



**US Army Corps  
of Engineers** ®  
Pittsburgh District

# Stonewall Jackson Lake

## General Design Memorandum Volume 1

January 1971

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STONEWALL JACKSON LAKE  
WEST FORK RIVER, WEST VIRGINIA

DESIGN MEMORANDUM NO. 1  
GENERAL DESIGN MEMORANDUM

U. S. Army Engineer District, Pittsburgh  
Corps of Engineers  
Pittsburgh, Pennsylvania 15222  
January 1971

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GENERAL DESIGN MEMORANDUM

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 WEST FORK RIVER, WEST VIRGINIA  
 GENERAL DESIGN MEMORANDUM  
 SECTION I - PERTINENT DATA

1. Project Location. - West Fork River, above Weston, W. Va.
2. Drainage Area. - 102 square miles
3. Features of the Reservoir. -

a. Pool Elevations and Areas:

	<u>Elevation, m.s.l.</u>	<u>Area, acres</u>
Reservoir full	1082.0	3,470
Maximum summer conservation pool	1073.2	2,650
Maximum winter conservation pool	1063.2	2,150
Permanent pool	1038.5	380

b. Reservoir Storage:

	<u>Storage, acre-feet</u>	<u>Runoff, inch</u>
Gross	74,650	13.7
Flood control, summer, minimum	26,480	4.9
Flood control, winter, minimum	38,550	7.1
Maximum summer conservation storage	45,050	8.3
Permanent storage	3,120	0.5

4. Features of Dam, Spillway and Outlet Works and Stilling Basin. -

a. Dam:

Type	Concrete gravity
Control	Low level and water quality sluices
Total length, feet	620
Length of left abutment, feet	319
Length of right abutment, feet	184
Elevation at the top, m.s.l.	1102
Elevation of streambed, m.s.l.	1007
Height of dam above streambed, feet	95

b. Spillway:

Type	Uncontrolled
Crest elevation of ogee weir, m.s.l.	1082
Length, feet	117
Width of piers, feet	4
Effective length, feet	105
Design flood discharge capacity, c.f.s.	27,800
Elevation of spillway design flood in reservoir, m.s.l.	1098.2
Elevation of standard project flood in reservoir, m.s.l.	1086.48

c. Outlet Works:

Number of sluices, low level	3
Number of sluices, water quality control	2
Size of low level sluices	3.5' x 7.0'
Invert of low level sluices, m.s.l.	1014.0
Size of water quality control sluice	3.0' x 2.0'
Invert of water quality control sluice, m.s.l.	1018.0

d. Stilling Basin:

Length, feet	75
Width, feet	117
Elevation, floor, m.s.l.	1008.0
Elevation, top of end sill, m.s.l.	1012.0
Elevation, top of training wall, m.s.l.	1030.0

5. Cost Estimates. -

a. First Cost:

Land and Damages	\$ 8,370,000
Relocations	29,500,000
Reservoir	691,000
Dam and Appurtenances	3,580,000
Service Roads	295,000
Public Use Facilities (Initial)	7,980,000
Buildings, grounds, and utilities	999,000
Permanent Operating Equipment	133,000

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Engineering and Design	\$ 4,048,000
Supervision and Administration	<u>3,668,000</u>
Subtotal	\$64,264,000
Future Public Use Facilities	\$ 8,240,000
Total First Cost	<u>\$72,504,000 *</u>
Total First Cost, rounded	\$72,500,000

\* Does not include \$155,000 cost of pre-authorization studies.

b. Investment

Initial First Cost	\$64,300,000
Interest During Construction	<u>5,870,000</u>
Initial Investment	\$70,170,000
Future Public Use Investment	<u>8,240,000</u>
Total Federal Gross Investment	\$78,410,000

c. Average Annual Charges:

Interest on Investment, 3.250%	\$ 2,415,000
Amortization, (100-year life), 0.138%	103,000
Operation and Maintenance	380,000
Major Replacements	101,000
Adjustment for Net Loss of Productivity on Land	<u>35,000</u>
Total Average Annual Charges	\$ 3,034,000

6. Average Annual Benefits.

	<u>National Account</u>	<u>Regional Account</u>
Flood Control	\$1,388,000	\$1,388,000
Water Quality Control	1,302,000	1,302,000
Water Supply	79,000	79,000
Recreation	1,128,000	1,128,000
Fish and Wildlife	<u>45,000</u>	<u>45,000</u>
Subtotal	\$3,942,000	\$3,942,000
Expansion		
Redevelopment	297,000	625,000
Development	<u>0</u>	<u>0</u>
Total Average Annual Benefits	\$4,239,000	\$4,567,000

	<u>National Account</u>	<u>Regional Account</u>
7. <u>Economic Evaluation.</u> -		
a. Ratio, benefits to charges without redevelopment benefits	1.30	1.30
b. Ratio, benefits to charges with redevelopment benefits	1.40	1.51

## SECTION II - PROJECT AUTHORIZATION

8. Authorizing Act. - The project for flood protection, water quality control, water supply and recreation in the West Fork River Basin in West Virginia was authorized by Section 203, Title II--Flood Control, of the Flood Control Act of 1966, Public Law 89-739, 89th Congress, Second Session, approved 7 November 1966, which provides as follows:

### "TITLE II - FLOOD CONTROL"

SEC. 203. The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and the supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements. Penstocks and similar facilities adapted to possible future use in the development of hydroelectric power shall be installed in any dam authorized in this Act for construction by the Department of the Army when approved by the Secretary of the Army on the recommendation of the Chief of Engineers and the Federal Power Commission.

### "OHIO RIVER BASIN"

"The project for Stonewall Jackson Reservoir, West Fork River, West Virginia, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers, in Senate Document Numbered 109, Eighty-ninth Congress, at an estimated cost of \$34,500,000."

9. The authorized project for Stonewall Jackson Reservoir, West Fork River, West Virginia, is hereafter referred to as Stonewall Jackson Lake in accordance with Public Law 90-46. The project is subject to the requirement that responsible local interests furnish assurances satisfactory to the Secretary of the Army that they provide local cooperation as follows:

(1) Make arrangements for repayment, under the provisions of the Water Supply Act of 1956, as amended, of that part of the construction cost and annual operation, maintenance, and replacement costs

allocated to water supply (municipal and industrial), presently estimated at \$726,000 for construction and \$3,000 annually for operation, maintenance, and replacements;

(2) In accordance with the Federal Water Project Recreation Act of 1965, Public Law 89-72:

(a) Administer project land and water areas for recreation and fish and wildlife enhancement;

(b) Pay, contribute in kind, or repay with interest, one-half of the initial separable first cost of the reservoir project allocated to recreation and fish and wildlife enhancement, an amount presently estimated at \$4,885,000.

(c) Pay or contribute in kind one-half of the separable first cost of future development for recreation and fish and wildlife enhancement. This one-half share is currently estimated to be \$4,120,000.

(d) Bear responsibility for operation, maintenance, and replacement of all facilities developed to support project recreation and fish and wildlife opportunities.

(3) Exercise to the full extent of their legal capability, control against removal of streamflow made available for water quality control; and

(4) Contribute to the control of pollution of streams subject to low-flow augmentation by adequate treatment or other methods of controlling wastes at their source.

10. Authority for the Design Memorandum. This report is submitted in conformity with Advice of Allotment No. C-510, dated 13 December 1967, from the Office, Chief of Engineers to the District Engineer, U. S. Army Engineer District, Pittsburgh, Appropriation 96 x 3122, Construction, General, Corps of Engineers, Civil, which included \$375,000 for initiation of pre-construction planning of the Stonewall Jackson Lake project.

### SECTION III - INVESTIGATIONS

11. Project Document. - Senate Document No. 109, 89th Congress, 2nd Session, is the basis for the West Fork River Basin, West Virginia, legislative action and is the project document. The Review of Reports on West Fork River and Tributaries, West Virginia, recommended revoking the reservoir project located on the West Fork River between Clarksburg and Weston, West Virginia, as authorized in the Flood Control Act of June 1936 and substituting in its place a multiple purpose project to include a concrete dam with uncontrolled spillway located at Brownsville on the West Fork River to create the Stonewall Jackson Lake.

12. Surveys, Studies and Planning. - For this report, advantage has been taken of field investigations and office studies made in conjunction with Senate Document 109, 89th Congress. Investigations have been made of possible reservoir sites throughout the West Fork River system. Of the 17 potential sites investigated, comparison of the engineering features and economic aspects indicated that the Brownsville site was more adaptable to multiple purpose use. Hydrologic, hydraulic, relocation, real estate, design and cost estimate studies at the Brownsville site were made in 1962 in conjunction with the authorizing document. Since authorization, studies on these different aspects of the project have been continuing towards developing a more desirable solution to the project needs. A public hearing was held by the District Engineer, U. S. Army Engineer District, Pittsburgh, at Clarksburg, West Virginia on 2 December 1964. There was virtually complete agreement among those present that flood control, water supply and water quality control, as well as recreational opportunities, were necessary for the area. There were few objections by affected land owners to the project. Topographic surveys were made of the dam site at Brownsville in July 1947, in March 1963 and again in March 1968 where mapping was obtained to a scale of 1 to 1,200. Topographic information for the remaining portion of the project area was obtained from aerial photographs exposed in October 1968 to a scale of 1 to 2,400 with five-foot contour intervals, supplemented by 1 to 24,000 scale U. S. Geological Survey quadrangle maps with 20-foot contour intervals. More detailed hydrologic, hydraulic and design studies were made to determine the features of the reservoir and dam. Highway and utility relocations have been planned with the cooperation of the operating agencies. A property valuation survey was made of the reservoir and dam site areas. Federal and non-Federal agencies concerned with the proposed Stonewall Jackson Lake have been contacted and the recommendations or comments of these agencies, if available, are incorporated in this memorandum.

