Executive Summary

20 Year Water Demand Forecast and Resource Availability Analysis for the Washington Metropolitan Area

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SUMMARY OF 20 YEAR WATER DEMAND FORECAST AND RESOURCE AVAILABILITY FOR THE WASHINGTON METROPOLITAN AREA

On January 11, 1978, the governments of the United States, District of Columbia, Maryland, Virginia, and the Chairmen of the Fairfax County Water Authority and the Washington Suburban Sanitary Commission committed their constituencies to an historic agreement which allocated low flows in the Potomac River. For the more than twelve years of its existence, the Potomac River Low Flow Allocation Agreement (LFAA) has not had to be implemented. However, in preparation for that possibility, the signatory parties have met during April in each year since its ratification in order to affirm its principles and approve data upon which its implementation would be based. Modification No. 1 to the LFAA changed Article 2.C. to include the following requirement: "In April 1990 and in April of each fifth year thereafter ... the Aqueduct, the Authority, the Commission and the District shall review and evaluate the adequacy of the then available water supplies to meet the water demands in the Washington Metropolitan Area which may then be expected to occur during the succeeding twenty year period." At their meeting of April 27, 1989, the parties to the agreement requested the Section for Cooperative Water Supply Operations on the Potomac (CO-OP) of the Interstate Commission on the Potomac River Basin to conduct the required review and evaluation of demands and supplies.

Water Demand Forecast

The forecasting method used by the CO-OP estimates raw water demands in 5 year intervals from 1985 to 2010 for the Washington Aqueduct Division (WAD), Fairfax County Water Authority (FCWA), Washington Suburban Sanitary Commission (WSSC), and the cities of Rockville, Maryland and Leesburg, Virginia. It disaggregates water demand among 6 different water use sectors (single family residential, multifamily residential, employment, unaccounted water use, process water use, and water committed to long term wholesale contracts) and geographically into almost 1300 zones. Predictions of households and employment levels for each zone come from the regional Cooperative Forecasting Program's Round IV demographic forecast. Estimates of water consumption per single family household, water consumption per multifamily household, water consumption per employee and percent of unaccounted and process (water used in treatment process) water use were determined utilizing billing records and discussions with water utility managers. Delineation of service areas and water committed to long term wholesale contracts through 2010 also were estimated through discussion with these managers.

The method used by CO-OP forecasts annual average water demand from demographic predictions and consumption factors. Disaggregating future annual average demands to monthly average and peak demands requires an analysis of current production patterns. This work utilizes daily production data from 1974 - 1988 provided to CO-OP by the utilities. Production factors for monthly average to annual average production and peak (peak 1, 7, 30, 60, 90, 120, and 180 days) to annual average production are calculated from these data. These production factors are assumed to be constant for the 1985-2010 forecast period. Although this assumption is not necessarily true, no discernable trends can be detected in these production factors.

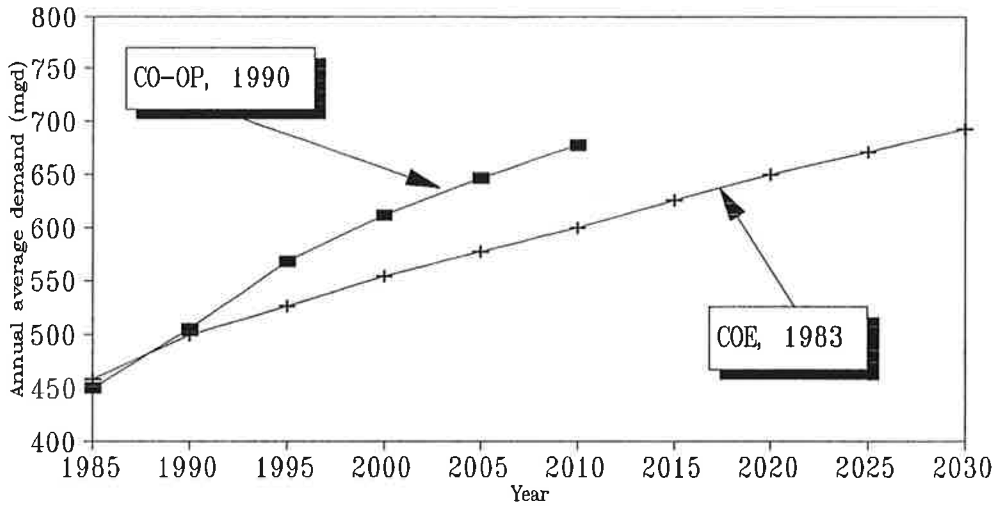
A method to forecast future water demands which have been reduced through water conservation savings also is developed. The method separates water demands into base level (mainly indoor and nonseasonal employment water use) and seasonal (mainly outdoor and seasonal employment water use) water demands and allocates varying percentages of savings to each. Two water conservation scenarios are developed. Scenario 1 assumes base level water demand is reduced by 5% and seasonal water demand by 25%. Scenario 2 assumes base level water demand is reduced by 10% and seasonal water demand by 50%. These scenarios are created with the aid of water supply utilities experienced in reducing water demands through various types of water conservation programs.

