left abutment and 100 feet on right abutment.

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TABLE 4 - ANNUAL COST

Cross Creek Watershed, Pennsylvania

(Dollars)^{1/}

Evaluation Unit	Amortization of Installation Costs ^{2/}	Operation and Maintenance Cost	Total
No. 1	165,300	45,500 ^{3/}	210,800
PA-659F			
PA-660			
PA-661			
Rec. Fac.			
PA-662			
Project Administration	14,500	--	14,500
GRAND TOTAL	179,800	45,500	225,300

^{1/} Price Base: Installation Costs - 1970; O&M - 1969 adjusted normalized prices.

^{2/} 100 years @ 5 1/8 percent interest.

^{3/} Includes \$43,700 for operation, maintenance, and replacement for the recreational development.

July 1971

TABLE 5

ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Cross Creek Watershed, Pennsylvania

(Dollars)^{1/}

Item	Estimated Average Annual Damage ^{2/}		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	70	10	60
Non-Agriculture			
Residential	13,620	1,080	12,540
Commercial	24,140	2,110	22,030
Road and Bridge	19,270	1,780	17,490
Railroad	16,290	950	15,340
Subtotal	73,390	5,930	67,460
Sediment			
Scour and Overwash	180	20	160
Subtotal	180	20	160
Indirect	15,790	1,260	14,530
TOTAL	89,360	7,210	82,150

^{1/} Price Base: 1969 adjusted normalized prices.

^{2/} Additional damages will be caused by floods of greater magnitude than the 100-year frequency, but were not evaluated.

July 1971

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Cross Creek Watershed, Pennsylvania

(Dollars) ^{1/}

Evaluation Unit	Damage Reduction	Changed Land Use Agr/Urban	Recreation	Municipal Water Supply	Redevelopment	Secondary	Total	Average Annual Cost ^{3/}	Benefit Cost Ratio
No. 1	78,930 ^{2/}	3,440	177,750	7,900	16,600	26,980	311,600	210,800	1.5 to 1.0
PA-659F									
PA-660									
PA-661									
Rec. Fac.									
PA-662									
Project Adm.	--	--	--	--	--	--	--	14,500	--
GRAND TOTAL	78,930	3,440	177,750	7,900	16,600	26,980	311,600	225,300	1.4 to 1.0

^{1/} Price Base: Installation costs, 1970 - Benefits and O&M costs, 1969 adjusted normalized prices.

^{2/} In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$3,220 annually.

^{3/} From Table 4.

July 1971

INVESTIGATIONS AND ANALYSES

Hydrology and Hydraulics

The hydrologic and hydraulic analyses were based on standard procedures of the Soil Conservation Service National Engineering Handbook and other technical references as indicated in this summary.

The flood of September 1 and 2, 1912, the flood of record, was selected as the key flood for watershed analysis. Rainfall of ten inches during a four hour period was reported by the U. S. Army Corps of Engineers for an area just northeast of the village of Cross Creek. The entire Cross Creek Watershed had over four inches of precipitation from this storm with the North Fork of Cross Creek averaging nearly eight inches.

A study of the hydrologic and hydraulic conditions was made; considered were such factors as soils, land use, stream channel characteristics, location of potential floodwater retarding structures, and floodwater damage locations. From this study, the watershed was divided into hydrologic sub-areas. The hydrologic soil classification was based on soil survey information for the watershed. Runoff curve numbers for forest land under present and future conditions were determined by the U. S. Forest Service from a study of forest cover conditions. Open land use and treatment classes for present and with project conditions were prepared by the State Office staff with the assistance of the soil scientist and district conservationist. Runoff curve numbers were computed from these data as outlined in Chapter 9 of the Soil Conservation Service National Engineering Handbook, Section 4, Hydrology (NEH-4). Composite runoff curve numbers were then computed for each sub-area.

The watershed was divided into sixteen sub-watersheds for flood routing purposes and key flood hydrographs were computed for the sub-areas and routed downstream using the Convex Routing Method. The computed flood discharge at the damage centers was compared with the surveyed high water marks. Agreement between computed and actual high water elevations served as a check on the accuracy of the hydraulic model.

Rainfall-duration-frequency data were obtained from U. S. Weather Bureau Technical Paper No. 40, "Rainfall Frequency Atlas of the United States." Rainfall was converted to runoff using cover complex numbers and Soil Conservation Service Technical Release 16.

Synthetic hydrographs based on the runoff from rainfall of

the 6- and 24- hour storms for two, ten, and 100-year frequencies were routed through the watershed using Soil Conservation Service Technical Release No. 20, "Computer Program for Project Formulation - Hydrology." The synthetic storms were routed under present conditions, with land treatment, and with land treatment and various combinations of structures. Discharge-frequency curves were plotted on logarithmic-probability paper for all reaches studied considering both present and with project conditions for various combinations of structures.

The time of concentration for the sub-areas was computed using stream channel hydraulics and overland flow and Soil Conservation Service Engineering Standard Drawing ES-1015. Travel time through each reach was determined by calculating the velocity of flow using bank-full conditions. Channel and valley, bridge and road, or dam cross sections were surveyed at selected locations.

Water surface profiles were computed through the damage reaches from Rockdale, West Virginia, upstream through Avella, Pennsylvania, using the step method for computing water surface profiles. Rating curves showing the relationship between stages and discharges were developed at pertinent locations in the damage reaches and indicated conditions with and without the project. Stream profiles were plotted for the major damage area on plan-profile sheets. The plan portion is an enlargement of the aerial photograph of the area showing cross section locations. Items on the profile are enumerated in the legend of Figure 3, Flood Plain Risk Map.

The September 1912 flood washed out highway bridges which were carried downstream and clogged the openings under several railroad bridges. The railroad bridges became major hydraulic obstructions. Other floods such as the August 1956 and March 1963 events did not wash out highway bridges. The stage versus discharge relationship reflects the presence of these obstructions for very high flows and normal conditions for floods of lesser magnitude.

Minimum floodwater storage requirements for the structures were determined as outlined in Chapter 21, NEH-4, Hydrology. The retarding volume storages indicated in Table 3 are larger than these minimum storage requirements to provide protection against the recurrence of runoff similar to that which occurred from the key storm. The maximum structure release rates were determined so that principal spillway flow would not cause out-of-bank flooding downstream from the dam. The release rates from all of the structures were adjusted to prevent increased flood stages on the Cross Creek flood plain. All of the

flood control structures will have a single stage riser configuration. Two stage riser designs were considered but would not have significantly affected evaluation reaches downstream.

Emergency spillway and freeboard hydrographs were developed according to procedures in Chapter 21, NEH-4, Hydrology. Precipitation data were obtained from Soil Conservation Service Engineering Standard Drawing 1020 (ES-1020). Point rainfall from ES-1020 was modified for areas as described in ES-1003.

A reservoir operations study, using the computer program available at the Regional Technical Service Center, was made to determine the normal operating range of multiple purpose structure PA-661 when records of the dry years 1961 - 1967 were considered. The flow available at the structure was based on the Brush Run gauge which is indicative of flow in a watershed adjacent to that of PA-661 and of almost equal size. In the analysis, average monthly values of streamflow and rainfall were compared against peak water supply demands of .6 acre-feet per day, State required release of 3.3 acre-feet per day, and average monthly seepage and evaporation losses. The study showed that structure storage was adequate to meet the demands of water supply, State required release, and reservoir losses to seepage and evaporation for a 6-month period in which there was practically no stream inflow.