#### SECTION IV - NON-FEDERAL COOPERATION

13. Non-Federal Cooperation Required.- The benefits from flood control and water quality control would be so widespread throughout the Monongahela and Ohio River basins that specific allocations to communities and industries were not made. Based on current laws, all costs of the project allocated to water quality control and flood control are considered as nonreimbursable and will be borne by the Federal Government. However, in accordance with the provisions of the Water Supply Act of 1958, as amended, costs which are allocated to water supply are to be repaid by the local interests to the United States. The current estimated costs to be repaid to the United States by the City of Weston is \$726,000 plus \$3,000 annually for operation and maintenance. (Water supply storage for the City of Clarksburg has been deleted from the project). An analysis of this segment of the project, derivation of costs and resolutions of local agencies can be found in Appendix XII, Water Supply. Also, in accordance with the Federal Water Project Recreation Act of 1965, the State of West Virginia is required to pay, contribute in kind, or repay with interest, one-half of the initial separable costs of the project allocated to recreation and fish and wildlife enhancement, the amount involved currently being estimated at \$4,885,000 ; and pay or contribute in kind one-half of the future separable first cost of future development for recreation and wildlife enhancement currently estimated to be \$ 4,120,000. Additionally, the State is required to administer project lands and water for recreation and fish and wildlife enhancement and bear the responsibility for operation, maintenance and replacement of all facilities developed to support project recreation and fish and wildlife opportunities.

14. Views of Non-Federal Interests.- The concensus of non-Federal opinion in the West Fork and Monongahela River basins is favorable toward the Stonewall Jackson Lake especially in the upper Monongahela River valley and the West Fork River valley where benefits would result from the control of flood waters and water for water supply and to augment the river flow during periods of low water. There was virtually complete agreement among non-Federal interests during the public hearing that flood control, water supply, water quality control and recreation developments were necessary for the area. Scattered opposition has arisen from individuals protesting the acquisition of their home sites or the homes of relatives that are located within the project area.

15. Responsible Local Officials.- The representatives of governing bodies and agencies responsible for fulfillment of the requirements of local cooperation (water supply and recreation) are as follows:

<u>Name</u>	<u>Title</u>	<u>Representing</u>
Joseph E. Craft	Mayor	City of Weston
Ray E. Myers	Mayor	City of Clarksburg
James Boyce	President	Harrison County Court
Everett W. Allen	President	Clarksburg Water Board
Ira S. Latimer, Jr.	Director	W. Va. Dept. of Natural Resources
Arch A. Moore, Jr.	Governor	State of West Virginia

## SECTION V - LOCATION OF PROJECT AND TRIBUTARY AREA

16. Location of Project Works. - The project is situated in the West Fork River basin reaching from Brownsville, West Virginia, to Walkersville, West Virginia. The dam site is located on the West Fork River at Brownsville, Lewis County, West Virginia, at a point 73 miles upstream from Fairmont, West Virginia, where it joins the Tygart River to form the Monongahela River. The location of the project in relation to Pittsburgh and to the West Fork River Basin is shown on Plate 1. A general map of the Stonewall Jackson Lake area is shown on Plate 2.

17. Project Area. - The project lies in Lewis County, West Virginia. The surface area of the lake at full pool elevation 1082 m.s.l. would be 3,470 acres. Filled to this level the steep valley hillsides and flat valley would form a narrow lake about 0.2 mile wide and 21 miles long, along the main stream. The area is serviced by U. S. Route 19 and numerous State roads. Utilities in the lake area consist of electric, telephone and gas lines. The population within the area is generally rural with small concentrations at Roanoke, Vandalia, Brownsville, and Walkersville. The number of persons expected to be displaced by development of the project is estimated at approximately 900. Since the majority of these persons are from rural homesites and prefer this type of environment, it is expected that they will relocate primarily within Lewis County just beyond the limits of Federal acquisition and should not, therefore, materially reduce the County population figures.

18. Tributary Drainage Area. - The drainage area of the watershed for the reservoir would be 102 square miles, composed of 33.05 square miles drained by Skin Creek, 12.33 square miles drained by Sand Fork, and 56.62 square miles drained by smaller tributaries to the West Fork River between the Brownsville and Ireland communities. The watershed is contained (almost) entirely within Lewis County in central West Virginia with its southeastern tip reaching into Upshur County. The land is principally used for small farming, strip and auger coal mining, and limestone, clay and building stone production. Roanoke, with a population of about 100, is the largest community in the basin above the dam site.

19. Areas Protected from Floods. - Operation of the Stonewall Jackson Lake for flood control would primarily benefit the West Fork River valley and the upper Monongahela River valley which includes the flood plain and backwater areas of the Monongahela River from Locks and Dam 4 to Fairmont, West Virginia. Its effect on the more downstream damage districts would be tangible but, in comparison, slight.

20. Water Supply. - Existing discharges of the West Fork River are sufficient for existing and future water supply requirements for communities obtaining water from the West Fork River, except for Weston and Clarksburg. Operation of the Stonewall Jackson project would supply an additional

source of water to meet existing demands of the Weston area during periods of drought. Both the Weston and Clarksburg areas estimated future water supply demands to the year 2010 will also be met by this water supply storage.

21. Water Quality. - The water of the West Fork River above Weston is of relatively good quality. The largest waste sources in the West Fork River basin occur in the Weston, Clarksburg and Fairmont areas. Other population centers along the river and its tributaries also contribute substantial waste loads. Organic wastes entering the river greatly exceed the capacity of the stream to absorb such wastes without serious damage to water quality during critical low-flow periods. The river below Clarksburg becomes increasingly acid, and sulphate hardness is increased as a result of acid mine wastes discharged into the drainage system. Consequently, improvement of water quality by storage of good quality water in the Stonewall Jackson Lake for low-flow regulation would be beneficial to points downstream on the West Fork River, the Monongahela River throughout its length, and, to a minor extent, locations on the upper Ohio River. Water quality is covered in detail in Appendix IV, Reservoir Regulation.

#### SECTION VI - PROJECT PLAN

22. Most Feasible Plan of Improvement. - The most feasible plan for development of the authorized West Fork River basin project consists of the multiple purpose Stonewall Jackson Lake with a total capacity of 74,650 acre-feet. The lake will be created by a concrete-gravity dam approximately 620 feet long and 95 feet high. The dam will be located at Brownsville, Lewis County, West Virginia. The permanent pool would contain storage equal to 3,120 acre-feet. Operation of the project will be conducted by discharging through three low-level sluices and two water quality sluices in a manner which will provide maximum benefits to flood control, water supply, water quality control and recreation.

23. Plates Accompanying the Memorandum. - The following plates accompany this memorandum:

<u>Title</u>	<u>Plate</u>
Basin Map	1
Project Area	2
General Plan	3
Dam Plan, Elevation and Sections	4
Detailed Project Schedule (PB-2A)	5

24. Exhibits Accompanying the Memorandum. - The exhibits resulting from interagency coordination and accompanying this memorandum are as follows:

#### Exhibit

A

State of West Virginia

## SECTION VII - DEPARTURES FROM PROJECT DOCUMENT PLAN

25. Departures from Project Document Plan. - The project document is Senate Document No. 109, 89th Congress, 2d Session, which describes the features of the project as conceived in the preauthorization stage. Studies for this memorandum indicate the necessity of revising the plan outlined in the authorizing document as follows:

a. The proposed alignment for relocated West Virginia State Route 30 from the dam site to the intersection with West Virginia State Route 30/7 represents a change from the project document plan. The alignment contained in the authorizing document would have resulted in steep side hill cuts and fills to achieve an acceptable alignment and further scarring of the existing landscape in the vicinity of the dam structure and major public access (overlook) area. By beginning the Route 30 relocation downstream of the dam and following an alignment up the Washburn Run valley it was possible to provide a more controllable access to the dam site area and take advantage of a gradually increasing slope to the ridge before Route 30/7 thus minimizing embankment costs.

b. The proposed plan for public-use development presented herein represents a major departure from the project document plan. Since authorization, increased emphasis has been placed upon meeting the tremendous mounting demand for public-use facilities for an increasingly affluent society. Camping and its related activities have become one of the fastest expanding industries in the nation. To meet this demand, all agencies involved in this new industry have had to review and update their master plans to better accommodate the heavy influx of leisure time adventurers. For this very reason, it was felt that a new analysis of the expected visitation should be conducted to determine if the project document adequately provided for this demand. To evaluate this particular phase of the project, procedures outlined in Technical Report No. 2, Plan Formulation and Evaluation Studies - Recreation, Estimating Initial Reservoir Recreation Use, October 1969, were used as a guide. As explained in Appendix XI of this memorandum, this particular study indicated an expected visitation from within the market area of 1,450,000 recreation days annually with full development of facilities for primary recreation activities, such as camping, fishing, picnicking, swimming, boating, sightseeing and hunting. Development of these facilities is in accordance with the West Virginia Statewide Outdoor Recreation Plan. The State of West Virginia also plans to develop facilities to accommodate the more sophisticated vacationer. Because they could not be provided under present cost-sharing regulations, the cooperating agency alone would construct these facilities on project lands. The facilities in this category include a golf course, clubhouse, restaurant, snack bar, tennis courts, outdoor games area, indoor recreation center and other related facilities. An additional 100,000 annual visitors above the 1,450,000 given above would be attracted by these facilities.

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c. The increased land acquisition presented in this memorandum represents a substantial departure from the project document plan. This increased acreage resulted from a detailed, more realistic analysis of topographic and property maps available and also an on-the-ground inspection of the proposed project boundary by real estate appraisers. The steep, rugged terrain adjoining the reservoir prohibits the development of a feasible access road network to a large portion of the lands adjoining the reservoir or buffer strip. Suitable access roads designed to State secondary standards average approximately \$300,000 per mile in the project area. In order to determine the amount of land requiring specific purchase for public-use purposes, an independent analysis of a project without this purpose was made. Planning personnel then estimated the additional acreage required to effectively develop the public-use program outlined in this memorandum.

#### SECTION VIII - HYDROLOGY

26. General. - Detailed hydrological studies to determine the reservoir design flood, standard project flood, spillway design flood, spillway width and freeboard are contained in Appendix III, Hydrology. In the derivation of the features for the design, sufficient actual runoff and precipitation data are available in the West Fork River basin for the development of the natural unit hydrographs.

