85th Congress
2d Session

COMMITTEE PRINT

# WATER SUPPLY

## STAFF REPORT

PREPARED FOR THE

## JOINT COMMITTEE ON WASHINGTON METROPOLITAN PROBLEMS

ON

## WATER SUPPLY IN THE WASHINGTON METROPOLITAN AREA

APRIL 1958

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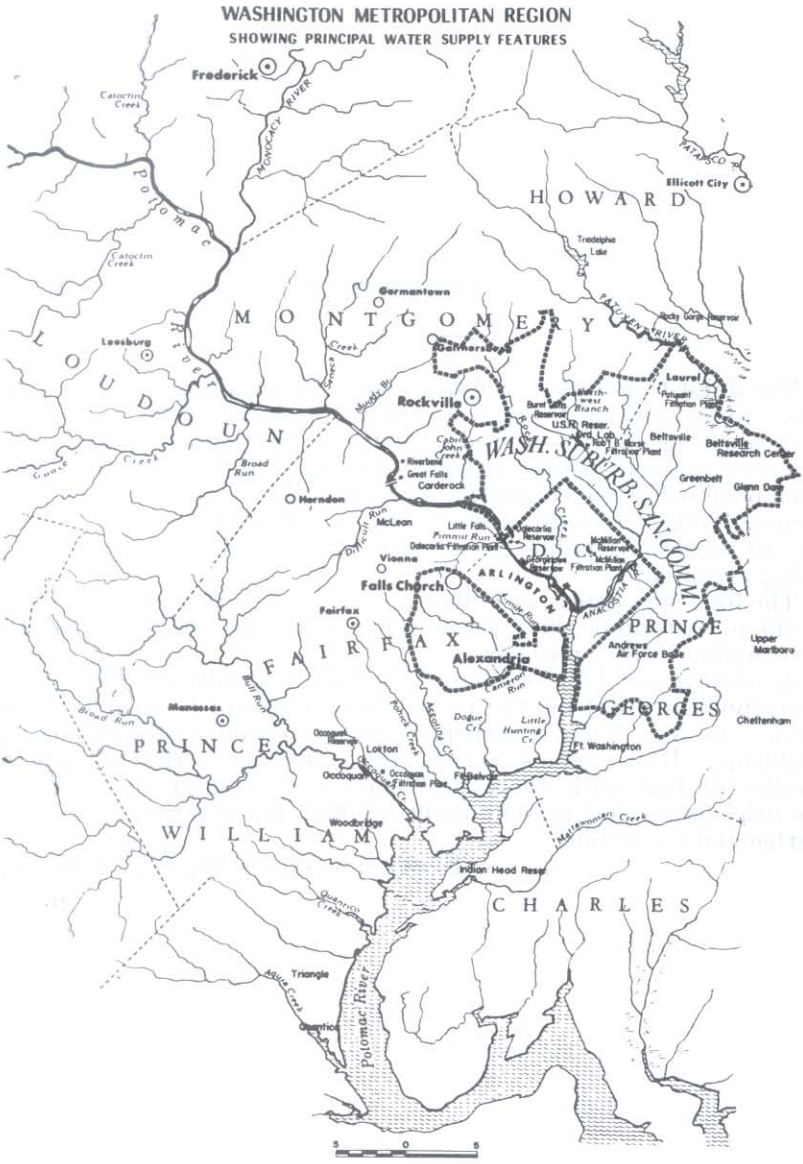
## FOREWORD

The Joint Committee on Washington Metropolitan Problems, pursuant to the terms of House Concurrent Resolution 172, 85th Congress, is conducting a series of studies of the growth and expansion of the Washington metropolitan region. The scope of this investigation has been outlined in the committee's progress report, published as Senate Report 1230. To facilitate studies by the committee and the presentation of material in public hearings, a series of staff working papers are being prepared.

The following paper, by Gilbert V. Levin, Resources Research, Inc., is one of a group of three working papers dealing with aspects of the metropolitan water problem.

As a background for hearings of the Joint Committee on Washington Metropolitan Problems the present report should be read as a companion to Mr. Levin's earlier report on Potomac River pollution problems. Both papers review the extensive series of previous studies dealing with these problems, and attempt to clarify the essential issues and present them for the consideration of the committee and the public.

FREDERICK GUTHEIM, *Staff Director.*


WASHINGTON METROPOLITAN REGION
SHOWING PRINCIPAL WATER SUPPLY FEATURES
Frederick
Catoctin Creek
MONOCACY RIVER
Potomac
Catoctin Creek
Leesburg
LOUDOUN
RIVER
Goose Creek
Broad Run
Herndon
Dulles Int'l Airport
McLean
Vienna
Falls Church
Fairfax
Broad Run
Manassas
PRINCE
WILLIAM
Occoquan Reservoir
Occoquan
Occoquan Filtration Plant
Woodbridge
Quantico Creek
Triangle
Aquia Creek
Quantico
Potomac River
Germantown
MONTGOMERY
Seneca Creek
Middle Br.
Rockville
Cabin John Creek
Riverbend
Great Falls
Carderock
Little Falls
Pimmit Run
Dalecarlia Reservoir
Dalecarlia Filtration Plant
Georgetown Reservoir
McMillan Reservoir
McMillan Filtration Plant
ARLINGTON
Four Mile Run
Alexandria
Potomac Creek
Accotink Creek
Dogue Cr.
Little Hunting Cr.
Ft. Washington
Piscataway Creek
Indian Head Resv.
CHARLES
HOWARD
Ellicott City
Tridelphia Lake
Rocky Gorge Reservoir
Patuxent River
Laurel
Patuxent Filtration Plant
Burnt Mills Reservoir
North-west Branch
U.S.R. Reser.
Bird. Lab.
Hall E. Bare Filtration Plant
Beltsville
Beltsville Research Center
Greenbelt
Glenn Dale
WASH. SUBURB. SAN. COMM.
Anacostia River
D. C.
PRINCE GEORGES
Andrews Air Force Base
Upper Marlboro
Cheltenham
Patapsco R.
3 0 3

# WATER SUPPLY IN THE WASHINGTON METROPOLITAN AREA

## INTRODUCTION

Until the beginning of the 19th century, the residents of Washington carried their drinking water from the area's "many sweet rivers and springs" first described by Capt. John Smith. In signing the first Act of Incorporation of the City of Washington, President Jefferson, in 1802, granted authority to the city "to sink wells and erect and repair pumps in the streets." In 1809, the city appropriated $300 to be applied to the laying of a pipe to convey water a distance of several blocks from a spring at 9th and F Streets NW. The piping and distribution of water from springs and the maintenance of public wells became inadequate as the city grew. By midcentury, water supply assumed the proportions of a major problem. In 1850, Congress appropriated money for a study of "the most available mode of supplying water" to the city.

## WASHINGTON AQUEDUCT

The Army Corps of Engineers was assigned to make the study and had the considerable foresight to recommend obtaining water from the Potomac River at Great Falls. Congress approved the plan and appropriated funds to construct intake works, a conduit from Great Falls to Dalecarlia, reservoirs at Dalecarlia and Georgetown, and ancillary facilities.

The Civil War delayed construction, and it was not until 1863 that the planned works were completed. An organization within the Corps of Engineers, named the Washington Aqueduct, was created by the Congress and assigned permanent responsibility for supplying and distributing water to the Federal City. In 1882, Congress gave the municipal government of the District of Columbia the responsibility for distributing the water supplied by the Washington Aqueduct. This pattern of joint responsibility continued and, today, the Washington Aqueduct performs the water supply operations that might best be described as "wholesaling" and the District of Columbia performs the "retailing" functions.

In 1905, with the construction of the McMillan filtration plant, the supply was filtered for the first time. This plant was supplied by tunnel from the Georgetown Reservoir to a reservoir built at McMillan. Pumping facilities were provided to serve areas that could not be served by gravity. Coagulation and chlorination were introduced in 1913 and 1922, respectively. In 1928, the Dalecarlia filtration plant was completed along with a second conduit from Great Falls, various pumping stations, and transmission pipelines. Many additions and

extensions to the distribution system were made by the municipal government of the District of Columbia.

Too much cannot be said about the great foresightedness of the plan to tap the Potomac River in 1850. At that time the population of Washington was 40,000 and Georgetown contained another 8,000 persons. Smaller and more convenient sources of water could have satisfied the immediate demand, and, in the view of many, the demand for the foreseeable future. Rock Creek, which was favored as the best source by an earlier report, was rejected by Congress. Great Falls was 9 difficult construction miles from the receiving reservoir to be built at Dalecarlia, but it offered an intake location not likely to be polluted with sewage for a long time to come. The conduit constructed to bring the water from Great Falls was 9 feet in diameter. It had a capacity in excess of 106 million gallons per day, certainly more than 35 times, and probably more than 50 times, the water demand in 1850.

No other engineering works in or around Washington has since displayed such bold planning and scope. The works conceived under this plan will shortly complete a full century of excellent service, and will continue their usefulness for many years to come. They provided a framework that did not have to be abandoned and built anew periodically, but one that could remain as the active core of a growing system. This system must now be expanded again to provide for the near future. The population to be served will shortly increase to the point where the free flow of the Potomac can no longer guarantee a continued adequate supply. Various plans for storing the flow of the river are now being examined.

### WASHINGTON SUBURBAN SANITARY DISTRICT

Another act of great foresight was the creation of the Washington Suburban Sanitary Commission in 1918. The Commission purchased the existing water systems of towns and real estate developments and began supplying water to portions of the Maryland region of the Washington metropolitan area. Over the years, it developed ground and surface water sources and built filtration plants to meet the needs of the time. Gradually, the distribution systems in the sanitary district were united until a single system now supplies most of the area. The principal source of water is the Patuxent River, but it is no longer adequate, and plans have been approved to tap the Potomac River.