Engineering

Twenty sites were initially selected on the basis of a study of the USGS 7 1/2 minute topographic maps of the watershed and a field study of specific site conditions. Ten sites were determined to be not feasible during the preliminary phase of the study. The ten remaining dam sites were developed in detail.

A ten-foot contour interval topographic map was prepared from a plane table-alidade survey for each site. The sites were proportioned in order to minimize the cost of the dam, the land and buildings in the site, and the necessary road and utility relocations. The bases for these costs are:

1. The construction cost of each dam was estimated from nine preliminary design quantities: clearing, clearing and grubbing, fill (earth and rock), excavation (common and rock), reinforced concrete pipe, concrete, filter material, rock riprap, and seeding.

2. Land, building, and mineral rights values associated with each site were determined by qualified representatives of the local sponsors. A qualified consulting engineering firm was retained by the Soil Conservation Service to determine the quantity, if any, of coal that can safely be mined under the dams and multiple purpose reservoir. The consultant's report indicates that complete extraction of the Pittsburgh coal will cause subsidence of the ground surface and could result in sufficient damage to the structures to eventually cause their failure. Therefore, in view of the hazard to public safety should a dam fail, limitations with respect to area and extraction have been imposed on the minerals that underlie the dams and the multiple purpose reservoir. Extraction refers to both removal of the mineral and access entries.
3. Road and utility relocation costs for each site were estimated by the State and Township Highway Departments and the appropriate utility companies.

Eight dam sites were selected for final evaluation on the basis of the site costs and benefits that would accrue. A four dam program was selected by the sponsors to meet project objectives.

Soil Conservation Service design criteria and procedures, as contained in the Engineering Memorandum 27 (Rev.) were used to proportion the dams. All of the structures were classified "c" according to this memorandum.

In all cases the retarding storage is greater than the minimum 100-year flood storage. This was done to provide protection against runoff similar to that which occurred from the key storm.

Structural dimensions are subject to change during final design due to a more detailed analysis of geological and soils mechanics laboratory information. The final design for each structure will be submitted to the Pennsylvania Department of Environmental Resources for review and issuance of a permit.

Geology

A reconnaissance of land subject to flooding was made to determine the damages by streambank erosion, swamping, flood plain scour, and infertile overwash. Special studies were made to determine the potential future damage to the

fill of the Norfolk and Western Railroad and the effects of the watershed program. Soil samples were taken at selected damage points to determine density, compactness, and grain size distribution of materials. Calculations using the Meyer-Peter equation were made to determine the amount of material that would be moving at various flood stages under present conditions and future controlled flood stages. The result of these studies indicates that the damage to the railroad will be reduced over 90 percent by the planned upstream discharge control.

Sediment storage requirements for the proposed dams were computed by procedures outlined in the Geology Section of the Watershed Planning Guide. Factors taken into consideration were land use, sheet erosion, channel erosion, delivery rate to the structure, and trap efficiency of the reservoir. Sheet erosion was computed from Musgrave's Soil Loss Formula, using basic data taken from soil maps, aerial photos, and field measurements. Sediment storage at each reservoir will contain the expected accumulation for a one hundred year period.

Detailed geologic site investigations were made at each of the proposed dam sites to determine the subsurface rock conditions and the engineering characteristics of the foundation and borrow materials.

The field procedures used in the investigations of the sites included the use of detailed drilling, portable refraction seismic instrument, manual sampling, and exploration tools, and soil testing equipment. The findings were correlated with published and unpublished geologic data, water and gas logs, and coal mine maps for the region. Features such as soil types, bedrock profiles, and coal were plotted and their relationship to the proposed dams evaluated.

The detailed geologic investigations of the proposed sites revealed the following conditions:

All of the sites are located on the Monongahela formation except PA-661 which is on the Washington formation. All of the sites are located in steep-sided narrow valleys which were formed by streams cutting down into nearly horizontal sandstones, shales, and limestone. Residual silty soils 2 to 3 feet thick occur above weathered rock on the abutments. An average of 4 to 6 feet of alluvium occurs on the flood plains. No mining has taken place beneath the sites, but all sites are underlain by the Pittsburgh coal seam at the following depths: PA-659F - 75 feet, PA-660 - 55 feet, PA-661 - 240 feet, and PA-662 - 205 feet. General Analytics, Inc. was retained by the Soil Conservation Service as advisory consultants to investigate coal operations and overburden conditions at the four

sites. They made recommendations pertinent to the amount of coal support required at each site to be consistent with long term safety. Support recommendations were confined to the four dams and the reservoir at PA-661. Their report is on file with the Soil Conservation Service, Harrisburg, Pennsylvania.

Economics

Basic information on damages was obtained in the field from personal interviews with property owners and was recorded on flood damage schedules. This information was related to the flood of September 1 and 2, 1912. The sponsoring organizations cooperated in contacting approximately 100 percent of the owners and operators of industrial and commercial property, 85 percent of residential, and 50 percent of agricultural property affected by floodwaters from Cross Creek and tributary streams. Damages for stages above and below the 1912 flood level were appraised in one-foot increments. The damage estimates were tabulated by stages and type of property damaged.

Floodwater damages and benefits were computed using the frequency method as described in Chapter 3, page 2, of the Economic Guide, Soil Conservation Service. Separate damage frequency analyses were developed for each of the 13 economic evaluation reaches using the stage frequency data provided by the hydrologic study. Damage and benefits affecting agriculture, residences, and commercial property were computed under: (1) conditions without the project, (2) conditions after installation of the proposed land treatment, and (3) conditions with all measures installed.

Changed land use benefits were calculated for selected areas along the stream which will be protected when the project is installed. These benefits were derived from increased land values as projected by the Washington County Planning Commission. It is expected that these lands will be developed into residential areas within the following 20 years.

Over 2,000,000 Pennsylvanians, along with many residents of West Virginia and Ohio, live within 50 miles of the watershed. These people create a demand for water-based recreation that far exceeds that which can be satisfied by the proposed recreation development. The quantity of facilities indicated in this plan does not depict an optimum development. It is representative only of the initial buildup desired by the sponsors. Facilities for additional recreational activities will be provided in

subsequent stages of development of the county park associated with PA-661. Benefits from these facilities and activities were not evaluated.

PA-661 is the most economical way of providing a dependable water supply. A single purpose water supply structure was evaluated as an alternate but its cost to provide a similar amount of water greatly exceeds the water supply portion of the cost of the multiple purpose structures. Water supply benefits are net of those benefits which will be generated by additional water supply. An adequate water supply cannot be fully appraised because of its value in attracting commercial and industrial businesses into an area which is in need of such developments.

Redevelopment benefits were computed for employment that would not be utilized in the absence of the project. These benefits were predicated on the use of local unskilled labor during construction of the proposed project and were discounted for the evaluation period. The redevelopment benefits from employment in the operation and maintenance phase of the project were also considered as project benefits. These benefits were limited to 20 years and prorated for the evaluation period.

