87th Congress, 2d Session House Document No. 508

CAPE FEAR RIVER BASIN, NORTH CAROLINA

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED JULY 16, 1962, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A REVIEW OF THE REPORT ON CAPE FEAR RIVER BASIN, NORTH CAROLINA, REQUESTED BY A RESOLUTION OF THE COMMITTEE ON FLOOD CONTROL, HOUSE OF REPRESENTATIVES, ADOPTED MAY 2, 1946

AUGUST 8, 1962.—Referred to the Committee on Public Works and ordered to be printed with five illustrations

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1962

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C.

IN REPLY REFER TO:

August 3, 1962

Honorable John W. McCormack

Speaker of the House of Representatives

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 16 July 1962, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on a review of the report on Cape Fear River Basin, North Carolina, requested by a resolution of the Committee on Flood Control, House of Representatives, adopted 2 May 1946.

In accordance with Section 1 of Public Law 534, 78th Congress, Public Law 85-624 and Public Law 87-88, the views of the State of North Carolina, the Department of the Interior and the Public Health Service are set forth in the inclosed communications. The views of the Departments of Agriculture and Commerce, and the Federal Power Commission are inclosed. Pertinent replies of the Chief of Engineers to the above comments are inclosed also.

The Bureau of the Budget advises that there is no objection to the submission of the report to the Congress; however, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Bureau of the Budget is inclosed.

Sincerely yours,

Cyrus Vance

Secretary of the Army

1 Incl (dup)
Rept w/accompg
papers & illus

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
WASHINGTON 25, D. C.

Honorable Cyrus R. Vance
Secretary of the Army
Washington 25, D. C.

July 27, 1962

Dear Mr. Secretary:

Assistant Secretary Schaub's letter of July 19, 1962, submitted the proposed report of the Chief of Engineers on Cape Fear River Basin, North Carolina, in response to a resolution of the Committee on Flood Control, House of Representatives, adopted May 2, 1946.

The Chief of Engineers recommends that the general plan of development of the Cape Fear Basin be approved as a guide for immediate and future water resources conservation, and specifically that the New Hope project, a multiple-purpose dam and reservoir on the Haw River, be authorized for construction in the interest of flood control, water supply, water quality control, recreation, and other purposes. The estimated construction cost is $25,462,000, and operation, maintenance, and replacement expenses are estimated to be $100,000 annually. In addition to certain stated conditions of cooperation, local interests would be required to repay the costs allocated to water supply, presently estimated at $319,000, in accordance with the Water Supply Act of 1958 and to pay $8,000 annually for operation, maintenance, and replacements. The benefit-cost ratio is stated to be 2.5. The Chief of Engineers further recommends that authority be granted to continue the Cape Fear River Basin studies.

In commenting on the proposed report, the State of North Carolina fully concurred in these recommendations and states "The proposed comprehensive plan for the current and future development of the water resources of the Cape Fear River Basin is considered to be sound and in the best interest of the region, the state, and the nation."

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the report to the Congress. However, no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project, if it is authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation.

Sincerely yours,

Carl H. Schwartz, Jr.
Chief, Resources and Civil
Works Division

April 25, 1962

Lieutenant General W. K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

This Department has reviewed your proposed report, together with the reports of the Board of Engineers for Rivers and Harbors, and of the District and Division Engineers, on a review of the report on the Cape Fear River Basin, North Carolina, which were transmitted with a letter from your office dated April 20, 1962.

The North Carolina Wildlife Resources Commission concurs in the views and recommendations of the U. S. Fish and Wildlife Service contained in the report.

The proposed comprehensive plan for the current and future development of the water resources of the Cape Fear River Basin is considered to be sound and in the best interest of the region, the state, and the nation. If adopted, it will open up a new era of development for this area, which contains approximately one-fourth of the state's population, and will provide the means for its continued and progressive economic growth. Its adoption and the prompt construction of the New Hope Dam are of the utmost importance to the welfare of the state.

This Department, on behalf of the State of North Carolina, fully concurs in the recommendations contained in your proposed report and urges their accomplishment at the earliest practicable date.

Sincerely yours,

Harry E. Brown

Harry E. Brown

COMMENTS OF THE DEPARTMENT OF THE INTERIOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

6 July 1962

Lt. General Walter K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

This is in reply to General Cassidy's letter of April 20, transmitting for our comment reports on Cape Fear River Basin, North Carolina. The reports recommend that the New Hope Project on the Haw River be authorized in the interest of flood control, water supply, water-quality control, recreation and other purposes, at a net Federal cost of $25,462,000.

The Bureau of Sport Fisheries and Wildlife commented on the tentative plans for New Hope Dam and Reservoir project in a report dated March 12, 1962. That report placed a monetary value on the fishery benefits created but, in keeping with the legislative intent of the Fish and Wildlife Coordination Act, did not so evaluate stream fish and wildlife losses. Neither did that report consider other elements in the comprehensive plan for which the Corps of Engineers requests approval.

The Bureau notes that the District Engineer apparently assigned a value of $1 per day to the estimated number of man-days of hunting lost as a result of the project, subtracting this total from the value of increased fishing use to obtain a net benefit. As stated, it is the policy of the Bureau of Sport Fisheries and Wildlife not to evaluate losses but develop recommendations which will prevent their occurrence. This is consistent with the statement by the Senate Committee on Interstate and Foreign Commerce in Senate Report 1981 (85th Congress) to the effect that dollar estimates of fish and wildlife losses would not be required by the Fish and Wildlife Coordination Act.

In his report, the District Engineer stated that careful consideration will be given to the suggestions of the Fish and Wildlife Service if a Design Memorandum for the New Hope project is prepared. The Bureau of Sport Fisheries and Wildlife indicates that it will have no objection

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to submission of the favorable report on the plan contained in the District Engineer's report of October 30, 1961, if assurances can be given by the Chief of Engineers that the Corps of Engineers will make available project lands for mitigation of wildlife losses and will modify the outlet works, as required, to provide downstream releases of adequate quality to protect the fishery.

Apparently no interests of the National Park Service would be affected by the project, with the possible exception of archeological evidence. It appears that archeological remains exist at the confluence of the Haw and Cape Fear Rivers. The scenic qualities and natural values which might be destroyed in the reservoir site are not outstanding.

The District Engineer should keep the Regional Director of the Service advised of progress on the project so arrangement can be made to survey, salvage and preserve such archeological remains as may be necessary to comply with provisions of Public Law 86-523, June 27, 1960 (74 Stat. 220).

The report appears to consider adequately the recreation potential of the New Hope Reservoir, the only reservoir of the Cape Fear River Basin on which Service cooperation was requested. However, it is not evident from the report whether the proposed acquisition of land coincides with the February 21 joint policies of land acquisition. Neither can a specific analysis and comparison be made between benefit and cost estimates of the Service and the Corps relating to proposed recreation use and development.

For these reasons and since the Corps' report predates the February joint policies agreement, we suggest that the Corps may wish to restudy the recreation resources and potential of the New Hope Reservoir to assure that adequate lands and facilities will be provided to meet the immediate and foreseeable future needs for public recreation purposes.

We appreciate the opportunity to present our views.

Sincerely yours,

Assistant Secretary of the Interior

LETTER TO THE SECRETARY OF THE INTERIOR

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

IN REPLY REFER TO
ENGCW-PD

16 July 1962

The Honorable Stewart L. Udall

The Secretary of the Interior

Dear Mr. Secretary:

Reference is made to the recent letter from the Assistant Secretary of the Interior commenting on the report of the Chief of Engineers on Cape Fear River Basin, North Carolina.

You may be assured that if the New Hope project, recommended in the report, is authorized and detailed planning is undertaken, careful consideration would be given to the comments of the Fish and Wildlife Service with the view to mitigating or offsetting prospective fish and wildlife losses to the extent that measures to accomplish that objective are justified. I concur in your interpretation of the Fish and Wildlife Coordination Act as expressed in Senate Report 1981, 85th Congress, that such justification would not have to be made, as in the usual instance, by comparing dollar estimates of economic losses with the costs for remedial measures. However, I do not consider that this interpretation precludes an economic analysis of this matter as an aid to judgement, should this prove to be desirable and feasible.

I also assure you that the recreational potential of the New Hope project would be explored fully in the planning stage of the project in accordance with the spirit and intent of the 21 February 1962 joint policies of the Departments of the Interior and Army on land acquisition.

Your comments on the report are appreciated. Copies of your letter and this reply will accompany the report to Congress.

Sincerely yours,

(Signed)

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

COMMENTS OF THE PUBLIC HEALTH SERVICE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

PUBLIC HEALTH SERVICE — WASHINGTON 25, D. C.

BUREAU OF STATE SERVICES

Refer to:

May 24, 1962

Major General Walter K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

This is in reply to General Cassidy's letter of April 20, 1962, requesting comments on the U. S. Army Engineers' Report on Cape Fear River Basin, North Carolina.

Comments contained in the letter from the Regional Office to the District Engineer, dated February 16, 1962, and included as attachment "C" to the Corps report, are still applicable. It is to be noted that the Public Health Service evaluated benefits only for the New Hope Reservoir and that water supply and water quality control benefits are also assigned to the Randleman, Howards Mill and other proposed projects. Page 62 of the Corps report indicates that benefits established by the Public Health Service for the New Hope project were extended to a 100-year basis by the Corps of Engineers by assuming that the rate of growth of benefits for the second 50-year period would remain the same as during the first 50-year period.

The Public Health Service reports, dated May 1959 and March 1961 (included as Appendix VI in the Corps report), were of a preliminary nature and were transmitted to the District Engineer with the recommendation that a more detailed study be undertaken and benefits re-evaluated prior to construction of the New Hope project.

The top of the conservation pool in the New Hope project would be at elevation 212, while the conduit for discharge of normal stream flow would be at elevation 166. Thus, water would be drawn from a depth of 46 feet and could be deficient in oxygen content during periods of reservoir stratification. Means of maintaining adequate dissolved oxygen concentrations in discharged waters are to be recommended. This could be accomplished by means of a multiple-level outlet structure, or similar means. Experience with Kerr Dam and other structures on the Roanoke and Catawba Rivers in North Carolina indicates that this is an extremely important factor to be considered if adequate water quality is to be maintained.

Power generation is suggested for possible inclusion in the New Hope project. Since such power would most likely be generated for peaking purposes,

provision for re-regulation of water quality flows should be included in the event power becomes a part of the project.

We are in agreement with comments received from the State of North Carolina as follows: (A) The proposed depth of discharge through the New Hope Dam may result in low dissolved oxygen concentrations and high manganese and iron concentrations. (B) The proposed reservoir clearing will leave large amounts of vegetation which may make it impossible to maintain the "A-II" (water supply) classification of the river below the project due to tastes and odors. (C) North Carolina legal requirements would be fulfilled (pertaining to reservoir clearing) if all trees in New Hope Reservoir were cut off at, or below, elevation 199, but in the interest of public health, efficiency and economy it is recommended that the entire reservoir below elevation 214 be cleared. This is recommended to effectively control mosquitoes which transmit malaria and encephalitis and which occur in the reservoir area.

Our recommendations regarding vector control are as follows: (A) That vector prevention and control measures be incorporated into the design or planning stage of the reservoir project; (B) that plans for reservoir clearing be concurred in by the North Carolina State Board of Health; (C) that borrow areas be permanently inundated or made self-draining; (D) that water-retaining depressions within the flood control zone be connected with the reservoir by drains; (E) that seepage areas be eliminated by providing drains to natural channels; (F) that vegetation of a type and density favorable for mosquito production be periodically controlled; and (G) that provision be made for supplemental use of insecticides in situations where adequate vector control is not obtained through source reduction measures outlined above.

The opportunity to review the report is appreciated. We stand ready to provide consultation concerning vector control, water supply and pollution control aspects of the project on your request.

Sincerely yours,

Keith S. Krause

Keith S. Krause
Chief, Technical Services Branch
Division of Water Supply and
Pollution Control

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

IN REPLY REFER TO
ENGCW-PD

2 July 1962

Mr. Gordon E. McCallum
Chief, Division of Water Supply
and Pollution Control
Public Health Service
Department of Health, Education
and Welfare

Dear Mr. McCallum:

Reference is made to the recent letter from Mr. Keith S. Krause, Chief Technical Services Branch, commenting on the report of the Chief of Engineers on the Cape Fear River Basin, North Carolina.

Concerning the projects at Randleman, Howards Mill and the others in the comprehensive plan which were not recommended for authorization at this time, consideration was given, in accordance with sound project formulation, to purposes which would serve the basic objective of future water resource development of the Cape Fear River Basin. Accordingly, storage for water supply and water quality control to serve growing needs of the area was included in the reservoir projects for evaluation and future planning.

The importance of maintaining an adequate concentration of dissolved oxygen in the discharge water is appreciated and suitable outlet works will be considered in the design of the New Hope Reservoir, if authorized. Peak power generating facilities at New Hope were not found warranted at this time. However, the possibility of generating a small amount of generally continuous power incidental to discharges for low flow augmentation also will be investigated in greater detail.

Criteria for clearing the reservoir will be examined further and will, of course, be in accord with legal requirements of the State of North Carolina.

You may be assured that these and other matters requiring investigation, in the design phase of the New Hope Project and for subsequent project authorization, will be fully coordinated with the Public Health Service.

Your comments on the report and your offer of consultation are appreciated. Copies of your letter and this reply will accompany the report to Congress.

Sincerely yours,

(Signed)

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

COMMENTS FROM THE DEPARTMENT OF AGRICULTURE

DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

May 25, 1962

Honorable Elvis J. Stahr, Jr.
Secretary of the Army

Dear Mr. Secretary:

This is in reply to the Acting Chief of Engineers' letter of April 20, 1962, transmitting for our review and comment his proposed review survey report on the Cape Fear River Basin, North Carolina.

The report recommends a general plan of development to meet the immediate and future water resource needs of the Cape Fear River Basin. As the first element of the plan, the report recommends for immediate construction, a dam and reservoir at the New Hope site on the Haw River. According to the report the proposed New Hope Project will provide for flood control, water supply, water quality control, recreation, and other purposes not specifically identified.

The data presented in the report indicates that the New Hope Reservoir will have a gross storage capacity of 660,000 acre-feet. Of this amount, 541,000 acre-feet will be for flood control, 72,000 acre-feet for low-flow regulation, and 47,000 acre-feet for sediment storage in the year 1965. The report estimates that by the year 2015, of the gross storage of 660,000 acre-feet, 476,000 acre-feet will be for flood control, 127,000 acre-feet for low-flow regulation and municipal water supply, 10,000 acre-feet for irrigation, and 47,000 acre-feet for sediment storage.

The total first cost of the New Hope Project is estimated to be $25,612,000, of which $319,000, the cost allocated to water supply, will be borne by non-Federal interests.

The other features of the general plan of development recommended in the report to be carried out between the years 1965 to 2065 provide for:

1. A dam and reservoir at the Randleman site on the Deep River. The reservoir would have a gross storage capacity of 98,000 acre-feet of which 54,000 acre-feet would be for flood control, 36,000 acre-feet for water supply, 4,000 acre-feet for irrigation, and 4,000 acre-feet for sediment storage;

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reservoir would have a gross storage capacity of 163,000 acre-feet, of which 130,000 acre-feet would be for flood control, 23,000 acre-feet for low-flow regulation, and 10,000 acre-feet for sediment storage; and

3. An unspecified number of "small" reservoirs at undetermined locations throughout the Cape Fear River Basin. These reservoirs ultimately would have an aggregate gross storage capacity of 923,000 acre-feet, of which 335,000 acre-feet would be for flood control, 207,000 acre-feet for municipal water supply, 96,000 acre-feet for low-flow regulation, 96,000 acre-feet for irrigation, and 41,000 acre-feet for sediment storage.

The estimated total first cost of the comprehensive program, based on 1960 prices, is $72,357,000. Average annual benefits, also based on 1960 prices, are estimated to be $4,744,000 by the year 2065 when the total program is installed. The report also estimates that the total storage needs for all purposes by the year 2065 will be 1,844,000 acre-feet.

The report is unique in the presentation of a program of development phased to meet the estimated needs of specific areas of the basin for a 100-year period in the future. However, the report does not provide information with respect to the specific areas where the water stored for municipal supply in the New Hope Reservoir, recommended for immediate construction, will be used nor the local entities of government that have indicated they will assume the costs allocated to such storage in accordance with the provisions of the Water Supply Act of 1958.

The Department of Agriculture would agree to the recommendation in the report to continue studies for the development of a comprehensive program of small reservoirs in the tributaries of the Haw, Deep, and Cape Fear Rivers if it is changed to provide that this study shall be undertaken by the Department of Agriculture in consultation with the Corps of Engineers. Benefits from such a system of small reservoirs would be primarily to agricultural lands and rural communities. Such improvements are obviously of the type which the Congress has provided for under the programs of this Department such as the Watershed Protection and Flood Prevention Act, Public Law 566, 83d Congress, as amended. Authorization for the Corps of Engineers to plan an unspecified number of small reservoirs at undesignated places would preclude this Department from providing assistance to local organizations to plan and install complete watershed treatment programs in the Cape Fear Basin during the next hundred-year period.

The report refers to the joint study of the Cape Fear River Basin by the Corps of Engineers, the Soil Conservation Service, and the State of North Carolina which was initiated in 1957. A joint report of this land and

water resource study was completed in 1961 and provided to members of the Congress and to interested individuals and organizations. The joint report presents two alternative plans for water resource development in the Cape Fear River Basin. Plan A, consisting of a relatively large reservoir at the New Hope site, was investigated by the Corps of Engineers. This plan is essentially the New Hope Reservoir Project now recommended in the Chief of Engineers' report. Plan B, consisting of 232 small and intermediate size reservoirs, was investigated by the Soil Conservation Service.

The Department of Agriculture, in the course of this study, obtained a considerable volume of information with respect to the resources, needs, and potential methods of development of the Cape Fear River Basin. This information is the basis of the following comments with respect to certain aspects of the Chief of Engineers' report:

1. The total average annual project benefits from the New Hope Reservoir were estimated to be $1,762,000 in the joint report. The total average annual project benefits from the New Hope Reservoir in the Chief of Engineers' report are now estimated to be $2,340,000.

2. In the joint study, agencies of the Department of Agriculture carried out detailed investigations of agricultural damages in Reach No. 1 of the Cape Fear River. This area has the largest damage from flooding to agricultural resources in the basin. These studies included measurement of recent aerial photographs to determine the area of the land in the flood plain subject to flooding. This method provides the most accurate map measurement of such areas that can be used at the present time. These measurements established the total area subject to flooding as 102,800 acres, and this value was used in the determination of flood-damage reduction benefits for the joint report. However, the Chief of Engineers' report now estimates the area subject to flooding in this damage reach to be 122,800 acres. Crop yields, crop acreages, prices, and production costs used in the evaluation of agricultural flood damages in the Chief of Engineers' report are such as result in significantly higher estimates than were developed by agencies of this Department and used in the joint report. We suggest that the Chief of Engineers re-examine the estimates, used in the report, of flood damage reduction benefits to agricultural lands and improvements in this damage reach.

3. Significant recreation benefits are attributed to the proposed New Hope Reservoir. However, the report indicates that the pollution factor would render this reservoir unsuitable for water-associated recreation activities such as swimming and water skiing. The pollution factor may also adversely affect the use of the reservoir for fishing. In view of these considerations, it appears that full realization of the recreation benefits would necessarily be postponed until some much later date when reservoirs were constructed in the upper Haw River Basin to provide sufficient dilution to reduce the pollution load to tolerable limits.

4. The New Hope Reservoir would provide for the needs for flood protection, municipal and industrial water supply, and water quality control for the area downstream from the confluence of the Deep and Haw Rivers. The principal urban damage center at Fayetteville would be afforded an adequate level of flood protection by this project. However, the total needs of the basin from water resource development would not be achieved until the total program recommended in the Chief of Engineers' report is installed. Flood control was the major element considered in the joint studies. The analysis of the alternatives considered in this study indicated that large reductions in the flood hazard on the main stem could be brought about by either of the methods of development. These studies did not indicate a clear-cut economic advantage for either plan with respect to flood damage reduction on the main stem. However, the studies did not reveal an economic justification, based on benefits from flood damage reduction, for the installation of all of the elements of both plans. It appears that the comprehensive program recommended in the Chief of Engineers' report, which is essentially a combination of the elements of both plans, is dependent on benefits which will accrue from purposes other than flood control. The estimated benefits which are presented in the report to establish the economic feasibility of such a plan are based on broad assumptions of developments in the basin which are expected to take place in the next 100 years.

In view of these and other factors, the Department of Agriculture believes that the data presented in the report do not conclusively show that the comprehensive plan of improvements recommended by the Chief of Engineers will provide the most feasible method for the development of the land and water resources of the Cape Fear River Basin.

Thank you for providing this report for our review.

Sincerely yours,

Frank J. Welch

Frank J. Welch
Assistant Secretary

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LETTER TO THE SECRETARY OF AGRICULTURE

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

IN REPLY REFER TO
ENGCW-PD

3 July 1962

The Honorable Orville L. Freeman

The Secretary of Agriculture

Dear Mr. Secretary:

Reference is made to recent letter from the Assistant Secretary of Agriculture commenting on the report of the Chief of Engineers on the Cape Fear River Basin, North Carolina.

We appreciate the earnest efforts and contribution of your Department in the joint study to the formulation of the comprehensive plan for the Cape Fear River Basin. As part of our recommendation for authority to continue studies toward accomplishment of the overall plan, we propose that, within the purview of Public Law 566 as amended, flood prevention and drainage measures, land stabilization, and watershed protection and management should be accomplished with the assistance of Federal programs under the direction of the Department of Agriculture. We believe that these measures and others in the plan, related to the Federal interest, should be accomplished by the agencies having primary responsibility and in consultation with other interested agencies.

Concerning the estimates of benefits, further detailed investigation was made of the economic analysis period for improvements and of future growth of urban areas and industry in the vicinity of Fayetteville.

The economic analysis in the current report is based on a 100-year period over which it is considered that the New Hope project would serve. In consideration of future urban and industrial development, benefits were credited to the projects for this purpose in addition to enhancement of lands for agriculture, which was evaluated in the joint study.

The area in the flood plain of Reach No. 1 was planimetered from U. S. Geological Survey maps at 123,500 acres. This value was noted in the joint study and in our current report.

Full realization of recreational potential in the New Hope Reservoir will only be obtained with water of high quality in the reservoir. However, we believe that the conservation pool will form an attractive lake and the recreational benefits evaluated on the basis of anticipated conditions are conservative.

Suitable assurances have now been furnished by local interests in North Carolina that they will bear the cost allocated to water supply of the New Hope Dam and Reservoir, in accordance with the Water Supply Act of 1958 as amended.

Your comments on the report are appreciated. Copies of your letter and this reply will accompany the report to Congress.

Sincerely yours,

(Signed)

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

COMMENTS OF THE DEPARTMENT OF COMMERCE

THE UNDER SECRETARY OF COMMERCE
FOR TRANSPORTATION
WASHINGTON 25, D.C.

31 May 1962

Lieutenant General W. K. Wilson, Jr., USA
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

As requested in General Cassidy's letter of April 20, 1962, I am transmitting herein the comments of the interested Department of Commerce agencies on your proposed report on the Cape Fear River Basin, North Carolina.

The Coast and Geodetic Survey advises that sufficient basic horizontal and vertical control are readily available in the basin area and that the construction of the New Hope Dam will not require the relocation of existing control monuments. The Coast and Geodetic Survey recommends that future land surveys conducted in the Cape Fear River Basin area be connected with the national geodetic network.

The Bureau of Public Roads notes that the construction of the New Hope Dam and Reservoir will necessitate the relocation of two primary State highways and a number of secondary highways and that the cost of this highway relocation has been included as a project cost. It is assumed that these highways will be reconstructed to the then current standards for the traffic existing at the time the highways are rebuilt and that the alignment of the relocations will be coordinated with the local highway authorities.

The Weather Bureau notes that an evaporation rate of 40.07 inches based on a 33-year record of the Weather Bureau "Class A" pan at Chapel Hill has been used in the report (Item 45, Page 25). The Weather Bureau would like to point out that the Chapel Hill pan was moved to a new location in 1950. The Weather Bureau feels that the evaporation rate at the new location (approximately 55 inches for the period 1950-1959) is more representative of actual conditions. This rate is consistent with that given in the Weather Bureau's technical paper "Evaporation Maps of the United States." It is also suggested that Section VIII of the report should mention the Weather Bureau's flood forecasting service as one of the means of reducing flood losses.

Your courtesy in providing a copy of this report for our review is appreciated.

Sincerely yours,

Frank L. Barton

Frank L. Barton
Deputy Under Secretary
for Transportation

FEDERAL POWER COMMISSION
WASHINGTON 25, D.C.

June 22, 1962

Lieutenant General W. K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Reference: ENGCW-PD

Dear General Wilson:

This is in reply to General Cassidy's letter of April 20, 1962, inviting comments by the Commission relative to your proposed report and to the reports of the Board of Engineers for Rivers and Harbors and of the District and Division Engineers on the Cape Fear River Basin, North Carolina.

The reports of your Department recommend that the general plan for improvement of the Cape Fear River basin, consisting of three main reservoirs supplemented by a number of smaller reservoirs and local protection projects, be approved as a guide for immediate and future development; and that the New Hope project, as a key element in the plan, be authorized for construction in the interest of flood control, water supply, water-quality control, recreation, and other purposes. The estimated construction cost of the New Hope project is $25,462,000, of which $319,000 would be repaid by local interests for water supply purposes. Minimum provisions would be made in the plans for that project for future installation of a small hydroelectric unit of about 2,500 kilowatts.

The Commission staff, which has cooperated with your Department in studies of the Cape Fear basin, has made studies of the power possibilities of the New Hope project. These studies show that use in the interest of power of the planned conservation storage of the project as recommended would make possible a continuous output of about 1,170 kilowatts during a critical low-flow period. This would warrant consideration of an installed capacity of 5,000 to 10,000 kilowatts. With an installation of 5,000 kilowatts the average annual generation would amount to approximately 30,000,000 kilowatts-hours and the resulting power benefits would exceed the added power costs.

The reports of your Department show that among the possible plans considered for the New Hope site was one providing for a dam about 15 feet higher than the one now proposed, including a power installation of 72,000 kilowatts capable of an average annual generation of about 75,000,000 kilowatt-hours. Although such a project was found to be economically feasible and would afford benefits to potential projects downstream, the reports state that it would be inadvisable in view of the local opposition indicated. Staff studies also show that such a project would be economically feasible and would provide for optimum development of power at the New Hope site.

Based on its consideration of the reports of your Department and the studies of its own staff, the Commission concludes that there is opportunity for the economical development of hydroelectric power at the New Hope project site. It notes, however, that the recommended project would not develop the full power potential of the site. Although the Commission is not in a position to evaluate the factors which have been raised in opposition to a more comprehensive development than is now proposed, it believes that the possibility for the construction of a higher dam which would more fully develop the power potential of the site should be brought to the attention of the Congress.

Sincerely yours,

Joseph C. Swidler

Joseph C. Swidler
Chairman

CAPE FEAR RIVER BASIN, NORTH CAROLINA

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D. C.

IN REPLY REFER TO

16 July 1962

ENGCW-PD

SUBJECT: Cape Fear River Basin, North Carolina

TO: THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, in response to a resolution of the Committee on Flood Control, House of Representatives, United States, adopted 2 May 1946, concerning the advisability of improvements for flood control in the Cape Fear River basin, North Carolina.

2. The District and Division Engineers recommend that their general plan for development of the Cape Fear basin be approved as a guide for immediate and future water-resources conservation, and that the New Hope project on the Haw River be authorized for construction in the interest of flood control, water supply, water-quality control, recreation, and other purposes, at an estimated cost of $25,462,000 for construction and $100,000 annually for operation, maintenance, and replacements, subject to certain conditions of local cooperation, including payment in accordance with the Water Supply Act of 1958, as amended, the construction costs allocated to municipal and industrial water supply, presently estimated at $319,000, and annual operation and maintenance costs, estimated at $8,000. They further recommend that authority be granted to continue the Cape Fear River basin studies, and that continuous and vigorous action be taken by Federal and non-Federal agencies toward the accomplishment of the overall plan, including the preservation of sites for the projects that comprise the entire plan. The net cost to the United States for the New Hope project is estimated at $24,143,000. Annual charges are estimated at $865,000 including $92,000 for Federal operation, maintenance, and replacements. With annual benefits estimated at $2,340,000, the benefit-cost ratio is 2.5.

3. The Board concurs in general in the views of the reporting officers and recommends approval of the plan essentially as proposed by the District Engineer, subject to certain conditions of local cooperation, including those noted above.

4. I concur in the recommendations of the Board.

W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS

CORPS OF ENGINEERS, U. S. ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
WASHINGTON 25, D.C.

ENGBR

23 March 1962

SUBJECT: Cape Fear River Basin, North Carolina

TO: Chief of Engineers
Department of the Army

1. Authority and scope.--This report is in response to the following resolution adopted 2 May 1946:

> Resolved by the Committee on Flood Control, House of Representatives, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the report on Cape Fear River, North Carolina, published in House Document No. 193, 73rd Congress, 2nd Session, with a view to determining whether any modifications of the recommendations for flood control contained therein are advisable at this time.

The report covers the needs for flood protection, municipal and industrial water supply, water-quality control, irrigation, and recreation, and presents a general plan of development. The Northeast Cape Fear River and Black River are not included in the scope of this report.

2. Basin description.--The Cape Fear River is formed by the confluence of the Deep and Haw Rivers in central North Carolina. It flows generally southeast 198 miles and empties into the Atlantic Ocean at Cape Fear, 28 miles below Wilmington, North Carolina. The basin is oblong in shape. Its length is about 200 miles, width about 60 miles, and drainage area 8,570 square miles. The tidal reach extends to lock and dam No. 1, about 39 miles above Wilmington. The average width of the flood plain is about 2.2 miles. At Fayetteville, 115 miles above Wilmington, the bankfull flow is about 35,000 cubic feet per second. The major tributaries of Cape Fear River included in this study are Haw and Deep Rivers, draining areas of 1,705 and 1,422 square miles, respectively.

3. General economy.--The population of the basin was estimated at 849,200 in 1960, about one-half urban. The headwaters area is highly industrialized, principally in the manufacture of textiles, wooden furniture, and tobacco products. Other industries include the production of cellophanes, machinery, fertilizers, chemicals, clay, glass, plastics, metal fabrications, and industrial rubber. Farm income averages about 15 percent of the total effective income of the basin. Wilmington, a major seaport, is the center of most waterborne traffic for the State.

4. Existing improvements.--There are no Corps of Engineers flood-control projects specifically authorized by Congress in the basin. In July 1961, under provisions of Public Law 685, Eighty-fourth Congress, construction was initiated on repair and raising of 4 miles of old dike and providing 11 miles of new dike to the existing White Oak Dike near Kelly, North Carolina, in the vicinity of lock and dam No. 1, 39 miles above Wilmington. About 20,200 acres will be protected to the 1945 flood level by the improvement. The Soil Conservation Service, United States Department of Agriculture, cooperates with local agencies in preparing plans for agricultural land use and land-treatment measures in the basin. The Bladen Lakes State Forest, containing 36,000 acres in the lower basin, is used by the State as a recreational area as well as for timber production and wildlife conservation.

5. Floods and other problems.--Floods occur in the Cape Fear River basin during all seasons of the year. In the upper reaches, floods are flashy and usually have a duration of 2 to 4 days. On the lower reaches, the flood plain widens to several miles, resulting in slower rising and falling stages. In this area, floods usually last from 5 to 14 days. Fayetteville, near the center of the basin, is subject to extensive flood damage. At this location, floods average 1.7 occurrences a year. About one-fourth of the commercial and residential area in Fayetteville and East Fayetteville were severely damaged by floodwaters in 1945. Recurrence of this flood would affect about 3,000 homes, 200 commercial and industrial establishments, schools, churches and other public buildings. Based on 1960 prices and stage of development, flood damages in the basin from recurrence of the 1945 flood are estimated at $10,965,000 of which $3,015,000 would be rural and $7,950,000, non-rural damages. Under the same conditions, average annual flood damage is estimated at $1,487,000. Water shortages have been experienced in some years by a number of municipalities. Municipal and industrial process water usage from all sources is expected to increase until by the year 1980 a total of approximate 200 million gallons per day will be needed. Discharge of untreate

and partially treated domestic sewage and industrial wastes have polluted the streams. Effluent of certain industries is very difficult to treat and in many instances water quality can be best improved by increasing minimum streamflows.

6. Improvement desired.--Local interests desire flood protection along Cape Fear River, particularly at Fayettsville, and emphasize the need of water conservation for the improvement of navigation, pollution abatement, and other uses. The Cape Fear Basin Development Association has been organized to promote development of the water resources of the basin. In the Greensboro area, local interests request development of the Deep River basin with a dam at the Randleman site. Others desire a series of small dams for various water uses.

7. Plan of improvement.--The District Engineer finds that there is an immediate and urgent need for improvements to provide flood protection, water-quality control, and recreation in the Cape Fear River basin. He notes that treatment by known methods will not alone suffice to bring the stream to acceptable standards of water quality and considers dilution of industrial and domestic wastes a necessary factor in maintaining acceptable streamflow conditions. He has developed a general plan of improvement and proposes sequential construction, which includes reservoirs on major and minor tributaries of the Cape Fear River, and complementary conservation programs by other Federal and State agencies. He proposes, as the first step of development, construction of the New Hope Dam on the Haw River below the mouth of the New Hope River to initially provide flood-control storage of 541,000 acre-feet and conservation storage of 119,000 acre-feet, a total of 660,000 acre-feet. The Randleman and Howards Mill Reservoirs and other local flood-control projects and reservoirs that are found feasible would be constructed as the need for additional water supply and flood control develops. When appropriate, a part of the flood-control storage in the New Hope Reservoir would be replaced by storage in other reservoirs and the vacated storage reallotted to water supply. The comprehensive plan contemplates the further development of watershed treatment to be initiated under the provisions of general laws.

8. The Randleman Dam on Deep River would be about 5 miles above the town of Randleman and would control a drainage area of about 168 square miles. The reservoir would have a storage capacity of 54,000 acre-feet for flood control and 44,000 acre-feet for

conservation at the time of initial construction. The Howards Mill Dam on Deep River would be about 1 mile below the Randolph County line and would control a drainage area of 575 square miles, including the area above the Randleman Dam site. The reservoir would have a storage capacity of 130,000 acre-feet for flood control and 33,000 acre-feet for conservation storage at the time of initial construction. Other reservoir projects, with storage estimated at 923,000 acre-feet, would be located in the headwaters of the Haw and Little Rivers, below the Howards Mill site and in other tributary areas upstream from Fayetteville.

9. Sequential development.--An analysis of each element of the comprehensive plan, from the standpoint of its economic feasibility and of its value toward meeting the immediate needs of the basin, indicates that the New Hope project should be the first unit constructed. The District Engineer evaluates the proposed comprehensive development plan for the Cape Fear River basin, aside from watershed treatment, based on 1960 prices and a 100-year period of analysis, as follows:

Project	Assumed year of completion	First costs, $1,000	Average financial annual costs	Average annual benefits	Benefit to cost ratio
New Hope	1965	$25,612	$ 865,000	$2,142,000	2.5
Howards Mill	1975	4,591	187,000	414,000	2.2
Randleman	1975	3,700	161,000	317,000	2.0
Small reservoirs	1975-2065	38,454	$1,532,000	$1,871,000	1.2

10. Costs and feasibility.--The District Engineer's estimated first cost, annual charges, and economic feasibility for the New Hope Reservoir, based on initial allocation of storage, are:

Item	Amount
First cost (average 1960 prices)	
Federal	$25,143,000
Preauthorization studies	150,000
Non-Federal (water supply)	319,000
Total	$25,612,000

Item	Amount
Annual charges	
Federal	$ 848,000 (1)
Non-Federal	17,000 (2)
Total	$ 865,000 (3)

(1) Includes $92,000 annual operation and maintenance.
(2) Includes $8,000 annual operation and maintenance.
(3) Excludes $79,000 annual economic cost of lands.

Average annual benefits	
Flood control	$1,697,000
Water-quality control	77,500
Water supply	46,500
General recreation	405,000
Fishing and hunting	114,000
Total	$2,340,000
Ratio of benefits to economic costs	2.5 (based on a 100-year period of analysis.)

The alternative costs for water-quality control were considered as the costs of small reservoirs at alternative locations without recreation facilities. The report by the Public Health Service which presents benefits on low-flow augmentation evaluated over a 50-year period was used as a basis for projecting water-quality control benefits an additional 50 years. The report on general recreation benefits--exclusive of fish and wildlife benefits--evaluated by the United States National Park Service, based on a 50-year project life also was used as the basis for extending values for recreation to a 100-year period by the District Engineer. The District Engineer recommends that his comprehensive plan of development of the Cape Fear River basin be approved, that the New Hope project be authorized for construction, and that authority be granted to continue the Cape Fear River basin studies all in accordance with his proposed plan, subject to certain conditions of local cooperation. The Division Engineer concurs.

11. Public notice.--The Division Engineer issued a public notice stating the recommendations of the reporting officers and affording interested parties an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

87782 O-62—3

12. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. It agrees that there is a need for the basic plan to serve as a general guide for development of the water resources of the Cape Fear River basin. The Board also agrees that while small- and intermediate-size reservoirs could provide substantial benefits to the basin many difficult problems would be encountered in developing such a system of reservoirs to meet the immediate needs of the area and to provide the maximum incremental benefits. On the other hand, the addition of tributary reservoirs would provide a practical solution to the more localized water-resources problems and would complement the flood-control, water-supply, and recreation features of the three principal reservoirs. Approximately 63 percent of the flood-control benefits, 16 percent of the water-supply benefits and 49 percent of the recreation benefits credited to the entire comprehensive plan of development of the basin would derive from the New Hope project. Full control of storage and releases would be achieved at one site in contrast to the complexities involved in the operation of a multiple-small-dams alternative project. The Board finds that the New Hope project, as recommended by the District Engineer, is suitable for the first stage of development and is economically justified by the prospective benefits. The Board further notes that the Governor of North Carolina strongly urges the immediate construction of the New Hope project.

13. Recommendations.--Accordingly the Board recommends:

a. That the general plan for development of the Cape Fear River basin, as presented by the District Engineer, be approved as a guide for immediate and future water-resources conservation;

b. That the New Hope project on the Haw River in North Carolina be authorized for construction in the interest of flood control, water supply, water-quality control, recreation and other purposes, generally in accordance with the plan of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost of $25,462,000 for construction and $100,000 annually for operation, maintenance, and replacements: Provided that prior to construction local interests furnish assurances satisfactory to the Secretary of the Army that they will:

(1) Protect downstream channels from encroachments and obstructions which would adversely affect operation of the project;

(2) Bear all of the construction cost allocated to municipal and industrial water supply, presently estimated at $319,000, and;

(3) Bear all the annual cost for operation, maintenance, and major replacements allocated to municipal and industrial water supply, an amount presently estimated at $8,000 annually;

c. That local interests be permitted to repay all of the costs assigned to them in general accordance with the principles outlined in the Water Supply Act of 1958, as amended;

d. That authority to continue the Cape Fear River basin studies be granted after authorization of the New Hope project in order that authorization reports for the Randleman, Howards Mill, and other projects may be prepared; and

e. Continuous and vigorous action by Federal and non-Federal agencies, separately and cooperatively under authorities that exist or may be provided, in prosecution of programs for land management, controlling and regulating the use and development of flood plains, preservation and development of recreation and fish and wildlife resources, abatement of stream pollution and improvement of water quality, conservation of ground and surface waters, and preservation of sites for the projects that comprise the entire plan.

FOR THE BOARD:

KEITH R. BARNEY
Major General, USA
Chairman

REPORT OF THE DISTRICT ENGINEER

SYLLABUS

The District Engineer finds that there is an immediate and urgent need for improvements to provide flood protection, water-quality control, and recreation in the basin of the Cape Fear River, North Carolina. He also finds a strong need to provide storage for future municipal and industrial water supply and irrigation, and additional storage for flood control, water-quality control, and recreational needs to keep abreast of economic growth in this region. Without projects he estimates the average annual flood damages in the area over the next 100 years to be $1,736,000; he finds that the present minimum streamflow of 19 cubic feet per second at Lillington, N. C., is inadequate for present-day water-quality control, and that by the year 2065 the storage needs are estimated to be 1,844,000 acre-feet. He has determined that the most practical, feasible, and economic means for providing for the needs of the Cape Fear River Basin over the next 100 years is a plan consisting of reservoirs, local flood protection projects, and watershed-treatment measures. He has developed a general plan of improvement and sequence of construction which would include reservoirs on major and minor tributaries of the Cape Fear River above Fayetteville, N. C., and complementary conservation programs by other Federal and State agencies. Accordingly, as the initial step of development, he recommends construction at this time of the New Hope Dam located on the Haw River below the mouth of the New Hope River; and that further studies be made of the Randleman and Howards Mill Reservoirs sites and of other local flood control and water-supply reservoir sites to verify and/or modify the sequence of construction of the future projects so as to provide for the progressive development of the water resources of the Cape Fear River Basin. He further recommends continuous and vigorous action by Federal and non-Federal agencies in prosecution of programs for land management, controlling and regulating the use and development of flood plains, preservation and development of recreational and fish and wildlife resources, improvement of water quality, conservation of ground and surface waters, and selection and preservation of sites for the projects that comprise the ultimate plan. He notes that the recommended New Hope project would fit into any plan of development for the Cape Fear River Basin and should be the initial project to be constructed, and that it would prevent 72 percent of the average annual flood damages occurring in the Cape Fear River Basin and furnish benefits from water-quality control and recreation. He estimates that the total construction cost, at 1960 prices, of the New Hope project will be $25,612,000, with annual costs of $100,000 for operation, maintenance, and replacements, and that the average annual benefits will exceed the average annual costs by 170 percent.