### VIRGINIA

The Virginia portion of the Washington metropolitan area has a history of small ground water supplies and the impoundment of minor streams. The principal deviation from this pattern was introduced in 1926 when the District of Columbia was authorized to sell water to Arlington County. Washington water is also supplied to Falls Church and a small area adjacent to that city. The water supply situation is complicated by the existence of a great many private companies which wholesale and retail water. All of these sources and systems, however, are now, or shortly will be, inadequate. Like Washington and suburban Maryland, suburban Virginia must make plans to secure additional water.

Today, the Washington metropolitan area faces a decision regarding its water supply which is similar to that which confronted the District of Columbia more than a hundred years ago. It must decide whether to undertake a plan that will provide for the century to come, or whether, by temporary expedients, to postpone for several years at a time the inevitable impact of the future.

## WATER REQUIREMENTS

### TYPES OF USE

Almost all of the water requirements in the Washington metropolitan area are for domestic and commercial uses. The industrial demand on the drinking water supplies is relatively small. The largest consumers of industrial water in the area, the power companies, obtain the great quantities of cooling water they require directly from the rivers. With the possible future exception of the new power plant to be built at Dickerson, Md., this use of cooling water does not interfere with any of the domestic supply sources.

### QUANTITIES NEEDED

The total water demand of the Washington metropolitan area is increasing rapidly for two reasons. First, and of greatest significance, is the phenomenal increase in population. Periods of war, depression, or prosperity increase the normal growth of the Nation's Capital. History has shown that during the realtively stable times that follow important periods of change, the population never recedes to its former level. It may dip somewhat, but it soon begins its ascent again. Table 1 (1) shows the population growth and forecast from 1950–2000 for the Washington standard metropolitan area, as defined by the United States Census.

TABLE 1.—*Population growth and forecast, 1950–2000, Washington standard metropolitan area*

| Area | Census, Apr. 1, 1950 | Estimate, Jan. 1, 1958 | Forecast, Apr. 1, 1960 | Forecast, July 1, 1965 | Forecast, Apr. 1, 1980 | Forecast, Apr. 1, 2000 |
|---|---|---|---|---|---|---|
| Washington, D. C | 802,178 | 865,000 | 870,000 | 890,000 | 940,000 | 1,000,000 |
| Montgomery County, Md | 164,401 | 317,000 | 355,000 | 435,000 | 670,000 | ---------- |
| Prince Georges County, Md | 194,182 | 336,000 | 375,000 | 460,000 | 770,000 | ---------- |
| Maryland suburban | 358,583 | 653,000 | 730,000 | 895,000 | 1,440,000 | 2,150,000 |
| Arlington County, Va | 135,449 | 169,000 | 180,000 | 190,000 | 210,000 | ---------- |
| Alexandria, Va | 61,787 | [1] 90,000 | 95,000 | 105,000 | 125,000 | ---------- |
| Falls Church, Va | 7,535 | 10,200 | 11,000 | 12,000 | 15,000 | ---------- |
| Fairfax County, Va | 98,557 | 218,000 | 247,000 | 318,000 | 570,000 | ---------- |
| Virginia suburban | 303,328 | 487,000 | 533,000 | 625,000 | 920,000 | 1,650,000 |
| Metropolitan area | 1,464,089 | 2,005,000 | 2,133,000 | 2,410,000 | [2] 3,300,000 | 4,800,000 |

[1] Alexandria city annexed 7.5 square miles from Fairfax County in 1952.
[2] In addition, Prince William County, Va. (forecast 200,000 population in 1980) will be included in the metropolitan area in 1980.

The second reason for the past and predicted increases in water consumption is the continuing rise in per capita consumption. Air conditioners, garbage grinders, dishwashers, washing machines, and

many other household and commercial appliances have 3 prodigious thirsts. Newer homes have increased plumbing facilities to make more water available for our ever-improving standards of cleanliness. The greatest increase in population is in the suburban areas where people live in individual houses with lawns to irrigate. More cars per family mean more car washing. And now the swimming pool business is beginning to go into mass production in the Washington metropolitan area. As stated, the Washington metropolitan area has very little heavy industry. Should industry move into the area, its needs will be reflected in a material rise in per capita water consumption.

The Washington Suburban Sanitary District recently (2) estimated its average per capita daily water consumption on the basis of its experience to date as follows:

| Year: | *Average gallons per capita per day* |
|---|---|
| 1960 | 81. 0 |
| 1970 | 88. 0 |
| 1980 | 95. 0 |
| 1990 | 102. 0 |
| 2000 | 108. 0 |

By contrast, recent per capita consumption in the District of Columbia proper has decreased somewhat. Usage dropped from 168 gallons per capita per day in 1955 to 156 in 1956 and 135 in 1957. This reversal, at least in part, is due to the effect of a substantial water and sewage rate increase in 1954. A regulation requiring reuse of air conditioning cooling water was also enacted in 1954. Slum clearance has removed many connections from the District system, as has the construction of downtown parking lots. It is quite likely that the decline is but a temporary reversal in the trend of rising per capita consumption. Despite the per capita consumption decline within the city, the total demand on the system is rising. This is because of the rapid growth of the suburban areas served.

An engineering report (3) prepared for Fairfax County, Va., estimates per capita consumption increases as follows:

| Year: | *Average gallons per capita per day* |
|---|---|
| 1955 | 75 |
| 1970 | 95 |
| 1985 | 110 |
| 2000 | 120 |

The above figures are average consumption values. A water system must be designed to accommodate peak demands. Peak demands in the Washington metropolitan area vary from 1.5 to 1.8 times the average daily consumption.

Estimates prepared (4) for Arlington County projected the following consumption figures:

| Year: | *Gallons per capita per day* |
|---|---|
| 1955 | 90 |
| 1970 | 110 |
| 1985 | 120 |
| 2000 | 130 |

Taking the various factors influencing water consumption into consideration, recent engineering reports have estimated future water

# ERRATA SHEET

Substitute this table for table 2, page 5, "Water Supply" report. Note change in "Population" total and "Water consumption" total on last line, and deletion of footnote 3, "Estimated connected population."

TABLE 2.—*Population and water consumption estimates, Washington metropolitan area*

| Area | Year | Population | | Average water consumption (million gallons per day) | |
|---|---|---|---|---|---|
| | | (Source: Reference 5) | (Source: as referenced) | (Source: Reference 5) | (Source: As referenced) |
| Washington Suburban Sanitary Commission | 1960 | | 535,000 (3) | | 44 (3) |
| | 1965 | 895,000 | | 80.5 | |
| | 1970 | | 701,000 (3) | | 62 (3) |
| | 1980 | 1,440,000 | 867,000 (3) | 151.0 | 82 (3) |
| | 1990 | | 1,033,000 (3) | | 105 (3) |
| | 2000 | 2,150,000 | 1,200,000 (3) | 258.0 | 130.0 (3) |
| Washington, D. C | 1965 | 890,000 | | 154.0 | |
| | 1980 | 940,000 | | 172.0 | |
| | 2000 | 1,000,000 | | 193.0 | |
| Arlington County | 1960 | | 200,000 (4) | | 19.5 (4) |
| | 1965 | 167,000 | | 20.6 | |
| | 1970 | | 240,000 (4) | | 26.4 (4) |
| | 1980 | 190,000 | | 25.1 | |
| | 1985 | | 285,000 (4) | | 34.1 (4) |
| | 2000 | 210,000 | 330,000 (4) | 27.8 | 42.8 (4) |
| Falls Church | 1965 | 12,000 | | 1.5 | |
| | 1980 | 15,000 | | 2.0 | |
| | 2000 | 16,000 | | 2.1 | |
| Alexandria | 1965 | 110,500 | | 12.9 | |
| | 1980 | 125,000 | | 16.5 | |
| | 2000 | 130,000 | | 17.2 | |
| Fairfax County | 1965 | 318,000 | | 28.6 | |
| | 1970 | | [1] 235,000 (3) | | [2] 19.0 (3) |
| | 1980 | 570,000 | | 60.0 | |
| | 1985 | | [1] 275,000 (3) | | [2] 25.9 (3) |
| | 2000 | 900,000 | [1] 300,000 (3) | 108.0 | [2] 31.3 (3) |
| Prince William County | 1980 | 200,000 | | 18.0 | |
| | 2000 | 389,000 | | 41.0 | |
| Total at year 2000 | | 4,795,000 | | 647.1 | |

[1] Not including city of Falls Church.
[2] Assuming 85 percent of population connected.

requirements for the whole or portions of the Washington metropolitan area. The projected total average water demands contained in these reports have been summarized in table 2. The only report that considered the entire predicted metropolitan area developed a total average water demand of 650.1 millions of gallons per day by the year 2000. This estimate did not foresee the probable development of Loudoun County to the point where it will be included in the metropolitan area.

