SECTION IV

QUANTITY ANALYSIS

The purpose of this chapter is to estimate the quantity of urban runoff. The first section provides some background information regarding models which are used to assist in making such decisions. Then, precipitation patterns are analyzed to form a basis for predicting the quantity of urban runoff.

MODELING OF URBAN RUNOFF

The overall goal of urban runoff modeling is to aid in decision making for the abatement of water quantity and quality problems. Thus, computer models do not provide "solutions" to problems, in and of themselves. Rather, they serve as useful tools to those charged with devising such solutions. Within this context, sub-objectives of the modeling process may be identified: planning, design, and operation. Models for the latter category are generally site-specific[1,2] and were not considered during this research study. However, numerous models are available for planning and design purposes[3,4] and two -- the Corps of Engineers' Storage, Treatment, Overflow and Runoff Model (STORM) and the USEPA Storm Water Management Model (SWMM) respectively -- were involved intimately with the study. However, they are not unique; several other urban runoff models are capable of similar tasks.[5]

Computer models are merely mathematical abstractions of the physics of rainfall-runoff-quality processes and do not necessarily produce accurate or even logical predictions without extensive calibration/verification data. This is in addition to data required as model input, such as topography, land use, rainfall, antecedent conditions, description of drainage system and storage-treatment facilities. Among the principal 1965 findings of the ASCE Council on Urban Water Resources[6] was the serious need for field data on rainfall-runoff-quality for several catchments. Unfortunately, in spite of efforts by Federal (US Geological Survey, Office of Water Resources Technology, USEPA) and other agencies, this need still exists, especially in the area of data for calibration/verification of urban hydrology models. For instance, few new discharge data have been acquired on sewered catchments, using flumes, weirs or other accurate devices rather than conversion of stage gauge readings for determination of flow rates.[7] The state-of-the-art in computation and simulation tools has, thus, outstripped its available calibration/verification data base. However, current analytical techniques will necessarily rely on computer models, especially for planning

and design purposes. Hence, the ultimate goal of acquisition of salient field data remains worthwhile and necessary. Throughout this section, gaps in available data for input and calibration/verification will be apparent. But the useful analyses which can still be performed without these data should also be clear.

The modeling procedures developed for the nationwide assessment will be discussed in detail. Two levels of sophistication in the assessment are considered: use of STORM for the development of the parameters used in the assessment methodology described in Section VI, and use of a very simple runoff prediction technique for the 248 urbanized areas of the nationwide assessment itself. Preliminary to both is a description of climatological considerations that influence selection of modeling sites and parameters.

PRECIPITATION ANALYSIS

Any analysis of stormwater runoff must first examine the associated rainfall patterns and volumes. The intensity, duration, and frequency of the rainfall have profound effects on the amount of runoff produced.

Precipitation patterns vary widely across the United States. This variation is found not only in total annual volume, as shown in Figure IV-1, Mean Annual Precipitation in the United States, in Inches, and Regional Boundaries used for Nationwide Assessment, but also in the seasonal distribution as shown in Figure IV-2, Month-to-Month Variation of Precipitation in the United States. Among the more dominant regional characteristics are the dry summers on the West Coast, the abrupt changes in the desert states such as Arizona, the peaks occurring in spring and winter in the Central Gulf and Ohio Valley states, and the uniformity of monthly totals throughout the year in the New England states.

In order to analyze the effect that precipitation patterns have on runoff patterns, and thus control alternatives, study areas were chosen which reflected varying rainfall characteristics. The five cities which were chosen are listed in Table IV-1, Precipitation Characteristics of Study Areas, along with the regions they represent and the main characteristics which distinguish each city from the others. Further discussion of precipitation characteristics is presented in Section VI.