27. Flood of Record. - The highest known flood of record on the West Fork River at the dam site in Brownsville occurred in June 1950 resulting in a flow of 6,420 c.f.s.

28. Flood Frequencies. - Flood flow frequency studies for the dam locality have been made for the West Fork River at Brownsville based on long-term records at Weston. The flood flow frequencies have been computed in accordance with ER 1110-2-1450 and OCE Civil Works Engineering Letter 63-5 with procedures set forth in the revised edition of "Statistical Methods in Hydrology," January 1962. The computations for determining the frequency curve and the graphical plotted positions based on Weston data are presented in Appendix III, Hydrology.

29. Major Storms. - The three major storms which caused the highest flooding in the West Fork River basin occurred in June 1950, March 1963, and March 1967. These storms are discussed in detail in Appendix III, Hydrology.

30. Natural Hydrographs. - The dam site natural unit hydrograph was developed from an incremental analysis of the Brownsville gage unit hydrograph. The inflow unit hydrograph for the reservoir was obtained by integration of the components used in the analysis of the natural unit hydrograph.

31. Reservoir Design Flood. - The reservoir design flood, in this case, is defined as the flood which the reservoir is designed to control under the adopted method for normal operation during the life of the project. The storm of 25 June 1950 over the Middle Island Creek and Leading Creek basins, about 15 miles northwest of the West Fork basin, was transposed over the Stonewall Jackson Lake drainage basin for development of the reservoir design flood. The storm was hypothetically arranged to closely duplicate the natural conditions most likely to occur to precipitate such a storm. Antecedent conditions were assumed whereby the reservoir would have been at elevation 1073.2 (summer pool) at the beginning of the design storm period.

32. Standard Project Flood. - The standard project flood is a flood that would be exceeded in magnitude only on very rare occasions. It is an estimated or hypothetical flood that might be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographic region excluding extraordinarily rare combinations. The standard project flood is somewhat less than the maximum probable flood and has been adopted as the flood which would be caused by a storm with rainfall as set forth in Civil Engineering Bulletin No. 52-8, Office of the Chief of Engineers, 26 March 1952, subject, "Standard Project Flood Determinations." It was assumed that the reservoir would be at summer pool elevation 1073.2 at the storm inception and under the adopted method of operations, and rise to a maximum storage elevation of 1087.1 feet above m.s.l. The maximum discharge from the reservoir would be 4,050 c.f.s.

33. Spillway Design Flood. - The computed Type IV storm resulted in the most critical storage and outflow conditions and has been adopted as the spillway design flood. The assumption with pool at elevation 1077.8, 50 percent of flood storage occupied at storm inception, would result in a maximum storage elevation of 1098.2 feet above mean sea level. The reservoir peak inflow for the flood is 85,500 c.f.s. with a maximum outflow of 27,800 c.f.s. The natural peak flow was computed to be 48,000 c.f.s.

#### SECTION IX - GEOLOGY

34. General Geology. - The Stonewall Jackson project site is located in the gently folded, highly dissected Kanawha section of the unglaciated Appalachian Plateaus. The dam site has been eroded through and into the basal portion of the Monongahela formation of the Pennsylvania system forming a narrow valley with a steep left bank and a sloping piedmont terrace on the right bank. The valley bottom soil is relatively thin ranging in thickness from five to 30 feet with the left abutment having only a thin cover over bedrock. The soil consists of lean clay and sandy silt with varying amounts of rock fragments. The strata of the abutments constitute interbedded siltstones, indurated clays, shales and sandstones. A report on the geology of the reservoir area and dam site is contained in Appendix V, Foundations and Materials Design.

35. Foundation Conditions. - The high monoliths of the gravity dam will be founded on siltstones and sandstones of acceptable thickness on the valley bottom. The excavation required to reach firm rock would range from 10 to 35 feet. In the abutments, the depth of rock to be excavated to reach firm rock would range up to 50 feet. The results of the investigations on foundation materials, foundation exploration borings are also included in Appendix V, Foundations and Materials Design.

#### SECTION X - OTHER PLANS CONSIDERED

36. Prior Reports. - House Document No. 306, 74th Congress, 1st Session, August 1935 recommended construction of the West Fork River Reservoir located between Clarksburg and Weston, West Virginia, on the West Fork River. Committee Document 1, 75th Congress, 1st Session, April 1937, submitted as a comprehensive flood control plan for the Ohio and lower Mississippi Rivers by the Chief of Engineers, reiterated the recommendation that the West Fork River Reservoir should be constructed. House Document 266, 78th Congress, 1st Session, August 1943, makes specific reference to this reservoir as a value to pollution abatement in the Monongahela River Basin and insuring an adequate water supply to the Clarksburg, West Virginia, area. Consideration was given to the construction of this project, but, due to local opposition, it was not initiated. On February 27, 1961, the project was reclassified from the deferred for restudy category to the inactive category. House Document 491, 83d Congress, 2d Session, August 1954, reviews a survey report by the District Engineer, Pittsburgh, Pennsylvania, dated 23 January 1948, in which it recommended the adoption of a project at Brownsville, West Virginia, for a reservoir (Stonewall Jackson Reservoir) that would utilize, more advantageously, the water resources of the West Fork River than would the authorized West Fork River Reservoir. These reports by the Department of the Army, as well as those not published, are tabulated as follows:

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Subject	Date	By	Where Published	Recommendation
Ohio River	14 August 1935	Chief of Engineers U. S. Army	House Document, 306 of 74th Congress, 1st Session, August 1935	Comprehensive basin plan for flood control
Comprehensive flood control plan for Ohio and lower Mississippi River	6 April 1937	Chief of Engineers U. S. Army	Committee Document 1 (Committee on Flood Control, House of Rep- sentatives) 75th Congress, 1st Session 1937	Favorable
Ohio River Pollution Control	27 August 1943	Ohio River Committee, Washington, D. C.	House Document 266 of 78th Congress, 1st Session, August 1943	Comprehensive plan for abatement of pollution of Ohio River and tribu- taries
Review of reports on the Monongahela River and West Fork River, from Lock and Dam 15 to Clarksburg, W. Va.	18 March 1946	District Engineer, Pittsburgh, Pa.	Not published	Unfavorable for extension of navigation
Report upon West Fork River and Tributaries W. Va. Multiple-Use Reservoirs	23 January 1948	District Engineer, Pittsburgh, Pa.	Not published	Favorable for single multi-purpc reservoir

Subject	Date	By	Where Published	Recommendation
Allegheny and Monongahela Rivers and Tributaries	7 October 1949	Chief of Engineers, Department of the Army	House Document 491 of 83d Congress, 2d Session, 1954	General
Report upon West Fork River and Tributaries W. Va. Multiple-Use Reservoirs	15 February 1955	District Engineer, Pittsburgh, Pa.	Not published	Favorable for single multi-purpose reservoir
West Fork River and Tributaries, W. Va.	30 September 1966	District Engineer, Pittsburgh, Pa.	Senate Document No. 109, 89th Congress, 2d Session	Construction of Stonewall Jackson Reservoir as multi-purpose reservoir

[REDACTED]

[REDACTED]

## SECTION XII - PROJECT FORMULATION AND EVALUATION

52. General. - During the course of pre-authorization studies, extensive evaluations were made of development which would partially satisfy the many related water resource problems existing in the West Fork River basin. These investigations involved the study of single and multiple purpose projects either singly or in a comprehensive system to alleviate the effects of quantity and quality of water flows originating within the basin.

53. Flood Control. - A single purpose flood control reservoir was previously authorized on the West Fork River between Clarksburg and Weston. Because of stiff local opposition, however, the project was never constructed. Modification of this project was considered but could not be expanded sufficiently to meet the many needs of the basin. Expansion of this project beyond a storage of 3.2 inches of runoff for flood control dropped the project into the uneconomical category. Further investigation resulted in the selection of 17 additional reservoir sites for study--three on the West Fork River and 14 on tributaries. In most cases, these investigations involved economic considerations for several different full pool elevations. Post-authorization review of these potential sites reaffirmed the unacceptability of all but the Brownsville site because of later development in the particular project areas which would increase the construction costs. Channel improvements in the most severe damage areas were also considered. Their economics were hindered, however, by the extremely high cost of channel excavation primarily in rock. In the Weston area alone, the excavation required to obtain satisfactory hydraulic characteristics would necessitate expenditures of over \$25 million when the maximum expenditure permitted, using a 1 to 1 benefit-cost ratio, would amount to less than \$15 million. In addition to this cost for channel excavation, costs would also be incurred in the protection or replacement of numerous bridge piers, utility relocations, replacement of a water supply dam and relocation of roads affected

by the channel excavation. As explained in Appendix I, Plan Formulation, a multiple purpose project at the Brownsville site capable of storing 4.9 inches of runoff in the summer season and 7.1 inches in the winter would alleviate approximately 76 percent of the average annual primary damages experienced along the main stem of the West Fork River.

54. Water Quality Control. - Studies have shown the Brownsville site to be the most economical and best suited for a project capable of providing the desired low-flow augmentation. Sites capable of storing the 42,050 acre-feet for water quality control are in extremely short supply. Nowhere else in the West Fork River basin is there a site which is capable of storing and releasing the quantity and quality of water that can be regulated at the Brownsville site. The most economical solution during plan formulation, as explained in Appendix I, was for providing the necessary water quality flows through the year 2010.

55. Water Supply. - In pre-authorization studies involving the projected water supply needs of the basin an estimate of water supply demands was prepared by the U. S. Public Health Service. During post-authorization studies these demands were reviewed using current information on municipal and industrial consumption and population trends experienced since the P.H.S. study. Using population and employment projections prepared by the Office of Business Economics and the Economic Research Service for the Water Resources Council, these new studies indicated that total demand from the two water areas, in million gallons per day would be smaller than that originally projected by the P.H.S. However, during detailed simulation routings of natural and potential regulated flows, it was determined that an additional 350 acre-feet of storage at the project site would be required to provide the dependability required to adequately augment natural flows during the period of record. This water supply storage is considered adequate to supply the conservatively projected demands on municipal and industrial systems of the two water areas until the year 2010 as explained in Appendix XII, Water Supply.