TABLE 2.—*Population and water consumption estimates, Washington metropolitan area*

| Area | Year | Population | | Average water consumption (million gallons per day) | |
|---|---|---|---|---|---|
| | | (Source: Reference 5) | (Source: as referenced) | (Source: Reference 5) | (Source: As referenced) |
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| | 1965 | 895,000 | | 80.5 | |
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| | 1990 | | 1,033,000 (3) | | 105 (3) |
| | 2000 | 2,150,000 | 1,200,000 (3) | 258.0 | 130.0 (3) |
| Washington, D. C | 1965 | 890,000 | | 154.0 | |
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| | 1965 | 167,000 | | 20.6 | |
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| | 1980 | 190,000 | | 25.1 | |
| | 1985 | | 285,000 (4) | | 34.1 (4) |
| | 2000 | 210,000 | 330,000 (4) | 27.8 | 42.8 (4) |
| Falls Church | 1965 | 12,000 | | 1.5 | |
| | 1980 | 15,000 | | 2.0 | |
| | 2000 | 16,000 | | 2.1 | |
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| | 2000 | 130,000 | | 17.2 | |
| Fairfax County | 1965 | 318,000 | | 28.6 | |
| | 1970 | | [1] 235,000 (3) | | [2] 19.0 (3) |
| | 1980 | 570,000 | | 60.0 | |
| | 1985 | | [1] 275,000 (3) | | [2] 25.9 (3) |
| | 2000 | 900,000 | [1] 300,000 (3) | 108.0 | [2] 31.3 (3) |
| Prince William County | 1980 | 200,000 | | 18.0 | |
| | 2000 | 389,000 | | 41.0 | |
| Total | | [3] 10,667,500 | | 650.1 | |

[1] Not including city of Falls Church.
[2] Assuming 85 percent of population connected.
[3] Estimated connected population.

Only one report (6) has dared to look at the water demand for the metropolitan area beyond the year 2000. Based on the same population projection as is reference 5, this report predicts an average demand of 1,390 million gallons per day to serve an estimated 10 million population in the metropolitan area in the year 2100.

## POLLUTION REQUIREMENTS

As explained in the companion joint committee paper entitled, "Sewage Disposal and Water Pollution in the Washington Metropolitan Area," the natural capacity of the Potomac River to assimilate sewage effluent is an essential component of any pollution abatement program. The flow in the Potomac River to which existing and planned abatement works have been designed has generally been

taken at 650 million gallons per day. Any flow substantially below this would be assumed to result in objectionable conditions arising in the river. Therefore, while the 650 million gallons per day is not a direct demand on the treated water supply, it is a demand on the river. The figure is not firmly established as much remains to be learned about the capacity of the river to assimilate pollution. But some minimum flow will be required to receive, dilute, assimilate, and carry away the pollution load in the treated sewage effluent. Reference 6 estimates that the 650 million gallons per day requirement will increase to 950 million gallons per day by 2000 and 2 billion gallons per day by 2100.

### IRRIGATION

A new, but rapidly increasing, trend toward agricultural irrigation in nearby farmlands has recently been described (7). As of 1955, irrigated lands were increasing at the rate of 8,000 acres per year. Frederick and Montgomery Counties have participated in this practice. Much of this irrigation water comes from surface supplies. If the practice continues to gain favor, farmlands in the Potomac Basin above the Washington metropolitan area will soon place a significant added demand upon the Potomac. Irrigation water would be diverted from the river during the summer months, the normal low flow period. Preliminary projections of the potential irrigation demands on the Potomac River were given in references 5 and 6. They were summarized as follows:

*Average demand during low flow periods*

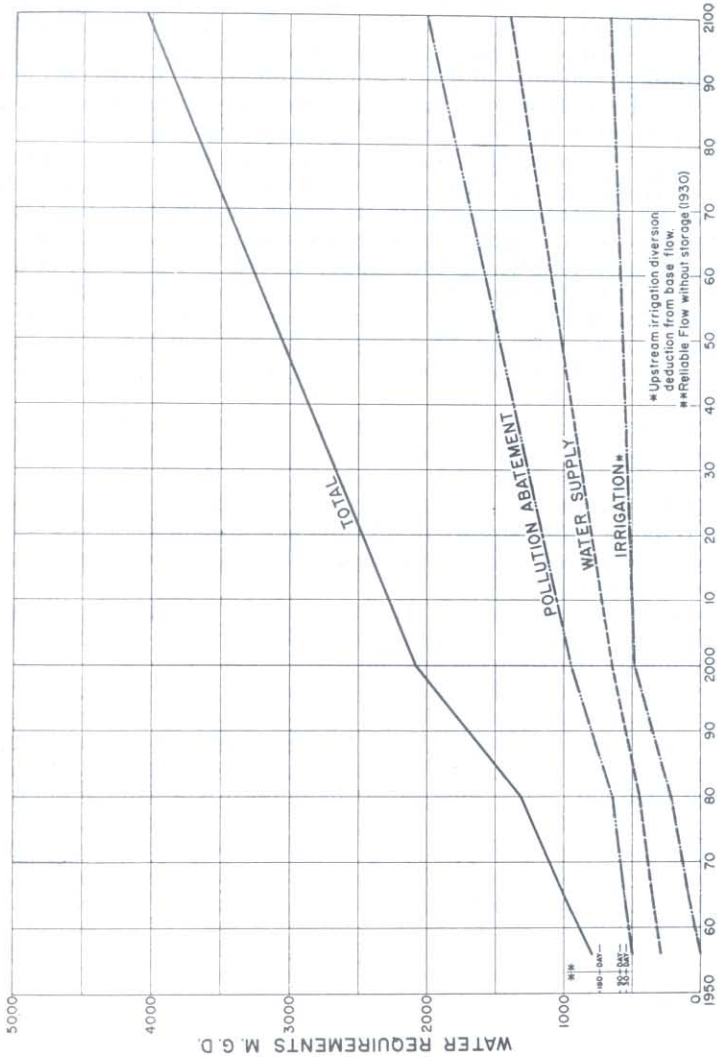
[Million gallons per day]

| Year | *Reference 5* | *Reference 6* |
|---|---|---|
| 1960 | 82 | --- |
| 1980 | 350 | 216 |
| 2000 | 770 | 480 |
| 2010 | 1050 | --- |
| 2100 | --- | 650 |

Figure 1 is taken from reference 6 and shows the domestic water supply needs, pollution abatement requirements, upstream irrigation potential, and the total water demand for the Washington metropolitan area up to the year 2100 as estimated in that paper.

FIGURE 1

TOTAL WATER DEMAND
WASHINGTON METROPOLITAN AREA




Source: "Potomac River Basin Studies, Byron Bird, 1957,"

MARYLAND

The Washington Suburban Sanitary Commission serves water to more than 500,000 people in the Maryland region of the metropolitan area. This constitutes service to more than 95 percent of the population within the sanitary district. The sanitary district and its principal transmission mains are shown in figure 2. The principal source of supply is the Patuxent River with impoundments of 7.0 and 6.4 billion gallons, respectively, at Brighton (Triadelphia Lake) and Rocky Gorge Dams. A 30 million gallon reservoir, the initial impoundment facility of the Commission, is at Burnt Mills on the Northwest Branch of the Anacostia. During the summer, its capacity is increased to 50 million gallons by the use of flashboards. Three wells supply water to the Forest Heights and Fort Foote communities south of Washington. Although the Commission, when first formed, declined an invitation to obtain its water supply from the District of Columbia system, it now has several emergency connections with the Washington system which can supply 4.5 million gallons per day.

Almost all of the water distributed by the Commission is treated at its Patuxent filtration plant near Laurel. The Robert B. Morse filtration plant at Burnt Mills serves as a standby facility for heavy demand periods. Filtered water storage totals 78 million gallons in 29 tanks.

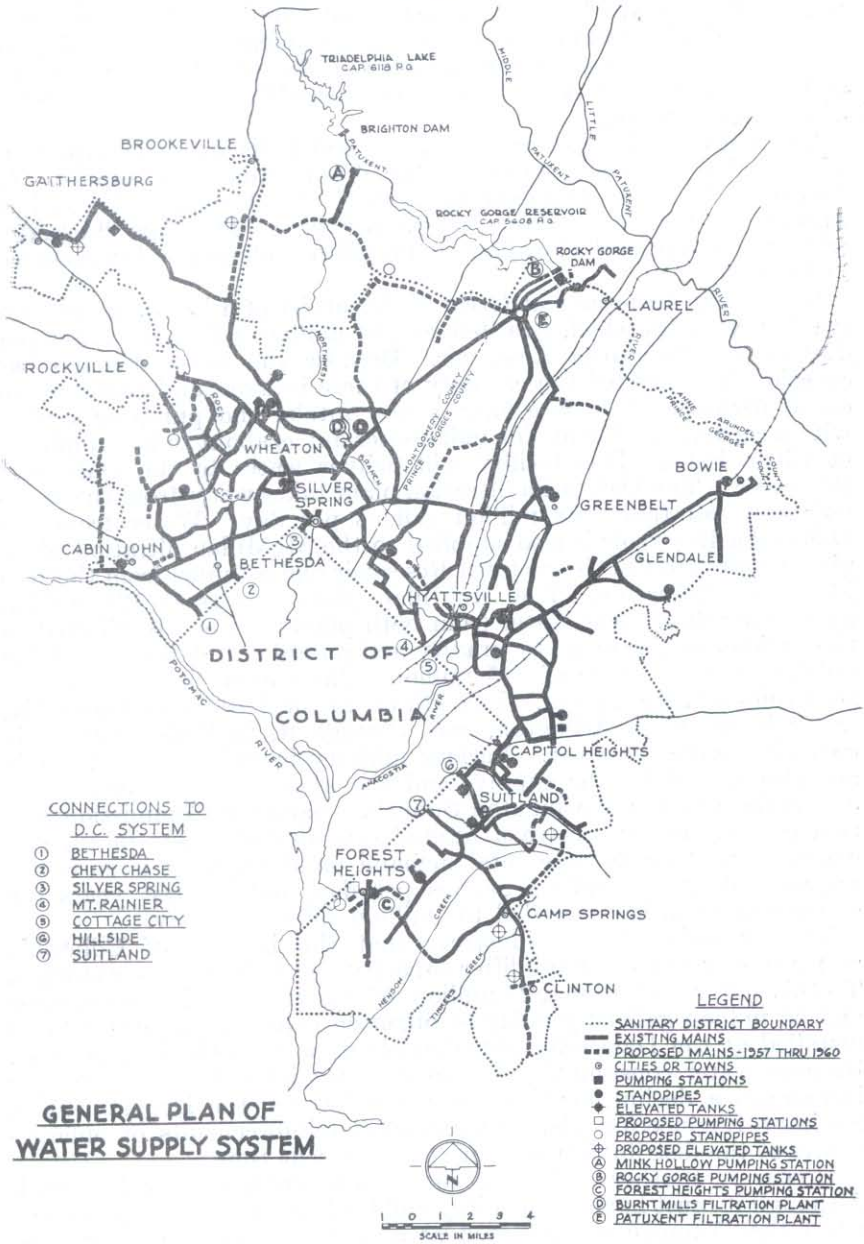
In the last 3 years, the population within the sanitary district has increased by 100,000. The average consumption in 1957 was 42 million gallons per day with a peak consumption of 76 million gallons on July 21 of that year. The sources of supply are no longer adequate as the reliable water supply of all the Commission's sources is approximately 42.5 million gallons per day. Plans have been made to obtain additional water.

