



DEPARTMENT OF THE ARMY  
OFFICE OF THE CHIEF OF ENGINEERS  
WASHINGTON, D.C. 20314-1000

REPLY TO  
ATTENTION OF:

DAEN-CWP-A

August 5, 1985

SUBJECT: Roanoke River Upper Basin, Virginia

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Roanoke River Upper Basin, Virginia. It is accompanied by the reports of the Board of Engineers for Rivers and Harbors and the District and Division Engineers. These reports are in partial response to a resolution adopted 3 June 1970 by the Committee on Public Works of the United States Senate. The Committee requested the Board of Engineers for Rivers and Harbors to review the report on the Roanoke River Basin, with particular reference to providing for the integrated and optimum development of the water resources of the Roanoke River Upper Basin.
2. The District and Division Engineers recommended authorization of a flood damage reduction plan for the Roanoke River in the City of Roanoke, Virginia. The plan consists of about 10 miles of channel widening, which would be accomplished by excavation of a "benched" channel adjacent to the existing channel. This channel design would eliminate substantial rock excavation, thus reduce cost; restrict widening, thus enhance bank stability; preserve the existing sediment transport capability; preserve the stream habitat; and improve pedestrian access and recreational value by virtue of the grassed bench (see attached figure). Flood control improvements would also include an earthen levee, three concrete floodwalls, floodproofing of the Roanoke Sewage Treatment Plant and the Roanoke Memorial Hospital, and a flood warning system. Recreation improvements would include a 9-mile-long hiking and biking trail, three pedestrian bridges, 14 picnic tables, and two areas for parking and public access to project lands. Two highway bridges would be replaced and native trees and shrubs would be planted along the channel on project lands.

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3. The Board of Engineers for Rivers and Harbors concurs in the views and recommendations of the reporting officers. The Board finds that the improvements are economically justified, technically sound, and environmentally acceptable. Based on October 1984 price levels, the first cost of the recommended plan is \$20,905,000. Average annual costs, based on an interest rate of 8-3/8 percent, and a 50-year period for economic analysis, are \$1,947,000. Average annual benefits are \$2,739,000 and the benefit-cost ratio is 1.4. The Board further recommends the plan subject to cost-sharing and financing arrangements satisfactory to the President and the Congress.

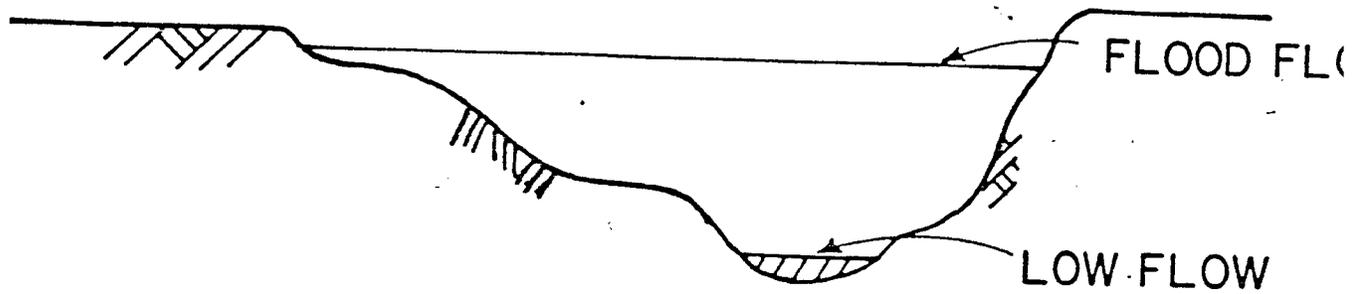
4. I concur in the findings, conclusions, and recommendations of the Board.