56. Public-Use. - Studies were conducted by the Corps of Engineers in cooperation with the West Virginia Department of Natural Resources with a view to determining the total unmet demand for facilities for public-use within the study area. Characteristics of the Stonewall Jackson Lake project were compared with similar projects in order to better determine the effect that access, terrain, drawdown and surface area would have on the expected visitation. This general recreation visitation was estimated at 650,000 initially and 1,450,000 ultimately over the life of the project. This demand can be met by the combined facilities explained in Appendix XI.

### SECTION XIII - CORROSION MITIGATION

57. Water Quality Tests. - Tests of water quality have been taken near the proposed dam site at Brownsville, West Virginia, from the West Fork River by the U. S. Army Engineer District, Pittsburgh, bimonthly since 1954. The ranges for various chemical parameters obtained from these samples were: pH 5.8 to 7.1 units (3.3 percent were less than 6, 63.3 percent from 6.0 to 6.5, 32.1 percent from 6.5 to 7.0 and 1.3 percent greater than 7.0); free carbon dioxide 2 to 35 mg/l as CaCO<sub>3</sub> (4.7 percent of the values were less than 5, 91 percent from 5 to 15 and 4.1 percent greater than 15); total alkalinity 8 to 50 mg/l as CaCO<sub>3</sub> (21.6 percent of the values were less than 15, 61.4 percent from 15 to 30 and 17 percent greater than 30); hardness 17.1 to 115.0 mg/l as CaCO<sub>3</sub> (14.8 percent of the values were greater than 50). Mineral acidity is often a corrosive factor in streams in the Appalachia region. Since no mineral acidity was found at the site within the last 17 years this is not considered a factor for construction here. The water supply dam in the West Fork River at Weston after 40 or 50 years has shown no deterioration of concrete. The chemical qualities at the Stonewall Jackson site are not greatly dissimilar from the qualities at Crooked Creek, Mahoning, Tionesta and Youghiogheny Lakes where no deterioration of concrete or metal at the dam has occurred in 25 to 30 years of operation. It is, therefore, concluded that corrosion mitigation will not be required for this project.

### SECTION XIV - ACCESS ROADS

58. Access Roads. - Access roads for use during construction of the dam will be permanent upon completion of the project construction. The access roads will be new roads connecting to existing state highways downstream of the dam. The main access road to the control house on the dam will be an 18-foot wide roadway located on the right abutment. The main access road will connect to existing State Route 30 a portion of which will require relocation due to construction of the project. Another shorter access road for servicing the gallery will be a 12-foot wide roadway constructed from a remaining portion of vacated, secondary State Route 38/3 to a turnaround at the gallery adit on the downstream left bank of the dam. The surfaces for the roadways will consist of ten inches of coarse aggregate covered by 2½ inches of bituminous paving. Adequate berms will be provided and guard rail will be furnished where necessary. The access roads are shown on the Site Plan, Plate 3.

### SECTION XV - SOURCES OF CONSTRUCTION MATERIALS

59. Materials for Concrete. -

a. Cement. - Cement is manufactured in the Morgantown, West Virginia, and Pittsburgh, Pennsylvania, areas and would be delivered to the dam site by rail and truck.

b. Fine Aggregate. - River sand may be obtained from an approved source in the Ohio River in the vicinity of Parkersburg, West Virginia, with a rail haul of about 100 miles.

c. Coarse Aggregate. - The nearest sources of coarse aggregate previously approved by the Office, Chief of Engineers, for exposed concrete for other projects in this District are the Greer quarry in the Greenbrier limestone at Greer, West Virginia, and the Garbart quarry in the Loyalhanna limestone near Uniontown, Pennsylvania. Although the rail haul would range from 70 to 85 miles for limestone aggregate, it would be much less than that for gravel aggregates as explained in Appendix V, Foundation and Materials Design.

d. Water. - Water from the West Fork River would be satisfactory for use in concrete. No filtering of impurities in the water is anticipated. Water from the West Fork River would also be satisfactory for curing concrete.

60. Lumber. - Finished lumber would be obtained from southern and western states. Rough lumber is available locally in the Clarksburg, West Virginia area.

61. Iron, Steel and Electrical Materials. - Iron and steel products would be obtained from Weirton and Wheeling, West Virginia, and Pittsburgh, Pennsylvania. Allied iron and steel products would be available in Fairmont and Morgantown, West Virginia. Electrical products are manufactured in Fairmont, Morgantown and Wheeling, West Virginia and Pittsburgh, Pennsylvania.

62. Transportation to the Dam Site. - The Baltimore and Ohio Railroad could be utilized to transport materials to within several miles of Weston, West Virginia. Trucks could be used to haul the materials to the dam site over a network of roads which would link up with State Routes 30 and 38/3 to service both banks of the West Fork River at the dam site.

#### SECTION XVI - RESERVOIR MANAGEMENT AND PUBLIC USE

63. General Characteristics. - The Stonewall Jackson Lake is located in a mountainous area of outstanding scenic beauty possessing a planned network of interstate routes that will, when completed, provide good regional access to large and growing urban population centers. Out-of-state tourists and vacationists account for a major part of the present use of existing recreation facilities in the State of West Virginia. The proposed plan of public-use development contained in this memorandum emphasizes multiple recreation use of all project lands and waters because of the steep relief that limits lands suitable for placement of recreational facilities.

64. Facilities. - The Stonewall Jackson Lake public-use facilities would provide for picnicking, swimming, fishing, boating, water skiing, sightseeing and camping in two major comprehensive development areas. The Stonewall Jackson Recreation Area would be developed initially and offer a full range of recreational facilities. Future recreational development would include expansion of the Stonewall Jackson Recreation Area and development of the Skin Bay Recreation Area. In addition to these two major areas, three small public access areas, principally for fishermen use, are planned for as part of the future development. In addition to facilities to be cost shared under Public Law 89-72, the State will attempt to develop, with its own funding, expanded facilities to meet the many varied and associated demands which are expected to occur in conjunction with a project of this magnitude. These facilities would include, but not be limited to, a golf course, clubhouse, restaurant, indoor recreation center, tennis courts and outdoor games area. All of the above facilities will be managed and maintained by personnel of the Department of Natural Resources of the State of West Virginia.

65. Visitation. - In combination, the cost-sharing facilities and those funded entirely by the State of West Virginia are expected to accommodate an initial visitation of 700,000 and ultimately 1,550,000 under realization of full facility development.

#### SECTION XVII - AGENCY COORDINATION

66. Soil Conservation Service. - Early in studies leading to completion of this design memorandum the Soil Conservation Service indicated that there was no conflict with any existing or proposed small watershed projects under Public Law 566.

67. Department of Housing and Urban Development. - This agency has reported that no HUD aided planning was underway at the time of coordination.

68. Federal Power Commission. - A feasibility study by the Federal Power Commission ended with a finding of uneconomical for firm power generation at the project site. A potential for a small pumped storage development, however, is recognized but is not recommended at this time because of other peak power proposals underway in the power supply area. No special provisions are required in the project to permit future development of this type of power.

69. Federal Water Quality Administration. - A survey made by the U. S. Public Health Service and reported in February 1965 as Appendix V of Senate Document No. 109 covered the West Fork River Basin and the main stem of the Monongahela River. It disclosed a future need for municipal and industrial raw water supplies and an immediate need for stream flow augmentation

for water quality control purposes. This determination was arrived at by projecting population trends and industrial growth patterns for the study areas. The Service concluded that the construction of a project on the West Fork River at Brownsville, incorporating multi-level outlets, would be a desirable means of providing water quality control in the West Fork River. It was recommended that this project contain sufficient storage to enable maintaining the required minimum stream flows at Clarksburg projected to the year 2010. Post-authorization studies by the Federal Water Quality Administration (now responsible for this type study) indicates that the earlier report adequately described the water supply and water quality (low flow) needs of the study area. Later discussions have resulted in revisions to the water supply storage requirements for the Weston and Clarksburg water areas. The complete PHS report, as such, is not included in this memorandum. Portions of that report, however, have been included in the appropriate sections or appendices of this report.

70. National Park Service. - Early in this phase of the Stonewall Jackson Lake project the National Park Service was requested to initiate an archeological survey and salvage program of the project area. Research studies and field surveys by the West Virginia Geological and Economic Survey for the Service failed to provide any further information on the archeology of the region than that previously reported by Ralph S. Solecki to the Smithsonian Institution in 1948. However, several small sites have been recommended for further exploration prior to impoundment. In order that this program can be developed to the fullest extent, the National Park Service will be periodically informed by the District of the project's status until the Service is sufficiently satisfied that all potential sites have been explored.

71. Bureau of Outdoor Recreation. - During preparation of the authorizing document the Bureau related that the then recent supplement to the West Virginia Statewide Outdoor Recreation Plan showed that the State was interested only in day-use recreational activities at the Stonewall Jackson Lake project. Since authorization, the State has restudied and revised its Statewide Outdoor Recreation Plan and reports that the Land Requirements Plan - Public Use contained herein is in contest with its Plan submitted to B.O.R. in June of 1970. Because of program priorities and funding limitations the Bureau was unable to participate in a re-evaluation of the public-use potential of this particular project. The public-use plan as presented in this memorandum was transmitted to the Bureau for their review and comments regarding post-authorization changes. A backlog of similar actions has prevented their reply to date.

72. U. S. Fish and Wildlife Service. - Personnel shortages, priorities, and report backlogs have prohibited this agency from actively participating in any reanalysis of fish and wildlife resources at the Stonewall Jackson Lake project. Findings and recommendations of the Service presented in its Conservation and Development Report for the authorizing document have, therefore, been used as the planning criteria for this resource development.

73. State of West Virginia.- Comprehensive planning has been effected with elements of the State Government, most specifically with the Department of Natural Resources. Efforts of this coordination have resulted with the Land Requirements Plan - Public Use presented as Appendix XI. Negotiations are presently underway to complete a contractual agreement with this agency under the provisions of Public Law 89-72 prior to initiation of project construction.