Secondary benefits such as business expansion, improved wages, and increased tax base are local in nature and not necessary for project justification. These benefits were not specifically evaluated; nevertheless, they do improve the local economy. Secondary benefits were considered to be a token 10 percent of the direct primary benefits.

Land Treatment

The land treatment program was developed by the Soil Conservation Service, and the U. S. Forest Service, with assistance from the Washington County Soil and Water Conservation District, the Agricultural Stabilization and Conservation Service, and the Pennsylvania Department of Environmental Resources. Basic data used to compile this program were developed from information on file at the Soil Conservation Service's office in Washington County, and Forest Service field data.

Conservation plans for landowners and operators were studied to determine interest in applying treatment, patterns of land use, land capability class, and conservation treatment needs. As a result, all lands were arranged by categories with similar land capability and conservation treatment needs. By categorizing all the land, it was possible to determine the total land treatment needs.

Knowing total needs and the desire of landowners to install conservation practices, this program was developed. It is reasonable to expect these measures will be installed during the installation period. Lands used for the county park at PA-661 are not included in the land treatment program. All developments on these lands will contain soil and water conservation practices as an integral part of their engineering and construction.

Fish and Wildlife

Preliminary investigations were made of the streams and the surrounding lands at each of the proposed structures to determine what effects they may have on the fish and wildlife resources. These studies were made by the Service Field Biologist and District Conservationist. Their findings were verified and supplemented by the local representatives of the Pennsylvania Game Commission and the Pennsylvania Fish Commission.

The streams are shallow, slow moving and warm. Cover is poor and streambank erosion is critical. None of the streams has a significant fishery in the area of the proposed impoundments, but the water quality appeared to be good with a pH of 6.8. More than 95 percent of the land area that will be affected by the permanent pools is grassland pasture.

Based on these facts, the creation of the floodwater retarding structures at the proposed sites appears to have no adverse effects on fish and wildlife resources. In fact, the reservoir created by PA-660, PA-661, and PA-662 should produce good warm water fisheries while the land treatment practices should improve the habitat for all species of wildlife in the watershed.

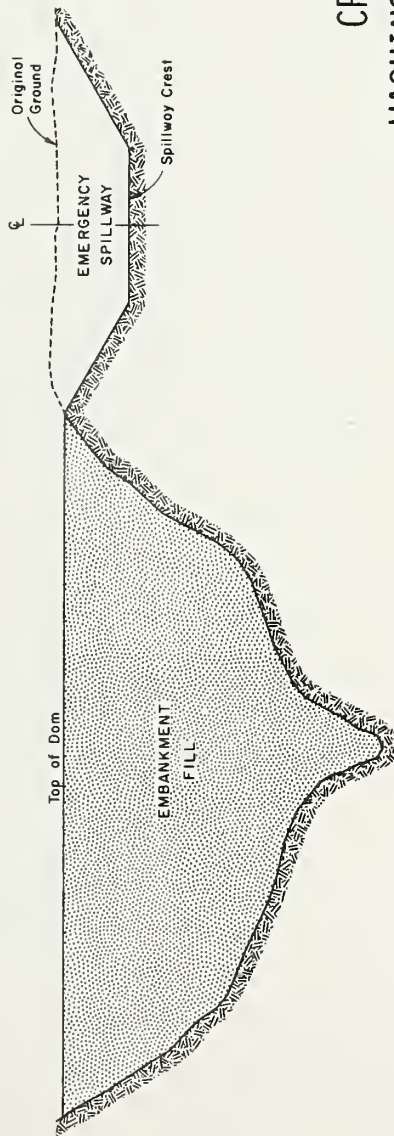
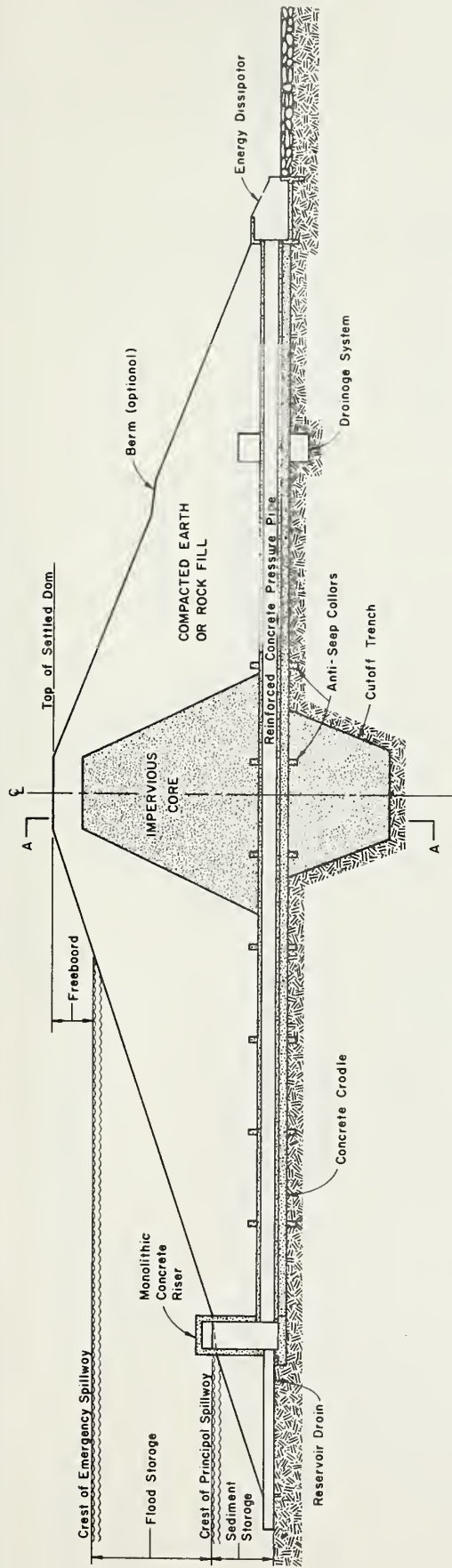
Recreation

A private consulting firm, George R. Kemp and Associates, Inc., was retained by the sponsors to plan the recreational facilities at PA-661. Guidance and consultation were also provided by Soil Conservation Service. Park facilities were designed using the criteria set forth in the Pennsylvania Technical Guide, "Planning Criteria for Recreation Enterprises." Reference was also made to the Public Health Service Publication No. 1195, "Environmental Health Practice in Recreational Areas," and the Pennsylvania Department of Health's "Minimum Standards for Sanitary Facilities in Organized Camps, Campgrounds, and Picnic Areas."

All of the land surrounding the reservoir was classified for its suitability for recreational developments according to soils criteria established by the Soil Conservation Service. Based on soils criteria, the land area considered for the first stage of the recreation development was classified as suitable for recreation or park development.

To insure a high degree of cooperation with state and other federal agencies, the Soil Conservation Service coordinated this study with the State-Wide Outdoor Recreation Plan. The Department of Environmental Resources' section of the state-wide plan was published in "Outdoor Recreation Horizons." It is the purpose of this book to serve as a working guide for cooperating agencies and the private sector in providing excellence in outdoor recreation opportunity for Pennsylvanians and out-of-state visitors.