5. The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

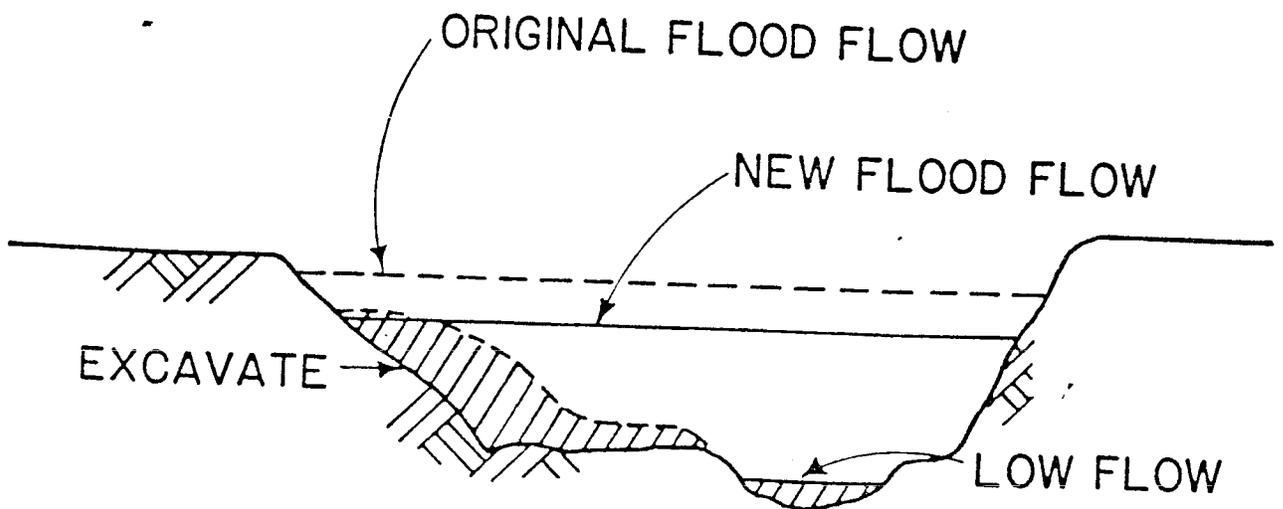
  
E. R. HEIBERG III  
Lieutenant General, USA  
Chief of Engineers

Enclosure

# ROANOKE RIVER UPPER BASIN



TYPICAL EXISTING CROSS SECTION



TYPICAL "BENCHED" CROSS SECTION

ROANOKE RIVER UPPER BASIN, VIRGINIA, HEADWATERS AREA  
SUMMARIZED FINANCIAL DATA (October 1986 Price Level)

	Project First Cost \$000	Traditional Cost-Sharing		Proposed Cost-Sharing	
		Federal \$000(%)	Non-Federal \$000(%)	Federal \$000(%)	Non-Federal \$000(%)
<u>Plan Recommended in the ASA (Civil Works) Report to Congress</u>					
LERR*	6,471		6,471		6,471
Nonstructural at Hospital and Sewage Plant	647		647		647
Nonstructural - Flood Warning Channel/Training Walls, etc.	326	261	65		647
Cash Contribution	13,352	13,352			
<b>SUBTOTAL FLOOD CONTROL</b>	<u>20,796</u>	<u>13,613</u>	<u>7,183</u>	<u>12,638</u>	<u>1,040**</u> 8,158
Recreation - Bridges	N/A	N/A	N/A	N/A	N/A
Recreation - Other	494	247	247	247	247
<b>SUBTOTAL RECREATION</b>	<u>494</u>	<u>247</u>	<u>247</u>	<u>247</u>	<u>247</u>
<b>TOTAL FIRST COST</b>	21,290	13,860	7,430	12,885	8,405**
Rounded First Cost	21,300	13,900	7,400	12,900	8,400