#### SECTION XVIII - RESERVOIR CLEARING

74. General.- Clearing of the reservoir would be accomplished generally in accordance with the limits defined in ER 415-2-1, 3 June 1969, with special consideration to clearing for immediate downstream water supply uses. Accordingly, the normal upper limit of clearing timber, brush and deadfall is estimated as elevation 1076.2 m.s.l. or three feet above the maximum summer pool and the normal lower limit is estimated as elevation 1055 m.s.l. or five feet below the ten-year frequency drawdown. In view of downstream water supply usage, however, clearing of timber, brush and deadfall in the pool below elevation 1055 was compared with the additional treatment costs required to eliminate the unpleasant odors caused by eutrophication of the hypolimnion. Clearing was the most economical alternative and was determined to be a project joint cost. Accordingly, the reservoir area will be cleared between stream bed and elevation 1076. The entire pool area to elevation 1087 will be cleared of all existing improvements of floatable construction.

#### SECTION XVIII A - ENVIRONMENTAL ASPECTS

74-A. Environmental Impact of Items of Work.- At total storage capacity, the lake would inundate about 1800 acres of crop land, 1100 acres of pasture and 400 acres of wood land, with the balance currently used for other purposes. The lake would extend upstream from the dam in rather thin tendrils up the several stream valleys. Principally, because of the high cost of severance of real estate holdings and secondarily, to acquire recreation lands, the total acquisition will include extensive areas between the stream valleys. Approximately 2650 acres of wildlife habitat will be inundated, and the loss of about 35 miles of free flowing streams will result from project construction.

Possibly the most marked changes caused by development of the project will relate to man-made structures and to the inhabitants themselves. The cemeteries will have to be relocated; arrangements will be made to search for and remove any prehistoric artifacts of significance; and roads, railroad trackage, power and communication lines, and gas lines will be relocated so as to provide equivalent service. Active and inactive gas wells below lake full elevation will be plugged. Gas storage and gas storage observation wells will be protected and provided with access. The gas compressor station will be relocated. Real estate within the project

area will be purchased outright. The owners will be paid the fair market value for their property and will receive reimbursement for relocation expenses.

Operation of the Stonewall Jackson Lake for flood control would primarily benefit the West Fork River valley and the upper Monongahela River valley which includes the flood plain and backwater areas of the Monongahela River from Locks and Dam 4 to Fairmont, West Virginia.

Movable bulkheads consisting of steel leaf gates will be provided on the upstream section of each water quality control wet well. The operation of these leaves, regulated between elevations 1038.0 and 1075.7 is designed to provide variable volume discharges to meet temperature and dissolved oxygen requirements for water quality control. Meeting river water quality objectives will enhance the general aesthetics of the waterway and contribute to a healthful environment. Storage for water supply to the city of Weston totals 2,200 acre feet.

Extensive recreational development, partly under a cost-sharing basis with the State of West Virginia, under Public Law 89-72, and partly as the sole responsibility of the State, has been prepared for the lake and adjacent areas. Most of the proposed development will be on land now cleared for agricultural use. The concept for environmental improvement measures includes preservation of existing vegetation wherever possible, restoration of all borrow areas and cut slopes, tree planting, meadow seeding, and refined landscaping of the areas close to public awareness. Plantings will be with indigenous species or types which harmonize with the natural vegetation.

In partial replacement of the inundated wildlife habitat, 1000 acres will be set aside for hunter use in the area. The replacement of a flowing stream by still water will be generally beneficial for fishing. The lake area will support much larger populations and more varied species of desirable warm-water fish than are now present in area streams. The principal sport fishes expected to populate the lake include largemouth bass, white and black crappies, bluegills, sunfish, and channel and flathead catfishes with probably a limited number of muskellunge.

The Soil Conservation Service points out that the proposed lake and developments would significantly reduce the agricultural productive capacity of the county. The project will remove about 10 percent of the total cropland and 16 percent of bottoms land and terrace soils in the county.

It may be assumed that most of the area inhabitants who are required to move from the project area will resettle in the vicinity. Those who at present support themselves in vocations other than farming will very likely keep on at their same jobs, unless project operation or occupations satellited on operation of the project offer better opportunities. On the other hand it is not as likely that individuals engaged in agricultural pursuits will reestablish themselves on farms, both because of the relative scarcity of good farmland, and the probable reluctance to start all over again. There is ample evidence, using the history of similar developments,

that the construction and operation of the project will provide substantial economic stimulation. In addition, the anticipated tourist trade will create heavy demands for services, and open up many opportunities for new commercial enterprises. The project will effect a major change in the social life of the area. Small rural communities and scattered farms will give way to a large transient population looking for recreation and relaxation.

Due to the erodible nature of the soils, contract controls will include all practical methods of reducing erosion and minimizing streambed disturbances and a sufficient surveillance system to monitor stream quality conditions during all phases of construction. The location, performance and timing of construction will be carefully controlled, together with clearing operations and revegetation of disturbed areas. Consideration could be given to the installation of check dams for controlling siltation downstream of the dam site.

74-B. Site Layout Plan.- The site layout plan, Dwg. No. 037d-R7-12/1, inclosed in Volume 1 of this report depicts the overall interrelationship of the various project features including roads, utilities, recreation areas, access, cemetery, power line treatment and gas storage well relocations.

74-C. Proposed Architectural Treatment.- Facilities will be constructed of brick and designed with neat, clean cut lines with an uncluttered appearance. Foremost, particular attention will be given to the design and location of safety railings, fencing, equipment layouts, power and communication lines and poles and appurtenances. Harsh appearances in structural forms will be subdued by use of architectural techniques, landscape planting or a combination of the two. Specialized architectural features will be applied to specific project features in order to enhance the overall appearance of the project.

#### SECTION XIX - ENVIRONMENTAL IMPROVEMENT

75. General.- The region in which the Stonewall Jackson Lake is located at the foot of the Alleghenies is characterized by relatively wide valleys and steep valley walls. Within the reservoir area, the predominant land use is for grazing. Strip mining has produced some unsightly hillside scarring and has, to a very limited degree, resulted in reclamation efforts by the State Government. Tree cover is scattered with larger amounts in the upper quarter of the hill slopes. Practically all of the merchantable timber has been cut down for lumber or deadened and burned off for agriculture. Agricultural crops are produced primarily for livestock feeding. Wildlife resources within the reservoir are low to moderate and consist of forest and farm game species. The predominant big game species in the area is the white-tailed deer but browsing is reduced as a result of grazing by livestock. Several smaller game species provide some limited sport hunting. In order to provide an overall improvement of the area environment and a habitat more conducive to the growth of the natural wildlife of the area, the Corps of Engineers and the West Virginia Department of Natural Resources are proposing an environmental improvement program in different areas of

the project. The specific treatment provided for this environmental improvement program has been planned in accordance with the policies of ER 1165-2-2 and outlined in EM 1110-2-38. The estimated costs for this treatment are included as specific items in the various construction features contained in Appendix XIII, Cost Estimates.

76. Dam Site. - On lands at the dam site to be retained under the operational control of the Corps of Engineers an environmental improvement program will be initiated to blend as much as possible with the surrounding natural setting. This program will consist of grading with topsoil and seeding, landscaping, erosion control, tree plantings, restoration of all contractor's work areas, architectural harmony of structures, an overlook location with an excellent view and scenic alignment of the access roads. These treatments are further described in Appendix XI of this memorandum.

77. Reservoir Area. - The reservoir will be completely cleared within the limits explained in paragraph 74 to minimize public health hazards, and achieve a good general appearance particularly in those areas most used and viewed by the visiting public. The remaining pool area and other lands included in the proposed acquisition would be selectively cleared to preserve timber and remove undesirable vegetation. Reclamation of strip mine areas has been initiated by the State of West Virginia with some financial aid from the Federal Government. Forage crops for wildlife will be planted on project lands by the managing agency, the West Virginia Department of Natural Resources.

78. Public-Use Lands. - Those lands to be open to public-use for camping and picnicking will be developed to blend with the natural environment in each of the three major recreation areas. The environmental programs in those areas will include landscaping, treeplanting, brush cutting and erosion control. This program is described in more detail in Appendix XI of this memorandum.

#### SECTION XX - REAL ESTATE REQUIREMENTS

79. General. - Authorization for the Stonewall Jackson Lake project provides that the United States shall acquire title to all lands, improvements, easements and rights-of-way necessary for the project. The Federal Government would acquire title to 3,470 acres to full pool elevation 1082 feet m.s.l.; 120 acres in the vicinity of the dam; 16,310 acres in lands contiguous to and including a buffer strip measured 300 feet horizontally from full pool elevation 1082 m.s.l. or to an elevation five feet above full pool (1087 m.s.l.), whichever is greater, and 1,140 acres for use by the public for recreation. The proposed acquisition includes the 1,000 acres authorized for wildlife mitigation unit. The total acquisition cost, including improvements, for the acreages outlined above is estimated at \$8,370,000. A gross appraisal for the types and values of lands and improvements to be acquired is contained in Appendix X, Real Estate.

80. Tentative Guide Taking Line. - The Federal Government is concerned with the right to flood and clear as necessary to the limit of the proposed storage at elevation 1082 m.s.l. and, in addition, to avoid damage to abutting properties from wave action, backwater effect, or shore erosion above the established upper reservoir level. A tentative guide taking line, which includes the buffer strip stated in the preceding paragraph, is proposed to provide for the effect of the foregoing in addition to acquiring those properties to which economical access cannot be maintained. The area above full pool, 1082 m.s.l., would be utilized for public access and recreation.

81. Monumentation. - A plan for monument and survey marks has been devised to define the land to be retained by the Corps of Engineers for project operation and maintenance. The plan was formulated in accordance with criteria furnished in "Boundary, Surveys and Marking--Water Resort Development Projects" issued on 12 November 1965. The details of the proposed monumentation are discussed in Appendix X, Real Estate; and the location of the proposed monumentation is shown on Plate 1 of that appendix. The estimated cost of the proposed program (\$154,000 including 12% contingencies) is shown on Table 10, Appendix XIII.