The forecast of unrestricted future annual average demand for the system is shown in Table 1. Annual average system demand is forecast to rise from 450.7 million gallons per day (mgd) in 1985 to 681.8 mgd in 2010. Water conservation scenario 1 reduces these annual average demands by approximately 7% and scenario 2 by approximately 15% for each utility and the system. Figure 1 compares this forecast with a recent forecast of water demands for the Washington Metropolitan Area, the forecast contained in the "Washington Metropolitan Area Water Supply Study" completed in 1983 by the Baltimore District of the U.S. Army Corps of Engineers. The Corps of Engineers (COE) forecast utilized the same basic method but earlier demographic data. This figure shows the current forecast of annual average demand in 2010 to reach the levels predict by the COE for 2025-2030. This increased growth rate is due to the updated demographic forecasts used by the CO-OP and the growth in service areas of the water supply utilities incorporated in the forecast.

Table 1 - Forecasted annual average water demands for the Washington Metropolitan Area.

Year	1985	1990	1995	2000	2005	2010
Utility	(millions of gallons per day)					
WAD	195.2	203.4	211.8	217.9	223.3	226.5
FCWA	90.9	112.6	146.8	164.8	176.6	187.4
WSSC	157.7	182.4	202.0	221.1	238.1	254.7
Rockville	5.5	6.2	7.3	8.0	8.2	8.4
Leesburg	1.4	2.0	2.6	3.3	4.0	4.8
System totals	450.7	506.6	570.5	615.1	650.2	681.8

Figure 1 - Water demand forecasts for the Washington Metropolitan Area.