Despite the water supply shortage, the Commission believes that the greatest problem facing it is probably that of expanding and reinforcing its distribution system.

The city of Rockville obtains its water supply from a system of approximately 40 wells reinforced by a connection to the Washington Suburban Sanitary District. The average demand is approximately 2 million gallons per day, of which about one-third is supplied by the sanitary district. The system is inadequate and major changes will shortly be initiated.

Upper Marlboro is supplied by a municipally owned system which obtains water from two wells. Each well has a safe yield of approximately 350 gallons per minute, and the system provides 100,000 gallons of storage.

FIGURE 2




Source: "Washington Suburban Sanitary Commission."

## DISTRICT OF COLUMBIA

Dating from the previously mentioned congressional actions of 1850 and 1882, the District of Columbia water supply has been operated jointly by the Washington Aqueduct of the United States Army Corps of Engineers and the District government. The Washington Aqueduct is responsible for developing the supply, treating and delivering the water to the District of Columbia owned and operated distribution system.

The Potomac River, now tapped at Great Falls and to be tapped at Little Falls, is the sole source for the Washington water supply. In this area, the river has a drainage area of 11,460 square miles and an average flow of 7.5 billion gallons per day. The flow fluctuates widely, however, and a low flow of 506 million gallons per day occurred in 1930.

The intake structures at Great Falls consist of a low dam and two gravity conduits which can deliver 233 million gallons of water per day to the Dalecarlia Reservoir. Because the water demand has occasionally exceeded the capacity of these intakes, and threatens to do so permanently before long, a new intake and pumping station with a capacity of 450 million gallons per day is about to be completed at Little Falls. This facility will deliver water to the Dalecarlia Reservoir. The Dalecarlia filtration plant takes water from the reservoir and can treat 108 million gallons per day. Water from the Dalecarlia Reservoir is also supplied to the McMillan filtration plant via a conduit to the Georgetown Reservoir and a tunnel from there to McMillan Reservoir. The McMillan plant can treat 125 million gallons per day. The water from both plants is then distributed to the various service areas by gravity and pumping. A total available finished water storage of 105 million gallons exists in underground reservoirs and standpipes. In addition to the District of Columbia, water is served to Arlington, and, through it, to Falls Church via conduits across the river. Various military installations in Virginia are also served by the supply, and the aforementioned emergency connections to the Washington Suburban Sanitary Commission system can supply or receive a limited quantity of water in time of emergency. The average total demand on the system is currently approximately 135 million gallons per day, but in past years the average demand has exceeded 165 million gallons per day.

The preceding figures illustrate that the District of Columbia water supply requires more filter capacity and finished water storage. To this end, an additional 25 million gallons of finished water storage and 54 million gallons per day of filtration capacity, the latter to be installed at the Dalecarlia filtration plant, were authorized in 1957. Because water consumption within the District of Columbia proper has shown a decline for the past several years, the Department of Sanitary Engineering plans no extensive reinforcements or enlargements of the distribution system at the present time.

However, another and more important problem must be faced. Although it must have seemed impossible almost a hundred years ago when the Potomac was selected as a source of water supply, that great river can no longer guarantee sufficient free flow to meet the demands of the metropolis it has nurtured. It is quite likely that the combined demands for domestic water supply, upstream irrigation,

and pollution control will not be satisfied during low flows which will certainly reoccur. Means for providing water for use during such periods must be considered.

### VIRGINIA

At the present time, the Virginia region of the metropolitan area is served by a great many separate systems. Most of them are privately owned. The systems impinge on each other in a complicated pattern in much of the area.

Arlington County purchases its water supply from the District of Columbia system via primary feeders over Chain Bridge and minor lines over Key Bridge. The county constructs and maintains the distribution system serving it. Some of the water obtained from the District of Columbia is resold to Falls Church. Falls Church distributes water within its corporate limits, and, in turn, sells a portion of the water to nearby areas of Fairfax County at substantial price increases. The legal right of Falls Church to resell District of Columbia water at a profit has been recently challenged (8).

There are now 16 separate water systems serving approximately 150,000 of Fairfax County's 218,000 population. The areas served by the various systems are shown in figure 3. Twelve of these companies are privately owned and operated. The principal water supply system in the county is the Alexandria Water Co., which also supplies the city of Alexandria. This company obtains water from an impoundment it recently constructed on Occoquan Creek. The reservoir presently produces a safe yield of 30 million gallons per day, and will shortly be expanded to provide a safe yield of 50 million gallons per day. A filtration plant treats the water at a rated average capacity of 16 millions gallons per day. The water is distributed by gravity and pumping.

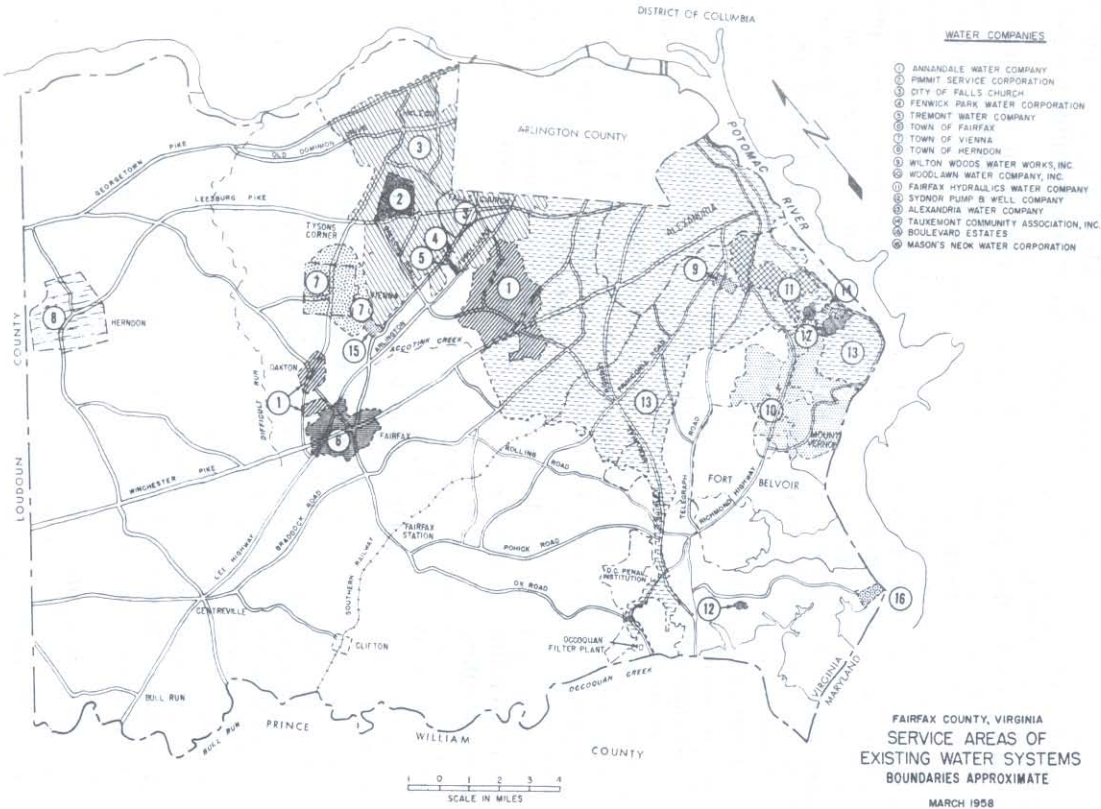
The Annandale Water Co. purchases its entire supply from the Alexandria Water Co. Approximately one-third of the water required by the Fairfax Hydraulics Co. is purchased from the Alexandria Water Co.

Except for the above-named areas served by the District of Columbia or the Alexandria Water Co. water, the water systems in the Virginia region of the metropolitan area obtain their supplies from wells.

There is considerable local sentiment for an integrated water system in Fairfax County. In 1955 and 1956, the county had engineering studies (3, 9) made for a comprehensive water supply plan. Approximately 6 months ago, a Fairfax County Water Authority was formed. A citizens' committee has recently organized to urge prompt action in constructing a countywide water supply to provide safe and adequate service.

Arlington County notified Falls Church this month that, after June 30, 1960, it will no longer sell that city water. By that time the population of the county will consume all the water that can be transported to it by existing lines from the District of Columbia. This action has already resulted in proposals from the Fairfax County Water Authority for Falls Church to join with it in tapping the Potomac. Falls Church has under construction a pipeline crossing the Potomac through the Little Falls Dam which will enable the city to obtain approximately 40 million gallons of treated water per day from the District of Columbia system.