U. S. ARMY ENGINEER DISTRICT, WILMINGTON
CORPS OF ENGINEERS
308 CUSTOMHOUSE
WILMINGTON, NORTH CAROLINA

30 October 1961

SAWEM

SUBJECT: Report on Comprehensive Survey of Cape Fear River Basin, North Carolina

TO: Division Engineer
U. S. Army Engineer Division, South Atlantic
Atlanta, Georgia

SECTION I - GENERAL

PURPOSE

1. The purpose of this report is to present a general comprehensive plan of development to meet current and future water-resource needs of the Cape Fear River Basin.

AUTHORITY

2. Authority for this report is contained in a resolution by the House of Representatives, Committee on Flood Control, adopted May 2, 1946, which reads as follows:

> Resolved by the Committee on Flood Control, House of Representatives, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby, requested to review the report on Cape Fear River, North Carolina, published in House Document No. 193, 73rd Congress, 2nd Session, with a view of determining whether any modifications of the recommendations for flood control contained therein are advisable at this time.

3. As the first step in response to the above resolution a preliminary-examination report on the Cape Fear River Basin was submitted on 25 July 1947 recommending a comprehensive survey report. In November 1947 the Chief of Engineers authorized a survey report on the basin. The studies for that report were initiated in 1948, but were suspended in 1950 because of a general curtailment of the reports program.

4. Work was resumed on the comprehensive survey report in September 1955. The study program included investigations of flood control reservoirs at Randleman and Howards Mill sites on the Deep River, and the New Hope site on the Haw River for flood control, power, and other studies. By 1957 the studies had progressed to the point where it was concluded that the New Hope Reservoir would be the most logical initial flood control development of the Cape Fear River Basin. Because of limited time and funds to complete a detailed project investigation for the comprehensive report and the indicated need to begin a flood control plan, it was decided to submit a general plan of basin development with a recommendation regarding the New Hope project. A public hearing was held in Fayetteville, N. C., on February 8, 1957, to determine the views of local interests. A question arose on the feasibility of substituting a system of small dams for the New Hope project. Congressional representatives subsequently requested that the Corps of Engineers and the Soil Conservation Service conduct a joint study with the State of North Carolina to determine how a system of small dams would fit into the overall development plan. This study was authorized in 1957 and completed early in 1961. Data obtained in that study have been utilized in this report.

SCOPE

5. Scope of report. This report covers the needs for flood protection, municipal and industrial water supply, pollution abatement, irrigation, and recreation in the basin, and presents a general plan of development to meet these needs. The Northeast Cape Fear River and Black River, tributaries which enter the Cape Fear River in the lower tidal reach, were not included in the scope of this report.

6. Surveys, investigations, and studies. A preliminary reconnaissance of the Cape Fear River Basin was made by the District Engineer. The following field and office surveys, investigations, and studies were made.

a. Hydrology. These studies were based on data developed by the Wilmington District, the Soil Conservation Service, the Weather Bureau, and the Geological Survey, and include data on climate, natural streamflow, probable maximum and standard project floods, flood frequency, and such additional component material as is necessary for their explanation (app. I).

b. Economic base survey. This study, made by the Wilmington District, analyzes the present and expected future economic development of the Cape Fear River Basin in relation to the State and national economic development. This study was based on data furnished by the North Carolina Department of Conservation and Development and from applicable data extracted from publications of various Federal agencies (app. V). These were used to estimate general economic trends for 50 years. The trends assisted in projecting water-resource needs for 100 years, the period of project evaluation selected for this report.

c. Flood damages. This investigation, based on detailed field observations along the Deep, Haw, and Cape Fear Rivers and by expanded sample methods on minor tributaries of the above rivers, summarizes the average annual damages. These studies were based on data compiled by the Wilmington District and the Soil Conservation Service.

d. Water supply and water-quality control. This study develops requirements and economic values of water supply and pollution-abatement control for the Cape Fear River Basin. Evaluations for the New Hope project were derived from data prepared by the Department of Health, Education and Welfare, United States Public Health Service (app. VI).

e. Recreation. A preliminary analysis was made of recreation and an evaluation was made of the potential recreational benefits. General recreation-benefit evaluation of the New Hope project was based on a study made by the United States Department of Interior, National Park Service (app. VII).

f. Fish and wildlife. An evaluation of the effect of the New Hope project on fish and wildlife resources was made by the U. S. Fish and Wildlife Service. Their report is included as appendix VIII.

g. Geology. This study is an analysis of foundation conditions and availability of construction material as determined by the Wilmington District (app. III).

h. Mineral resources. The effect of water development on mineral resources is considered negligible at this time.

i. Hydroelectric power. The possibility of inclusion of hydroelectric power generation in the plan was studied in cooperation with the Federal Power Commission.

j. Project data and cost estimates. Preliminary field investigations were made of eight possible, large dam and reservoir sites. Detailed study was made of three of these sites and of local flood protection projects for two communities. In addition, preliminary field investigations of a system of small reservoirs in five sample basin areas and preliminary design studies and cost estimates on these sites were made by the Wilmington District. Design studies and cost estimates based on the sample basin areas were expanded to provide an evaluation for a system of small reservoirs in the Cape Fear River Basin above Fayetteville, N. C.

7. Consultation with interested parties. A public hearing was held on February 8, 1957, at Fayetteville. A detailed summary of this hearing is included in appendix IX. A complete transcript is available in the office of the District Engineer.

8. Flood control reports. No prior reports have been submitted to Congress for flood control and allied purposes other than the report under review (H. Doc. 193, 73d Cong., 2d sess.). That report, dated September 27, 1933, investigated flood control, power, irrigation, and navigation needs of the Cape Fear River Basin. The Chief of Engineers recommended that there be no Federal improvement by the United States at that time beyond that provided for navigation by the existing project.

a. Joint study by the Corps of Engineers, U. S. Soil Conservation Service, and the State of North Carolina. At the public hearing in Fayetteville on February 8, 1957, some participants requested that the feasibility of utilizing a system of small dams be investigated. As a result of those requests and subsequent expressions of interest by Congressional representatives the Soil Conservation Service was invited by the Corps of Engineers, by letter of 19 June 1957, to make a joint study of the Cape Fear River Basin. The joint report was not intended to serve as an authorizing document, but rather to provide a framework within which the Corps of Engineers, the Soil Conservation Service, and other agencies concerned could proceed with the preparation of reports on specific projects for authorization. The Corps of Engineers agreed to defer submission of its report on the Cape Fear River until the joint study had progressed sufficiently to define an overall basin plan and the position of the New Hope Reservoir in that plan. The Soil Conservation Service, in accordance with the authority contained in Public Law 566, 83d Congress, as amended, agreed to participate. The State of North Carolina also agreed to cooperate in the joint study. The joint study was completed in May 1961. Data from the joint study were used in this report.

b. White Oak Dike report. A report recommending repairs and additions to the existing White Oak Dike near Kelly, N. C., was approved by the Chief of Engineers in November 1960 under the provisions of Public Law 685, 84th Congress. Construction of this project began in July 1961 and is discussed in paragraph 66 of this report.

9. Navigation reports. Prior reports on two existing navigation projects are indirectly related to this investigation.

a. The existing navigation project for the Cape Fear River above Wilmington was authorized in accordance with House Document 890, 60th Congress, 1st session; House Document 786, 71st Congress, 3d session; and Rivers and Harbors Committee Document 17, 75th Congress, 1st session. The project provides principally for a channel 25 feet deep from Wilmington to Navassa, a distance of 4 miles. By means of three locks and dams a navigable channel with a minimum depth of 8 feet is provided from Navassa to Fayetteville.

b. The existing project for Wilmington Harbor, as authorized in accordance with House Document 87, 81st Congress, 1st session, and prior reports, was completed in 1958. It serves mostly ocean commerce

and has little bearing on the present report except that it is an important factor in the future economic growth of the basin.

DESCRIPTION

10. Cape Fear River Basin. The Cape Fear River Basin is oblong in shape; its greatest width is about 60 miles and its length is about 200 miles. The total basin has a drainage area of 8,570 square miles. The Northeast Cape Fear River and Black River Basins were not investigated for the report as mentioned before. The drainage area of the main stem of the Cape Fear River Basin for which this report is prepared is approximately 5,200 square miles. A map of the Cape Fear River Basin is shown on plate 1. Table 1 shows pertinent data on the Cape Fear River and tributaries.

TABLE 1

Pertinent data on Cape Fear River and tributaries

	Drainage areas (square miles)			Elevation of low water surface (feet m.s.l.)
	Subtotal[1]	Total	Miles[2]	
Haw River Basin				
New Hope River	(333)	-	4.5	160
New Hope damsite	1,690	1,690	4.0	159
Mouth	15	1,705	0	158
Deep River Basin				
Randleman damsite	168	168	89	616
Howards Mill damsite	407	575	55.0	320
Rocky River	(260)	-	7.3	193
Mouth	847	1,422	0	158
Cape Fear River				
Head of river	3,127	3,127	170	158
Lillington	313	3,440	150	107
Lower Little River	(485)	-	135.8	53
Fayetteville	930	4,370	115	29
Lock and dam No. 3	440	4,810	95	29-20
Lock and dam No. 2	130	4,940	71	20-11
Lock and dam No. 1	250	5,190	39	11-1
Black River	(1,410)	-	16	0
Northeast Cape Fear River	(1,650)	-	0	0
Wilmington	3,110	8,300	0	0
Mouth	270	8,570	-28	0

[1] Areas shown in parentheses are drainage areas of major tributaries.

[2] Miles above mouth for Haw and Deep Rivers; above Wilmington for Cape Fear River. Mouth of Cape Fear is 28 miles below Wilmington.

11. The Cape Fear River. The Cape Fear River is formed by the confluence of the Deep and Haw Rivers. It flows generally southeast 198 miles and empties into the Atlantic Ocean at Cape Fear, 28 miles below Wilmington, N. C. The tidal reach of the Cape Fear River has a length of approximately 67 miles. The average width of the flood plain of the Cape Fear River is approximately 2.2 miles. Bankfull flow at Fayetteville is about 35,000 cubic feet per second, and at lock No. 2 it is about 20,000 cubic feet per second. The difference between high and low stages is 69 feet at Fayetteville and 44 feet at lock No. 2. Profiles of the Cape Fear, Deep, New Hope, and Haw Rivers are shown on plate 2.

12. Major tributaries.

a. Haw River. The Haw River, the main tributary of the Cape Fear River, rises in eastern Forsyth County at an elevation of about 1,000 feet (all elevations in this report refer to mean sea level unless noted otherwise) near the source of the Deep River. It flows northeast, then east, and then southeast for the greatest part of its length of about 90 miles, joining with the Deep River at an elevation of 158 feet above mean sea level to form the Cape Fear River. The gradient of the river varies from about 4 feet per mile in the headwaters to 12 feet per mile near the confluence. The gradient of the Haw River near the confluence is much greater than that of the corresponding section of the Deep River. The bankful flow at Pittsboro, N. C., is approximately 15,000 cubic feet per second. The difference between high and low stages at Pittsboro is about 27 feet. The width of the Haw River from the New Hope damsite under consideration to the confluence with the Deep River averages about 250 feet. The largest tributary of the Haw River is the New Hope River which joins the Haw River near its mouth. The drainage area of the Haw River Basin is about 1,705 square miles. Flood plains along the Haw River are narrow as compared with the Cape Fear River flood plains.

b. Deep River. The Deep River also rises in eastern Forsyth County, N. C., in the central Piedmont region. The elevation of its source is about 1,000 feet and its mouth is about 158 feet. This fall of 842 feet in 116 miles gives the stream a steep gradient, creating numerous falls and rapids. Its largest tributary, the Rocky River, joins it near the mouth. The drainage area of the Deep River is about 1,422 square miles.

13. Topography and geology. The Cape Fear River Basin is divided into three distinct physiographic areas: the Piedmont Plateau, the Sand Hills region, and the Coastal Plain.

a. The Piedmont Plateau extends eastward from the Appalachian Mountains to the Sand Hills region and consists largely of rolling hills and deeply eroded valleys. The hills in this region are largely forested. Highest elevations in the region vary from 1,000 feet in

the headwaters to about 300 feet at the boundary with the Sand Hills region. The surface mantle of the Piedmont Plateau consists largely of soils of slate or granite origin which are underlaid by several varieties of rocks generally classified as gneisses, schists, and metamorphosed volcanics. The rocks in the Piedmont Plateau are of a nature that would be suitable for foundations of large concrete structures.

b. The Sand Hills region is a wedge-shaped area located between the Piedmont Plateau and the Coastal Plain. This region is more undulating than the Piedmont Plateau and its drains are rather shallow, only the main stream having cut through the softer deposits to the basement rocks. Surface soils are composed largely of sand, clays, marl, and gravel. The entire area is underlaid by an igneous formation known as the basement rocks.

c. The Coastal Plain begins at the eastward edge of the Sand Hills region at the "fall line," and continues eastward to the Atlantic coast. The terrain is flat, resulting in relatively sluggish streamflows. The soils consist primarily of sands, clay, and marls, much of which are unconsolidated.

SECTION II - ECONOMIC DEVELOPMENT

EXISTING ECONOMIC CONDITIONS

14. General. Some of the largest metropolitan areas of North Carolina are located in or near the Cape Fear River Basin. The area is served by four main railroads: The Atlantic Coast Line, Southern, Seaboard Air Line, and Norfolk Southern. The Atlantic Coast Line traverses the south-central portion of the basin, providing direct rail connections with large east coast metropolitan centers from Maine to Florida. The Southern Railroad crosses the north and central portions of the basin, providing connections with principal cities in the south and east, such as Birmingham, Ala.; Memphis, Tenn.; and Washington, D. C. The Seaboard Air Line Railroad crosses the central part of the basin in a northeast-southwest direction and connects with principal cities in Virginia, North Carolina, South Carolina, Florida, and Georgia. The Norfolk Southern Railroad traverses the basin in a north-south direction, paralleling the Cape Fear and Haw Rivers between Raleigh and Fayetteville, N. C. The Cape Fear River Basin is also served by a network of highways. Interstate Highways 40, 85, and 95, and U. S. Highways 17, 74, 701, 76, 401, 421, 1, 301, 29, and 70 traverse the basin, and numerous good State highways serve as interconnections. Bus travel is excellent between large cities, and commercial air service is available to such cities as Wilmington, Fayetteville, Raleigh, Durham, and Greensboro, and others. A deepwater channel for oceangoing vessels is available from the Atlantic Ocean to the Port of Wilmington, N. C. The Cape Fear River is also navigable via an 8-foot channel from Wilmington to Fayetteville, a distance of 115 miles. Barges are used for most commercial transportation on the river, with

cargoes consisting chiefly of oil and wood products. Water-transportation facilities, combined with excellent highway and rail facilities, afford the Cape Fear River Basin with connections to a wide market area.

15. Population. The 1960 population of the Cape Fear River Basin was estimated to be 849,200 persons. Population density varies from 320 per square mile in the more highly industrialized areas at the northern end of the basin to 75 per square mile in the area between Fayetteville and Wilmington. About one-half of the population, 405,000 persons, reside in urban areas; whereas, about 444,000 persons reside in rural areas. The total farm income averages about 15 percent of the total effective income throughout the basin. Listed below in table 2 are populations of some of the principal municipalities in the basin or near the basin border.

TABLE 2

Populations of principal municipalities (1960)

Municipality	Population
Greensboro	119,574
Raleigh[1]	93,931
Durham[1]	78,302
High Point[1]	62,062
Fayetteville	47,106
Wilmington	44,013
Burlington	33,199
Reidsville[1]	14,267
Chapel Hill	12,573
Sanford	12,253
Asheboro	9,449
Dunn	7,566
Smithfield	6,117
Graham	7,723
Southern Pines	5,198

[1]Cities just outside or on watershed divide.

16. Income. The average per capita income for the Cape Fear River area during the year 1960 was about $1,630 annually. The income ranged from about $1,400 per capita along the main stem of the Cape

Fear River Basin to about $1,671 per capita in the more highly industrialized areas on the Deep and Haw Rivers. The 1960 North Carolina per capita income was estimated to be about $1,600. This is a much lower per capita income than in the United States as a whole where per capita income for 1960 is $2,260. The latest data available on distribution of personal income in North Carolina for 1955 are as follows:

Farms	15.3	percent
Mining	0.3	"
Construction	5.3	"
Manufacturing	31.9	"
Wholesale and retail	19.0	"
Finance - real estate	3.1	"
Transportation	4.4	"
Communication	1.9	"
Services	9.4	"
Federal Government	2.7	"
State and local govt.	6.5	"
Other	0.2	"
Total	100	percent

17. Land use and development. The Cape Fear River Basin as a whole is rural. Approximately 60 percent of the land area is in farms. Woodland is concentrated primarily in the flood-plain areas near streams and along hillsides and steep slopes. Croplands are concentrated in the fertile bottom lands and adjacent to flood-plain areas. Much land not suitable for growing crops is used to raise livestock. Dairying is carried on extensively in the Haw River Basin, and all areas produce large numbers of chickens and hogs. Some of the swamplands in the lower part of the basin that cannot be reclaimed for farms are used for cattle raising.

18. Natural resources. The mineral resources of the Cape Fear River Basin are relatively unimportant. Although a large variety of metals are present, the quantities are too small to warrant commercial mining. The timber resources of the Cape Fear River Basin are extensive. In the Piedmont area the most important varieties of timber produced commercially are oak, Virginia pine, and shortleaf Southern pine. In the coastal area, loblolly and longleaf pines, gum, and cypress are the leading commercial varieties. It is estimated that over 250 million board feet of lumber are produced annually from the forests in the basin. Another important forest product is pulpwood, with about one-half million standard cords being harvested

in 1955. Wildlife in the area includes big game, small game, fur-bearing animals, and waterfowl. Fish such as bass, bream, catfish, suckers, carp, white perch, robin, and jack are found in the fresh-water streams and lakes.

19. Agriculture. Of the nonurban land in the basin, approximately 44 percent is in cropland, 31 percent is in woodland, and 25 percent is in pasture. The principal crops raised today are corn, tobacco, hay, cotton, peanuts, soybeans, truck, small grains, and pastures. Peach production, although not extensive, is important in certain local areas. The practice of using surface water for irrigation is steadily increasing, particular in the upstream areas. Table 3 presents data relative to average crop yields and farm values in the basin for several crops. There has been a slight decrease in the average-size farm in the Cape Fear River Basin during recent years, although the average-size farm in the State has shown a slight increase. No definite trend in change in land use has been established. Agricultural development is further discussed in appendix II.

TABLE 3

Average land values and yields for the Cape Fear River Basin

Location in basin	Percent of area in basin	Average 1957 crop yields per acre					Average farm value per acre, including lands and buildings
		Corn (bushels)	Cotton (pounds)	Tobacco (pounds)	Wheat (bushels)	Oats (bushels)	
Haw River	21	35.6	177	1,511	24.7	40.3	$ 115.49
Deep River	17	37.2	266	1,528	24.5	38.1	86.67
Main stem, Cape Fear River	62	39.6	359	1,614	26.9	41.1	117.71
Entire basin	100	38.4	305	1,578	26.1	40.5	111.96

20. Industrial development. The Cape Fear River Basin, the most highly industrialized basin in the State, leads the nation in the manufacture of textiles, wooden furniture, and tobacco products. Textile manufacturing comprises the principal industry in the basin, with most plants being located along the Cape Fear River and tributaries in many of the cities, towns, and communities north of Fayetteville. The artificial-fibers industry is showing rapid growth, with dacron, dynel, and new synthetic fibers being produced. The production of paper and pulp products is rapidly becoming a major industry. Plants for the production of cellophanes, machinery, fertilizers, chemicals, clay, glass, plastics, metal fabrications, and industrial rubber are increasing in number. The number of meat, food, and beverage-processing plants is likewise increasing. Wilmington is a major seaport and, as such, is the center of most of the waterborne traffic for the State. Southport, at the mouth of the Cape Fear River, is an important fishing center. Trade is carried on over the many highways, railroads, and airlines interlacing the basin and by means of the Cape Fear River and Wilmington Harbor.

21. Power development. Approximately 6,000 kilowatts of hydroelectric power are being produced in the Cape Fear River Basin by privately owned power companies at small hydroelectric developments. However, by far the greatest portion of the electric power used in the basin is generated by steamplants. A network of electric transmission lines, operated by three major power companies, serves the area. The capacities and locations of the larger steamplants and hydroelectric plants in the basin are shown in table 4 below. All of these plants are owned and operated by the Carolina Power and Light Company.

TABLE 4

Principal electric power developments in and near the Cape Fear River Basin

Name and location	River	Type of plant	Total nameplate capacity in kilowatts
Sutton, near Wilmington	Cape Fear	Steam	[1]200,000
Cape Fear, near Corinth	Cape Fear	Steam	[1]373,000
Quaker Neck, near Goldsboro	Neuse	Steam	[1]128,500
Eno, near Durham	Neuse	Steam	30,000
Buckhorn, at Buckhorn Falls	Cape Fear	Hydro	2,900
Lockville, near Moncure	Deep	Hydro	1,000
Carbonton, near Carbonton	Deep	Hydro	500
Eury, near Pittsboro	Rocky	Hydro	600

[1]The capacity of these plants is being expanded.

22. Water supply. Public water supplies for the principal communities in the Cape Fear River Basin are obtained largely from reservoirs on tributary streams or pumpage of ground water to storage tanks. Water is taken from the main stem of the Cape Fear River by several cities for municipal supplies, and a number of industries use water from the river for various purposes, including cooling. A more thorough discussion of water supply is contained in section V.

23. Navigation. The Cape Fear River is navigable to Fayetteville, with a channel width of generally 400 feet and depth ranging from 30 to 35 feet from the Atlantic Ocean to Wilmington; thence a 200-foot width and 25-foot depth from Wilmington to Navassa; and a depth of 8 feet with varying widths for the remaining distance to Fayetteville. Wilmington Harbor is the major deepwater port in North Carolina and one of the major petroleum distribution centers on the Atlantic seaboard. Commerce for 1959 totaled about 5,137,900 tons, of which about 64 percent, or 3,425,000 tons, was petroleum products. The remaining commerce consisted of substantial quantities of sugar, unmanufactured tobacco, molasses, pulpwood, paper and paper products, sulphur, iron and steel scraps, finished steel mill products, fertilizer materials, and miscellaneous commodities. In 1959 waterborne commerce between Wilmington and Fayetteville totaled about 464,400 tons, including about 293,300 tons of petroleum products and 156,400 tons of pulpwood and logs. The remainder consisted of crushed limestone and coal tar products. Petroleum products are transported from Wilmington to Fayetteville, 115 miles; most of the pulpwood and log commerce originates at points along the river between locks and dams Nos. 1 and 3 and moves to Wilmington. Commerce along the river is important to the national defense and to the local economy. Petroleum products delivered to Fayetteville are used locally and are distributed to surrounding towns and communities, including Fort Bragg and other military establishments.

MEASURES OF ECONOMIC ACTIVITY

24. General. The economic activity of an area can be measured by the magnitude and growth in its per capita income, employment, total population, and number of households. These statistical data, in comparison with those of adjacent areas and the nation as a whole, provide a basis for estimating the area's future needs for land, water supply, transportation, raw materials, power, flood control, housing, and recreation.

25. Personal income. The United States Department of Commerce, Office of Business Economics, states that personal income is one of the most comprehensive measures of economic activity that can be prepared on a regional basis. It provides a yardstick for measuring the past growth and future potential of an area. The basic reason why personal income is such a comprehensive measure of economic activity is that over the past decades the total personal income has grown

nationally at about the same rate as the gross national product. The gross national product, a more precise measure of economic activity, is not available on a regional or subregional basis, whereas, personal income data are generally available on a state and county basis. The projections of personal income for the State of North Carolina and the Cape Fear River area, as presented in this report, are keyed to national projections, but account has been taken of local differential trends.

26. Employment and population. Employment data which are used to measure economic opportunities have been based on an industry-by-industry and area-by-area appraisal of differential growth rates relative to national averages. Since employment is a measure of the number of persons engaged in economic activity, employment projections are directly related to the increases in the national product and the output per worker. The population of an area is controlled by two basic forces. The first of these is the natural increase (net increase of births over deaths) and the second force is net migration. When the number of job opportunities lags behind the size of the labor force, there is an out-migration and, conversely, when job opportunities lead the size of the labor force, there is an in-migration. During short-term periods there may be fluctuations where the level of economic activity may either lead or lag the population growth. However, over an extended period of several decades the population growth of an area will generally follow the national trend. The Office of Business Economics considers that the long-term population projection has a primary advantage in that moderate deviations are compensated by possible variations in other economic developments.

27. Households. The number of households in an area is directly related to per capita income. An increase in per capita income would bring with it an increase in the standard of living and, in addition, probably would permit more families to have their own separate dwelling rather than living under crowded conditions with other families. Inasmuch as the household is a basic unit of consumption of certain goods and services, the number of households in an area may also be used as an indicator of demand for such things as land, water supply, and sewerage.

TRENDS IN ECONOMIC ACTIVITY

28. General. Estimates of future growth are based on relationships fundamentally derived from an analysis of past economic trends and then modified to correct for the anticipated changes in the economic environment. The estimates were based on data compiled by various Federal and North Carolina State agencies. The trends are presented in appendix V.

29. National trends. The past rate of progress in the United States' economy has been considerable and impressive. The projections shown in table 5 present a summary of the future growth that can be reasonably expected. All of the projections are based upon the assumption

of a high level of employment and activity, no major depressions or wars, and a continuation of the current relative needs of the civilian economy and the national defense.

a. The gross national product in 1959 amounted to $482 billion, which is equivalent to $488 billion in 1960 dollars. In 1960 price terms and assuming that the future compound annual rate of growth will be about 4.5 percent, the 1960 gross national product would be about $510 billion, rising to $1,550 billion in 1985 and $4,620 billion by the year 2010.

b. Personal income in 1959 amounted to $389 billion (1960 dollars) for the nation and is expected to rise to $405 billion in 1960, $1,200 billion by 1985, and $3,660 billion by the year 2010. The rate of growth of the nation's personal income is assumed the same as that used to project the gross national product.

c. Population projections represent in general a medium growth on the basis of the historical trend. The national population (excluding Alaska and Hawaii) is projected to rise from about 180 million in 1960 to 263 million in 1985 and to reach 378 million by 2010. This increase in population reflects an estimated 1.5 percent annual growth rate.

d. Personal income per capita estimates were keyed to the assumed growth pattern. In terms of constant 1960 dollars these estimates indicate the national per capita purchasing power rising from about $2,260 in 1960 to approximately $4,720 by 1985 and $9,690 in the year 2010.

e. Employment growth in the future was related to the increases in the national product, to the output per worker, and population. Total employment was 68 million in 1959 and about 72 million in 1960. It is estimated to increase to 105 million by 1985 and to 151 million by 2010.

TABLE 5

Summary of national projections

Item	Actual			Actual			Projections		
	1957	1958	1959	1957	1958	1959	1960	1985	2010
	(Billions of current dollars)			(Billions of 1960 dollars)					
Gross national product	443	444	482	464	453	488	510	1,550	4,620
Personal income	351	360	383	369	368	389	410	1,200	3,660
	(Current dollars)			(1960 dollars)					
Gross national product per capita	2,590	2,560	2,750	2,710	2,620	2,790	2,840	5,820	12,240
Personal income per capita	2,050	2,080	2,190	2,150	2,120	2,220	2,260	4,720	9,690
	(Millions)			(Millions)					
Population	171.2	173.1	175.0				[1]180	260	380
Employment	66.2	67.8	67.8				70	110	150

[1] From 1960 census.

30. North Carolina trends.

a. Personal income over the past decade in the United States has grown at the same rate as the gross national product. For this reason, personal income was used as a substitute for gross national product in measuring the economic growth of North Carolina and the Cape Fear River area where gross product figures are not available. According to this economic measure of personal income, the economy of North Carolina has lagged the national economy for the period of record, but in recent years it has been increasing at a faster rate than that of the United States as a whole. Personal income projections for the North Carolina area and the Cape Fear River area were keyed into the national projections of personal income, and consideration was given to differential trends. Total personal income of North Carolina is projected to grow at a somewhat higher rate than the national average until the year 2010, when it is assumed that the rate will decrease and conform to the national average. From $6.8 billion in 1959 (in constant 1960 dollars) the North Carolina income is estimated to reach $28 billion in 1985 and $92.9 billion by the year 2010.

b. Population. The expanding population increase will promote rapid growth of the North Carolina economy during the next century. Past population growth rates for the State of North Carolina have been generally similar to the corresponding growth rates of the Nation. The population of North Carolina has grown from 1.89 million in 1900 to 4.56 million in 1960, which reflects an annual compound growth rate of 1.5 percent. The population is expected to increase to about 6.6 million by 1985 and 9.6 million by the year 2010.

c. Personal income per capita for North Carolina, although less than the national average, has recently shown a greater rate of increase than the national average. It was assumed, therefore, that the North Carolina per capita income would continue to increase at a greater rate until it equalled the national average in the year 2010, and thereafter increase along with the national rate. Per capita income for North Carolina, in terms of 1960 dollars, is projected from $1,503 in 1959 to about $4,130 in 1985 and about $9,690 in 2010.

d. Summary. Projections for the State of North Carolina are shown in table 6.

TABLE 6

Summary of North Carolina State projections

Item	Actual			Actual			Projections		
	1957	1958	1959	1957	1958	1959	1960	1985	2010
	(Millions)			(Millions)					
Population	4.472	4.469	4.510	-	-	-	4.560	6.570	9.590
	(Millions of current dollars)			(Millions of 1960 dollars)					
Total personal income	5,948	6,283	6,697	6,240	6,410	6,780	7,290	28,000	92,900
	(Current dollars)			(1960 dollars)					
Personal income per capita	1,330	1,406	1,485	1,400	1,440	1,500	1,600	4,130	9,690

31. Cape Fear River area trends.

a. Personal income. According to the basic measure of personal income the economy of the Cape Fear River area is somewhat more advanced than that of the State as a whole. The total personal income for the Cape Fear River area is expected to grow at a slightly greater rate than that of the North Carolina average. From $2.1 billion in 1958 the Cape Fear River area income is estimated to reach $2.3 billion by 1960, about $7.5 billion by 1985, and $28.1 billion by the year 2010. The monetary values are in terms of 1960 constant dollars.

b. Population.

(1) General. Five population projections were made relative to the Cape Fear River Basin area. Although these projections were made for different areas, they were integrated to yield results consistent with the overall projections. These projections are discussed in the following paragraphs.

(2) The Cape Fear River area consists of the 22 counties lying wholly or partially within the Cape Fear River Basin. Approximately 30 percent of the North Carolina population live in this area and contribute significantly to the economic activity of the basin. The annual growth rate of the Cape Fear River area is expected to average about 1-3/4 percent during the next century. At this rate the 1960 population will rise from 1.4 million to 2.2 million by the year 1985 and to about 3.4 million by the year 2010.

(3) The Cape Fear River Basin consists of only those counties or portions of counties lying wholly within the drainage limits of the Cape Fear River. This projection was made primarily because North Carolina water laws are based on riparian rights which may legally preclude the use of surface-water sources in the basin by users outside the basin. Approximately 60 percent of the population of the Cape Fear River area reside within the basin. The annual growth rate of the Cape Fear River Basin for the next century is expected to be the same as that for the Cape Fear River area, or an average of 1-3/4 percent. The Cape Fear River Basin population has increased from about 593,000 in 1940 to 849,200 in 1960. The projected basin population for the year 1985 is estimated at about 1.3 million and is expected to increase further to about 2.0 million by the year 2010.

(4) Subbasin population projections were made for the Haw River Basin, the Deep River Basin, and the Lower Cape Fear River Basin. For any given year the sum of these three subbasin projections is equal to the projection for the Cape Fear River Basin. These subbasin projections were made primarily to serve as factors in determining an equitable distribution of surface-water storage projects throughout the Cape Fear River Basin. The results of these subbasin projections are presented and discussed in appendix V.

c. Personal income per capita. Personal income per capita for the Cape Fear River area has been less than the national figure, but slightly greater than the State figure for the past decades. Per capita income for the Cape Fear River area increased from $1,520 in 1958 to $1,630 in 1960. The projected 1985 per capita personal income for the area is estimated, in terms of 1960 dollars, at $3,700 and would increase to about $8,340 by the year 2010. A summary of the projections for the Cape Fear River area is given in table 7.

TABLE 7

Summary of Cape Fear River area projections[1]

Item	Actual			Actual			Projections		
	1957	1958	1959	1957	1958	1959	1960	1985	2010
	(Millions)			(Millions)					
Population:									
Cape Fear River Basin[2]	0.81	0.82	0.84	-	-	-	[3]0.85	1.32	2.02
Cape Fear River area	1.35	1.37	1.39	-	-	-	1.41	2.20	3.36
	(Millions of current dollars)			(Millions of 1960 dollars)					
Total personal income	1,930	2,040	2,170	2,020	2,090	2,200	2,300	7,500	28,060
	(Current dollars)			(1960 dollars)					
Personal income per capita	1,430	1,490	1,560	1,500	1,520	1,580	1,630	3,700	8,340

[1] Includes all counties lying wholly or partially within the Cape Fear River Basin.

[2] Includes only counties and portions of counties lying within the Cape Fear River Basin.

[3] Based on 1960 census.

FACTORS UNDERLYING ECONOMIC GROWTH IN THE CAPE FEAR RIVER BASIN

32. The expanding national economy projected for future years is based on the fundamental assumption that the forces which have produced the dynamic, expanding economy of the United States in the past will continue to exert a similar influence in the future. The same basic forces which make for national growth affect, in varying degrees, the activity of any subarea of the nation's economy. The economic makeup of the Cape Fear River Basin area is perhaps more advanced than the average for the nation; however, national trends are expected to exert their influence in the basin.

33. Growth factors which produced differential growth in the past and such other factors as might have an influence in altering the past relations of the area were considered in deriving estimates. In the Cape Fear River Basin the dominant, past, regional factors have been the rise of the textile, tobacco, and wood furniture industries. Agriculture has also played an important role in the development of the basin in the past and continues to exert a very strong force today. While average farm size remains about the same, agricultural production continues to increase as a result of increased mechanization, specialization, and diversification. Within recent years positive trends have developed from the growth of the pulp and paper, chemical, and electronics industries.

34. The metropolitan areas of Greensboro, Burlington, Fayetteville, and Durham are located within the basin, while other important urban areas such as Winston-Salem, High Point, and Raleigh are situated just outside the drainage basin. A network of excellent highways connects these and other metropolitan areas of the State, while a modern, rural, collector highway system provides suburban and farm-to-market roads.

35. Four major railroads serving the basin and the deepwater port facilities at Wilmington have long been important economic factors in the growth of the basin and the State. Wilmington is one of the leading southeastern ports of the United States in tonnage handled. A navigational channel, adequate to accommodate barges and towboats, extends about 90 miles inland from Wilmington to Fayetteville.

INDICATORS OF ECONOMIC GROWTH IN THE CAPE FEAR RIVER BASIN

36. Industrial expansion within the basin has increased at a rapid rate in recent years as indicated in the following table.

TABLE 8

New and expanded industries in the Cape Fear River Basin area, 1954-1960

Number		Capital investment (in $1,000)		Payroll (in $1,000)		Employees	
New	Expanded	New	Expanded	New	Expanded	New	Expanded
369	490	174,118	152,632	77,367	59,239	25,508	18,506

37. Many of the industries which have shown an interest in locating in or near the basin require large land areas, large quantities of clean water, abundance of electrical power, economical fuel costs, and deepwater transportation facilities. The Cape Fear River Basin can meet all of these requirements at present, with the possible exception of water supply in its upper reaches.

38. Availability of natural gas since 1951 has opened the door to major new industries within the basin. Since 1951, major natural gas companies have invested more than $100 million in making service available to every major city in the State.

39. The State Ports Authority docks at Wilmington, with their modern facilities, have developed into a thriving business since their construction in 1952. The number of ships calling at the docks has increased from 16 in 1952 to 254 in 1959. The benefits from these port facilities are widespread. Industry throughout the basin benefits from reduced transportation costs, and estimates indicate that an average ship calling at Wilmington will trigger the circulation of something like $5,000 in additional money. Unnumbered new jobs have been created directly as the result of the rapid growth of the port. Indications are that the present tonnage will be doubled within the foreseeable future if existing facilities are expanded to meet demands. To meet this challenge, the State Ports Authority is presently considering plans for expansion which include a capital outlay of approximately 8 to 10 million dollars. The future also looks very bright for the early establishment of State Ports docking facilities at Fayetteville.

40. Recent construction and expansion of the principal steamplants owned and operated by the Carolina Power and Light Company, located near the midportion and lower end of the Cape Fear River Basin, insure an ample supply of electrical power to meet industrial needs within the foreseeable future.

41. In 1956 the Research Triangle of North Carolina was established. It is located within the Cape Fear River Basin and within a

triangle formed by Duke University at Durham, University of North Carolina at Chapel Hill, and N. C. State College at Raleigh. The purpose of the Research Triangle is to familiarize industrial and governmental research interests with the scientific resources and cultural advantages of the area and thereby to further advance the research resources of the area. The Research Triangle Foundation has purchased a 4,300-acre campus in the center of the triangle area and has restricted its use entirely to the development of industrial and governmental research facilities. This Research Triangle area thus has begun to flourish as one of the most attractive sites to be found anywhere in the nation for the location of industrial laboratories.

PROJECTED ECONOMIC DEVELOPMENT OF THE CAPE FEAR RIVER BASIN

42. The estimation of the long-term projections of economic development, as discussed in the previous paragraphs, was made by mathematical methods. The projections are generally semilogarithmic in nature; that is, they spiral upward. This characteristic is intrinsic to the mathematical concept of growth compounded at a constant percentage rate per year. The compound annual growth rate for the gross national product, as well as the personal income projections for the nation, State, and Cape Fear River Basin area, were assumed at 4-1/2 percent. The compound annual growth rate for the population projections was generally assumed at 1-3/4 percent.

SECTION III - HYDROLOGY

CLIMATOLOGY

43. Climate. The Cape Fear River Basin has a temperate climate, with warm summers and usually mild winters. Extreme temperatures are modified by the effects of the Atlantic Ocean and prevailing moist winds from the southwest. The Appalachian Mountain Range located to the west of the basin forms a partial barrier to the cold airwaves moving southeastward from the interior of the country. January is the coldest month, with a mean temperature in the basin of about 42° F. upstream from Fayetteville and about 48° F. downstream. July is the warmest month, with a mean temperature of about 78° F. upstream from Fayetteville and about 80° F. downstream. The extreme temperatures of record in the basin are 108° F. and -9° F. Severe freezing seldom occurs; however, annual snowfall over the basin ranges from an average of about 9 inches in the west to about 2 inches near the coast. The moisture-laden winds from the South Atlantic and gulf coast contribute notably to the relatively high average humidity over the basin.

44. Precipitation. Plate I-1, appendix I, shows all United States Weather Bureau rainfall stations now in operation, both within and immediately adjacent to the Cape Fear River Basin. The average annual precipitation over the basin is 46.2 inches. Except for the normal heavy rainfall during the summer, the rainfall is quite evenly distributed throughout the year, with 23 percent falling in winter,

23 percent in spring, 34 percent in summer, and 20 percent in fall. July is the wettest month, with an average precipitation of 6.0 inches. October is the driest, with 2.7 inches. (There is no apparent relationship between altitude and precipitation in this basin.) The maximum annual precipitation below Fayetteville, recorded throughout the period 1875-1958, is 85.0 inches at Southport, and the maximum upstream from Fayetteville is 74.0 inches, occurring at Southern Pines. The average unmelted annual snowfall in the Piedmont belt, above Fayetteville, is about 11.4 inches, decreasing to about 1.8 inches at the coast. Snow is not an important factor in the production of floods. The mean monthly and annual precipitation for the basin are shown in table I-4, appendix I.

45. The average annual evaporation for 33 years of record at Chapel Hill, North Carolina, as observed from U. S. Weather Bureau "Class A" land pan, is 40.07 inches. Evaporation losses used in this report were taken from Engineering Manual, Civil Works Construction, Part CXVII, Chapter 2, April 1952, based on data from Raleigh Station, near the proposed New Hope Reservoir.

46. Storms. Flood-producing storms occur in all seasons of the year in the Cape Fear River Basin. Two general types of storms which produce major floods over the basin are thunderstorms and hurricanes. Thunderstorms accompanied by torrential rains of short or sustained duration may occur over the basin during any season of the year. North Carolina lies in the path of tropical hurricanes as they move northerly from their origin north of the Equator in the Atlantic Ocean, and these hurricanes, usually occurring in the late summer and fall, have caused the heaviest rainfall and largest floods throughout the basin. Storms which have produced the most severe floods of record in the Cape Fear River Basin are described in appendix I. More information on temperature, precipitation, wind, humidity, and storms is given in appendix I.