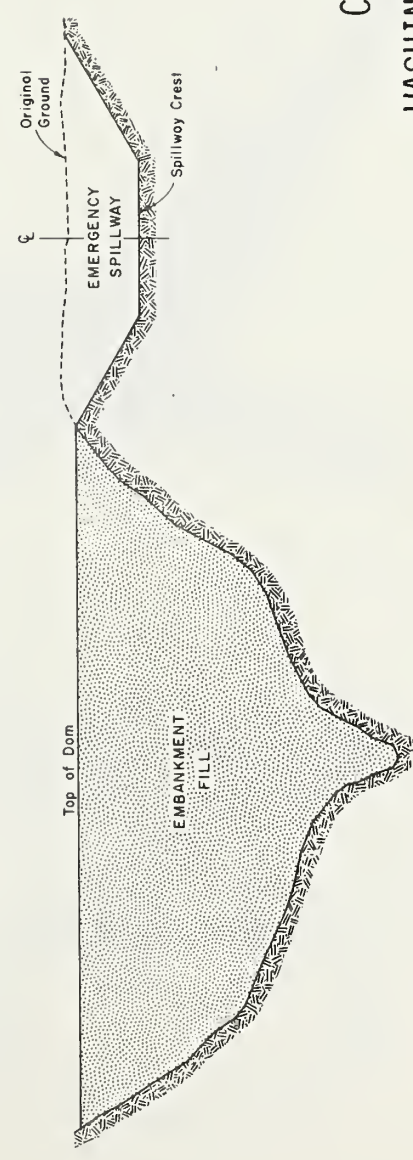
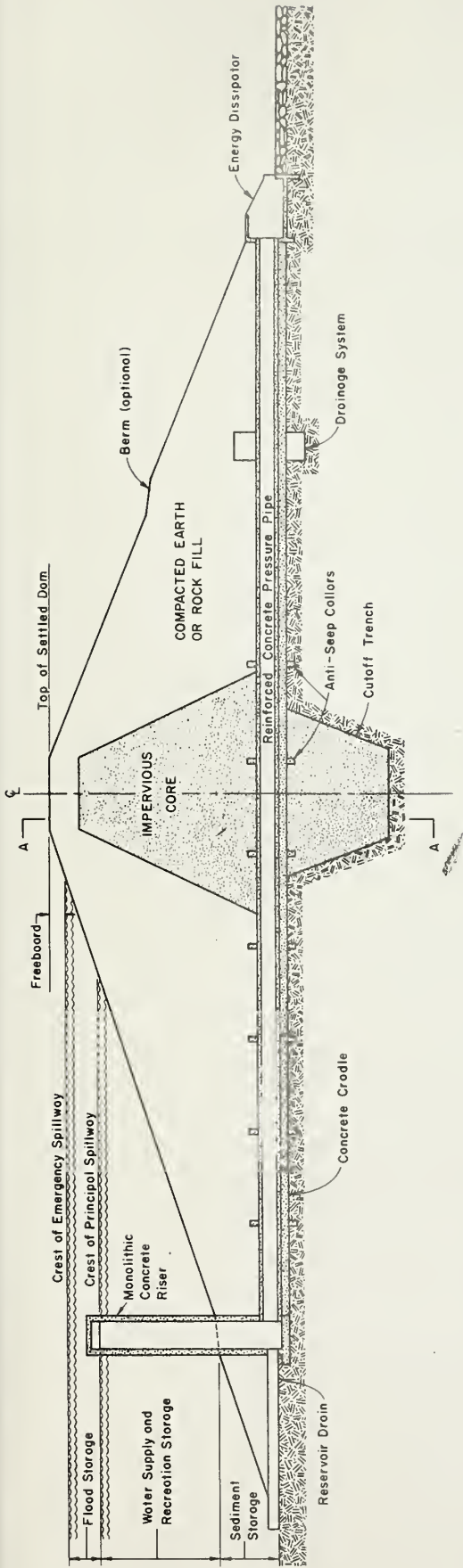
CROSS CREEK WATERSHED WASHINGTON COUNTY, PENNSYLVANIA