#### SECTION XXI - RELOCATIONS

82. General. - This report covers all highways, railroad, utility and cemetery relocations as required in General Design Memorandum scope. Also included in this report are certain highway and related utility relocations in Feature Design Memorandum scope in order that the first phase of construction can be initiated to expedite completion of the project. The latter includes a Report on Necessity and Attorney's Reports for the highway and utility relocations considered in the initial construction program. The Equitable Gas Company-owned Skin Creek compressor station and connecting pipelines which require relocation to accommodate the project were covered in previously submitted Design Memorandum No. 3, Feature Design Memorandum. The proposed relocations are further discussed in Appendix IX, Relocations.

83. Highways. - Highway relocations are proposed to maintain principal existing routes and to provide access to areas bordering the reservoir. The plan of relocation is one of equivalent substitute facilities and would involve U.S. and State roads. Highway relocations would consist of about 6.8 miles of U.S. Route 19 and about 18.2 miles of West Virginia secondary and tertiary roads. Included in this relocation would be approximately 1.3 miles of U.S. Route 19 and intersecting roads to specifically accommodate the recreation development. The proposed relocations of highways has been designed in accordance with the latest design criteria appearing in Section 207 (b) of Public Law 86-645, as amended. These relocations are shown on Plate 2 and discussed in more detail in Appendix IX, Relocations. Detailed cost estimates for the proposed changes are shown in Appendix XIII, Cost Estimates.

84. Railroads. - The proposed lake would require the relocation of about 1.4 miles and the raising of about 1.6 miles of the Baltimore and Ohio Railroad main line and the raising of approximately 950 feet of spur tracks in the southern end of the lake in the vicinity of Walkersville. A description of the proposed adjustments required by the construction of the Stonewall Jackson Lake is contained in Appendix IX. Detailed cost estimates for the railroad relocations are included in the relocations cost estimates in Appendix XIII, Cost Estimates.

85. Utilities. - Utilities in the Stonewall Jackson Lake project area that would be affected by relocation, alteration, abandonment, or removal consist of power lines, communication lines, gas lines, and one natural gas compressor station. Grants for rights-of-way and contracts for relocation will be located and administered to minimize adverse effects on the aesthetic qualities of the lake area. The work would be done by the owning agencies under fixed amount lump sum and/or cost reimbursable type relocation contracts. Descriptions of existing utilities and proposed plans of adjustments are contained in Appendix IX. Detailed cost estimates for the proposed plans are contained in Appendix XIII.

86. Cemeteries. - Six public cemeteries and two private cemeteries totaling approximately 673 graves would require relocation. One cemetery lies entirely below full pool elevation 1082 m.s.l.; four lose access resulting from the project; and the remaining three cemeteries are located on lands proposed to be acquired for recreation. A detailed description of the cemeteries and the proposed reinterment site are contained in Appendix IX of this memorandum. Detailed cost estimates for these proposed cemetery relocations are shown in Appendix XIII.

*Chas. Nelson*

SECTION XXII - COST ESTIMATES

87. Estimate of First Cost.- The estimated total first cost of the Stonewall Jackson Lake project including contingencies is \$70,500,000. Detailed cost estimates are contained in Appendix XIII, Cost Estimates, and are based on the July 1970 cost level. The estimated first cost is summarized as follows:

SUMMARY OF ESTIMATED FIRST COST  
(JULY 1970 COST LEVEL)

<u>Feature</u>	<u>Amount</u>
Lands and Damages	\$ 8,370,000
Relocations	29,500,000
Reservoir	691,000
Dam and Appurtenances	8,580,000
Service Roads	295,000
Public-Use Facilities (Initial)	7,980,000
Buildings, Grounds and Utilities	999,000
Permanent Operating Equipment	133,000
Engineering and Design	4,048,000
Supervision and Administration	<u>3,668,000</u>
Subtotal	\$64,264,000
Future Public-Use Facilities	<u>8,240,000</u>
Total	\$72,504,000 *
Total, rounded	\$72,500,000 *

\* Does not include \$155,000 cost of pre-authorization studies.

88. Estimate of Investment Cost.- The estimated total Federal gross investment based on an interest rate of 3.25 percent is as follows:

Estimated Initial First Cost	\$64,300,000
Interest during Construction (3.25% for 1/2 of a six-year construction period)	<u>5,870,000</u>
Initial Investment	\$70,170,000
Future Public-Use Investment	<u>8,240,000</u>
Total Federal Gross Investment	\$78,410,000

89. Estimate of Average Annual Charges.- The average annual charges for the Stonewall Jackson Lake project based on costs presented in the preceding paragraph with an interest rate of 3.25 percent and a 100-year project life is as follows:

<u>Item</u>	<u>Amount</u>
Interest on Investment, 3.25%	\$2,415,000
Amortization, 0.138%	103,000
Operation and Maintenance Costs	380,000
Major Replacements	101,000
Adjustment for Net Loss of Productivity on Land	<u>35,000</u>
Total Average Annual Charges	\$3,034,000

90. Comparison of Current Costs with the Latest Approved Federal Estimate and Project Document Estimate.- The differences between the estimated Federal costs as contained in this memorandum, the latest approved Federal estimate, and the Federal costs presented in the project document are shown in the following table. The differences between the latest approved estimate and the project document estimate are due to changes in price levels. The differences between the current costs and the latest approved estimate are discussed in the subparagraph following the table.

Feature	Project Document Estimate (944.7 Base)	Latest Approved Estimate July 1970	GDM Estimate July 1970	Difference Between Current and Approved Estimates	References *
Lands and Damages	\$ 6,884,000	\$10,315,000	\$ 8,370,000	- \$ 1,945,000	a
Relocations	17,679,000	26,525,000	29,500,000	2,975,000	b
Reservoir	672,000	1,005,000	691,000	- 314,000	c
Dam and Appurtenances	3,621,000	5,450,000	8,580,000	3,130,000	d
Service Roads	---	---	295,000	295,000	e
Public-Use Facilities (Initial)	970,000	1,690,000	7,980,000	6,290,000	f
Buildings, Grounds and Utilities	158,000	236,000	999,000	763,000	g
Permanent Operating Equipment	60,000	89,000	133,000	44,000	h
Engineering and Design Supervision and Administration	1,675,000	2,344,000	4,048,000	1,704,000	i
	<u>1,466,000</u>	<u>2,146,000</u>	<u>3,668,000</u>	<u>1,522,000</u>	i
Subtotal	\$33,185,000	\$49,800,000	\$64,264,000	\$14,464,000	
Future Public Use	<u>1,319,000</u>	<u>1,980,000</u>	<u>8,240,000</u>	<u>6,260,000</u>	f
Total (rounded)	\$34,500,000	\$51,780,000	\$72,500,000	\$20,700,000	

\* For discussion of differences, see following subparagraphs lettered as shown.

a. A more detailed comprehensive and realistic appraisal program has resulted in a reduction in real estate acquisition costs of \$1,945,000. A general decline in property values in the project area is also responsible for a portion of this reduction.

b. Relocation costs have increased by \$2,975,000. This increase is due primarily to the more detailed quantity estimating from new topographic maps, better information from utility owners, and the additional cost of \$1,091,000 for adjusting a portion of Route 19 on a new alignment in consideration of the esthetic and environmental impact of the highway and \$143,000 for relocating cemeteries to accommodate the proposed recreational developments.

c. Better topographic mapping of the project area has resulted in a significant reduction in acreage classed as woodland. This consideration together with more efficient methods of clearing has enabled the cost estimate for reservoir clearing to be reduced by \$468,000. However, reservoir monumentation, in the estimated amount of \$154,000, has been added to this feature resulting in a net decrease of \$314,000.

d. A more detailed and refined design analysis for the dam and appurtenant structures has resulted in an increase of \$3,130,000. Included in this increase is the extra cost associated with lowering several monoliths to a more suitable rock line and also the provision of two quality control towers to provide more effective control of withdrawal from the various levels of the reservoir.

e. A road system to provide access to the dam and overlook area has increased the cost estimate by \$295,000. Previously, access to these areas was to be provided from relocated West Virginia Secondary Route 30. This alignment for Route 30 was discarded, however, in favor of a more suitable alignment along Washburn Run just downstream of the dam.

f. Since authorization, the Nation has experienced a great boom in demand for recreational facilities to meet the increasing needs of a society possessing the most fashionable leisure time equipment available. All over this country, existing recreational areas have had to be expanded and redesigned to meet this growing industry. To provide for the expected demand in this project area a complete reanalysis was made of the market area surrounding the project with a view to determining what portion of the unmet recreational demand could be satisfied by the Stonewall Jackson Lake project. During preparation of this reanalysis it was confirmed that two interchanges on Interstate Route 79 will be located nearby adjacent to the project and that two sections of the Appalachian Corridor highway system will pass near to it. This increased accessibility to the project and a restudy of its recreation potential have resulted in attendance estimates significantly higher than those given in the authorizing document. The area within 75 road miles of the project would contribute the majority of its day users. It is anticipated that most of the overnight use would originate from within. The combined general recreation and fish and wildlife day use and overnight attendance estimates developed from these use origin studies are given below:

<u>Year</u>	<u>Day-Use Attendance</u>	<u>Overnight Attendance</u>	<u>Total Attendance</u>
1980	530,000	120,000	650,000
2080	1,190,000	260,000	1,450,000

In addition to the attendance given above for the usual primary outdoor recreation, an additional attendance of 50,000 users initially and 100,000 users ultimately would be attracted by additional more sophisticated facilities to be developed by the State of West Virginia. These attendances represent a significant increase over the attendances of 204,000 initially and 419,000 ultimately given in the authorizing document. To accommodate these users, a more unified park complex allowing more efficient management and fee collection is proposed. A total area of 2,025 acres at a cost of \$241,000 was proposed for recreation use in the authorizing document. The currently proposed park complex would include 3,780 acres at a cost of \$340,000. In the authorizing document, facilities for camping, fishing, picnicking, swimming, boating, sightseeing, hunting and hiking. The latest approved estimates for these facilities are \$1,690,000 and \$1,980,000 for initial and future developments, respectively. The facilities currently proposed for cost-sharing under the provisions of Public Law 89-72 to accommodate the increased visitation would be developed at an initial and future cost of \$7,980,000 and \$7,100,000, respectively. This represents an increase of \$6,290,000 initially and \$6,260,000 future, over the latest approved estimate.

g. In order to provide for the health and safety of the visiting public at the damsite it was necessary to develop a Visitor's Center on a bench just upstream of the dam axis on the right bank. In addition, to provide the needed control and administration of the Government facilities at the project it is proposed to provide two dwellings for operating personnel and a maintenance complex with the necessary equipment for servicing a project of this nature. In addition the trail terminus for the Weston & Gauley Bridge Turnpike Trail will be constructed at Federal Expense. These items have increased the buildings, grounds, and utilities cost by \$763,000.

h. Numerous items necessary for operation and control of the project have increased the cost estimate for permanent operating equipment by \$44,000.

i. Additional engineering and design with subsequent supervision and administration on the cost increases shown above have added an additional \$3,226,000 to the project cost estimate, exclusive of future recreation facilities.

