

WATER SUPPLY AND SEWAGE DISPOSAL

STAFF REPORT

PREPARED FOR THE

JOINT COMMITTEE ON WASHINGTON
METROPOLITAN PROBLEMS

ON

WATER SUPPLY AND SEWAGE DISPOSAL IN THE
WASHINGTON METROPOLITAN AREA



DECEMBER 1958

Printed for the use of the Joint Committee on Washington
Metropolitan Problems

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1958

JOINT COMMITTEE ON WASHINGTON METROPOLITAN PROBLEMS

ALAN BIBLE, Nevada, *Chairman*

DEWITT S. HYDE, Maryland, *Vice Chairman*

WAYNE MORSE, Oregon

J. GLENN BEALL, Maryland

JOHN L. McMILLAN, South Carolina

HOWARD W. SMITH, Virginia

FREDERICK GUTHEIM, *Staff Director*

FOREWORD

This paper, by Gilbert V. Levin, Resources Research, Inc., follows his two earlier reports prepared for the Joint Committee on Washington Metropolitan Problems, setting forth the chief administrative and technical problems posed in these important fields. These reports, published as committee prints, Water Supply (April 1958) and Sewage Disposal and Water Pollution (March 1958) should be read as background material for the present report. Mr. Levin's report, like other working papers prepared for the joint committee by its staff and consultants, are independent research documents and do not reflect any decision or views adopted by the joint committee.

The present report does reflect, of course, the public hearings conducted by the joint committee in April 1958 which have been published and widely distributed, Washington Metropolitan Area Water Problems, Hearings Before the Joint Committee on Washington Metropolitan Water Problems, 85th Congress, 2d session. Committee staff and consultants have also maintained close coordination with other current studies of metropolitan area water problems, particularly those of the Interstate Commission on the Potomac River Basin, the District Engineer Office of the United States Army Corps of Engineers, and various State and District of Columbia agencies, and would like to acknowledge the cooperation and assistance received from these bodies.

FREDERICK GUTHEIM,
Staff Director.

C O N T E N T S

	Page
Introduction-----	1
Part I. Summary and recommendations:	
1. Northern Virginia Sanitation Authority-----	3
2. Expanded role of Washington Aqueduct-----	3
3. Washington Metropolitan Sanitary Board-----	4
4. Relocation of Federal agencies-----	4
5. Corps of Engineers Potomac study-----	4
6. Land for Riverbend impoundment-----	4
7. New water supply intake conduit-----	5
8. Silt as a pollutant-----	5
9. Aquatic recreational facilities-----	5
10. Chantilly airport-----	5
11. District of Columbia combined sewers-----	6
12. Planning ahead-----	6
13. Washington Suburban Sanitary Commission-----	6
14. Pollution capacity of the Potomac-----	6
15. Disposal of sewage effluent-----	6
16. Financing of works-----	7
17. Capital costs-----	7
Part II. Discussion of public hearings:	
Consolidation-----	8
Water storage-----	9
Federal responsibility-----	11
Control of development-----	12
Potomac River Commission-----	12
Combined sewers-----	13
Downstream communities-----	13
Keynote and summary-----	14
Part III. Situation brought current:	
Fairfax County Water Authority-----	15
Town of Fairfax water supply-----	16
Fairfax County sewage-----	17
Chantilly Airport-----	17
Zoning-----	20
Recreation on the Potomac-----	20
Part IV. Problems common to water supply and sewage disposal-----	24
Part V. Details of recommendations:	
A. Recommended organizational structures:	
Northern Virginia Sanitation Authority-----	25
Washington Aqueduct-----	29
Washington Suburban Sanitary Commission-----	30
District of Columbia-----	30
Washington Metropolitan Sanitary Board-----	31

Part V. Details of recommendations—Continued**B. Recommendations concerning problems enumerated in staff reports:**

Water supply:	Page
1. Source-----	33
2. Consolidation-----	35
3. Cooperation-----	36
4. Upstream protection----- Chantilly Airport-----	36
5. Planning-----	37
6. Financing-----	38
Sewage disposal:	Page
1. Consolidation-----	39
2. Silt-----	40
3. Protection of water supply-----	40
4. Downstream development-----	42
5. Potomac pollution capacity-----	43
6. Effluent disposal-----	43
7. Separation of combined sewers-----	45
8. Aquatic recreational facilities-----	49
9. Planning-----	53
10. Financing-----	53
Part VI. Capital costs associated with recommendations:	Page
Northern Virginia Sanitation Authority-----	55
Washington Suburban Sanitary Commission-----	55
District of Columbia-----	55
Washington Aqueduct-----	55

FIGURES

1. Washington metropolitan region, showing recommended Northern Virginia Sanitation Authority and principal water supply and sewage-disposal facilities-----	VIII
2. Recreational hazard in the Potomac-----	21
3. Rescue from sewage-laden waters-----	22
4. Geological strata near Brandywine, Md-----	Facing page 43
5. Water-level fluctuation at Riverbend, assuming 215-foot reservoir elevation-----	50
6. Water-level fluctuation at Riverbend, assuming 235-foot reservoir elevation-----	51

TABLES

1. Comparison of costs for separating versus reinforcing combined intercepting sewer system-----	46
2. Costs associated with formation of Northern Virginia Sanitation Authority-----	54

WASHINGTON METROPOLITAN REGION
SHOWING APPROXIMATE AREA OF RECOMMENDED NORTHERN VIRGINIA SANITATION AUTHORITY

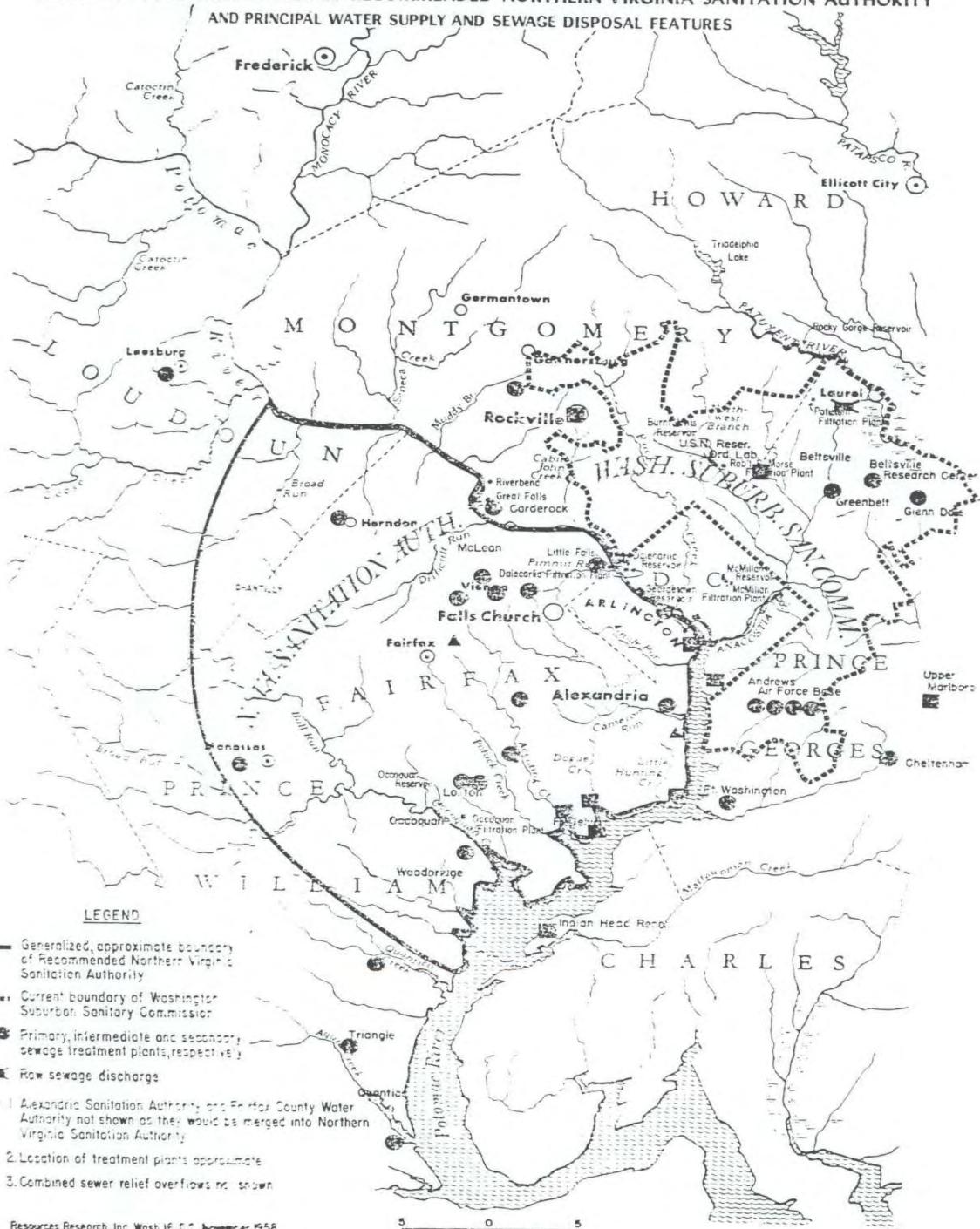


FIGURE 1

INTRODUCTION

Metropolitan Washington is at an historic crossroads with respect to its physical structure. This statement applies equally to the older portions of the District of Columbia itself and to the outlying, freshly developed suburbs of the National Capital area. It applies with particular emphasis to the region's water supply and sewage disposal facilities.

The District of Columbia is considering a huge sewer construction program to control the discharge of raw sewage to Rock Creek, the Potomac River, and the Anacostia River, and to prevent local flooding of downtown streets and basements. The Virginia portion of the metropolitan area is in ferment over how best to contend with the tremendous problems brought by its intensifying population explosion. The full implications of this growth are just becoming apparent. A major program to provide extensive water supply and sewage disposal facilities for the Virginia region is urgently needed to channel the oncoming development into a desirable and orderly pattern. In addition to these highly important subregional requirements, the entire metropolitan region is confronted with the paramount problem of controlling the flow of the Potomac River to assure an adequate source of water supply.

Other momentous decisions and actions impending in the District of Columbia have a direct bearing on its sewer construction and pollution abatement problems. These include the construction of highways and, most important, the rapid rate at which the older sections, those served by combined sewers, are being changed or rebuilt. The old buildings in the heart of Washington have run their race with time. The face of this section of the city is changing more rapidly than when the original buildings were erected. Planned public and private renewal projects, together with the high rates of construction outside the renewal project areas, leave no doubt that the next 20 or so years will almost see a new core city emerge.

The older portions of Washington have approached marginal utility and, therefore, are being rebuilt at the same time that the periphery of the metropolitan area is developing and expanding so rapidly. The coincidence is fortunate because the problems throughout the region are large and immediate enough to permit and, indeed, demand solutions designed to serve the best interests of the entire region. Without this coincidence, it is far more likely that the problems would be solved on a highly local basis with many interfering and conflicting uses of the area's natural and man-made resources. The unusual opportunity for coordinated action in metropolitan Washington should be seized now. If not, it will evaporate, never to return in the foreseeable future.

The water-supply and sewage-disposal systems constitute the very foundation of a large city's physical plant. This report deals with that foundation of the Capital of the United States. The author has attempted constantly to bear this in mind and, in making recommendations, has sought to do so in keeping with the spirit of the L'enfant plan and the future of our Nation's Capital.

WATER SUPPLY AND SEWAGE DISPOSAL

PART I

SUMMARY AND RECOMMENDATIONS

1. Northern Virginia Sanitation Authority

In order to achieve greater economy in the construction and operation of water and sewerage systems, provide better service, reduce water pollution, give increased public health protection and promote adequate planning for the future, a Northern Virginia Sanitation Authority should be formed as soon as possible. The Alexandria Sanitation Authority and the Fairfax County Water Authority should be merged, under the Virginia Water and Sewer Authorities Act, as the first step in the formation of the new authority. While a detailed study will be necessary to establish the initial boundaries of the Northern Virginia Sanitation Authority, they should encompass Alexandria, Arlington County, Fairfax County and the nearer portions of Loudoun and Prince William Counties. The general area is shown in figure 1. Private systems in this area should be purchased outright, using the right of eminent domain where necessary, and public systems should be taken over by the assumption of their outstanding indebtedness.

2. Expanded role of Washington Aqueduct

The Joint Committee should institute the necessary legislation to designate the Washington Aqueduct of the Corps of Engineers as the agency to procure, treat and supply water on a wholesale basis to the Northern Virginia Sanitation Authority, the District of Columbia and the Washington Suburban Sanitary Commission for distribution by the latter three agencies. This arrangement would be similar to that now existing between the Washington Aqueduct and the District of Columbia. The Northern Virginia Sanitation Authority and the Washington Suburban Sanitary Commission should be given the option of continuing to operate their water treatment plants for the remainder of their economic lives or turning the plants over to the Washington Aqueduct immediately or at any intermediate point. The designation of a single agency to procure and treat water for the entire metropolitan area will assure an adequate water supply for all jurisdictions and preclude possible future litigation over water rights. It will also increase the overall economy of supply construction and operation.

In view of the general plan of water supply recommended, the town of Fairfax should reconsider its decision to construct a small reservoir by damming Goose Creek

3. Washington Metropolitan Sanitary Board

A Washington Metropolitan Sanitary Board should be formed to promote coordination of the Northern Virginia Sanitation Authority, the Washington Suburban Sanitary Commission, the District of Columbia and the Washington Aqueduct. The Board should consist of 11 members, as follows: 2 from the District of Columbia, 2 from the Washington Suburban Sanitary Commission, 2 from the Northern Virginia Sanitation Authority, 1 from the National Capital Regional Planning Council, 1 from the Army Corps of Engineers, and the health officers of the District of Columbia, and the States of Virginia and Maryland. Although joint planning and discussion with subsequent voluntary action by its member agencies should be its primary *modus operandi*, the Board should be given review authority over all sanitary engineering projects in the metropolitan area for which Federal funds, exclusive of District of Columbia appropriations, as aid or participation are provided. This will assure protection of the Federal interest in the entire National Capital area. The joint committee should determine the need for and initiate any congressional legislation required to establish the Board as outlined.

As one of its early tasks, the Board should consider means to promote the extension of sanitary sewers up both sides of the Potomac to protect the river above Washington.

4. Relocation of Federal agencies

The Joint Committee should initiate legislation requiring all Federal agencies desiring to construct or expand major installations in the Washington metropolitan area to submit plans for water supply and sewage disposal to the Washington Metropolitan Sanitary Board. When, in the opinion of the Board, adequate water supply and sewage disposal facilities for the installation and associated development are not available, the plans of the Federal agency must provide for these and meet the approval of the Board before construction can begin. The Federal agency should be required to pay the appropriate sanitary agency proportionate costs for providing these services.

5. Corps of Engineers Potomac study

The Joint Committee should take steps to provide sufficient funds for the Army Corps of Engineers to complete its Potomac Basin study as soon as possible. Because of the overriding importance of water supply and the fact that the Potomac is the only major source available to metropolitan Washington, the plan evolved to assure the adequacy of the supply should be designed to provide for at least a century ahead.

6. Land for Riverbend impoundment

It seems highly probable that Riverbend will be found to be the best site for the water supply impoundment essential to metropolitan Washington. However, the Army Corps of Engineers study of the Potomac River, needed before any site selection can be made, will not be finished for several years. Action may subsequently be delayed for several additional years. In view of the rapidly rising price of land in the affected area, the required land should be purchased now. Should the decision be against building a dam at Riverbend, the land could be dedicated as a much needed park. Any portion not required could be resold without loss and, almost certainly, at a gain.

7. New water supply intake conduit

In order to protect the Washington and future metropolitan area water supply from increasing pollution in the Little Falls area, a new conduit should be built upstream. The conduit should connect to the Riverbend Reservoir if the latter is built. In addition to affording an important safeguard to the water supply, the conduit will preclude the necessity for severely restricting development of the valuable lands above Little Falls. River pollution near the intake should be closely studied by a continuing sampling program.

8. Silt as a pollutant

Good forestation and farming practices and control of construction grading practices will help alleviate the problem of silt pollution but, in themselves, are not capable of reducing it sufficiently. Impoundment of the Potomac in the upstream vicinity of Washington could furnish the necessary settling capacity to provide for silt removal for centuries to come. This should be carefully considered in selecting the site for a water storage reservoir and silt capacity should be included in the design of the reservoir.

9. Aquatic recreational facilities

Major new aquatic recreational facilities in the National Capital area would be a great boon to residents and visitors. If an impoundment is built at Riverbend, or elsewhere near Washington, it should be designed to provide for swimming, boating, fishing, picnicking and other outdoor activities to the maximum extent compatible with the protection of the water supply. Until a decision on the reservoir(s) required for water storage is made, consideration of the special construction which would be associated with creating a recreational basin in the Potomac River above the 14th Street Bridge should be deferred.

10. Chantilly Airport

Prior to the selection of Chantilly as the new airport site, District of Columbia officials and the Washington Metropolitan Regional Conference abundantly informed site selection officials of the attendant sewage disposal problems. The Council made a special request that no sewage be discharged above the Washington water supply intake. The subsequent selection of the Chantilly site and the consideration of a plan by the Civil Aeronautics Administration to discharge the sewage effluent in the upstream vicinity of the water-supply intake constitutes flagrant disregard of community interests. No discharge of treated or untreated sewage from the Chantilly Airport should be permitted at any point where it will result in the contamination of any public water supply in the metropolitan area. The Civil Aeronautics Administration now has a unique opportunity to solve its problem and simultaneously benefit the northern Virginia area. It should build a long trunk sewer to bring the sewage downstream, probably delivering it to the District of Columbia system. This sewer should be sized to serve the growing needs of northern Fairfax and a portion of southern Loudoun Counties. Connections to the sewer should be limited to those areas forming the Northern Virginia Sanitation Authority to which the sewer should be assigned. The authority would reimburse the Administration for the former's prorated share of costs out of revenue. The construction of the sewer in this manner should be a great inducement for the voluntary formation of the Northern Virginia Sanitation Authority.