SECTION A-A

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FIGURE 1-A

TYPICAL CROSS SECTIONS OF FLOODWATER RETARDING STRUCTURE
ALONG PRINCIPAL AND EMERGENCY SPILLWAYS



SECTION A-A

**CROSS CREEK WATERSHED
WASHINGTON COUNTY, PENNSYLVANIA**

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

FIGURE 1-B
TYPICAL CROSS SECTIONS OF MULTIPLE PURPOSE STRUCTURE
ALONG PRINCIPAL AND EMERGENCY SPILLWAYS



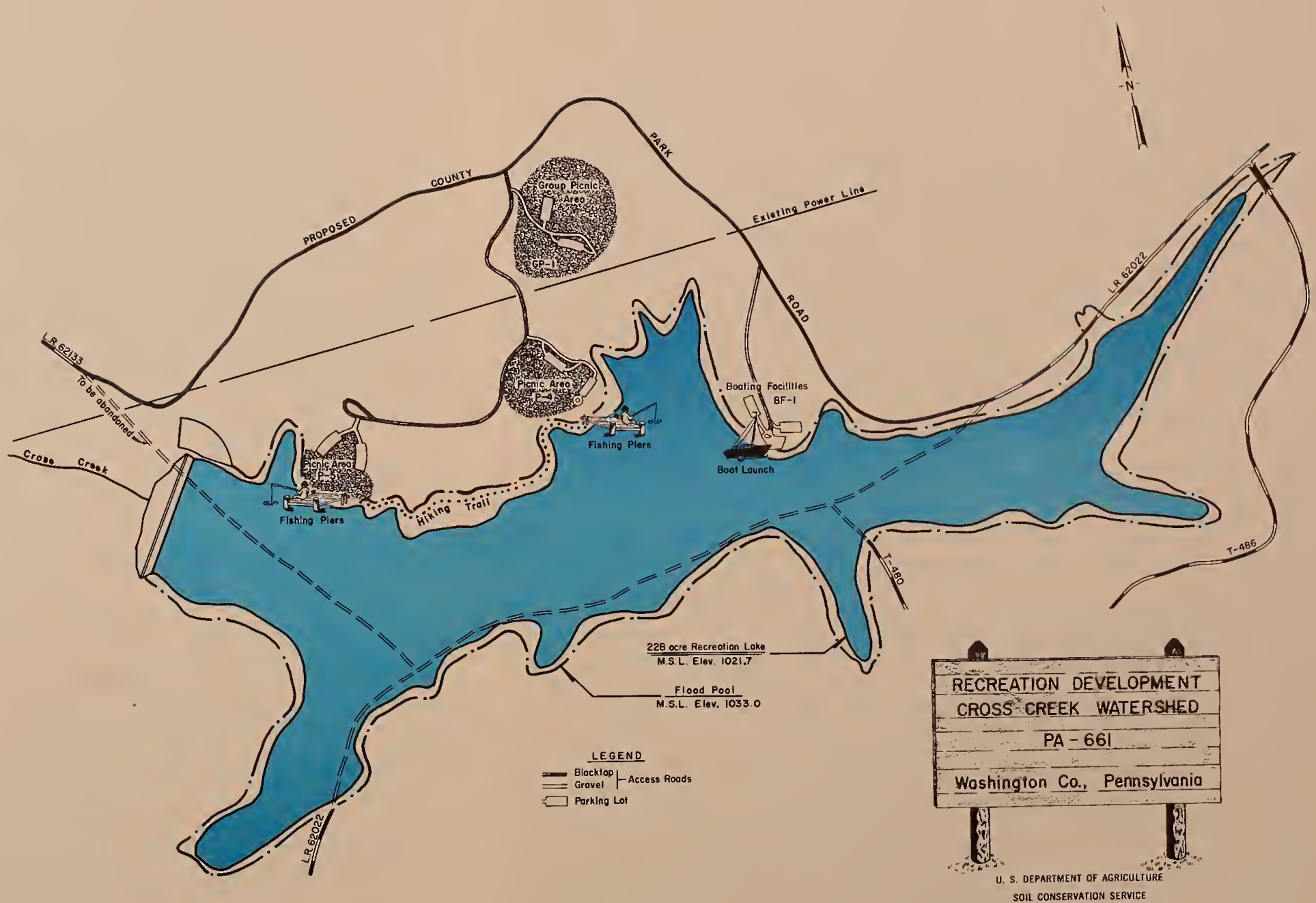
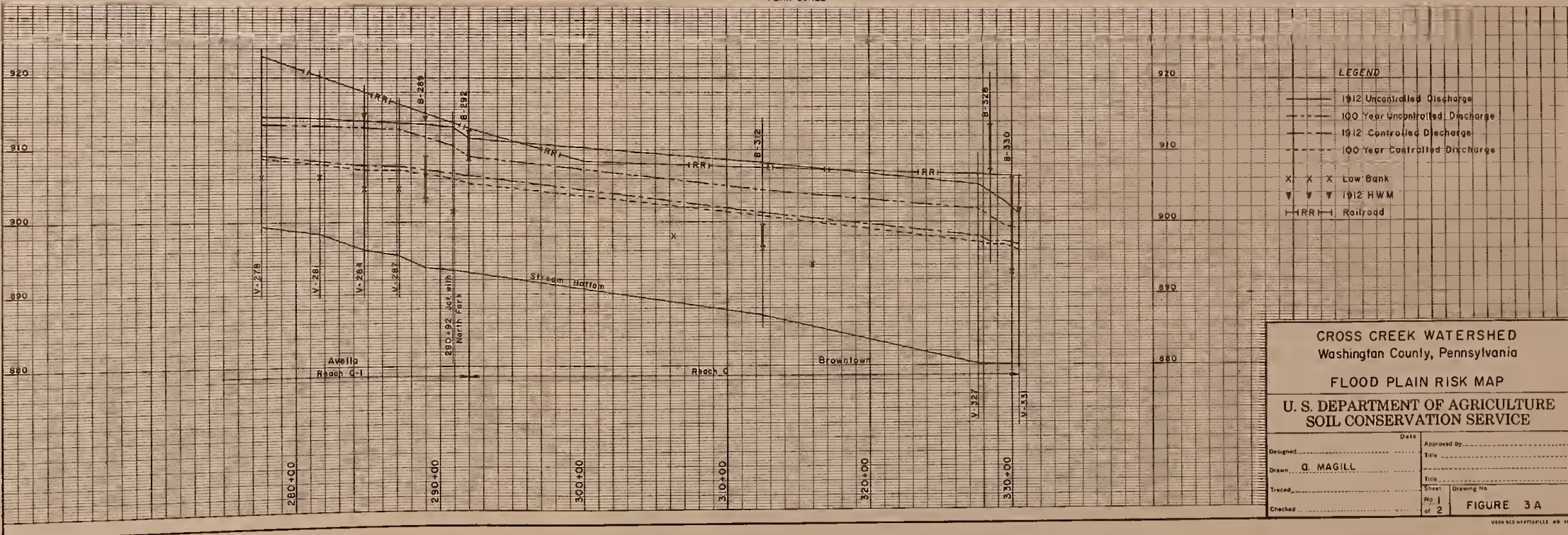


Figure 2





0 200 400 800 FEET
PLAN SCALE



- LEGEND**
- 1912 Uncontrolled Discharge
 - - - 100 Year Uncontrolled Discharge
 - - - 1912 Controlled Discharge
 - - - 100 Year Controlled Discharge
 - X X X Low Bank
 - ▼ ▼ ▼ 1912 HWM
 - RR- Railroad

CROSS CREEK WATERSHED
Washington County, Pennsylvania

FLOOD PLAIN RISK MAP

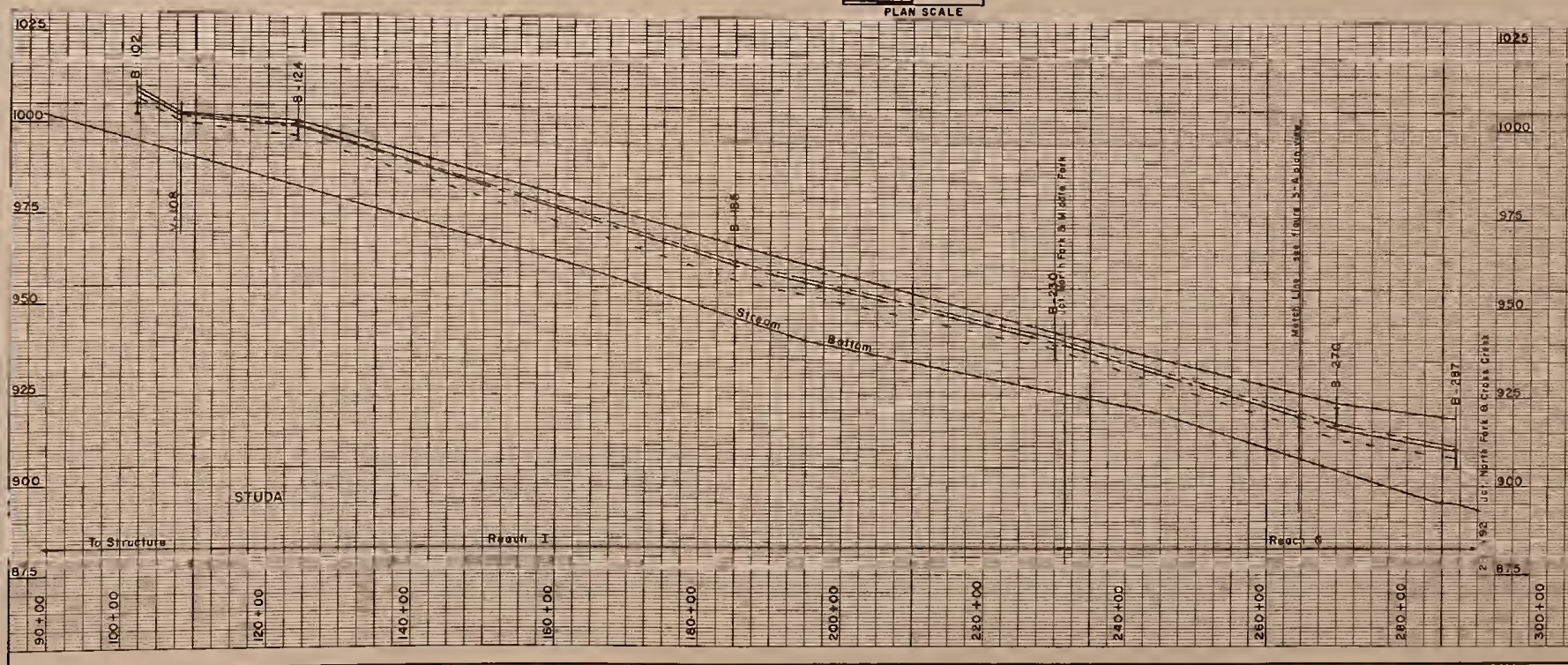
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SOIL CONSERVATION SERVICE