SECTION XXIII - SCHEDULES FOR DESIGN AND CONSTRUCTION

91. General. - Feature design memoranda covering specific phases of project development which are to be prepared prior to their construction are as follows:

- a. Utilities - Skin Creek Compressor Station (Submitted July 1970)
- b. Real Estate
- c. Highway Relocations
- d. Concrete Aggregates
- e. Dam and Appurtenances
- f. Railroad Relocations
- g. Utility Relocations
- h. Public-Use Plan

92. Contract Plans and Specifications. - Contract plans and specifications for highway relocations, where practicable, will be prepared by the Corps of Engineers. Contract plans and specifications for dam construction will be scheduled for completion approximately 24 months after initiation of the compressor station relocation work.

93. Construction Schedule. - The proposed schedule for design and construction is shown on the Detailed Project Schedule (PB-2A), included as Plate 5 of this memorandum.

94. Sequence of Operations. - The sequence of operations shown on the design and construction schedule is based on the following criteria:

- a. Funds would be appropriated for planned, orderly and economic construction.
- b. Lands would be acquired and relocations of highways and utilities would be well advanced to assure continuous construction of the dam and appurtenant facilities.
- c. Construction of the dam would be completed in accordance with the planned stages of diversion during construction.

95. Fund Requirements. - Federal funds previously expended and additional funds required for planning and construction are shown in the table that follows. For the purpose of funding, facility costs for future recreation are not included.

Previous	\$ 1,253,000 (rounded)
First Fiscal Year	600,000
Second " "	3,350,000
Third " "	8,700,000
Fourth " "	16,900,000
Fifth " "	18,100,000
Balance to complete (2 Fiscal Years)	<u>15,397,000</u>
Total	\$64,300,000 *

\* Does not include pre-authorization costs of \$155,000

## SECTION XXIV - OPERATION AND MAINTENANCE

96. General. - Personnel would be permanently assigned to the Stonewall Jackson Lake to operate the project for flood control, water supply, water quality control and recreation. The proposed structures associated with the project are designed for convenient access to all appurtenances requiring maintenance and replacement. Ordinary maintenance for the dam, damtenders' dwellings, visitors' access area and maintenance complex in the vicinity of the dam would be provided by dam operating personnel. In addition to the aforementioned maintenance, operating personnel would be responsible for mowing grass and controlling the growth of trees and shrubbery adjacent to the proposed structures.

97. Operation and Maintenance Personnel. - It is planned that an Area Manager would be assigned the responsibility for the supervision of operation and maintenance at Stonewall Jackson Lake, Rowlesburg Lake, Tygart Lake, and Youghiogheny River Lake. The maintenance complex facilities at Rowlesburg Lake would serve as the headquarters for the Area Manager. Operation and maintenance personnel at Stonewall Jackson Lake will consist of:

a. Full time employees

One (1) Reservoir Manager  
One (1) Ranger  
One (1) Chief Maintenance Man  
Two (2) Maintenance Men

b. Temporary summer employees

Two (2) Laborers

Approximately one-third the costs for operation and maintenance of the reservoir would be reserved for dam and appurtenances, permanent operating equipment, and buildings, grounds and utilities. Supervision and administration costs would also be included. The cost of operation and maintenance for the multiple-purpose project, including wages as well as depreciation and upkeep of equipment, is estimated at \$380,000 per year as shown in detail in Appendix XIII, Cost Estimate.

98. Instrumentation and Inspection Program. - Instrumentation facilities and a periodic inspection program for assuring structural integrity and operational adequacy of the structure will be accomplished as required by ER 1110-2-100. Planned for installation are nine uplift cells for the monitoring of uplift pressures on the dam. Also, monuments are to be located along the axis of the dam for detecting any movement which may occur. The type, location and installation of the instruments to be

incorporated in the dam will be as discussed and shown in EM 1110-2-4300, "Instrumentation for Measurement of Structural Behavior of Concrete Gravity Structures." Details of the type, location and installation of the instrumentation will be presented in the feature design memoranda. Also included in the feature design memoranda will be details of the periodic inspection program, the proposed instrumentation program, observation schedule, inspection plan and an initial check list to facilitate conduct of the inspections. The cost of this instrumentation and inspection plan is included in the above amount for operation and maintenance.

#### SECTION XXV - RESERVOIR REGULATION

99. General. - The Stonewall Jackson Lake would be operated as a unit of the coordinated reservoir system in the upper Ohio River basin for flood control, recreation, water supply and water quality control in the Monongahela and Ohio River valleys. Basic meteorologic and hydrologic data necessary for the development and verification of the reservoir regulation plan are presented in Appendix III, Hydrology. Regulation for water quality control and water supply is based on requirements estimated by the U. S. Public Health Service and later confirmed by the Federal Water Quality Administration. Details of the reservoir regulation are contained in Appendix IV, Reservoir Regulation.

100. Channel Capacity. - Capacity of the channel immediately downstream of the dam would govern the rate of release of excess storage from high flood runoff. Maximum controlled release of flood storage in excess of low water reservation would be limited to the all-season, non-damaging downstream channel flow capacity of 2,300 c.f.s. This flow corresponds to a biannual frequency of occurrence and a 1.5-year recurrence interval during the construction season, May through December. Excess flood impoundment will be released at maximum channel capacity to prevent encroachment on the stream channel. It is contemplated that this release could be accomplished about once every two years.

#### SECTION XXVI - HEALTH CONTROL

101. Health Control. - The Public Health Service, Region III, Charlottesville, Virginia, of the U.S. Department of Health, Education and Welfare prepared a report titled, "Water Supply and Water Quality Control Study, Stonewall Jackson Reservoir, West Fork River Basin, West Virginia." This report, included as Appendix V in the Review of Reports on the West Fork River and Tributaries, West Virginia, does not comment on any potential health problems resulting from the lake.

## SECTION XXVII - BENEFITS

102. General.- The estimated average annual benefits which would result from the Stonewall Jackson Lake consists of the following:

a. Benefit from the elimination or reduction of primary damages resulting from a decrease in flood flows in the West Fork River at and downstream of Weston, West Virginia, and also the Monongahela River.

b. Benefit from the elimination or reduction of primary damage which would apply to normal future development which would occur in the flood zones, even if flood protection were not provided.

c. Benefit from the inclusion of storage to provide water supply for present and future needs of the communities of Weston and Clarksburg, West Virginia.

d. Benefit from inclusion of storage in the reservoir to provide water quality control in the downstream flows by augmenting these flows to assure maintenance of water quality consistent with its expected use.

e. Benefits from annual visitation of persons utilizing the recreation and fish and wildlife developments provided at the project site.

f. Benefits from the utilization of labor and other resources required for project construction, and expected to be used in project operation, maintenance, and added area employment during the life of the project, to the extent that such labor and other resources would, in the absence of the project, be unutilized or under-utilized.

g. Benefit from the development of industries that would be attracted to the downstream reaches where construction of the project would eliminate flooding on areas of sufficient acreage where these industries could locate and distribute their products.

103. Primary Flood Control Benefits.- Flood control benefits that would be credited to the proposed Stonewall Jackson Lake are derived in Appendix XIV of this report. These benefits are applicable to a dam and reservoir for flood control alone or for flood control in combination with any other purpose or purposes, and would result from the reduction of primary damages as evaluated from stage-damage and stage-frequency curves. Average annual primary damages after reduction by Stonewall Jackson Lake and average annual benefits attributable to Stonewall Jackson Lake are tabulated below. The figures are based on July 1970 values.

It should be noted that 70 percent of the flood damages are in Weston, which would receive practically complete protection from the reservoir.

<u>Location</u>	<u>Average Annual Primary Damage After Reduction By Existing Reservoirs</u>	<u>Average Annual Residual Damage After Reduction by Stonewall Jackson Lake</u>	<u>Average Annual Benefits</u>
West Fork River			
Weston District	\$ 656,200	\$ 4,800	\$651,400
Clarksburg District	554,800	285,000	269,800
Monongahela River			
Upper Monongahela River District	<u>21,300</u>	<u>18,000</u>	<u>2,500</u>
Total	\$1,232,300	\$308,600	\$923,700

It is recognized that flood control benefits would result on the Monongahela and Ohio Rivers downstream from Locks and Dam 4, the lower limit of the Upper Monongahela Damage District, from reductions of flood stages attributable to Stonewall Jackson Lake. These reductions, however, are small and although the resulting benefits therefrom are tangible, they are nevertheless small in comparison with those benefits tabulated above. Therefore, for this report, monetary values for flood control benefits downstream from Locks and Dam 4, Monongahela River have not been evaluated.

104. Future Primary Flood Control Benefits.- Normal future development in the flood areas that would benefit from the proposed reservoir has been evaluated. The average annual benefits resulting from reduction of primary damage to the developments have been computed on the basis of normal future growth projections developed from "OBERS (Office of Business Economics, Economic Research Service)" as described in Appendix XIV. The estimated average annual flood control benefit applicable to normal future development and creditable to the proposed project is \$464,600. In addition to benefits derived from reduction of flood damage, there are other supplementary benefits of intangible nature. Improved economic and business conditions, improvement of public security and non-interruption of traffic and industrial production are intangible benefits that have not been assigned monetary values for this report. Details in support of the benefits are included in Appendix XIV.