FIGURE 3




FAIRFAX COUNTY, VIRGINIA
SERVICE AREAS OF
EXISTING WATER SYSTEMS
BOUNDARIES APPROXIMATE
MARCH 1958

Consumers in Virginia have experienced severe water restrictions in recent years because of short supplies and inadequate piping. Residents outside some of the existing service areas cannot be supplied because the systems do not have the capacity to meet the rapidly growing needs. Fire protection is inadequate, resulting in increased insurance rates. Industry is desired in order to broaden the tax base, but new plants will not locate where they cannot obtain adequate industrial water. Because of the limited sources, small systems, and considerable sale of water for profit, some of the water rates are quite high.

The entire water supply picture in the Virginia region of the metropolitan area is in ferment. Actions will shortly be forthcoming. Any decisions should certainly be made only after careful consideration of the water-supply problems of the entire Washington metropolitan area.

## Existing Planning

### MARYLAND

Based on recent engineering reports (2, 10), the Washington Suburban Sanitary Commission plans to develop the Potomac River in four successive stages of construction. When completed around 1990, the works will add approximately 150 million gallons per day to the existing supply of the commission system.

The first stage will shortly go under construction and is to be completed by 1960 at a cost estimated to be $12,525,000. It will consist of an intake on the Potomac near Watts Branch and a filtration plant to treat more than 30 million gallons per day. The decision was made to go to the Potomac after a careful examination of other possible sources showed them either to be developed to their maximum safe yield, or uneconomical to develop in view of the limited supply that would be available.

The second, third, and fourth stages of the plan are to be built as required, at an additional estimated cost of $16 million.

In 1955, the Commission formulated (11) and undertook a 5-year construction program to reinforce and expand the distribution system. This program will extend water service to several small communities and developments now outside the sanitary district. It is anticipated that the Washington Suburban Sanitary District will be extended, and in the foreseeable future will include sizable portions of Howard, Anne Arundel, and possibly Charles Counties.

Rockville has decided to abandon its present sources of supply and tap the Potomac River. An intake and filtration plant are now under construction near Potomac, Md., and are scheduled to be in operation by June. The new works will supply up to 4 million gallons per day. The capacity can be enlarged to 10 million gallons per day.

Frederick will shortly tap the Potomac as a source of water supply and divert an average of approximately 7 million gallons per day.

### DISTRICT OF COLUMBIA

In 1946, the Washington Aqueduct and the District of Columbia jointly published a report (12) planning for the future water supply of Washington and the portions of the metropolitan area then visualized

as being served by the supply. Proposed construction was divided into four stages.

The first stage, planned for 1946 to 1950, called for increased filtration, pumping, and finished water storage capacities as well as improvements to the distribution system.

In the second stage of construction, planned for 1950 to 1955, additional filtration facilities to increase the Dalecarlia plant capacity to 169 million gallons per day, additional storage capacity, and further distribution system improvements were planned.

During the period from 1955 to 1961, the third stage of construction was to provide a new intake at Little Falls, improvements to the intake works at Great Falls, a major crosstown main, and filtered water storage as the major items.

From 1961 to 1990, the fourth stage was to add filters to the Dalecarlia plant to bring its capacity up to 217 million gallons per day, and to reinforce and improve the distribution system.

The Washington Aqueduct and the District of Columbia have coordinated the phases of construction planned for each organization. In effect, the purse strings are controlled by the District of Columbia since all appropriations for the improvements were made in accordance with the water service revenue collected by the District of Columbia. A substantial portion of the program has now been completed. As population and demand trends shifted, the program and scheduling were modified somewhat. The principal changes made have been considerable reductions in the improvements originally scheduled for the distribution system and distribution system storage. Several major improvements in this area have been canceled and others deferred further into the future, due primarily to fiscal considerations and the recent slack trend in water demand in the District of Columbia. In some areas of the city, however, the schedule has had to be advanced to meet growing needs and projects originally scheduled for as late as 1963 are already in service.

The principal need in the District of Columbia is for storage of raw and finished water. Table 3 lists all storage currently provided in the municipal water supply system. At current average demands, a maximum of considerably less than 1 day's supply of available finished water is on hand. The total available raw water supply would satisfy the demand for only 2 additional days. During summer peak demand periods, the total storage would supply less than 1½ days' demand. This situation is serious in view of current needs, and is critical in terms of the needs of the near future.

In 1946, the same year that reference 12 was published, the Corps of Engineers reported (13) to the Congress on a survey it had made for the development of the entire Potomac River Basin from the aspects of flood control, water supply, pollution abatement, highway facilities, recreation, navigation, and waterpower. This report recommended a series of dams on the Potomac including 1 at Riverbend, approximately 2 miles above Great Falls. The purposes of the dam were cited as the generation of hydroelectric power, flood control, pollution abatement, and other beneficial purposes. The report, however, did not visualize that one of the needs for the impoundment would be to store the flow of the Potomac for the purpose of water supply in the metropolitan area.

Public hearings were held by the Corps of Engineers and considerable opposition was voiced to the proposed inundation of farmlands and changes that would be imposed on the recreational, fishing, and wildlife culture of the area. Taking cognizance of this sentiment, the Board of Engineers for Rivers and Harbors and the Chief of the Corps of Engineers recommended against enactment of the major portions of the plan, including the Riverbend Dam.

TABLE 3.—*Water storage in the District of Columbia*

RAW WATER

[Millions of gallons]

| Reservoir | Total capacity | Available capacity [1] |
|---|---|---|
| Dalecarlia | 237 | 60 |
| Georgetown | 226 | 56 |
| McMillan | 292 | 165 |
| Total raw | 755 | 281 |

FINISHED WATER

| | | |
|---|---|---|
| Dalecarlia clearwells (2) | 44.5 | 28.0 |
| McMillan clearwells (2) | 33.2 | 25.6 |
| 1st High (MacArthur Blvd.) | 14.5 | 9.0 |
| 1st High (Soldiers' Home) | 15.0 | 9.0 |
| 2d High | 14.6 | 9.0 |
| 3d High (Reno, new) | 20.0 | 12.0 |
| 3d High (Reno, south) | 5.4 | 3.0 |
| 4th High (2) | .2 | .1 |
| Anacostia 1st High (2) | 13.0 | 8.0 |
| Anacostia 2d High (2) | 2.5 | 1.5 |
| Total finished | 162.9 | 105.2 |
| Grand total | 917.9 | 386.2 |

[1] Entire contents of reservoirs are not available because of relative elevations.

Since then, developments previously cited have shown that storage of Potomac River water for water supply will shortly be necessary in the Washington metropolitan area. The United States Senate Committee on Public Works adopted a resolution on January 26, 1956, directing that the Corps of Engineers review its 1946 Survey Report on the Potomac River and Its Tributaries. The Engineers are instructed to determine whether modifications of the previous recommendations are advisable at this time with a view toward preparation of a comprehensive plan for control of floods and the development and conservation of water and related resources of the basin with emphasis on present and future water supply and pollution abatement. Initial funds were appropriated for the study and subsequent appropriations were to be made to enable the study to be completed in June 1962. The appropriations, however, have been severely cut below the amounts originally anticipated, with the result that the study is now far behind schedule.

VIRGINIA

Of the private water companies in the Virginia region of the metropolitan area, the only one with a significant source of supply of its own is the Alexandria Water Co. When it completes its plan to expand its

newly constructed reservoir to supply 50 million gallons per day, it will, in essence, have developed its facilities to their maximum.

In 1954, Arlington County obtained engineering advice on its water supply system. The ensuing report (4) recommended expansion of the distribution system, additional storage facilities, expansion of pumping capacities, installation of new feeder mains, and the construction of a new Potomac River crossing to bring additional water from the District of Columbia system. The recommended program called for an expenditure of $5,784,000 for construction of works modestly spaced over a 10-year period.

To date, more than one-half of the program has been completed. With some modifications, the schedule is proceeding according to plan. The major undertakings remaining are the Potomac River crossing and the installation of several primary feeders. The report states that the program will provide sufficient water storage capacity until the year 1970 and supply mains of sufficient capacity for the population expected in the year 1985.

In attempting to cope with its intricate water problems, Fairfax County contracted for an engineering report (3) which was published in 1955. The report found 19 water systems then serving the county. Despite the number of systems, only 46 percent of the county population was served by them. With few exceptions, the existing systems were inadequate with respect to supply sources and distribution systems. Service essential to the needs of the county could not be rendered, nor was there potential capacity for the future growth in population. The report recommended that Fairfax County acquire all the water systems then serving it and integrate them into a single system. This system would be extended to the other areas in the county and would obtain its source of supply directly from the Potomac River, or by purchasing water from the District of Columbia. The county is particularly fortunate in that storage provided at Tysons Corner would be at an elevation sufficient to serve the entire county by gravity. Two possible plans were proposed, one including the Falls Church franchise area outside the city limits, and the other excluding the Falls Church franchise area. The estimated costs were $34,560,000 and $29,300,000, respectively. The first 2 years of the proposed construction programs would have called for respective expenditures of $23,350,000 and $20,100,000 for the 2 schemes. The remaining construction work would have been programed through 1971. The plan, however, is highly conservative. It is based on an estimated Fairfax County population of only 300,000 by the year 2000. The forecast cited in reference 1 predicts the county will attain this population by 1964. The population for the year 2000 is estimated at 800,000.

Paradoxically, the effect of the report was to make the realization of its recommendations more difficult. This arose because the sale of water is an enterprise that some of the individual private and public systems are not willing to relinquish. When faced with the possibility of being absorbed by the county or losing as yet unclaimed service area to the county, these systems immediately began to extend their frontiers. From the point of view of the systems, this action was safeguarded by the question of whether the county had the right to acquire by condemnation either the privately owned systems or those

belonging to incorporated municipalities. It has now been determined that the county has the right to condemn and acquire private systems, but not the systems of incorporated municipalities. This expansionist attitude and action of local systems threatens the Fairfax County plan by seriously depleting its pay area.