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Drawn Q. MAGILL	Title.....
Traced.....	Sheet No. 1	Drawing No.
Checked.....	of 2	FIGURE 3 A





0 200 400 600 FEET
PLAN SCALE



LEGEND

- 1912 Uncontrolled Discharge
- - - 100 Year Uncontrolled Discharge
- · · 1912 Controlled Discharge
- · - 100 Year Controlled Discharge

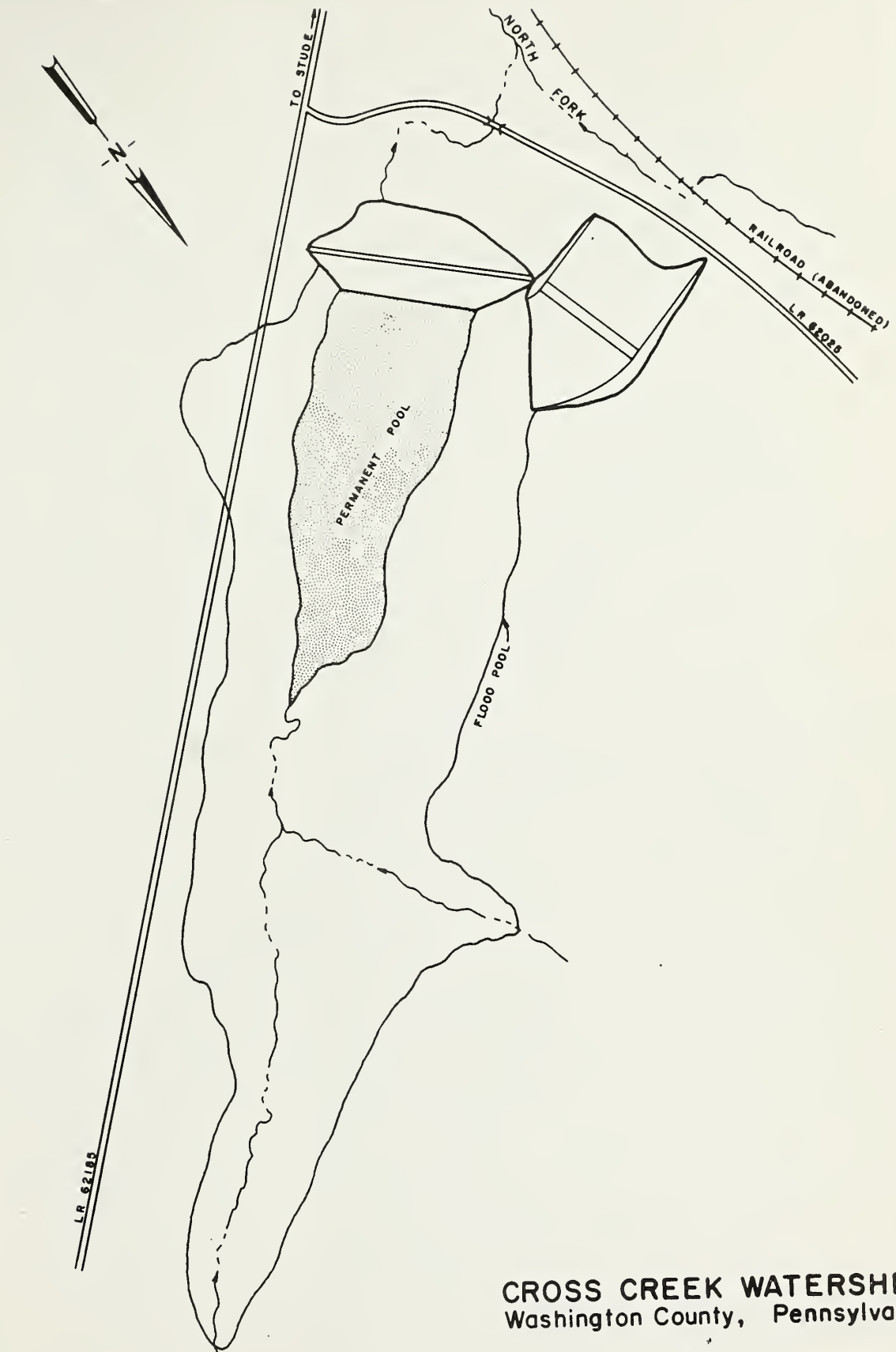
CROSS CREEK WATERSHED
Washington County, Pennsylvania

FLOOD PLAIN RISK MAP

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

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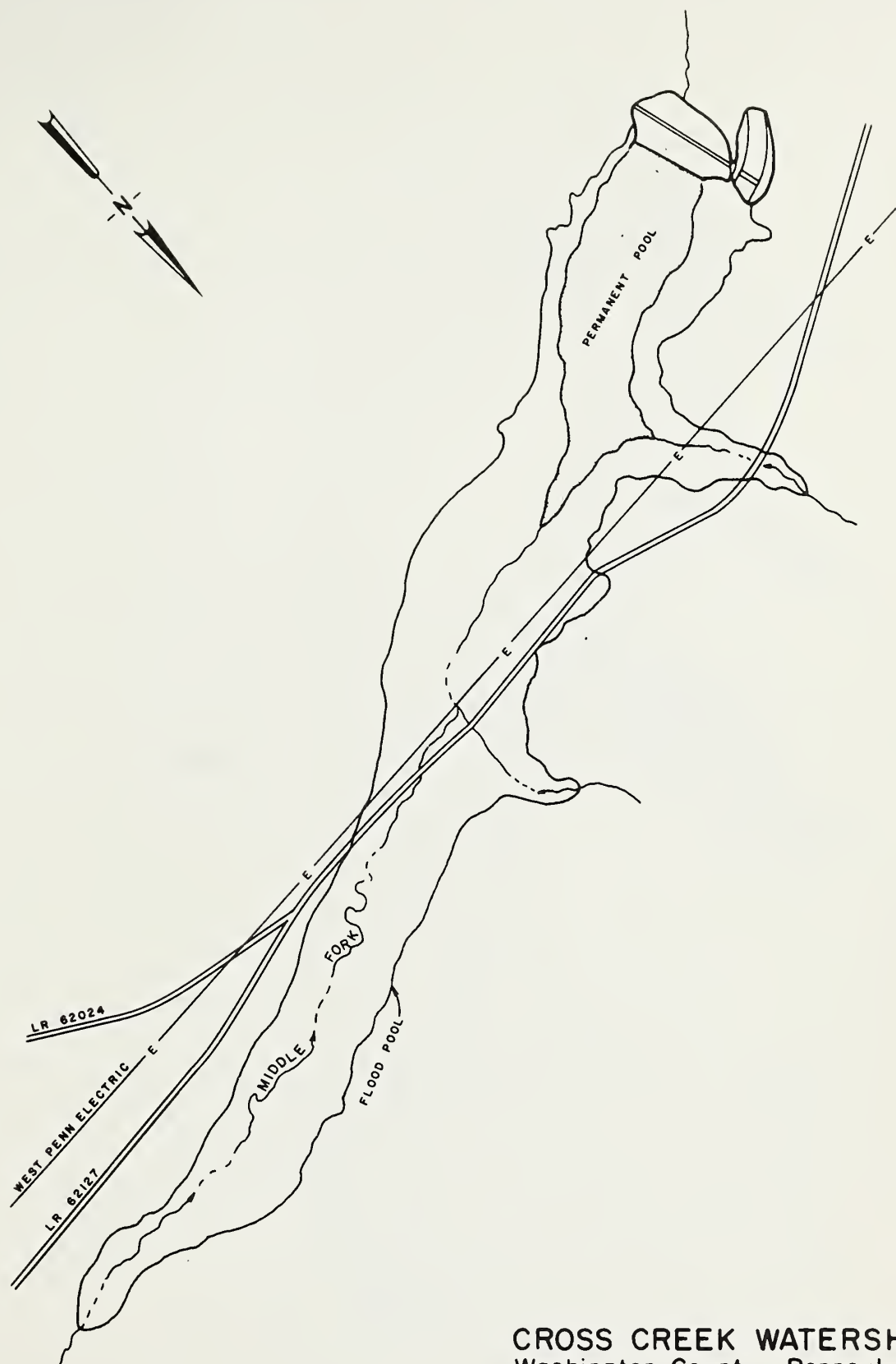
CROSS CREEK WATERSHED
Washington County, Pennsylvania