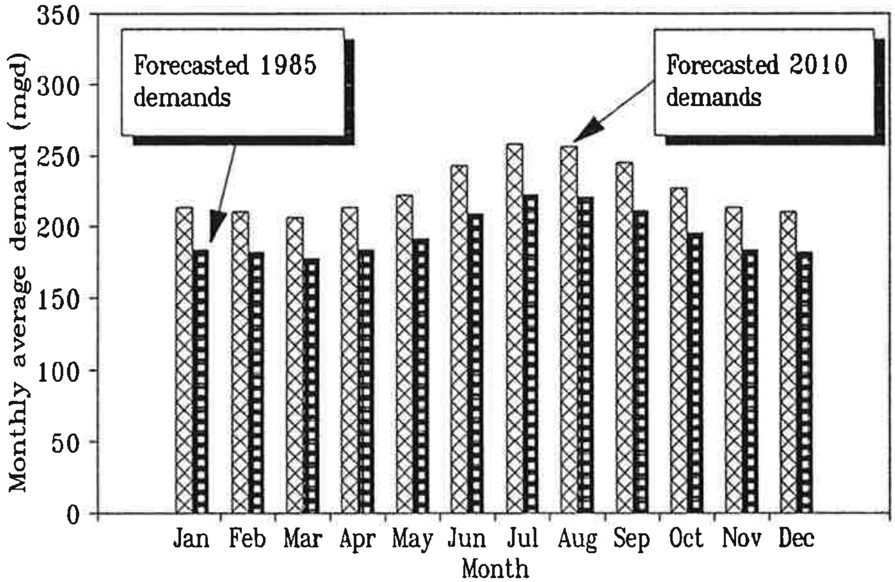


Forecasts of 1985 and 2010 monthly average demands for WAD, FCWA, WSSC and the whole system are shown in Figure 2 (a)-(d), respectively. WAD shows an increase of 35.6 mgd for July average demands (the peak demand month for all utilities) from 1985 to 2010, a 16% increase over the 1985 forecast. FCWA shows the largest increase in peak month demands from 1985 to 2010, an increase of 114.9 mgd or 106% over the forecasted 1985 July demand. WSSC shows an increase in July average demands of 110.6 mgd from 1985 to 2010. This represents a 62% increase over their forecasted 1985 July demand. Overall, the system is forecasted to show an increase in July average water demand of 265.8 mgd or 51% from 1985 to 2010. System July average demands are reduced by 9% for conservation scenario 1 and by 18% for conservation scenario 2.

There are several major unknowns in this forecast that will affect its likelihood of realization.

- There are certain inherent uncertainties in the demographic predictions on which the water demand forecast is based. These uncertainties range from local to national economic and demographic factors on which estimates of households and employment levels are derived.

(a)



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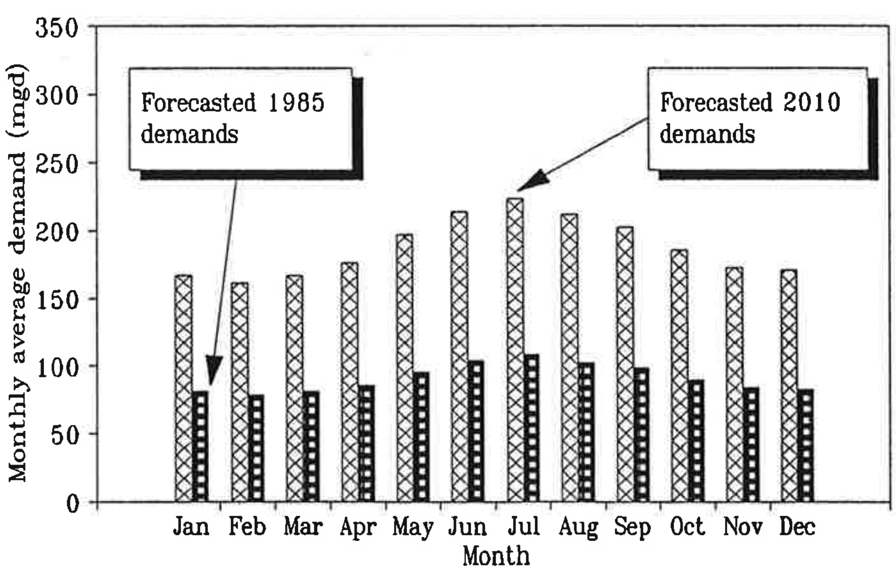
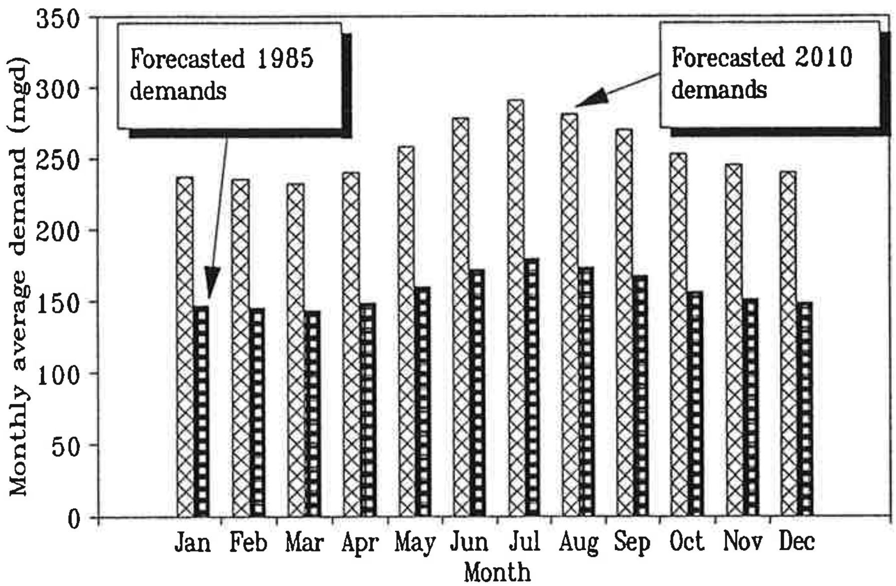