Acquisition of the Annandale Water Co. was the cornerstone of the plan for Fairfax County. When this fact was revealed, the then extant Virginia Water Co. and the city of Falls Church displayed active interests in acquiring the Annandale company before the county could. In the face of this competitive atmosphere, the county attempted to purchase the system immediately and submitted to a referendum for that purpose. The referendum failed, partly because of active opposition to the service area priorities assigned by the county plan.

The basis of the Arlington County and Fairfax County water-supply plans was the assumption that the flow in the Potomac River was adequate for all foreseeable metropolitan area needs, and that the District of Columbia treatment facilities were also adequate to supply the two counties for the foreseeable future. The Washington Aqueduct, as previously discussed, has announced that both assumptions are no longer valid. This fact is reflected in the later report (9) of the consulting engineering firm retained by Fairfax County. Because the Washington Aqueduct indicated that it would expect Fairfax County to pay its proportionate share of construction costs for future facilities, the report considers more favorably than its precedessor the scheme for tapping the Potomac River directly and constructing a filtration plant. However, neither this action, nor obtaining water from the District of Columbia system, will solve the problem of the future adequacy of the Potomac

The report revised the proposed alternate plans in view of the events that had transpired subsequent to the initial report. It accepted the loss of potential service area and accordingly scaled down the program to accommodate only 213,500 persons by the year 2000.

Another complication to the proposed Fairfax County plan has developed. The town of Fairfax has approved a bond referendum authorizing an issue of $4,500,000 to impound Goose Creek in Loudoun County and construct a filtration plant to develop a dependable supply of 3.5 million gallons per day. Loudoun County attempted to block the action in an appeal to the Virginia Supreme Court. In January 1958, however, the court ruled in favor of the town of Fairfax.

A citizens' committee expresses (8) the fear that the new system may enable the town of Fairfax to sell water to the Chantilly Airport site, the town of Herndon, and Sunset Hills. These areas, the committee contends, are vital to the Fairfax County plan. The report further points to the competition threatening the Fairfax County plan by citing the White House report on Chantilly Airport which states that "the town of Falls Church's program of expansion will make available sufficient (water supply) capacity by 1962 to meet the future needs of the airport." In a supplemental report (14) the citizens' committee urges the county to plan a permanent and independent source of water supply from the Potomac River. Again, however, this action alone cannot assure the adequacy of that supply.

## Principal Water Supply Problems Facing the Metropolitan Area

### DEMAND

The most direct way to ascertain whether or not there is an adequate supply of water is to compare the total population in the Washington metropolitan area to the total available water resources.

The present population of the metropolitan area is slightly more than 2 million, distributed as shown in table 1. On the basis of a weighted average of the daily per capita water consumption figures cited earlier for various portions of the area, the "average metropolitan resident" consumes approximately 110 gallons per day. Thus the total demand for treated water in the area averages 220 million gallons per day. A conservative estimate of the peak demand that must be met during the summer months is 1.5 times the average demand. The finished water storage in the area is not sufficient to offset peak demands, as experience has frequently demonstrated. This means the sources of water must be able to provide 330 million gallons per day during periods of low river flow in order to meet the peak demands which occur then.

### SUPPLY

The Potomac River had a 50-year average flow record of 7.5 billion gallons per day, and a low of 506 million gallons per day, which, because of the lack of storage, must be accepted as the controlling value. Having fully developed its water resources other than the Potomac River, the Washington Suburban Sanitary Commission can supply an additional 42.5 million gallons per day. The only major dependable source of water other than the Potomac River in Virginia is the impoundment on Occoquan Creek which will provide a maximum safe yield of 50 million gallons per day when fully developed.

When populations the size of that in the Washington metropolitan area must be supplied with water, ground water sources can rarely play a significant role. Experience indicates that this is true here also. The area has an undependable and declining ground water table, with the possible exception of southern Maryland. Rockville, for example, has installed some 40 wells attempting to meet its demand from ground water sources. The failing water table has now forced the city to go to the Potomac for its supply. The Virginia portion of the metropolitan area has had a similar history. Most of the wells are failing rapidly because of the increased demand thrust upon the water table. In view of the general inability of ground water to satisfy heavy demands and the local experience with wells, no reliable major contribution to the needs of the area can be expected from this source.

Adding up the available water resources named produces a total dependable supply of approximately 600 million gallons per day. We must now recall the quantity of water that must flow through the metropolitan area in order to prevent the treated sewage effluent from creating obnoxious conditions. If we assume that the estimated figure of 650 million gallons per day previously cited is approximately correct, it is obvious that a return of the low flow conditions of 1930 would confront the residents with a dilemma. It would be necessary either to invoke water use restrictions or to permit unpleasant and dangerous water pollution to occur in the metropolitan reach of the

Potomac River. This presupposes that the present polluted condition of the river would have been cleaned up before serious drought conditions returned. If this were not the case, the degradation of the river would be even more severe. The net water deficit would be the 980 million gallons required for water supply and pollution control minus the 600 million gallons available, which equals 380 million gallons per day during the low-flow period.

Thus it is evident that storage facilities on the Potomac River are needed now. The rapidly expanding population in the metropolitan area and the increasing use of water upstream for domestic water supply and irrigation make this need greater each year.

## STORAGE CAPACITY

Once the undeniable fact is accepted that the flow of the Potomac River must be stored, the only questions are how much storage should be provided and where. On the basis of the Potomac Basin study the Corps of Engineers is currently making, reference 6 cites calculations which produce net water supply storage requirements for the metropolitan area as follows:

| Year | Storage required | |
|---|---|---|
| | Acre-feet | Billion gallons |
| 1980 | 280,000 | 91.5 |
| 2000 | 660,000 | 215.7 |
| 2100 | 2,140,000 | 700.0 |

The calculations show that in the 50-year period 1965 to 2015, storage requirements increase at the rate of 20,000 acre-feet, or 6.54 billion gallons, per year. This is equivalent to the amount that would be stored by the construction of one Rocky Gorge size reservoir annually. These calculations are based on summer month demands, allow for modest increases in per capita consumption, include the water required for pollution control which also increases with the years, and deduct from the flow of the river amounts which the study indicates will be removed upstream for irrigation.

In light of these storage requirements, the study reported in reference 6 examined the relative costs of constructing various combinations of reservoirs selected from a list of more than 100 possible sites examined by the Corps of Engineers. Four combinations of reservoirs were analyzed. The first scheme utilized the Riverbend Dam at an elevation of 235 feet to satisfy the demand until the year 2025. Back Creek and Springfield Reservoirs of moderate size would be constructed subsequently to provide storage until sometime after 2080. The second plan assumed a lower dam at Riverbend and subsequent construction of medium size reservoirs on Back Creek, Patterson Creek, the Conococheague, the Cacapon, Royal Glen, Brocks Gap, Wills Creek, and the Monocacy. The third combination consisted of all medium-size reservoirs, omitting Riverbend. In the fourth plan, all storage was provided by small impoundments ranging in size from 75 acre-feet up to 27,000 acre-feet. The study indicated that the portion of the total basin drainage that can be developed by

reservoirs of this size range is limited to approximately 25 to 30 percent. Small reservoirs alone would only be able to assure a supply to meet the demand to the year 2000. The cost comparison of providing storage by the four possible schemes is as follows:

| *Storage scheme* | *Cost per million gallons stored* |
|---|---|
| High Riverbend now plus 2 moderate size reservoirs in 2025 | $13. 50 |
| Low Riverbend now plus 8 medium size reservoirs as needed | 20. 50 |
| No Riverbend, all storage by medium size reservoirs | 26. 50 |
| No Riverbend, storage supplied wholly by small reservoirs [1] | 34. 00–37. 00 |

[1] Adequate only to year 2000.

## RIVERBEND DAM

Other values than the cost of storing water enter the picture so that, at the present time, there is considerable controversy in the community and its environs concerning how, where, and in some instances even whether, the storage should be provided. The heart of the controversy rages around the Riverbend Dam site. The impoundment that a high dam at Riverbend would create is shown in figure 4. Residents living in the areas that the reservoir would inundate have stated that they do not wish to give up their land. Proponents of the dam say that this is a fact that must be faced wherever storage is located and requires the democratic subjugation of the desires of a few to the public good.

Officials and residents of counties containing sizable areas that would be inundated protest that these very valuable lands close to Washington would be forever removed from the tax rolls. Proponents of the dam say that construction of the reservoir is inevitable if the growth of the metropolitan area is to continue. They contend, therefore, that delay in acquiring the lands only increases the ultimate cost and inconvenience because of the rising land values and the considerable improvements which will have been constructed.