RUNOFF AND STREAMFLOW DATA

47. The U. S. Geological Survey now operates 24 stage-discharge recording stations in the Cape Fear watershed. Records are also available for several such stations that have been discontinued. The U. S. Weather Bureau operates three stations that record river stages only. Records from these gages extend over periods of 5 to 67 years. The first gage was established at Fayetteville in 1889 and has the longest record. Table I-6 in appendix I lists all of the gages and essential data about each. Locations of stage-discharge recording stations and stage recording stations are shown on plate I-1, appendix I. The streamflow records are considered adequate for this report.

48. For the periods of record available up through 1958 the average annual runoff from the Cape Fear River Basin is approximately 13.6 inches as recorded at lock No. 3 near Tarheel, N. C., or about 30 percent of the average annual basin rainfall. The annual runoff

from the Haw River amounts to 12.8 inches as recorded at Pittsboro, N. C., for the period 1928-1958, and the annual runoff for the Deep River amounts to 13.7 inches as recorded at Moncure, N. C., for the period 1930-1958. The runoff from the Haw and Deep Rivers amounts to about 28 and 30 percent, respectively, of the average annual rainfall for the entire Cape Fear River Basin. The percent runoff from each of the Haw River and Deep River watersheds is somewhat higher than those indicated above, since average annual rainfall over the basin tends to decrease as distance from the coast increases. Average flows at recording stations are shown on table I-6 of appendix I.

FLOODS OF RECORD

49. Flood stage was exceeded 269 times at lock No. 2 near Elizabethtown during the 43-year period 1915-1957, and 66 times at Lillington during the 35-year period 1924-1958. Likewise, there have been 52 floods recorded by the Pittsboro gage on the Haw River during the 28-year period 1928-1955 and 26 floods recorded by the Moncure gage on the Deep River during the 26-year period 1930-1955. The average annual occurrence of floods at these locations may be seen in table 9 below. Flooding increases considerably below Fayetteville where the river enters the flat, broad valley of the Coastal Plain.

TABLE 9

Monthly flood occurrence for period of record

Month	Pittsboro	Lillington	Fayetteville	Lock No. 2 at Elizabethtown
January	8	14	20	42
February	8	8	18	47
March	7	9	21	43
April	7	8	10	30
May	1	1	2	15
June	0	0	2	8
July	2	3	6	14
August	5	5	13	16
September	4	6	8	11
October	5	4	7	11
November	3	5	4	14
December	2	3	8	18
Total	52	66	119	269
Years of record	28	35	70	43
Average events per year	1.9	1.9	1.7	6.3

50. The September 1945 storm generally caused the highest flood stages of record throughout the Cape Fear River Basin, except in the headwaters. A flood of this magnitude has an estimated occurrence frequency of about once in 67 years at Pittsboro, once in 70 years at Moncure, once in 67 years at Lillington, once in 37 years at Fayetteville, and once in about 21 years at lock No. 2. The September 1945 flood stages at Fayetteville exceeded the August 1908 flood stages by 0.2 foot, which was the previous record flood. Floods of record for several principal gages along the Cape Fear River and its tributaries are tabulated in tables I-7a through I-7d of appendix I. Discharge-frequency curves are shown on plates I-3, I-4, and I-5 of appendix I.

51. Floods on the headwaters of the Cape Fear River in the upper reaches are flashy and usually have a duration of 2 to 4 days. On lower reaches of the river the flood plain widens to several miles, which results in slowly rising and falling stages. In this area floods usually last from 5 to 14 days."

SECTION IV - THE FLOOD PROBLEM

EXTENT AND CHARACTER OF FLOOD AREA

52. General. Above the confluence of the Deep and Haw Rivers the basin is hilly, with narrow flood plains. Below the confluence the basin generally flattens and the flood plains become much wider. This area is devoted primarily to farming and contains some of the most productive agricultural land in the State. In general, all the main highways and railroads that cross the flood plains throughout the basin have been elevated so that they are flooded only by extreme stages. However, many miles of secondary roads are flooded frequently. The extent of flooding was determined primarily by plotting established high-water marks on U. S. Geological Survey topographic maps and/or aerial photographs. The amount of cleared, cultivated, and wooded land, as well as the determination of current and expected future farming practices, were derived from data obtained directly from county agents, other State and Federal agricultural agencies, and farmers cultivating the areas subject to floods.

53. Urban development. Many small communities located on tributaries throughout the basin are subject to infrequent flood damages of varying severity. Several industrial plants and mill villages located on or adjacent to the main-stem flood plains of the Haw and Deep Rivers have suffered severe damages in the past.

54. Lillington and Elizabethtown, having 1960 populations of 1,242 and 1,625, respectively, are located generally on high ground and are subject to relatively minor damage from large floods. Wilmington is in the tidal zone and is not affected by floodwaters of the Cape Fear River.

55. Fayetteville, located near the center of the basin, is by far the principal urban area subject to extensive damage from floods.

About one-fourth of the commercial and residential area in and about Fayetteville and the community of East Fayetteville across the river are in the flood plain and were severely damaged by floodwaters in 1945. The area inundated by the 1945 flood west of the river at Fayetteville averaged about 1 mile in width and terminated at the edge of the main business and residential sections of Fayetteville; slightly higher flood stages would have caused considerably more damage. If the 1945 flood should occur again, a total of about 3,000 homes, 200 commercial and industrial establishments, schools, churches, and other public buildings which are now located in the 1945 flood zone would be affected. The commercial establishments are primarily retail stores and the industries affected consist of large oil and asphalt plants, textile factories, a chemical plant, a steel fabrication shop, cotton gins, and bottling plants. Many industrial tracts readily accessible to the navigable channel and water supply of the river have not been developed because of the risk of floods.

56. Rural development. The flood plains of the minor tributaries are generally well developed, primarily because of the heavier, more fertile soils on the flood plains as compared to the adjacent uplands. While the flood plains of the main stems of the Haw and Deep Rivers are generally narrow and in some areas relatively inaccessible for farming, the soils are fertile and are farmed to some extent. The flood plains below the confluence of the Haw and Deep Rivers are very wide and generally more fertile and better adapted to more diversified farming than other farmlands throughout the basin.

57. The flood plains in the Cape Fear River Basin produce excellent crops of corn, tobacco, hay, and cotton. In addition, many acres of truck, peanuts, and soybeans are grown in the lower basin flood plains. The extensive timberlands supply many logs for lumber and pulpwood.

58. About 70 percent of the total 314,000 acres of flood plain in the Cape Fear River Basin is located along the main stem of the Cape Fear River, beginning about 13 miles upstream from Wilmington and extending upstream some 157 miles to the confluence of the Deep and Haw Rivers. Of the 219,100 acres of flood plain in this reach, 48,000 acres have been cleared primarily for agricultural uses. Much of the woodland, which makes up about 60 percent of the flood-plain area, has soils that would make good cropland if it were not for the floods. The cleared land used for farming has 41 percent of its acreage in corn, 20 percent in pasture, 26 percent in small grains and hay, 2 percent in truck crops, 9 percent in cotton, and 2 percent in tobacco. Only a small part of the land is used for growing winter crops. Livestock raising is rather extensive, with 20 percent of the cleared land being used for pasture.

59. The cleared and wooded lands lying below the confluence of the Deep and Haw Rivers and subject to floods are shown by reaches on table II-3, appendix II. Plate II-1 in appendix II shows the limits of the flood plain and the downstream reaches studied in this report.

FLOOD DAMAGES

60. General. A considerable amount of flood damage occurs annually throughout the Cape Fear River Basin. Most of the flood damage occurs on the broad flood plains below the confluence of the Deep and Haw Rivers. The greatest loss in rural areas results from tangible physical damage to agricultural property, crops, and to public roads. Nonrural losses are suffered predominately at the Fayetteville area and result from tangible physical and business damage to urban and industrial properties. The following paragraphs discuss the results of the flood-damage-evaluation studies. Details of the evaluation of flood damages pertinent to the justification of the New Hope project are presented in appendix II.

61. The average annual losses used in this report are based on flood-damage-appraisal studies made after the September 1945 flood, detailed property surveys made in 1955, and upstream studies made jointly with the Soil Conservation Service in 1958-59. These damage studies were evaluated on the then-current price levels and were later adjusted to 1960 price levels.

62. Rural flood losses. Since the value of a crop depends upon maturity, the extent of damage from flooding varies not only with the area flooded but also with the season of the year. For a given flood magnitude the resulting damage is much greater during the growing season than during winter or early spring when few crops are in the field.

63. With the present agricultural development of the flood plains it is estimated that a recurrence of the September 1945 flood would cause rural damages amounting to about $3 million throughout the basin. Approximately 93 percent of these damages, or $2.8 million worth, would occur on the flood plains along the main stem of the Cape Fear River below the confluence of the Deep and Haw Rivers. The average annual damages to the same properties are estimated to be $521,000 for the basin. About 82 percent of these average annual damages occur on the flood plains below the confluence of the Deep and Haw Rivers.

64. Nonrural flood losses. These losses are the tangible physical and business losses inflicted on urban and industrial properties, utilities, and transportation facilities, and the additional expenses incurred in providing emergency and precautionary measures. With the present nonrural flood-plain development in the Cape Fear River Basin it is estimated that a recurrence of the September 1945 flood would cause nonrural flood damages amounting to about $8 million, of which 82 percent would occur on the main-stem flood plains of the Cape Fear River below the confluence of the Deep and Haw Rivers. The average annual damage to nonrural properties in the basin is estimated to be $966,350. Approximately 85 percent of these damages occur on the lower Cape Fear River flood plains and are broken down as follows: Urban property, 62 percent; transportation facilities, 17 percent; industrial property, 13 percent; emergency and precautionary measures, 5 percent; and 3 percent to utilities.

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65. Summary of flood-damage-evaluation studies. The greatest portion of the flood plains in the Cape Fear River Basin cannot be put to optimum use, largely due to the existing flood hazard. This applies particularly to the main-stem flood plains of the Cape Fear River. Assurances of reduced river stages are necessary to stimulate changes in current farming practices and urban development growth so that greater net returns may be realized from the lands lying in the flood plains. Table 10 summarizes the results of the flood-damage-evaluation studies for the flood plain in its 1960 stage of development and in the stage of development expected to occur by the years 2010 and 2060. The estimates of the future flood damages are based on past growth rates and anticipated future growth rates, assuming no provision of flood control projects. Because of the predominant amount of basin flood damage that occurs on the lower Cape Fear River flood plains, a more detailed breakdown of the flood damages pertinent to that area is also included in table 10.

TABLE 10

Summary of Cape Fear River Basin flood-damage-evaluation studies
(1960 price level)

Item	Flood damages based on 1960 state of flood-plain development		Estimate of annual future flood damages, without projects	
	Estimate of flood damage from recurrence of September 1945 magnitude flood	Average annual flood damage	2010	2060
Cape Fear River Basin:				
Rural flood damages	$ 3,015,000	$ 520,650	$ 668,000	$ 720,000
Nonrural flood damages	7,950,000	966,350	1,558,000	2,160,000
Total	$10,965,000	$1,487,000	$2,226,000	$2,880,000
Main-stem Cape Fear River:				
Annual crops	$ 1,494,000	$ 217,000	$ 259,000	$ 301,000
Pastures	36,000	10,000	17,000	24,000
Rural buildings	484,000	81,000	116,000	151,000
Rural fixed improvements	801,000	121,000	181,000	241,000
Subtotal, rural items	$ 2,815,000	$ 429,000	$ 573,000	$ 717,000
Transportation facilities	$ 1,202,000	$ 142,000	$ 209,000	$ 276,000
Industrial property	874,000	107,000	165,000	223,000
Urban property	3,650,000	506,000	792,000	1,078,000
Utilities	220,000	24,000	38,000	52,000
Emergency and precautionary measures	555,000	44,000	97,000	150,000
Subtotal, nonrural items	$ 6,501,000	$ 823,000	$1,301,000	$1,779,000
Total	$ 9,316,000	$1,252,000	$1,874,000	$2,496,000

EXISTING CORPS OF ENGINEERS' FLOOD CONTROL PROJECTS

66. There are no Corps of Engineers' flood control projects specifically authorized by Congress. As mentioned in paragraph 8, repairs and additions to the existing White Oak Dike near Kelly, N. C., were authorized by the Chief of Engineers in November 1960 under the provisions of Public Law 685, 84th Congress. Construction began on this project in July 1961. The improvements to this dike, which was originally built by local interests, will consist of repair and raising of 4 miles of the old dike and the construction of 11 miles of new dike, all to a height of 2 feet above the water surface reached by the 1945 flood. About 20,200 acres will be protected by the improved and extended dike from Cape Fear River flood stages up to the 1945 flood peak.

IMPROVEMENTS BY OTHER FEDERAL AND NON-FEDERAL AGENCIES

67. Federal improvements. The Soil Conservation Service, U. S. Department of Agriculture, cooperates with local soil conservation districts which cover the entire watershed of the Cape Fear River. The Soil Conservation Service works with individual farmers in preparation of plans for using agricultural lands most efficiently and for treating the land according to its needs for protection and improvement.

68. The Deep River forms the northeast boundary of the Uwharrie National Forest. However, none of these forest lands are involved in the water-resource improvements considered in this report.

69. Non-Federal improvements. The Bladen Lakes State Forest is located in Bladen County in the lower section of the Cape Fear River Basin. The 36,000-acre forest is leased Federal land which was purchased by the Resettlement Administration and later administered by the Soil Conservation Service before being turned over to the State in 1939. It is now being used as a recreational area as well as for timber and wildlife production.

VIEWS OF LOCAL INTERESTS

70. Public hearing. A public hearing was held in Fayetteville, N. C., on February 8, 1957, in connection with this report. About 550 people attended, consisting of Federal, State, county, and city officials, industrial representatives, railroad officials, and citizens of urban and rural areas. Flood protection at Fayetteville and along the Cape Fear River was strongly advocated and the need for water conservation for the improvement of navigation, pollution abatement, and other usages was emphasized by local interests.

71. Local interests have organized the Cape Fear Basin Development Association, with members from every county in the basin (except one), which is actively promoting the development of the water resources of the basin. Many meetings have been held and information distributed

to indicate the desire for the full development of the basin. Local interests from the Greensboro area expressed a desire for development of the Deep River Basin and voiced their desire for a dam at the Randleman site. Other interests, primarily from Chatham County, N. C., have organized the New Hope Valley Association which is actively opposed to the construction of any project that would inundate the New Hope River Valley. The New Hope Reservoir, proposed by the Corps of Engineers, would inundate this valley. The New Hope Valley Association is in favor of flood protection along the Cape Fear River, but by some other plan of development, possibly a series of small dams, that would not adversely affect them. Records and digests of the public hearing will be found in appendix IX.

SECTION V - THE WATER-SUPPLY PROBLEM

GENERAL

72. Although the Cape Fear River Basin is located in one of the most favored climatic regions where rainfall is generally well distributed and relatively abundant, water shortages have been experienced in some years by a number of municipalities.

EXISTING WATER-SUPPLY PROJECTS

73. Practically all of the cities in the Cape Fear River Basin are continually expanding their water-supply systems to meet demands attendant upon population and industrial growth. In 1960 there were approximately 569,000 people being served by municipal or publicly owned water-supply systems located in the Cape Fear River Basin. About 83 percent of the users were served by systems utilizing impounded surface water which was used at an average rate of approximately 55 million gallons per day. The total design capacity of these systems is estimated at about 81 million gallons per day. Some 76 industrial plants used water at the average rate of about 45 million gallons per day, with 26 of the plants accounting for 97 percent of the average daily rate from surface-water supplies. The above industrial water-use rate does not include an average 561 million gallons per day required by two large thermopower generating plants for cooling water. This cooling-water requirement at times exceeds the daily flow at the intakes, and recirculation becomes mandatory.

NEEDS FOR ADDITIONAL WATER

74. General. Municipal and industrial process water usage from all sources is expected to about double in the Cape Fear River Basin within the next 20 years. Therefore, by the year 1980 an estimated total of approximately 200 million gallons per day will be needed. Future water requirements were based on the population growth and anticipated percent rate of industrial growth. A rigid interpretation of historical records has, in the past, almost always resulted in an under-designed water system. The Select Committee on National Water

Resources estimates that the present 147 gallons per capita per day of average numicipal water use could conceivably increase to about 185 gallons per capita per day in 1980 and 225 gallons per capita per day in the year 2000, with a possible leveling off thereafter. Conservative figures used for this report include 115 gallons per capita per day for present-day usage, 150 gallons per capita per day by 1980, and 180 gallons per capita per day thereafter. Municipal water requirements consist of domestic, commercial, public, and municipally supplied industrial water needs. These requirements were estimated by utilizing the record of three areas within the Cape Fear River Basin and projecting increased use. This method takes cognizance of the varying uses in each area, as these factors are reflected in the record and define the amount and location of storage requirements for the Cape Fear area. Industrial water requirements were based on the expected degrees of expansion of existing industries and the appearance in the area of new, high-rate, water-using industries.

75. Municipal water requirements. Based on an annual population growth of 2 percent, the projected demands will surpass the available supply by 1970. Table 11 shows the municipal water used in 1960 and estimated requirements for the Cape Fear River Basin in the future.

TABLE 11

Average municipal water requirements for the Cape Fear River Basin

Item	1960	1980	2010
Population served	569,000	845,000	1,531,000
Estimated per capita use, in gallons per day	115	150	180
	(Millions of gallons per day)		
Total municipal requirements	66	127	276
Developed capacity	81	-	-
Total additional requirements	0	46	195

76. Industrial water requirements. The factors that have brought about the present high industrial development in the Cape Fear River Basin are expected to continue in the future. The expected future industrial growth includes industries requiring large amounts of water, such as the textile, chemical, and pulp and paper products industries. Table 12 shows the estimated requirements for industry in the Cape Fear River Basin.

TABLE 12

Industrial water requirements for the Cape Fear River Basin[1]
(in millions of gallons per day)

Item	1960	1980	2010
Industrial process water	45	74	155
Developed capacity	70	-	-
Total additional requirements	0	4	85

[1]Does not include water used for cooling.

77. Agricultural water needs. Because agriculture plays an important part in the overall economy of the Cape Fear River Basin, there is an accelerating trend toward using surface water for irrigation. There are approximately 10,000 acres of agricultural land currently being irrigated in the basin. The projected agricultural irrigation needs are estimated by assuming an annual rate of increase of irrigable land of 2 percent and a use rate of 2 acre-feet of water for each acre of crop irrigated. The use rate includes an allowance for evaporation and seepage. The projected needs for agricultural irrigation needs are shown in table 13.

78. Summary of water needs. The following table summarizes the estimated total water-supply requirements for the Cape Fear River Basin to the year 2010; investigations were also made to the year 2060, the total evaluation period for this report. It is imperative that these requirements be met in order for the general economy of the Cape Fear River Basin area to achieve its potential. Criteria used in determining storage requirements to meet the estimated water-supply needs of the basin are presented in paragraph 21 of appendix V.

TABLE 13

Summary of water-supply needs for the Cape Fear River Basin
(in millions of gallons per day)

Item	1960	1980	2010
Additional amounts required			
Municipal water supply	66	127	276
Industrial process water supply[1]	45	74	155
Agricultural water supply	72	108	195
Total water supply needs	183	309	626

[1]Does not include water used for cooling.

SECTION VI - THE POLLUTION PROBLEM

PRESENT STREAM-WATER QUALITY

79. The waters of the Cape Fear River Basin, in the areas of heaviest concentration of industry and population, have been damaged by the discharge of untreated and partially treated sewage and industrial wastes. All sources of pollution have a total sewage population equivalent of approximately 1,300,000 before treatment, whereas after treatment these wastes represent a sewage population equivalent of about 930,000 as discharged to the waters of the basin.

EXISTING TREATMENT WORKS

80. There are 143 significant sources of pollution throughout the basin. Of these, 62 are at present discharging untreated wastes directly into the streams, 28 are giving the wastes secondary treatment, and 53 provide only primary treatment. The overall reduction resulting from treatment amounts to only 26 percent. This degree of treatment will vary with the different drainage areas. From the confluence of the Deep and Haw Rivers to the Atlantic Ocean, a distance of some 200 miles, the overall reduction is only 16 percent. In the Deep River area, where there is a larger percentage of secondary treatment plants, the overall reduction is 41 percent. The reduction in the Haw River area is 36 percent.

STREAM-QUALITY OBJECTIVES

81. On April 6, 1951, the General Assembly of North Carolina created the State Stream Sanitation Committee, charged with the duty of protecting the water supplies for health, recreation, fishing, agriculture, industry, and animal life. This committee has established criteria for classifying streams according to best water usages, and quality and purity requirements meeting Public Health Service standards have been assigned accordingly. Under this program the streams are to be brought to the required standards by additional treatment works within a reasonable length of time.

NEED FOR INCREASED STREAMFLOW

82. There is a definite movement of the population from the rural areas of the Cape Fear River Basin to the urban area. This is indicated by the steady growth of the towns and cities and the decrease in the number and size of farms. Industrial development of the basin, already high in relation to the rest of the State, is expected to continue at an increasing rate. This development will increase the volume of wastes discharged into the streams, while simultaneously increasing the need for clean water for industrial and domestic use. To maintain present water quality, additional treatment plants will have to be provided at a rate commensurate with the population and industrial growth. If the much-needed improvement in water quality is to be achieved, treatment

plants must be provided at an even greater rate. However, even with the most efficient treatment plants operating at near 90 percent efficiency, there will still be a growing amount of pollution entering the streams of the basin as industrial development increases. This is particularly true where there is growth of the textile, chemical, and woodpulp industries. The effluent of these industries is very difficult to treat, and it is practically impossible to remove all objectionable materials. Unless means are provided to increase minimum streamflows, these residual wastes could make the maintenance of high water-quality standards very difficult.

SECTION VII - OTHER PROBLEMS AND NEEDS

RECREATION

83. No major recreational areas exist in the Cape Fear River Basin, except for an area near Elizabethtown which contains several large natural lakes and an area around Wilmington which includes several beaches. The main stem of the river is used for boating to a limited extent. About half a million people reside in Raleigh, Durham, Greensboro, and the adjoining industrial centers, and the anticipated growth of population in these areas is expected to bring about an ever-expanding need for additional recreational facilities. Reservoirs with impounded water suitable for swimming, boating, and fishing would meet many unfilled recreational needs.

FORESTATION AND SOIL CONSERVATION

84. The pulp and paper industry presently uses large quantities of forest products. The expected expansion of this industry in the Cape Fear River Basin will require an extensive increase in pulpwood supplies. Improved soil-cover conditions which can be achieved by proper land and forest management are needed in the Cape Fear River Basin to reduce erosion by damaging overland flows and to insure adequate pulpwood supplies. Investigations by the Department of Agriculture indicate the need for watershed plans in several areas of the basin. Soil conservation and land and forest management in the Cape Fear River Basin are expected to become economic necessities to provide for expanding industrial development and as a means of water-resource enhancement.

FISH AND WILDLIFE

85. The heavy pollution load of streams in the upper basin, particularly in the Haw River, has had an adverse effect on the fish habitat. Current utilization of the fishery resources of the Haw and New Hope Rivers within the proposed reservoir area is generally low. Downstream from the New Hope damsite to the vicinity of Fayetteville the utilization varies from low to high. The high utilization takes place in the vicinity of dams and better access points. Construction of the New Hope project would replace the existing stream fishery above the damsite with a reservoir fishery with an increase in utilization. The value of the fishery below the dam would remain about the same as at present. Wildlife resources in the basin consist of big game in the lower Cape Fear River area, small game, and migratory birds. Construction of the reservoir would directly eliminate 9,400 acres of

excellent-quality wildlife in the permanent pool, and productivity on the remaining 20,600 acres in the reservoir would be reduced by periodic inundation. In the downstream flood zone the project would encourage intensified use of agricultural and forest lands and other development which would result in a loss to the wildlife resources.

HYDROELECTRIC POWER

86. As discussed in paragraph 21 the power needs of the basin are met principally by power generated by steam-electric plants. A small amount of power is generated by a few small, old hydroelectric plants. The power demand is growing steadily in the basin, as elsewhere. Any additional power which could be generated economically in competition with modern steam-electric powerplants could be used to assist in supplying the demand. However, the conditions of streamflow and head for generating hydroelectric power in this basin are unfavorable in comparison with neighboring basins which have their headwaters in the mountains. The only potential site where hydroelectric power might be developed as a major purpose, in conjunction with other purposes, is the New Hope site. Preliminary studies in appendix IV indicate power to be justifiable economically as a project purpose. However, the additional benefits possible are not enough to warrant inclusion of power as a major purpose in the face of the overwhelming local opposition to the large reservoir which inclusion of power would require. Such a reservoir would inundate existing sewerage plant outfalls near Durham, damage several present developments of various kinds, and hinder future development in Durham and Chapel Hill. A possibility exists of developing a small amount of power incidental to flow regulation at the New Hope site as discussed later.

NAVIGATION

87. Commercial use of the Cape Fear River waterway will undoubtedly increase with industrial growth of the area. This waterway has complete towing and barge services from Fayetteville to the Atlantic Ocean and connects with the Atlantic Intracoastal Waterway. The present low flow of water is now considered adequate for lockage and navigation between Fayetteville and Wilmington; however, at flood stages, navigation is difficult and often hazardous. While flood-stage reductions would reduce this hazard appreciably, the greatest benefit resulting from the reduction of flood stages would stem from the stimulating effect on the growth of industries, particularly those requiring waterborne traffic facilities.

EROSION

88. Erosion within the Cape Fear River Basin varies from slight to very severe. Areas of shallow soils and soils with slowly permeable subsoils that have been used for cropland are generally severely eroded. Effects of erosion are evident throughout the upper part of the basin. Both sheet and gully erosion have been active in the destruction of former areas of cropland and in substantially reducing crop and forage yields on land presently being farmed. Stream channels

also have been adversely affected by having their carrying capacity seriously impaired by depositions from eroding uplands. Erosion-control practices have been effective in controlling excessive soil losses on some of the cropland, but there are still many areas that are subject to heavy annual soil losses.

SECTION VIII - SOLUTIONS CONSIDERED

GENERAL

89. The various schemes considered to meet the water-conservation needs of the Cape Fear River Basin include dual- and multiple-purpose reservoirs to provide flood control, water-supply, low-flow regulation, hydroelectric power generation, and recreation; local protection works such as levees and dikes for flood control; flood-plain zoning and excavation; channel improvement; and combinations thereof.

SOLUTION TO THE FLOOD PROBLEM

90. Flood control reservoirs. Sites for the development of storages of surface water for flood control purposes exist in sufficient number to provide a large degree of flood protection throughout the basin. These sites are distributed generally throughout the basin above Fayetteville. Large reservoirs at the New Hope, Randleman, and Howards Mill sites and a system of small- and intermediate-size reservoirs were determined to be feasible and would offer a solution to the flood problem. The New Hope damsite is located on the Haw River immediately below the mouth of the New Hope River; the Randleman and Howards Mill damsites are both located on the Deep River. Small- and intermediate-size dams would be located at various sites on tributaries throughout the basin and would supplement the flood control in the large reservoirs as well as serving other purposes. Reservoirs were studied individually and in various combinations.

91. Local protection works. Levees and dikes were considered for areas where flood damages were concentrated. Although there were several sites where these projects could be used, the system of reservoirs discussed above could also provide flood protection for these sites. It was concluded from the study that it would be more feasible to use the reservoirs as well as being more practicable, considering the feasibility of reservoir projects. This does not preclude the use of local protection works, since future conditions may dictate their need.

92. Flood-plain zoning and evacuation. Reduction of flood damages could be accomplished by completely restricting the use of the flood plain or evacuating the flood plain entirely. Neither of these solutions is considered practical in view of the highly developed economy based on installations presently located within the flood plains. Complete restriction of further development in highly developed flood plains is considered impractical because such zoning would in no way provide protection for those installations and communities now subject to flood damages. Flood-zone regulation for undeveloped flood plains

would certainly be a practical means to lessen future, potential flood damages. Flood-resistant construction may also be a solution to eliminate future flood damages if the cost is not prohibitive.

93. Channel improvement. The channel of the main stem of the Cape Fear River is generally wide, well cut, and with relatively few sharp bends. The channels of the Haw and Deep Rivers are similar, but have considerably steeper gradients. Therefore, only minor benefits could be achieved by channel improvements. Many minor tributaries and canals in the lower portion of the basin are subject to severe damages from high-stage riverflows which tend to fill them with sand and debris. Continuing maintenance programs by local drainage districts will help to reduce agricultural flood damages in these areas.

SOLUTION TO THE WATER-SUPPLY PROBLEM

94. General. Solutions considered for the water-supply problem consist of development of ground-water supplies, diversion of water from adjacent watersheds, and storage of surface water in reservoirs.

95. Ground water. Ground-water yields are not available in sufficient quantities to satisfy all of the future water-supply needs of the Cape Fear River Basin. In the upper portion of the basin the most pressing water-supply needs will be concentrated at the metropolitan centers and industrialized areas. This area lies in the Piedmont Plateau which is underlain with relatively low-yielding aquifers. In the lower portion of the basin, where the underlying aquifers produce considerably higher and more dependable yields, high-yielding wells would have to be spaced so that adjacent wells would not produce mutual interference. In some instances this would preclude an industry from having more than one heavily pumped well on its property. Near the coast another limiting factor in future expansion of ground-water supplies is the encroachment of saline water in the more heavily pumped wells. Ground-water supplies are, however, expected to be developed considerably to provide future agricultural water supplies.

96. Diversion from other watersheds. Adjacent watersheds to the Cape Fear River Basin are expected to develop similar water-resource needs. With such development it is highly unlikely that appreciable quantities of water will be available for diversion purposes. In addition, the extremely high cost of diverting and transporting the water from other watersheds precluded further consideration of this alternative when compared to the less costly method of developing local surface-water supplies. North Carolina water law is based on the riparian doctrine, and the legality of diversion of water by nonriparian owners may be questioned in providing water from other watersheds.

97. Surface water. The conservation of the surface-water resource is considered a practicable and economical means of increasing the dependable water supply in the basin, particularly for a long-range plan of development. An adequate supply of water can be made available through the development of the multiple-purpose-reservoir storage plan,

the details of which are presented later in this report. The plan will include reservoir storage for water-quality control as well as water supply.

WATER-QUALITY IMPROVEMENT

98. General. The two most practical methods of reducing the pollution load in rivers and streams are treatment of wastes at their source and dilution of the discharged wastes through increased streamflow.

99. Treatment at source. The treatment of wastes at their source is an essential element of pollution reduction and is the responsibility of the State of North Carolina and local agencies. Through the N. C. State Stream Sanitation Committee's active and excellent pollution-abatement program the quality of water in the streams of the Cape Fear River Basin is expected to be improved considerably within the next few years. Present technology permits a high degree of treatment of domestic sewage and some industrial wastes. Further retreatment of industrial wastes to virtually eliminate residual pollutants would be extremely expensive. Certain colored wastes and persistent chemicals typical of papermill and textile mill discharges are not susceptible to existing or foreseeable practical methods of treatment. As the industrial development continues throughout the basin, these residual wastes in the stream will continue to build up. Whether or not, in future years, pollution abatement can progress rapidly enough to offset the increases in residual wastes is a moot question.

100. Dilution. Dilution offers a practical method of controlling residual wastes in streams. Therefore, the overall plan of water-resource development of the Cape Fear River includes surface-water storage for water-quality control which will provide adequate streamflow to effect a reasonable amount of dilution. The key to a high degree of water-quality control in the basin is considered to be (1) complete secondary treatment at all pollution sources and (2) adequate dilution of residual wastes.

OTHER PROBLEM SOLUTIONS

101. Recreation. The construction of surface-water-storage reservoirs at strategic points throughout the basin would provide the necessary facilities for fishing, bathing, camping, boating, and other water-related recreational activities. The location of other recreational developments, major cities, and their distances from the center of the general area of the proposed reservoirs is shown on plate V-13, appendix V.

102. Fish and wildlife. Solutions considered for the fish and wildlife problem are as follows: Creation of fisheries, increased utilization of existing fisheries, and conservation and improvement of wildlife habitat. The reduction of pollution and the increases in low flow provided by the proposed reservoirs would improve existing fisheries and would create additional areas suitable for fisheries

development. Reservoirs could be stocked with suitable varieties, and the reservoirs themselves would have only minor detrimental effects on the existing wildlife resources.

103. Hydroelectric power. There is no opportunity for generation of hydroelectric power of any substantial amount, for reasons stated in paragraph 86. In the initial studies for this report a project for the New Hope site, with power as a major purpose, was studied in cooperation with the Federal Power Commission Regional office in Atlanta, Georgia. That plan was abandoned because of the marginal economic justification, the strong opposition to the permanent flooding of a large area of land, and the problems caused by inundation that a plan including power would raise in Durham and Chapel Hill. It was superseded by a plan without power as a major purpose, as described later.

104. Soil conservation. Solutions considered for soil conservation problems are land treatment and structural measures such as flood-retention structures on small watersheds. As stated previously, forestation and soil conservation problems in the Cape Fear River Basin and their solutions are being investigated by the Department of Agriculture under continuous long-range programs. Any soil conservation measures adopted as a result of these programs will be supplementary to, and have no adverse effect on, other proposals covered by this report.

SECTION IX - COMPREHENSIVE PLAN OF DEVELOPMENT

GENERAL DESCRIPTION OF PLAN

105. General. The comprehensive plan of water-resource development is designed to meet the water-resource needs for the next 100 years. This plan is proposed as a guide for the efficient development and conservation of the water resources. A plan of this scope will necessarily require periodic review and reevaluation to keep it consistent with its ever-changing economic environment. Storage in reservoirs would be impounded by large dams on both of the main tributaries and by many smaller dams on the minor tributaries in the headwaters of the basin. This plan would afford a high degree of flood control, water supply for the projected great expansion of municipal and industrial users, water for additional irrigation, increased flow for water-quality control in conjunction with sewage treatment, and water areas for recreation, fish, and wildlife. It is expected that land-treatment measures will be installed which will supplement the plan. Principal features of the comprehensive plan of development are described in the following paragraphs and are shown on plate 1.

106. New Hope Reservoir. This reservoir, the largest of the three principal reservoirs, would be formed by the construction of a dam across the Haw River immediately below the mouth of the New Hope River. This project is described in detail in section X.

107. Randleman Reservoir. The Randleman Reservoir would be formed by the construction of an earth dam across the Deep River in Randolph County, about 5 miles north of the town of Randleman, North Carolina. The drainage area controlled by the dam would be about 168 square miles. The dam would be approximately 1,920 feet long and about 99 feet high above streambed. Discharges would be controlled by an ungated, 400-foot spillway section in a saddle on the right bank and a 17-foot-diameter concrete outlet through the dam. The reservoir would have a storage capacity of 54,000 acre-feet for flood control and 44,000 acre-feet for conservation at the time of initial construction.

108. Howards Mill Reservoir. The Howards Mill Reservoir would be formed by the construction of an earth dam across the Deep River in Moore County, about 1 mile below the Randolph County line. The drainage area controlled by the dam, including 168 square miles above Randleman damsite, would be about 575 square miles. The dam would be approximately 1,790 feet long and about 105 feet high above streambed. Discharges would be controlled by an ungated, 1,000-foot spillway section in a saddle on the right bank and a 17-foot-diameter concrete outlet through the dam. The reservoir would have a storage capacity of 130,000 acre-feet for flood control and 33,000 acre-feet for conservation at the time of initial construction.

109. Other reservoir projects. These structures would be located in the headwaters of the Haw and Little Rivers, and below the Howards Mill site on the Deep River as well as in other tributary areas upstream from Fayetteville, excluding the Fort Bragg area. The drainage area controlled by these reservoirs would be approximately 1,650 square miles. The dams for these projects would be rolled-earth construction with ungated emergency spillways located adjacent to the dams. Reinforced concrete outlets would be provided to release stored water at the designed rate. Initial and ultimate storage capacities for these reservoirs as well as for the other reservoir projects in the plan are shown in table 14. Other pertinent data relative to the reservoir projects are also included in this table.

TABLE 14

Pertinent data relative to the reservoir projects of the comprehensive plan of development

Item	Units	New Hope project	Randleman project	Howards Mill project	Other reservoir projects	Total storage capacities
Drainage area above damsite	Square miles	1,690	168	575	1,650 ±	-
Dam:						
Type	-	Concrete and earth	Earth	Earth	Earth	-
Total length	Feet	1,220	1,920	1,790	400 to 2,500 ±	-
Height above streambed	Feet	101	99	105	20 to 70 ±	-
Spillway:						
Type	-	Gated concrete section at main channel	Ungated emergency spillways located adjacent to dam structures			-
Length of crest	Feet	340	400	1,000	100 to 500 ±	-
Types of gates	-	Tainter	None	None	None	-
Number and size of gates	-	7 @ 40' x 36'	-	-	-	-
Outlet works:						
Type	-	Concrete conduits located in structures of all dams				-
Diameter of sluice	Feet	6	17	17	1.5 to 4.5	-

TABLE 14 (Cont'd)

Pertinent data relative to the reservoir projects of the comprehensive plan of development

Item	Units	New Hope project	Randleman project	Howards Mill project	Other reservoir projects	Total storage capacities
Reservoir:						
Maximum length	Miles	22.5	12.5	10.5	Variable	-
Storage capacity:						
Conservation pool (initially)[1]	Acre-feet	119,000	44,000	33,000	12,000	208,000
Conservation pool (ultimately)[1]	Acre-feet	260,000	57,000	45,000	588,000	950,000
Flood control pool (initially)	Acre-feet	541,000	54,000	130,000	35,000	760,000
Flood control pool (ultimately)	Acre-feet	400,000	41,000	118,000	335,000	894,000
Gross storage (initially and ultimately)	Acre-feet	660,000	98,000	163,000	923,000	1,844,000
At standard project pool elevation	Acre-feet	820,000	107,000	198,000	Variable	-
At maximum pool elevation	Acre-feet	1,010,000	170,000	253,000	Variable	-
Surface area at:						
Top of flood control pool (initially and ultimately)	Acres	30,000	4,400	5,600	Not estimated	-
Top of conservation pool (initially)[1]	Acres	9,400	2,400	2,000	Not estimated	-
Top of conservation pool (ultimately)[1]	Acres	16,400	2,900	2,400	Not estimated	-

[1] Includes storages for water supply, water-quality control, irrigation, and sedimentation.

110. Other features included. Other features included in the comprehensive basin plan are as follows:

a. Further development of watershed-management programs.

b. Construction of other local flood protection works throughout the basin as needs arise. Local protection projects and watershed-treatment measures initiated under the provisions of Public Laws 566 and 685 should be integrated into the framework of the three principal multiple-purpose reservoirs which serve as the nucleus of the comprehensive plan of development. Other local improvements initiated by other Federal, State, or local governments should be integrated in a like manner.

OPERATION OF PLAN

111. Most of the reservoirs included in the proposed comprehensive plan would be dual- and multiple-purpose projects. The reservoir system would be operated under a regulation plan designed to obtain the maximum water supply consistent with the most advantageous operation for the project needs. This will necessitate altering the operation schedules for individual reservoirs from time to time as the comprehensive plan develops from construction of the initial reservoir to the completion of all units. Release schedules would be established to maintain desired minimum flows throughout the basin and to maintain reservoir levels so as to contribute to a high degree of utilization of the reservoirs for recreation. The flood control operation of the system would be based on minimizing the flood damages.

EFFECTS OF THE COMPREHENSIVE PLAN

112. Flood control. The reservoirs of the comprehensive plan of development, as described in GENERAL DESCRIPTION OF PLAN of this report, would afford a high degree of protection to the flood plains of the Cape Fear River Basin. Basin-wide average annual flood damages are estimated to be $1,736,000. After completion of the initial project, these damages would be reduced by about 69 percent, or to about $534,000. By the end of the 100-year evaluation period, during which time the entire comprehensive plan of development would be completed, the average annual flood damages in the basin would amount to $87,000, or an overall flood-damage-reduction effect of 95 percent. Stage-regulating effects estimated to result from the operation of the contemplated reservoirs are shown in table 15. Detailed effects of various plans considered along the Haw, Deep, and Cape Fear Rivers are shown in table I-10, appendix I.

TABLE 15

Estimated stage-reduction effects of reservoir projects on the September 1945 flood at the principal damage reaches in the basin (in feet)

Item	Reach 1	Reach 2	Reach 2A	Reach 3	Reaches 4 and 5	Reach 6	Reach 7	Reach 8	Reaches 9 and 10
Index station gage	Lock and dam 2	Fayetteville	Fayetteville	Lillington	Pittsboro	Haw River	Moncure	Carbonton	Ramseur
September 1945 flood-peak stage	43.2	68.9	68.9	33.2	28.6	31.1	17.2	32.5	34.0
Zero-damage stage in reach[1]	25.5	32.5	[2]50.0	15.2	14.0	14.0	8.4	10.0	18.0
Stage reductions for September 1945 flood from:									
New Hope project alone	5.2	9.5	9.5	10.4	(3)	(3)	(3)	(3)	(3)
Randleman project alone	0.4	0.9	0.9	0.1	(3)	(3)	0.1	0.5	5.8
Howards Mill project alone	1.4	1.6	1.6	0.9	(3)	(3)	0.7	7.5	(3)
New Hope, Randleman, and Howards Mill projects, combined	6.5	9.9	9.9	11.6	(3)	(3)	0.7	7.5	5.8
System of small reservoirs only above Fayetteville	4.1	7.4	7.4	7.6	6.6	7.2	2.3	9.5	7.2
Total comprehensive plan of development	6.9	11.0	11.0	12.0	4.6	7.2	2.7	10.0	5.8

[1]Based on 1960 development.