11. District of Columbia combined sewers

Complete separation of its combined sewers is an announced ultimate goal of the District of Columbia. This is the only means by which the discharge of untreated sanitary sewage to Rock Creek, the Potomac River, and the Anacostia River can be permanently remedied. The District of Columbia should take advantage of required downtown sewer construction and the rapid pace at which the older, combined sewer sections of the city are being rebuilt to increase markedly its rate of combined sewer separation. Funds presently planned for increasing combined sewer interceptor capacity should be transferred to the separation program. The District of Columbia plumbing code should be amended immediately to require the installation of completely separate interior plumbing in all new buildings and buildings undergoing major renovation. An intensive study of the Slash Run and other old and rapidly rebuilding areas should be made to determine the most economical means of separation. The intensified separation program should then be implemented on the priority basis of achieving the greatest removal of sanitary sewage from storm sewers per dollar spent. In conjunction with this program, all relief sewers to be constructed in downtown Washington to prevent local flooding should be installed in the form of two or more pipes, one of which should be sized for the ultimate sanitary flow of the area served.

12. Planning ahead

In general, the periods into the future for which water supply and sewage disposal are planned and constructed should be lengthened. Specific recommendations for various types of sanitary works are presented in the main body of this report.

13. Washington Suburban Sanitary Commission

Although the service district of the Washington Suburban Sanitary Commission has expanded greatly over the years, there are some areas not yet included where development is taking place, or will take place, rapidly. The Commission should undertake a study to evolve a plan for expansion of the sanitary district in the best interests of the metropolitan area. The commission should then make the information available to nearby communities and encourage them to act accordingly.

14. Pollution capacity of the Potomac

A technical study should be made to determine the capacity of the Potomac River to assimilate pollution. Knowledge of this capacity of the river is necessary to plan degrees of sewage treatment needed in the metropolitan area now and in the future.

15. Disposal of sewage effluent

A future problem of sewage disposal in the metropolitan area may arise from the discharge to the river of large quantities of highly treated effluent.

Deep, sandy geological strata which probably outcrop beneath the Atlantic Ocean have been found as the result of exploratory work connected with underground gas storage in the vicinity of Brandywine, Md. A study should be made to determine if sizable quantities of highly treated sewage effluent might be pumped underground economically. This practice is used successfully in disposing of oilfield

waste water. If the method does not prove feasible in reducing the quantity of effluent that would have to be discharged to the river, a long outfall sewer extending to the wider downstream reaches of the Potomac should ultimately be built. This will prevent the sewage effluent from overfertilizing the river in the metropolitan area and causing undesirable aquatic growths and subsequent oxygen depletion with effects similar to those of pollution.

If built, this outfall should also carry away treated effluent from southern Maryland communities and thus prevent local downstream pollution.

16. Financing of works

Specific methods for financing works in the Washington metropolitan area will be recommended in the final committee report. However, the financial position of the northern Virginia area as a whole would be materially improved by the formation of the Northern Virginia Sanitation Authority. This is because the authority would have considerable immediate and potential revenue to support the sale of bonds. The Washington Suburban Sanitary Commission is in a favorable financial position and should have no difficulty funding its planned construction. The District of Columbia badly needs increased financing if it is to solve its sanitary problems. The committee report will suggest solutions to this predicament.

17. Capital costs

Insofar as they may be obtained or estimated at this time, capital costs are presented for specific items recommended by this plan. They are outlined in part VI.

PART II

DISCUSSION OF PUBLIC HEARINGS

With the three staff consultant reports concerning water serving as background material, the joint committee held hearings on the subject of water supply and pollution problems on April 22, 23, and 25. Special invitations were sent to many experts throughout the metropolitan area, and the hearings were open to the public. Thirty-four witnesses appeared or submitted written statements. Most of the witnesses represented governmental or community organizations. Those witnesses appearing personally amplified their views in response to questions from committee and staff members. In addition, more than 50 pertinent letters and documents were placed in the record of the hearings. The testimony was representative of the many diversified official, group, and individual interests that are part of the complex topic. Close reporting through the public news mediums was evidence of considerable public attention.

CONSOLIDATION

The most intensive discussion centered about possible administrative or physical consolidation of the water supply and sewage disposal agencies and facilities of metropolitan Washington. The types of consolidation considered ranged from a minimum of physical consolidation of a portion of the Virginia region to the physical and administrative integration under a single authority of all water and sewer agencies in the metropolitan area. Support for some type of consolidation came mostly from planning and public health agencies and technical experts. These people expressed considerable concern that present plans and enforcement powers are not sufficient to cope with the problems that will come with the great and continued increase in population almost universally forecast. They felt that unplanned and uncontrolled development would result in gross pollution of the Potomac, including the region of the Potomac above the water-supply intakes of the area and would, thus, impair the safety of the supply. Water service would be spotty, inadequate, and high in cost.

Those public health officials testifying were unanimous in stating that physical consolidation of sewage collection and disposal systems in the Virginia region was important to the protection of the public health. It was stated that public health principles require the discharge of sewage effluent to small streams in populated areas be eliminated in favor of conveyance of the sewage to larger plants for treatment and discharge at more remote points into streams of adequate flows. Similarly, public health considerations make consolidation of the many inadequate water supply systems in the Virginia region desirable. It was stated that public health control over the purity of these small supplies was deficient since most of the systems have no laboratory facilities. Despite the need, no plan to bring about consolidation of sewage disposal or water supply systems in the Vir-

ginia region exists. (Since the hearings, preliminary action has been taken to consolidate some of the water systems in Fairfax County.)

Experts in the field of sewage treatment pointed out that there are first cost and operating cost advantages to centralized treatment of sewage. Technical and financial reasons were also cited by persons advocating consolidation of the many small water supply systems in the Virginia area. The type of consolidation of sanitary facilities that has been achieved in the Maryland suburban area by the creation and growth of the Washington Suburban Sanitary Commission was believed to be possible in metropolitan Virginia.

Support for a regional authority was voiced by some of the conservation groups which expressed fears that, unless some comprehensive planning and enforcement are exercised, the many great natural attributes of the beautiful Potomac Valley may be destroyed.

Those opposed to consolidation of sanitary facilities were principally representatives of operating water and sewer agencies in the area. The heads of these agencies were almost unanimous in opposing any type of administrative consolidation. Some of them, however, did cite advantages to be gained from the physical joining of services in the Virginia region, and in physically connecting some of the Virginia systems to those of the District of Columbia. These witnesses felt that such physical consolidation could be brought about voluntarily and without any administrative consolidation or reorganization. They particularly opposed the creation of any single metropolitan area authority. This course of testimony is quite similar to the feeling expressed by operating agency spokesmen in Dade County, Fla., prior to the creation of the metropolitan authority. It reflects genuine fears that an extensive reorganization may disrupt long established patterns of operation, cause a period of administrative chaos and finally result in poorer operation because of increased organizational complexity.

Some of the operating heads and others who opposed interjurisdictional authorities or control did so on the grounds of States rights and local determination. These considerations were deemed important in applying to the right of citizens of a locality to retain immediate and sole control over sewage collection and disposal works and water supply systems. Proponents for some degree of consolidation stressed that any interjurisdictional agency would be composed of representation from each of the member areas.

WATER STORAGE

The issue receiving the next greatest amount of attention was that of water storage. There was general agreement that the Potomac River offered the only feasible source of water supply for the Washington metropolitan area. The engineer and public health witnesses were emphatic in stating that the natural flow of the Potomac was insufficient to assure an adequate supply and that, unless storage by impoundment was provided, the situation could become critical in the near future. Such storage, they stated, should be provided upstream from Washington. Much controversy centered about the possible construction of a major dam at Riverbend. Some of the engineers contended that Riverbend is the best site for the reservoir.

Reference was made to engineering reports recommending Riverbend as the site at which an impoundment could be erected to store the largest quantity of water at the cheapest unit price.

At present the Corps of Engineers is conducting an intensive and comprehensive study of the Potomac River Basin. This study will investigate the water supply situation in metropolitan Washington and recommend a specific impoundment or impoundments. The study, however, is not scheduled to be completed until 1961. The great majority of witnesses discussing the water supply problem advocated a substantial increase in the congressional appropriation to the Corps of Engineers in order to advance the completion date of the study. The Washington district engineer of the Corps of Engineers stated that, if the appropriation were not increased, the completion date of the study might be delayed until some time after 1961. He further stated that a minimum of 6 years would elapse following the completion of the study before the reservoir could be placed in service. (The Congress subsequently did not increase the appropriation and, in effect, delayed the study of water supply for metropolitan Washington by stipulating that the appropriation made this year should not be used for studying any portion of the Potomac below Harpers Ferry.)

Some witnesses contended that the Corps of Engineers study was not broad enough in scope, particularly respecting sociological implications of the creation of a large impoundment near Washington. Strong opposition to the construction of a dam at Riverbend was voiced by commercial interests, subdivision developers, and groups residing in the area to be inundated. It was pointed out that a large dam at Riverbend would flood great areas of highly desirable and valuable land in Maryland and Virginia. These lands would be permanently removed from the tax rolls. The possibility that failure of a dam at Riverbend or military destruction of it might destroy Washington by an advancing wall of water was also raised.

Witnesses representing recreation and conservation organizations were strongly opposed to the construction of a dam at Riverbend. Their concern was that much of the natural beauty and historical landmarks of the Potomac Valley would be inundated. These landmarks include a portion of the historic Chesapeake and Ohio Canal. They denied that the creation of a large reservoir would offer increased recreation on the ground that fluctuation of the water level would frequently expose large and impassable mud flats around the shoreline. The Corps of Engineers produced figures to show that drawdowns would seldom exceed 1 foot, thus exposing relatively little reservoir bottom.

Those opposing the construction of a large reservoir near Washington offered alternatives. Some suggested that reservoirs be constructed in the headwaters of various tributaries to the Potomac and be used to regulate the flow in the main stem of the river. Still others, despite engineering evidence to the contrary, contended that no storage was required. They felt that the natural flow of the Potomac was adequate to meet future demands. Even if this were not the case, one witness stated, the best way to cope with the water supply problem would be to curtail the use of water in the area during severe low flow periods which he believed would occur only rarely.

Several persons opposing the storage of water advocated that the water supply for the metropolitan area be taken from the large pool of the Potomac in and immediately below Washington. They suggested that the water be distilled to remove it from the large quantities of sewage effluent discharged in this area. Technical experts stated that distillation would not be an economical way to obtain the quantity of water required by Washington. They could not visualize any technological development which would offer a cheaper means of obtaining fresh water than mere storage of river flows where available. It was also stated that an upstream reservoir was necessary to allow silt in the Potomac to settle out to prevent its deposition in Washington. Some witnesses believed this could be accomplished by upstream land conservation. Others stated that, while such conservation was important, it could not alone accomplish the desired result.

Another facet of the water-storage problem was stressed by representatives of rural electrification groups. They advocated the construction of a maximum-height dam at Riverbend for multiple-purpose use, including the generation of hydroelectric power. The electric power, they contended, would be a major factor in repaying the cost of the total project. One witness, formerly Assistant Secretary of the Department of the Interior and also formerly Chief of the Bureau of Reclamation, called for complete and maximum development of the entire Potomac River. This would mean a series of multipurpose, including hydroelectric, dams at all economically feasible sites.

Opponents of the inclusion of hydroelectric projects in water-supply impoundments contended that: the Potomac could not develop great quantities of electric power, and that the limited energy available could not economically compete with electric energy generated by fossil fuels; there was no need for additional power sources in this area; the Federal Government should not subsidize power production; the production of subsidized power might attract large industries to the vicinity of the Nation's Capital which would not be in keeping with the character of the area.

Several witnesses advocated early Federal purchase of the land that would be required for the Riverbend Reservoir. They feared that land values were rising so rapidly that delaying the purchase until the Corps of Engineers report was finished would mean that the project would become extremely expensive. If the Riverbend site were ultimately rejected, much of the purchased land would be used for needed parks and recreational areas. The remainder could easily be resold at no loss to the Government.

FEDERAL RESPONSIBILITY

A great deal of testimony was presented concerning the Federal responsibility in water-supply and sewage-disposal problems in the metropolitan area. This testimony was unanimous in indicting the Federal Government for unilateral action in creating many of the problems and not adequately assisting in their solution. Examples, such as the dispersal of major agencies to remote areas at Germantown, Gaithersburg, and Chantilly, were cited to show the difficulties that arise when large installations and resultant satellite communities

are placed beyond reasonably available water and sewer service. A strong plea was made for Federal coordination with local authorities before sites for major installations are selected. The Federal Government should not only assist in planning for solutions, but also in financing the construction of the needed works.

Witnesses declared that, because metropolitan Washington is the Capital of the Nation, sanitation standards in the area should set an example for the world, the Potomac should be cleaned up and maintained so, water and sewer services should be excellent. The Federal Government should recognize that its presence creates the need for standards higher than in other cities. Accordingly, it should help pay to attain them rather than place the added burden on the local taxpayers as is now the case.

It is significant that none of the witnesses voiced disagreement with any of these contentions.

CONTROL OF DEVELOPMENT

Zoning or other controls to induce orderly development of the metropolitan area was recommended by many witnesses. It was stressed that coordination of zoning regulations throughout the several jurisdictions in the metropolitan area is necessary. Because such coordination is lacking, "leapfrogging" has become a prevalent type of development. This occurs when a rapidly developing county invokes minimum standards regarding lot sizes or sewage disposal. While good planning would dictate that subsequent development should comply with these requirements and take place in sufficient proximity to the existing communities so that central water supply and sewage disposal become economical, this is not done. Instead, developers frequently prefer to create subdivisions in a nearby, but more rural, county where regulations have not yet been enacted. In this manner, development becomes very spotty, with miles of undeveloped land separating subdivisions from larger communities. Accordingly, it becomes prohibitively expensive to provide centralized services. Private wells and septic tanks are installed at each house, or small, quickly outgrown systems are constructed. Eventually, the creation of such situations becomes a county problem that is extremely costly to remedy. The witnesses stated that means should be found to insure community growth in a manner consistent with the orderly expansion of existing sanitary facilities. Some witnesses thought this might be accomplished by voluntary coordination between the counties in the metropolitan area, and others felt that an interjurisdictional or regional type of approach was necessary.

POTOMAC RIVER COMMISSION

The role of the Interstate Commission on the Potomac River Basin was discussed by many of the witnesses. These persons, including planners, civic leaders, technical experts, and those representing recreation and conservation groups, were unanimous in requesting that the Commission be strengthened and expanded. All felt that the educational and informational facilities of the Commission should be increased. The minimal budget of the Commission should be enlarged to permit the organization to fulfill its important role in pro-

moting public interest and understanding of the water-use problems of the Potomac River Basin. Some witnesses felt the staff of the Commission should be expanded so that it could undertake detailed studies of water supply and pollution problems and make planning recommendations. Others felt that the Commission should be given the role of planning agency for coordinating governmental agencies in the basin. The possibility was advanced that the Commission be empowered with regulatory control and enforcement responsibilities in the field of water-pollution abatement and, in this manner, attain the status of a regional authority. While the whole range of possibilities for increasing the effectiveness of the Commission was discussed, it was evident that all witnesses were of the opinion that the present Commission staff and funds are too small to permit accomplishment of any of those objectives.

COMBINED SEWERS

The subject of the combined sewer system of the District of Columbia which, in the course of rains, discharges storm water and raw sewage through many overflows into Rock Creek, the Potomac, and the Anacostia Rivers was discussed. The District of Columbia Department of Sanitary Engineering presented a plan which it has recommended to reduce the frequency of overflows. Consulting engineers for the Department had found complete separation of the extensive combined sewers too costly to advocate. The principal cost would be involved not in building a separate sewerage system for sanitary wastes, but in divorcing the private plumbing inside homes, apartment houses, and commercial buildings so that roof water would not be placed in the sanitary sewers along with sanitary sewage. The Department of Sanitary Engineering feels that this expense should be borne municipally and not by the owners of private property. The total cost becomes prohibitive in its view, as does the inconvenience to traffic that would be caused by a major program to install new sewers in the streets. The Department, nonetheless, feels that complete separation of the combined sewers should be its fixed policy, but believes that the achievement may take 100 years. Department officials were asked if a modified plan for separation, whereby roof water is permitted to discharge to the sanitary sewers, might be feasible. They explained that this was not feasible because the quantity of roof drainage in some of Washington's more densely built-up areas was too large.

DOWNSTREAM COMMUNITIES

Several representatives of communities in the metropolitan area downstream from Washington demanded that any sewage disposal plans for Washington take their plight into consideration. These communities developed around the Potomac River in order to take advantage of the esthetic and recreational opportunities afforded by it. Over the years, the quantity of sewage placed in the river in the denser portion of the metropolitan area has increased to the point where the downstream communities are being denied the benefits of the river and are subjected to health hazards. Even the construction of sewage treatment plants in the metropolitan area has not, and

probably will not, relieve their situation because the effluent from the plants will be discharged upstream from these communities. As do all residents of affected areas, they feel that the sewage should be discharged elsewhere.

KEYNOTE AND SUMMARY

The witness who opened the hearings and sounded the keynote was Dr. Edward A. Ackerman, Head of the Water Resources Division of Resources for the Future. The substance of his remarks may be better appreciated in light of the difficult problems mentioned in the preceding paragraphs. Dr. Ackerman foresees the future descending upon us at a very rapid rate. He points out that all past published estimates of the growth of Washington have erred on the conservative side. It is highly likely, he feels, that our present estimates of future development, startling as they may seem to some, will also be found to be overly conservative. He cites three specific reasons to support his contention that the growth facing us is still great:

First, the United States population is going to continue growing, and as it grows, so must the Capital.

Secondly, compared to the older capitals of the world, the ratio of Washington's size to the total population of this country is small. This suggests that Washington may not yet have matured completely as a capital city.

For instance, France has only nine times the population of its capital, Paris. The population of Great Britain is only six times that of London. The present population of the United States is about 85 times that of the Washington area.

Third, Washington is almost certain to become a more important manufacturing center in some respects than it is, and it is likely to develop as more of a commercial center.

In briefest essence, then, the hearings revealed a keen public awareness of the water use problems confronting us, a recognition of the intricate relationships between various aspects of these problems, and a serious desire to find solutions so that the many benefits and healthful growth of our metropolitan city will not be needlessly curtailed. Superimposed on this was the feeling that important decisions must be made now, before our development irretrievably outstrips our planning.