Figure 2 - Forecasted monthly average water demands for 1985 and 2010 for (a) WAD, (b) FCWA, (c) WSSC, and (d) system.

(c)



(d)

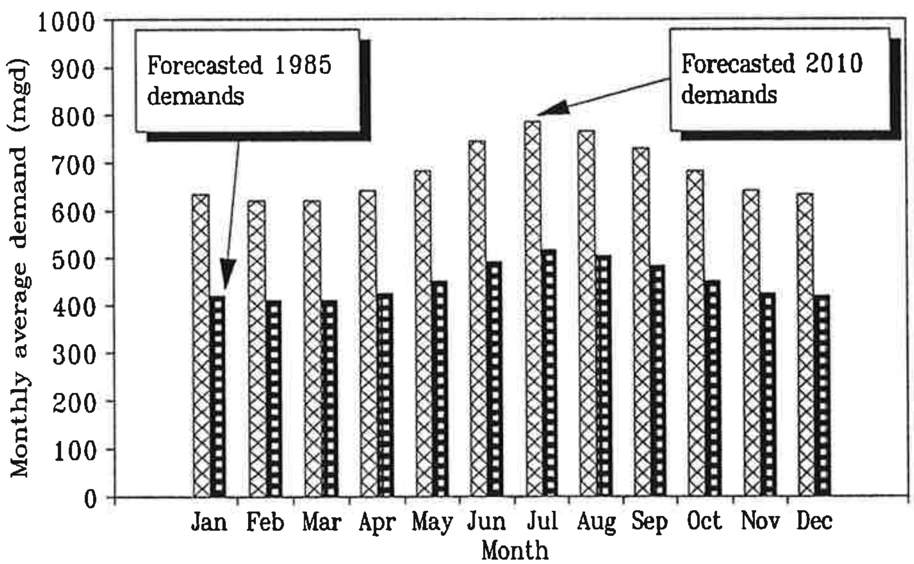


Figure 2 (continued)- Forecasted monthly average water demands for 1985 and 2010 for (a) WAD, (b) FCWA, (c) WSSC, and (d) system.

- Unforeseen local political pressures may change the pattern and magnitude of water demand growth away from some transportation corridors and towards others. For example, efforts to downzone portions of Fairfax County, particularly along Highway 29, and upzone portions of western Prince William County will affect the location and the magnitude of future growth along these highway corridors. These issues will affect FCWA particularly.

- Since 1985, WAD's annual average production has steadily dropped. This may be due to a decrease in population within the District of Columbia. Preliminary results of the 1990 census indicate such a decrease in population from the 1980 census. For the forecast in this study to be realized, WAD's water demand will need to increase over the forecast period.

- Long term variation in climate may affect demands and supplies in an unknown way, contributing to the overall severity of a water supply shortage or varying consumption patterns significantly.

Water Resource Adequacy Analysis

A lower bound on available system yield may be obtained by summing the independent yields of the system resources. For each of the reservoirs, the yield is calculated as the maximum continuous reliable release which could be maintained during the critical period. The critical period is defined as the longest interval in the historic record when the reservoir would go from being full to empty to full again while subject to the largest feasible constant withdrawal. The assumed yield of the Potomac River is the lowest daily average flow during any consecutive 120 days in the period of record for Little Falls. Table 2 displays independent yields for the system resources.

Table 2 - Independent yields of major system resources.