[2]Flood damage occurring between 50- and 60-foot stages is relatively minor. Major urban damages begin approximately at 60-foot stage.

[3]Not applicable.

113. Water supply.

a. Reservoir storage for upstream needs. The proposed comprehensive plan of development of water resources is designed to fulfill the anticipated water supply needs for the next 100 years in the Cape Fear River Basin. Where practicable, reservoirs would be located so that water users would have pumping access to reservoir impoundments. A total of 548,000 acre-feet, or 30 percent of the gross storage capacity provided under the comprehensive plan, is allocated as municipal, industrial, and agricultural water-supply storage for upstream needs and would be a dependable supply available through direct pumping from the reservoirs. This allocation will provide about 65 percent of the estimated water-supply storage needs in the basin.

b. Low-flow augmentation features incorporated into the comprehensive plan of development would provide for minimum flows ranging from 600 cubic feet per second to 1,200 cubic feet per second at Lillington, N. C., depending upon water quality and water-supply needs. Similar increases in minimum flows at various points in the upper basin would also be provided. These increases in minimum flows would create dependable flows from which municipal, industrial, agricultural, and pollution-abatement benefits would be derived in accordance with the growth of the downstream water-supply needs. A total of 300,000 acre-feet, or 16 percent of the gross storage capacity provided under the comprehensive plan, is allocated as low-flow regulation storage for downstream water-supply needs. This allocation will satisfy the remaining 35 percent of the estimated water-supply storage needs in the basin.

114. Other effects. Reservoirs constructed under this plan would provide recreational facilities which would serve a wide area. Improvement in water quality would be beneficial to fish life. The flood control and low-flow regulation features of the plan would encourage industrial development along the main stem of the Cape Fear River, which in turn would stimulate usage of the navigable waterway below Fayetteville.

ESTIMATE OF COSTS OF COMPREHENSIVE PLAN

115. Estimated construction cost of reservoirs. The total estimated first cost of the comprehensive development plan considered for the Cape Fear River Basin is $72,357,000, at 1960 price levels. Construction costs are summarized in table 16.

116. Estimated investment for reservoirs. The total estimated investment for the comprehensive development plan considered for the Cape Fear River Basin is $75,020,000, at 1960 price levels. The investment costs are summarized in table 16.

117. Estimated annual charges for reservoirs. The total estimated annual financial charge for the comprehensive development plan considered for the Cape Fear River Basin is $2,745,000, at 1960 price levels. Annual charges are shown in table 16.

TABLE 16

Summary of estimated cost of the comprehensive plan
(in thousands of dollars (1960))

Feature	New Hope	Randleman	Howards Mill	Small reservoirs	Total
Construction cost:					
Total first cost	$25,612	$3,700	$4,591	$38,454	$72,357
Investment costs:					
Interest during construction	1,345	97	121	1,100	
Total investment costs	$26,957	$3,797	$4,712	$39,554	$75,020
Annual charges:					
Interest on investment	$708	$100	$124	$1,038	
Amortization of investment (100 yrs.)	57	8	10	84	
Operation and maintenance	70	47	47	360	
Major replacement	20	3	3	40	
Radio reporting network	10	3	3	10	
Total financial annual charges	$865	$161	$187	$1,532	$ 2,745
Economic cost of land	79	7	7	124	
Total economic annual charges	$944	$168	$194	$1,656	$ 2,962

ESTIMATE OF BENEFITS FROM COMPREHENSIVE PLAN

118. General. Benefits which would accrue from the comprehensive plan of development result from flood control, provisions for immediate and future water-supply storage, water-quality improvement, provision of recreational facilities, fish and wildlife conservation measures, and increased flows for downstream water users. These benefits, as discussed in the following paragraphs, were determined in accordance with their expected rate of accrual over the time as established by the estimated sequence of construction. All future benefits for each project were discounted to the present worth at the time of project completion and were distributed over the 100-year evaluation period in an equivalent annual series. Further details regarding benefits are contained in appendices II and V.

119. Flood control benefits result from the reduction of flood damages and the enhancement of flood-plain lands due to the protection afforded by the plan of improvement. Flood-damage-reduction benefits were determined as the difference between the estimated average annual damages with and without the projects. Land-enhancement benefits, expressed in average annual values, were based on the projected changes in flood-plain utilization resulting in higher type uses. The agricultural enhancement benefits were determined as the difference in net returns from protected and unprotected agricultural lands. The average annual nonagricultural enhancement benefit per acre was computed as 5 percent of the difference in net market value of protected and unprotected land. The flood control benefits were adjusted to reflect normal development of the area in the absence of the projects. The total average annual flood control benefits credited to the comprehensive plan of development are estimated to be $2,152,000, of which $1,589,000 are flood damage reduction benefits and $563,000 are land-enhancement benefits. These benefits are based on 1960 price levels.

120. Water-supply benefits would accrue to the comprehensive plan of development from the provision for immediate and future water-supply storage for municipal, industrial, and agricultural water uses. These storages would provide reservoir supplies for upstream needs as well as low-flow regulation for downstream water-supply needs. Water-supply benefits were estimated as the difference of cost in fulfilling the present and future water-supply needs of the basin by the proposed comprehensive plan of development and the most economical alternative method. The total average annual water-supply benefits credited to the comprehensive plan of development of the Cape Fear River Basin are estimated to be $1,200,000, of which 50 percent is municipal water-supply benefits, 33 percent is industrial water-supply benefits, and 17 percent is agricultural water-supply (irrigation) benefits.

121. Water-quality control. The low-flow regulation afforded by the plan will dilute wastes, thus improving the quality of water in the streams affected. In accordance with Public Law 87-88, 87th Congress, July 20, 1961, the estimated benefit produced is considered to be the benefit from water-quality improvement after adequate treatment is provided at the source by local interests. The water-quality-control benefit from the comprehensive plan is estimated to be $255,000.

122. Recreation benefits are expected to accrue from the proposed water-resources-development plan in the two categories of general recreation and fishing and hunting. The average annual recreation benefits attributable to the proposed projects are estimated to be $1,137,000. These benefits were based on estimates of projected annual attendance and use of recreational facilities provided.

123. Other benefits. In addition to the previously evaluated benefits attributable to the water-resources-development plan for the Cape Fear River Basin, certain intangible benefits which are not susceptible to direct monetary evaluation would be realized. The flood control provided by the plan would result in prevention of loss of human life in addition to the prevention of monetary damages. Flash floods which occur in the upper reaches of the basin, often with little or no warning, would be retarded and considerably reduced in magnitude by the proposed reservoirs. The relatively abundant supply of water in the Cape Fear River Basin has been a major factor in promoting the expansion of industry in the area, with investments in plants amounting to hundreds of millions of dollars. Other factors, such as the navigable portion of the river, the deepwater port of Wilmington, adequate labor supply, climate, and a wide variety of available sites, provide strong stimulation for continuing industrial growth. Industrial demand is now dangerously close to equaling the dependable water supply, and it is logical to assume that an increase in this supply will result in further industrial expansion in the basin. Improved water quality, in addition to its monetary value, would reduce local nuisances such as scum and ordor and would provide an overall improvement in general sanitation and appearance of the streams. Navigation benefits, while not evaluated monetarily in this report, would result from the flood control features which would reduce navigation hazards prevalent during flood stages and reduce maintenance costs at the existing locks and dams. Land-treatment measures as well as the upstream reservoirs would tend to reduce the sediment load of the stream, resulting in decreased cost for maintenance dredging in the navigable channels. Additional benefits to the basin would result from the recreational facilities provided under the proposed plan. Sporting-goods stores, motels, restaurants, and other commercial activities would develop to support the recreational activities of both the resident and nonresident population; however, these benefits would be secondary and have not been evaluated. Benefits to the general welfare, economy, and security of the people in the Cape Fear River Basin cannot be predetermined nor evaluated in monetary terms.

124. Summary of benefits. The total tangible benefits resulting from the reservoirs considered in the water-resources-development plan of the Cape Fear River Basin are summarized in table 17. All values are in terms of 1960 price levels.

TABLE 17

Summary of average annual tangible benefits for reservoirs in comprehensive plan (1960 dollars)

Benefit	New Hope project	Randleman project	Howards Mill project	Other reservoir projects	Total
Flood control benefits:					
Flood-damage-reduction benefits	$ 988,000	$117,000	$234,000	$250,000	$1,589,000
Land-enhancement benefits	368,000	17,000	50,000	128,000	563,000
Subtotal	$1,356,000	$134,000	$284,000	$378,000	$2,152,000
Water-supply benefits:					
Municipal water supply	$ 44,000	$ 72,000	$ 9,000	$473,000	$ 598,000
Industrial water supply	30,000	1,000	10,000	354,000	395,000
Agricultural water supply	6,000	8,000	1,000	192,000	207,000
Water-quality control	152,000	-	28,000	25,000	255,000
Subtotal	$ 232,000	$ 81,000	$ 48,000	$1,094,000	$1,455,000
Recreational benefits	$ 554,000	$102,000	$ 82,000	$ 399,000	$1,137,000
Total	$2,142,000	$317,000	$414,000	$1,871,000	$4,744,000

SEQUENTIAL DEVELOPMENT

125. To effect the comprehensive plan, a schedule of development had to be determined. As a result of analyzing each element of the plan from the standpoint of its economic feasibility and of its contribution toward providing the immediate needs, it was concluded that the New Hope project should be the first project authorized for construction. More than half of the Cape Fear River Basin's needs, relative to the conservation of water resources, could be met by the initial construction of this one project. As indicated in table 17, approximately 63 percent of the flood control benefits, 16 percent of the water-supply benefits, and 49 percent of the recreation benefits credited to the entire comprehensive plan of development of the basin would accrue from the effects of the New Hope project. The sequence of development is proposed as follows: New Hope, Howards Mill, Randleman, and smaller tributary reservoirs. The estimated present-worth financial annual charges, average annual benefits, and benefit-cost ratios for the sequential development for the comprehensive development plan considered for the Cape Fear River Basin are shown in table 18.

TABLE 18

Sequential development - summary of benefits and costs

Project	Assumed year of completion	Gross storage (acre-feet)	Average financial annual costs (1960 dollars)	Average annual benefits	Benefit-to-cost ratio
New Hope	1965	660,000	$ 865,000	$2,142,000	2.5
Howards Mill	1975	163,000	187,000	414,000	2.2
Randleman	1975	98,000	161,000	317,000	2.0
Small reservoirs	1975-2065	923,000	1,532,000	1,871,000	1.2

SECTION X - THE NEW HOPE PROJECT

GENERAL

126. Because of its relative importance as the initial project in the comprehensive plan, a more detailed evaluation of the New Hope project is presented in this section. Data, considerations, and results presented hereafter, unless otherwise indicated, are for the present-day construction of the New Hope project which is recommended as the initial

project of the comprehensive plan of development for the Cape Fear River Basin. The New Hope Reservoir would be a multiple-purpose project including flood control and low-flow-regulation storages and recreational facilities.

LOCATION

127. The New Hope damsite is located on the Haw River below the mouth of the New Hope River, about 2.5 miles north of Moncure, N. C. The damsite is in Chatham County, but the proposed reservoir extremities extend into Wake, Durham, and Orange Counties. The main body of the reservoir would be principally in the New Hope River Basin in Chatham County. The location of the damsite is shown on the General Map, plate 1.

DESCRIPTION OF PROJECT

128. General. The drainage area above the New Hope damsite is approximately 1,690 square miles. A summary of pertinent data is shown in appendix IV, table IV-1.

129. Description of the dam. The reservoir waters would be impounded by a concrete and earth dam with an overall length of 1,220 feet and maximum height of 101 feet above streambed elevation. The 340-foot ogee spillway with crest elevation of 205 feet above mean sea level would be controlled by seven 40-foot by 36-foot tainter gates. Concrete abutment sections totaling 430 feet in length connect to each end of the spillway. A 6-foot-diameter conduit would be constructed through the spillway section below the crest to discharge normal streamflow. The 460-foot earth section, including 10 feet of overlap, joining the concrete abutment to the left-bank hillside would have a top width of 30 feet and 3:1 side slopes. The dam would have an impervious core (10 feet wide at top), a rock toe on the downstream side, and the upstream side would be riprapped above elevation 195 feet above mean sea level which is 5 feet below the top of the minimum pool (see pl. 3). Minimum provisions would be made in the plan for future installation of a small, feasible hydroelectric power unit of about 2,500 kilowatts. It may become economically justifiable to generate power with the flows released in the water-quality-control features of the project. It will not be possible to determine whether the power unit should be installed until details of the operating conditions are fully known.

130. Description of the reservoir. The reservoir would inundate approximately 30,000 acres of land at the top of the flood control pool, elevation 240 feet above mean sea level, and would have a gross storage capacity of 660,000 acre-feet. The 30,000 acres of land below the top of the flood control pool plus an additional 10 percent allowance for "blocking out" would be purchased in fee. Various installations subject to relocation would be affected wherever they exist within the proposed reservoir area and below the 245-foot mean-sea-level contour. The top of the conservation pool would be initially at elevation 212 feet above mean sea level (see pl. 4). The conservation pool would have a surface

area of approximately 9,400 acres, and reservoir lands lying between elevations 198 and 213 feet above mean sea level would be cleared. Storage allocations for the reservoir would be 541,000 acre-feet for flood control and 119,000 acre-feet in conservation pool.

HYDROLOGIC AND HYDRAULIC CONSIDERATIONS

131. Standard project flood. The adopted standard project flood was developed from a storm computed substantially in accordance with Civil Works Engineer Bulletin No. 52-8, "Standard Project Flood Determinations." The standard project flood amounts to 9.89 inches of runoff from the drainage area above the damsite and includes a reservoir peak inflow of 258,000 cubic feet per second. This flood was routed through the reservoir beginning at elevation 212 feet mean sea level (top of conservation pool) and reached a maximum pool elevation of 245 feet mean sea level.

132. Spillway design flood. Rainfall depth-duration relationships developed to produce probable maximum precipitation above the New Hope damsite were derived by the Hydrometeorological Section of the U. S. Weather Bureau. The spillway design flood developed from the probable maximum precipitation values amounts to 19.35 inches of runoff from the drainage area above the damsite and includes a reservoir peak inflow of 511,000 cubic feet per second. This flood was routed through the reservoir beginning at elevation 240 feet above mean sea level (top of flood control pool) and reached a maximum pool elevation of 250 feet above mean sea level while discharging a peak of 326,000 cubic feet per second through the spillway. A freeboard of 5 feet above the maximum pool elevation was adopted as being adequate to protect the earthen sections of the dam from wave action. Low flows downstream from the dam would be supplemented up to 600 cubic feet per second by the inclusion of a 6-foot-diameter conduit through the dam, invert elevation at 166 feet above mean sea level.

133. Flood routing. Flood-routing studies were made to establish the effectiveness of the New Hope project in reducing flood peaks at damage index stations. These studies indicate that the flood of record, which occurred in September 1945, with discharge peaks of 150,000 cubic feet per second at Lillington, 124,000 cubic feet per second at Fayetteville, and 103,200 cubic feet per second at lock No. 2, would have peak-discharge reductions of 52, 29, and 23 percent, respectively, at these stations had the New Hope project been in operation. Detailed hydrologic and hydraulic considerations for the New Hope project are presented in appendix I. Other regulating effects of the New Hope project are included in table 19.

TABLE 19

Regulating effects of the New Hope project

Item	Recurrence frequency				
	1 year	5 years	10 years	25 years	50 years
Natural, unregulated peak discharge at index stations (in c.f.s.):					
Lock and dam No. 2 gage – Reach 1	40,000	70,000	83,000	110,000	135,000
Fayetteville gage – Reach 2	40,000	70,000	85,000	110,000	135,000
Lillington gage – Reach 3	40,000	70,000	85,000	110,000	135,000
Peak discharge regulated by New Hope project at index stations (in c.f.s.):					
Lock and dam No. 2 gage – Reach 1	20,000	49,000	66,000	86,000	104,000
Fayetteville gage – Reach 2	25,000	42,000	57,000	79,000	97,000
Lillington gage – Reach 3	18,000	33,000	41,000	54,000	66,000
Natural stage at index station (in feet):					
Lock and dam No. 2 gage – Reach 1	27.0	35.0	37.8	43.6	48.8
Fayetteville gage – Reach 2	39.2	53.8	58.5	65.2	71.3
Lillington gage – Reach 3	16.3	22.5	24.9	28.8	31.9
Stage reduced by New Hope project at index station (in feet):					
Lock and dam No. 2 gage – Reach 1	20.5	29.7	34.0	38.4	42.4
Fayetteville gage – Reaches 2,2A	32.7	40.4	48.5	56.6	61.8
Lillington gage – Reach 3	10.5	14.7	16.5	19.3	21.7

TABLE 19 (Cont'd)

Regulating effects of the New Hope project

Item	Recurrence frequency				
	1 year	5 years	10 years	25 years	50 years
Stage reduction at index station (in feet):					
Lock and dam No. 2 gage - Reach 1	6.5	5.3	3.8	5.2	6.4
Fayetteville gage - Reach 2	6.5	13.4	10.0	8.6	9.5
Lillington gage - Reach 3	5.8	7.8	8.4	9.5	10.2
Gross area flooded, without project (in acres):					
Reach 1	42,800	63,300	68,600	128,000	144,000
Reach 2	3,000	10,000	16,000	33,000	72,000
Reach 3	1,600	9,100	14,300	23,500	33,650
Total	47,400	82,400	98,900	184,500	249,650
Gross area flooded, with New Hope project in operation (in acres):					
Reach 1	3,800	53,000	61,300	71,300	111,300
Reach 2	2,000	3,600	6,100	13,500	22,500
Reach 3	0	150	1,820	4,750	8,000
Total	5,800	56,750	69,220	89,550	141,800
Cultivated land flooded, without project (in acres):					
Reach 1	1,820	6,490	8,200	15,500	-
Reach 2	300	1,800	3,500	8,350	-
Reach 3	240	1,595	2,560	5,350	-
Total	2,360	9,885	14,260	29,200	-

TABLE 19 (Cont'd)

Regulating effects of the New Hope project

Item	Recurrence frequency				
	1 year	5 years	10 years	25 years	50 years
Cultivated land flooded, with New Hope project in operation (in acres)[1]:					
Reach 1	0	4,200	6,300	8,600	13,000
Reach 2	0	450	850	2,850	5,050
Reach 3	0	0	280	810	1,620
Total	0	4,650	7,430	12,260	19,670
Timberland flooded, without project (in acres):					
Reach 1	30,950	43,240	46,200	79,000	-
Reach 2	2,100	6,200	9,350	18,200	-
Reach 3	1,120	6,140	9,595	14,600	-
Total	34,170	55,580	65,145	111,800	-
Timberland flooded, with New Hope project in operation (in acres):					
Reach 1	2,800	36,900	41,800	47,700	70,500
Reach 2	1,500	2,450	4,050	8,000	13,000
Reach 3	0	130	1,265	3,220	5,200
Total	4,300	39,480	47,115	58,920	88,700

TABLE 19 (Cont'd)

Regulating effects of the New Hope project

Item	Recurrence frequency				
	1 year	5 years	10 years	25 years	50 years
Wasteland flooded, without project (in acres)[2]:					
Reach 1	10,030	13,570	14,200	33,500	-
Reach 2	600	2,000	3,150	6,450	-
Reach 3	240	1,365	2,145	3,550	-
Total	10,870	16,935	19,495	43,500	-
Wasteland flooded, with New Hope project in operation (in acres)[2]:					
Reach 1	1,000	11,900	13,200	15,000	27,800
Reach 2	500	700	1,200	2,650	4,450
Reach 3	0	20	275	720	1,180
Total	1,500	12,620	14,675	18,370	33,430

[1]Cultivated land includes lands planted in annual crops and pastures.

[2]Wasteland includes idle land, homesteads, barn lots, roads, water areas, and other nonagricultural areas.

ESTIMATE OF COSTS

134. Estimated construction cost of the New Hope project. The cost of the New Hope project, as presented in this section, is based upon estimates of quantities using the latest surveys and foundation information shown in appendix III, plate III-1. Cost estimates were made by using unit costs based upon past experience and 1960 contract prices applied to the estimated quantities. Costs covering contingencies, engineering and design, and supervision and administration are included in the above-mentioned estimates. The detailed cost estimate of the best plan for the New Hope Reservoir is given in table IV-2 of appendix IV. The total construction cost of the project is estimated to be $25,612,000, shown in table 20.

135. Estimated investment for the New Hope project. The estimated total investment for the New Hope project is $26,957,000, which is based on an interest rate of 2.625 percent for one-half of the assumed period of 4 years of construction time.

136. Estimated annual charges for the New Hope project. The total estimated annual financial charge is $865,000 and is based on 1960 price levels. Annual charges were computed at the current interest rate of 2.625 percent and amortized assuming a 100-year useful project life. A summary of costs is shown in table 20.

TABLE 20

Summary of estimated costs of New Hope project
(in 1960 dollars)

Feature	Costs
Construction costs:	
Lands and damages	$ 5,823,000
Relocations	6,773,000
Reservoir pool preparation	976,000
Dams and appurtenances	7,948,000
Access roads	120,000
Recreational facilities	720,000
Building, grounds, and utilities	80,000
Permanent operating equipment	150,000
Engineering and design	997,000
Supervision and administration	1,875,000
Preauthorization survey costs	150,000
Total first costs	$ 25,612,000
Investment costs:	
Interest during construction	1,345,000
Total investment costs	$ 26,957,000

TABLE 20 (Cont'd)

Summary of estimated costs of New Hope project
(in 1960 dollars)

Feature	Costs	
	Financial	Economic
Annual charges:		
Interest on investment	$ 708,000	$ 708,000
Amortization of investment	57,000	57,000
Operation and maintenance	80,000	80,000
Major replacements	20,000	20,000
Economic cost of land	-	79,000
Total annual charges	$ 865,000	$ 944,000

ESTIMATES OF BENEFITS

137. General. The early construction of a multiple-purpose reservoir on the Haw River at the New Hope site for flood control, water-quality control, and recreation would satisfy to a large degree the present-day water-resource needs of the Cape Fear River Basin. Approximately 87 percent, or $1,252,000, of the basin's present annual flood damage now occurs within the flood plains of the main stem of the Cape Fear River below the confluence of the Deep and Haw Rivers. These flood plains would be protected by the New Hope project to the extent that the basin's annual damages would be reduced by 72 percent. The flood control protection offered by the New Hope project would permit the use of additional land for agriculture and industry. The need for improved quality of water would be satisfied to a large degree by the low-flow regulation features of the New Hope project which would increase the dependable flows below the confluence of the Haw and Deep Rivers from 90 cubic feet per second (average flow for driest month of period of record) to a minimum of 600 cubic feet per second. The construction of the New Hope project would also provide a major facility for alleviating the recreation needs of the upper basin area. The results of benefit-evaluation studies relative to the New Hope project are discussed in the following paragraphs.

138. Flood control benefits. Details of the computation of the flood control benefits to be derived from the New Hope project are presented in appendix II. The two types of tangible flood control benefits resulting from the operation of the New Hope Reservoir are flood-damage-reduction benefits and land-enhancement benefits.

a. Flood-damage-reduction benefits. Annual flood damages along the main stem of the Cape Fear River, now amounting to $1,252,000, are expected to increase to $2,496,000 annually by the year 2065 if no flood control protection is provided. Operation of the New Hope Reservoir would reduce these current annual damages about 82 percent, or to

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$225,000 annually. Anticipated future damages would be reduced by the New Hope Reservoir about 75 percent, or to $621,000 annually. By applying the appropriate discount factors to the future flood-damage-reduction benefits, and considering the current benefits, the total flood-damage-reduction benefits are estimated at an average of $1,202,000 annually. Of these benefits, 87 percent accrue to non-rural properties and 13 percent to rural properties. Details of the methods and procedures used to determine flood damages and flood-damage-reduction benefits are presented in appendix II.

b. Land-enhancement benefits. The flood control features of the New Hope Reservoir would provide sufficient flood protection to create substantial land-enhancement benefits resulting from the stimulation of increased utilization of flood-plain lands due to reduced flooding. It is estimated that these land-enhancement benefits would amount to $495,000 annually, of which $77,000, or 16 percent, would result from the increased utilization of agricultural land and $418,000, or 84 percent, from the increase in utilization of flood-plain lands for urban and industrial development due to project effects. These benefits would be general in nature, distributed throughout the area protected, and would therefore not require local cooperation contributions. Details of the computation and methods used to determine the land-enhancement benefits are given in appendix II.

139. Low-flow-regulation benefits. Discharge-regulation features of the New Hope project include 72,000 acre-feet of storage for low-flow regulation, of which 20,000 acre-feet are allocated to downstream water supply. This storage would provide substantial water-quality-control benefits and water-supply benefits. The U. S. Public Health Service evaluated these benefits in their report on low-flow augmentation of the Cape Fear River dated May 1959 and reviewed in 1961, a copy of which is included as appendix VI. This report by the Public Health Service presents benefits evaluated on a 50-year life of the New Hope project. In order to make these benefits consistent with other project benefits evaluated on a 100-year project life, the Public Health Service's report was used as a basis for projecting the low-flow-regulation benefits an additional 50 years. This was done by assuming that the rate of growth of future benefits as established in the Public Health Service's report for the first 50 years would remain the same during the second 50-year period. The average annual equivalent for the future benefits were then computed assuming an interest rate of 5 percent. The results of these studies indicated that the average annual low-flow-regulation benefits amounting to $108,300, based on a 50-year evaluation period, would amount to $124,000 annually when evaluated on a 100-year basis. Of these annual benefits $77,500 results from water-quality control and $46,500 results from additional water supply. General concurrence by the Public Health Service in this breakdown of low-flow-regulation benefits is noted in their letter, a copy of which is included at the end of this report as attachment C.

140. Recreational benefits. The use of the proposed New Hope Reservoir for general recreational purposes would undoubtedly develop very rapidly. The reservoir would be strategically located in relation to several major population centers. In 1950 about a million and a quarter people lived within a 75-mile highway distance of the site, and population within this zone is definitely increasing. The reservoir would have a surface area of about 9,400 acres at the top of the conservation pool. In addition to the scenic attractiveness of the area the impounded water would be suitable for boating and fishing. Many miles of shoreline would be provided for use as possible parks, boat harbors, group camps, and fishing camps; other areas would be suitable for vacation cottage sites. Development for public recreation will involve careful planning in cooperation with appropriate agencies, including the North Carolina Recreation Commission, North Carolina Wildlife Resources Commission, State Board of Conservation and Development, U. S. National Park Service, U. S. Forest Service, and U. S. Fish and Wildlife Service, and with counties and municipalities. The U. S. National Park Service has prepared a report evaluating the general recreational benefits for this report, and it is included as appendix VII. Their evaluations were based upon the assumption that the reservoir waters would, before construction of the dam, be brought up to the standards of "C" and "D" classifications established by the State Stream Sanitation Commission, which would be adequate for fish and wildlife propagation; agriculture, including irrigation and livestock watering; drainage; and industrial cooling and process water supply. The Park Service also reported that preliminary studies by State health authorities indicate that the pollution factor within the foreseeable future would generally render the reservoir unsuitable for swimming, with the exception of sheltered coves not receiving water from the main stem. The Public Health Service in their report, appendix VI, indicates that prolonged storage would improve the quality of water. Excluding the evaluation for swimming and fishing, the National Park Service estimated the recreational benefits to be $376,000 annually, based upon an average annual visitation of 235,000 persons at $1.60 per person. This figure projected for 100 years gave a benefit of $405,000. If at a later date the State requires that the quality of water be brought up to the standard required for swimming, it is estimated that the additional treatment costs would be offset by the gains in recreational benefits. The U. S. Fish and Wildlife Service has prepared a report evaluating the hunting and fishing benefits to be derived from the New Hope project. A copy of this report is included as appendix VIII. The Fish and Wildlife Service reports that the New Hope project would be beneficial to the fishery aspects within the reservoir and downstream area provided the quality of water is raised to class "C" standard and fishing access is provided in the reservoir area and to the area immediately below the dam. They also suggested that the quality of water released to downstream areas could be improved by multiple-stage release levels. The Fish and Wildlife Service also reported that there would be a substantial loss

to large game, upland game, and waterfowl in the project area due to losses in habitat. They suggested partial mitigation of those losses by creation of wildlife management areas and the construction and control of shallow impoundment areas on the upper reaches of tributaries to the reservoir. The suggestions by the Fish and Wildlife Service for management, control, and construction of facilities to mitigate wildlife losses will be given careful consideration if a design memorandum for the New Hope project is prepared. The net fishing and hunting benefits evaluated by the U. S. Fish and Wildlife Service were based on the assumption of a 50-year project life. These benefits amounted to $106,000 annually. In order to be consistent with other project benefits which are based on a 100-year evaluation period, the Fish and Wildlife Service's 50-year benefit evaluation was projected an additional 50 years. This resulted in a net fishing and hunting average annual benefit of $114,000.

141. Summary of benefits. A summary of the project benefits creditable to the New Hope project is shown in table 21.

TABLE 21

Summary of average annual benefits from proposed New Hope Reservoir project (based on 100-year evaluation period and 1960 price levels - all future benefits discounted to present-worth values)

Flood control benefits:	
Flood-damage-reduction benefits	$1,202,000
Land-enhancement benefits	495,000
Subtotal	$1,697,000
Low-flow-regulation benefits:	
Water-quality-control benefits	$ 77,500
Water-supply benefits	46,500
Subtotal	$ 124,000
Recreation benefits:	
General recreation benefits	$ 405,000
Fishing and hunting benefits	114,000
Subtotal	$ 519,000
Total project benefits	$2,340,000

ALLOCATION OF COSTS AMONG INITIAL PURPOSES

142. Preliminary allocations of costs of the multiple-purpose New Hope project to the purposes of flood control, low-flow regulation, and recreation were made by the separable-costs remaining-benefits method. Details of the cost allocation are presented in appendix IV. Pertinent physical and financial data on the alternative single-purpose

projects considered in establishing benefit limits are given in table IV-5 in appendix IV. In order to determine the most equitable allocation of costs it was assumed that alternative recreation projects should have approximately the same surface area, location, water quality, and general attractiveness as the multiple-purpose project. Therefore, alternative single-purpose recreation project costs were considered to be equivalent to the cost of a project with a water surface equal to 9,400 acres plus the specific costs of recreational facilities. Alternate project costs for flood control were considered as the cost of a project storing 541,000 acre-feet for flood control at New Hope without recreational facilities. The alternative costs for low-flow regulation were considered as the costs of small reservoirs at alternate locations without recreational facilities. A summary of cost allocations for the New Hope project is shown in table 22.

TABLE 22

Summary of cost apportionment - New Hope project

Project purposes	Federal	Non-Federal	Percent of total cost
Total construction expenditures:			
Flood control	$17,343,000	-	67.7
Low-flow regulation:			
Water-quality control	819,000	-	3.2
Water supply	-	$319,000	1.2
Recreation:			
General recreation	5,562,000	-	21.7
Fishing and hunting	1,569,000	-	6.2
Total	$25,293,000	$319,000	100
Annual operation, maintenance, and replacement costs:			
Flood control	$ 33,000	-	33
Low-flow augmentation:			
Water-quality control	19,000	-	19
Water supply	-	$ 8,000	8
Recreation:			
General recreation	31,000	-	31
Fishing and hunting	9,000	-	9
Total	$ 92,000	$ 8,000	100

TABLE 22 (Cont'd)

Summary of cost apportionment - New Hope project

Project purposes	Federal	Non-Federal	Percent of total cost
Annual charges:			
Flood control	$551,000	-	63.7
Low-flow regulation:			
Water-quality control	44,000	-	5.1
Water supply	-	$17,000	2.0
Recreation:			
General recreation	197,000	-	22.8
Fishing and hunting	56,000	-	6.4
Total	$848,000	$17,000	100

COMPARISON OF BENEFITS AND COSTS

143. Based on 1960 price levels and the initial allocation of storage in the New Hope project, the total average annual benefits for the New Hope project resulting from flood control, water-quality control, and recreation features are estimated to be $2,340,000. The total annual Federal financial costs are $865,000 and the total Federal economic costs are $944,000, resulting in benefit-cost ratios of 2.7 based on financial costs and 2.5 based on economic costs.

APPORTIONMENT OF COSTS AMONG INTERESTS

144. General. A division of project costs of the New Hope project between Federal and non-Federal interests was based on presently applicable laws and regulations governing cost-sharing practices.

145. Apportionment of flood control costs. Costs allocated to flood control were apportioned in accordance with Section 201 of the Flood Control Act of 1958 (Public Law 85-500). Costs allocated to flood control are considered to be all Federal.

146. Apportionment of low-flow-regulation costs.

a. Water-quality-control costs. The streamflow regulation occurring downstream from the proposed New Hope Reservoir would provide improvement of water quality. In accordance with Section 2 of Public Law 87-88 this improvement in downstream water quality is considered to be general throughout the lower portion of the basin for a distance of 170 miles; as such, the costs allocated to water-quality control are considered to be all Federal.

b. Water-supply costs. In accordance with the Water Supply Act of 1958 (Title III of Public Law 85-500), costs of providing water-supply storage for immediate and anticipated future use are apportioned to State or local non-Federal interests. All construction, operation and maintenance, and replacement and interest costs incurred by the Federal Government and allocated to water supply are to be repaid by the water users. No interest will be charged on the investment costs up to 30 percent of total project costs allocated to future water supply until use is initiated, but such interest-free period shall not exceed 10 years. No payment will be required for the cost allocated for future water supply until use is initiated, except for the payment of current interest charges on the unpaid balance after the interest-free period. However, all costs for future water supply, including interest, incurred after the interest-free period must be repaid within 50 years after use is initiated.

147. Apportionment of recreation costs.

a. General recreation costs. Section 4 of the Flood Control Act of December 22, 1944 (Public Law 534, 78th Congress), authorizes construction, operation, and maintenance by the Federal Government of basic facilities for public use and access for general recreation. Under this authority the cost allocated to general recreation is apportioned to the Federal Government. However, the State, adjoining counties, and nearby cities are known to be interested in developing general recreational areas on the reservoir, utilizing the general recreational opportunity which the project would afford. It is believed that considerable such development will take place if the project is built, although no definite plans exist for it at this time.

b. Fish and wildlife costs. The conservation pool included in the New Hope project would be operated for low-flow-regulation purposes and the fish and wildlife benefits, while substantial, would be generally incidental. Neither modifications in the project nor the acquisition of lands or higher estate in lands is proposed for fish and wildlife purposes. The only costs required to obtain the net benefits to fish and wildlife would be those paid for recreation under authority of the Flood Control Act of 1944. The State of North Carolina is interested in utilizing the reservoir for fish and wildlife purposes, and it is believed that substantial non-Federal expenditures will be made for these purposes if the project is built. The U. S. Fish and Wildlife Service report finds that the New Hope project may produce fishery benefits of more than local significance. Therefore, no costs are allocated to non-Federal interests for fish and wildlife purposes.

LOCAL COOPERATION

148. The extent to which non-Federal interests are required to financially cooperate in implementation of the New Hope project is discussed in the preceding paragraphs. The items and amounts of non-Federal cost are shown in table 22. Repayment of costs allocated to

water supply may be made by either sharing construction costs during project construction plus annual payments of operation and maintenance costs and payment of replacement costs when incurred, or by annual payments for the construction costs, including interest during construction, and interest on the unpaid balance plus annual payment for operation and maintenance and payment of replacement costs when incurred. Reasonable assurance that these obligations for water-supply storages will be assumed has been received from the Department of Water Resources, State of North Carolina. This assurance is included as attachment B to this report. Local interests are further required to prevent obstruction and encroachment on the channels downstream of the reservoir. Related programs of land and water management required for full realization of the water-resource potentials of the area necessitate sustained and vigorous pursuit of such programs by local and Federal interests. Authorization of the project by Congress would materially assist in resolution of the problem of non-Federal cooperation.

COORDINATION WITH OTHER AGENCIES

149. General. Federal, State, and municipal agencies were consulted during the investigations and during the preparation of the portion of this report concerning the proposed New Hope project. Private firms and industrial concerns affected by the plan were also consulted and gave freely of their time and data. The agencies concerned with various phases of the development plan are as follows.

150. The United States Weather Bureau furnished climatological and meteorological data as well as river stages for various stations throughout the basin.

151. The United States Geological Survey operates stream-gaging stations throughout the basin, and furnished streamflow records and topographic maps.

152. The United States Public Health Service prepared a "Report on Water Supply and Pollution Abatement Benefits from Low Flow Augmentation Storage in the New Hope Reservoir" shown as appendix VI.

153. The National Park Service prepared a "Report on the Recreation Benefits to be derived from the New Hope project" shown as appendix VII. This report evaluates the general recreation benefits.

154. The United States Fish and Wildlife Service prepared a report on the fish and wildlife resources in the Cape Fear River Basin and the estimated benefits and damages to fish and wildlife attributable to the proposed New Hope project. This report is discussed in paragraph 140 and is included as appendix VIII.

155. The Department of Agriculture cooperated with the Wilmington District and the State of North Carolina in preparing a joint report which investigated the effect of a system of small reservoirs in the

tributaries of the Cape Fear River Basin. Data determined in this study served as a foundation for various portions of the comprehensive plan of development.

156. The Federal Power Commission reviewed the potential power-producing capabilities of developments at the New Hope site and furnished power values.

SECTION XI - SUMMARY AND DISCUSSION

THE PROBLEMS

157. Flood control. The need for protection of the flood plains of the Cape Fear River Basin from disastrous floods has long been recognized. The general economic improvement, the development of new or enlarged industrial plants, and the topographic limitations of areas suitable for development have increased property values within the flood plains. The major flood of 1945, which caused extensive damage, focused attention sharply on the Cape Fear River Basin and emphasized the urgent need for flood protection. Recurrence of a storm equal in magnitude to that which produced the maximum flood stages of record would subject the area to damages estimated to range between $8 million and $15 million, depending upon rainfall-intensity distribution and season of the year. The average annual damages in the basin under present conditions amount to $1,445,000 (1960 price level). Developments within the flood-plain area during the last decade indicate that further industrial and agricultural growth can be expected even if flood control is not provided. Taking this growth into consideration, average annual damages are estimated to be $1,736,000 over the next 100 years.

158. Water supply. In several areas the dependable flow of the Cape Fear River and its tributaries is barely adequate to meet the present water-supply needs of industries and municipalities. Expansion of industry now under construction or planned will require either additional minimum dependable flow or expensive recirculation equipment. While the water supply for domestic consumption is fairly adequate at present, these local sources will be fully developed by the end of the next decade. After then, water must be taken in ever-increasing quantities to meet growing domestic needs. When these needs are considered it must be concluded that a higher dependable streamflow is essential if serious water shortages are to be avoided in the future. While the use of water for irrigation has not developed to any great extent at the present in the Cape Fear River Basin, it is anticipated that in the foreseeable future irrigation storage facilities will be a primary and urgent need throughout the basin.

159. Water-quality control. The pollution of the streams in the Cape Fear River Basin by industrial effluents and domestic sewage is of serious concern to the area because of its effect on the suitability of the stream for water supply and recreation and because of its

public-health implications. Treatment by known methods will not alone suffice to bring the streams to acceptable standards of quality. Therefore, dilution of industrial and domestic wastes is a necessary factor in maintaining acceptable standards of water quality. The amount of water flowing during dry periods is insufficient to provide adequate dilution under present conditions.

160. Recreation. The growth in the population in the basin, especially in the industrial and metropolitan centers near the upper portion of the basin, has increased the need for recreational development. Such development requires facilities for water sports, fishing, and for activities such as camping, picnicking, and sightseeing. Existing recreational facilities are inadequate and incapable of being expanded to meet the needs.

THE SOLUTION

161. The comprehensive plan of development of water resources presented in this report is designed to provide a basis for solution of most of the water problems in the basin for the next 100 years. Cognizance was taken of views and desires of local interests and other agencies of the State and Federal governments; however, the plan was not based on the opinions of any one group, but envisions the needs of the basin as a whole and how those needs may be best met in the future with a balanced system of improvements. It is contemplated that all interested agencies will be working cooperatively on the different phases of development during the life of the plan. The immediate needs are for flood protection, low-flow regulation, and recreation. Construction of the New Hope project would be the most efficient way to fulfill the immediate needs. The Randleman and Howards Mill projects as well as several small reservoir projects would be completed by 1975 and would provide additional flood protection, water supply, and recreational facilities which would meet the basin's growing needs. Additional reservoirs throughout the basin would be phased into the plan to provide solutions to the anticipated future water-conservation needs. This arrangement provides sufficient flexibility in scheduling of the latter projects to offset any inaccuracies in the projections of anticipated needs.

162. Solution of immediate needs. Approximately 87 percent of the average annual flood damage in the basin occurs on the flood plains below the New Hope damsite, and the New Hope project is capable of reducing the flood damages on the flood plains below that point by about 80 percent, which is equivalent to about 70 percent of all basin damage. The immediate low-flow-regulation needs occur primarily on the main stem of the Cape Fear River below the New Hope project site. The low-flow augmentation from the New Hope project, which would assure a dependable minimum flow of 600 cubic feet per second at Lillington, would meet these immediate needs. The immediate recreation needs for the basin are primarily centered in the more heavily populated upper basin area. Since the proposed New Hope project is located in this area,

the 9,400-acre reservoir would substantially satisfy the immediate recreation needs of the area. In summary, the New Hope project's capability of (1) reducing average annual flood damages in the basin by about 70 percent, (2) providing a solution to the immediate low-flow-regulation needs in the basin, and (3) providing an adequate solution to the immediate recreation needs of the basin is considered as sound justification for scheduling it as the initial project for construction. The New Hope site is the only site in the basin suitable for development as a major reservoir and, since a high degree of flood control in the basin would be impracticable without this reservoir, its early construction is recommended.