PART III

SITUATION BROUGHT CURRENT

Although only several months have elapsed since the publication of the committee staff reports on water supply and sewage disposal, events of considerable significance in these matters have occurred. An accelerating tempo of decision-making and action is evident throughout the metropolitan area. The present transition period is favorable to the work of the committee which will have an opportunity to make its recommendations and suggest supporting legislation at a highly receptive and influential moment in these affairs.

FAIRFAX COUNTY WATER AUTHORITY

Handicapped by the fact it has no legal means for taking over publically owned systems in Fairfax County, the newly created Fairfax County Water Authority suffered another setback. In June, the town of Fairfax was granted the right to annex more than 3 square miles of unincorporated land. In general, the annexation, which becomes effective January 1, 1959, includes the areas served by the town's municipal water and sewerage systems. Fairfax County vigorously opposed the action which more than doubled the area of the town. This is another instance in which the Fairfax County Water Authority has lost immediate revenue area. Because the authority is limited to financing through revenue bonds, these areas are vital in providing the financial base for works that will be required to create the proposed county system. From a technical point of view, the removal of service areas from the projected consolidated system means that service to the area as a whole will be less satisfactory and more costly. These separate systems are now, or shortly will be, too close together to permit efficient operation and service by other than a consolidated system.

An attempt by the Fairfax County Water Authority to negotiate with the city of Falls Church for joint use of the latter's new transmission main which carries Washington Aqueduct water across the Potomac via a conduit through the Little Falls Dam has been unsuccessful. In July, the water authority announced plans of its own to construct a pipeline across the Potomac to obtain water from the District of Columbia system. This means that there would be three major pipelines and several minor ones crossing the Potomac to carry water to Virginia from the District. Each would have been built from the point of view of serving a small portion of the Virginia region of the metropolitan area. The existing line across Chain Bridge supplying Arlington and Falls Church and portions of Fairfax County served by Falls Church is already taxed to its limit. Arlington has notified Falls Church that, beginning in 1960, there will be no capacity for the latter. It was because of this that Falls Church was forced to build its new line. The new line, however, was not designed to supply more

water than that which will be required by Falls Church. This was the reason cited by Falls Church for refusing to share the line with the Fairfax County Water Authority. The water authority can plan to serve only a portion of Fairfax County's existing population, and its ability to sell revenue bonds will be severely limited by the attrition of its projected service area. Accordingly the new Potomac crossing it plans to build will not be adequate for long. The limitations that will thus be imposed on the transmission line mean that it cannot be designed on the basis of the entire Virginia region. Crossings are expensive, but, once one is undertaken, it is much cheaper to build it a little larger than to come back and build another crossing in several years.

Despite these difficulties, the Fairfax County Water Authority persisted in its efforts to organize and begin operations. In June, it requested an advance of operating funds from the Board of County Supervisors of Fairfax County. The request was granted and the authority opened offices and employed an engineer director and secretary as its first full-time employees. Negotiations for the purchase of the Annandale Water Co. and the Alexandria Water Co. were intensified. The negotiations with the Annandale Water Co. were successful and, on September 29, the water authority announced that it had contracted for the purchase of the company system for \$1,225,000. The authority hopes to begin operating the system as soon as the financing through revenue bonds is arranged, probably within a few months. The system, at present, serves some 15,000 persons in more than 10 Fairfax County subdivisions. It has no water source of its own, but purchases water from the Alexandria Water Co. A rate rise will be forthcoming, but the rise will be less than the 29 percent increase previously planned by the Annandale Water Co. The water authority is now studying joint purchase with the city of Alexandria of the Alexandria Water Co. This system serves some 24,000 customers in Alexandria and southern Fairfax County. The authority has also reopened negotiations with Falls Church for the purchase of water.

TOWN OF FAIRFAX WATER SUPPLY

Following the above-mentioned annexation, the town of Fairfax proceeded with its plans to construct an independent source of water supply on Goose Creek, a Loudoun County tributary to the Potomac. In September, the Fairfax Town Council authorized the immediate sale of bonds in the amount of \$260,000 and drew up terms for the eventual sale of additional bonds totalling \$4.5 million to pay for the project. Engineering plans are now being prepared and construction of the dam across Goose Creek is expected to begin this spring. Water from the reservoir will be piped across Fairfax County to the town. This further fractionation of water service in the Virginia region was strongly opposed by both Loudoun and Fairfax Counties. Fairfax County feared that the new system would place the town of Fairfax in a position to compete with the Fairfax County Water Authority for service area, thus further reducing the shrinking financial base of the authority.

FAIRFAX COUNTY SEWAGE

Negotiations instigated by the District of Columbia's invitation to Fairfax County for the latter to deliver sewage from the northern portion of the county to the District sewerage system have progressed well. It now seems certain that an agreement will be reached to effect this physical consolidation of sewage systems and thus prevent sewage from Pimmit Run and related watersheds from entering the Potomac above the new Little Falls water supply intake. Though this amount of sewage is relatively small at present, it would increase markedly in the near future. In accordance with the suggestion of the Director of the Department of Sanitary Engineering of the District of Columbia, action was taken to introduce the congressional legislation necessary to authorize the District to receive Virginia sewage. The bill, S. 4153, was passed August 21, 1958, and became Public Law 85-703. It states as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That for the protection of the Potomac River and its tributary streams within the metropolitan area of the District of Columbia from pollution by sewage or other liquid wastes originating in Virginia, and for the protection of the health of the residents of the District of Columbia and of the employees of the United States Government residing in such metropolitan area, the Commissioners of the District of Columbia are authorized in their discretion, from time to time, to enter into and renew agreements, for such periods as they deem advisable, with the proper authorities of the Commonwealth of Virginia, including county, municipal, and other governmental units thereof, for the drainage of such sewage or other liquid wastes into the sewerage system of the District of Columbia for treatment and disposal: Provided, That to the extent and in the manner determined by such agreements, the proper authorities of such Commonwealth, county, municipal, or other governmental units shall pay part or all of the costs of construction, expansion, relocation, replacement, repair, maintenance, and operation (including administrative expenses, interest, and amortization) of such sewers and other facilities as may be necessary or appropriate to convey and treat such sewage or other liquid wastes either separately or with sewage or other liquid wastes originating in said District or elsewhere. All payments or reimbursements made to the District of Columbia pursuant to this Act and the agreements entered into hereunder shall be made to the Commissioners and shall be deposited in the Treasury of the United States to the credit of the District of Columbia Sewage Works Fund.

On September 25, the Board of Supervisors of Fairfax County announced the adoption of a master plan for sewerage development in the area. Pending amendments, however, the plan has not been made available.

An important development in sewage disposal problems in Fairfax County is related to the new Chantilly Airport. Because of general implications of this problem, it will be discussed separately as follows:

CHANTILLY AIRPORT

In early September, the Washington metropolitan area was startled into indignation by the revelation of a plan the Civil Aeronautics Administration is considering for sewage disposal at the Chantilly Airport. The plan calls for the construction of a treatment plant which would discharge sewage effluent into Broad Run from which it would flow into the Potomac at a point near and above the Washington water supply intake at Great Falls and, of course, also above the new intake at Little Falls. The plan, disregarding mounting public concern over water supply protection, met with immediate reaction

from local officials, newspapers, and civic organizations. The Deputy Director of the District of Columbia Department of Sanitary Engineering described the plan as "incredible." The Engineer Commissioner of the District of Columbia protested the plan, as did many other appointed and elected officials in the area.

The Director of the Northern Virginia Regional Planning and Economic Development Commission commented on the situation with the following reply to a committee staff report question concerning planning:

All the carefully laid plans of Fairfax and Loudoun Counties for the area immediately west of Herndon and north of Route 50 were tossed into a trash heap when the Chantilly Airport was dumped in our laps. This Federal Government facility, in which the local governments had no hand in planning, will impose on this section of the two counties a land-use pattern entirely at variance with anything which they had contemplated. Until a national policy is adopted and Federal installations located in accordance with local, metropolitan, and regional plans, there seems little opportunity to develop future plans for the treatment of sewage.

The National Capital Regional Planning Council adopted a resolution condemning the Chantilly sewage disposal plan. The local press gave much prominence to the plan and printed editorials strongly opposing and criticizing it. The chairwoman of the Board of County Supervisors of Fairfax County proposed an alternate plan whereby the treated sewage would be discharged into Cub Run which flows into the Occoquan Creek, the source of water supply for Alexandria and parts of Fairfax County. While this source of water supply is not as important to the metropolitan area as is the Potomac, it is, nonetheless, vital to the people using it. Its pollution seems equally unacceptable.

There is increasing feeling on the part of officials and the public that the only satisfactory answer to the problem is to convey the sewage effluent to a point below any water supply intake in the area. Meanwhile, however, some fear the Virginia State Water Control Board may be asked to study the feasibility of constructing a local plant according to the Civil Aeronautic Administration's plan. Under the regulations of the board, it would have to approve the location and plans if the engineering design is sound. The Civil Aeronautics Administration has refrained from submitting the disputed plan for the Board's approval and has begun exploring other possible plans.

The committee staff reports on water supply and sewage disposal expressed concern over the manner in which Federal agencies have ignored and refused to accept responsibility for the problems they created by moving large installations to portions of the metropolitan area remote from water and sewerage facilities. The former report states:

The relocation of Federal agencies to upstream areas assures the fact that, unless prompt steps are taken, unplanned development in these areas will discharge sewage to the Potomac River. * * * Some means for enforcing strict and uniform control of any discharges that might adversely affect the quality of the Potomac River above the water supply intakes should be provided.

Events have moved so rapidly that, less than 5 months later, the threat has materialized. Of all the instances in which the Federal Government has acted against the water supply or sewage disposal interests of metropolitan Washington, this latest example is the most flagrant. The sewage disposal plan was made despite considerable effort on the part of local authorities to achieve a voluntary agreement

to prevent the discharge of untreated or treated sewage into the Potomac River between Washington and the Monocacy River.

But of even more significance is the fact that the sewage disposal plan does not represent an attempt by the Civil Aeronautics Administration to cope with an unforeseen problem among the many complex ones of airport development. The Administration had been fully advised of water supply and sewage disposal difficulties early in its site selection studies.

In anticipation of sewage disposal problems that might be associated with a new airport, the chairman of the Water Supply and Pollution Abatement Committee of the Washington Metropolitan Regional Conference called this matter to the attention of the Special Assistant to the President who was charged with selecting the airport site. This was done through the following letter:

DECEMBER 20, 1957.

Mr. E. R. QUESADA,
Special Assistant to the President,
The White House, Washington, D. C.

DEAR MR. QUESADA: At its meeting on November 22, 1957, the Washington Metropolitan Regional Conference recognized the protection of the purity of the Potomac River for water-supply purposes as one of the principal and most urgent problems in the metropolitan area. Also recognized was the fact that the Potomac can be protected only by observance of appropriate land use plans in the areas upstream from the various water intakes so the wastes from residents and activities therein will not enter the river with harmful effects. To this end, the conference unanimously adopted the following statement of recommended policy:

"To protect the purity of the Potomac supply, development should be so designed as to prevent discharge of effluent from sewage treatment plants either into the river or into tributaries which flow into it between Little Falls and the Monocacy. This does not completely preclude development within the watershed; it does, however, limit it either to densities low enough to make possible individual sewage treatment without effluents flowing into any stream in polluting quantities or to development close enough to the watershed line to make feasible pumping sewage or effluent into a drainage area not involved in water supply."

The foregoing statement of policy was taken from a report on Policies for a Regional Land Use Plan for the National Capital Region, prepared by Mr. John T. Howard, consultant, which was endorsed by the National Capital Regional Planning Council in joint session with the National Capital Planning Commission on November 8, 1956.

The local jurisdictions which are contiguous to the Potomac between Little Falls and the Monocacy are being requested to assume responsibility for carrying out the principles of policy expressed above.

I am calling this to your attention so you may be in position to give full consideration to the possible effects on the Potomac River of any land use for airport or related activities in the affected areas.

Sincerely yours,

A. C. WELLING,
*Colonel, Corps of Engineers, U. S. A., Chairman, Water Supply and
Pollution Abatement Committee.*

Several days later, General Quesada replied to the letter in kind and stated:

I thank you for the information you sent me pertaining to the protection of the purity of the Potomac River water supply.

In view of its impact on a possible site selection, I am sending it to our engineers immediately.

Subsequently, conferences were held at the White House in which officials of the Department of Sanitary Engineering of the District of Columbia discussed technical aspects of the problems.

These foresighted efforts were ignored in the final selection of the site for the airport. This incident provides eloquent testimony for the need of some legally imposed means to limit independent planning of sanitary facilities by Federal agencies constructing new installations in the metropolitan area.

ZONING

Zoning of land for low-density residential use in the vicinity of reservoirs or water supply intakes reduces the quantity of sewage generated in these areas and hence the threat to the supply. This protective device is widely used where adequate sewage collection and disposal facilities are not or cannot be made available. The committee staff reports on sewage disposal and water supply have pointed out that neither the District of Columbia nor the Washington Aqueduct exercise any control over the Potomac watershed. In the face of increasing development, this presents a serious potential hazard to the Washington, and ultimately the metropolitan, water supply. The only attempt to remedy this situation was that made recently by the Washington Metropolitan Regional Conference. As are all activities of the conference, this effort was a voluntary one. The conference members, representing all local and county jurisdictions in the metropolitan area, approved a resolution advocating that no sewage, treated or untreated, be discharged into the Potomac between Washington and the Monocacy River. It was agreed that this area, on both sides of the river, should be zoned to prevent dense development.

Several weeks after the adoption of the resolution, the Montgomery County Council enacted a new zoning ordinance. Despite the fact that a member of the county council was also a member of the Washington Metropolitan Regional Conference and had endorsed the resolution of the latter, the county council ignored the resolution. Instead of adopting 2-acre minimum lot sizes for areas draining to the critical stretch of the Potomac in accordance with the plan of the resolution, the county council zoned some 13,000 acres to permit one-half acre lots. This action also disregarded the recommendation for 2-acre lots made by the Maryland National Capital Park and Planning Commission. The issue turned on a purely local matter having overtones of personal interest. The action reaffirmed the fact that there is still no effective means for protecting the water supply of the Washington metropolitan area.

RECREATION ON THE POTOMAC

The natural features of the Potomac River in the Washington metropolitan area are ideal for various types of water sports. Many persons, in defiance or ignorance of the health hazards, indulge in recreation which brings them into close contact with the polluted waters of this stretch of the river. For years, the National Capital Parks has had plans to construct a number of recreational facilities along the Potomac in and near Washington. A principal factor which has caused these plans to be held in abeyance has been the polluted condition of the river. The National Capital Parks has now tired of waiting for the required antipollution works. In the belief that construction of recreational facilities will increase public demand for, and thereby

hasten, pollution abatement, the National Capital Parks, this summer, requested, and, on June 4, the Congress approved, an appropriation of \$290,000 to build a water sports center on the Potomac at the mouth of Rock Creek. Construction will begin shortly and plans call for the center to be in operation by July 1959. The facility will provide capacity for approximately 40 racing shells and also space for 150 canoes, a large portion of which will be for hire to the public. The center will serve as headquarters for rowing teams of colleges and high schools in the area and all over the Nation. The center will also play host to international racing events. Teams from Russia and South America are planning to race at the center this coming summer.



FIGURE 2.—Recreational hazard in the Potomac (Washington Evening Star photo).

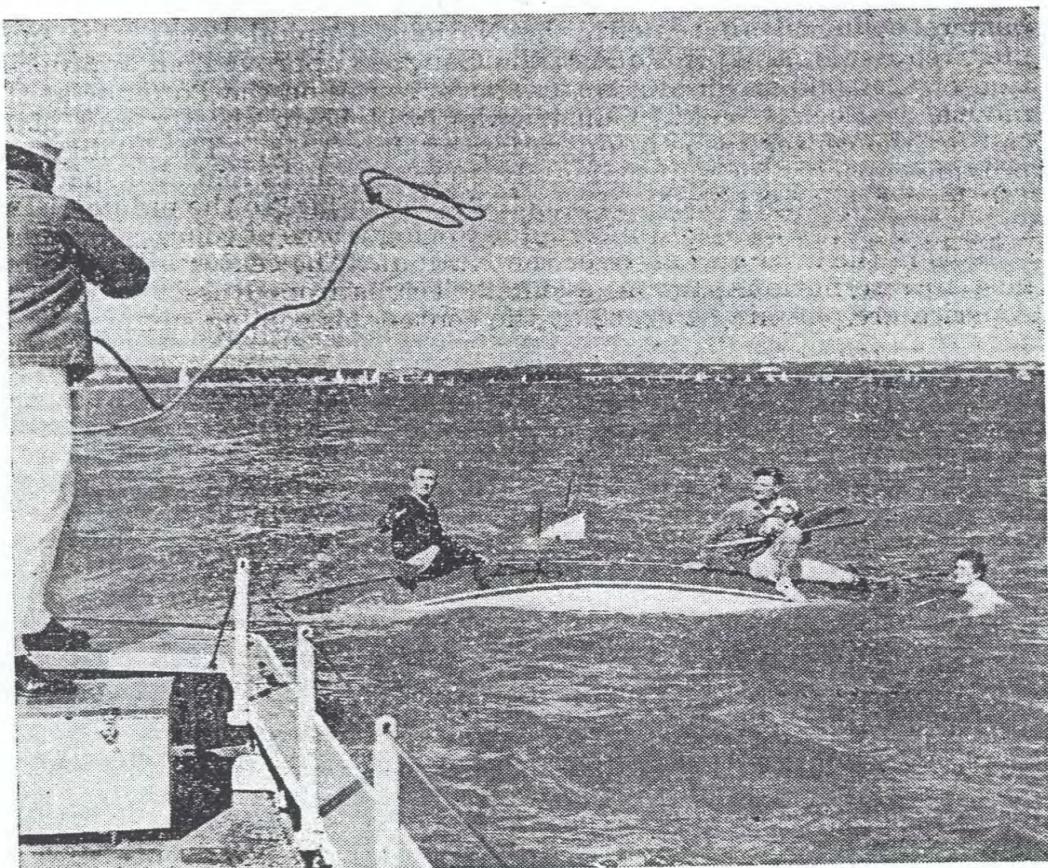


FIGURE 3.—Rescue from sewage-laden waters (Washington Evening Star photo)

An example of what users of the sports center may look forward to is shown in figures 2 and 3, photographs taken September 28, 1958, during the President's Cup regatta off Hains Point. This annual regatta continues to brave the contamination in the Potomac. Fifteen to twenty boats capsized during the day's sailing and produced scenes similar to those shown. The young lady in figure 3 who seems to be swallowing more than her pride upon being hauled out of the water is probably unaware that the routine water sample taken by the District of Columbia Department of Sanitary Engineering on October 1 showed that there were 23,000 coliform organisms, bacteria of sewage origin, present per 100 milliliters of the water. This means that approximately 3,000 sewage bacteria would have accompanied each gulp of the water, assuming that the water quality on September 28 was as "good" as that of October 1. It is frequently far worse. Those yachtsmen skilled or fortunate enough to avoid a dunking are nonetheless exposed to sewage bacteria in the spray and on the oars and wet lines. While there is little scientific data to indicate how many pathogenic bacteria of various types constitute a dose sufficient to produce disease in persons with varying degrees of resistance, it is obvious that a sizable inoculum could be ingested.