	Independent yield (mgd)
Occoquan Reservoir	65
Jennings Randolph Lake	158
Little Seneca Reservoir	9
Patuxent River Reservoirs	32
Potomac River (historic 120 day minimum flow)	585
Total independent yield	849

This method provides a conservative total yield value of 849 mgd. In actuality, the available yield would be larger by the inclusion of a number of influential factors. The greatest improvement in yield is likely to come from combined system operation of the resources. In the past, this has produced significant increases in yield. The true independent yield of the Occoquan Reservoir may be higher, especially if the treated effluent from the UOSA wastewater treatment plant is included. Although the Jennings Randolph Reservoir yield is computed from the combined water supply and water quality storage, it would in all likelihood be augmented by releases from Savage Reservoir. The yield of the Patuxent Reservoirs is the lowest of several quoted in various reports, and excludes 10 mgd minimum release. Sources not included here, but potentially available to the demand region by the year 2010 include: treated effluent from the proposed Broad Run wastewater treatment plant in Loudoun County, Beaver Dam Creek Reservoir, Goose Creek Reservoir, and releases from Lake Manassas.

The year 2010 maximum 120-day demand was selected as the criterion for comparison with resources because it approximates the number of days of required releases from Jennings Randolph in a repeat of the drought of record with the forecast demands. The value of 891 mgd for the year 2010 maximum 120-day unrestricted demand is the product of the year 2010 annual average demand for the system and the maximum 120-day production factor plus 100 mgd for environmental flow-by required at Little Falls. The average day demand for the system is the sum of the year 2010 annual average demands for WAD, FCWA, WSSC, Rockville, and Leesburg. The maximum 120-day production factor is set equal to the highest 120-day production factor for the combined productions of the three major utilities in the fifteen years of record (1974-1988); where each calendar year was analyzed separately. Also used were the year 2010 maximum 120-day demands utilizing water conservation scenarios 1 and 2. These demands were determined in a similar manner with the annual average demands reduced through water conservation savings. Conservation scenario 1 yields a maximum 120-day demand of 837 mgd and conservation scenario 2 yields a maximum 120-day demand of 783 mgd.

Table 3 displays the comparison of the year 2010 maximum 120-day demands with the estimated resource yield of 849 mgd. The unrestricted demand shows an apparent resource deficit of 42 mgd. However, the deficit is also approximately 5% of system yield which is within the range of yield enhancement expected by coordinated system operations. In addition, comparisons of the estimated yield of 849 mgd with the conservation scenario 1 demand of 837 mgd and conservation scenario 2 demand of 783 mgd indicate adequate resources in both cases.

Table 3 - Comparison of independent yield of system resources with year 2010 maximum 120 day demands.

	Unrestricted demand (mgd)	Conservation scenario 1 demand (mgd)	Conservation scenario 2 demand (mgd)
Year 2010 average system demand	682	635	589
Maximum system 120-day demand factor	1.16	1.16	1.16
Maximum 120 day system demand	791	737	683
Little Falls flow-by	100	100	100
Year 2010 maximum 120 day demand	891	837	783
Independent yield	849	849	849
Resource excess (+) or deficit (-)	-42	+12	+66

Study Conclusions

The following conclusions may be drawn from the forecast of long term raw water demands for the Washington Metropolitan Area and the comparison of this forecasted demand with available resources.

- The annual average demand of 682 mgd forecasted in this study for the Washington Metropolitan Area had not previously been forecasted to be reached until 2025-2030.

- In general, most growth in water demand will be outside the Beltway, concentrated along major transportation corridors.

- WAD's growth in water demand will be in the employment water use sector. Total residential water demands will remain flat within their service area. There also will be no expansion in their service area during the forecast period.

- WSSC's growth in water demand will be evenly divided between single family residential, multifamily residential, and employment water use sectors. Most of this growth will be due to expansion and filling in of their direct service area.

- FCWA's growth in water demand will be primarily in the single family residential water use sector. Their growth will be approximately equally split between growth in their direct (Fairfax County) and indirect (Prince William and Loudoun counties) service areas. As a percent, however, FCWA's water demand will grow much faster in their indirect service area.

- The combined independent yield of the existing system resources is approximately 849 mgd. There is an apparent resource deficit of 42 mgd with respect to the unrestricted maximum 120-day demand expected to occur in year 2010. However, there is no resource deficit when the maximum 120-day demand is reduced through water conservation.