163. Solution of future needs. The Randleman and Howards Mill projects, when constructed as the second phase of the comprehensive plan of development, would not only satisfy the more pressing upper basin water-resource-conservation needs, but would also provide a desirable hydrologic balance to the basin-wide plan. The addition of tributary reservoirs would provide the only practical solution to the more localized water-resource problems and would complement the flood control, water supply, and recreation features of the three principal reservoirs.

164. Related basin programs of other agencies include the watershed program of the Department of Agriculture and the conservation programs of the State of North Carolina. The Department of Agriculture program could produce significant water control effects on the land itself and on the smaller tributaries of the Cape Fear River. These facilities, when provided, would complement the overall plan and create additional benefits. Additional programs of State and Federal agencies responsible for pollution control, recreation, and fish and wildlife conservation could be developed as adjuncts to the comprehensive plan of development.

165. Additional information on recommended and alternative projects called for by Senate Resolution 148, 85th Congress, adopted January 28, 1958, is contained in attachment A to this report.

SECTION XII - CONCLUSIONS

CONCLUSIONS

166. The plan of improvement presented in this report is a comprehensive plan for meeting the water-resource needs of the basin over a long-range period. This plan is presented for approval as a general framework or guide. It is intended to be sufficiently flexible to permit future changes as conditions require.

167. Three principal reservoirs, the New Hope project on the Haw River and the Randleman and Howards Mill projects on the Deep River, would provide storage capacity for flood control and water supply for the benefit of these tributaries and the Cape Fear River itself. No

significant amount of storage for these purposes exists at the present time. The releases from these reservoirs during low-flow periods would, if reasonably adequate sewage treatment is provided by local interests, afford water-quality control to enhance the use of the streams for water supply, fishing, and recreation. The water areas of the reservoirs would provide good recreation areas accessible to the general public.

168. The three main reservoirs would be supplemented by many smaller reservoirs in the headwaters and downstream areas which would provide additional flood control, water supply, and other uses as the needs dictate. The location of the individual small reservoirs is not specified in the plan at this time, but can be selected from many sites known to exist. Minor local flood protection projects would be constructed in some areas when needed. It is contemplated that soil conservation measures under programs of the Department of Agriculture would be extended throughout much of the basin and would be of benefit to the streams as well as the land.

169. The New Hope project is the major single project of the comprehensive plan and is the key element. Without the New Hope project the program of basin development provided by the comprehensive plan would not reach its objectives of providing for both the immediate and long-range water-resource needs. This project will provide immediately for flood control, low-flow regulation, and recreation, as well as being a source of future water supply if it is needed locally. In the future its reservoir storage may be allocated for other purposes as the smaller reservoirs of the plan supplement it. The New Hope project provides the base upon which the comprehensive plan can be efficiently developed and should be constructed as soon as possible.

170. Authorization should be provided to continue the comprehensive study of the water-resource development of the Cape Fear River Basin. A long-range program of development will necessarily require future review and reevaluation to keep it in phase with the ever-changing economic activity of the basin.

SECTION XIII - RECOMMENDATIONS

171. The District Engineer recommends:

a. That, to provide a means for immediate and future water-resource conservation, the comprehensive plan of development of the Cape Fear River Basin as presented herein be approved.

b. That the New Hope project on the Haw River in North Carolina be authorized for construction in the interest of flood control, low-flow regulation, recreation, and other purposes in general accordance with the plans outlined in this report; at an estimated first cost of $25,612,000 and $100,000 annually for operation, maintenance, and replacement; provided that, before construction is initiated,

local interests agree to: (1) Protect downstream channels from encroachments and obstructions which would adversely affect operation of the project; (2) bear the portion of the cost of constructing the project allocated for water supply, amounting to 1.2 percent of the total cost of constructing the joint-use facilities, that portion presently estimated at $319,000; (3) bear the portion of the annual cost of operating and maintaining the project allocated to water supply, amounting to 7 percent of the annual cost of operating and maintaining the joint-use facilities, that portion presently estimated at $7,000 annually; (4) bear 5 percent of the cost of major capital replacement of joint-use facilities as these costs are incurred, that portion presently estimated at $1,000 on an average annual basis.

c. That local interests be permitted to repay all of the costs assigned to them in general accordance with the principles outlined in the Water Supply Act of 1958.

d. That authority to continue the Cape Fear River Basin studies be granted after authorization of the New Hope project in order that authorization reports for the Randleman, Howards Mill, and other projects may be prepared.

e. Continuous and vigorous action by Federal and non-Federal agencies, separately and cooperatively under authorities that exist or may be provided, in prosecution of programs for land management, controlling and regulating the use and development of flood plains, preservation and development of recreation and fish and wildlife resources, abatement of stream pollution and improvement of water quality, conservation of ground and surface waters, and preservation of sites for the projects that comprise the entire plan.

R. P. DAVIDSON
Colonel, Corps of Engineers
District Engineer

[First endorsement]

SADEW (30 Oct 61)
SUBJECT: Report on Comprehensive Survey of Cape Fear River Basin, North Carolina

U. S. Army Engr Div, South Atlantic, Atlanta, Ga., 12 December 1961

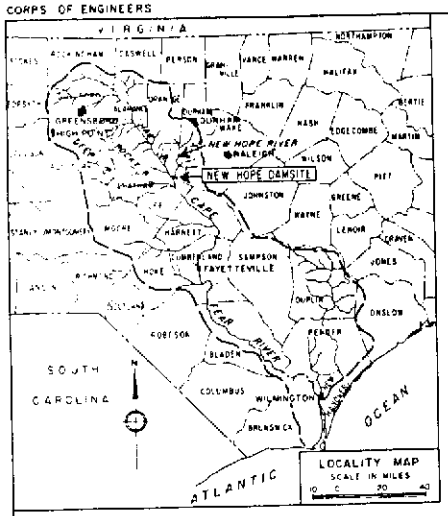
TO: Chief of Engineers, Department of the Army, Washington, D. C.

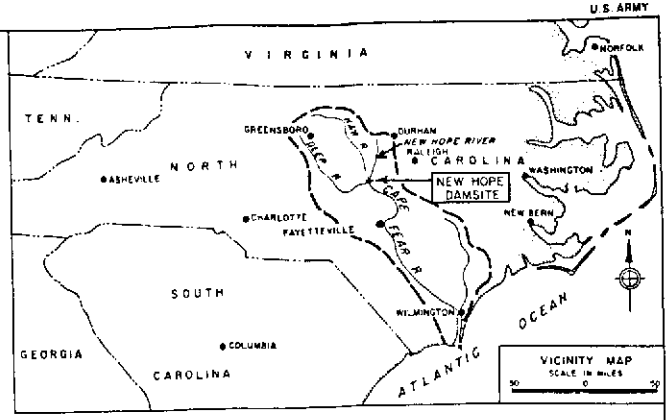
The Division Engineer concurs in the recommendation of the District Engineer.

H. A. MORRIS
Brigadier General, USA
Division Engineer

CORPS OF ENGINEERS

U.S. ARMY





CAPE FEAR RIVER BASIN, NORTH CAROLINA

GENERAL MAP

SCALES AS SHOWN

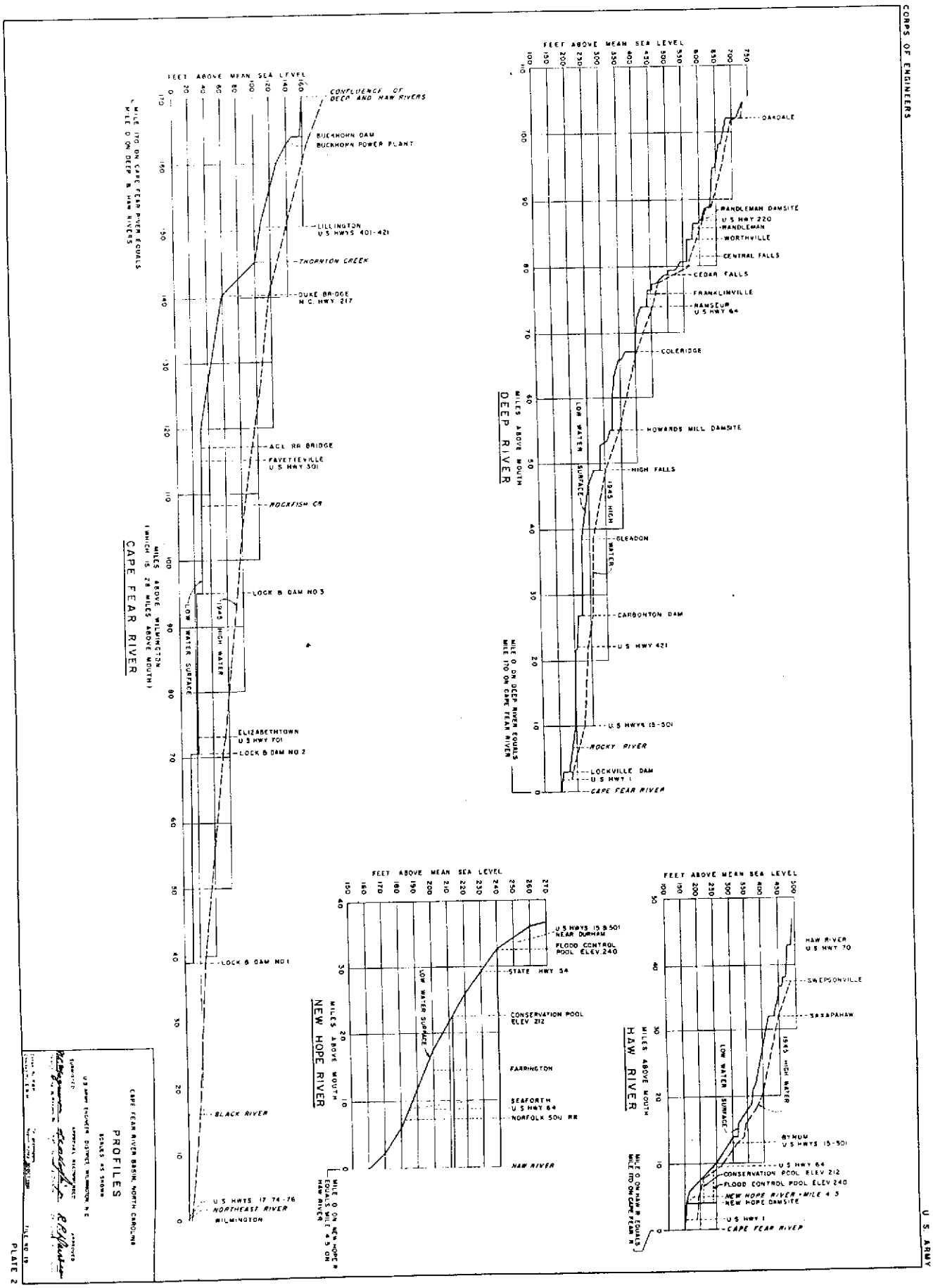
U.S. ARMY ENGINEER DISTRICT, WILMINGTON, N.C.

SUBMITTED APPROVAL RECOMMENDED APPROVED

FILE NO. 19

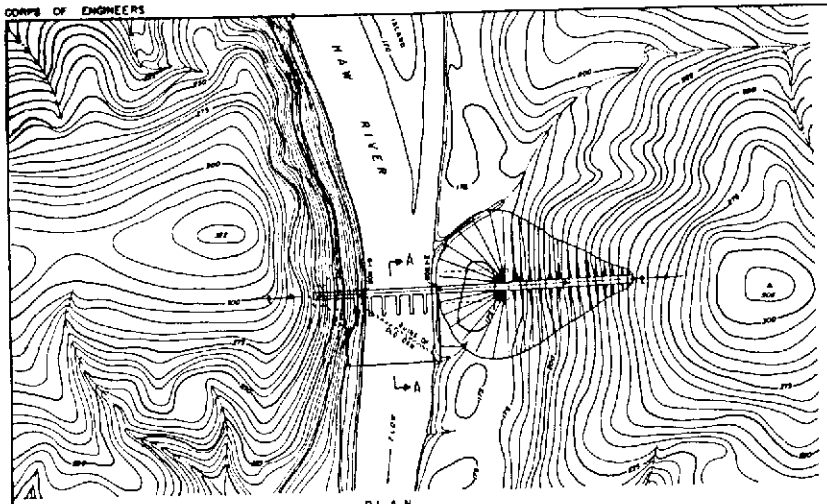
PLATE I

87782 O-67 (Face p. 84) No. 1


CAPE FEAR RIVER
FEET ABOVE MEAN SEA LEVEL
MILES ABOVE WILMINGTON (WHICH IS 28 MILES ABOVE MOUTH)
MILE 0 ON CAPE FEAR RIVER EQUALS MILE 0 ON DEEP & HAW RIVERS
CONFLUENCE OF DEEP AND HAW RIVERS
BUCKHORN DAM
BUCKHORN POWER PLANT
LILLINGTON U.S. HWYS 401-421
THORNTON CREEK
DUKE BRIDGE N.C. HWY 217
ACL RR BRIDGE
FAYETTEVILLE U.S. HWY 301
ROCKFISH CR
LOCK & DAM NO 3
1945 HIGH WATER
LOW WATER SURFACE
ELIZABETHTOWN U.S. HWY 701
LOCK & DAM NO 2
LOCK & DAM NO 1
BLACK RIVER
U.S. HWYS 17 74-76
NORTHEAST RIVER
WILMINGTON
DEEP RIVER
MILES ABOVE MOUTH
OAKDALE
RANDLEMAN DAMSITE
U.S. HWY 220
RANDLEMAN
WORTHVILLE
CENTRAL FALLS
CEDAR FALLS
FRANKLINVILLE
RAMSEUR U.S. HWY 64
COLERIDGE
HOWARDS MILL DAMSITE
HIGH FALLS
GLEADON
CARBONTON DAM
U.S. HWY 421
U.S. HWYS 15-501
ROCKY RIVER
LOCKVILLE DAM
U.S. HWY 1
CAPE FEAR RIVER
MILE 0 ON DEEP RIVER EQUALS MILE 170 ON CAPE FEAR RIVER
NEW HOPE RIVER
U.S. HWYS 15 & 501 NEAR DURHAM
FLOOD CONTROL POOL ELEV. 240
STATE HWY 54
CONSERVATION POOL ELEV 212
FARRINGTON
SEAFORTH U.S. HWY 64
NORFOLK SOU. RR
HAW RIVER
MILE 0 ON NEW HOPE R EQUALS MILE 4.5 ON HAW RIVER
HAW RIVER
HAW RIVER U.S. HWY 70
SWEPSONVILLE
SAXAPAHAW
BYNUM U.S. HWYS 15-501
U.S. HWY 64
CONSERVATION POOL ELEV 212
FLOOD CONTROL POOL ELEV 240
NEW HOPE RIVER - MILE 4.5
NEW HOPE DAMSITE
U.S. HWY 1
CAPE FEAR RIVER
MILE 0 ON HAW R EQUALS MILE 170 ON CAPE FEAR R
CAPE FEAR RIVER BASIN, NORTH CAROLINA
PROFILES
SCALES AS SHOWN
U.S. ARMY ENGINEER DISTRICT, WILMINGTON, N.C.
SUBMITTED
APPROVED
PLATE 2
CORPS OF ENGINEERS
U.S. ARMY

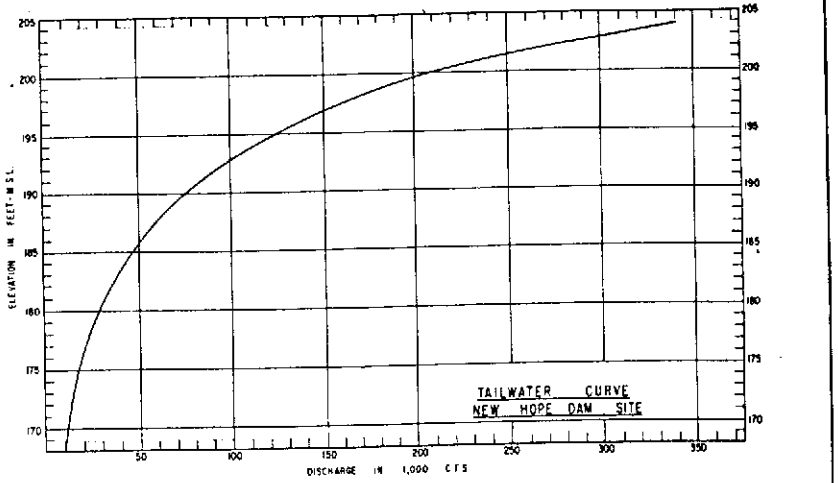
CORPS OF ENGINEERS

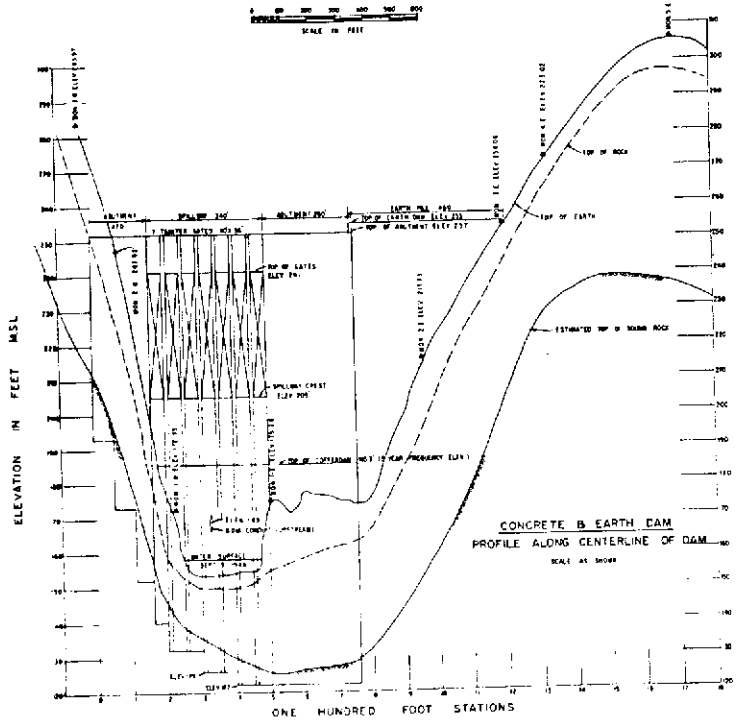
U.S. ARMY



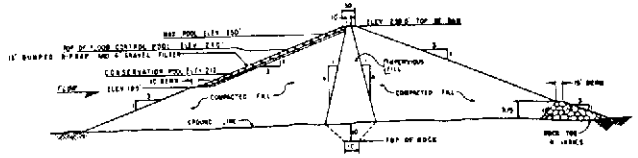
PLAN

SCALE IN FEET

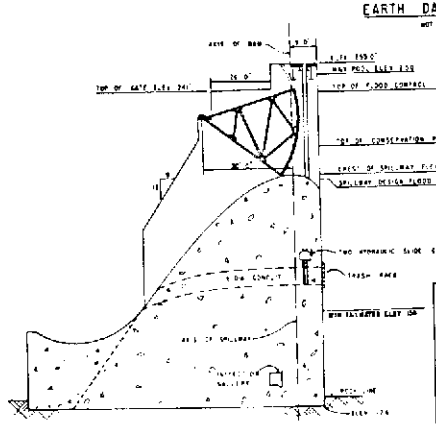




CONCRETE & EARTH DAM
PROFILE ALONG CENTERLINE OF DAM
SCALE AS SHOWN



EARTH DAM SECTION
NOT TO SCALE



SECTION A-A OF SPILLWAY
NOT TO SCALE

CAPE FEAR RIVER BASIN, NORTH CAROLINA

PLAN AND SECTIONS NEW HOPE DAM

U.S. ARMY ENGINEER DISTRICT, WILMINGTON, N.C.

PLATE 3

87102 O-62 (Face p. 84) No. 3

ATTACHMENT A

CAPE FEAR RIVER BASIN, NORTH CAROLINA

Additional information on the recommended project
Required by Senate Resolution 148, 85th Congress, 1st session
Adopted January 28, 1958

CAPE FEAR RIVER BASIN, NORTH CAROLINA

Additional information on the recommended project
Required by Senate Resolution 148, 85th Congress, 1st session
Adopted January 28, 1958

(1) General information relative to projects in proposed plan of development. Emphasis is given to the effects of alternative standards of evaluation, economic analysis, and cost allocation on project feasibility, scope, and cost-sharing arrangements. Through successive screening and investigation processes used in formulating the comprehensive plan of development of the Cape Fear River, the New Hope project was selected from the potential projects inventoried as the project to be recommended for construction in the first phase of development, for reasons of topography, geography, storage capacity, accessibility, and economic results. Further evaluation of four different plans of development at the New Hope site substantiates the fact that plan 1 should be the recommended plan. For the foregoing reasons there is no physically feasible alternative to the recommended multiple-purpose reservoir project at the New Hope site to which application of the alternative evaluation standards called for in Senate Resolution 148 would provide a basis for findings substantially different from those contained in the report.

(2) Project recommended for authorization. The New Hope project is recommended for authorization. Additional information called for in Senate Resolution 148, with respect to this project, is presented in the following paragraphs.

(3) Project description and economic life.

a. General. The Cape Fear River, which is formed by the confluence of the Deep and Haw Rivers, drains all or part of 22 counties in central and eastern North Carolina. The river flows generally southeast 198 miles and empties into the Atlantic Ocean about 28 miles below Wilmington, N. C. The Cape Fear River Basin has a total area of 8,570 square miles, of which 3,127 square miles are located above the confluence of the Deep and Haw Rivers. The Deep and Haw Rivers both rise in Forsyth County, N. C. The Deep River has a total length of 116 miles and drainage area of 1,422 square miles. The Haw River is about 90 miles in length and drains approximately 1,705 square miles. Both rivers rise at elevations of about 1,000 feet above mean sea level and have numerous falls and rapids, with the Haw River having the steepest gradient. The elevation of the junction of the two rivers is about 158 feet mean sea level. The New Hope River is the principal tributary of the Haw River and empties into the Haw River about 4.5 miles above the confluence of the Deep and Haw Rivers.

b. The New Hope damsite is located about 2.5 miles north of Moncure, N. C., on the Haw River and is about 1/2 mile below the mouth of the New Hope River. A dam built at this site would form a reservoir

lying principally within the New Hope River Basin in Chatham County, N. C. The project area lies in a region of rolling hills and deeply eroded valleys known as the Piedmont Plateau and is noted for good foundations for dams.

c. Plans of development. Four different plans of development were studied utilizing the New Hope damsite. These plans differ in design purposes and the resulting types of structures required. Detailed descriptions of the plans may be found in appendix IV of the report. The principal features of all plans are shown in table 1, project costs are shown in table 2, and benefit-cost ratios are shown in table 3 of this attachment. A brief description of the four plans is given below.

(1) Plan 1 is the recommended plan for New Hope. Its principal purposes are flood control, low-flow regulation, and recreation.

(2) Plan 1a is a plan for flood control alone.

(3) Plan 2 was computed on the basis of flood control and recreation.

(4) Plan 3 has as its principal features flood control, power, and recreation.

TABLE 1

Plans of development at the New Hope damsite

Item	Plan number 1	1a	2	3
Design function:				
Flood control	X	X	X	X
Low-flow regulation	X			X
Hydroelectric power			X	X
Recreation	X			
Type of dam & spillway:				
Concrete and earth, gated	X	X	X	X
Reservoir storage allocation (in inches of runoff and acre-feet):				
Flood control	6 541,000	6 541,000	6.8 613,000	6 541,000
Hydroelectric power	- -	- -	- -	6.2 562,000
Conservation pool	1.3 119,000	0.5 47,000	0.5 47,000	- -
Total storage	7.3 660,000	6.5 588,000	7.3 660,000	12.2 1,103,000
Top of pool elevations (in feet above mean sea level):				
Flood control	240	237	240	260
Hydroelectric power	-	-	-	245
Conservation pool	212	200	200	245
Land-acquisition requirements (in acres):				
Fee	33,000	28,000	33,000	51,000
Easements	2,000	7,000	2,000	6,000
Total	35,000	35,000	35,000	57,000
Total first cost	$25,612,000	$23,100,000	$24,872,000	$53,133,000

d. Economic life of projects. The economic life of each of the plans of development studied is assumed to be 100 years. Benefit-cost ratios, however, are presented herein based on the assumption of both a 50-year and 100-year economic life.

(4) Project costs. Cost estimates showing both first costs and annual charges for the recommended plan 1 as well as the alternate plans are given in table 2. Details of the derivation of these costs are presented in appendix IV of the report. These costs are based on 1960 price levels, using the separable-cost remaining-benefits method and assuming a 100-year project life.

TABLE 2

Project costs

Item	Plan number			
	1	1a	2	3
Total first costs	$25,612,000	$23,100,000	$24,872,000	$53,133,000
Annual charges	865,000	740,000	843,000	2,338,000

(5) Benefit-cost ratios. Benefit-cost ratios for the recommended plan 1 as well as the alternate plans considered are shown in table 3. The benefit-cost ratios are computed in terms of 50-year and 100-year amortization periods, and details of the complete benefit-cost ratio analysis are presented in appendix IV of the report.

TABLE 3

Benefit-cost ratios: 50- and 100-year periods of analysis
(based on separable-cost remaining-benefits method)

Plan	50-year amortization			100-year amortization		
	Total tangible annual benefits	Total annual costs	Benefit-cost ratio	Total tangible annual benefits	Total annual costs	Benefit-cost ratio
1	$2,024	$1,075	1.9	$2,340	$ 865	2.7
1a	1,434	928	1.6	1,697	740	2.3
2	1,724	1,046	1.7	2,028	843	2.4
3	3,776	2,783	1.4	4,039	2,338	1.7

(6) Intangible project effects.

a. General. Some of the project effects specified in this part of the resolution have been considered tangible and have been evaluated monetarily. Discussion of each specified item follows.

(1) Protection of life and property. During the September 1945 flood, which was the maximum flood of record, several persons were drowned in the Cape Fear River Basin. There is no record of loss of life as a direct result of floods prior to 1945. In general, the comparatively slow rise in the floodwaters allows sufficient time for evacuation operations in the flooded areas. During the September 1945 flood, units of the U. S. Army at Fort Bragg and U. S. Marine Corps at Camp Lejeune evacuated hundreds of people from the flooded areas between Fayetteville and Currie, N. C. Public water supplies and sewerage systems have been damaged by floodwaters, resulting in conditions which expose the populations of several communities to diseases such as dysentery, typhoid fever, etc.

(2) The protection of property has been evaluated monetarily as a benefit in terms of physical losses prevented by the various alternative projects. All plans considered at the New Hope site would reduce average annual physical property flood damage in the Cape Fear River Basin by about 69 percent, and would provide about 80 percent reduction of flood damages occurring on the main-stem flood plains below the damsite. Intangible benefits stemming from the protection of property could be reasonably expected to be produced in approximately the same portion as the percentages given above relative to tangible benefits.

(3) Intangible benefits expected to be derived from the operation of any of the plans studied in this report and resulting from the improvement of transportation facilities; the conservation of soil, water, forest resources, and wildlife; the provision of recreational facilities and sedimentation control; the abatement of pollution; and the enhancement of the agricultural, commercial, and industrial economy of the area affected were not evaluated in this report. These benefits, which may stem from direct primary effects of the plans studied, are of an intangible nature and are not considered pertinent to the determination of the overall effectiveness of the various plans.

(4) The control of salinity is not applicable to the problems under consideration in this area.

(7) Physical feasibility and cost of providing for future needs.

a. Future water supply. Existing trends indicate that, in the near future, demands for reservoir water-supply storage will become critical. Plan 1 includes in its reservoir storage allocation approximately 0.8 inch of runoff, or 72,000 acre-feet, which could be made available for future water-supply needs at the request of local

interests, with an expression of their willingness and ability to reimburse the Federal Government for their proportionate share of construction costs.

(8) Allocation of costs.

a. General. Table 4 shows annual cost allocations according to the methods prescribed in the resolution, using 50- and 100-year amortization periods.

TABLE 4

Alternative cost allocations (average annual amounts)

Plan	Type of function	Total benefits (annual)	Sep.-costs rem.-bens. method	Priority-of-use method	Incremental cost method	Total project cost (annual)
		50-year amortization				
1	Flood control	$1,434,000	$ 726,000	$ 650,000	$1,018,000)	
	Recreation	482,000	288,000	349,000	52,000)	$1,075,000
	Low-flow regulation	108,000	61,000	76,000	5,000)	
	Total benefits	$2,024,000				
1a	Flood control	$1,434,000	928,000	928,000	$ 928,000	$ 928,000
2	Flood control	$1,474,000	852,000	828,000	$ 970,000)	
	Recreation	250,000	194,000	218,000	76,000)	$1,046,000
	Total benefits	$1,724,000				
3	Flood control	$1,434,000	787,000	758,000	$1,009,000)	
	Power	1,590,000	1,461,000	1,401,000	1,714,000)	$2,783,000
	Recreation	752,000	535,000	624,000	60,000)	
	Total benefits	$3,776,000				

TABLE 4 (Cont'd)

Alternative cost allocations (average annual amounts)

Plan	Type of function	Total benefits (annual)	Sep.-costs rem.-bens. method	Priority of-use method	Incremental cost method	Total project cost (annual)
		100-year amortization				
1	Flood control	$1,697,000	$ 551,000	$ 469,000	$ 816,000)	
	Recreation	519,000	253,000	318,000	44,000)	$ 865,000
	Low-flow regulation	124,000	61,000	78,000	5,000)	
	Total benefits	$2,340,000				
1a	Flood control	$1,697,000	740,000	740,000	$ 740,000	$ 740,000
2	Flood control	$1,748,000	650,000	614,000	$ 772,000)	$ 843,000
	Recreation	280,000	193,000	229,000	71,000)	
	Total benefits	$2,028,000				
3	Flood control	$1,697,000	572,000	528,000	$ 806,000)	
	Power	1,590,000	1,341,000	1,260,000	1,481,000)	$2,338,000
	Recreation	752,000	425,000	550,000	51,000)	
	Total benefits	$4,039,000				

(9) Extent of interest in project. A public hearing was held in Fayetteville, N. C., on February 8, 1957, in connection with the New Hope project. About 550 people attended, and a strong plea was made for flood protection at Fayetteville and along the Cape Fear River. Local interests have organized the Cape Fear Basin Development Association, with members from every county in the basin except one, which is actively promoting the development of the water resources of the basin. Many meetings have been held and information distributed to indicate the desire for full development of the entire Cape Fear River Basin. On the other hand, other interests have organized the New Hope Valley Association, with members primarily from Chatham County, which is actively opposed to the project. These people are primarily those whose property would be inundated or adversely affected by the reservoir. These people are in favor of flood control protection by some other means, possibly a series of small dams. The majority of local interests seem to be opposed to a high dam with power as described under plan 3, and plan 1 seems to be the most liked project.

(10) Repayment schedules. All costs for the project will be borne by the Federal Government until local interests express their desire and willingness to purchase water from the reservoir. At such time, a schedule of repayment will be made.

(11) Effect of project on State and local governments. The construction and operation of the New Hope project would probably cause significant changes in the demand for local and State governmental services. The immediate effects of project construction on local economics would be to afford additional employment within the area. The assurance of an added, dependable water supply in the area would stimulate opportunity for the location of new industry and the expansion of existing plants. Guaranteed flood protection would result in a general enhancement of the flood-plain and reservoir-area economy due to increased occupancy of the areas. Water-quality control benefits would provide additional stimulation to the general economy above that now experienced. Recreational facilities would induce changes primarily in the reservoir area resulting from the development of use-areas and waterfront property. Reductions in tax revenues due to acquisition of lands required for the projects would be offset by the above-mentioned increased activities. The change in tax revenues due to downstream project effects would be significant, with an anticipated net increase in tax revenue. The above-mentioned changes would require services from local, State, and Federal agencies, and close cooperation with each other and any other new administrative machinery necessarily formed to promote the development of the basin.

STATE OF NORTH CAROLINA

DEPARTMENT OF WATER RESOURCES

HARRY E. BROWN, DIRECTOR
P. O. BOX 9392
RALEIGH, N. C.

OFFICE OF THE DIRECTOR

February 15, 1962

Colonel R. P. Davidson
District Engineer
U. S. Army Engineer District, Wilmington
Corps of Engineers
308 Customhouse
Wilmington, North Carolina

Dear Colonel Davidson:

Reference is made to the New Hope Reservoir in the Cape Fear River Basin, North Carolina, under study by your office.

You have stated that the best plan of improvement would include 72,000 acre-feet of storage for low flow regulations, of which 20,000 acre-feet would be allocated for water supply. You also estimated that the cost of the portion of the project allocated to water supply would amount to 1.2 percent of the cost of constructing the joint-use-facilities, currently estimated at $319,000. Annual operation and maintenance costs to be borne by non-federal interests are estimated at $8,000.

It is the view of this Department that provision of capacity for water supply in the reservoir is extremely desirable and in the interest of the State. It is our opinion that the necessary assurances to meet the requirements of the Water Supply Act of 1958 will be met if the New Hope Reservoir is provided. However, the time element involved does not permit the several interested municipalities to take the formal action which is necessary before absolute assurance can be given that the non-federal share of the cost of the project for the part of the regulated flow allocated to water supply will be provided.

Sincerely yours,

Harry E. Brown

Harry E. Brown

ATTACHMENT B

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE

Region III
Charlottesville, Virginia

PUBLIC HEALTH SERVICE

February 16, 1962

Your reference:
SAWRM

Col. R. P. Davidson
District Engineer
U. S. Army Engineer District, Wilmington
P. O. Box 1890
Wilmington, North Carolina

Dear Colonel Davidson:

This is in reply to your letter of February 8 concerning the Corps of Engineers report on the Cape Fear River Basin, North Carolina. In response to your request we have reviewed the report and the letter, and offer the following comments.

In excerpt "1a" from the letter from the Board of Engineers for Rivers and Harbors mention is made of the evaluation by the Public Health Service of storage in the proposed New Hope Reservoir project for pollution abatement, and increased municipal and industrial water supply. To clarify the basis upon which the benefits were calculated in the Public Health Service report, tabulated in summary item 7 and on page 50, it should be noted that the report states there is adequate quantity for municipal water supply within the 50-year evaluation period in the areas downstream from the reservoir. There is need, however, for improvement in water quality, and the benefits as calculated were based entirely on improvement in water quality which would result from the proposed augmentation of low flows. The industrial water supply benefits listed in the report are due to an increase in quantity for cooling purposes. Thus, the benefits listed in the report for municipal water supply and pollution abatement should be attributed to water quality control.

We agree with the comments of the Board indicating that ". . . storage for water supply without reimbursement is not in accord with the Water Supply Act of 1958, and that the method of conveyance of water supply from the reservoir is considered incidental to its use, whether by the natural river or by other means. The cost for water developed through reservoir storage which is used for water supply needs in excess of natural stream flow should be reimbursable to the United States by local interests. Water supply benefits, therefore, would be those derived from a project's ability to increase the quantity of existing or future water supplies."

ATTACHMENT C

Excerpt "1b" from the Board's letter indicates that ". . .derivation of benefits for water quality control and water supply for the 100-year evaluation period should be furnished with appropriate support and comment by the Public Health Service. . ." In view of the fact that we do not have available to us the method used in arriving at the benefits for the 100-year evaluation period, we are unable to furnish comments at this time. As indicated in our letter of August 9, 1961, the studies leading to the preparation of our reports on the New Hope Reservoir were of a preliminary nature and were not designed to forecast needs for the next 100 years. Information available to us is not adequate to permit projection of water needs 100 years hence. Compilation of data adequate to allow such a long-range forecast will require detailed study of demographic and economic factors affecting population and industrial growth in the basin.

We would be most happy to meet with you or members of your staff to discuss the methods of derivation and evaluation of benefits for the 100-year period. If you feel that such a meeting is desirable, we would appreciate receiving your suggestion for an appropriate date.

Sincerely yours,

William A. Rosenkranz

William A. Rosenkranz
Acting Regional Program Director
Water Supply and Pollution Control

APPENDIX VI

REPORT FROM U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

NEW HOPE RESERVOIR STUDY

Report on
Benefits to Water Supply and Pollution Abatement
Resulting from Low Flow Augmentation of
Cape Fear River in North Carolina

Prepared at the request of and in cooperation with
the District Engineer, Wilmington District
Corps of Engineers, U. S. Army

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of State Services
Division of Water Pollution Control

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

May 1959

INTRODUCTION

By letter dated April 16, 1958, the District Engineer, Wilmington District, Corps of Engineers, requested an evaluation of the average annual pollution abatement and water supply benefits that might be expected from increasing the downstream minimum low flow through releases from low flow regulation storage of the proposed New Hope Reservoir in the Cape Fear River Basin of North Carolina. This report has been developed to furnish the requested information.

A survey of the surface waters of the Cape Fear River Basin was made and a report prepared by the State Stream Sanitation Committee, Division of Water Pollution Control of the North Carolina State Board of Health, Raleigh, North Carolina, in order to proceed with the classification of the waters of the basin according to the General Statutes of North Carolina. The survey was performed during 1954 and 1955, and special studies were continued in 1956 and 1957. All data within this report concerning stream conditions, usage of water resources within the basin, sources of pollution entering these waters, and pollution abatement measures prevailing during the period

of study have been obtained from the report prepared by the Division of Water Pollution Control entitled, "Pollution Survey Report No. 6, The Cape Fear River Basin." It was the primary source of information for this report and will be referred to hereafter as "Pollution Survey Report No. 6."(1)

Hydrologic data were obtained from the office of the District Engineer, Wilmington District, U. S. Army Corps of Engineers, Wilmington, North Carolina, and the North Carolina District Office, U. S. Geological Survey, Raleigh, North Carolina.

SUMMARY

1. Multipurpose reservoir sites at which provision can be made for low flow augmentation are limited in number and it is only prudent that they be fully developed whenever they are available.
2. Increased low flow minimum discharges would have pollution abatement values in eliminating or postponing additional treatment works.
3. Cape Fear River is now used for municipal water supply purposes by Lillington, Dunn, Fayetteville, and Wilmington, North Carolina, and could be used to augment the present Sanford supply.
4. If supplemental irrigation grows into a large consumptive user of surface waters, natural flows would not be adequate under drought conditions for present or future uses of communities which utilize, or could utilize, Cape Fear River as a source of raw water.
5. The quality of river water, with the exception of manganese and iron concentrations, would be improved by prolonged storage and dilution provided by New Hope Reservoir. The present raw water supply available to Lillington, Dunn, and Fayetteville would be

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changed from one of doubtful quality and barely adequate quantity to one of good quality and bountiful quantity.

6. The increased water quantity would have both immediate and potential industrial water supply values.

7. A summation of tangible benefits which would result from low flow augmentation from New Hope Reservoir are listed below.

	Annual Benefit		
Category	Immediate	Potential	Total
Pollution Abatement	$ 15,000	$ 26,000	$ 41,000
Municipal Water Supply	22,800	5,800	28,600
Industrial Water Supply	8,000	30,700	38,700
Total	$ 45,800	$ 62,500	$108,300

8. The increased low flows would provide an intangible benefit to the water supply of Wilmington due to prolonged storage of polluted waters and dilution of adverse chemical constituents.

9. The possibility of claims for damages from municipalities and industries located in the reservoir area should be recognized. Where higher water uses such as recreation are created by construction of a reservoir, a higher degree of treatment of wastes than that which would have been required under natural conditions might be necessary to protect the health of the users. Where treatment or additional treatment would be required by the State to protect the new uses, the community or industry required to furnish such treatment may look to the agency which has made the new use possible for funds to provide the additional treatment.

DESCRIPTION OF THE AREA

GENERAL

The Cape Fear River Basin lies entirely within the State of North Carolina and drains a total of 8,570 square miles. Of this total, 1,705 square miles are in the Haw River Drainage Basin, 1,422 square miles are in the Deep River Drainage Basin, leaving a total of 5,443 square miles in the drainage basin of the main stem of the Cape Fear River below the confluence of the Deep and Haw Rivers. The entire Cape Fear River Basin and the proposed New Hope Reservoir location are shown on Figure 1.

The Haw River is the largest tributary to the Cape Fear River. It has its source in the northwest edge of Guilford County and flows first in a northeasterly direction, then easterly, and then finally in a southerly direction to its junction with the Deep River at the Chatham - Lee County line to form the Cape Fear River.

New Hope River is the only large tributary to the Haw River. It has its beginning in central Orange County as New Hope Creek, flows east for a distance, and then flows south to join the Haw River. From its source to the mouth of Morgan Creek, it is identified as

FIGURE 1

NEW HOPE RESERVOIR STUDY

CAPE FEAR RIVER BASIN AREA MAP

ROBERT A. TAFT SANITARY ENGINEERING CENTER
CINCINNATI, OHIO

DEC. 1, 1958

New Hope Creek, while the remainder of the stream is called New Hope River. Other smaller but important tributaries to the Haw River are Troublesome Creek, Reedy Fork, and Alamance Creek.