Another of the routine water-sampling stations of the Department of Sanitary Engineering of the District of Columbia is the Potomac River at Roosevelt Island, the waters adjacent to the future sports center. Weekly samples taken from April through September of 1958 contained an average of 6,400 coliform organisms per 100 milliliters of the river water at this location. From a public-health point of view, canoeing and rowing in these waters should be discouraged. From a public-relations point of view, inviting foreign teams to race in these polluted waters seems equally undesirable.

PART IV

PROBLEMS COMMON TO WATER SUPPLY AND SEWAGE DISPOSAL

It was pointed out in the staff report on water supply that solutions to problems of water supply and sewage disposal are very closely related and are, in fact, part of a single concept—proper water use. It was, therefore, suggested that the two sets of problems be solved jointly. Further study of these matters in metropolitan Washington and review of the testimony given at the hearings confirm the validity and desirability of this approach.

The administration and financing of sewerage works closely parallel the administration and financing of water supply works. The technical aspects surrounding both types of works are also closely related. Professional training combines both water and sewage technology in the curriculums of all colleges and universities offering courses in sanitary engineering. The professional and subprofessional personnel in the fields of water supply and sewage disposal commonly belong to the same technical associations. An example in this area is the Maryland-Delaware (and District of Columbia) Water and Sewage Association. As a general practice, municipal and other public agencies combine both water supply and sewage disposal in the same organization.

In the Washington metropolitan area the two phases of sanitary engineering are woven even more closely together than in many urban areas by the common thread of the Potomac River. At present, the Potomac River is the major source of water supply for metropolitan Washington and, in the future, the entire region will depend upon the Potomac as it is the only source of water capable of meeting the demand. Almost all sewage generated in metropolitan Washington is ultimately discharged to the same Potomac River. These two facts alone make it obligatory that the problems of water supply and sewage disposal be considered jointly.

In testifying at the committee hearings, the director of the Bureau of Environmental Hygiene of the Maryland State Department of Health succinctly described the situation in metropolitan Washington as follows:

The objectives of preventing pollution and in assuring this unpolluted source of water supply (the Potomac) should be supplementary. I submit, that at the present time, the measures we have for assuring they both be carried out are almost mutually exclusive.

Accordingly, the results and recommendations of the study into the water supply problems of the Washington metropolitan area have many administrative and technical features in common with those of the sewage disposal study and are, therefore, jointly discussed in this single report.

PART V
DETAILS OF RECOMMENDATIONS
RECOMMENDED ORGANIZATIONAL STRUCTURES
NORTHERN VIRGINIA SANITATION AUTHORITY

Administrative and physical consolidation of sanitary facilities is most urgently needed in the Virginia region of the Washington metropolitan area. Testimony at the hearings confirmed that poor economy results from the construction and operation of numerous sewage treatment plants and that this practice of sewage disposal presents a public health problem. Economy and control of plant operation and the removal of potentially dangerous sewage effluent from small streams in populated areas are best served by consolidated treatment plants. Public health protection, adequacy of supply and reliability of service of water supply systems would similarly benefit from consolidation in the Virginia area.

It is, therefore, recommended that priority be given to the early formation of a Northern Virginia Sanitation Authority. This authority should be empowered to acquire, construct and operate works and systems for the provision of water and collection of sewage and, possibly, for the collection and disposal of garbage and refuse. The latter two functions are not within the purview of this report, but should be carefully considered for assignment to the sanitary authority as they logically fit within the framework of such an agency.

A detailed study of existing populations and trends, existing services, topography and related-factors is recommended before the exact initial boundaries for the Northern Virginia Sanitation Authority are established. However, these boundaries, as approximately shown in figure 1, should encompass Alexandria, Arlington County, Fairfax County, and those nearer portions of Prince William and Loudoun Counties where development has begun. Means for extending the boundaries upon request of adjacent areas should be provided.

Existing facilities which can still render useful and economic service should not be abandoned. They should gradually be woven together into consolidated water supply and consolidated sewage disposal systems. This consolidation will include conveyance of sewage to the District of Columbia system and the ultimate abandonment of some existing sewage treatment plants which are, or soon will become, overloaded. Witnesses who testified against administrative consolidation, as well as those who argued for it, agreed that physical consolidation of facilities would ultimately be achieved since it was desirable when the economic base could support it. The creation of a single sanitary authority for the Virginia metropolitan region will immediately provide the area with a broader financial base and considerably hasten physical consolidation. Instead of seeking to serve a particular fragment of the Virginia region, a unified authority would be designed to serve the entire region to maximum advantage. Ad-

ministration of the region as a whole will assure better uniformity of construction and operating standards. It will also promote a more equitable system of charging for services. This does not mean that all portions of the sanitary authority need pay for services at equal rates. Some persons might feel that a uniform rate structure, providing services to the more remote areas at the expense of increased costs to those earlier developed areas, would be unfair. If desired, a system of zone charges, based on proportionate costs of service, could be established within the sanitation authority. Those areas requiring the extension of services or the construction of new facilities, could be charged higher rates. However, the philosophy that all persons within an organized authority should pay equal rates in view of the benefits to the area as a whole has much to commend it.

Some witnesses at the hearings were opposed to the creation of a regional sanitation authority in Virginia on the grounds that, while such an agency would have been desirable years ago, the cost of acquiring existing systems by the authority are now too high. It is true that considerable works will have to be acquired, but the broad revenue-producing base of the new authority should enable it to sell bonds to finance equitable acquisition of the existing works and assume the necessary financial obligations. Of considerable help in this respect will be some of the special methods of financing public works recommended in the full committee report. It should be borne in mind that the Virginia region is growing very rapidly and new works will constantly be required under the present short-range methods of providing services. From this time on, the cost of acquisition of works and the complexities associated with such acquisition will increase materially.

In creating the sanitation authority, privately owned sanitary systems would be acquired by outright purchase which would be financed through revenue bonds. It is recommended, however, that, in the case of public systems, the systems merely be taken over by the sanitation authority which would, thereupon, assume the outstanding indebtedness of the system. This is a widely used and equitable practice of sanitary authorities.

Two existing sanitary agencies in the metropolitan area of Virginia which are legally constituted to permit expansion of the areas served by them are the Alexandria Sanitation Authority and the Fairfax County Water Authority. The Alexandria Sanitation Authority was created in 1952 under the Virginia Water and Sewer Authorities Act (Code of Virginia, 1950, secs. 15-764.1 to 15-764.32, inclusive). The authority collects and treats sewage from the city of Alexandria and parts of adjacent Fairfax County as its sole function. The Virginia Water and Sewer Authorities Act, however, empowers the authority to act as follows:

5. POWERS OF AUTHORITY

- (f) To acquire, purchase, lease as lessee, construct, reconstruct, improve, extend, operate and maintain any water system, or sewer system, or sewage disposal system, or a garbage and refuse collection and disposal system or any combination of such systems within or partly within or partly without one or more of the political subdivision or subdivisions by action of whose governing body or governing bodies the authority was created, and to acquire by gift purchase or the exercise of the right of eminent domain lands or rights in land or water rights in connection therewith; and to sell, lease as lessor, transfer or dis-

pose of any property or interest therein at any time acquired by it; provided, however, that the provisions of sections 25-233 of the Code of Virginia, 1950, shall apply as to any property owned by a corporation possessing the power of eminent domain that may be sought to be taken by condemnation under the provisions of this act, and, provided further, that no property or any interest or estate therein owned by any county, city, town or other political subdivision of the State shall be acquired by the exercise of the power of eminent domain without the consent of the governing body of such county, city, town or political subdivision.

(g) To issue revenue bonds of the authority, such bonds to be payable solely from revenues to pay all or a part of the cost of a water system, sewer system, or sewage disposal system, or a garbage and refuse collection and disposal system, or any combination of such systems;

(h) To combine any water system, sewer system, sewage disposal system, or garbage and refuse collection and disposal system as a single system for the purpose of operation and financing;

(i) To fix, charge and collect rates, fees and charges for the use of or for the services furnished by any system operated by the authority;

(j) To enter into contracts with the Federal Government, the Commonwealth of Virginia, or any agency or instrumentality thereof, or with any unit, private corporation, copartnership, association, or individual providing for or relating to the furnishing of services and facilities of any water system, sewer system, sewage disposal system, or garbage and refuse collection and disposal system of the authority or in connection with the services and facilities rendered by any such system owned or controlled by the Federal Government or this Commonwealth, any agency or instrumentality thereof, and unit, private corporation, copartnership, association or individual;

(k) To contract with any municipality, county, corporation, individual or any public authority or unit of this or any adjoining State, on such terms as the said authority shall deem proper, for the construction and operation of any project which is partly in this Commonwealth and partly in such adjoining State;

(l) To make and enter into all contracts or agreements, as the authority may determine, which are necessary or incidental to the performance of its duties and to the execution of the powers granted by this act, including contracts with any Federal agency or with any unit, on such terms and conditions as the authority may approve, relating to (1) the use by such agency or by such unit or the inhabitants thereof of any water system, sewer system, sewage disposal system, or garbage and refuse collection and disposal system acquired or constructed by the authority under this act, or the services therefrom or facilities thereof, or (2) the use by the authority of the services or facilities of any water system, sewer system, sewage disposal system, or garbage and refuse collection and disposal system owned or operated by an owner other than the authority. Any such contract shall be subject to such provisions, limitations or conditions as may be contained in the resolution of the authority authorizing revenue bonds of the authority or the provisions of any trust agreement securing such bond. Any such contract may provide for the collecting of fees, rates, or charges for the services and facilities rendered to a unit or to the inhabitants thereof, by such units or by its agents or by the agents of the authority, and for the enforcement of delinquent charges for such services and facilities. The provisions of any such contract and of any ordinance or resolution of the governing body of a unit enacted pursuant thereto shall be irrepealable so long as any of the revenue bonds issued under the authority of this act shall be outstanding and unpaid, and the provisions of any such contract, and of any ordinance or resolution enacted pursuant thereto shall be and be deemed to be for the benefit of such bond-holders. The aggregate of any fees, rates or charges which shall be required to be collected pursuant to any such contract or any ordinance or resolution enacted thereunder shall be sufficient to pay all obligations which may be assumed by the other contracting party;

Section 7 and 8 of the act authorize and restrict an authority to pay for the cost of any water system, sewer system, sewage-disposal system, or garbage and refuse collection and disposal system by the issuance of revenue bonds.

The Alexandria Sanitation Authority, in its brief history, has been successful in providing a high degree of service and has obtained the confidence of the public. However, it has no plans for expansion of services beyond its present boundaries. Nor does it contemplate

undertaking to provide sanitary services other than sewage collection and disposal.

The Fairfax County Water Authority came into existence in 1957. Like the Alexandria Sanitation Authority, it was created under the Virginia Water and Sewer Authorities Act (Code of Virginia, 1950, secs. 15-764.1 to 15-764.32, inclusive). Its powers are, therefore, identical with those of the Alexandria Sanitation Authority discussed above.

As yet, the Fairfax County Water Authority does not have a water supply system in operation. Its total life has been devoted to negotiating for various portions of the proposed system. In the late summer of 1958, the Fairfax County Water Authority employed a full-time technical director and secretary and opened offices. Prior to this time, the business of the authority was conducted in the available time of persons otherwise fully employed. Purchase of the Annandale Water Co. has just been arranged and the Alexandria Water Co. may be acquired shortly. If a mutually acceptable agreement between private companies and the authority cannot be reached, the authority has the right to take the systems by condemnation. However, as stated in the above excerpt from the Virginia Water and Sewer Authorities Act, the water authority cannot exercise this power over systems owned by political subdivisions of the State without the consent of the governing body of such political subdivisions. A large and important water service area of Fairfax County is served by the city of Falls Church. Most of this area is outside the boundaries of the city. Falls Church does not have its own source of supply, but purchases its water from Arlington County which, in turn, purchases the water from the Washington Aqueduct. Resale of this water by Falls Church to customers within and, particularly, without the city has proven sufficiently profitable to help finance other municipal operations. Accordingly, Falls Church does not wish to surrender this source of revenue. This means that a vital segment of any consolidated water system to serve Fairfax County is denied to the authority. In effect, the authority can only plan to serve those areas presently not served by public supplies despite the fact that those public supplies may have inadequate or no original sources of water. The same restrictions apply to the Fairfax County towns of Fairfax, Vienna, and Herndon which have public supplies and are not inclined to join the authority.

Compared to the existing status of water service in Fairfax County, which contains 16 separate systems, the plan of the water authority is commendable. However, even if the proposed system could be established, the unit would still be too small to satisfy the needs of the Virginia portion of metropolitan Washington. The prospects for the formation of a truly comprehensive water system by the Fairfax County Water Authority are remote. Major changes and reorganizations would be required. In view of these facts, the current period of transition is the logical time to create a water authority to serve the entire Virginia region of the Washington metropolitan area. If the governing bodies of various communities having public water supplies fail to agree to the consolidation of these supplies in the public interest of the whole region, various financial inducements, which will be discussed in the full report of the joint committee, may ac-

complish this end. Control of the source of supply for the metropolitan area, as discussed later, would also promote consolidation.

The Virginia area now has a fully operating, but geographically limited, sanitation authority collecting and disposing of sewage, and the nucleus of a somewhat limited water authority. Both authorities are legally empowered by law to extend their services to include water supply, sewage collection and disposal, and refuse and garbage collection and disposal. Both are permitted to extend the boundaries of the area served. Neither authority, as presently constituted, meets the overall needs of the Virginia region. The Northern Virginia Sanitation Authority should, therefore, be formed by the merger of the facilities and staffs of the Alexandria Sanitation Authority and the Fairfax County Water Authority. The creation of a Northern Virginia Sanitation Authority will do more than provide the region with better service at an earlier date; it will become a highly effective force in shaping the development of the region into an orderly and desirable pattern.

WASHINGTON AQUEDUCT

The second major organizational change concerns the Washington Aqueduct of the Army Corps of Engineers. As pointed out in the committee staff report on water supply, the Washington Aqueduct has done an excellent job in developing, treating, and supplying water to the District of Columbia for distribution in the system of the latter. This water is also currently being supplied to Arlington County, Falls Church, and various military installations in the area. There is no doubt that the Potomac River constitutes the ultimate source of water supply for the entire metropolitan area. The Corps of Engineers is actively studying means by which the flow of the Potomac can be impounded to that end. Several water supply agencies in Maryland and Virginia are now planning or constructing works to tap the Potomac. More will follow. Unless these plans are coordinated, there will be duplication of effort and facilities, disputes, and, possibly, litigation over rights to water.

It is recommended, as the best way to achieve the required planning and coordination, that the Washington Aqueduct be made responsible for developing, treating, and supplying water to the entire Washington metropolitan area, with the possible exceptions and in the manner to be discussed below. The Washington Aqueduct, just as it does in its present relationship with the District of Columbia, would "wholesale" water to the District of Columbia, the Washington Suburban Sanitary Commission, and the Northern Virginia Sanitation Authority. Congressional legislation should be passed authorizing such sale and *limiting it* to the three specific agencies mentioned. These three agencies would be responsible for the distribution of the water within their jurisdictions. The provision of a good and adequate supply of water, at rates below which individual communities could supply themselves, would provide an added incentive for the Virginia communities to join the Northern Virginia Sanitation Authority.

The possible exceptions to overall control of water development and treatment by the Washington Aqueduct would be the Occoquan Creek water treatment plant now operated by the Alexandria Water Co., and the Patuxent and Robert B. Morse filtration plants of the Washington Suburban Sanitary Commission, as well as the commission's planned

plant at Watt's Branch on the Potomac River. The Alexandria Water Co. plant would be acquired by the Northern Virginia Sanitation Authority. Under the proposed plan, the authority would have the option of operating the plant itself or requesting the Washington Aqueduct to acquire and operate the plant. As the water supply system in the Northern Virginia Sanitation Authority is established, bringing with it water produced from the Potomac by the Washington Aqueduct, this plant could be used to supply the southern portion of the Virginia region of the metropolitan area. Ultimately, the plant would probably assume the position of a standby because of the limited supply that can be furnished by Occoquan Creek. However, the plant, a new facility, will undoubtedly be operated for a good many years before the system grows to the point where the use of the plant as a standby is indicated. This pattern would be similar to the history of the Robert B. Morse plant of the Washington Suburban Sanitary Commission.

The Washington Suburban Sanitary Commission would also be accorded the option of transferring its treatment plants to the Washington Aqueduct or continuing to operate them for the remainder of the useful, economic lives of the plants. In all likelihood, the Commission would elect to continue operating the plants. Since it is doing so in a fashion that provides a high degree of service to the Maryland region of metropolitan Washington, and since it had the foresight to construct the necessary facilities, it would seem only fair to permit these operations to continue. As more water is needed by the Commission, however, it should be supplied by the Washington Aqueduct. In 25 or 50 years, the existing Commission plants would probably be acquired by the aqueduct. It is not improbable, however, that the Commission, upon careful examination of the relative economies, may elect to transfer its treatment facilities and operations to the Washington Aqueduct upon designation of the latter as principal supplier of the metropolitan area, or shortly thereafter.