Plan Recommended in the Chief of Engineer's Report

	RR*	Traditional Cost-Sharing		Proposed Cost-Sharing	
		Federal	Non-Federal	Federal	Non-Federal
LERR*	6,471		6,471		6,471
Nonstructural at Hospital and Sewage Plant	647	517	130		647
Nonstructural - Flood Warning Channel/Training Walls, etc.	326	261	65		647
Cash Contribution	13,352	13,352			
<b>SUBTOTAL FLOOD CONTROL</b>	<u>20,796</u>	<u>14,130</u>	<u>6,666</u>	<u>13,285</u>	<u>1,040***</u> 7,511
Recreation - Bridges	466	233	233	233	233
Recreation - Other	494	247	247	247	247
<b>SUBTOTAL RECREATION</b>	<u>960</u>	<u>480</u>	<u>480</u>	<u>480</u>	<u>480</u>
<b>TOTAL FIRST COST</b>	21,756	14,610	7,146	13,765	7,991***
Rounded First Cost	21,800	14,600	7,200	13,800	8,000

\*LERR = Lands, easements, rights-of-way, and relocations

\*\*With proposed cost sharing, the plan recommended to Congress by the ASA (Civil Works) requires that local interests provide LERR (\$6,471,000) a cash contribution (\$1,040,000) equal to 5% of the cost of the flood control features, all of the cost of nonstructural measures for the Roanoke Hospital and the Sewage Treatment Plant (\$647,000), and 50% of the cost of recreation features (\$247,000).

\*\*\*With proposed cost sharing, the plan recommended in the Chief of Engineer's Report requires that local interests provide LERR (\$6,471,000), a cash contribution (\$1,040,000) equal to 5% of the cost of the flood control features, and 50% of the cost of recreation features (\$480,000).

Date: 29 April 1986



DEPARTMENT OF THE ARMY  
BOARD OF ENGINEERS FOR RIVERS AND HARBORS  
KINGMAN BUILDING  
FORT BELVOIR, VIRGINIA 22060

REPLY TO  
ATTENTION OF:

BERH-PLN

21 November 1984

SUBJECT: Roanoke River Upper Basin, Virginia

Chief of Engineers  
Department of the Army  
Washington, DC 20314-1000

Summary of Board Action

The Board finds that improvements for flood control and recreation along the Roanoke River in the City of Roanoke, Virginia, are economically justified and environmentally and socially acceptable. The reporting officers' recommended plan includes about 10 miles of channel widening, a levee and three floodwalls, floodproofing several structures, modification of highway bridges, a flood warning system, and recreation facilities. Native trees and shrubs would be planted along the new channel. Based on October 1984 price levels, the estimated first cost of the recommended plan is \$20,905,000. The benefit-cost ratio is 1.4. The Board recommends the plan in accordance with cost-sharing and financing arrangements satisfactory to the President and the Congress.

Summary of Report Under Review

1. Authority. This interim report is in partial response to a resolution adopted on 3 June 1970 by the Committee on Public Works of the United States Senate. The Committee requested the Board of Engineers for Rivers and Harbors to review the report on the Roanoke River Basin, Virginia and North Carolina, with particular reference to providing for the integrated and optimum development of the water resources of the Roanoke River Upper Basin. The resolution is quoted in the District Engineer's report. That report addresses only the headwaters area of the basin. A final report on the other portions of the Roanoke River Upper Basin will be submitted later.

2. Description of the study area. The study area is in south-central Virginia and encompasses about 510 square miles in the headwaters of the Roanoke River Basin. The area includes the Cities of Roanoke and Salem, the Town of Vinton, most of Roanoke County, and portions of Botetourt, Floyd, and Montgomery Counties. The area is bordered on the east and south by the Blue

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Ridge Mountains and by the Appalachian Mountains on the west and north. Topography is characterized by high mountain ridges, narrow valleys, and steep stream gradients. Approximately 60 percent of the area has slopes greater than 25 percent, which is generally too steep for extensive development. Therefore, most of the development has occurred in the valleys and floodplains. About 65 percent of the area is forested, with mixed hardwoods being the dominant species.