Cape Fear River is formed by the confluence of Haw and Deep Rivers at the Chatham - Lee County line, 4.8 miles downstream from the confluence of New Hope River with the Haw River. The river flows southeasterly to the mouth of Lower Little River, thence due south to the mouth of Rockfish Creek, and thence in a southeasterly direction to Wilmington from which point it flows in a southerly direction to the Atlantic Ocean.

This report is limited to the Haw River sub-basin and to the main stem of the Cape Fear River. The Deep River flow would not be affected by construction of the New Hope Reservoir as the Deep River joins the Haw River downstream from the proposed damsite. (See Figure 1.) The Deep River flow would be a portion of the proposed minimum continuous 600 c.f.s. flow at Lillington, and its quality would influence the water quality of the Cape Fear River. If treatment of wastes is provided in the Cape Fear River Basin as recommended in Pollution Survey Report No. 6, the water drawn from the New Hope Reservoir and mixed with flow from Deep River should result in a water quality in Cape Fear River which would achieve the benefits developed later for municipal water supply.

POPULATION ESTIMATES

Based on the 1950 census, the estimated population within the Haw River Drainage Area is 268,000. An estimate based on the 1940 census indicated a population of 221,000 for the area. This is an increase of 21% in the area while the increase in the State was only 13.7%.

The Haw River Drainage sub-basin is one of the most highly developed areas in the State of North Carolina. Sixty-eight percent of the population of the sub-basin lives in four municipalities having a combined population of 182,000. Over 99.5 percent of the population of the drainage basin resides upstream from the proposed dam. Because of geographical location, it is doubtful that the Haw River Basin communities could receive water supply or pollution abatement benefits from the project although they could benefit from the recreational opportunities the reservoir would offer. As drainage from this heavily populated area would become a part of the proposed reservoir waters, estimated future population and waste loads need be considered.

Based on the 1950 census, the estimated population of the main river drainage sub-area is 392,000. This represents a 10-year gain of approximately 72,000 over the population of 320,000 estimated in 1940. This increase of 23 percent greatly exceeds the 13.7 percent increase for the State as a whole. While there are no large cities in the sub-basin, three areas (Fayetteville, Fort Bragg -

Spring Lake, and Wilmington) have a population of about 125,000 which is 32 percent of the total population of the main river drainage area. The communities which could affect the quality of the waters of the proposed reservoir or benefit from the reservoir are listed in Table 1 along with estimates of growth during the next 50 years.

Table 1 - Population Estimates

Community	Population by Year						
	1950[1]	1960[2]	1970[2]	1980[2]	1990[2]	2000[2]	2010[2]
Burlington	24,560	31,400	40,200	49,000	59,800	72,900	88,800
Chapel Hill	9,177	13,050	15,500	18,400	21,900	26,000	30,900
Durham	71,311	87,200	103,800	123,300	146,800	174,400	207,500
Greensboro	74,389	103,500	139,100	169,600	206,700	252,000	307,000
Reidsville	11,708	13,900	16,500	19,600	23,300	27,700	32,900
Sanford	10,013	11,900	14,200	16,800	20,000	23,800	28,300
Dunn-Erwin	9,660	11,450	13,600	16,100	19,100	22,500	26,800
Fayetteville	34,715	50,000	55,700	62,500	70,600	80,200	91,600
Wilmington	45,043	55,500	66,000	78,500	93,400	111,000	132,000

[1]U. S. Census Figures.

[2]Community growth estimated at rate of 1.75 percent per year except that the military population at Fayetteville was assumed to be constant.

HYDRAULIC DATA

The proposed New Hope Dam would be located on the Haw River downstream from the confluence of New Hope River. The proposed reservoir would have volumes of about 119,000 acre-feet (El.211) and 47,000 acre-feet (El.200) at maximum and minimum low flow regulation pools, respectively. The average 10-year frequency draw-down would be about two feet. Waters would be taken from elevation 190 for discharge.

For pollution abatement purposes, the regulated discharge would be of great importance at points below the dam, and should be compared with the design flow established by the State of North Carolina; that is, the mean 7-day flow that has a recurrence interval of once in ten years. For industrial water supply, comparisons of present and future duration curve data are necessary to determine benefits.

On the main stem of the river below the proposed damsite, stream flow records are available from Lillington, Fayetteville, and Lock 3. Flows of record are compared with predicted regulated flows in Table 2. In addition, stream flow data on Haw River below the proposed damsite are shown. Effect of regulation on duration curve data is given in Table 3.

Table 2 - Comparison of Design and Regulated Flows

Station	7-Day Mean 1/10 Frequency	Minimum Regulated	Minimum Increased Q due to Regulation
	cfs	cfs	cfs
New Hope Damsite	40	370	330
Lillington	80	600	330
Fayetteville	220	> 600 ±	330
Lock 3	385	> 600 ±	330

Table 3 - Effect of Regulation on Duration Curve

Station	Time	Unregulated Q	Regulated Q
Lillington	(Percent)	cfs	cfs
	80	590	600
	90	336	600
	95	215	600
	98	130	600
	99	93	600
	99.8	47	600
	99.9	36.5	600
Fayetteville	90	610	> 600
	95	420	> 600
	98	280	> 600
	99	215	> 600
	99.8	127	> 600
	99.9	105	> 600

Table 3- Effect of Regulation on Duration Curve
(continued)

Station	Time	Unregulated Q	Regulated Q
	(Percent)	cfs	cfs
Lock 3	95	673	> 600
	98	487	> 600
	99	397	> 600
	99.8	272	> 600

The average rainfall provides an ample stream flow in the Cape Fear Basin. However, there are periods of fluctuation in rainfall resulting in drought conditions. For instance, the annual rainfall for the Haw River Drainage Basin in 1954 was 43.8 inches, or about 1.7 inches less than the normal rainfall of 45.5 inches. But in that year (1954), during the period April through December, some rainfall stations reported a deficiency of as much as three inches per month. The lack of rain resulted in dry stream beds at some points. Communities which depended upon surface water supplies for municipal purpose were severely inconvenienced during the drought periods. Adequate water storage which anticipates such drought flow is one solution to this water supply problem.

GROUND WATER SUPPLY

The Cape Fear River Basin lies in two major physiographic provinces which differ greatly in topography and geology and in their

ground water resources. The Haw River Basin is in the Piedmont Province. The lower reaches of the Cape Fear River and some of its tributaries such as Little River, South River, Black River, and Northeast Cape Fear River are in the Coastal Plain province. The two provinces are separated by a belt known as the Fall Zone in which the geology and topography of the Piedmont gives way to the geology and topography of the Coastal Plain.

The source of ground water is precipitation as rain or snow. In the unconsolidated sedimentary formations of the Coastal Plain water moves through the openings between the grains of soil, sand, and clay. In the crystalline and consolidated rocks of the Piedmont, the water moves largely through joints and other fractures and along cleavage planes.

Ground water, then, is an important natural resource in the Coastal Plain and is used as a source of supply for communities and military establishments. In the Piedmont section, ground water occurs in joints and other fractures and cleavage and bedding planes. Because drilled wells obtain their water from these openings, the wells that encounter the most and largest openings usually yield the largest supplies of water. The productiveness of the rocks ranges widely not only from one type of rock to another, but also from place to place within each rock type. In the Piedmont area, wells can be used for private or small municipal supplies. For larger supplies, surface sources should be considered.

SUPPLEMENTAL IRRIGATION

Agricultural demands for water in the humid areas of the East are just beginning to develop. In the State of North Carolina 400 acres were under irrigation in 1944. By 1954 this figure had increased to 17,850.(2)

Although the Haw River Drainage Basin is very highly industrialized, there is considerable land used for agriculture. Many people devote all their time to farming. The 1954 Census of Agriculture by the U. S. Department of Commerce shows that 2,654 acres in the Haw River Basin were under irrigation. Pollution Survey Report No. 6 noted a definite trend toward more such utilization of water.

The importance of agriculture in the Main River Drainage Basin is emphasized when it is noted that many of the sparsely populated counties derive most or all of their income from farming. In the upland counties, there is a definite trend toward using surface water for irrigation. In 1954, there were 4,800 acres of land under irrigation in this area.

Use of water for supplementary irrigation is essentially a consumptive use. Any substantial development for use of the surface waters for irrigation would have important conflicts with municipal and industrial water supply and pollution abatement programs with respect to quantity, unless such development is accompanied by storage of surplus water during high run-off periods.(3)

POLLUTION ABATEMENT

PRINCIPLES OF POLLUTION ABATEMENT EVALUATION

Where wastes are discharged into flowing streams, the extent and seriousness of the damage caused generally depends upon the volume of stream flow as related to the amounts, strengths, and characteristics of the pollutants discharged. Various other factors can modify the effects of pollutants, so that it is not practicable to establish standard dilution ratios which could be applied generally. Nevertheless, the dilution available is one of the most important factors governing the extent and seriousness of pollution effects.

Pollution damage can generally be decreased either by reducing the waste load or by increasing the volume of dilution water. As most streams have widely varying natural flows, and as the design of waste treatment works must be based upon a selected critical low flow condition, it is frequently possible to reduce the required treatment by storing flood waters for release during low flow periods.

Several important qualifications to these statements must be made. For many types of wastes, dilution alone cannot be considered an entirely satisfactory substitute for treatment, at least within

the range of dilutions which it might be practicable to provide. For example, oils and floating solids will be objectionable in many cases regardless of how much dilution water is available. Settleable solids, either putrescible or inert (e.g., coal ash wastes), will not be greatly affected by increased dilution. Sludge deposits from sewage or other organic wastes may seriously damage the stream. Neither does dilution necessarily solve problems of bacterial pollution. The effects of dilution may be off-set by the shorter travel time between the source of pollution and the point of water use since fewer organisms will die in the reduced interval. Although additional dilution may be a valuable supplement, it cannot be considered a satisfactory substitute for waste treatment in solving such pollution problems. Therefore, treatment of wastes is considered necessary before any benefit can be credited to dilution flow.

Increased minimum flows have a value, either immediate or potential, when used in combination with sewage treatment plants and growing communities. Where the minimum natural flow is sufficient to dilute the effluent of a treatment plant for the design period, maintaining a satisfactory minimum dissolved oxygen content downstream from the plant outfall, no immediate benefit can be credited to additional dilution water. However, where natural flow is adequate and additional flow is provided, a surplus waste assimilative capacity of the stream is indicated. This surplus capacity provided by increased flow has a potential value which will be utilized as the

community grows. The potential benefit can be calculated as the cost of equivalent sewage treatment plant facilities. Where natural flow is not sufficient to dilute the effluent of a treatment plant for the design period and provide a satisfactory dissolved oxygen content downstream from the plant outfall, supplementary dilution flow will have an immediate benefit in eliminating or postponing additional treatment works. Flow regulation in such cases will affect savings in waste treatment costs insofar as dilution can be substituted for physical treatment.

Whether the cost of equivalent treatment is considered as a measuring device to show the value of water to the State or as a substitute for treatment and therefore a charge to the community immediately benefited by not constructing facilities, makes only a time difference in the evaluation. The value would be identical, but would change from potential to immediate, according to the manner which the State accepted the evaluation. As the community grows, greater pollution loads will be added to the treatment plant and to the stream. Eventually secondary treatment and increased flows could provide a stream water quality not obtainable by any other conventional method of sewage treatment, and at that time, the potential value would change to the immediate value.

Water uses have changed and should be expected to change over the years. It is very difficult to foresee how these changed uses may influence demand in the future. Multipurpose reservoir sites at

which provision can be made for low flow augmentation are limited in number and it is only prudent that they be developed whenever they are available.

ITEMS CONSIDERED IN ASSESSING STREAM QUALITY

There are a number of chemical and bacteriological tests which can be used to evaluate the sanitary quality of a stream. In this study the tests considered were generally limited to the dissolved oxygen (D.O.), biochemical oxygen demand (BOD), pH, temperature, and coliform organisms. The results of field measurements of these factors are available in Pollution Survey Report No. 6. The significance of these measurements in determining the sanitary quality of the water is discussed below.

Dissolved Oxygen (D.O.)

The amount of dissolved oxygen in water is normally limited by the saturation value (9.17 ppm at 20°C at sea level). However, in some cases, as a result of the photosynthetic activity of algae and non-emergent aquatic plants, this value may be exceeded, causing "supersaturation." The saturation value is a function of temperature and decreases with higher temperatures.

To support fish and aquatic life and for natural aerobic purification of stream waters, dissolved oxygen must be present. The minimum quantity permissible is dependent upon the quality of

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water desired. Some dissolved oxygen must be present to prevent nuisance conditions associated with putrefaction of waste materials in a stream. To support fish life a higher proportion of the saturation dissolved oxygen level is required. Dissolved oxygen values significantly below the saturation level are almost always an indication of the presence of organic material which is being biologically oxidized, and thus utilizing oxygen from the stream water.

Biochemical Oxygen Demand (BOD)

The biochemical oxygen demand (frequently referred to as BOD) of sewage, industrial wastes, treatment plant effluents, or other waste waters, is the oxygen in parts per million (ppm) utilized during stabilization of the decomposable organic matter by aerobic bacterial action. Incubation for five days at 20°C is the recommended standard procedure and is the value upon which this study is based unless otherwise noted. With knowledge of the rate of reaction conversion of the data from one temperature to another can be approximated.

As the rate of biochemical oxidation increases as the temperature rises and the amount of dissolved oxygen which may be present in oxygen-saturated water decreases with rising temperatures, critical stream conditions usually occur during the summer months, particularly as these high temperatures are often associated with low stream flows.

Hydrogen Ion Concentration (pH)

The pH is defined as the negative logarithm to the base ten of the hydrogen ion concentration. The pH value indicates the relative acidity or alkalinity of a water. Water of pH 7.0 is neutral while pH values below 7.0 indicate increasing acidity, and values above 7.0 indicate alkaline conditions. For normal fish life the pH should be within the range of 6.5 to 8.5. Observed pH values outside this range are generally the result of industrial waste discharges of either acid or alkaline materials which exceed the buffering capacity of the stream. It is recognized that naturally occurring swamp waters may have pH values well below this range.

Temperature

The temperature of the water controls the oxygen solubility or saturation level of dissolved oxygen in the stream. Within the range of temperatures normally encountered in streams, the rate of bacterial growth and/or activity and hence the rate of natural purification is increased or decreased with higher or lower temperatures, respectively. The activity of fish and the types which will normally occur in a particular stream environment are affected by temperature.

Coliform Organisms

Coliform organisms are present in the intestines of warm-blooded animals and are discharged in vast numbers in their feces.

These organisms may be found in unpolluted streams in small numbers while in streams which receive feces, they are found in large numbers. Human feces constitute the main source of these bacteria in domestic sewage. The relative number of coliform organisms is an indication of the degree of sewage pollution and also an indication of the hazard of infection from water borne diseases. Because of the number of coliform organisms in a polluted water have been observed to decrease with time, the number observed may also be a function of the proximity in time of a pollution source.(4) The density of coliform organisms is usually measured by the application of statistical methods to the presence or absence of these organisms in appropriate media in multiple decimal dilutions of the water or waste tested and is reported in terms of the "most probable number" (MPN) of organisms per 100 milliliters of sample.

PRESENT AND FUTURE CONDITIONS

The surface waters of the Cape Fear River Basin were surveyed by the State Stream Sanitation Committee in 1954 through 1957 to fulfill the requirements of State law that a study be made to obtain the essential data and facts required for classification of surface waters. As has previously been noted, Pollution Survey Report No. 6 prepared from those data has been used as the primary source of information on existing conditions.

Table 4 shows the major municipalities and industries discharging wastes to the New Hope River and its tributaries above the

proposed damsite. Note that significant sources of pollution on New Hope River and its tributaries are located at or near their respective headwaters where small natural flows occur.

Table 5 lists the major municipalities and industries discharging wastes to the Haw River Basin.[1] It has been observed that these waters are being seriously polluted by untreated or partially treated wastes from many sources, the majority of which are well upstream from the proposed New Hope Reservoir damsite. The dissolved oxygen content of the river was observed to be near saturation by the time the waters reached the proposed damsite and had become acceptable for many beneficial uses at that point. However, three sources of wastes are located very near the Haw River arm of the proposed New Hope Reservoir. These three sources are the town of Pittsboro and the Webster Poultry Company in Pittsboro, both of which discharge to the Haw River through Robeson Creek; and the O'Dell Manufacturing Company in the town of Bynum, which discharges directly to the Haw River.

The raw or treated wastes discharged by the communities and industries listed in Tables 4 and 5 would become a part of the impounded reservoir waters. With treatment of wastes, as noted in Pollution Survey Report No. 6, the combined residual wastes would result in serious lowering of the dissolved oxygen content of the water in the reservoir. Recreational use of the proposed reservoir would become important; and in that event, the State might consider higher degrees of treatment of waste loads in order to protect the health of the users of the reservoir.

It has been observed in some other States that where treatment or additional treatment is required by the State as a result of new uses resulting from the creation of a reservoir, the community or industry required to furnish such treatment has looked to the agency which made the new use possible for the funds necessary. If payments are required for such purposes, the sum of such payments would be a part of the damages attributable to the project. Degradation of water quality in the proposed reservoir is not excepted with present pollution loads if treatment of wastes is provided as recommended in Pollution Survey Report No. 6. However, in order to protect the quality of the water in the proposed reservoir for recreational uses, it is possible that a higher degree of treatment will be required as population grows and industry is developed.

Table 6 lists the major municipalities and industries discharging wastes to the Cape Fear River and its tributaries from the confluence of the Deep and Haw Rivers to the Atlantic Ocean.

Table 4 - Pollution Loads in New Hope River Basin

Name	Type Waste	Type Plant	Influent (PE)	Effluent (PE)	Receiving Stream
Durham-New Hope Plant	D & I	Secondary	9,260	800	New Hope Creek
Durham-Third Fork Creek Plant	D & I	Secondary	50,800	5,050	Third Fork Creek
Hope Valley Mutual Sewage Disposal Assoc. (Near Durham, N.C.)	D	Primary	260	200	Third Fork Creek
Town of Carrboro	D	Secondary	1,556	235	Morgan Creek
Chapel Hill-Morgan Creek Plant	D & I	Secondary	8,000	1,200	Morgan Creek
Chapel Hill-Bolin Creek Plant	D & I	Secondary	7,840	1,960	Bolin Creek
Town of Apex	D	Primary	660	429	Beaver Creek
Virginia-Carolina Chemical Co., Durham	I	To City			

D = Domestic Waste
I = Industrial Waste
PE = The 5-day 20°C BOD of the per capita flow of the sewage in terms of the 5-day 20°C BOD of a standard sewage. For a strictly domestic sewage, this will be approximately .17 to .18 pounds of oxygen per day.

Table 5 - Pollution Loads in Haw River Basin

Name	Type Waste	Type Plant	Influent (PE)	Effluent (PE)	Receiving Stream
Carolina Power & Light Co., Cape Fear Steam Plant, Moncure	I	Lagoon	-	-	Shaddox Creek
City of Reidsville	D & I	Secondary	9,450	900	Little Trouble-some Creek
Town of Kernersville	D	Imhoff Tank & Sand Filter	650	260	Reedy Fork
Guilford College	D	Secondary	438	66	Horsepen Creek
City of Greensboro					
South Buffalow Creek Plant	D & I	Secondary overloaded	78,800	14,000	South Buffalo Creek
North Buffalo Creek Plant	D & I	Secondary-additions & alterations under construction	166,000	93,000	North Buffalo Creek
In or near Greensboro					
Cone Mills Corporation	I	None - Secondary under construction		90,600	North Buffalo Creek
American Agricultural Chemical Co.	I	None		Inorganic	South Buffalo Creek

Armour and Co.	I	None		Inorganic	South Buffalo Creek
Swift and Co.	I	None		Inorganic	South Buffalo Creek
Town of Gibsonville					
Southside Plant	D	Secondary	570	125	Michael Branch (Cedar Creek)
Northside Plant	D & I	Secondary	1,800	486	Travis Creek (Stoney Creek)
City of Burlington Haw River Plant	D & I	Secondary just completed	51,000	15,000 est.	Haw River
City of Burlington Little Alamance Creek Plant	D & I	Secondary	30,000	6,300	Little Alamance Creek
Haw River Sanitary Dist.(Near Burlington)	D & I	None - Secondary under construction	-	1,316	Haw River
Town of Mebane	D & I	Primary	3,523	2,297	Moadams Creek
Town of Graham	D & I	None - Secondary under construction		11,719	Haw River
Town of Elon College and Elon College	D & I	Secondary	1,765	265	Gum Creek
O'Dell Mfg. Co. (Bynum)	D	Secondary Nit. field	38	None	None

(Continued)

Revised March 1961

Table 5 - Pollution Loads in Haw River Basin (continued)

Name	Type Waste	Type Plant	Influent (PE)	Effluent (PE)	Receiving Stream
Town of Pittsboro	D & I	Primary (Septic Tank)	988	692	Robeson Creek
Glen Raven Mills (Altamahaw)	D & I	Secondary	1,035	260	Haw River
Greensboro-Highpoint Airport	D	Secondary	-	10	Brush Creek
Burlington Mills (Ossipee)	D & I	Secondary	106	10	Reedy Fork
Frissell Fabrics (Ossipee)	D	Secondary	68	7	Reedy Fork
Copland Fabrics Copland Converting & Finishing Co. Copland-Fowler Industries, Inc. (Hopedale)	D & I	None		443	Stoney Creek Haw River
Cone Mills Corp. Granite Plant Tabardrey Plant (Haw River)	D & I	None - Secondary under construction with Haw River San. Dist.		13,392	Haw River
Virginia Mills, Inc. (Swepsonville)	D & I	None	-	944	Haw River
Kayser-Roth Hosiery Co., Inc. (Alamance)	D & I	Secondary	62	6	Alamance Creek
Sellers Mfg. Co. (Saxapahaw)	D & I	None	-	2,665	Haw River
Webster Poultry Co.	I	None	-	4,500	Robeson Creek

Table 6 - Pollution Loads in Main Stem Drainage Area - Cape Fear River Basin

Name	Type Waste	Type Plant	Influent (PE)	Effluent (PE)	Receiving Stream
Fuquay Springs	D	Primary (inadequate)	2,000	App. 2,000	Kenneth Creek
Lillington	D	None		1,200	Cape Fear River
Campbell College	D	Septic Tank	550	410	Buies Creek
Sanford-Jonesboro	D	Secondary	1,840	300	Gasters Creek
Erwin and Erwin Mills	D & I	None	-	9,200	Stuart Creek
Pinehurst-Nicks Creek Plant	D	Stabilization Pond	2,340	565	Board Branch
Southern Pines	D	Secondary	4,000	1,200	McDeeds Creek
Fort Bragg	D	Secondary	42,000	3,300	Lower Little River
Brooks Trailer Camp	D	Septic Tanks	Unk	Unk	McDuffies Creek
Spring Lake Enterprises, Inc.	D	Haye's Process	5,760	1,440	Lower Little River
Fayetteville	D & I	Secondary	32,400	4,900	Cape Fear River
Carolina Power & Light Co.	D	Secondary Nit. Field	Small	None	None

Table 6 - Pollution Loads in Main Stem Drainage Area - Cape Fear River Basin (Continued)

Name	Type Waste	Type Plant	Influent (PE)	Effluent (PE)	Receiving Stream
Becker County Sand & Gravel Co.	I	Settling Pond	Inorganic	-	Cape Fear River
Moores Dairy, Erwin	I	None	-	-	Stuart Creek
Cumberland Gravel & Sand Co.	I	None	Inorganic	-	Buffalo Creek
Holt-Williamson Co. (Fayetteville)	I	To Fayetteville Waste Treatment Plant			
McDaniel Abbattoir	I	Settling Basin		180	Buzzard Branch
Esso River Terminal	I	None		-	Cape Fear River
Borden Co.	I	None		None	Cape Fear River
Sycamore Dairy	I	None		132	Hybarts Branch
Riegel Industries	I	Ponds	380,000	330,000	Cape Fear River
Wilmington	D	None	44,700	44,700	Cape Fear River

BENEFITS OF INCREASED FLOW

Downstream from the damsite there are two possible areas in which flow augmentation could provide pollution abatement benefits. The first area is the reach of the Cape Fear River which receives wastes from the Riegel Paper Corporation (near Acme, North Carolina). In Pollution Survey Report No. 6, it was reported that the stream loading in that reach is the largest in the Cape Fear River Basin and the 1955 and 1956 data indicated objectionable stream conditions even prior to the plant's expansion program. Dilution water for the wastes from Riegel Paper Corporation is deficient during extended dry seasons. Based on the data in Pollution Survey Report No. 6 and an increased minimum design flow for this reach of the river from 385 to greater than 60 cfs, it has been estimated that the value of this additional flow would be $15,000 per year in terms of equivalent waste treatment costs.

The other area is the reach below Lillington. The seven day mean flow in this reach which has a recurrence frequency of once in ten years would be increased from 80 to 600 cfs by regulation at the dam. The waste assimilation capacity of the increased flow would be about 11,000 pounds of BOD per day. In terms of capital cost of a treatment plant which would accomplish the reduction of 11,000 pounds of BOD per day, operation and maintenance of such a plant, and interest at 4.5 percent, the increased discharge would have a potential value of $26,000 annually.

The flow augmentation would be even more valuable if it was to be used where treatment beyond conventional secondary treatment would be required to meet stream water quality objectives.

WATER SUPPLY

PRINCIPLES OF WATER SUPPLY EVALUATION

The domestic use of water is universally classified as the most important beneficial use of that resource. Accelerating demands for water by cities are beginning to add up to a significant load on the water resources of the United States. In certain parts of the country the total use of water is approaching physical limits.

Further municipal water demands can be estimated with a reasonable degree of accuracy. The water needs of small and moderate sized industries within a community are normally included in its water requirements.

The water use of large industries both within and without a community may be highly variable depending upon the type of industry, the importance attached to the economics of water use, and waste disposal considerations. While the future industrial water use of large areas can be estimated in a manner similar to that for communities, for any particular area as is under consideration here,

the time at which an increased dependable water supply will be utilized is subject to conjecture.

The use of water for supplemental irrigation in the humid areas of the Eastern United States is just beginning.[2,3] How far farming practice will make it practical to extend and how far it will extend in light of other competing demands for water can hardly be inferred from the limited data at hand. Judgment must be exercised in considering use of small streams which pass through agricultural areas as an alternate source of raw water for municipal water supply.

In principle, the evaluation of water supply benefits is the same as for pollution abatement. A benefit will be assessed in terms of predicted requirements and the savings occasioned on the use of water from the proposed project over the most economical alternative method of satisfying the requirements. Where an alternate method can more economically satisfy the predicted needs for water, no benefit can be assigned.

The adequacy of the Cape Fear River as a water source will be evaluated in terms of its ability to meet the water demand which would be expected to occur coincident with the record low seven-day mean flow. Though this may require a large expenditure to meet a given water use requirement, the necessity of a continuous and dependable public water supply justifies such planning.

The per capita use of domestic water supplies is increasing along with standards of living. Facilities such as multiple bathrooms, dishwashers, garbage disposal fixtures, automatic washers, air conditioning plus lawn sprinkling and other outdoor uses place a heavy demand on domestic water supplies. For purposes of this report, it is extimated that by 1970, domestic use in the cities will average 170 gpcd and by 2010, 200 gpcd.(5)

ITEMS CONSIDERED IN ASSESSING WATER QUALITY FOR DOMESTIC USE

The Public Health Service Drinking Water Standards of 1946(6) as modified from time to time, prescribe the standards to which drinking water and water supply systems used by interstate carriers shall conform. These standards have been voluntarily accepted by the American Water Works Association for all public water supplies, and are therefore used on this basis in this report. The Public Health Service published a Manual of Recommended Water Sanitation Practice which outlined the practices and procedures which the committee felt would be helpful in the field of water sanitation.(7) In this report supplies will be evaluated in terms of both the requirements of the Drinking Water Standards and the recommendations of the Public Health Service in regard to raw water quality. The items considered are discussed below.

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Total Solids

Total solids in finished water of good chemical quality should not exceed 500 ppm, although 1,000 ppm will be permitted if no other water is available.

Iron and Manganese

Iron (Fe) and manganese (Mn) together should not exceed 0.3 ppm.

Turbidity

The finished water should not exceed 10 ppm in turbidity. High turbidity requires coagulation and results in higher chemical costs. It may also result in extra cost for sludge removal facilities. Widely varying turbidity in the raw water requires treatment facilities to handle extreme high values and a high degree of supervision and control to meet the changing situation.

Taste or Odor

The finished water should have no objectionable taste or odor. Objectionable taste or odor in the raw water can, in some cases, be handled by modern water treatment practice through the use of such materials as activated carbon, breakpoint chlorination, or chlorine dioxide. However, the cost of treatment and the difficulty in achieving a satisfactory water quality are thereby increased.

Coliform Organisms

The significance of coliform organisms and measurement procedures were discussed under the items considered in assessing stream quality.

The Public Health Service has recommended that raw water should meet the following standards to be considered relatively safe when subjected to treatment under normal operating procedures:

		Coliform Test Results	
Group	Treatment Required	Monthly Average	Extremes
I	None	Applicable only to ground water.	
II	Simple chlorination or its equivalent	50/100 ml.	
III	Complete rapid sand filtration or its equivalent together with continuous post chlorination	5,000/100 ml.	Exceeding 5,000 in not over 20% of the samples in each month
IV	Additional treatment beyond rapid sand filtration and post chlorination	5,000/100 ml.	Exceeding 5,000 in more than 20% of the samples and 20,000 in not over 5% of the samples in any one month

If the average coliform results in any month exceed 5,000/100 ml or the water is more variable than suggested above, it was felt that the water would be unsuitable for use as a source

of domestic water supply except as it was made to meet these standards by prolonged storage or some other measure of equal permanence and reliability.

While many water treatment plants are now handling raw water having coliform densities in excess of that in the recommendations, such high densities require more elaborate treatment, more extensive and competent supervision and control, and result in a greater hazard to the consumer in the event of system overload or unexpected failure.

As the Haw River Basin communities are located upstream from the proposed damsite, it is doubtful that the project would be used by them for a source of raw water. Therefore, these communities will not be considered further in the water supply evaluation.

In the area tributary to the main stem of Cape Fear River, there are eight public surface water supplies and 12 industrial surface water supplies. Table 7 lists these supplies.

In order to evaluate water supply benefits, Table 8 has been prepared. This table shows possible users of water supply facilities of New Hope Reservoir as well as an estimate of future populations and requirements. Previous discussion indicated that the increased water use per capita was a result of higher standards of living.

Table 7 - Public and Industrial Surface Water Supplies
Main Stem Drainage Area -
Cape Fear River Basin*

Location	Pop. Served	Average Use (mgd)	Source
Dunn	10,200	1.280	Cape Fear River
Fayetteville	42,860	4.000	Cross Creek & Cape Fear River
Fort Bragg	42,000	4.500	Little River
Lillington	1,600	.075	Cape Fear River
Pinehurst, Inc.	1,600	.200	Rattlesnake Creek & Jumper Branch
Sanford	13,500	1.100	Lick Creek & Little Lick Creek
Southern Pines	7,000	.500	Mill Creek
Wilmington	55,150	5.500	Cape Fear River
Acme Fertilizer Co. - Acme	-	-	Livingston Creek
Riegel Paper Corp. - Acme	-	24.00	Cape Fear River
Rockfish-Mebane Yarn Mills	-	-	Big Beaver Creek
Cumberland Sand and Gravel	-	0.67	Little River
Brower Mills at Hope Mills		-	Rockfish Creek
Rockfish-Mebane Yarn Mills at Hope Mills		-	Little Rockfish Creek

Table 7 - Public and Industrial Surface Water Supplies
Main Stem Drainage Area -
Cape Fear River Basin (continued)*

Location	Pop. Served	Average Use (mgd)	Source
Becker Co. Sand and Gravel at Lillington		1.92	Upper Little River
Carolina Power and Light Co. at Moncure		256.32	Cape Fear River
Armour Fertilizer Co. at Navassa		-	Cape Fear River
Virginia-Carolina Chemical Co. at Navassa		-	Cape Fear River
Carolina Power and Light Co. at Wilmington		181.44	Cape Fear River
Swift and Co. at Wilmington		0.16	Northeast Cape Fear River

* Data from Pollution Survey Report No. 6, 1954-1956.(1)

Table 8 - Estimated Future Water Requirements

	Present Conditions*		Estimated for 2010**	
Community	Pop. Served	Use(mgd)	Population	Use(mgd)
Sanford	13,500	1.100	28,300	5.6
Lillington	1,600	.075	2,400	.5
Dunn	10,200	1.280	24,000	4.8
Fayetteville	42,860	4.000	91,600	18.3
Wilmington	55,150	5.500	132,000	26.4

* Data from Pollution Survey Report No. 6 (1954-1956).

** Based on 200 gpcd average.

PRESENT AND FUTURE WATER SUPPLY

While Haw and Deep Rivers are heavily polluted, considerable recovery takes place before the confluence forming the Cape Fear River. The chemical quality of water at Lillington is generally good; however, it is greatly influenced by the upstream tributaries. Industrial and municipal wastes which enter these tributaries cause the quality to be erratic, particularly at times of low water discharge. Silica, sodium, chloride, fluoride, and alkalinity from pollution alter the character of the water. Coliform bacteria are usually within acceptable limits for conventional treatment for

domestic use, although there is an occasional sample with excessive numbers of such bacteria.

A matter of considerable importance is the discharge of waste containing large quantities of fluorides from fertilizer plants at Greensboro and Durham in relation to the public water supplies drawn from Cape Fear River. In 1954, during the low river flows of that year, it was stated in Pollution Survey Report No. 6 that the fluoride content of the water at the Dunn intake exceeded limits normally considered safe.

It was also reported that while water taken from Cape Fear River and treated by conventional methods is usually satisfactory for use in boilers, foaming has occurred under low flow conditions.

At the present time Lillington, Dunn, and Wilmington obtain their municipal water supply from Cape Fear River. Fayetteville has built an intake in Cape Fear River recently as a supplemental water supply.

The town of Lillington supplies 75,000 gpd from the Cape Fear River to a population of 1,600, after conventional treatment. The over-all quality of the raw water supply would be improved by storage in the New Hope Reservoir; the bacterial quality by prolonged storage; and the minerals, by dilution. There is a possibility of increased concentrations of iron and manganese in waters released from the reservoir. If such concentrations exceed limits established in the drinking water standards, the benefits to down-

stream users would be diminished. Information is not available to predict magnitudes of concentrations of iron and manganese which would result from the proposed impoundment. The volume of natural flow is ample for the present and future requirements of Lillington.

The city of Dunn takes its raw water (1.28 mgd) from the Cape Fear River. Water from this municipal supply is furnished to Erwin and Erwin Mills. There is ample quantity of water in the Cape Fear River at low flows for present and future municipal requirements. However, the quality would be improved by prolonged storage in the New Hope Reservoir in the same manner as stated for Lillington.

The city of Fayetteville has impoundments on Little Cross Creek and Cross Creek. In 1957, the city installed an intake in Cape Fear River at a point above Cross Creek to provide a supplemental water supply. The Cape Fear water will be pumped to one of the existing impoundments where it will be stored before it is sent to the filter plant. The quantity of water presently available in the Cape Fear River is adequate for present (4.0 mgd) and probable future uses at Fayetteville. However, the water quality would be improved by the New Hope Reservoir in the same manner as indicated for Lillington.

The city of Wilmington takes its raw water supply (5.5 mgd) from Cape Fear River above Lock Number One. The natural discharge is adequate for estimated future domestic uses. While the flow augmentation during drought periods would tend to improve the water quality at the Wilmington intake, the New Hope dam site is over 130 miles upstream from that point. Any water quality improve-

ment would be intangible as there is considerable dilution water added by tributaries below the dam site.

The city of Sanford secures raw water from impoundments on Lick and Daniels Creeks and an emergency supply from Oldhams Lake. After conventional treatment, 1.1 mgd are supplied to a population of 13,500. In 1953 and 1954, Sanford was listed as a community experiencing municipal water shortages. With estimated population growth, Sanford will have to develop an additional raw water source. At the present time, by building a pipeline about six miles long, Sanford could tap the Cape Fear River for the quantity which would be required, but the quality would not be equal to other sources which appear to be available. With the New Hope project, however, the quality of water discharged from the reservoir should be very good.(*)

BENEFITS OF INCREASED FLOW

The State Stream Sanitation Committee has an active pollution abatement program; and river water quality improvement in the Cape Fear River Basin is anticipated prior to the time of construction of New Hope Dam. This is evidenced by the fact that the necessary

(*) Since the preparation of this report, the city of Sanford, North Carolina, has built an emergency intake and pipeline from the Cape Fear River to one of its existing impoundments. Approval is for such use only, pending accomplishment of the upstream Comprehensive Pollution Abatement Plan for the Cape Fear River Basin.

stream studies have been completed, public hearings held, all streams in the basin classified, and a comprehensive pollution abatement plan covering the entire basin has been adopted. Certain facilities have already been constructed. However, the time at which the comprehensive abatement plan will be fulfilled is not now known.

For the purpose of this report it is believed necessary to base the benefits on existing river conditions, recognizing that the benefits will decrease in value as the State's pollution abatement program progresses and adequate treatment facilities are installed. In view of the above, low flow augmentation and water supply benefits should be re-evaluated at a later date and prior to construction of New Hope Dam.

Water impounded in the New Hope Reservoir would have immediate and potential municipal and industrial water supply values. There would be sufficient storage within the impoundment to control flows from it to furnish a continuous discharge of 370 cfs. The reservoir could be regulated, in combination with flows from tributaries downstream from the dam site, to provide a minimum continuous discharge of 600 cfs at Lillington.

MUNICIPAL SUPPLY

The cities listed in Table 8 obtain their present supplies from either Cape Fear River or from streams tributary to Cape Fear River. According to flow records, there is ample flow in the

Cape Fear River to meet requirements for quantity through the year 2010. However, it is again pointed out that when the minimum mean seven-day flow of record at Fayetteville of 105 mgd occurred in 1930, use of water for supplemental irrigation was minor. Should such a drought occur at the present time, it is conceivable that irrigation could take a significant portion of the low flow. The possible effects of insecticides and herbicides should be considered. The greatest water pollution danger would probably exist when a high-intensity, short-duration rainfall occurs just after a heavy application of an insecticide. The increasing practice of supplemental irrigation would, in the near future, affect low flows in such a manner than existing discharges would not be adequate in either quantity or quality as a reliable source of municipal supply for short periods of time. Since development of supplemental irrigation is subject to conjecture, it has been presumed for purposes of this evaluation, the present supply in the Cape Fear River will be adequate in quantity. Therefore, increased low flow by itself will not be considered a benefit at this time with respect to quantity required for municipal purposes.

The New Hope Project would provide an over-all water quality much improved over the present quality. The regulated discharge from the project would provide water acceptable as a raw water supply during the entire year for the communities of Sanford, Lillington, Dunn, and Fayetteville. That discharge would be a tangible benefit to Lillington, Dunn, and Fayetteville in that the present doubtful

water quality, but adequate supply, would be improved to an acceptable water quality with a bountiful water supply which could be used to attract industries to these cities. The regulated discharge would be a potential benefit to Sanford, and would become real when utilized. The regulated discharge would have only an intangible value to the Wilmington water supply as many tributaries discharge into the Cape Fear River downstream from the dam site, providing an ample water supply for municipal purposes.

The estimated immediate tangible benefits to Lillington, Dunn, and Fayetteville, are based on the improved quality of 9 mgd, i.e., an average of one half of the additional estimated quantity required by the year 2010. This average quantity is then used for the fifty-year life of the project, and would actually vary from near zero in 1960 to 18 mgd in the year 2010. The average population increase would be about 30,000, and would vary from near zero in 1960 to 60,000.

The most economical alternative method to obtain the same quality of water from the Cape Fear River water would be to pump it into a storage basin and then to provide a lime treatment plant to remove fluoride. Five days storage would be adequate to provide a good bacterial quality. The cost of storage has been estimated to be about $150,000 capital cost. The capital cost of a lime treatment plant would be about $10.00 per capita, or $300,000. The total tangible benefit to municipal water supply would be $450,000, or at 4½ per cent and 50 year period, the annual benefit would be $22,800.

The potential tangible benefit to Sanford would be based on an average population increase of 7,500 and an average 2.75 mgd during the 50 year life of the project. The storage value would be about $40,000 and the lime treatment plant cost would be about $75,000 for a total potential benefit of $115,000, or an annual benefit of $5,800.

INDUSTRIAL WATER SUPPLY

The flow augmentation from the New Hope Reservoir would assure a minimum continuous flow of 600 cfs in the Cape Fear River at Lillington. Natural flows at that point have been recorded as low as 29 cfs. This large increase in dependable supply should be very attractive to water using industries, and therefore would have a potential as well as an immediate tangible benefit.

The tangible benefit would accrue to the Carolina Power and Light Company steam power plant located near Moncure and below the confluence of the Deep and Haw Rivers. That plant requires 256 mgd or about 400 cfs for normal operation. From the duration curve data (Table 3) it can be seen that ten per cent of the time, there are 336 cfs or less available for cooling purposes. To operate without loss of efficiency, or without creating unacceptable temperature rises in the river during the low flow periods, cooling towers could be used in a recirculating system. The cost of the cooling towers and appurtenant works plus an annual operation charge would be the approximate value of additional flow up to 400 cfs. This value is

estimated to be $8,000 annually. If the Carolina Power and Light Company builds additional capacity into the Moncure Plant after the New Hope Dam is built, the value of the guaranteed 600 cfs discharge would be quite large as the flow augmentation would permit a savings in capital cost of supplementary cooling plant equipment. A new 600,000 kilowatt steam plant could be built near the present site at a future date, replacing the present structure if the New Hope Project was in operation. The value of ample cooling water to the new power plant would be approximately $21,000 annually, or $13,000 more than the immediate tangible benefit to the existing facility.