105. Summary of Flood Control Benefits.- A summary of the average annual flood control benefits attributable to the proposed project is as follows:

<u>Benefit</u>	<u>Amount</u>
Primary Flood Control	\$ 923,700
Normal Future Development	<u>464,600</u>
Total Average Annual Flood Control (rounded)	\$1,388,000

106. Water Supply Benefits.- The water supply benefit attributable to the reservoir project by inclusion of 2,200 acre-feet of storage, as discussed in Appendix XIV is \$79,000.

107. Water Quality Control Benefits.- Water quality control benefits derived from storage releases from the proposed reservoir have been developed as stated in Appendix XIV. This annual benefit, based on providing the controlled release schedule is estimated to be \$1,302,000.

108. Recreation Benefits.- The recreation benefits to be derived from development for public use of the lands adjacent to the reservoir have been evaluated by this District. Derivation of these benefits is contained in Appendix XIV. The annual visitation (not including Fish and Wildlife visitation) at the reservoir has been estimated to be 596,000 initially and 1,396,000 ultimately for general recreation activities, other than hunting and fishing. The average annual benefit from these visitations attributable to the project is \$1,128,000.

109. Fish and Wildlife Benefits.- An evaluation of the effect of the reservoir on fish and wildlife resources has been made by the U. S. Fish and Wildlife Service. This evaluation is contained in Appendix XIV. A summary of the estimated annual fisherman use, with and without the reservoir, is tabulated below.

<u>Fisheries</u>	<u>Without the Project Man-days</u>	<u>With the Project Man-days</u>
Within reservoir site	6,200	46,000
Reservoir tailwaters	200	8,300
Downstream from tailwaters	<u>8,600</u>	<u>13,800</u>
Total, rounded	15,000	69,000

The total net benefit accruing to the reservoir, based on the above tabulation, would be \$45,000 annually. Mitigation of wildlife losses is proposed to be met through the acquisition and management of approximately 1,000 acres. These lands will be part of the total recreation and fish and wildlife complex to be administered by the State of West Virginia Department of Natural Resources. A letter setting forth the view of the State of West Virginia is contained in Appendix XI. A summary of the estimated annual hunter-day use is listed below and is given no benefit value.

<u>Item</u>	<u>Without Project</u>	<u>Project Only</u>	<u>Project With Mitigation</u>
Hunter days	4,350	2,350	4,350

110. Expansion Benefits.- The proposed reservoir would be located in Lewis County, West Virginia. This county as well as many surrounding counties have been designated as redevelopment areas by the Appalachian Redevelopment Act of 1965.

a. Redevelopment Benefits.- Senate Document 97 provides that, in areas so designated, "project benefits shall be considered as increased by the value of the labor and other resources required for project construction, and expected to be used in project operation, project maintenance, and added area employment during the life of the project, to the extent that such labor and other resources would, in the absence of the project be unutilized or under-utilized." These benefits have been determined based on estimates of labor requirements for projects of similar scope and construction costs, and consist of wages paid to persons employed during construction and operation of the project who would otherwise be under-employed or unemployed. The National account portion of these benefits consist of wages paid to persons recruited from local areas classified as economically depressed. Redevelopment benefits computed in accordance with the above were considered as incidental benefits in project evaluation and are added to the primary project benefits. The benefits attributable to this project are estimated at \$625,000 for the Regional account and \$297,000 for the National account. The calculation of these benefits and a discussion of the procedure used are contained in Appendix XIV.

b. Development Benefits.- In addition to the above-mentioned benefits, the project would contribute to the stimulation of economic development in the West Fork River basin. This contribution to the stimulation of economic development is a benefit attributable to the proposed project. As explained in Appendix XIV, however, conditions in the influenced area were not adequate to effect any benefit measurement in this particular category.

111. Secondary and Intangible Benefits.- Certain secondary benefits of intangible nature could result from the project such as betterment of the general welfare and security of the people, improvement of sanitation, and the elimination of losses due to interruption of commerce, production and traffic during periods of high water. These benefits would supplement other benefits but are impracticable to evaluate at this time and have not, therefore, been assigned a monetary value in this memorandum.

112. Total Average Annual Benefits.- The total average annual benefits resulting from operation of the proposed reservoir project are summarized below:

	<u>National Account</u>	<u>Regional Account</u>
Flood Control	\$1,388,000	\$1,388,000
Water Supply	79,000	79,000
Water Quality Control	1,302,000	1,302,000
Recreation, Fish and Wildlife	1,173,000	1,173,000
Expansion	<u>297,000</u>	<u>625,000</u>
Total	\$4,239,000	\$4,567,000

#### SECTION XXVIII - COST ALLOCATION

113. Cost Allocation.- Allocation of costs by the separable cost-remaining benefits method was made for the proposed Stonewall Jackson Lake project. Project purposes considered in the allocation were flood control, water supply, water quality control and recreation. The details of these allocations are contained in Appendix XV of this report. For cost allocation purposes, alternate projects were developed in which tri-purpose and single-purpose projects for flood control, water supply, water quality control and recreation were developed in order to provide the same benefits as attributable to those purposes in the multi-purpose project. A summary of the cost allocation is shown on page 43.

#### SECTION XXIX - PROJECT ECONOMICS

114. Annual Charges.- Total estimated average annual charges are \$3,034,000 as determined earlier in this report.

115. Benefit-Cost Ratio.- A comparison of the average annual benefits to average annual charges results in the following ratios:

	: Without	: With Redevelopment	
	: Redevelopment:	: National	: Regional
Estimated average annual benefits:	\$3,942,000	\$4,239,000	\$4,567,000
Estimated average annual charges :	3,034,000	3,034,000	3,034,000
Benefit-Cost Ratio	: 1.30	: 1.40	: 1.51

TABLE 3

STONEWALL JACKSON LAKE  
ALLOCATION OF COSTS (\$1,000)  
SEPARABLE COSTS - REMAINING BENEFITS METHOD

(July 1970 Cost Level)

Line No.	Item	Flood Control	Water Quality	Water Supply	Recreation	Redevelopment	Total
<u>Allocation of Annual Charges</u>							
1.	Average annual benefits	1,388	1,302	79	1,173	283	4,225
2.	Alternative costs	1,589	1,954	51	1,307	2,747	7,648
3.	Benefit limits	1,388	1,302	51	1,173	283	4,197
4.	Separable costs	265	16	0	754	--	1,035
5.	Remaining benefits (3 - 4)	1,123	1,286	51	419	283	3,162
6.	Allocation of restricted joint costs	--	1,286	51	419	--	1,756
	a. Remaining benefits	--	0,724	0,0290	93	--	1,000
	b. Ratio	--	287	11	93	--	391
7.	Separable plus allocated restricted costs (4 + 6c)	265	303	40	847	--	1,486
8.	Remaining benefits (3 - 7)	1,123	999	10	388	283	2,771
9.	Ratio	0,4053	0,3605	0,0144	0,1177	0,1021	1,000
10.	Allocated joint costs (7 + 10)	536	476	19	155	135	1,321
11.	Total allocated financial cost	601	779	30	1,002	135	2,747
<u>Allocation of O., M., &amp; R. Charges</u>							
12.	Separable O., M. & R. charges	10	3	0	263	--	276
13.	Allocated joint O., M. & R. charges	83	74	3	24	21	205
14.	Total allocated O., M. & R. charges (12 + 13)	93	77	3	287	21	481
<u>Allocation of Investment Costs</u>							
15.	Investment costs (11 - 14)	708	702	27	715	114	2,266
16.	Allocated investment	20,901	20,724	797	21,108	3,366	66,896
17.	Adjustment for future public-use facilities	--	--	--	4,077	--	4,077
18.	Total allocated investment (16 + 17)	20,901	20,724	797	25,185	3,366	70,973
<u>Allocation of Construction Expenditures</u>							
19.	Specific investment costs	--	313	--	18,570	--	18,883
20.	Interest during construction	--	28	--	560	--	588
21.	Investment, joint-use lands & facilities (18 - 19)	20,901	20,411	797	6,615	3,366	52,090
22.	Interest during construction (of line 21)	1,857	1,813	71	588	299	4,688
23.	Construction costs, joint-use lands & facilities (21 - 22)	19,044	18,598	726	6,027	3,067	47,468
24.	Construction costs, specific lands and facilities	--	285	--	9,770	--	10,055
25.	Total allocation (23 + 24)	19,044	18,883	726	15,797	3,067	57,511

1/ Based on average annual cost for multiple purpose project.

116. Comparison With Benefit-Cost Ratio in the Project Document. -

For economic purposes, a comparison of the benefit-cost ratio including redevelopment benefits attributable to the National account was made with the ratio developed in the project document.

	Current July 1970		Project Document (July 1964)	
	With Re- development	Without Re- development	With Re- development	Without Re- development
Estimated average annual benefits	\$4,239,000	\$3,942,000	\$2,464,000	\$2,274,000
Estimated average annual charges	3,034,000	3,034,000	1,442,000	1,442,000
Benefit-Cost Ratio	1.40	1.30	1.71	1.58

The difference in the above comparison of figures can be attributed to the continued increase in prices for construction materials and the high cost of operation and maintenance for a project of this nature. A decrease in recreation benefits was realized by use of a lower unit value for a recreation day.

SECTION XXX - RECOMMENDATIONS

117. Recommendations. - The District Engineer recommends that the Stonewall Jackson Lake, on the West Fork River above Weston, West Virginia, authorized for flood control, water supply, water quality control and recreation be constructed in accordance with the General Plan as outlined in this General Design Memorandum at a total first cost of \$64,300,000 exclusive of \$155,000 for pre-authorization studies, and \$8,240,000 for future recreation.

E. C. WEST  
Colonel, Corps of Engineers  
District Engineer