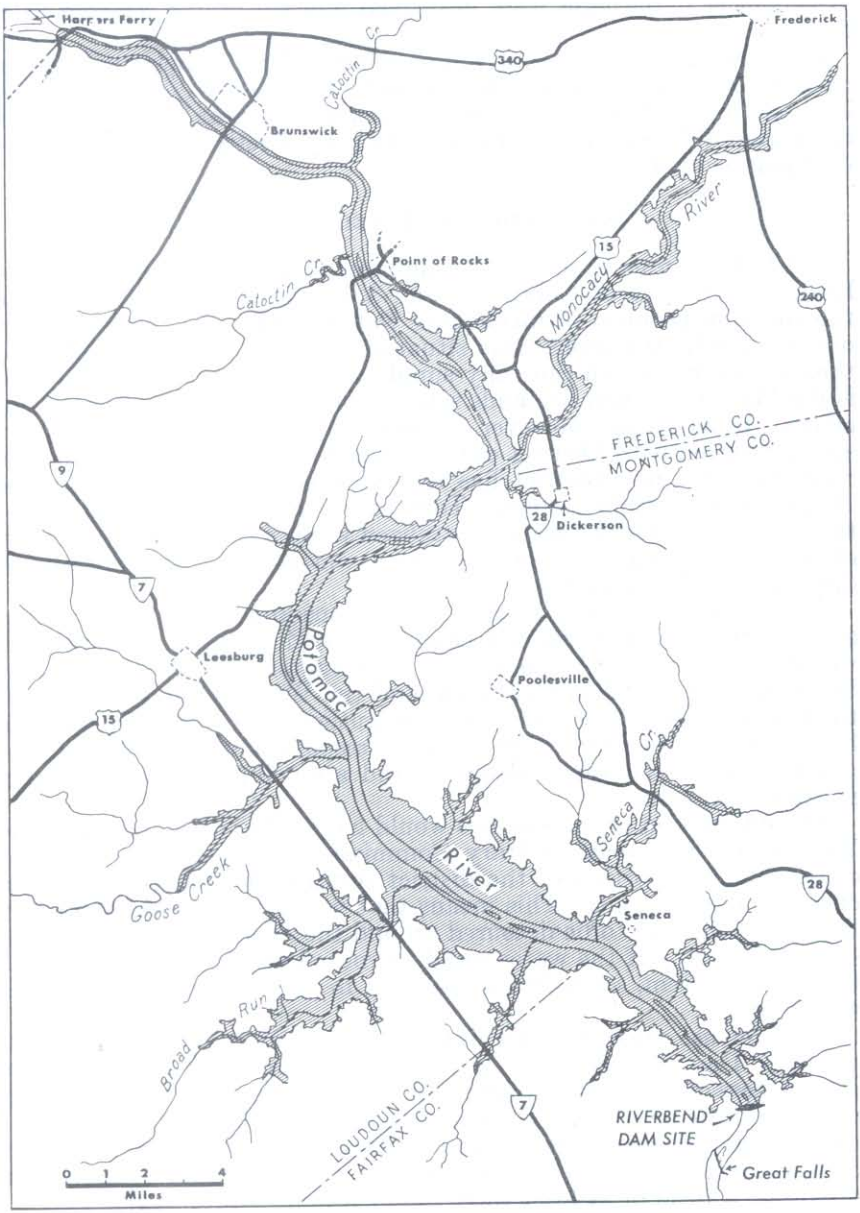
Arguments have been voiced that construction of the Riverbend Reservoir would destroy a large portion of the C. & O. Canal and other historical landmarks. Counterarguments say this is not an unreasonable price to pay when weighed against our need for water and that much of the canal will still remain in existence.

Some recreationalists strongly believe that the reservoir would seriously impair the recreational opportunities which the area to be inundated now offers. Hiking and riding trails, fishing streams, outdoor camping sites, and similar facilities would be lost. Other recreationalists think just the opposite. A large fresh water lake near the metropolitan area would provide much needed swimming, boating, fishing, picnicking, camping sites, and the like to hundreds of thousands of persons in the area. They cite Lake Meade as a case in point which attracts more than 2½ million visitors annually because of the recreation it offers.

The possibility that fluctuations in the level would create extensive mud flats around the reservoir and impair its recreational use has been raised. However, many existing water supply reservoirs have not suffered in this manner. If required, engineering works could provide level stability to large areas except during extreme drought.

Some protagonists for the dam insist that hydroelectric power generation be included in the project. Others say added importance should be given to the flood-control aspect.

FIGURE 4




PROPOSED DAM AT RIVER BEND

Shaded Area Shows Maximum Inundation

Source: "Interstate Commission on the Potomac River Basin."

Questions which have been raised regarding the Riverbend Dam include the difficulty that will be imposed on future bridge construction between Maryland and Virginia, and the possible consequences to Washington if the dam were destroyed and the water released in a flood.

Certainly all interests that will be affected by the construction of a dam at Riverbend should be carefully considered. So should all interests that will be affected by the lack of a dam at Riverbend, and the required decision reached in time to take effective action by whatever plan is evolved.

### INTEGRATION OF WATER SYSTEMS

All three segments of the Washington metropolitan area—Maryland, the District of Columbia, and Virginia—are confronted with the common problem of inadequate water supply. If there were no other compelling reasons, this situation, coupled with the fact that the only source which can fully supply any of the three jurisdictions is the Potomac River, demands serious consideration of a cooperative effort. In addition, however, sizable populations in Virginia are already served with District of Columbia water, and the Washington Suburban Sanitary District has several minor connections with the District of Columbia system. Together with the economy of operation that would result from a centralized water system, the possibility of creating a single metropolitan area water authority or sanitary district should be examined.

A single agency would assume the systems and functions currently administered by the various counties, municipalities, and private water companies in Virginia, the Washington Suburban Sanitary District, the District of Columbia, and the Washington Aqueduct of the Corps of Engineers. If a sanitary authority of this scope were to be established, it might also be given responsibility for sewage disposal, garbage and refuse disposal, and air pollution control in the metropolitan area.

The integration of the systems would have other advantages. The Washington Suburban Sanitary Commission will soon face a heavy demand in the portion of the district south of Washington because of rapid development. This means that water to be taken from the Potomac will have to be detoured around the District of Columbia to serve this area. If the water could be routed through the District of Columbia system, considerable savings in the cost of transmission would result.

Civil defense considerations also argue for an integrated distribution system. Damaged sections of the system could be valved off to prevent loss of water and water could be routed through the remaining portions of the network. The construction of another major filtration plant at an upstream location to help meet the demands of a unified distribution system would also improve the defensive situation by providing a total of at least three major intakes and filtration plants.

However, some step short of unification under a single agency might satisfy the water supply needs of the area. The Washington Suburban Sanitary Commission has met and, no doubt, can continue to meet successfully the water supply needs of its expanding service area. The Washington Aqueduct and the District of Columbia Department

of Sanitary Engineering, sharing responsibility for the Washington water supply, have evolved a highly compatible working relationship. This fact is amply supported by the cooperation they have demonstrated over the past 12 years in carrying out much of the water system improvements recommended in their joint report (12).

A satisfactory solution to the water supply problems might, therefore, be found in a mechanism that would continue the present administrative arrangements in Maryland and the District of Columbia, but provide some positive, legally empowered means for integrating the water supply planning and physical systems of the entire metropolitan area. In such an arrangement, the Washington Aqueduct might be assigned the task of developing the Potomac River to supply the needs of the area, treating the water and delivering it to the three political jurisdictions, which, in turn, would be responsible for distributing it. This scheme might offer most of the advantages of centralized water supply operations without requiring extensive administrative reorganization.

The possibilities discussed above assumes that there will be some water supply entity with which to deal in Virginia. The water supply conditions in the Virginia region of the metropolitan area are desperate and constitute an urgent problem. The intrusion of political bickering and overemphasis of the profit motive creates an atmosphere which should not compete with the provision of a safe, adequate, and economical water supply. Water supply planning by the various Virginia systems is entirely too limited in scope. The rapid development of the Virginia area requires that plans for water supply be made on a broader base than seeking to provide small service areas with supplies that will be inadequate in a few years. While integration of the water supply systems in the Washington metropolitan area may be desirable, integration of the systems in the Virginia region is imperative. Some means to accomplish this should be provided with the least possible delay. Since the Virginia region faces similar problems in sewage disposal, as discussed in the companion paper, Sewage Disposal and Water Pollution, the creation of a single sanitary district to serve the Virginia region of the Washington metropolitan area seems to be an attractive possibility.

Perhaps one fact best demonstrates the need for integration of water supply planning, if not operations also, in the metropolitan area. The Washington Aqueduct has concluded that the flow of the Potomac River can no longer meet the growing needs of the area. Yet, the Washington Suburban Sanitary District, Fairfax County, Arlington County, and Falls Church plan to satisfy their increasing water demands by going to the Potomac, apparently without concern that, unless storage is provided, the pipes may run dry.

### THREAT OF POLLUTION

It is now clear that the Potomac River constitutes the single adequate source of supply for the future of the Washington metropolitan area. Nothing is more vital to the needs of the area than water. Plans for protecting this priceless resource against sewage contamination which can render it unfit as a water supply source are extremely important. Until recently, this has not been a great problem. The water intake at Great Falls was sufficiently remote from suburban

Washington development so that there was no threat of sewage being discharged in the upstream proximity of the intake. Recent events or trends have changed this situation.

The relocation of Federal agencies to unsewered upstream areas assures the fact that, unless prompt steps are taken, unplanned development in these areas will discharge sewage to the Potomac River. Unlike most other cities, Washington has no control over any portion of its watershed. 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.

Water supply for a city is almost always taken upstream from the city in order to obtain water free from sewage contamination originating in the urban area. The remarkable foresight of the Corps of Engineers in selecting Great Falls as the Washington intake site approximately a century ago has been discussed. Unfortunately, however, the recent construction of a new intake at Little Falls, just above the upstream boundary of the District of Columbia, is not in keeping with that philosophy. The Little Falls intake will shortly be placed in service and, as presently planned, it will become the major intake for the Washington Aqueduct, and ultimately the only intake. Thus the new intake, instead of trying to outdistance the oncoming tide of urbanization, has moved approximately 9 miles toward town to meet it. Even if the Washington Aqueduct had direct control over the watershed, it would be difficult to prevent sewage from reaching the river in this area. The reasons given for the selection of the Little Falls site were economic ones. The Washington Aqueduct also contends that it is cheaper to prevent pollution of the water supply by building sewers to carry the upstream sewage to points below Little Falls rather than to extend the large intake conduit further upstream. However, no plans exist for the construction of such sewers sufficiently far upstream on both sides of the Potomac. The safest way to protect the Little Falls intake would be to prevent development for some distance above it. Perhaps the economic loss of such land use restriction should be taken into consideration. Compared to other cities, the distance the conduit would have to be extended to accommodate an intake at Great Falls or even beyond is quite small. Perhaps, if a dam is built at Riverbend, consideration should be given to constructing a conduit to the dam rather than taking the regulated river flow at Little Falls.