The worth of water to industry is admittedly difficult to determine and depends upon the specific plant. However, it has been observed that minimum costs of industrial water, where it has been necessary to develop such, will vary from $30 to $1,400 per mgd per year. An arbitrary value of $100 per mgd per year, or one cent per 150 tons of water, appears to be a conservative figure to assign to the potential worth of increased flow. From the duration curve data, it was determined that 177 mgd for 73 days per year were needed to provide a minimum continuous 390 mgd (600 cfs) discharge at Lillington. The flow augmentation would then have a potential tangible benefit of $17,700 per year.

SUMMATION OF TANGIBLE BENEFITS

The benefits of low flow augmentation attributable to the New Hope Project are listed below. The capital costs have been developed into yearly benefits on basis of 50 year life and $4\frac{1}{2}$ per cent interest rate.

Item	Annual Benefits		
	Immediate	Potential	Total
Pollution Abatement	$ 15,000	$ 26,000	$ 41,000
Municipal Water Supply	22,800	5,800	28,600
Industrial Water Supply	8,000	30,700	38,700
Total Tangible Benefits	$ 45,800	$ 62,500	$108,300

REFERENCES

1. State Stream Sanitation Committee, "Pollution Survey Report No. 6, The Cape Fear River Basin" - A study of existing pollution in the Cape Fear River Basin, together with recommended classification of its waters, 1954-1956, Division of Water Pollution Control, North Carolina State Board of Health, Raleigh, North Carolina, 1957, 613 pp.

2. Committee on Water Resources, Inlets and Coastal Waterways, "Water Resources of North Carolina," Division of Water Resources, Inlets and Coastal Waterways, Department of Conservation and Development, Raleigh, North Carolina, 1955, 185 pp.

3. Wiseman, John W., "Potential Conflicts Between Supplemental Irrigation and Pollution Abatement Programs," Sewage and Industrial Wastes, 27, 1284-7, (November, 1955).

4. Butterfield, C. T., "Determining the Bacterial Quality of Water," Journal of the Inter-American Association of Sanitary Engineers, 2, 89-93, (July 1948).

5. See "Report on Seven Cities Water Project - Yadkin River, 1957," Engineering Report by Pratt and Davis, Wm. C. Olsen and Assoc., and Hazen and Sawyer, (February 15, 1957).

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6. "Public Health Service Drinking Water Standards - 1946," Public Health Reports, 61, 371-384, (March 15, 1946).

7. "Manual of Recommended Water Sanitation Practice - Recommended by the Public Health Service - 1946, "Public Health Bulletin 296, United States Government Printing Office, Washington, D. C., (1949).

POTENTIAL WATER SUPPLY BENEFITS ABOVE THE NEW HOPE DAM SITE

Prepared at the request of the District Engineer,
Wilmington District, Corps of Engineers,
U. S. Army

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of State Services
Division of Water Supply and Pollution Control

Region III, Charlottesville, Virginia
and
Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

March 1961

SUMMARY

1. No large municipality in the vicinity of the proposed New Hope Reservoir plans to take its municipal raw water supply from the proposed New Hope Reservoir.
2. When the Comprehensive Pollution Abatement Plan for the Cape Fear River Basin as announced by the State (North Carolina) Stream Sanitation Committee is accomplished, class "C" and "D" waters in the free flowing streams within the proposed reservoir area would be available for agricultural purposes and as a source of industrial cooling and process water.
3. The proposed New Hope Reservoir project would increase the quantity of the water available while maintaining the quality of class "C" and "D" waters when the Comprehensive Pollution Abatement Plan is accomplished.
4. While impoundment would probably improve water quality above the minimum required by the assigned classification, any future use of such waters requiring higher quality than that provided by class "C" should be planned only after a complete study has been made of water quality by the responsible State agency.
5. It is believed that the impounded New Hope waters will be used for industrial purposes. If such use is made in the reservoir area and then re-used downstream, the values previously reported in the May 1959 study, page 49, would be substantially increased.

INTRODUCTION

The preparation of this report on "Potential Water Supply Benefits Above the New Hope Dam Site" was authorized by the District Engineer, U. S. Army Engineer District, Wilmington, North Carolina, by letter dated January 12, 1961. This report supplements the New Hope Reservoir Study, dated May 1959, and explores the possibility of using the waters impounded by the proposed New Hope Dam for water supply purposes.

MUNICIPAL WATER SUPPLY USE OF IMPOUNDED NEW HOPE WATERS

Municipal users of large quantities of water located in the vicinity of the New Hope Reservoir area were consulted to determine their plans for expansion of raw water sources to meet future needs. All such users stated that their future plans involved sites in the Neuse River Basin for reasons of proximity and quality. There appeared to be preferences for different sites in the Neuse River Basin, again for reasons of proximity and quality. No large municipality reported plans to use waters from the proposed New Hope Reservoir for municipal water supply.

POTENTIAL WATER SUPPLY USE OF IMPOUNDED NEW HOPE WATERS

In a document dated February 17, 1959, the State Stream Sanitation Committee gave notice that it had adopted and assigned classifications to waters of the Cape Fear River Basin during its meeting of January 20, 1959, in Raleigh, North Carolina. That document is of interest in that the following classifications are made of waters which would be a part of the proposed New Hope Reservoir:

Name of Stream	Description	Class
HAW RIVER	From water supply intake for O'Dell Manufacturing Company to Cape Fear River (Junction with Deep River)	C
		D
Pokeberry Creek	From source to Haw River	D
Ward Branch	From source to Pokeberry Creek	D
Robeson Creek	From source to dam at Pittsboro water supply	A-II
	From source to Robeson Creek	A-II
Hill Creek	From dam at Pittsboro water supply to Haw River	D
Robeson Creek	From source to Robeson Creek	D
Turkey Creek	From source to Haw River	D
Stinking Creek	From junction of New Hope Creek and Morgan Creek to Haw River	C
New Hope River	From source to Little Creek (southeast of Capel Hill)	D
New Hope Creek	From source to New Hope Creek	D
Mountain Creek		

Name of Stream	Description	Class
Unnamed Tributary	From source to New Hope Creek including lake at Camp New Hope	B
Old Field Creek	From source to New Hope Creek	D
Church Branch	From source to New Hope Creek	D
Little Creek (Orange County)	From source to New Hope Creek	D
Mud Creek	From source to New Hope Creek	D
Sandy Creek	From source to New Hope Creek	D
Third Fork Creek	From source to New Hope Creek	D
Gum Creek	From source to New Hope Creek	D
New Hope Creek	From Little Creek (southeast of Chapel Hill) to New Hope River	C
Little Creek (southeast of Chapel Hill)	From junction of Bolin Creek and Booker Creek to New Hope Creek	D
Bolin Creek	From source to Little Creek	D
Buckhorn Branch	From source to Bolin Creek	D
Hogan Creek	From source to Bolin Creek	D
Jolly Branch	From source to Bolin Creek	D
Tarbark Branch	From source to Bolin Creek	D
Booker Creek	From source to dam at Eastwood Lake	B
Crow Branch	From source to Booker Creek	B
Cedar Fork	From source to Eastwood Lake	B
Booker Creek	From dam at Eastwood Lake to Little Creek	D
Crooked Creek	From source to New Hope Creek	D
Northeast Creek	From source to New Hope Creek	C
Burdens Creek	From source to Northeast Creek	C
Buck Branch	From source to Burdens Creek	C
Kit Creek	From source to Northeast Creek	C
Long Branch	From source to Kit Creek	C
Panther Creek	From source to Northeast Creek	C
Morris Branch	From source to Panther Creek	C
Nancy Branch	From source to Panther Creek	C
Indian Creek	From source to New Hope Creek	C
Lick Creek	From source to New Hope Creek	C
Morgan Creek	From source to dam at University Lake	A-II
Phils Creek	From source to University Lake	A-II
Neville Creek	From source to Phils Creek	A-II
Price Creek	From junction of East and West Branches to University Lake	A-II
East Branch Price Creek	From source to Price Creek	A-II

Name of Stream	Description	Class
West Branch Price Creek	From source to Price Creek	A-II
Mill Creek	From source to Price Creek	A-II
Cumbo Branch	From source to Mill Creek	A-II
Morgan Creek	From dam at University Lake to New Hope River	D
Wilson Creek	From source to Morgan Creek	D
Fan Branch	From source to Wilson Creek	D
Meeting of the Waters	From source to Morgan Creek	D
Chapel Creek	From source to Morgan Creek	D
Buck Branch	From source to Morgan Creek	D
Cub Creek	From source to Morgan Creek	D
Big Branch	From source to Cub Creek	D
Folkner Branch	From source to New Hope River	D
Bush Creek	From source to New Hope River	C
Hendon Creek	From source to Bush Creek	C
Jones Branch	From source to Hendon Creek	C
Overcup Creek	From source to Bush Creek	C
Beartree Creek	From source to New Hope River	D
White Oak Creek	From source to New Hope River	D
Jack Branch	From source to White Oak Creek	D
Bachelor Branch	From source to White Oak Creek	D
Clark Branch	From source to White Oak Creek	D
Rocky Ford Branch	From source to White Oak Creek	D
Mill Branch	From source to White Oak Creek	D
Parkers Creek	From source to New Hope River	D
Beaver Creek	From source to New Hope River	D
Unnamed Tributary (at Apex's west side sewage plant)	From source to Beaver Creek	D
Reedy Branch	From source to Beaver Creek	D
Little Beaver Creek	From source to Beaver Creek	D
Weaver Creek	From source to Beaver Creek	D

The definitions of various classifications of waters as used in this report are documented in "Rules and Regulations and Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina," adopted by the State Stream Sanitation Committee, State Board of Health, Raleigh, North Carolina.

There are six fresh water classifications. The proposed New Hope Reservoir area would consist entirely of class "C" and "D" waters. Briefly, class "C" is applicable to waters that must be protected as a suitable habitat for fish and wildlife. Class "D" is applicable to waters serving as sources of water for agricultural purposes, including irrigation and livestock watering, and should be satisfactory as a source of industrial cooling and process water after necessary treatment, and fish survival.

In consideration of the classifications assigned to the waters of the Cape Fear River Basin together with existing stream flow and various other pertinent factors, the Comprehensive Pollution Abatement Plan for the Basin was developed. In many instances municipalities and industries have already complied with the provisions of the Plan by installing the required treatment facilities and by the time the proposed dam is constructed all polluters in the Basin will have constructed the required facilities. At such time, the free flowing waters within the proposed New Hope Reservoir area, as well as the waters downstream from the proposed impoundment, will be of such quality as to conform to the requirements of the classifications. Both class "C" and "D"

waters will then be available for fish and wildlife propagation, agricultural purposes and as a source of industrial cooling and process water.

Impoundment of such waters would increase the quantity of class "C" and "D" waters available, but would not decrease the degree of treatment required at a given source of pollution.

While impoundment of such waters would undoubtedly improve the water quality above the minimum required by the assigned classifications, any proposed future use of such waters requiring a higher quality than class "C" must be contingent upon future studies showing the availability of the required higher quality water.

Based on the present classifications of the waters of the Cape Fear River Basin which includes the proposed New Hope Reservoir area, the availability of an ample raw water supply of good quality for municipal purposes in the Neuse River Basin, and considering the probable impact of the Research Triangle Foundation of North Carolina on industrial development in the vicinity of New Hope Reservoir, it appears reasonable to assume that water from New Hope Reservoir would be used for industrial water supply.

The entire concept of water quality management is based on re-use of water. It is believed that in future years, waste treatment methods will be improved and that water quality below points of waste discharge will also be improved. It is entirely possible that the

waters of the proposed reservoir could be used for industrial water supplies and later re-used at some point downstream, thereby substantially increasing the previously developed potential tangible benefits reported for Industrial Water Supply and shown on page 49 of the May 1959 report. The increased value would be proportionate to the re-use of waters and modified by the relative location of industries along the rivers.

APPENDIX VII

REPORT FROM NATIONAL PARK SERVICE

In reply refer to:
L7423

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
Region One
Richmond, Virginia

May 7, 1958

Col. H. C. Rowland, Jr., District Engineer
Wilmington District, Corps of Engineers
P. O. Box 1890
Wilmington, North Carolina

My dear Colonel Rowland:

We are pleased to submit the recreation reconnaissance report on the proposed New Hope Reservoir, Cape Fear River Basin, North Carolina, in accordance with request from your office, dated February 13, 1958.

Two copies of the report are being forwarded by copy of this letter to the South Atlantic Division, Corps of Engineers. Eight copies are enclosed, four of these are complete with maps and photographs and four without.

Consistent with our mutual policy of cooperation with the State Park authority and the Fish and Wildlife Service, we believe it would be appropriate for you to furnish one copy of the report to each of the following:

Thomas W. Morse, Superintendent of State Parks, Division of State Parks, North Carolina Department of Conservation and Development.

W. D. Lawson, Fish and Wildlife Administrator, Branch of River Basin Studies, U. S. Bureau of Sport Fisheries and Wildlife, 2404 Hillsboro Street, Raleigh.

We appreciate the opportunity of this cooperative effort and trust the material presented may be of value to your office and to other interested agencies in continued studies for the realization of full recreation potentialities of the New Hope Reservoir project.

Sincerely yours,

s/ E. M. Lisle

t/ E. M. Lisle
Acting Regional Director

Copy to: South Atlantic Division, Corps of Engineers.

RECONNAISSANCE REPORT

on the

RECREATION RESOURCES

of

NEW HOPE RESERVOIR

Cape Fear River Basin, North Carolina

May - 1958

I. INTRODUCTION

A. AUTHORITY

This report has been prepared under basic authorization of the Park, Parkway and Recreation Study Act of June 23, 1936, and in accordance with request of February 13, 1958, from the Corps of Engineers, Office of the District Engineer, Wilmington District.

B. PURPOSE

The prupose of this report is to offer a preliminary appraisal and analysis of recreation aspects of the New Hope Reservoir project, and to present material which may be of value to the District Engineer in continued studies for the formulation of plans and programs for appropriate development, conservation, and wise use of the recreation resources inherent with the project. At the request of the Corps the report contains an estimate of project recreation benefits which might be realized by the public.

C. GENERAL

In this study we have continued our long-established policy of close cooperation with the North Carolina Division of State Parks. The material presented herein, directly relating to state park development has resulted from joint studies and recent discussions with that agency.

Since the U. S. Fish and Wildlife Service is currently making studies of the New Hope Reservoir, this report by the National Park Service does not include specific consideration of use or evaluation of fishing and hunting resources related to the project.

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D. GENERAL COMMENTS RECEIVED FROM THE NORTH CAROLINA DIVISION OF STATE PARKS:

It appears very doubtful that any site on the New Hope Reservoir will meet established North Carolina state parks standards. Because of this, the proposed New Hope Reservoir, as is often the case with reservoir projects, presents a knotty problem to the state park administrator.

On the one hand, any large federal reservoir offers new recreational opportunities which, having been provided by public funds, should be maintained and operated solely for public benefit and should not be permitted to be exploited for private gain at the expense of the public.

On the other hand, when lands adjoining the reservoir are not of state park caliber the state park administrator is not justified in recommending land purchase with state funds, nor is he justified in recommending establishment of a state park. This is particularly true when acquisition of other areas of much higher quality is under consideration. Yet, the state park administrator is acutely aware of the need to adequately protect the public interest in the recreational resources of the reservoir.

It is strongly recommended that the whole matter of federal reservoirs be carefully restudied in cooperation with the states, with the view of establishing policies that will adequately protect and provide for public use of reservoir recreation resources without forcing the states to lower or abandon established state parks standards and policies.

E. INVESTIGATION

Field investigation was made March 31-April 2 by the following:

Francis J. Guscio, Chief, Master Planning Branch, South Atlantic Division, Corps of Engineers.

Charles W. Hixon, Civil Engineer, Wilmington District, Corps of Engineers.

John Kibler, Landscape Architect, North Carolina Division of State Parks.

C. A. Jeffers, Regional Chief, Branch of State Cooperation, Region One, National Park Service.

During the field survey discussions were held with the following:

Thomas W. Morse, Superintendent of State Parks, North Carolina Division of State Parks.

W. D. Lawson, Fish and Wildlife Administrator, Branch of River Basins, Raleigh, U. S. Bureau of Sport Fisheries and Wildlife.

J. H. Cornell, Chief, Fisheries Division, North Carolina Wildlife Resources Commission.

This report is of a preliminary nature and based on project data which are not entirely firm. Therefore, conclusions reached and recreation values designated are tentative and subject to revision.

II. SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

A. IT HAS BEEN FOUND THAT:

1. New Hope Reservoir site is strategically located in relation to several major population centers. In 1950 about a million and a quarter people lived within a 75-mile highway distance of the site and population within this zone is definitely increasing.

2. The Haw River is heavily polluted with municipal sewage and industrial wastes. The New Hope River carries moderate to severe pollution.

3. Except for hunting and fishing, very little recreation use is now made of the site and no public recreation facilities were observed within or adjacent to the proposed impoundment area.

4. There are no large lakes or reservoirs within a radius of 50 miles of the New Hope site. John H. Kerr Reservoir, 75 highway miles distant, is the chief existing water resource of day-use recreation interest to residents of the New Hope Reservoir area.

5. Preliminary study of the reservoir area has been made by the U. S. Fish and Wildlife Service in cooperation with the North Carolina Wildlife Resources Commission. However, a final report has not yet been completed.

6. The State Stream Sanitation Committee of North Carolina is making pollution studies and surveys of the Cape Fear River and its tributaries, including the New Hope site.

7. The Division of State Parks, North Carolina Department of Conservation and Development has made preliminary studies on the recreation portion of the Upper Cape Fear State Joint Land and Water Resources Study.

B. IT IS CONCLUDED THAT:

1. The New Hope Reservoir will not be realized prior to 1964.

2. No existing major park or recreation area will be directly effected by the construction of the reservoir, nor would any outstanding scenic values be destroyed.

3. Portions of peripheral lands possess desirable characteristics for extensive recreation development.

4. During the recreation season of normal years, the reservoir would have a stability favorable to recreation.

5. Extreme high stages and prolonged storage of flood waters would have a serious adverse effect upon scenic qualities of the shoreline. Possibility of high flood pools would be disadvantageous regarding site locations for some water-related facilities.

6. Preliminary studies by State health authorities indicate that the probable pollution factor within the foreseeable future would generally render the reservoir unsuitable for swimming. Inference may be drawn that considerable improvement in pollution must be made before the reservoir will be suitable for fish life.

7. An important needed water recreation resource for boating would be created by the proposed impoundment.

8. The reservoir would be chiefly of interest to residents living within a 75-mile highway distance. It would serve primarily as resource for day-use and to a lesser degree for week end use.

9. The mountain region to the west and the seashore to the east are more attractive to North Carolinians for vacation type use.

10. If the quality of the water proves satisfactory, sufficient land is acquired for recreation use, and adequate facilities are provided and properly administered, it is estimated that the total average visitation for non-fishing, non-hunting recreation use may be about 235,000* annually.

11. Net annual recreation benefits which would accrue from the above use of the proposed reservoir are estimated to be $376,000.

C. IT IS RECOMMENDED THAT:

1. Continued efforts be made by State and local agencies to reduce pollution of the Haw River drainage basin.

2. The Corps cooperate with and encourage State and local governments with the objective of providing effective ordinances and legislation regarding building codes and land-use zoning in the vicinity of the impoundment, as to effect a proper balance of public and private control.

3. During pre-construction and construction periods the Corps maintain close liaison with public agencies, organizations, and individuals interested in recreation and conservation aspects of the project, and encourage and coordinate such development as is in the best public interest.

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* Based on 1950 census figures.

4. The Corps exercise the full extent of its present authority in obtaining maximum usable land at sites suitable and warranted for extensive public recreation development and use, especially in cases where qualified State or local sponsors are assured.

5. As feasible and consistent with sound overall planning, limited land which can be obtained under the Joint Policy, be acquired with emphasis on length rather than depth as related to the shoreline.

6. Concurrently with explorations and discussions with prospective administrators for recreation developments, the Corps encourage early adquisition of supplementary land needed for these developments.

7. In the relocation of roads and railroads due consideration be given to their respective beneficial or adverse effects upon conservation and recreation aspects.

8. The Corps give further consideration and study to the possibility of providing access and essential basic facilities for public use at strategic locations.

9. The State park authority make additional reconnaissance of the reservoir site, and if, through further studies, a recreation development of State significance appears warranted, that it be considered in the future program of the agency.

III. PROJECT DATA

A. STATUS

The New Hope Reservoir Project is in the study report stage. It is anticipated that it would be at least two years before construction funds would be appropriated. Construction would extend over a three to four year period.

B. PURPOSE

The reservoir is being planned for the primary purpose of flood control.

C. PROPOSED DAM

The dam would be of concrete construction with an over-all length of about 1,150 feet and a maximum height of about 96 feet above the streambed. A 760-foot spillway with crest elevation at 205 feet m.s.l. would be controlled by twelve 50'x36' Taintor gates and one 40'x36' gate. All New Hope dam structures are classified as permanent-type structures.

D. POOL DATA

Capacity Designation	Proposed Elevation	Water Surface
Total Storage Volume	245 ft. above m.s.l.	34,000 Acres
5 Yr. Frequency Flood Pool	225 ft. above m.s.l.	18,200 Acres
Top Flow-Regulation Pool	211 ft. above m.s.l.	8,800 Acres
Permanent Pool	200 ft. above m.s.l.	4,300 Acres

E. OPERATION

During periods of excessive runoff, water would be impounded for comparatively short periods and released so as to ease conditions downstream. Floods would most likely occur during the months of December to March and July to September. For 26 years of record the maximum runoff from the Haw River basin has occurred most frequently during the month of July.

Top of flow-regulation pool (elevation 211) is considered as normal pool. In dry periods water would be released so as to maintain a downstream flow of 600 c.f.s. Hydrographic data indicate that a ten year frequency drawdown below normal pool would be about two feet.

The maximum flood control pool would be at elevation 240 feet above mean sea level. Frequency of floods reaching this elevation would average about once in 50 years. The frequency of floods reaching the elevation of 245 feet above mean sea level would be rare.

F. PRESENT STREAM FLOW

The estimated average annual stream flow in the vicinity of the dam site is 1,580 c.f.s. This includes water of both the Haw River and the New Hope River, representing a combined drainage basin of 1,690 square miles.

IV. GENERAL DESCRIPTION OF THE AREA

A. LOCATION

The New Hope dam site is located about 23 miles southwest of Raleigh on the Haw River immediately below its confluence with the New Hope River near the ruins of an old dam. The proposed impoundment area lies in Chatham County with the upper reach extending into Durham County. At extreme flood storage stage very limited portions of the pool would spread into Wake and Orange Counties.

B. PHYSICAL CHARACTERISTICS

The reservoir site lies near the central eastern edge of a region of rolling hills knows as the Piedmont Plateau, about 15 miles west of the fall line separating the Piedmong Plateau from the Coastal Plain Region.

The Haw River, about 90 miles in length, rises in Forsyth County and joins the Deep River (about 4 miles below the New Hope dam site) to form the Cape Fear River. The Haw River has a relatively narrow valley and steep stream gradient averaging about 10 feet per mile. It is reported to be heavily polluted by industrial and domestic wastes. Within the proposed impoundment the Haw River varies from about 200 to 300 feet in width and has an average flow of about 1,240 c.f.s. At the time of the field study the waters of both the Haw and New Hope as well as that of their tributaries were swollen by recent rains and were very muddy.

An existing small power reservoir is located on the Haw River about five miles upstream from the upper limit of the New Hope Reservoir site.

The New Hope River, largest tribuatary to the Haw River, has its confluence with that stream just above the New Hope dam site. The New Hope River, within the proposed impoundment area, has a comparatively wide flood plain and a gentle stream gradient. Portions of the stream are sluggish and adjoined by marshy ground, particularly along its tributaries. Sections of the stream observed were from 20 to 50 feet wide. Rate of discharge near its confluence averages about 235 c.f.s., which is only about one-fifth of that of the Haw River.

While the dam site is on the Haw River, most of the area which would be directly affected by the project is in the New Hope River basin. Impoundment water would normally extend about 20 miles up the New Hope valley and about 5 miles up the Haw valley. Due to the difference in stream gradients and large flow of the Haw River, much of its waters would be backed up into the New Hope basin.

For the most part the impoundment site is forested with bottomland hardwoods and mixed stands of pines and hardwoods on higher elevations. Agricultural land constitutes only a minor portion of the site, being limited by frequent flooding and irregular topography. Adjacent lands support extensive forested areas (especially to the west) and many farmsteads.

The gradient of the proposed impoundment shoreline varies from fairly steep to gentle slopes, with the latter predominating. Hills to the west rise to heights of 200 to 500 feet above the streambed; to the east the elevations are somewhat lower.

Most of the forested areas in the vicinity, while attractive, show evidence of continuous lumbering operations.

A line of the Norfolk Southern Railroad follows the New Hope valley, traversing most of the length of the impoundment site. Considerable revision to highways and railroads would result from construction of the reservoir.

C. CLIMATE

The climate of the general area under study is moderate and conducive to long-season recreation use. Cooler temperatures of the mountain region to the west and refreshing breezes of the sea coast to the east are more attractive for summer vacation use.

In the vicinity of the New Hope Reservoir site the average annual temperature is about 60 degrees; average maximum 71 degrees, and average minimum 49 degrees. The average annual precipitation is about 45 inches, only a very small percentage being in the form of snow. The growing season averages about 200 days per year. Prevailing wind direction is from the southwest.

D. HIGHWAY ACCESS

The impoundment site is generally paralleled, a few miles to the west, by combined U. S. Highways number 15 and 501. U. S. Highway number 1 lies to the southeast and passes about 2 miles downstream from the dam site. More removed is U. S. Highway number 70 to the northeast. U. S. Highway number 64 cuts across the lower third of the impoundment area.

A network of connecting state and county roads covers the basin, connecting inhabited centers. In the immediate vicinity of the reservoir site some of the county roads are hard surfaced and others are of clay-gravel construction.

E. POPULATION

North Carolina has a larger population than any other southeastern state (1950 population 4,061,929); percentage population

increase during the period 1940-1950 was 13.7, being exceeded by only that of Florida and Virginia. Based on 1950 census figures, about 31 percent of the State's population or 1,245,000 people live within a 75-mile highway distance of the New Hope Reservoir site. Approximately one-half of these are urban residents. Three of the State's six standard metropolitan areas are in this zone.

Fort Bragg (estimated non-resident population 30,000), one of the largest military reservations in the United States, is located about 50 miles from the reservoir site. Numerous educational institutions within the 75-mile zone also contribute some non-resident population.

The following table shows approximate highway distances of major urban areas within the anticipated zone of reservoir influence.

	Distance from New Hope Site	Population 1940	Population 1950
Raleigh*	22 miles	109,544	136,450
Durham*	23 miles	80,244	101,639
Greensboro-High Point*	50 miles	153,916	191,057
Chapel Hill	10 miles	3,654	9,177
Sanford	25 miles	4,960	10,013
Burlington	38 miles	12,198	24,560
Fayetteville	60 miles	17,428	34,715
Reidsville	65 miles	10,387	11,708
Wilson	70 miles	19,234	23,010
Goldsboro	73 miles	17,274	21,454

F. ECONOMY

The economy of the locality adjacent to the reservoir site is based on farming, lumbering and textile industries. The principal farm crop is tobacco; other crops include corn, cotton, small grains, and hay. Several dairy farms and three lumber mills were observed in the vicinity. Textile factories located at Bynum and Pittsboro are located close to the site. Farms generally look prosperous. Some local mill workers supplement their income by living in the country and operating small farms.

Recently a tract of approximately 4,000 acres, located about six miles east of the impoundment area, was purchased by a non-profit corporation for the purpose of developing a science community and research center. The tract is located in the heart of a triangle formed by Duke University at Durham, the University of North Carolina at Chapel Hill, and North Carolina State College at Raleigh.

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* Designated as Standard Metropolitan Areas in the 1950 U. S. Census of Population.

Several of the State's leading trade and manufacturing centers are located within east driving distance of the reservoir site. The 1950 United States Census of population gives $1,864 as the median income for the State. Corresponding 1950 figures for counties from which most New Hope Reservoir visitation would be expected are:

County	Median Income	County	Median Income
Alamance	$2,667	Harnett	$1,755
Chatham	1,559	Lee	2,073
Cumberland	1,769	Orange	1,375
Durham	2,264	Randolph	2,151
Guilford	2,476	Wake	2,011

G. EXISTING AND PROPOSED RECREATION AREAS

There are no large lakes or reservoirs in the vicinity of the New Hope Reservoir site. The closest large body of water is John H. Kerr Reservoir (Buggs Island Lake), which lies about 75 highway miles to the northeast.

High Rock Lake, Badin Lake, Lake Tillery and Blewett Falls Lake, existing private power reservoirs in the Pee Dee River Basin, are about 75 to 90 highway miles to the southwest. No on-site study was made of these water resources. It is reported that High Rock, Badin, and Tillery receive considerable recreation use.

Smaller bodies of water within the zone of influence which receive recreation use include the following:

WATER AREA	APPROXIMATE SURFACE AREA	HIGHWAY DISTANCE FROM NEW HOPE SITE
University Lake	20 acres	12 miles
Crabtree Creek Lake		20 miles
Lake Michie		45 miles
Holts Lake		50 miles

Several small private farm ponds were noted in the vicinity of the reservoir site. These receive some fishing use. Towns, cities, and counties within the zone of influence now provide little in the way of opportunities for non-urban diversified recreation.

Lake Wheeler Reservoir (575 acres) located a few miles southwest of Raleigh has recently been completed. It is reported that this reservoir will soon be opened to the public for fishing, boating, and water sports, sponsored by the City of Raleigh.

Within the next two or three years the State plans to build a 50-acre lake in William B. Umstead State Park, for fishing and use of small boats (no motor boats).

NORTH CAROLINA STATE PARKS AND APPROXIMATE AIRLINE DISTANCES FROM THE NEW HOPE RESERVOIR SITE

NORTH CAROLINA STATE PARKS	DISTANCES FROM NEW HOPE SITE	ACRES IN PARK	VISITOR ATTENDANCE 1955	1956	1957
Wm. B. Umstead	15 miles	3,846	125,737	138,504	185,522
Reedy Creek	15 miles	1,234	24,031	17,459	21,221
Morrow Mountain	65 miles	4,135	224,356	228,731	230,255
Cliffs of Neuse	70 miles	355	128,643	143,258	149,522
Jones Lake	75 miles	2,000	34,147	56,290	51,224
Hanging Rock	80 miles	3,865	202,253	190,609	185,890
Singletary Lake	80 miles	1,287	8,788	7,540	10,674
Mount Jefferson	145 miles	474			1,097
Fort Macon	145 miles	390	420,308	367,065	321,121
Pettigrew	140 miles	16,828	10,089	16,771	15,572
Mount Mitchell	180 miles	1,224	346,770	383,475	292,017

Four other areas are currently under study for addition to the North Carolina State Parks System. All of these are more than forty miles from the New Hope Reservoir site.

V. ANALYSIS OF RECREATION VALUES

A. SCENIC AND RECREATION VALUES

1. Pre-Project Values:

The scenic qualities of the area to be inundated are not outstanding. The small reach of the Haw River affected generally possesses more natural charm than that of the New Hope River. Considerable quantities of domestic and industrial wastes are dumped into the proposed reservoir's watershed, principally in the Haw River valley.

It is reported that the reservoir site receives considerable use for hunting and limited fishing use. Only two bank fishermen were observed during the field study and no boats were noted. Except for hunting and fishing, extremely little recreation use is made of the site. No recreation facilities were seen within the proposed impoundment area. The New Hope River is not attractive for extensive recreation use and access to it by road is limited.

2. Post-Project Values:

The reservoir would create extensive new opportunities for boating. Dependent upon acquisition of sufficient land and adequate provision of facilities, new opportunities for picnicking, camping, hiking, and associated activities would be provided.

Present stream fishing values would be replaced by increased lake fishing values. Quality of fishing established would be directly related to water pollution conditions. Extensive areas of attractive, but cut-over woodlands, as well as valuable wildlife habitat would be inundated.

Preliminary studies by State health authorities indicate that the probable pollution factor within the foreseeable future, would render the reservoir unsuitable for swimming, with the possible exception of sheltered coves not receiving water from main stems.

During the recreation season of normal years the reservoir would have a stability favorable to recreation use. During extreme dry years drawdown could be as much as 11 feet below normal pool. Anticipated 5-year frequency would raise the impoundment to elevation 225, or 14 feet above normal pool. Hydrological data indicate that about once in 50 years the flood pool would reach an elevation of 240 feet.

An 800-acre wildlife plant nursery operated by the North Carolina Wildlife Resources Commission is located on Morgans Creek. At flood levels above elevation 230 this area would be directly affected.

The Hope Valley Experimental Forest of North Carolina State College (1,700 acres) is also partially within the proposed impoundment area.

B. HISTORICAL AND ARCHEOLOGICAL VALUES

No survey relating to the historical and archeological aspects of the New Hope Reservoir project has been made by this Service.

C. FISH AND WILDLIFE VALUES

Preliminary studies by the U. S. Fish and Wildlife Service indicate that substantial loss of wildlife resources would result from construction of New Hope Reservoir, while fishery resources would be greatly increased. Realization of the full enhancement of fishery values of the reservoir would be dependent upon (1) modification of project facilities, (2) adequate public access, and (3) development of a water management plan for fisheries of the reservoir.

Dependent upon necessary land acquisition and suitable development of subimpoundments, certain sites would be desirable as public wildlife management areas.

VI. RECREATION NEED AND USE

The proposed reservoir's anticipated contributing area includes a large and growing urbanized population as well as many small towns. Existing, close at hand, water recreation resources are extremely limited. There is a particular local need of opportunities for boating, water sports and fishing. Studies indicated this need will be intensified in the lapse of years before the reservoir would be constructed.

The proposed impoundment, with suitable provision of facilities, would help fill warranted recreation needs. If good fishing is established and maintained the impoundment would attract many local anglers who now travel long distances. Competition of John H. Kerr Reservoir would depend a lot on the quality of fishing offered at New Hope.

The only major non-urban park developments near the site are William B. Umstead and Reedy Creek State Parks (formerly Crabtree Creek State Park). It is believed that the proposed impoundment would not compete with these areas, but would rather serve to supplement them in offering a wider range of water associated activity.

VII. RECOMMENDED RECREATION DEVELOPMENT

During the joint field study several tentative sites were selected for consideration of the Corps of Engineers in the development of public access areas and provision of essential basic facilities. Some of these sites represent potential nuclei where further expansion and recreation development beyond the province of the Corps could be accomplished. Some would be suitable for concessioner establishments. (Report size reservoir maps, suitable for delineation of these sites, are not available at the time of this publication.)

On the basis of preliminary investigation, three sites were selected because of their adaptability for diversified park and recreation development. They are as follows:

Site Number 1 - located on the western side between the valleys of Bush Creek and Parkers Creek. The landscape is formed by wooded, rolling hills. Cursory examination indicates that this area, in conjunction with a favorable water resource, may have possibilities which would justify the State in carefully studying its suitability for recreation development.

Site Number 2 - located on the eastern side about 2 miles upstream from the dam site and about four miles northwest of U. S. Highway Number 1. This site, while limited in size, has desirable park characteristics. It is possible that the City of Raleigh or Wake County may become interested in developing the area.

Site Number 3 - located on the eastern side just to the south of U. S. Highway 64. Unless a similar adaptable area is found farther upstream this could well serve as a development center by the City of Durham or Durham County.

Further field study will possibly reveal other suitable development sites adaptable for development by educational institutions in the vicinity in event such a demand arises. However, ideal sites on the impoundment would be limited by gentle shoreland where exaggerated horizontal fluctuation would occur, and by restricted wooded highlands and adjacent expensive agricultural land, particularly along the eastern shore.

The North Carolina Wildlife Resources Commission now administers 40 public fishing access areas throughout the State. It appears logical to assume that the Commission will be interested in the operation of several similar developments at New Hope Reservoir.

VIII. LAND ACQUISITION

No land for the project has been acquired and no drawing of the proposed take-line, at this writing, is available. The land acquisition program will be based on the Joint Policy, Department of the Interior--Department of the Army (January 13, 1954). Fee taking line will generally coincide with top of 5-year flood level (elevation 225) and include approxiamtely 22,000 acres. A similar amount of land above elevation 225 will be taken under flood easement.

In order to provide for limited public use and reasonable access at essential sites it is planned to buy in fee simple selected areas outside of the 5-year flood level. The size of these areas would range from 5 acres up to perhaps as much as 200 acres, dependent upon needs and conditions. To be eligible for inclusion in the North Carolina State Park System, areas must have a minimum area of 400 acres. Additional lands that are needed beyond the Corps of Engineers acquisition authority, would necessarily have to be obtained by interested agencies.

Predicated upon sufficient interest and desire by the State or local governmental units, it is deemed desirable by this Service that the Corps cooperate with such agencies in acquiring warranted additional lands for public park and recreation purposes, and where possible to assist to the extent of acquiring such lands simultaneously with basic project acquisition upon agreement that the Corps be reimbursed for additional costs incurred within a reasonable period, by the respective agencies.

IX. MONETARY EVALUATION OF RECREATION BENEFITS

A. INTRODUCTION

Primary benefits resulting from provision of recreation facilities are intangible and are not subject to usual methods of measurement. However, the need for comparison of recreational values with other values for use in water-control project planning makes it necessary to translate the beneficial and adverse effects of such projects on recreation into monetary terms, insofar as possible.

Primary benefits from recreation consist of the personal welfare gains accruing to the consumers of recreation services. To the extent that these primary benefits of water-control projects can be measured, they consist of the value of any increase in the amount of recreational use expected as a result of the construction of water-control projects. To provide a monetary measurement of these benefits, the values are expressed in terms of estimated or derived values comparable to market values, since market prices are not available for a monetary evaluation of increases or decreases in recreational use.

In addition to the primary benefits, other benefits may arise from such supporting activities as hotels, camps and restaurants, which provide goods or services to recreationists. There is some question, however, of the validity and usefulness of figures derived to estimate secondary benefits. The calculations in this report, therefore, are limited to a determination of the monetary equivalent of the primary benefits attributable to the project.

No outstanding or unique recreation values would be destroyed by construction of the reservoir. Scenic values lost would be more than compensated for by similar new values created by the impoundment.

Since the U. S. Fish and Wildlife Service is currently making studies of the New Hope Reservoir, this report by the National Park Service does not include evaluation of fishing and hunting resources related to the project.

B. ANTICIPATED ANNUAL ATTENDANCE

Studies of New Hope Reservoir indicated that the "design-load" or number of persons who may be expected to utilize the reservoir area at one time for non-fishing, non-hunting recreation pursuits on the average summer Sunday afternoon would be about 5,000. It is further estimated that the total average attendance for such use would be about 235,000 visitors annually (based on 1950 population).

Present visitation at the impoundment site for non-fishing, non-hunting recreation pursuits is so limited that no deduction for

it has been made. The above figures are therefore considered as net visitation.

The above attendances are estimated in terms of total non-fishing, non-hunting active recreation use at the entire reservoir area with the project in full operation and are predicated on the assumption that adequate basic recreation facilities will be provided and attractively maintained. The estimated attendance does not include persons who will visit the area only because of the attraction elements of the dam during or immediately after the construction of the project, since the measurement of benefits is intended to apply to the average annual recreation use on a long-range basis. Visits attributable to the attraction elements of the dam and sight-seeing made possible because of the building of scenic drives or access roads contribute significant recreation uses, but there are no standards for measurement of such benefits.

C. RECREATION BENEFITS

In order to arrive at a monetary figure which may serve to indicate possible annual recreation benefits, the estimated net average annual attendance is multiplied by $1.60, a derived market value for a day of reservoir recreation. The resultant figure of $376,000 represents our judgement of the annual non-fishing, non-hunting recreation benefits which may result from the project (235,000 x $1.60 = $376,000).

If more comprehensive recreation development materializes at the reservoir than is visualized at present, in response to well-demonstrated need, additional benefits may arise.

X. FURTHER STUDY AND PLANNING

The field investigation in connection with this report was not of sufficient duration to permit detailed study. Additional and more comprehensive field work should be accomplished with particular thought being given to specific locations of potential development sites.

When further project data, including that of highway relocations, are known, site planning and process of adjustment can proceed on a firmer basis. The benefit of various related studies by the State and the U. S. Fish and Wildlife Service report, when completed, will also facilitate future analysis and determinations of recreation aspects.

It is suggested that the Corps' recreation master plan be a balanced comprehensive, flexible instrument consistent with other beneficial uses of the region's land and water resources and serving to guide the course of development and control within the take-line, and at the same time recognizing complementary development which may be affected by other agencies or individuals on adjacent land.

In connection with master plan preparation, it is suggested that research and study be made as to the possibilities of State or local zoning and control which could be accomplished regarding the appropriate recreational development and use of the project.