SITE LOCATION MAP
PA-659-F

FIGURE 4A

400 200 0 400
SCALE in FEET

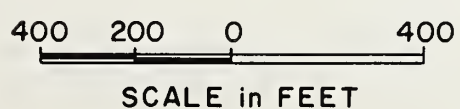


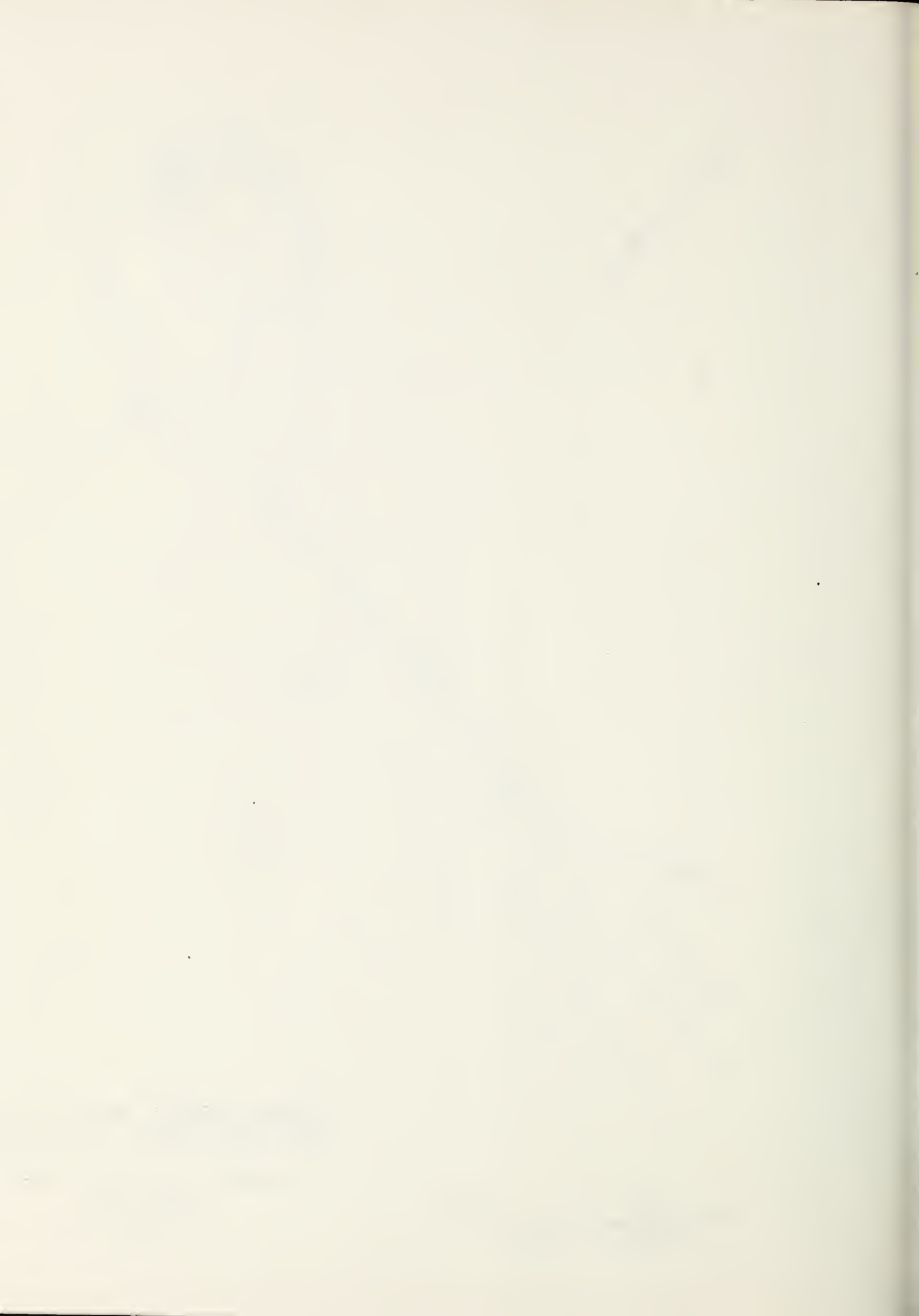


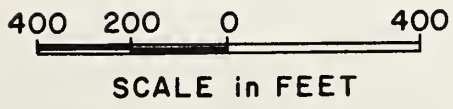
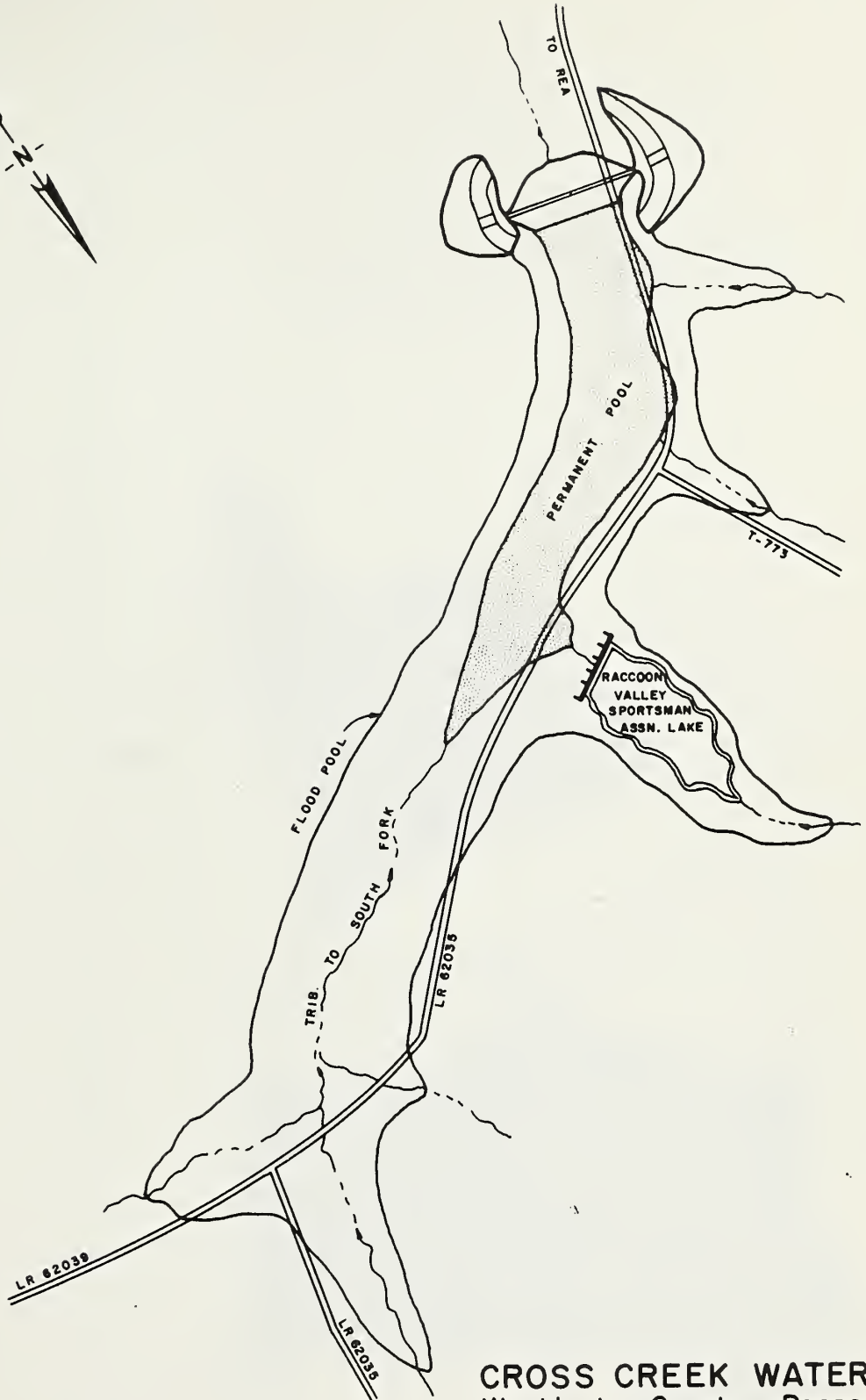
CROSS CREEK WATERSHED
Washington County, Pennsylvania

SITE LOCATION MAP
PA-660

FIGURE 4 B







CROSS CREEK WATERSHED
Washington County, Pennsylvania

SITE LOCATION MAP
PA-662

FIGURE 4 C



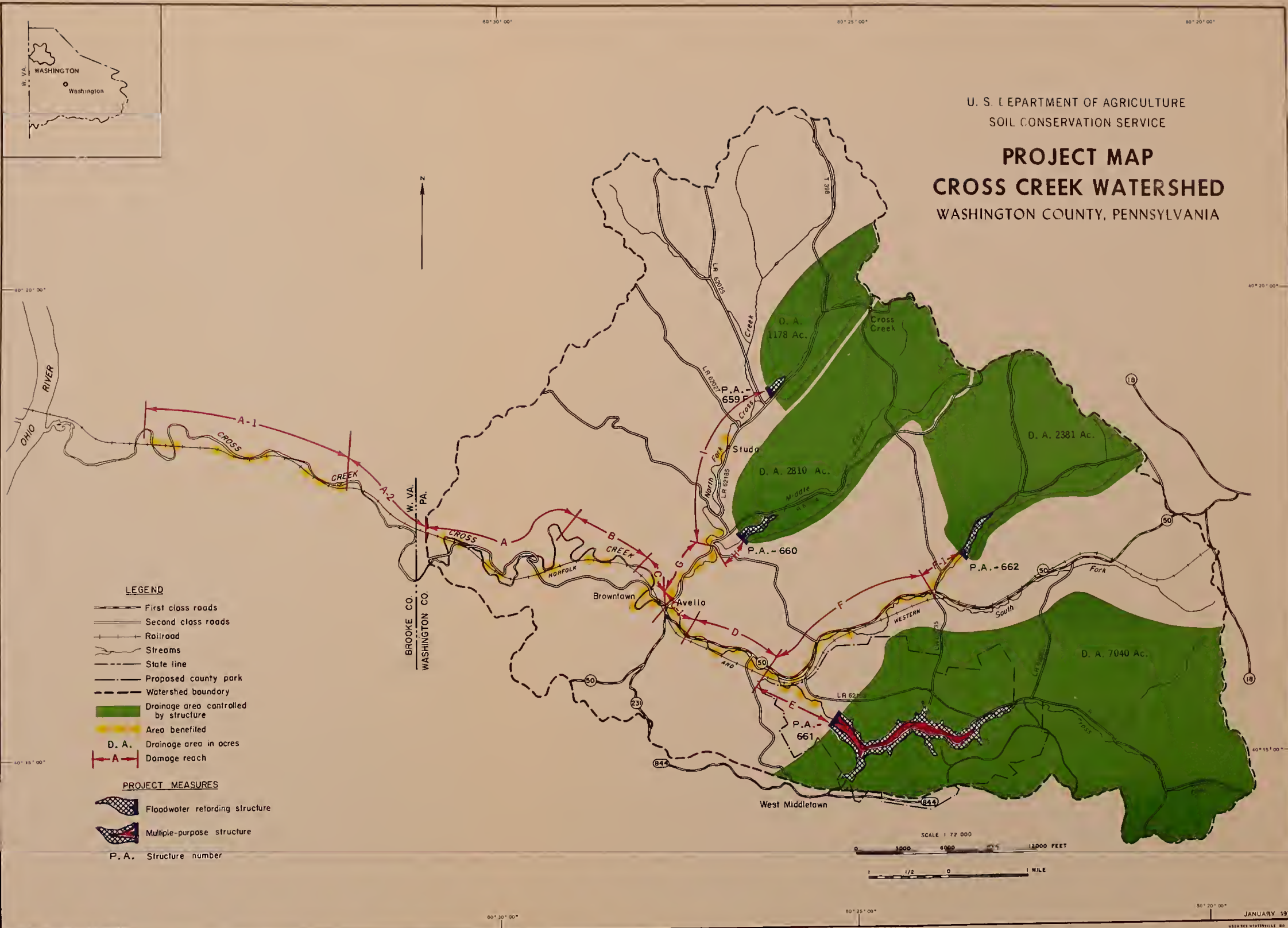


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP

CROSS CREEK WATERSHED

WASHINGTON COUNTY, PENNSYLVANIA



LEGEND

- First class roads
- Second class roads
- Railroad
- Streams
- State line
- Proposed county park
- Watershed boundary
- Drainage area controlled by structure
- Area benefited
- D. A. Drainage area in acres
- Damage reach

PROJECT MEASURES

- Floodwater reordering structure
- Multiple-purpose structure
- P. A. Structure number