Various isolated sections of the area to be included in the Northern Virginia Sanitation Authority are served by well supplies. These supplies would be acquired by the authority and, where practicable, the systems would be consolidated into the central system to be created. Where early consolidation of such systems is not practicable, the Authority would operate the supplies until connection with the central system can be made. This same procedure would be followed in the case of the Washington Suburban Sanitary Commission well supplies serving Forest Heights and Fort Foote.

WASHINGTON SUBURBAN SANITARY COMMISSION

The Washington Suburban Sanitary Commission would continue to function as at present with the exception that the procurement and treatment of water would be immediately or gradually discontinued.

DISTRICT OF COLUMBIA

The District of Columbia would continue to receive its supply of water from the Washington aqueduct and to be responsible for distribution of the water. It would also continue to operate its sewage collection and disposal system.

WASHINGTON METROPOLITAN SANITARY BOARD

There would, thus, emerge four distinct sanitary entities in metropolitan Washington: The Northern Virginia Sanitation Authority, the Washington Suburban Sanitary Commission, the District of Columbia Department of Sanitary Engineering, and the Washington Aqueduct. Ultimately, the plan herein proposed calls for the Washington Aqueduct to develop and supply water to the other three agencies for locally controlled and operated distribution. In the matter of sewage collection, and treatment, the present relationship between and functions of the Washington Suburban Sanitary Commission and the District of Columbia, whereby the Commission collects sewage and conveys it to the District system for treatment would continue. The Northern Virginia Sanitation Authority would plan toward consolidation of its sewage collection systems and treatment plants. Such consolidation would occur much more rapidly than if the present system prevails because the economies of integrated construction and operation would become quite clear to an agency responsible for the entire Virginia area. The authority would deliver increasing quantities of its collected sewage to the District of Columbia system for treatment so that the District plant would become the principal of several treatment plants in metropolitan Washington.

In order for these four interrelated agencies to serve the component parts of the Washington metropolitan area, careful coordination will be necessary. This coordination should allow each of the local territorial agencies—the Northern Virginia Sanitation Authority, the Washington Suburban Sanitary Commission and the District of Columbia—to exercise the maximum degree of self-determination consistent with the best interest of the metropolitan area as a whole. In order to achieve this relationship, the coordination must be formalized. It is recommended that a Washington Metropolitan Sanitary Board be created to fulfill this function. Should the full committee report recommend the creation of an overall planning agency for the metropolitan area, or should such an agency be created at some future time, the Sanitary Board would become one of the divisions of the broader board. The recommended composition of the 11 member Sanitary Board is as follows: 2 members from the District of Columbia, 2 members from the Northern Virginia Sanitation Authority, 2 members from the Washington Suburban Sanitary Commission, 1 member from the National Capital Regional Planning Council—or from the metropolitan planning agency if created—1 member from the Army Corps of Engineers, the State health officers of Virginia and Maryland, and the health officer of the District of Columbia. The Board should have a permanent technical director and staff to conduct planning and review studies. Decisions of the Board would be reached by majority rule. The operations of the Board should be financed jointly by the member agencies.

The member agencies of the Board may now have legal authority to enter into an agreement creating and authorizing the Board. Sections (j) and (k) of the Virginia Water and Sewer Authorities Act previously quoted would permit the Northern Virginia Sanitation Authority to enter into contracts with the various agencies concerned when such contracts provide for or relate to the furnishing of services.

Agreement DCF-A-, between the District of Columbia and the Washington Suburban Sanitary Commission, provides a precedent for these agencies to participate. An act of Congress would probably be required to authorize the Washington Aqueduct to enter into such an agreement and also to permit it to furnish water to the Maryland portion of the metropolitan area. A legal study is recommended to determine if any additional congressional action is required to establish the Board. Such legislation should be introduced by the joint committee.

The Board should meet monthly or bimonthly and provide a means for coordinating activities of the member agencies. The Board should make recommendations to member agencies concerning planning and major extensions of services.

Much of the value of the Board would be in bringing together the member agencies for meetings in which the problems which affect the metropolitan area would be discussed. This, in itself, would achieve a good deal of coordination of planning and action in a voluntary manner. The Board would undertake a systematic and continuous review of metropolitan sanitary problems and agree upon area-wide plans, policies, and standards.

As a formal power, the Board should be given review authority over all plans for principal water or sewerage works for which Federal funds would be made available. The Federal funds would be those provided in accordance with the plan for Federal participation recommended in the final report of the joint committee, the present Water Pollution Control Act, and such other means as the Congress has authorized or shall authorize, excluding District of Columbia appropriations. In order for the member agencies to obtain regional financing and an appropriate Federal payment for services, the planned works would require approval by the Sanitary Board. Bonding authority would continue to be vested in the jurisdictional agencies.

It is recommended that a congressional act provide for the review and required approval by the Sanitary Board of all plans of Federal agencies desiring to construct major installations in the Washington metropolitan area when, in the opinion of the Board, adequate sanitary facilities to serve the installation and associated development are not available. The Federal agencies should be required to pay to the appropriate sanitary agencies proportionate costs of providing these services. This provision will stop unplanned, disruptive action by Federal agencies and will also be of considerable benefit to those agencies by placing at their disposal the invaluable engineering knowledge and information pertaining to the area possessed by the members of the Board.

The organizational structure that would be required by this plan has now been outlined. It should be noted that the only major changes required are the creation of the Northern Virginia Sanitation Authority, the designation of the Washington Aqueduct as ultimate wholesaler of water to the entire metropolitan area, and the creation of the Washington Metropolitan Sanitary Board.

The Virginia authority would be created under existing Virginia law. As has been explained, it is a merger of existing agencies. As such, it can hardly be considered as an infringement on the right of self-determination of the area served; rather, it is a step toward regional self-determination. The creation of such an authority rep-

resents truly democratic action in treating problems too large for the individual communities to solve. In attempting to preserve the local, democratic character of this plan, the recommended Washington Metropolitan Sanitary Board has had its authority limited to review powers concerning Federal participation in financing works. In addition, the Board contains representatives of the agencies so affected.

The intent with which this plan is drawn is to provide as many of the benefits of an areawide authority as possible without incurring the objectionable features of such an authority as voiced by the witnesses at the committee hearings. The requirement that plans made by member agencies of the Board be approved by the Board before any Federal payment or financing can be obtained is only fair. The interest of the Federal Government that would be represented by its financial participation is not limited to any particular jurisdiction in the metropolitan area. When the Federal Government assumes its proper responsibility to the National Capital area, its interest should be devoted to the area as a whole. The review feature of the Washington Metropolitan Sanitary Board will assure the fact that Federal moneys are spent in that interest.

The Interstate Commission on the Potomac River Basin can and should play a valuable role in assisting the organizational structure outlined herein. The commission can supply data and information important to analyzing many of the problems that will be studied by the Washington Metropolitan Sanitary Board. The commission should also serve to help coordinate major water-supply and sewage-disposal activities in the Washington metropolitan area with those throughout the Potomac River Basin. As reviewed in the section entitled "Discussion of Hearings," the commission has the confidence of all groups in the area. To assume these functions, the commission will undoubtedly have to undergo considerable expansion. This expansion, however, is long overdue. A detailed study containing recommendations for the future activities of the commission has been made by Abel Wolman & Associates and is now in press.

B. RECOMMENDATIONS CONCERNING PROBLEMS ENUMERATED IN STAFF REPORTS

The committee staff documents on sewage disposal and water supply each concluded with a list of questions defining the major problems confronting metropolitan Washington. Some of these questions have been answered in the section Recommended Organizational Structures in the development of the main thesis of this report. However, for the sake of clarity in associating the recommendations of this report with the specific questions of the preceding reports, these questions will now be considered.

WATER SUPPLY

1. *How shall an adequate source of water supply be provided for the present and future needs of the area?*

The staff report on water supply stated the need for water storage for metropolitan Washington. It pointed out that, other than the Potomac River, all other significant sources of water supply in the area are, or shortly will be, fully developed. The Potomac River is the only source available to meet present and future water demands.

Although the average flow of the Potomac is more than adequate to meet any foreseeable demand, the record shows that the flow can drop to levels that will not meet our needs.

Since publication of the staff report on water supply, no conclusive information has been forthcoming from the Corps of Engineers Potomac River Basin studies regarding water storage for Washington. However, this September, the corps announced a preliminary plan for the North Branch of the Potomac River. The plan proposes three multipurpose reservoirs: North Branch Potomac River Reservoir, formed by a dam 2.4 miles above the junction of Savage River; Stony River Reservoir, formed by a dam near Mount Storm, W. Va.; and Savage River No. 2 reservoir, formed by a dam 3.5 miles above the existing Savage River Dam. The storage would add 250 million gallons per day to low flow at Luke, Md. This increase in flow would be available at Washington. The low flow of the river near Washington would be boosted to approximately 750 million gallons per day compared to the regulated flows of 2,250 million and 835 million gallons per day that would be provided by reservoirs at Riverbend at heights of 235 and 215 feet, respectively. While helping to increase the available supply, the construction of the upstream reservoirs would not obviate the need for storage for metropolitan Washington as cited in the Committee staff report on water supply. An additional factor in this need was since presented in the committee staff report on economic development. A greater industrial future for metropolitan Washington was predicted than hitherto foreseen. While this industry will be primarily of the light variety, an increased water demand will undoubtedly accompany it.

As mentioned in the section Situation Brought Current the Congress granted only \$200,000 of the \$500,000 requested by the Corps of Engineers this year for the Potomac River study, and those funds carried the stipulation that they were not to be spent studying the Potomac below Harper's Ferry. It now seems doubtful, unless this restrictive condition is relieved, that the study can be completed by 1961 as planned. In order to rectify this situation, it is recommended that the joint committee take action designed to assure sufficient funds in future years to complete the study as soon as practicable, and to prevent the inclusion of geographical or other restrictions interfering with the normal course of the study.

Any final decision on storage for metropolitan Washington must await the findings of the study by the corps. However, on the basis of the information on storage capacities and costs available to date and presented in the staff report on water supply, it seems likely that the plan selected will consist of or include a reservoir at Riverbend. The silt and water supply quality problems discussed previously in this report add important reasons for providing storage in the near upstream vicinity of Washington. Storage at this point would also facilitate the future construction of a filtration plant near the reservoir. Such a plant will ultimately be required to serve the area of Virginia and Maryland northwest of Washington. It will also provide further diversification of the water supply for the metropolitan area in case of attack or disaster. The recreational assets that could be provided for metropolitan Washington constitute another favorable factor.

One of the questions raised concerning a dam at Riverbend was that the proximity of Washington to a large reservoir might render the city vulnerable to a disastrous flood as the result of a military attack on the dam. This matter was explored with the Corps of Engineers. To produce the worst possible flood, it would be necessary to knock the dam over on its side, or otherwise effect its complete and instantaneous removal. According to the corps, a hydrogen weapon would have to be used to accomplish this degree of destruction. Should an enemy deliver a hydrogen weapon to the Washington area, it is unlikely that he would drop it on the dam when he could use the same weapon and effort to destroy the city directly. However, the assumption was made that the dam was suddenly removed from the valley and the waters of the reservoir descended on Washington. Calculations to determine the seriousness of the resultant flood showed that, while it would be severe, the city would not suffer a catastrophe. The corps reported that the water level in Washington would rise only several feet above the maximum elevation of the 1936 flood.

The writer believes and recommends that any plan for the storage of water supply for metropolitan Washington should be designed to provide for at least a century ahead. This would be in keeping with Washington's first intake at Great Falls which has served for more than a century and constantly proven the value of the grand planning which created it. Water is the elemental material of our civilization and people and, out of civic and filial responsibility, its future provision cannot be overly guaranteed. Any storage plan of this scope would further increase the likelihood of a dam at Riverbend. A considerable portion of the costs of this reservoir would be spent on land acquisition. The price of land in the area that would be inundated by a reservoir at Riverbend has been rising rapidly in recent years and almost certainly will rise further in the near future. As an example, Montgomery County officials recently reported that average farmland in the county sold for \$227 per acre in 1950, rose to \$302 in 1954 and is more than \$500 per acre now.

It is, therefore, recommended that the necessary land to accommodate a 235-foot normal elevation reservoir at Riverbend be acquired now. If a reservoir of lower elevation is built, or if the final decision is against any reservoir in this area, the public will not lose by the purchase of this land. In that case, portions or all of it could be used for badly needed parklands and other public purposes. Similarly, any or all of the land could be resold as future plans may dictate. Any such resale could almost certainly be made at a profit due to appreciation in land values.

2. *Should the water supply systems in the Washington metropolitan area be consolidated either administratively or physically, or both?*

The recommended answer to this question has been given in Recommended Organizational Structures.

There is one specific comment that might be made here because of its timeliness. Construction of the Goose Creek Dam to serve the town of Fairfax has not yet commenced. The plan to establish this small source of supply should be reconsidered in view of the water supply features of this report.

3. What steps can be taken to assure that future decisions affecting water supply be made in a spirit of cooperative area planning rather than community competition?

The plan advocated in Recommended Organizational Structures will accomplish this by assuring the fact that all plans concerning water supply and sewage disposal will be made in accordance with the best interests of the entire metropolitan area and with the knowledge and majority consent of the various agencies representing the several jurisdictions.

4. How can the Potomac River upstream from Washington be protected against future pollution from residential, commercial, and industrial development?

Were the plan set forth in Recommended Organizational Structures put into effect, it would do much to supply the framework for the needed protection. In addition to promoting general coordination as discussed in answering question 3 above, the plan would encourage the adoption of specific, uniform regulations controlling upstream development by the member agencies. The Washington Metropolitan Sanitary Board should report the protective measures it deems necessary to the Maryland, Virginia, and District of Columbia water pollution control and health agencies and request those agencies to cooperate by all means at their disposal in achieving the desired protection of the water supply.

CHANTILLY AIRPORT

Concerning the threat from the Chantilly Airport, it is specifically recommended that no raw or treated sewage from the airport or its future satellite community be discharged above the water supply intakes of the Washington Aqueduct, the Alexandria Water Co. or any other source of supply in the area. As reported in Situation Brought Current, the selection of the Chantilly site was made with full knowledge of the problem of sewage disposal. It must, therefore, be assumed that the site offered other advantages to offset this problem. It is only reasonable to expect the Civil Aeronautics Administration to bear the cost of providing satisfactory sewage disposal, even if this should mean the construction of a long sewer line.

However, the Civil Aeronautics Administration should do more than merely solve its own problem. An outstanding opportunity exists for it, as a Federal agency, to fulfill its true obligation to the area and materially assist in solving the sanitary problems of the National Capital region.

As discussed elsewhere in this report, upstream development will ultimately result in contamination of our water supply if no preventive measures are taken. One of these preventive measures would be the construction of a trunk sewer up the Virginia side of the Potomac. This is one possible route for the sewer that will probably be required to prevent the discharge of Chantilly sewage above public water supply intakes.

If the Civil Aeronautics Administration were to build this sewer, and size it for future development in the portions of southern Loudoun and northern Fairfax Counties that could be served by it, the Virginia region would be greatly benefited. The Administration can finance such a project as a minor portion of the cost of the airport. It could

then offer the sewer as an aid to the formation of the Northern Virginia Sanitation Authority to which the sewer could be turned over on the basis of long-term prorated repayment to the Federal Treasury. The sewer would serve as a backbone for development of the extensive areas which could be served by it. The downstream end of the sewer might connect to the District of Columbia system via the Pimmit Run connection, which would probably require enlargement, or via a crossing to Maryland and the Washington Suburban Sanitary Commission. In the latter event, a sewer main on the Maryland side would be required. This might be financed jointly between the sanitary commission, the Civil Aeronautics Administration, and the Northern Virginia Sanitation Authority. Such a sewer might serve as a segment of an upstream main on the Maryland bank protecting the Potomac above the present reaches of the sanitary commission system.

It is, therefore, recommended that the Civil Aeronautics Administration solve its sewage disposal problem in a manner that will stimulate the formation of the Northern Virginia Sanitation Authority, create a major sewer main for that authority and facilitate the assumption by the authority of its prorated cost of the sewer.

5. For what period into the future should plans and construction be undertaken?

Almost without exception, construction of sanitary engineering works in the metropolitan area has been based on population forecasts which have been overly conservative. As a result, the works have had to be expanded or abandoned before fully serving their planned life. This problem, of course, is not unique with sanitary engineering works, but occurs also in many other fields such as highways, bridges, recreational facilities, schools and the like. Generally, conservative population forecasts are used in designing public works to be sure that the burden of overdesign is not added to the difficulties of financing. In addition, and again because of financial considerations, works are often constructed to be of sufficient capacity for 10 to 20 years only. The net result, however, is that, frequently, additional construction is required within several years and the total cost of supplying the service becomes greater than if it were originally built with the enlarged capacity. This is because it is cheaper to build to a given size in 1 rather than 2 or several overly limited construction stages, and because of continually increasing prices.

An argument advanced against building sufficient work capacity to accommodate the more distant future is that today's users should not pay for future users. However, major engineering works are very long-lived and, therefore, could be realistically financed over long periods. In this way, the cost of the works could be better proportioned between current and future users. The problems would be solved for longer periods of time and future users would benefit by paying the lower construction costs of the past. Furthermore, periods of health hazards and inadequate service would be avoided. Experience has shown that, when the demand on a given works exceeds its capacity, there is a delay of many years before the condition is remedied. In the interim, the consumer suffers considerable inconvenience in the case of water supply and, in the case of sewage disposal, the streams become badly polluted.

Pertaining to specifics, the following degrees of planning are recommended: Street mains should be sized to accommodate the total ultimate demand to be exerted by the area served; transmission mains should be installed with sufficient capacity to carry the quantities required for 50 to 75 years into the future; intakes and purification plants should be designed to provide adequate service for 50 to 75 years although the latter should be built in stages of no less than 25 years. The major water supply necessity, that of source, should be planned and constructed on a scale to serve the metropolitan area for the next 100 years.