APPENDIX VIII

REPORT FROM U. S. FISH AND WILDLIFE SERVICE

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
CLARENCE F. PAUTZKE, COMMISSIONER

A REPORT ON THE FISH AND WILDLIFE ASPECTS OF THE NEW HOPE RESERVOIR PROJECT CAPE FEAR RIVER BASIN NORTH CAROLINA

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA 23, GEORGIA

SOUTHEAST REGION
(REGION 4)
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
KENTUCKY
TENNESSEE
ALABAMA
MISSISSIPPI
ARKANSAS
LOUISIANA
VIRGINIA
MARYLAND
PUERTO RICO
VIRGIN ISLANDS

ADDRESS ONLY THE
REGIONAL DIRECTOR

March 12, 1962

CE-MA-cf (New Hope Reservoir, N. C.)

District Engineer
U. S. Army, Corps of Engineers
Wilmington, North Carolina

Dear Sir:

Pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Bureau of Sport Fisheries and Wildlife, in cooperation with the North Carolina Wildlife Resources Commission, has studied the fish and wildlife resources in the area that would be influenced by the proposed plan for development of the New Hope Reservoir, Haw River, Cape Fear River Basin, North Carolina.

The attached evaluation report presents the findings of our study. Determination of the effects of the proposed project was based on engineering data furnished by your office in November 1961.

Three basic assumptions were made by the Bureau in appraising the project effects. These were: (1) that the project would be designed or modified so as to discharge waters meeting the water quality standards for a class "C" stream as defined by North Carolina codes, (2) that vegetation retained in the reservoir under the timber-clearing plan finally adopted would not adversely affect water quality and would permit full use of reservoir waters, and (3) that adequate access would be provided and project lands and waters would be appropriately zoned to provide for the recreational use of fish and wildlife resources.

The Bureau recognizes that some changes in the present project plans would be needed. Specifically, the Bureau believes that modification of project design to include multiple-level discharge features would be necessary to provide for water quality control in keeping with one of the purposes for project construction. Further, the plan for reservoir clearing may require revision in the interests of public safety and reservoir water quality.

The Bureau finds that the proposed project would provide fishing opportunity of more than local significance. The average annual recreational value of the fishery, created incidental to project construction and operation, is estimated to be $133,500. In addition, the project would

redistribute fishing pressure in the downstream area as seasonal fish concentrations occurred in the tailrace. Construction and operation of the project would adversely affect wildlife habitat and result in an average annual loss of hunting opportunity--estimated to be 27,300 man-days.

While the wildlife habitat lost could not be replaced in kind, the loss of recreational use of wildlife resources could be partially compensated by specific development and management of portions of the project lands and waters. About 10,000 acres of land would be required for wildlife management. With the exception of the areas proposed for subimpoundment development for waterfowl, shown on plate 2, management would be directed toward increasing the productivity of forest and farm game animals. Detailed studies to determine the specific location of lands and the measures for wildlife management would be undertaken concurrently with studies by the Corps of Engineers following project authorization. The Bureau believes that the cost of specific development to partially replace wildlife losses should be funded as a project cost.

Licensing of project lands and developments to the North Carolina Wildlife Resources Commission should give that agency the right to manage all associated resources, reserving to the Corps the right to use those lands as may be necessary to fulfill the authorized project purposes.

The Bureau of Sport Fisheries and Wildlife, therefore, recommends:

1. That public access facilities, as provided for by the Flood Control Act of 1944 (P. L. 534-78th Congress), as amended, include an access site, with appurtenances, to the tailwater.

2. That appropriate consideration be given to the development of a reservoir zoning plan in connection with overall planning for the reservoir to insure that certain areas (or certain periods) will be available for fishing, hunting, and other wildlife purposes without conflicting use for general recreation; such reservoir zoning plan to be developed cooperatively by the Corps of Engineers, the Bureau of Sport Fisheries and Wildlife, and the North Carolina Wildlife Resources Commission.

3. That project plans be modified to provide multiple level discharge facilities through which reservoir water of the quality required to maintain the streams water quality standards at class "C" could be released at all times.

4. That project-occasioned loss of wildlife resources be mitigated by the development and management of about 10,000 acres, essentially

as shown on plate 2 of the attached report; such lands to be initially developed at project cost and licensed to the North Carolina Wildlife Resources Commission in accordance with a General Plan for wildlife management as provided in section 3 of the Fish and Wildlife Coordination Act.

5. That the report of the District Engineer recognize the need for additional studies of the fish and wildlife resources and that such reasonable modification may be made in project construction and operation as may be agreed upon by the Corps of Engineers for the conservation and development of fish and wildlife resources.

This report has been reviewed by the North Carolina Wildlife Resources Commission and a copy of their letter of comment with a copy of the resolution adopted by that Commission is attached. The Commission endorses the recommendations presented in the report should New Hope reservoir construction be approved by the Congress. Their letter further emphasizes certain items in the Bureau's report and sets forth conditions under which the Commission will undertake management of project lands as a measure to mitigate losses in hunting opportunities.

Sincerely yours,

Walter A. Gresh
Regional Director

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
REGION 4
ATLANTA, GEORGIA

AN EVALUATION REPORT OF FISH AND WILDLIFE RESOURCES IN RELATION TO PROPOSED DEVELOPMENT OF NEW HOPE RESERVOIR, HAW RIVER NORTH CAROLINA

Planning Agency	:	Corps of Engineers, United States Army
Source of Engineering Data	:	District Engineer, Wilmington, N. C.
Report Prepared	:	December 1961

Branch of River Basin Studies
Raleigh, North Carolina

INTRODUCTION

1. This report describes the effects which the proposed New Hope Reservoir, Cape Fear River Basin, North Carolina, would have upon fish and wildlife resources. It has been prepared by the Bureau of Sport Fisheries and Wildlife in cooperation with the North Carolina Wildlife Resources Commission and the United States Army Corps of Engineers, Wilmington District, pursuant to the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

2. The District Engineer was directed to review the reports on Cape Fear River Basin, North Carolina, pursuant to a resolution by the House of Representatives, Committee on Flood Control, adopted May 2, 1946, and prepare a survey report. The scope of the Corps' report considers basin-wide needs for flood protection, municipal and industrial water supply, pollution abatement, irrigation and recreation. Development of the New Hope project is given primary consideration.

DESCRIPTION OF THE AREA

3. The Cape Fear River Basin has a drainage area of about 8,570 square miles and lies entirely in North Carolina. About one-third of the basin lies in the Piedmont Plateau, a region of rolling hills and deeply eroded valleys ranging in elevation from 300 feet to 1,000 feet[1/], and extends

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1/ All elevations in this report are in feet and refer to mean sea level datum.

from the Appalachian Mountains eastward to the fall line. The remainder of the basin is in the Coastal Plain, a relatively flat and featureless area rising in a series of terraces from sea level to an elevation of 300 feet at the fall line.

4. The Cape Fear River is formed by the confluence of the Deep and Haw Rivers in Chatham County, North Carolina. It flows southeastward 198 miles and empties into the Atlantic Ocean 28 miles downstream from Wilmington. In the Piedmont, the river consists of falls, rapids, and pools. Channel capacities are relatively greater than they are downstream and flood plains are narrower. Downstream from the fall line, the slope of the river flattens. Channel capacities are sufficient to carry only small freshets and as a result the relatively wide flood plains are frequently inundated. An existing federal project provides for navigation to Fayetteville, North Carolina, by means of three locks and dams. Tidal range of the river extends to Lock #1 Dam, at river mile 67, a distance of 39 miles upstream from Wilmington.

5. Haw River, a headwater tributary, which drains about 1,670 square miles, rises in Forsyth County and flows northeastward for a short distance, then southeastward for the remainder of its 90 mile length. It rises at an elevation of about 1,000 feet and joins Deep River to form Cape Fear River. The stream gradient is very steep near its mouth.

6. New Hope River is the largest of a number of tributaries to Haw River. It rises at an elevation of about 500 feet in central Orange County and flows eastward and then southward to the Haw River at Mile 3.3. New Hope River, in Orange County, is typical of Piedmont streams having a relatively steep gradient and narrow valley. The stream and its main tributaries in Durham County are somewhat unique in the Piedmont by virtue of the broad, flat flood plains. Above the first and second bottoms of the valleys, however, elevations rise rather abruptly. From its entrance into this county, the river flows 47 miles to its mouth and has a fall of only 100 feet.

7. The Cape Fear River Basin, the location of New Hope damsite and the flood plain areas are shown in plate 1.

DESCRIPTION OF THE PROJECT

8. The New Hope damsite is located on Haw River at mile 3, near Moncure, North Carolina, and immediately below the mouth of New Hope River. The damsite is in Chatham County, but the proposed reservoir would extend into Wake, Durham, and Orange counties inundating 6 miles of Haw River and 28 miles of New Hope River. The New Hope Reservoir would be a multiple-purpose project providing storage for flood control, water-quality control by low-flow regulation, recreation, and other purposes.

9. The reservoir waters would be impounded by a concrete and earth dam with an overall length of 1,220 feet and maximum height of 101 feet above streambed elevation. The spillway, with a crest elevation of 205 feet, would be controlled by tainter gates. A conduit 6 feet in diameter would be constructed through the spillway section to discharge normal stream flows. Consideration is being given to future installation of a hydroelectric power unit in the event that it becomes economically feasible to generate power with the waters released to supplement low flows downstream. Pertinent engineering data are shown in table 1.

10. The reservoir would inundate about 30,000 acres of land at elevation 240 feet, and would have a storage capacity of 660,000 acre-feet. Waters stored in the flood pool would be released as rapidly as downstream conditions permit. The low-flow augmentation pool would have a surface area of 9,400 acres at elevation 212 feet. Water would be released from this pool to maintain a minimum downstream flow of 600 cubic feet per second measured at the Lillington, North Carolina, gage. The sediment pool would have a surface area of 4,300 acres at elevation 200 feet. This permanent pool would have an initial maximum depth of about 45 feet.

11. The 30,000 acres of land inundated at maximum flood control pool elevation plus an allowance for "blocking out" would be purchased in fee title. It is planned to clear only those reservoir lands lying between elevations 198 and 213 feet.

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12. Most of the affected lands and waters upstream from the damsite are in the New Hope River drainage. Only a small portion of the area lies along the Haw River proper. About 87 percent of the reservoir site at elevation 240 feet is in woodlands, with mixed hardwoods in the first and second stream bottoms. Hardwoods mixed with cedar, loblolly pine, and shortleaf pines occur on the higher elevations. Agriculture within the area is predominantly general farming with small grains, corn, cotton, tobbaco, and pasture grasses being the main crops.

13. The downstream area which would be affected by the proposed project is considered to be the area inundated by the 1945 flood, a total of 219,100 acres. For purposes of evaluating project effects the downstream area has been divided into three reaches (plate 1).

14. Reach #1 extends from the lower Pender County line upstream to the lower boundary of Cumberland County and contains 123,500 acres of which 77,710 acres are wooded. The river attains flood stage at an average interval of 0.17 year (6 times per year). Within this reach of the Cape Fear River there are three dams with navigation locks, operated by the Corps of Engineers, which provide an 8-foot navigable channel upstream to Fayetteville. The dams are equipped with fish ladders, which are believed to be inoperable.

15. Reach #2 lies entirely within Cumberland County and contains 56,500 acres of which 30,500 acres are wooded. The river attains flood stage at an average interval of 0.26 year (3.8 times per year).

16. Reach #3 extends from the upper boundary of Cumberland County to the proposed damsite, and contains 39,100 acres of which 23,380 are wooded. The river attains flood stage at an average interval of 0.40 year (2.5 times per year). Buckhorn Dam and Reservoir, a Carolina Power and Light Company run-of-the-river development providing water for both hydro and steam power generation, is located at river mile 163. The 20-foot-high dam impounds within stream banks, Deep and Haw Rivers. The reservoir backwater extends up Haw River almost to the New Hope damsite.

EFFECTS OF THE PROJECT

17. The probable effects of the proposed New Hope Reservoir on fish and wildlife resources have been determined by comparing the human utilization of these resources expected to occur without the project and that expected to occur with the project in operation. Human utilization based on the productive capability of the site and expressed as fisherman-days and hunter-days, is estimated under both conditions as an average annual amount expected to occur over a 50-year period of analysis.

18. Monetary evaluations of fish and wildlife resources are based on the "Report of the Panel on Recreational Values on A Proposed Interim Schedule of Values for Recreational Aspects of Fish and Wildlife," approved by the Subcommittee on Evaluation Standards and the Inter-Agency Committee on Water Resources in October, 1960. The monetary values derived do not encompass all recreational values of fish and wildlife but represent a

judgment estimate of net values of the recreational aspects of fishing and hunting. This procedure is used to evaluate benefits which accrue to fish and wildlife as a result of construction of the proposed project. If the proposed project results in losses to fish and wildlife, measures for preventing or mitigating such losses are determined and recommended for inclusion in project plans.

19. Waters considered in the analyses of fishery resources are the segments of the Haw and New Hope Rivers and their major tributaries within the maximum flood control pool. In addition, the possible effects of the proposed project on the fishery resources downstream from the damsite as far as Fayetteville, about 58 stream miles, are discussed.

20. The segments of Haw and New Hope Rivers within the proposed reservoir have been classified as Class C by the State of North Carolina. Class C water may be defined as being suitable for fish and wildlife propagation and for other uses requiring waters of lower quality. Quality standards that apply to Class C streams within the reservoir area specify that the pH shall generally range between 6.0 and 8.5; that there shall be not less than 4.0 parts per million of dissolved oxygen; and that solids, sludge deposits, toxic and other wastes, and heated liquids, alone or in combination, shall not be introduced in quantities sufficient to render the receiving waters unsafe or unsuitable for fish and wildlife or adversely affect their palatability.

21. The segment of Cape Fear River as far downstream as Fayetteville has been classified as Class A-II. Waters so classified may be defined as being suitable, subject to complete approved treatment, for drinking water supply and culinary or food-processing purposes, and any other best usage requiring waters of lower quality. The quality standards for Class A-II waters specify pH and minimum quantities of dissolved oxygen identical to that required in Class C water. Additionally, only those quantities of solids, odor-producing substances, toxic or other wastes, or heated liquids, may be introduced into receiving waters which will, with approved treatment, render the waters not unsuitable for any best usage established for this class.

22. The evaluation of fishery resources presented in this report assumes that under the final plan of construction and operation the above described water quality would be maintained or improved for the reproduction and growth of aquatic organisms during the period of analysis. It is further assumed that under the final clearing plan, vegetation retained in the reservoir below the clearing line would not adversely affect water quality and recreational use in the reservoir.

23. In evaluating wildlife resources the land area that would be affected by construction of the proposed reservoir has been considered. The area comprises 30,000 acres within the maximum flood control pool and 219,100 acres in the downstream flood plain. The extent of the downstream area

is shown in plate 1. The average annual land use pattern within the reservoir site without and with the project is shown in table 2.

Fishery Resources Without the Project

24. Current utilization of the fishery resources of the Haw and New Hope Rivers and their tributaries within the proposed reservoir area is generally low. Angling is restricted by a lack of access points, particularly to New Hope River. Most angling is done from stream banks near highway crossings.

25. Upstream from New Hope damsite fish taken by anglers include largemouth bass, crappie, bluegills and other sunfishes, carp, bowfin, suckers, and pickerels, with catfish predominating the catch. Probably the most successful fishery for individual fishermen is the gigging of suckers during the spring spawning runs in tributary streams. During the period of analysis, the average annual fisherman utilization of the stream segments within the reservoir site is estimated to be 8,800 man-days.

26. Downstream from New Hope damsite to the vicinity of Fayetteville, current utilization of the fishery resource in Cape Fear River varies from low to high; the high utilization taking place in the vicinity of dams and better access points. Anglers take catfishes, largemouth bass, bluegills and other sunfishes, crappie, yellow perch, and carp. Historically,

striped bass and American shad were taken in this reach of the Cape Fear River. If efforts to improve fish passage facilities at the dams downstream from Fayetteville materialize, striped bass and American shad may once again be taken in this reach of the river. In addition to angling, bow nets are used from bank platforms to take suckers during the spring spawning run. Suckers also are taken by use of gill nets during the spring in a short segment of the river immediately downstream from Buckhorn Dam. Here, suckers concentrate during high flows and become trapped in numerous pools when flows are totally diverted around this segment of stream through the power plant. Buckhorn Lake and the reach of Haw River downstream from the New Hope damsite are highly utilized by anglers from the larger surrounding cities.

Fishery Resources With the Project

27. Construction of the proposed project would replace the existing stream fishery above the damsite with a reservoir fishery. The reservoir fishery would be composed of species of warm-water game and rough fish now present in the streams and would exhibit a pattern of development similar to that found in other warm-water reservoirs in the region. With initial impoundment, the fish population would expand more rapidly than fisherman utilization and angler success would be excellent. As fisherman utilization increased in later years, average angler success would be moderated.

28. The low-flow augmentation pool, at elevation 212 feet, would have a surface area of 9,400 acres. About 48 percent of the reservoir would be in the "productive zone", having a depth of 10 feet or less. During the period of analysis, it is estimated that average annual fisherman utilization

of the reservoir would be 142,300 man-days, having a recreational value of $142,300.

29. Construction of the project would not appreciably change total fishing pressure downstream, but it would redistribute part of the fishermen use. Large numbers of fish would congregate seasonally in the tailrace and attendant utilization would be high. Because of the altered pattern of stream flows, suitable conditions for the specialized spring sucker fishery below Buckhorn Dam would be reduced or eliminated. The normal alternating pattern of short duration high flows which attract the suckers to the dam, followed by periods during which the normal flows are diverted through the power plant and suckers are trapped in pools, would be changed. It is expected that operation of the project for the control and subsequent release of flood waters would result in prolonged periods of near bank-full flows downstream from Buckhorn Dam during the sucker spawning period. However, there would not be a reduction of the sucker population; and it is assumed the ingenuity of fishermen would be equal to the task of finding other means to harvest these fish. Some benefit would result from the regulated increase of low flows. The stream habitat, though not measurably increased in size, would be stabilized during the critical low-flow period.

30. In summary, project development would result in an estimated average annual loss in stream fishing of 8,800 man-days and an average annual gain in reservoir fishing of 142,300 man-days having a recreational value of $142,300. Estimated annual utilization without the project and estimated annual utilization and recreational value of the fishery with the project are shown in table 2.

Wildlife Resources Without the Project

31. Whitetail deer (in flood zone Reaches 1 and 2), turkey, cottontail and swamp rabbits, gray squirrel, foxes, racoon, opposum and bobwhite quail are the most common resident game animals. Within the period of analysis, it is expected that deer will become established in Reach 3 of the flood zone and in the reservoir area and contribute significantly to the wildlife harvest. Black bear are present in Reach 1 of the flood zone. Fur animals include mink, muskrat, weasel, and otter. Woodcock, mourning dove, and woodduck commonly nest and winter in the area. Several species of waterfowl utilize the project area in considerable numbers during the migration and winter seasons.

32. Wildlife resources of the 30,000 acres of land considered in the reservoir area would support an estimated average annual use of 27,800 man-days of hunting during the period of analysis. In the three downstream reaches, the average annual use is estimated to be 217,500 man-days.

Wildlife Resources With the Project

33. Construction and operation of the project would affect wildlife resources on 30,000 acres of land in the reservoir area. About 9,400 acres of habitat would be destroyed by permanent flooding and wildlife productivity on the remaining area would be reduced by periodic inundation. Of the 20,600 acres of intermittently flooded lands, about one-half would

be adjacent to the main body of permanent water and would have potential for development for recreational uses other than hunting. Wildlife productivity and utilization would be greatly reduced on these areas. About one-half of the intermittently flooded lands would be located in the tributary stream valleys and have potential for development as wildlife management areas. Without specific management for wildlife and considering the plan of the Corps of Engineers not to clear lands above elevation 213 feet, wildlife productivity for most species in these areas would continue at about the same level as would occur without the project. Loss of the protective cover afforded by the large central block of woodland coupled with the project-occasioned increase in human activity would reduce the carrying capacity of the remaining lands for deer and turkey.

34. With the project in operation, the frequency and extent of flooding would be reduced in the downstream flood plain and make possible the conversion of about 19,000 acres of woodland to agricultural uses. This would reduce waterfowl habitat. More intensive use of remaining woodlands, both for grazing and forest management, would adversely affect productivity of forest game species, however, the area would be more suitable for certain species of farm game. The overall effect of the project would be a reduction in total wildlife populations with a corresponding reduction in hunting opportunity.

35. The project area supports fur animal populations of moderate value. Habitat conditions would be altered by project construction and operation and corresponding changes would occur in the populations of the several species of fur animals. This would result in a species composition differing from that expected without the project. The over-all value of this resource is expected to remain the same.

36. With the project in operation, the 20,600 acres of reservoir land between elevations 212 and 240 would support an estimated average annual hunter use of 12,000 man-days. The three reaches of the downstream flood zone would support an estimated average annual use of 206,000 man-days. The average annual loss of hunting opportunity attributable to the project is 27,300 man-days. Annual utilization without the project and with the project is shown in Tables 4 and 5.

DISCUSSION AND CONCLUSIONS

37. The proposed New Hope Reservoir with management and adequate public access would in great measure satisfy the need for more fishing opportunity for this section of North Carolina. Project development would stabilize downstream flows over a distance of about 58 miles and provide minor benefits to the fishery resources of the Cape Fear River to the head of the pool maintained by Lock 3 Dam in the vicinity of Fayetteville.

38. Realization of the recreational potential of fish and wildlife resources of the project area would require adequate public access for hunting and fishing. This condition was assumed in estimating the impact of project development on fish and wildlife resources and in evaluating changes in hunting and fishing opportunities.

39. Although the completed project would be expected to benefit the total downstream fishery in only a minor way there would be seasons when fish would concentrate in the tailwater area. So that this resource could be adequately utilized, a public access facility, including parking space and boat launching ramp, should be provided to the tailwater downstream from New Hope Dam.

40. The analysis and evaluation of the probable effects of the proposed project on fish and wildlife resources has been based on engineering data supplied by your office. It has been assumed that project downstream flows would be of quality sufficient to fulfill stream classification requirements designated by the State Stream Sanitation Commission; namely Class C for that portion of Haw River downstream from the proposed dam and Class A-II for the Cape Fear River from the junction of Haw and Deep Rivers downstream to Fayetteville.

41. One of the purposes of the project would be low-flow augmentation during periods of low natural runoff. In essence, the aim of low-flow

augmentation would be to better water quality by means of increased flow. We have doubts that water of a quality sufficient to fulfill downstream classification requirements could be discharged at all times through a single level sluice with top of intake at elevation 172 feet. In this regard, it is noted that the report prepared by the Public Health Service in May 1959 and revised in March 1961, attributes benefits to increased low flows on the assumption that the discharges would emanate from elevation 190 feet.

42. It is assumed that there were valid reasons, other than cost, for locating the sluice relatively deep in the reservoir. Such reasons could include the removal of silt and the release of low quality water during times high natural flows are being released over the spillway. A greater degree of reservoir fishery management, especially rough fish control, could be achieved if during infrequent years the reservoir could be drawn to a low level. Therefore, it is suggested that project plans be modified to include multi-level discharge features.

43. The evaluation of the reservoir fishery assumed that under the final reservoir clearing plan, vegetation retained in the reservoir would not adversely affect water quality or recreational use of the reservoir. However, we have doubts that water quality and recreational use would be unaffected if vegetation were retained to elevation 198 feet, as presently planned. During infrequent years, maximum draw-off of the low flow regulation pool would reduce the reservoir level

to elevation 200 feet, only two feet above the clearing line elevation. The combination of low inflow to the reservoir, high water temperature, increased rate of decomposition of the shallowly inundated vegetation, and crowding of fish could create an oxygen deficient condition possibly resulting in fish kills. Also, shallow water depth over brush and tree tops could create nuisance conditions for fishermen and those pursuing other water associated recreation, particularly in the vicinity of public access sites and recreational developments.

44. The maintenance of high utilization of the reservoir fishery would be contingent on the establishment of a zoning plan for reservoir use. The placing of speed limits or the exclusion of speed boats and water skiers from shallow coves and relatively narrow tributary embayments would help realize maximum utilization of the fishery and provide safer recreation for both fishermen and those pursuing other forms of recreation.

45. Construction of the project would directly eliminate 9,400 acres of excellent quality wildlife habitat. In addition, the project would lower the carrying capacity of the remainder of the reservoir lands for some species, notably deer and turkey. In the downstream flood zone, the project would encourage intensified use of agricultural and forest lands and other development. These shifts in land use would be detrimental to

forest game and there is no indication that the increase in agricultural lands would result in an increase in utilization of farm game.

46. It is concluded that the magnitude of project-occasioned losses in wildlife resources and hunting opportunities would be sufficiently important that they should be mitigated. The 20,600 acres of land in the flood storage pool which would be acquired in fee offer opportunities for mitigation of wildlife losses.

47. The several large finger-like segments of the flood storage pool lands lying in the tributary stream valleys could be developed and managed for forest game and waterfowl. In general, these lands are shown in plate 2, and would have a combined area of about 10,000 acres. That portion of the flood storage pool lands adjacent to the main body of the reservoir would have potential for recreational development that would be incompatible with wildlife management.

48. The major portion of the lands proposed for wildlife management comprise forest game habitat. Emphasis would be placed on management techniques designed to improve the productive capability of the woodland to support increased numbers of turkey, deer, and squirrel. All forest game species, however, would be expected to respond favorably. Agricultural lands would be managed primarily for farm game animals, particularly quail and doves.

49. Within the areas suggested as desirable for mitigation of wildlife losses there are a few sites topographically suitable for the development of "green-tree" subimpoundments for waterfowl management. The subimpoundments would pond water shallowly over extensive wooded bottomlands during the period November to February. The shallow flooding of grain crops planted each summer in small openings and mast would attract and supply food for a substantial number of waterfowl. In general, the proposed subimpoundments would be located between elevations 225 and 240; thus they would be at or above the five-year flood frequency level. Loss of flood storage could be remedied by temporarily lowering the level of the reservoir by less than one foot. It seems probable that the utilization of raised, relocated, or possibly abandoned roads as dikes would make possible the development of subimpoundments at much less cost than that of constructing separate structures. The general locations of suitable sites for subimpoundments are shown in plate 2.

50. In order to determine the actual areas suitable for wildlife management to mitigate wildlife resource losses, it would be necessary to conduct additional detailed studies. These studies would be made by the Bureau of Sport Fisheries and Wildlife and the North Carolina Wildlife Resources Commission in conjunction with detailed design studies after the project is authorized for construction.

51. Ideally, to develop and manage an area to achieve the highest carrying capacity for wildlife the lands should be held in ownership by the managing agency. Management to achieve a high carrying capacity involves more than the enforcement of game protection laws and the planting of game foods. It must also include management and utilization of all associated resources. Therefore, on all lands licensed to the North Carolina Wildlife Resources Commission that agency should have complete control of all resources on and utilization of those lands except for those rights retained by the construction agency necessary to fulfill the authorized purposes of the project.

52. In summary, it is concluded that construction and operation of the proposed New Hope Reservoir project would substantially increase sport fishing opportunity. It is also concluded that project-occasioned losses of wildlife resources and hunting opportunity within the reservoir area and the downstream flood zone would be significant. Means by which fishery benefits could be maintained or increased and wildlife losses mitigated have been determined and discussed.

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TABLE 1

NEW HOPE RESERVOIR

PERTINENT ENGINEERING DATA

Damsite	
Stream Miles above Wilmington	173
Drainage Area (square miles)	1,690
Stream Flows (cubic feet per second)	
Maximum of record (estimated)	99,000
Average annual (estimated)	1,580
Minimum monthly (estimated)	17
Average minimum (estimated)	400
Proposed regulated minimum at Lillington	600
Elevations (feet above mean sea level)	
Top of dam	255
Maximum pool (spillway design flood)	250
Standard project flood pool (surcharge)	245
Maximum flood-storage pool	240
Fee-taking line	240
Clearing plan - upper line	213
Low-flow augmentation pool	212
Spillway crest	205
Sediment pool	200
Clearing plan - lower line	198
Top of intake (6' diameter)	172
Stream bed	154
Areas (acres)	
Maximum pool (spillway design flood)	39,200
Maximum flood-storage pool	30,000
Areas to be acquired in:	
fee (includes 3,000 for "blocking out")	33,000
easement	2,000
Low-flow augmentation pool	9,400
Sediment pool	4,300
Storage (acre-feet)	
Maximum flood storage pool	541,000
Low-flow augmentation pool	72,100
Sediment pool	47,000

TABLE 2

AVERAGE ANNUAL FISHERY UTILIZATION AND VALUES

NEW HOPE RESERVOIR

Item	Without the Project		With the Project		
	Stream Area (Acres)	Average Annual Use (Man-Days)	Reservoir (Acres)	Average Annual Use (Man-Days)	Recreational Value ($)
Haw River	172	4,800			
New Hope River	128	3,400			
Tributaries	29	600			
Reservoir			9,400	142,300	142,300
TOTAL		8,800		142,300	142,300

TABLE 3

AVERAGE ANNUAL LAND USE OF MAXIMUM FLOOD STORAGE POOL

NEW HOPE RESERVOIR

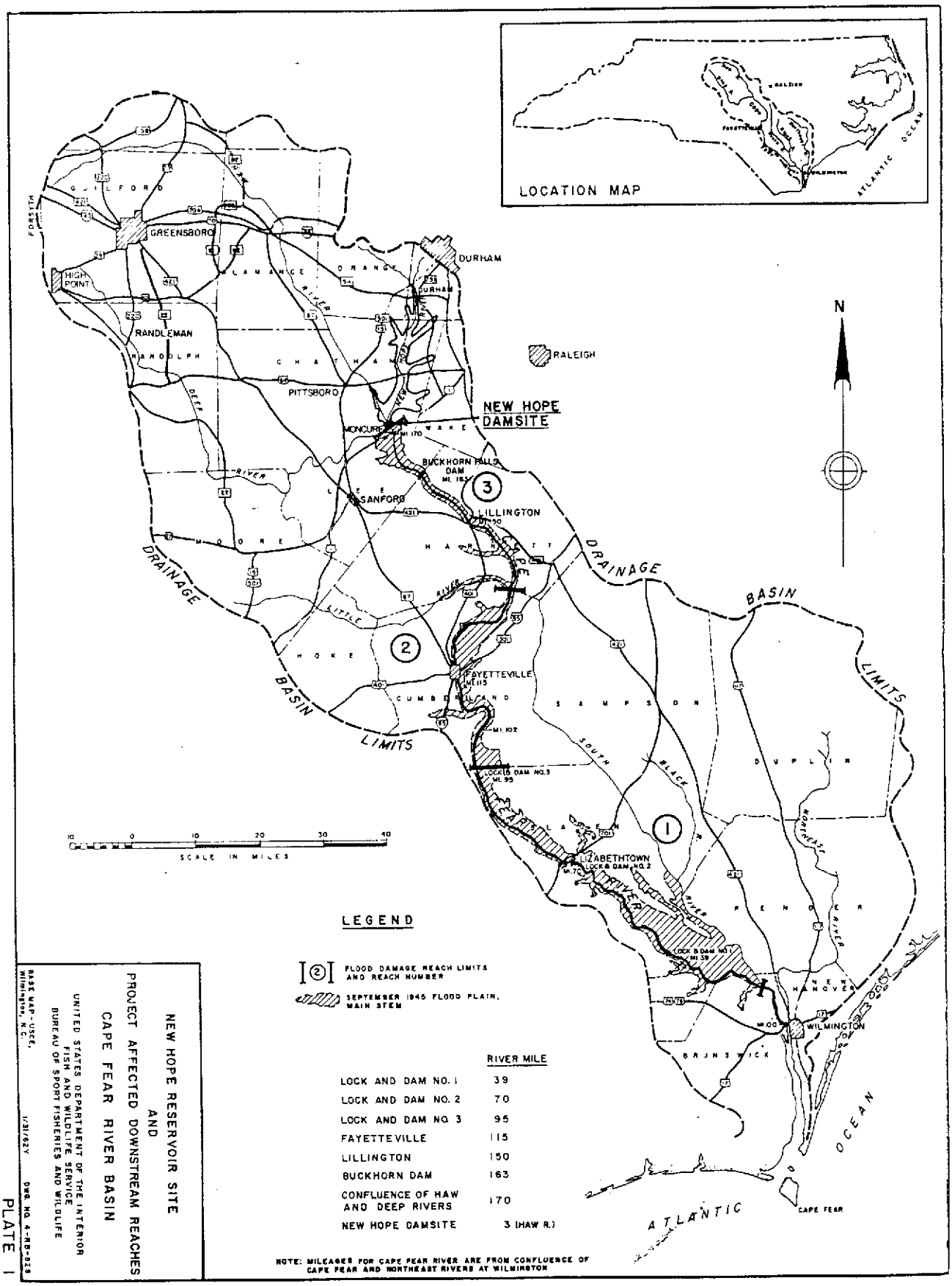
Land Use	Without the Project Acres	With the Project Acres
Cleared Land	3,500	4,000
Wooded Land	26,000	16,100
Water	300	9,400
Miscellaneous	200	500
TOTAL	30,000	30,000

TABLE 4

AVERAGE ANNUAL HUNTER UTILIZATION

NEW HOPE RESERVOIR, N.C.

Wildlife	Without the Project Man-day Use	With the Project Man-day Use
Big Game		
Deer, Turkey	10,460	2,450
Small Game		
Mammals	14,970	7,780
Birds	1,860	1,260
Waterfowl	500	500
TOTAL	27,790	11,990
TOTAL ROUNDED	27,800	12,000

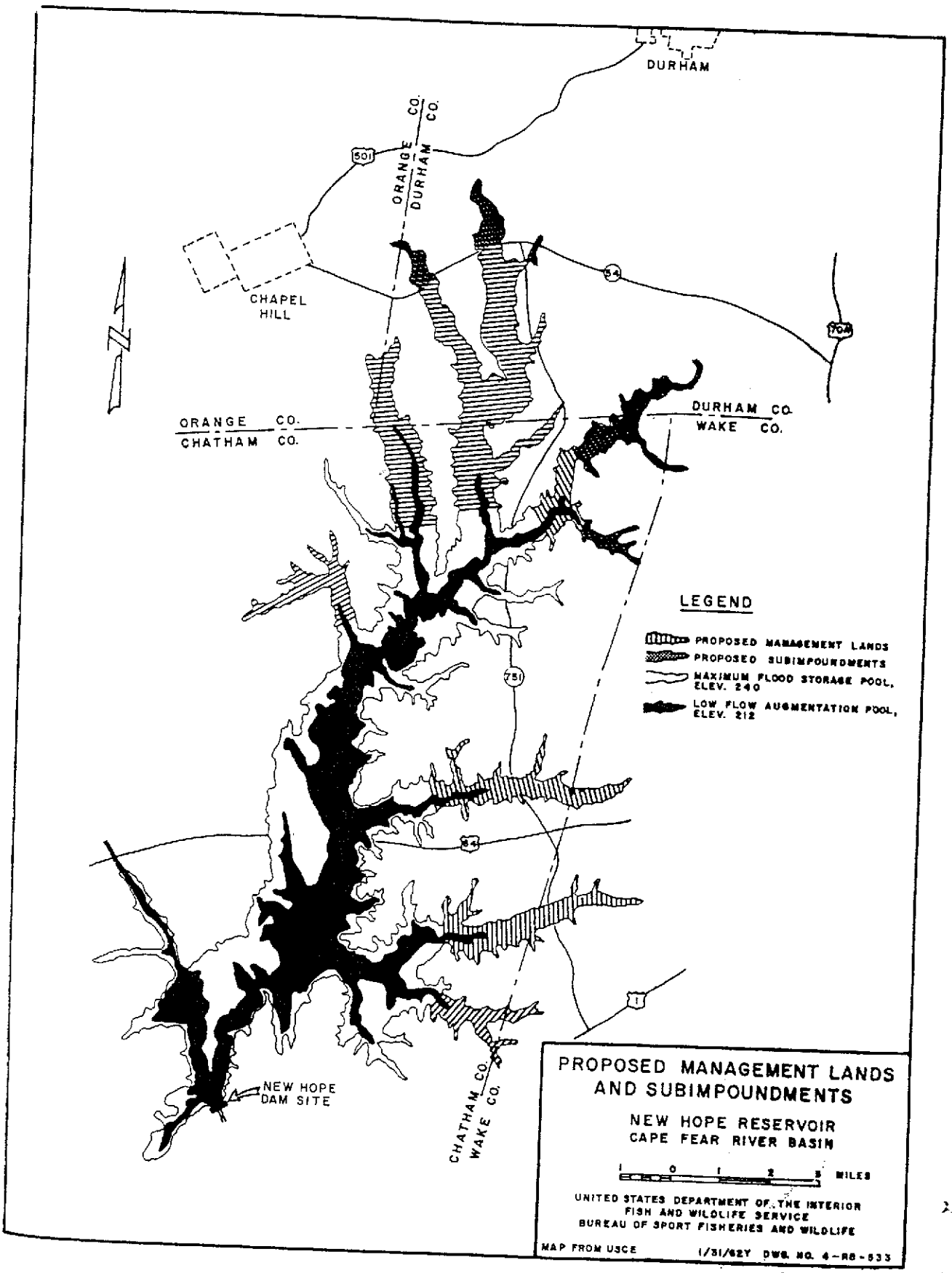


NEW HOPE RESERVOIR SITE
AND
PROJECT AFFECTED DOWNSTREAM REACHES
CAPE FEAR RIVER BASIN

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

BASE MAP - USCE, Wilmington, N.C. 1/31/62Y DWG. NO. 4-RB-5528

PLATE 1



PROPOSED MANAGEMENT LANDS AND SUBIMPOUNDMENTS

NEW HOPE RESERVOIR
CAPE FEAR RIVER BASIN

1 0 1 2 3 MILES

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

MAP FROM USCE 1/31/62Y DWG. NO. 4-R8-533

PLATE 2

State of North Carolina
Wildlife Resources Commission
RALEIGH, N. C.

March 7, 1962

Mr. Walter A. Gresh, Regional Director
Bureau of Sport Fisheries and Wildlife
U. S. Fish and Wildlife Service
Peachtree-Seventh Building
Atlanta 23, Georgia

Dear Mr. Gresh:

This will acknowledge receipt of the draft copy of your evaluation report on the New Hope Reservoir project, Cape Fear River Basin, N. C., furnished with Mr. Smith's letter of February 6, 1962.

We have reviewed the report and its recommendations were considered by the Wildlife Resources Commission on March 5, 1962. The Commission felt that it could not properly assess whether the over-all purposes and goals of the Commission would be served best by one major reservoir or numerous small reservoirs. The Commission did, however, endorse the recommendations contained in the report which would insure adequate protection to fish and wildlife and call for mitigation of project-occasioned losses to the wildlife resources in the basin, should the New Hope Reservoir construction be approved by Congress. A copy of the resolution adopted by the Commission is enclosed.

The evaluation report is based on the findings of studies jointly conducted by the Bureau of Sport Fisheries and Wildlife and the North Carolina Wildlife Resources Commission. We believe that some of its aspects should be further emphasized.

The New Hope Reservoir, if constructed, would provide fishing opportunity needed in this region of our State, but the maintenance of a fishery of sufficiently high quality to sustain the utilization estimated in this report would require more than token management by our Commission.

It may be anticipated that the water provided from the "minimum flow regulation pool" would necessarily be drawn off at the very top of the "conservation pool" in order to maintain the downstream water quality standards prescribed for the river by the North Carolina State Stream Sanitation Committee. In addition, a very low-level outlet would be desirable so that, in infrequent years, the impounded water

could be reduced to a minimum to provide for the possible necessity of chemical reclamation of the reservoir fishery.

We are concerned about the proposed clearing plan which provides for the retention of vegetation below elevation 198 feet, and only 2 feet below the top of the "conservation pool." The eventual decomposition of this vegetation may create an oxygen deficiency resulting in a deterioration of water quality detrimental to the fishery resources in the reservoir and the downstream area. Additionally, as administrator of the North Carolina Boating Safety Act, I am concerned about the safe conduct of all boating activities. It appears that water skiers, in particular, might face hazardous conditions during the years when the "minimum flow regulation pool" would be lowered to elevation 200 feet.

The development of this project would occasion a significant loss of hunting opportunity in the reservoir area and in the downstream flood zone. In the event that this project is authorized for construction, we urge that the lost hunting opportunity be mitigated.

The study indicates that adequate mitigation of lost hunting opportunity would require intensive management for forest game, farm game, and migratory waterfowl on a substantial portion of the project lands. Management of the forest lands would be directed primarily toward increasing the populations of turkey, deer, and squirrel. Agricultural lands would be managed for farm game. The management of migratory waterfowl would necessitate project development of structures to control shallow ponding during the migration and winter seasons. The location of lands suitable for wildlife management and sub-impoundment development is described and generally located in the report. Detailed studies to delineate specific areas suitable for intensive wildlife management and sub-impoundment development would be made after the project is authorized for construction.

On the condition that the timber resource within the project boundaries shall be assigned to the Wildlife Resources Commission to help finance the necessary management program, the North Carolina Wildlife Resources Commission would desire a license to the reservoir area lands and developments sufficient to mitigate project-occasioned losses to the wildlife resources in the reservoir and in the downstream flood zone. The Commission would assume responsibility for executing a suitable plan of fish and wildlife management.

We realize that the construction and location of outlet pipes in the reservoir dam, the extent of timber clearing, and the construction of low-level sub-impoundments in the headwater reaches of the reservoir area are details which may be resolved and adjusted in final construction plans.

We shall be pleased to cooperate in a detailed study at such time as the project is authorized for construction.

Cordially and sincerely,

Clyde P. Patton

Clyde P. Patton