### INDUSTRIAL WASTES

The possibility of contamination of the water supply with industrial wastes now also requires attention. Heavy industries were not included in the original concept of the National Capital area, but recently official and unofficial sources have favored bringing industry into the area in order to diversify and broaden the tax and employment bases. The location of the planned Potomac Electric Power Co. powerplant at Dickerson, Md., may provide power and other inducements for additional industries to move to the Potomac watershed upstream from Washington. The railroad spur which will be constructed to serve the powerplant will be attractive to other industries. Unless some control is exercised over this potential industrialization above the water supply intakes, the effects of complex industrial wastes might be imposed on our water supply problems.

Several experts have voiced (15) concern over possible effects that the powerplant itself may have on the River. These effects range from temperature increases which will derive from the use of large quantities of river water for cooling purposes and might promote undesirable biological growths in the river, to pollution from coal piles and industrial operations of the plant. The powerplant will be one of the largest planned for the metropolitan area. At the present time it will generate electricity from coal. However, it is likely that, in the future, when nuclear energy will attain an economic advantage, the company will desire to install atomic reactors as the power source. The large quantities of cooling water that would probably be required by the reactors might, upon return to the river, raise the radioactivity level of the Potomac to a point that would present another pollution hazard to the water supply.

### FINANCING

As is the case with sewage disposal and water pollution problems, lack of adequate financing is an important factor in the water supply problems of the Washington metropolitan area. It certainly seems that the present and future assets of the area should be enough to provide a basis for long-range financing of the works required for an adequate and safe water supply for the present and foreseeable needs of the area. Metropolitan Washington is extremely fortunate in having at its front door a source of water that, properly husbanded, can supply all its requirements. This fact alone gives Washington a great advantage over other cities in the Nation which must import water from rivers up to hundreds of miles away.

## Summary of Major Problems Requiring Attention

The major water supply problems requiring attention in the Washington metropolitan area are:

1. How shall an adequate source of water supply be provided for the present and future needs of the area? This question primarily resolves itself to "What type of storage facilities should be provided on the Potomac River?"
2. Should the water supply systems in the Washington metropolitan area be consolidated either administratively or physically, or both?
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?
4. How can the Potomac River upstream from Washington be protected against future pollution from residential, commercial, and industrial development?
5. For what period into the future should plans and construction be undertaken?
6. What is the best means for financing the necessary organization, administration, engineering, and construction to attain the desired goals?

It will be noted that the problems of water supply are very closely related to the major problems described in the companion paper, Sewage Disposal and Water Pollution. Water supply and sewage problems are really part of a single concept—proper water use. For

this reason, the Washington metropolitan area would do well to solve both sets of problems by means of unified or closely related planning, construction, and operation.

### References Cited

1. Dr. Jerome P. Pickard, research director, Washington Board of Trade, Washington Board of Trade News, February 1958, and report of July 17, 1957.
2. Future Water Supply of the Sanitary District. Harry B. Shaw, chief engineer, Washington Suburban Sanitary Commission, September 28, 1956.
3. Comprehensive Water Supply Plan, Fairfax County, Virginia, Preliminary Report. Alexander Potter Associates, March 18, 1955.
4. Report on Water Supply and Distribution System Improvements, Arlington County, Virginia. Alexander Potter Associates, March 1954.
5. Water Consumption, Maryland-District of Columbia-Virginia Metropolitan Area. D. V. C. Birrell, Washington Aqueduct, United States Corps of Engineers, August 12, 1957.
6. Potomac River Basin Studies. Byron Bird, Washington Aqueduct, United States Corps of Engineers, October 31, 1957.
7. Trends and Developments in Irrigation in Maryland. Luther B. Bohanan, Department of Agricultural Economics and Marketing, University of Maryland, October 1955.
8. Public Report on a Proposed Water System for Fairfax County, Virginia. The Committee for a Fairfax County Water System, Carl D. Soresi et al., McLean, Va., March 3, 1958.
9. Résumé of Engineering Studies and Reports on Comprehensive Water Supply Plan, Fairfax County, Virginia. Alexander Potter Associates, March 26, 1956.
10. A Report on Future Water Supply. The Washington Suburban Sanitary District, Abel Wolman, September 20, 1956.
11. Reinforcement and Expansion Program for the Commission's Water Distribution System, 1955–60, Inclusive. Harry B. Shaw, Washington Suburban Sanitary Commission, September 23, 1955.
12. Adequate Future Water Supply for the District of Columbia and Metropolitan Area. House Document No. 480, 79th Congress, 2d session, February 19, 1946.
13. Survey Report on Potomac River and Its Tributaries. House Document No. 622, 79th Congress, 2d session, 1946.
14. A Proposed Water System for Fairfax County, Virginia. Supplementary report, the Committee for a Fairfax County Water System, Carl D. Soresi et al., McLean, Va., March 10, 1958.
15. Proposed Pepco Plant. Printed for the use of the Committee on the District of Columbia, United States Government Printing Office, Washington, December 16, 1955.

### Additional References Reviewed

A Clean Potomac River in the Washington Metropolitan Area. Wolman, Geyer & Pyatt, Interstate Commission on the Potomac River Basin, 1957.

Agenda for Meeting, Advisory Group for the Potomac River Basin. United States Army Engineer District, Corps of Engineers, Washington, D. C., November 19, 1957.

Authorization for Construction of Dams on the Potomac River. Hearing before the Subcommittee on Rivers and Harbors of the Committee on Public Works, House of Representatives, 84th Congress, 2d session, on H. R. 11481 and S. 4099, a bill granting the consent of Congress to the Pittsburgh Plate Glass Co., for the construction of a dam on the North Branch of the Potomac River.

Construction of Dam on North Branch of Potomac River. United States Senate, Committee on Public Works, Subcommittee on Flood Control, Rivers and Harbors, July 3, 1956.

D. C. Building Program. Report of proceedings of hearing held before United States Senate Subcommittee on Health, Education, Welfare, and Safety of the Committee on the District of Columbia, S. 1760, volume 2, July 31, 1957.

Future Potomac Resources. Interstate Commission on the Potomac River Basin, 1956.

Geology and Water Resources of Prince Georges County. Department of Geology, Mines and Water Resources, State of Maryland, Baltimore, 1952.

Granting the Consent of Congress to the Potomac Electric Power Co., for the

Construction of a Dam on the Potomac River. House Report No. 2940, 84th Congress, 2d session, July 26, 1956.

Integration—Is It the Cure for Water Troubles? Engineering News Record, volume 155, September 29, 1955, pages 255–260.

Metro—City of Tomorrow. Series in Washington Star commencing October 27, 1957.

Metropolitan Water System Organization and Functions. Panel discussion, Campbell, Diemer, Gerstein, Shaw, AWWA, 46:8, 788, 1954.

Plan of Action for Fairfax County, Phase I Report. Public Administration Service, January 1958.

Policies for a Regional Land Use Plan for the National Capital Region. John T. Howard, National Capital Planning Commission, National Capital Regional Planning Council, November 1956.

Population Growth in the Washington Metropolitan Area. Jerome P. Pickard, Washington Board of Trade, January 1956.

Preliminary Outline Report Establishing the Definitive Scope of an Economic Study of the Potomac River Basin. Day & Zimmermann, Inc., 1956.

Proposed Pepco Plant. Hearing before the Special Subcommittee To Investigate the Proposal of Potomac Electric Power Co. To Erect a Steam Plant on the Potomac River in Loudoun County, Va., of the Committee on the District of Columbia, United States Senate, 84th Congress, 2d session, November 10, 1955.

Public Works Programs as Amended April 29, 1957. Department of Sanitary Engineering, District of Columbia, 1957.

Recreation Views on the Potomac. Interstate Commission on the Potomac River Basin, 1957.

Report of Proceedings. Hearing held before United States Senate Subcommittee on Public Health, Education, Welfare, and Safety on the Committee on the District of Columbia, S. 1760, to amend the Hospital Center Act, volume 1, June 21, 1957.

Report of Status of the County Water System Improvements. Alexander Potter Associates, March 4, 1957.

Report of the Committee on the Certification of the District of Columbia Water Supply. Washington, D. C., 1956.

Survey Report on Potomac River and its Tributaries. Volume 2, appendix, United States Engineer Office, Washington, D. C., 1944.

Survey Report on Potomac River and its Tributaries. Volume 3, appendix, United States Engineer Office, Washington, D. C., 1944.

Survey Report on Potomac River and its Tributaries. Volume 4, appendix, United States Engineer Office, Washington, D. C., 1944.

Ten Rivers in America's Future. No. 8, The Potomac. From volume 2, the Report of the President's Water Resources Policy Commission, 1950.

Transcript of Proceedings of Public Hearings. United States Army Corps of Engineers Comprehensive Development Plan for the Potomac River, Rockville, Md., Washington, D. C., Fairfax, Va., 1957.

Upstream Conservation. Interstate Commission on the Potomac River Basin, 1957.

Water in Maryland: A Preliminary Report on the Water Resources Problem in Maryland. Special Commission To Study the Water Resources Problem in Maryland, 1956.

The Water Resources of Howard and Montgomery Counties. Department of Geology, Mines and Water Resources, State of Maryland, Baltimore, 1954.

The Water System of the District of Columbia. Department of Sanitary Engineering, District of Columbia, 1957.

Water Utility Data and Financial Statements of Water Utilities in 1956. Citizens' Governmental Research Bureau, questionnaire of October 24, 1956.

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