6. What is the best means for financing the necessary organization, administration, engineering, and construction to attain the desired goal?

The final report of the committee will present a plan for financing the works required in the metropolitan area. This plan has some novel facets and will not be reviewed here. However, there are some additional factors relating to sanitary systems which can operate within and assist the overall financial plan. The recommended Northern Virginia Sanitation Authority has its method of financing clearly defined in the Virginia Water and Sewers Authorities Act under which the authority would operate. Fund raising is limited to the sale of revenue bonds. These bonds, operating expenses, and necessary reserves are paid for out of service charges. Changing the act to permit pledging some percentage of the full faith and credit of the area served might somewhat add to the financial capabilities of the authority. The actual advantage of this, however, is open to doubt since the full faith and credit of a community is determined by its assessed value. In order to secure a given level of financing by this method, the assessed value must be correspondingly high. Thus, an area which could secure a given loan on the basis of assessed valuation would also have the potential revenue to sell revenue bonds and would probably be able to finance the same works in this manner. In any event, a change to permit pledging the faith and credit of the area served would have to be approved by the Virginia Legislature. Such a change might upset other important fiscal policies of the State and it is doubtful if it would be approved.

From the point of view of the northern Virginia area as a whole, the ability to finance works would be considerably improved by the creation of the Northern Virginia Sanitation Authority. This is because the potential revenue of the more heavily developed areas would allow the extension of services to areas in need of such services, but where the revenue would not immediately be sufficient to carry the required bond issue. With the service available, in a short space of time, the revenue will appear. Those persons in the more densely populated areas now provided with service may object to this philosophy on the grounds that they would have to "carry" the less populated areas. There is some merit to this argument, but it can be extended to the point where the region would be compartmented, growth would be retarded and the overall economy would suffer. The net adverse effect on the persons in the more developed sections would then be greater than if they had assisted in providing for desirable and orderly growth. Good fiscal guidance can pace the extension of services to keep this situation in reasonable balance.

The financial status of the Washington Suburban Sanitary Commission is quite good. However, the Commission will shortly under-

take an expensive construction program. With the assistance that would be rendered if the Federal Government became responsible for helping solve the sanitation problems it creates and by use of the financial devices that will be proposed in the committee report, it should be possible for the Commission to extend its boundaries to provide services to more of suburban Maryland.

The problems of financing sanitary works in the District of Columbia stem from the refusal of the Federal Government, until 1954, to pay its share for services rendered and the continuing refusal of the Congress to provide a fair annual appropriation to the District in lieu of payment of taxes. In addition the District may not finance works through the sale of bonds. The prohibition prevents the District from raising funds through this most important conventional municipal resource. It was not until 1954 that Congress permitted the District to finance its sewerage construction under anything other than a pay-as-you-go basis. The District is now authorized to borrow up to \$5 million for sewerage works from the United States Treasury. Each request for loan under this program is subject to approval by the District Committee.

The Congress may soon be requested to increase the borrowing limit. However, the plan for financing to be recommended in the Joint Committee report, or some plan designed to the same end, is vitally needed if the District is to carry out its necessary sanitary engineering and other construction programs.

The one remaining operating agency in the plan proposed in this report is the Washington Aqueduct of the Corps of Engineers. It was pointed out in the hearings by the Director of Sanitary Engineering of the District of Columbia that almost all costs of the aqueduct are paid for by the District of Columbia out of its appropriations. It is through this method, and with relatively minor direct Federal assistance, that the extensive system of the Washington Aqueduct has been developed. Under the plan herein recommended, the Washington Aqueduct would sell treated water at wholesale rates to the District of Columbia, the Northern Virginia Sanitation authority, and, either initially or in the future, to the Washington Suburban Sanitary Commission. Prorated participation could be worked out on a formula similar to that now operating between the Washington Suburban Sanitary Commission and the District of Columbia concerning sewage disposal. The Northern Virginia Sanitation Authority and the Washington Suburban Sanitary Commission would pay initial sums for use of the facilities now in existence. These payments would be divided between the District of Columbia and the Washington Aqueduct in proportion to the equity of each in the system. Then, each of the three agencies supplied by the aqueduct would pay proportional shares of future water supply, treatment and transmission works. Operating, repair, maintenance, and similar costs would be financed out of the revenue obtained by the aqueduct by its sale of water.

SEWAGE DISPOSAL

1. *Should the sanitary facilities of the Washington metropolitan area be consolidated either administratively, or physically; or both?*

The recommended answer to this question has been given in Recommended Organizational Structures.

2. What must be done to control the deposition of silt in the area?

The Wolman report, discussed in the staff document on sewage disposal, emphasized that silt is the most important pollutant of the Potomac River. If unchecked, millions of tons of silt will deposit in the Washington metropolitan area and choke the Potomac. During the committee hearings, various methods were proposed to control the silt problem. The education of the upstream farmers to contour plowing and other soil conservation practices was advocated as a solution. Forestry measures were also cited as helping to reduce erosion. Upstream farm impoundments to confine and settle silt near its points of origin were favored by some. Regulatory control over subdividers who strip land and allow it to remain uncovered for long periods of time preceding and during construction activities was advanced as a need. All of these measures are desirable and their adoption should be encouraged. However, their combined effect is not sufficient to solve the problem. Dr. John Geyer, chairman of the Johns Hopkins University Department of Sanitary Engineering and coauthor of the Wolman report, clearly defined the magnitude of the problem:

Conservation practices on farmlands will cut down soil erosion, and cut it down spectacularly in some cases, but the soil erosion from the farms is only a part of the problem with regard to silt.

Silt comes from riverbanks and gullies and roadside ditches and everything else—the mountainsides are washing down. It is hard to believe that soil-erosion control could reduce the amount of silt by more than 50 percent, let us say.

The only sure way to control the silt problems is through one or more large impoundments which will permit the silt to settle upstream from Washington. At least one of these impoundments will have to be near Washington, because much of the silt is eroded from the Piedmont Plateau.

Sufficient capacity to absorb the silt load for such periods can economically be built into only large reservoirs. It is not suggested that impoundments be built solely for the purpose of accumulating silt. As previously discussed, a reservoir or reservoirs are needed to assure the future water supply of the metropolitan area. If large reservoirs are to be built anyway, it is relatively cheap to install silt capacity. It is recommended, in concurrence with the finding of the Wolman report that such reservoir(s) should be designed so that one purpose is the settling of silt. The silt problem can be met in this fashion for centuries to come.

3. What actions are required to protect the Washington water supply from pollution from future upstream development?

The rational and fiscal persuasions of the proposed Washington Metropolitan Sanitary Board, as discussed in Recommended Organizational Structures, would do much to provide an answer to this problem. By considering local encroachment of development on the water supply as a matter affecting the entire metropolitan area, the Board would function to control excessive or unwise development and encourage the provision of sewerage facilities to prevent pollution. The Board could not prevent the reoccurrence of instances such as the $\frac{1}{2}$ -acre zoning episode of the Montgomery County Council. Such prevention could be achieved only by the surrender of sovereignty by the counties in the metropolitan area to some interjurisdictional agency. Although this may come about in the future, the testimony at the committee hearings clearly showed that the right of local determination is jealously guarded.

One of the most important needs to protect the water supply from pollution is some local, coordinating control over the Federal Government in its site selection and planning for new installations or major additions to existing ones in areas where adequate water and sewer facilities are not available. The provision, discussed in Recommended Organizational Structures, requiring Federal agencies to obtain approval of plans for sanitary facilities associated with new or expanded installations would fill this need.

In addition to these general means for protecting the water supply, two specific needs are apparent at this time. One deals with the leadership and direction to be supplied by the Washington Metropolitan Sanitary Board. It is recommended that early in its work, it consider means to promote the extension of sanitary sewers up both sides of the Potomac. While actual construction will have to proceed in accordance with economic feasibility, the announcement of the scheduling of extensions for some years in the future would do much to make the pattern of development conform to the plan.

The second specific recommendation relates to the new water supply intake constructed by the Washington Aqueduct at Little Falls. The staff report on water supply discussed the disadvantage of this location in that it was some 9 miles closer to Washington than the original intake at Great Falls. The site, immediately above the District of Columbia boundary, is one that will be extremely difficult to protect from the effects of suburban development. This could only be done at the price of prohibiting economic use of the valuable land in the quadrant to the northwest of Washington.

The effect on the quality of the water supply produced by moving the intake closer to Washington and sources of sewage is measurable. The Washington Aqueduct has conducted water quality studies at Great Falls and Little Falls. Weekly samples taken from May through November 1951, revealed an average of 110 coliform organisms, bacteria of sewage origin, per 100 milliliters of river water at Great Falls, and an average of 838 per 100 milliliters at Little Falls. The maximum quantities found were 460 coliform organisms per 100 milliliters of water at Great Falls and 2,400 at Little Falls. This study was repeated over approximately the same period in 1957. Average coliform organism content of the water had increased to 784 and 2,895 per 100 milliliters at Great Falls and Little Falls, respectively. The maximum had increased to 2,500 and 25,000, respectively. The studies indicate substantial increases in sewage pollution at both locations. The Public Health Service recommends the following for the grossest category of water which, with extensive treatment, should be used as a source of drinking water:

The coliform organism content should not exceed 20,000 per 100 milliliters in more than 5 percent of the samples examined during any 1 month.

This monthly percentage was exceeded once at Great Falls and once at Little Falls during the 1957 sampling period. However, the total number of samples taken was not large enough to permit firm quantitative conclusions in this regard. The sampling program should be intensified and followed closely.

The data discussed above show a trend toward greater pollution of the river near the water supply intakes. The trend may be expected to increase with development in the area. It is recommended, as part

of the anticipated construction of a reservoir upstream from Washington, that a conduit be built to the new reservoir to serve as the principal transmission structure for supplying water to Washington. This will add perhaps 20 percent to the total cost of the reservoir project. Compared to the distances from which other cities commonly bring water, the expenditure is entirely reasonable. If no reservoir is built, the intake should, nonetheless, be moved upstream.

The Little Falls pumping station, the cost of which was approximately \$8 million, should be maintained on standby as a very much needed alternate source of supply in case of accidental or intentional damage to, or destruction of, the longer conduit. Such alternate intake structures and facilities are important to the civil defense and survival plans for the area.

The boundaries of the Washington Suburban Sanitary Commission are designated by the Maryland Legislature. The usual procedure for extension of these boundaries is for a county delegation to introduce a bill into the legislature. In 1955 and 1957, the legislature empowered the commission with review authority for all water and sewerage systems connecting two or more houses proposed anywhere in Prince Georges or Montgomery Counties, respectively. This allows the commission to control new systems and development yet outside its actual service area. Thus, as the service area expands, it will find favorable conditions awaiting it. Expansion of the service area has been rapid over the years. Nonetheless, there are some areas beyond the actual sanitary district where considerable development is taking place or is imminent. It is possible, that, unless some encouragement is given, these areas may not request admission to the sanitary district in time for optimum planning of sanitary facilities. In some instances, the commission may not desire to encourage adjacent areas to request services because of fear of a high initial cost to initial revenue ratio.

In order to resolve the above considerations in the best interest of the Washington metropolitan area, it is recommended that the sanitary commission undertake a study to evolve a plan for expansion of its district. The information obtained from this study should be presented to the communities beyond the sanitary district boundaries, and those communities should be urged by the commission to act accordingly. Of particular interest in this respect are the areas around the Rockville-Germantown portion of Montgomery County and the Upper Marlboro and Fort Washington areas in Prince Georges County.

4. How can sewer service be provided to allow and promote the orderly and pollution-free development of the downstream section of the area?

Here again, the Washington Metropolitan Sanitary Board can effectively promote the solution of this problem. It can keep the member agencies cognizant of the metropolitan impact of development in their jurisdictions and advocate advance planning. The early announcement of planned extensions will set the pattern for development. The control exercised by the Board over Federal financial participation, as discussed in Recommended Organizational Structures, will insure that major works are in keeping with the interests of the area as a whole.

The portion of question 3, immediately above, pertaining to planning for expansion of the Washington Suburban Sanitary Commission applies equally here.

Fig. 4. Geological Strata Near Brandywine, Maryland.
COURTESY WASHINGTON GAS LIGHT COMPANY.

E R A S	P E R I O D S	E P O C H S	G R O U P S	L O W L A N D S E D I M E N T S	F O R M A T I O N S	M E M B E R S	L I T H O L O G I E S	R A N G E S O F T H I C K N E S S	D E S C R I P T I O N	
									O F T H E	G E N E R A L
C E N O Z O I C	Q U A T E R N A R Y	E O C E N E - MIOCENE ?	P LIOEocene?	U P L A N D S E D I M E N T S	B R A N D Y W I N E	N O R T H K E Y S	B R A N D Y W I N E	0 - 150	G r a v e l , s a n d , s i l t , c l a y	
T E R T I A R Y	P A N I N K E Y	E O C E N E - MIOCENE ?	P LIOEocene?	U P L A N D S E D I M E N T S	N A N J E D O - C A L V E R T	N A N J E D O	N A N J E D O	0 - 100	G r a v e l , s a n d , s i l t , c l a y	
	A Q U I A							0 - 75	U N C O N F O R M I T Y S a n d , s i l t , a n d c l a y , g r a v e l t o w a r d b a s e	
	M O N M O U T H							0 - 19	U N C O N F O R M I T Y S a n d , y e l l o w t o o r a n g e , f i n e g r a i n e d	
	M A G O T H Y							0 - 181	C l a y , s i l t , a n d s a n d , g r a y i s h g r e e n t o g r a y , s o m e f o s s i l f r a g m e n t s , g l a u c o n i t i c t o w a r d b a s e , n o n c a l c a r e o u s t o c a l c a r e o u s U N C O N F O R M I T Y C l a y , s i l t , a n d s a n d , g r a y i s h g r e e n t o g r a y , s o m e f o s s i l f r a g m e n t s , g l a u c o n i t i c t o w a r d b a s e , n o n c a l c a r e o u s t o c a l c a r e o u s ; b a s a l 2 0 ' o r s o , p i n k i s h M a r l b o r o c l a y m e m b e r w h e r e p r e s e n t	
	V E N U S							105 - 152	S a n d , g r e e n i s h g r a y t o g r a y , l o c a l l y b r o w n i s h g r a y , f i n e t o c o a r s e g r a i n e d , s i l t y , a r g i l l a c e o u s , f o s s i l i f e r o u s , v e r y g l a u c o n i t i c , c a l c a r e o u s , l o c a l l y c e m e n t e d	
								28 - 74	U N C O N F O R M I T Y C l a y , s i l t , a n d s a n d , g r a y t o d a r k g r a y , m i c a c e o u s , s o m e g l a u c o n i t e , s o m e f o s s i l s , c a l c a r e o u s	
								72 - 154	C l a y , s a n d a n d g r a v e l , o f t e n o c c u r r i n g a s a n u p p e r a n d a l o w e r l i g h t g r a y c o l o r e d s a n d a n d c l a y s e p a r a t e d b y a m i d d l e z o n e o f p o r o u s a n d p e r m e a b l e s a n d a n d g r a v e l	
								331 - 442	U N C O N F O R M I T Y I n t e r b e d d e d c l a y , s a n d , a n d g r a v e l , g r a d i a t i o n s a n d m i x t u r e s ; c l a y , v a r i e g a t e d , l o c a l l y g l a u c o n i t i c ; s a n d , f i n e t o c o a r s e g r a i n e d ; g r a v e l , g r a n u l e s a n d p e b b l e s ; l o c a l l y s o m e h e m a t i t e , l i m o n i t e , a n d s i d e r i t e n o d u l e s , c a l c a r e o u s t o n o n c a l c a r e o u s , f e w b l a c k w o o d a n d c o a l f r a g m e n t s	
	V U L C A N							39 - 74	S a n d , f i n e t o c o a r s e g r a i n e d , p o o r t o w e l l s o r t e d , a n g u l a r t o s u b - r o u n d e d , c l e a n t o c l a y e y , s i l t y , l o c a l l y c l a y a n d g r a v e l l e n s e s	
	D I A N A							11 - 27	C l a y , v a r i e g a t e d , d o m i n a n t l y r e d s , b r o w n s , a n d g r a y s , s o m e s a n d a n d l o c a l l y g r a d e s t o a c l a y e y s a n d , n o n c a l c a r e o u s	
								8 - 21	S a n d , g r e e n , l i g h t g r a y i s h g r e e n , a n d r e d t o b r o w n , f i n e t o c o a r s e g r a i n e d , l o c a l l y s i l i c e o u s o o l u h s , g l a u c o n i t i c , c l a y e y , n o n - c a l c a r e o u s	

				56 - 109	Clay, variegated, silty, locally sandy, some clayey sand lenses, locally grades to a clayey silt, noncalcareous, contains <u>PAN FAUNULE</u>
				21 - 64	Sand, variegated medium to coarse grained, angular to subangular, clean to clayey, some amethyst grains, some clay lenses, locally grades to a gravel
				7 - 105	Clay, variegated, but dominantly reds, greens, grays, and yellows, locally sandy, some clayey silt and sand lenses, some clay pebbles, very slightly to noncalcareous
				10 - 30	Sand, variegated medium to coarse grained, some granules, slightly silty, some clay, little coal, locally cross-bedded, some clay bands
				12 - 37	Clay, variegated, silty, slightly glauconitic, some sand, locally grading to clayey silt, noncalcareous; locally occurs as interbedded clay and sand, contains <u>LOKI FAUNULE</u>
				22 - 46	Sand, gray to grayish green, very fine to coarse grained, slightly glauconitic, some clay zones, locally cross-bedded, some silt lenses
				22 - 86	Clay, variegated, little sand, some internal slickensides, few clayey sand zones
				8 - 42	Sand, variegated fine to medium grained, locally arkosic, some heavy minerals, slightly glauconitic, some sandy clay zones
				27 - 58	Clay, variegated, locally sandy and silty some clayey sand zones, some clay pebbles, locally slickensided, slightly to noncalcareous, contains <u>CUPID FAUNULE</u>
				19 - 42	Sand and clay, gradations and mixtures; clay, variegated; sand, fine to coarse grained
				13 - 154	Interbedded clay and sand; clay, variegated, locally sandy; sand, dominantly coarse grained, clean to clayey
				18 - 32	Sand, variegated fine to coarse grained, locally silty and clayey, some brownish gray clay bands, few silt zones
				17 - 66	Clay, variegated, silty, slightly sandy, some slickensides, locally grades to clayey silt, noncalcareous
				28 - 41	Sand, variegated, fine to coarse grained, good to poor sorting, silty, locally arkosic, clean to clayey, some coal fragments, locally grades to sandy clay, in a few areas bed is a variegated clayey silt
				24? - 167	Interbedded sand and clay: sand, dominantly light gray to gray, fine to coarse grained, silty, clayey, some feldspar, some coal; clay, variegated, locally carbonaceous, silty, and sandy; some silt zones; locally conglomerate at base, contains <u>MERCURY FAUNULE</u>
				0 - 238+	UNCONFORMITY Interbedded sandstone, siltstone, clay, and shale, variegated, locally some coal; near base some conglomerate composed of metamorphic fragments, locally beds inclined to 50°, locally siltstone, shale, and clay have white spots
					UNCONFORMITY Gneiss

5. What is the natural capacity of the Potomac to assimilate polutions?

This question can be answered only by a careful field and laboratory study of the Potomac. Until this study is made and the results accepted by the jurisdictions in the metropolitan area, it will be difficult to achieve realistic agreement upon the degrees of treatment that must be attained now and in the future to maintain the Potomac in a satisfactory condition. This is basic information required for sewage treatment design. It is recommended that the necessary scientific investigation be undertaken and jointly supported by the jurisdictions concerned.