3. The headwaters area is rich in fish and wildlife resources. Streams are characterized by rock and gravel bottoms, moderate to swift currents, and a combination of run, riffle, and pool habitats. Overall, the streams provide a good aquatic habitat with high species diversity and abundance. Forests and open land also provide good wildlife habitat supporting diverse and abundant bird and small mammal populations. No Federally listed or proposed endangered or threatened species are known to exist in the area.

4. Economic development. Economic activity is centered in the Roanoke-Salem metropolitan area located in a broad valley in the south-central portion of the study area. The urban center consists of Roanoke, Salem, Vinton, and a portion of Roanoke County. The 1980 population of the headwaters area was about 240,000, with about 65 percent of those people living in the Roanoke-Salem metropolitan region. Also, in 1980, this urban center accounted for 70 percent of the employment in the headwaters area. The primary industrial activity is manufacturing. The Roanoke-Salem metropolitan area is a popular center for conventions; and tourists are attracted by the many national and State forests and wilderness areas, scenic trails and parkways, campgrounds, and resorts located in south-central Virginia.

5. Existing and authorized improvements. A channel improvement project was constructed in 1972 by the U.S. Army Corps of Engineers on Lick Run in the City of Roanoke. The U.S. Department of Agriculture, Soil Conservation Service, has an authorized watershed protection plan for the South Fork Roanoke River in Montgomery County, Virginia. Local interests have constructed a levee along the left bank of the Roanoke River near Cleveland Avenue in Roanoke to protect several industries from flooding.

6. Problems and needs. Water resources needs involve water supply, flood damage reduction, hydropower, recreation, and environmental conservation. The most critical short-term need is solution of the flooding problems, particularly in the Cities of Roanoke and Salem. Total average annual damages in the headwaters area are about \$5.2 million, of which \$4.2 million occurs

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in the City of Roanoke. The metropolitan area has a long history of flooding, and there have been four major floods in the last 45 years. The flood of June 1972, which was estimated to be a 30-year frequency event, resulted in about \$11.6 million in damages. A 100-year frequency flood event would cause about \$90 million in damages to about 800 buildings. Approximately 3,800 acres of land and about 3,300 properties are in the floodplain, and those properties have a total value of about \$1 billion.

7. Improvements desired. Local interests desire assistance in reducing existing flood damages, providing additional recreational facilities, and in conserving fish and wildlife habitats and esthetic values along the Roanoke River, particularly in the Cities of Roanoke and Salem. Development of both hydroelectric power generating facilities to meet future energy demands and reservoirs to meet future water supply demands is also desired.

8. Alternatives considered. A variety of structural and non-structural measures were considered to meet the needs of the headwaters area. A total of 12 reservoir plans were evaluated which would satisfy water supply and hydropower needs, provide recreation and environmental conservation opportunities, and reduce flood damages. In addition, seven channel plans and a nonstructural floodplain evacuation plan were considered to reduce flood damages in the Cities of Roanoke and Salem.

9. During the study, it was found that local interests have plans to construct an offstream water supply reservoir which will meet the projected needs in the Roanoke-Salem metropolitan area through the year 2040. Recent data also showed that additional electrical power generating facilities would not be needed until the year 2015. Due to the reduced need for additional water supply and hydropower facilities, none of the reservoir plans were found to be economically feasible. In May 1983, the City of Salem decided not to participate in a project within the City. As a result, local protection plans were modified to include only those elements which would be supported by the City of Roanoke.

10. Plan of improvement. The plan proposed by the District Engineer, Plan 2C Modified, would provide varying levels of flood protection along the Roanoke River. Elements of the proposed project are as follows:

a. A 10-mile-long benched channel would be constructed from a point about 2,000 feet downstream of the eastern Roanoke city limit to the western Roanoke city limit. Under normal conditions, water would continue to flow through the existing natural channel, and only spill over onto the benched channel during