6. What shall be the ultimate disposal of the treated sewage effluent from the metropolitan area?

Even if sewage is highly treated, there is a limit, as indicated in the above paragraph, to how much effluent the Potomac can assimilate. In addition to the organic materials normally considered as sewage pollution, high degrees of treatment produce another problem. Relatively large quantities of dissolved minerals extracted from the sewage are discharged in the effluent. These minerals fertilize the receiving body of water. Together with the greater intensities of sunlight which pass through water to which little or no particulate pollution has been added, this effect permits the water to support large growths of aquatic life. Great algal blooms or other undesirable biological effects may occur. In turn, the death of these organisms may consume all available oxygen in the stream, rendering it septic. This is a matter of increasing concern to sanitary engineers throughout the Nation. Both the Wolman report and the Renn report, which became part of 1954 Potomac River Commission Report on Water Pollution in the Washington Metropolitan Area, expressed fears that such undesirable conditions might develop in the Potomac. In this connection, the Wolman report foresaw the time when it would be necessary to carry sewage effluent away from the Washington metropolitan area.

The staff report on sewage disposal raised the possibility of utilizing some of the effluent for crop irrigation. The effluent could provide water enriched with some fertilizer. Irrigation practices in the East, including Maryland, have been increasing and are expected to achieve large proportions. Maximum irrigation demand occurs during low river flows. Thus the use of effluent for irrigation would keep it out of the river during the most critical periods. Accordingly, a brief study of the possibility was made. It was learned that tobacco, which constitutes a major crop in the farming area south of Washington, is extremely sensitive to chlorides. Several parts per million are sufficient to impair the leaf. This precludes irrigating tobacco land with sewage effluent. The remaining acreage still constituted a considerable potential irrigation demand for years of average or less than average precipitation. However, the criterion for disposal of the effluent must be the reliable demand. The level of this demand was found to be too low to guarantee that summer requirements would repeatedly be sufficient to utilize appreciable quantities of the available effluent. The use of the sewage effluent for irrigation cannot, therefore, offer an important solution to the problem of effluent disposal.

There is another possible way of disposing of sewage effluent without returning it to the Potomac River. Since 1954, the Washington Gas Light Co. has been exploring the geology of the Brandywine, Md., area in developing information concerning the availability of natural underground storage of gas. Geologists retained by the company have found that the strata alternate between clay and sand for considerable depths. Figure 4 presents a profile of the strata. Twelve wells have been drilled in the area to depths as great as 1,700 feet where bedrock was encountered. The permeability of some of the deep sandy strata or aquifers seems good. The deepest recorded water supply wells in the Brandywine area are less than 500 feet. It is unlikely that future supplies will be drawn from depths greater than that, and certainly not from depths in the neighborhood of 1,000 feet or more. It appears that conditions may be satisfactory for the construction of a number of deep wells through which the highly treated sewage effluent might be pumped underground. The wells would be cased and installed so that the sewage effluent could escape only into those strata found to be satisfactory and safely below feasible sources of water supply. The clay strata above the aquifers would prevent the effluent from rising to the upper strata. It is believed that, because of the large capacity of the deep aquifers, the sewage would move horizontally very slowly, as does the water in them at present. In passing through the sand, the effluent would soon be rendered innocuous. This, however, may be immaterial since the water would probably not find its way to the surface again for many years, and then very likely by means of diffusing into the Atlantic Ocean where these deep aquifers are believed to outcrop.

Disposal of waste waters by pumping underground to deep aquifers is commonly used by the oil industry. In some oilfields, as many as 10 or more million gallons per day of wastes are pumped below. In some ways, these wastes are more difficult to handle than highly treated sanitary sewage effluent would be. Treatment of the oil wastes may be required to prevent them from clogging the receiving aquifer. Even so, the method has been found to be economical for the oil industry. In the coastal region of California, sewage effluent is pumped underground to act as a barrier against the intrusion of sea water so that the latter will not contaminate well supplies further inland. In terms of the alternative, the construction of a long outfall sewer and pumping facilities, deep aquifer disposal of a portion of the sewage effluent may be economical. What is known of the geology, at present, seems to be encouraging. It is recommended that a detailed study be made of this possibility.

Should it be determined that the pumping of sewage effluent underground is not an economical answer to the disposal problem, it is recommended that a long outfall sewer ultimately be built to discharge into the wider and deeper downstream reaches of the Potomac River. Several points of discharge should be incorporated into the length of the outfall sewer in order to achieve quicker and better mixing of the effluent with the stream water and to permit some economy in the diameter of the pipeline. The pipeline should be designed to receive the effluents of sewage treatment plants serving the southern Maryland portion of the metropolitan area. In this way, the outfall sewer will serve a secondary purpose in helping to prevent local pollution in areas beyond the reach of the District of Columbia sewerage system.

7. Can the cost of separation of the combined sewers in the District of Columbia be reduced to the point where total separation is ultimately feasible?

The committee staff report on sewage disposal discussed the combined sewers in the District of Columbia which discharge mixed sanitary sewage and storm water through some 70 outlets to Rock Creek and the Potomac and Anacostia Rivers. Separation of these sewers, which serve 39 percent of the area of the District, would permit all sanitary sewage to be conveyed to the Blue Plains plant for treatment and disposal downstream. The committee hearings established the fact that all parties interested in or concerned with the combined sewer problem are in agreement that the combined sewer system should be separated into sanitary and storm systems. The principal question which was unresolved was "When?"

The Director of the Department of Sanitary Engineering of the District of Columbia fears that, because of the high cost, separation may not be completed for 100 years. He, nonetheless, believes that it is important to take some immediate remedial action in the problem of the combined sewage overflows. Accordingly, a plan has been devised toward this end. Basically, the plan will prevent any discharge of raw sanitary sewage to the Potomac River above Rock Creek and will reduce the frequency of discharge of mixed sanitary sewage and storm water to Rock Creek. Although some limited areas of the combined sewerage system will be separated, the effect will principally be achieved by building new sewers to increase the capacity of the interceptors from which the discharge takes place. The increased capacity of the interceptors will permit the sewage to be carried downstream below Rock Creek before discharge to the Potomac and Anacostia at several points. Because of the effect of the storm water on the composition of the sanitary sewage and the huge conduits that would be required, it is not practicable to carry the combined sewage to the sewage treatment plant. Thus, the plan does not prevent the discharge of the sewage to the streams, but it does redistribute discharge so that the upper portion of the Potomac in Washington and Rock Creek will receive considerable benefit. From this point of view, the plan has much to commend it.

The cost of the plan, as now contemplated by the District, has been estimated at \$57,784,000. There is an aspect to the cost which is disconcerting. It is the fact that, while total separation of the combined sewerage system is a firm goal, much of the money spent on the plan to relocate the points of overflow will not bring us any closer to that goal. This fact is shown in table 1 which compares the cost of total separation of the intercepting sewers with the costs of the plan to enlarge the interceptors to prevent overflows upstream. Of the total of \$46,500,000 which the latter plan will require, only \$24,244,000, or 52 percent, are specifically directed toward achieving separation. The remaining \$22,256,000 will actually be invested in the combined sewer system. If the goal of separation were to be achieved in the future, the \$22,256,000 would represent an excess expenditure. This does not take into account debt service for this sum which would amount to more than \$1 million per year, nor the fact that a completely separated system would be \$164,000 per year cheaper to operate in terms of pumping costs alone. The District plans to reinforce the combined interceptor system rather than separate it although the latter course is cheaper. This is because separa-

tion of the interceptors would also require separation of the street and trunk sewers, which the District fears is prohibitively expensive. The principal item of expense in this regard is reported to be the cost of separating the interior plumbing in the houses and buildings served.

TABLE 1.—*Comparison of costs for separating versus reinforcing combined intercepting sewer system*

Item	Cost:		Difference in cost
	Plan to separate combined sewers	Plan to reinforce combined sewers	
Upper Potomac interceptor relief:			
1-3-----	\$1,520,000	\$1,520,000	0
3-4-----	1,150,000	1,260,000	110,000
Rock Creek main interceptor relief:			
9-12c-----	1,520,000	1,520,000	0
13-14-----	210,000	1,340,000	1,130,000
4-5-----	740,000	3,960,000	3,220,000
Potomac River Sewage Pumping Station-----	2,771,000	4,136,000	1,365,000
Potomac River force main-----	4,900,000	8,670,000	3,770,000
East side interceptor relief sewage pumping station-----	573,000	1,645,000	772,000
East side interceptor relief:			
15-16-----	690,000	540,000	-150,000
16-17-----	1,450,000	2,380,000	930,000
Outfall sewer relief:			
17a-17-----	0	1,100,000	1,100,000
17-6-----	2,230,000	3,860,000	1,630,000
6-8-----	5,750,000	10,400,000	4,650,000
Main sewage pumping station-----	0	1,329,000	1,329,000
Overflows from interceptors to stream:			
5-----	50,000	1,000,000	950,000
8-----	360,000	1,700,000	1,340,000
West Rock Creek Diversion sewer extension-----	0	140,000	140,000
Total-----	24,214,000	46,500,000	22,286,000

¹ The source of these figures is table 23, Report to District of Columbia Department of Sanitary Engineering on Improvements to Sewerage System, Board of Engineers, Feb. 28, 1957.

Because many trunk sewers in downtown Washington are now too small, the District is undertaking a major sewer construction program. The purpose of this program is to relieve storm flooding. A number of new sewers will be built to increase the capacity of the existing ones. The cost of this project has been estimated at \$57,190,000 in the report cited in table 1. All of this work will be done in the section of the city served by combined sewers. If the new sewers are installed merely to increase the capacity of the existing ones, the \$57,190,000 would be invested in perpetuating the combined sewerage system. Adding the \$22,256,000 that would be similarly expended, as described in the above paragraph, one finds that a total of \$79,446,000 would be spent in revitalizing the combined sewerage system. If this course were taken, there can be no doubt that Washington would forever be married to a system of combined sewers.

This, however, need not be the case. Indeed, the necessity for sewer relief in the combined system presents a great opportunity to take major immediate steps toward separating the sewerage system. The Director of Sanitary Engineering is seeking to take advantage of this opportunity. Accordingly, in contracting for the detailed engineering design of relief trunk sewers for one of the combined areas, he has asked that a study be made to determine if any construction features can be incorporated to facilitate future separation. A preliminary draft¹ of a portion of the report points to definite possibilities

¹ Convertibility of L Street Sewers After Relief to Modified Combined Sewerage System, Slash Run Area, Rummel, Klepper and Kahl, undated, Baltimore, Md.

in this direction. The relief trunk capacity may be provided in the form of 2 sewers rather than 1. One of the new sewers can be sized to serve as a sanitary sewer in the future. For the time being, the two sewers would be interconnected, but as separation commenced in the future, the systems could readily be separated by breaking the limited number of interconnections. It was pointed out that, unless this were done, it would be extremely expensive and difficult to install some portions of the sanitary sewers in the future.

For yet another reason, the present time, rather than the future, is most propitious for the elimination of combined sewers in the older parts of the District, particularly south of Florida Avenue. During the last 20 years, this area has been changing rapidly. Many original buildings have been replaced with modern ones which have completely separate interior plumbing systems. Many old buildings have been removed to provide automobile parking space. Entire large areas, totaling nearly 1,200 acres in the central city, are being systematically redeveloped, with public subsidy, and should be rebuilt in less than 10 years. Each such change reduces the task of separation and should be used fully to achieve this end.

The opportunity now is especially apparent in the Slash Run area. With many of the original buildings nearing a century in age, the relatively near future of this area is a general complete rebuilding and separation would be facilitated in the course of it. It can be done more cheaply because of the impending rebuilding than at any time to come. Of course, any separation plan requires a second drainage system, just as newer areas served on the separate plan. Accordingly the construction of such a second system should be considered as an expense of adequate drainage rather than a cost of separation. The cost of separation should be considered only that necessary to connect separately the storm and sanitary drainage from a property.

A block-by-block study of sewers in each subarea would be required to develop the most economical plan for separation. In the upper reaches of an area, the existing lines could probably be kept to serve as a sanitary system. Going downstream perhaps to where the pipe sewers change to monolithic construction, the sanitary flow would be diverted to a new sanitary line from that point downstream. Above this point, the necessary storm drainage lines would be built to serve catch basins intercepting street drainage. Such lines could be appreciably shallower than the former combined sewer. While admittedly an expedient, the private property storm outlets might be discharged to the curb to save construction of new storm drainage lines to each abutting property. From the point of monolithic construction downstream, the existing storm drainage capacity would be retained.

In attacking the problem of separating storm and sanitary drainage on private property, it should be remembered that lines carrying these discharges are not hopelessly intermingled in buildings but that these flows are brought together in or below the building basement where a single discharge to a combined sewer is used. Certainly, the cost of under-basement-floor construction is high, but this could be avoided by bringing the storm water line through the basement at minimum cost to connect to the storm water sewer. The character of the existing buildings where this step would be required is such that, in the great majority of cases, this method of plumbing

would be satisfactory. It is earnestly believed that costs of separating drains on private property, the principal deterrent to separation, would be much less for the Slash Run area and similar ones than that being used in current estimates.

It may be argued that, for a portion of the money spent on separating the combined sewerage system, the degree of treatment provided at the treatment plant could be increased more than enough to offset the combined overflows to the rivers. Why not, then, allow the sewers to remain combined and further expand the sewage treatment plant? It is true that, in this way, the *total* pollution load discharged to metropolitan waters could be reduced. However, Rock Creek and the upper portion of the Potomac in the metropolitan area would not be cleaned up. The maximum beneficial use of these waters would continue to be denied. As the metropolitan area continued to develop, the overflows to these waters would increase, as would the concentration of sanitary sewage in the discharges. Thus, the object of separation would not have been achieved. It should be remembered that a cost comparison between engineering solutions of a problem are valid only when their results are the same or practically the same.

A recent engineering report¹ stated:

Combined sewers result in a second-rate system which can never satisfactorily serve either of its intended functions.

In view of this fact and the above discussion, it appears to be the course of wisdom for the District of Columbia to increase substantially the activity of its program aimed toward complete separation of its sewers. Only in this way can fully satisfactory sewer service be rendered and the Potomac and Anacostia Rivers and Rock Creek be protected, to the maximum reasonable extent, from sewage pollution.

As an immediate initial step in that program, it is recommended that the District of Columbia Board of Commissioners amend the plumbing code to require that *all* new buildings and existing buildings undergoing major reconstruction install completely separate systems of interior plumbing. In the course of the years ahead, particularly in the rapidly rebuilding downtown areas, this regulation will greatly reduce the cost to the city of separating interior plumbing. Since new construction in the 61 percent of Washington which is separately sewerized must now comply with this requirement, it cannot be considered unfair to anyone to make the requirement uniform.

Another recommendation for the initial phase of the program is that an intensive study of the Slash Run and other old and rapidly rebuilding drainage areas be made to determine the most economical means of separating the sewers. This study should not include detailed engineering design of the sewers, but should review each existing sewer to determine how it best might be utilized to reduce the cost of new construction that will be required to separate the system.

It is recommended that an active and progressive program of separation then be implemented. Such a program will have to be carefully planned over the years ahead in order to take maximum advantage of all forms of urban renewal, street and highway construction, and other features which can reduce the cost and inconvenience to the public. A priority of construction should be established to separate those areas first where the greatest quantity of

¹ Metropolitan Tacoma Sewerage and Drainage Survey, p. 148, Brown & Caldwell, San Francisco, Calif., June 1957.

sanitary sewage can be removed from the storm sewer system per dollar spent. This will provide the greatest rate of reduction of sanitary discharges to the streams.

With reference to the District's plan to relieve downtown sewers to prevent flooding, it is recommended that all relief capacity be installed in the form of two or more sewers. One of the sewers should be sized for the ultimate sanitary flow of the area served. Initially, this sewer should be interconnected with the combined system. New buildings should be required to connect to the sewers as if they were separate and, after rebuilding in the area has progressed to a certain point, the interconnections should be broken and the systems separated.

It is recommended that all expenditures on the combined sewerage system which are not designed toward separation be kept to an irreducible minimum. In keeping with this philosophy, it may be necessary to permit existing overflow discharges to continue for some time. In the long run, however, it is better to wait a little longer, if necessary, for separation to reach the point where the discharges of sanitary sewage are permanently eliminated than to expand the combined system. As separation progresses, these discharges will diminish and a pronounced improvement in the streams will be evident long before complete separation is achieved.