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flood events. The benched channel would be excavated to about 2 to 4 feet above the existing river bottom. The total bottom width of the modified channel, including the benched portion, would be about 185 feet. Generally, channel excavation would be confined to one side of the river. Riprap or concrete slope protection would be placed along the benched channel slopes in areas subject to erosion. The channel modification requires replacement of two highway bridges. Openings under many other highway and railroad bridges along the Roanoke River would be enlarged to improve their capacity to pass floodflows. The channel provides a wide range of flood protection varying between a 10-year to 100-year frequency level.

b. An earthen levee, about 10 feet high and 2,400 feet long, would be constructed along the left bank of the river to provide an 80-year frequency level of protection to a commercial and industrial area near Cleveland Avenue.

c. A series of three concrete floodwalls, with a total length of about 4,150 feet and ranging from 2 to 8 feet high, would be constructed along the left bank of the river to provide a 43-year frequency level of protection to a commercial, industrial, and recreation area near Victory Stadium.

d. The City of Roanoke Sewage Treatment Plant and the Roanoke Memorial Hospital would be floodproofed by installation of 6-foot-high concrete floodwalls. The treatment plant and hospital would be provided with 100-year and 400-year level frequency protection, respectively.

e. A flood warning system would be developed for the City of Roanoke.

f. A 9-mile-long hiking/biking trail, 14 picnic tables, and 2 areas for parking and public access would be provided along the benched channel.

g. Native trees and shrubs would be planted for landscaping along project rights-of-way and at disposal areas.

11. Economic evaluation. Based on October 1983 prices, the District Engineer estimates the first cost of the proposed project to be \$20,302,000, including \$896,300 for recreational access lands and facilities. Annual costs, based on a 8-1/8 percent interest rate and a 50-year period for economic analysis, are \$1,843,600, including \$82,000 for operation and maintenance. Average annual benefits for flood damages prevented and recreation are estimated at \$2,610,700, and the benefit-cost ratio is

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1.4. The recommended plan is the plan which maximizes net National Economic Development (NED) benefits.

12. Project effects. The proposed project would reduce flood stages from about 2 to 4 feet for all floods up to the Standard Project Flood event. About 415 acres and 260 structures would no longer be in the 100-year frequency floodplain, while damages from that flood event would be reduced by about 40 percent. Existing average annual damages in the City of Roanoke and a portion of the City of Salem would be reduced about 50 percent to \$2,063,800. About 290 acres of land would be affected by the project, including 163 acres for construction, 124 acres for disposal of excavated materials, and 3 acres for parking and public access. Most environmental impacts are short-term and are the result of changed habitat, such as from woodlands to grassed areas. There would be a net loss of 28 acres of wooded habitat and a net gain of 11 acres of grassed habitat. Flood protection would directly enhance the welfare and security of people working and living in the area by eliminating frequent flooding and the burden of repeated repairs and replacement of damaged property. The trail system and additional picnicking facilities would also enhance recreational opportunities and improve the general well-being of people in the study area.

13. Recommendation of the reporting officers. The District Engineer recommends authorization for flood protection along the Roanoke River at the City of Roanoke, Virginia, generally in accordance with the plan described in his report and subject to cost-sharing and financing arrangements satisfactory to the President and the Congress. The Division Engineer concurs.

Review by the Board of Engineers for Rivers and Harbors

14. General. The scope of the Board's review encompassed the overall technical, economic, social, and environmental aspects involved in improvements proposed by the reporting officers. The Board considered whether the report and its technical supporting documentation conformed to the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies and to other applicable administrative and legislative policies and guidelines. The Board also considered the views of interested parties, including Federal, State, and local agencies.

15. Responses to the Division Engineer's public notice. In response to the Division Engineer's public notice, dated 30 March 1984, letters were received from representatives of the Roanoke Archeological Society, the American Canal Society, the Virginia Research Center for Archaeology, and a private archaeologist from

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Salem, Virginia. Each expressed concern for the adequacy of the study's cultural resources survey and concern that the proposed project would have adverse effects on cultural resources. The reporting officers have considered the information provided by these groups, and have indicated that additional archeological investigations will be conducted prior to construction to determine if there are significant archeological deposits in the project area. The reporting officers also plan to implement measures to mitigate for any effects the recommended plan would have on significant cultural resources.