8. *Shall the metropolitan portion of the Potomac River above 14th Street be converted into a recreational basin suitable for swimming, fishing, and boating?*

The need for aquatic recreational facilities in or near metropolitan Washington is great. The nearest bathing beaches are on the Chesapeake Bay and its estuaries, approximately 40 miles away. To appreciate the intense desire of metropolitan Washingtonians for swimming, boating, fishing, and other recreational, spiritual, and esthetic values derived from large bodies of water, one need only brave the summer weekend traffic to and from the bay. Despite considerable progress in road improvement, the trip to and from the beach is frequently so tedious and vexing that it negates much of the benefit of the holiday. The rising population of the metropolitan area and the increasing number of cars per family augur intensification of road and beach crowding. If a major new water playground can be provided, it would significantly add to the many pleasures and benefits enjoyed by residents and visitors in the National Capital area.

It has been estimated, as reported in the staff document on sewage disposal, that, for \$25 million to \$30 million, the Potomac River above the 14th Street Bridge could be restored to and maintained in a state of cleanliness that would permit swimming, boating, fishing, and other related uses.

As discussed in this report, one or more large impoundments are required on the Potomac in order to store drinking water and to remove the silt load from the river. At least one of the major impoundments will probably be constructed near Washington for reasons previously cited. The size of such a reservoir has not yet been determined, but it is safe to conclude that it will be large enough to permit considerable recreational use except in the proximity of the water-supply intake. This use can include swimming, fishing, boating, water skiing, picnicking, and the like. Some of these sports could be more fully enjoyed than on the Potomac because of the greater width of the reservoir.

PREDICTED FLUCTUATIONS IN LEVEL OF 215 FOOT NORMAL ELEVATION RESERVOIR AT RIVERBEND

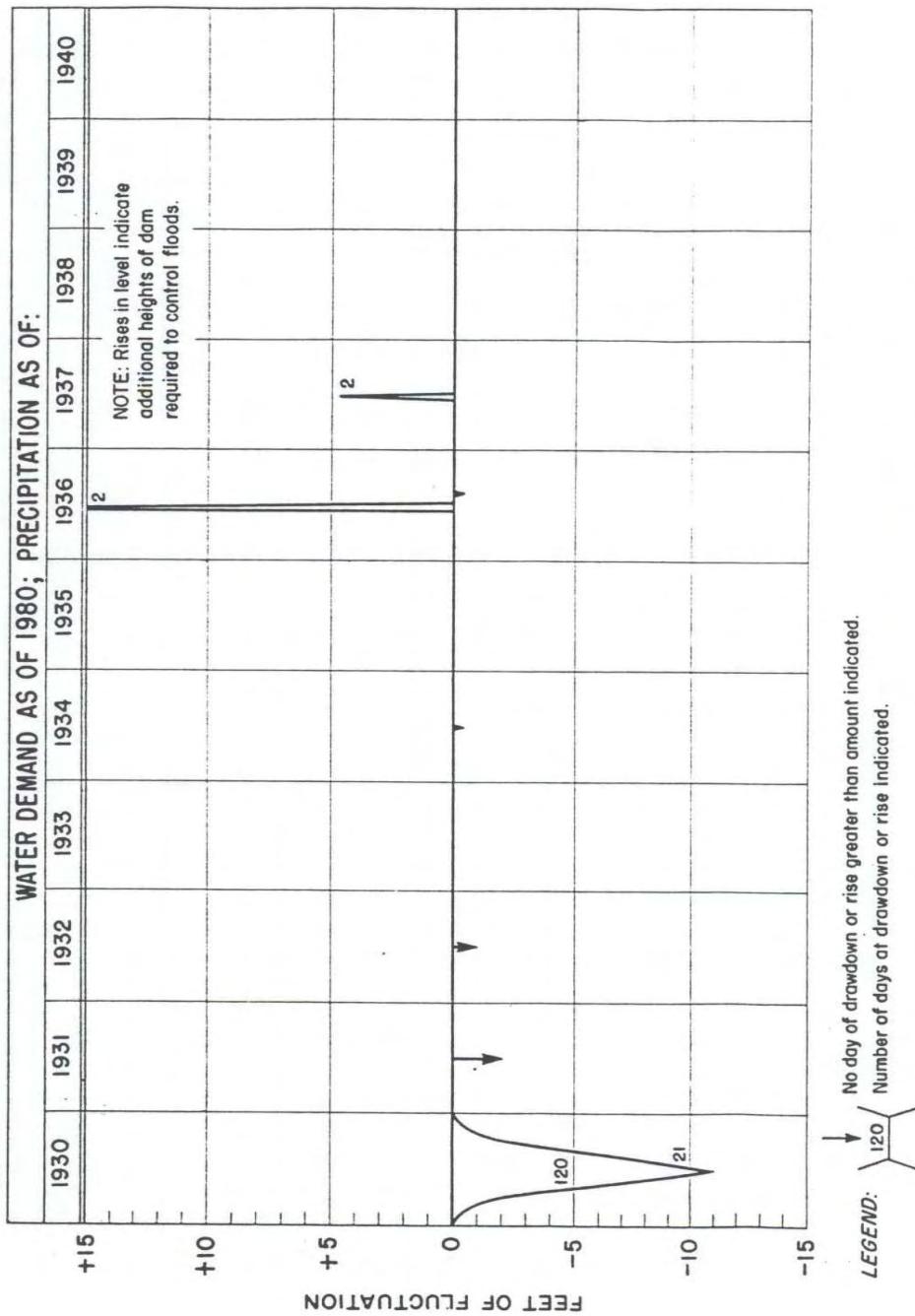


FIGURE 5.—Water-level fluctuation at Riverbend, assuming 215-foot reservoir elevation

PREDICTED FLUCTUATIONS IN LEVEL OF 235 FOOT NORMAL ELEVATION RESERVOIR AT RIVERBEND

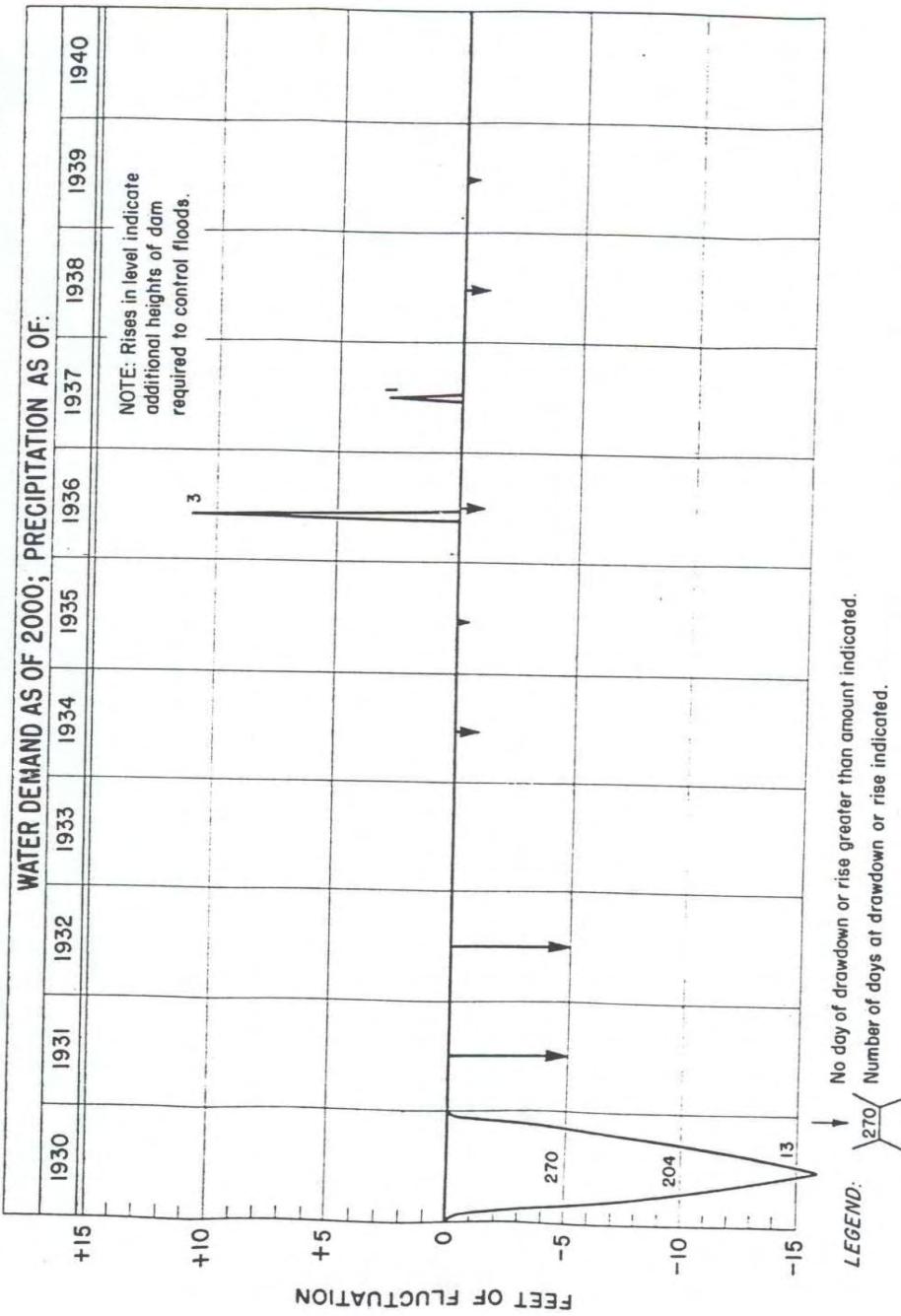


FIGURE 6.—Water-level fluctuation at Riverbend, assuming 235-foot reservoir elevation

The section Discussion of Public Hearings presents the various viewpoints concerning recreational use of a large reservoir. Many of those who denied that any recreational advantage would accompany creation of an impoundment did so on the grounds that sports such as rock climbing and white-water canoeing would suffer. This is undoubtedly true. However, the swimming, boating, fishing, and mere spectator enthusiasts far outnumber the exponents of the more rugged types of active leisure, as can be seen by comparing the many thousands of Washingtonians who descend upon the beaches to the hundreds who recreate along the upstream Potomac Valley on a typical summer weekend. A major fresh-water lake near Washington would undoubtedly attract hundreds of thousands of visitors annually.

The other principal argument against recreational use of a large reservoir above Washington was that the fluctuations in water level resulting from operating the reservoir as a source of water supply would create a wide band of mud flats around the lake, making it unattractive and inaccessible. While the reservoir level will fluctuate as contended, major fluctuations will be relatively unfrequent. The Corps of Engineers was asked to analyze this problem, and responded with the information on which figures 5 and 6 are based.

The figures present the calculated future fluctuations in water level corresponding to two possible dam elevations that could be constructed at Riverbend. It was necessary to assume amounts of precipitation to make the calculations. The actual precipitation figures for the 11-year cycle, 1930 through 1940, were chosen for the analyses because this period includes the maximum and minimum Potomac River flows of record. Water demand conditions also had to be assigned. The predicted demand for 1980 was used for the 215-foot normal elevation reservoir and that for 2000 was used for the 235-foot normal elevation reservoir. At these dates, the respective reservoirs will be at the two-thirds point of the period in which each can supply the total demand anticipated for it. The demands include the quantities required for water supply and pollution abatement. These predicted respective quantities for 1980 are 700 million and 1,000 million gallons per day, and for 2000 they are 1,000 million and 1,460 million gallons per day.

At 215 feet of elevation, the reservoir would have a surface area of approximately 24,000 acres. A 5-foot drop in elevation would expose approximately 2,000 acres of shoreline. At 235 feet, the surface area would be approximately 35,000 acres and a 5-foot drop in elevation would expose approximately 3,000 acres of shoreline. The width of band created by the 5-foot drawdown would probably vary for the most part between 20 and 60 feet. At any particular spot, of course, this would depend on the steepness of the bank. Reference to the figures shows that shoreline bands of this width range or greater would only occur to any appreciable degree when conditions similar to the 1930 drought reoccur. Drawdowns of 5 feet would also occur under conditions similar to those of 1931 and 1932, but would not exceed 1 day in duration for any such drawdown. It is also shown that increased dam elevations would be necessary, although only needed for several days, to control floods equal to those of 1936 and 1937. Based on these calculations, it is fair to conclude that level fluctuation will not interfere with recreational use of a reservoir at

Riverbend except during relatively rare periods of extreme flood or drought.

Recreational use of the Potomac above the 14th Street Bridge will increase as the river is cleaned up. In view of the above discussion, however, it is recommended that the water supply and silt control reservoir, which will probably be constructed in the upstream vicinity of Washington, be used as a recreational basin for water sports including swimming. In anticipation of this development, it is recommended that consideration of the special construction that would be associated with the creation of a protected basin above the 14th Street Bridge be deferred.

9. *For what period into the future should plans and construction be undertaken?*

The general considerations of this question are identical with those discussed in answering No. 5 of the water supply questions in this section.

Specifically it is recommended that all street sewers be built to accommodate the total ultimate sewage flow from the area served. Trunk and interceptor sewers should be built to accommodate flows anticipated for 50 to 75 years in the future. In some instances, it will be necessary to build small treatment plants to serve until the gap between developed areas is narrowed. Such plants should be recognized as having a temporary life only and should be abandoned when the system served can be joined to the major area system. Important characteristics of principal sewage treatment plants, such as site location, site size and ultimate plant capacity and type of treatment, should be planned for 75 to 100 years in the future. The minimum span for construction stages based on the ultimate plan is recommended as 25 years.

10. *What is the best means for financing the necessary organization, administration, engineering, and construction to attain the desired goals?*

This is the same as the answer to question No. 6 relating to water supply.

PART VI

CAPITAL COSTS ASSOCIATED WITH RECOMMENDATIONS

Several of the items recommended obviously require detailed studies to determine reliable cost estimates. Estimates for other items are available from engineering studies already made or are readily obtained from various financial statements. An array of the costs which can be accurately or even roughly supported will be helpful in arriving at an appreciation of the dollar magnitude of the plan advocated in this report.

NORTHERN VIRGINIA SANITATION AUTHORITY

The indebtedness that would be assumed by the Northern Virginia Sanitation Authority upon its creation as recommended would be constituted as given in table 2.

TABLE 2.—*Costs associated with formation of Northern Virginia Sanitation Authority*

ASSUMPTION OF PUBLIC INDEBTEDNESS

Existing agency	Water indebtedness	Sewer indebtedness
Arlington County.....	\$2,731,240	\$3,800,000
Alexandria Sanitation Authority.....	0	\$,125,000
City of Alexandria.....	0	¹ 2,000,000
Fairfax County.....	0	20,000,000
Town of Fairfax.....	300,000	1,367,000
Falls Church.....	1,504,000	49,000
Vienna.....	(²)	(²)
Herndon.....	94,400	143,000
Miscellaneous.....	500,000	500,000

¹ Estimated.

² No breakdown, total for both: \$1,230,000.

ESTIMATED COSTS OF ACQUIRING PRIVATE SYSTEMS		
Water.....		\$5,000,000
Sewer.....		500,000

ESTIMATED EARLY CONSTRUCTION COSTS		
Water.....		\$35,000,000
Sewer.....		(¹)
Total estimated cost.....		² 82,843,640

¹ Not estimated.

² Plus early sewer costs.

NOTE.—Assumption of public indebtedness does not represent new costs to consumers. They are currently paying that indebtedness through service charges.

The outstanding indebtedness of public systems which would become part of the authority were obtained from the agencies listed. The cost of acquiring existing privately owned systems was obtained from the sales agreement concerning the Annandale system and the updating of existing engineering estimates. The estimated early construction costs for the water supply system are based on engineering estimates prepared for the Fairfax County Water Authority.¹ These estimates have been liberalized to allow for intervening cost increases and to include the portions of the authority outside Fairfax County.

Unfortunately, no figure can be presented for early sewerage system construction because the formation of the authority would undoubtedly have a major effect on existing planning. Some study would be required before any cost figure could be assigned here.

When studying table 2, one should bear in mind that the assumption of the outstanding indebtedness by the authority does not constitute new costs to residents in the area. These residents are, of course, now paying service charges designed to meet this indebtedness.

WASHINGTON SUBURBAN SANITARY COMMISSION

Costs of this plan exceeding those now obligated or contemplated by the Washington Suburban Sanitary Commission would be indicated by the study recommended to determine whether areas not within the sanitary district should request to join. Until the study is made, it is not possible to evaluate, even approximately, what, if any, the cost of extending the sanitary district would be.

DISTRICT OF COLUMBIA

The major costs to the District of Columbia, beyond expenditures now obligated or contemplated, would be associated with increasing the rate of separating the combined sewers. It is, of course, impossible to program these costs accurately in advance of the detailed study recommended. However, an approximate figure offered to propose a reasonable rate of attack on the problem over the next 10 to 12 years is \$100 million. This does not include the planned construction to provide relief trunk sewers downtown to prevent flooding. It does include, however, funds now planned for increasing the capacity of the combined sewer system on the assumption that these funds would be diverted to separation.

WASHINGTON AQUEDUCT

Should the Northern Virginia Sanitation Authority elect the option of turning over its water treatment plants to the Washington Aqueduct, the \$5 million cost of acquiring these systems would be assumed by the aqueduct rather than by the Authority. In this event, the sum would be deleted from table 2.

Should the Washington Suburban Sanitary Commission decide to transfer its water treatment plants to the Washington Aqueduct, the aqueduct would assume the outstanding indebtedness for these plants. That amount is \$8,191,000. Again, it should be pointed out that, in this type of transaction, no additional cost is incurred by the population served.

¹ Fairfax County, Résumé of Engineering Studies and Reports on Comprehensive Water Supply Plan. Alexander Potter Associates, March 26, 1956.

It is estimated that the approximate cost of land acquisition for the probable construction of a water supply impoundment at Riverbend is \$20 million.¹ This expenditure is included here only because the land purchase is advocated now to preclude paying for substantial increases in future land costs.

The cost of construction of the recommended upstream intake conduit is based on a 1946² estimate which has been adjusted for increased costs and is approximately \$20 million.

¹ This independent estimate is based on average county land values assuming a purchase of 40,000 acres. Independent estimate by the Corps of Engineers, based on sample appraisals, produced approximately the same figure.

² Adequate Future Water Supply for the District of Columbia and Metropolitan Area, H. Doc. No. 480, 79th Cong., 2d sess., February 19, 1946.