16. Findings and conclusions. The Board of Engineers for Rivers and Harbors concurs in the findings and recommendation of the reporting officers. The recommended improvements are economically justified, engineeringly feasible, and do not have adverse environmental impacts. The recommended plan will reduce financial losses, health hazards, and the risk to human life and safety associated with existing flood problems.

17. The recommended plan was selected from a full range of structural and nonstructural alternatives and is acceptable to local interests. Separable increments of the recommended plan are justified and the overall plan maximizes net benefits.

18. Based on October 1984 price levels, the total first cost of the proposed project is \$20,905,000, of which \$14,040,000 would be Federal and \$6,865,000 would be non-Federal under traditional cost-sharing policies. The first cost of flood control features is estimated at \$19,982,000, while the first cost of recreation facilities and lands for parking and public access is \$923,000. Average annual charges, based on an interest rate of 8-3/8 percent and a 50-year period for economic analysis, are \$1,947,000, including \$83,000 for operation and maintenance. Average annual benefits are estimated at \$2,739,000, including \$2,147,000 for prevention of existing flood damages, \$42,000 for prevention of future flood damages, and \$550,000 for recreation. The benefit-cost ratio is 1.4.

19. The Administration's policy on water project financing and cost sharing is that all Federal water development agencies will continue to seek out new partnership arrangements with the states and other non-Federal interests in the financing and cost sharing of the proposed projects. Each such agency will negotiate reasonable financing arrangements for every project within its respective area of responsibility. In addition, prior commitments to individual states with regard to water development within their borders will be considered and shall be a factor in negotiations leading up to project construction; and, consistency in cost sharing for individual project purposes, with attendant

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equity, will be sought. Project beneficiaries, not necessarily governmental entities, should ultimately bear a substantial part of the cost of all project development.

20. Recommendation. The Board recommends that flood control and related recreation improvements along the Roanoke River in the City of Roanoke, Virginia, be authorized for Federal implementation generally in accordance with the reporting officers' plan, with such modifications as in the discretion of the Chief of Engineers may be advisable, and subject to cost-sharing and financing arrangements satisfactory to the President and the Congress. This recommendation is made with the provision that, prior to implementation, local interests will, in addition to the general requirements of law for this type of project, agree to comply with the following requirements:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas and disposal areas determined suitable by the Chief of Engineers and necessary for implementation and operation and maintenance of the project;

b. Accomplish without cost to the United States all alterations and relocations of buildings, transportation facilities, utilities, storm drains, and other structures and improvements made necessary by implementation of the project;

c. Provide a cash or in-kind contribution of lands, easements, and rights-of-way equal to 20 percent of the separable costs of floodproofing and the flood warning system;

d. Provide a cash or in-kind contribution of lands, easements, and rights-of-way equal to 50 percent of the separable cost of recreation facilities;

e. Hold and save the United States free from damages due to construction, operation, maintenance, and public use of the project, not including damages due to the fault or negligence of the United States or its contractors;

f. Maintain and operate the project after completion, including recreation facilities and the floodwarning system, in accordance with regulations prescribed by the Secretary of the Army;

g. Administer and assure access to the recreational facilities and lands to all on an equal basis;

h. At least annually, inform affected interests regarding the limitations of the protection afforded by the project;

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i. Publicize floodplain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to insure compatibility between future development and protection levels provided by the project; and

j. Prior to initiation of construction, prescribe and enforce regulations to prevent obstruction or encroachment on channels and interior ponding easement areas which would reduce their flood-carrying capacity or would interfere with maintenance and operation of the project, and to control development in the project area to prevent an undue increase in the flood damage potential.

21. The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

FOR THE BOARD:



N. G. DELBRIDGE, JR.  
Major General, USA  
Chairman