RUNOFF ANALYSIS USING STORM

STORM was developed by Water Resources Engineers, Inc., for the Hydrologic Engineering Center of the Corps of Engineers.[8,9] The model was designed for planning purposes, i.e., for long-term simulation of many storm events using an hourly time step. For instance, the model has been used to simulate runoff quality and simple storage-treatment options from a 63-year record of hourly rainfalls in San Francisco.[9]

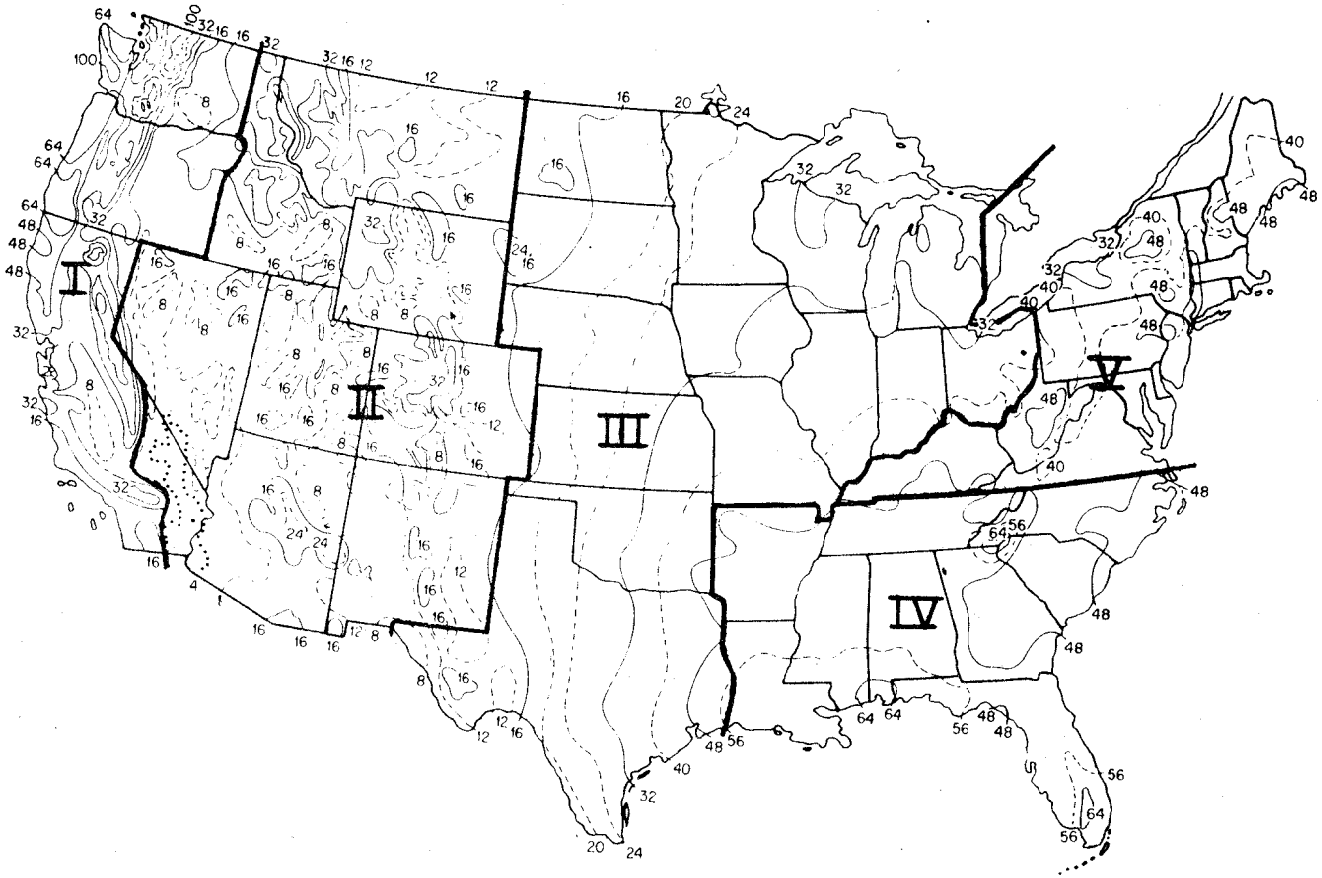

Figure IV-1. Mean Annual Precipitation in the United States, in Inches, and Regional Boundaries Used for Nationwide Assessment

Source: US Weather Bureau Climate Atlas of the United States, 1968

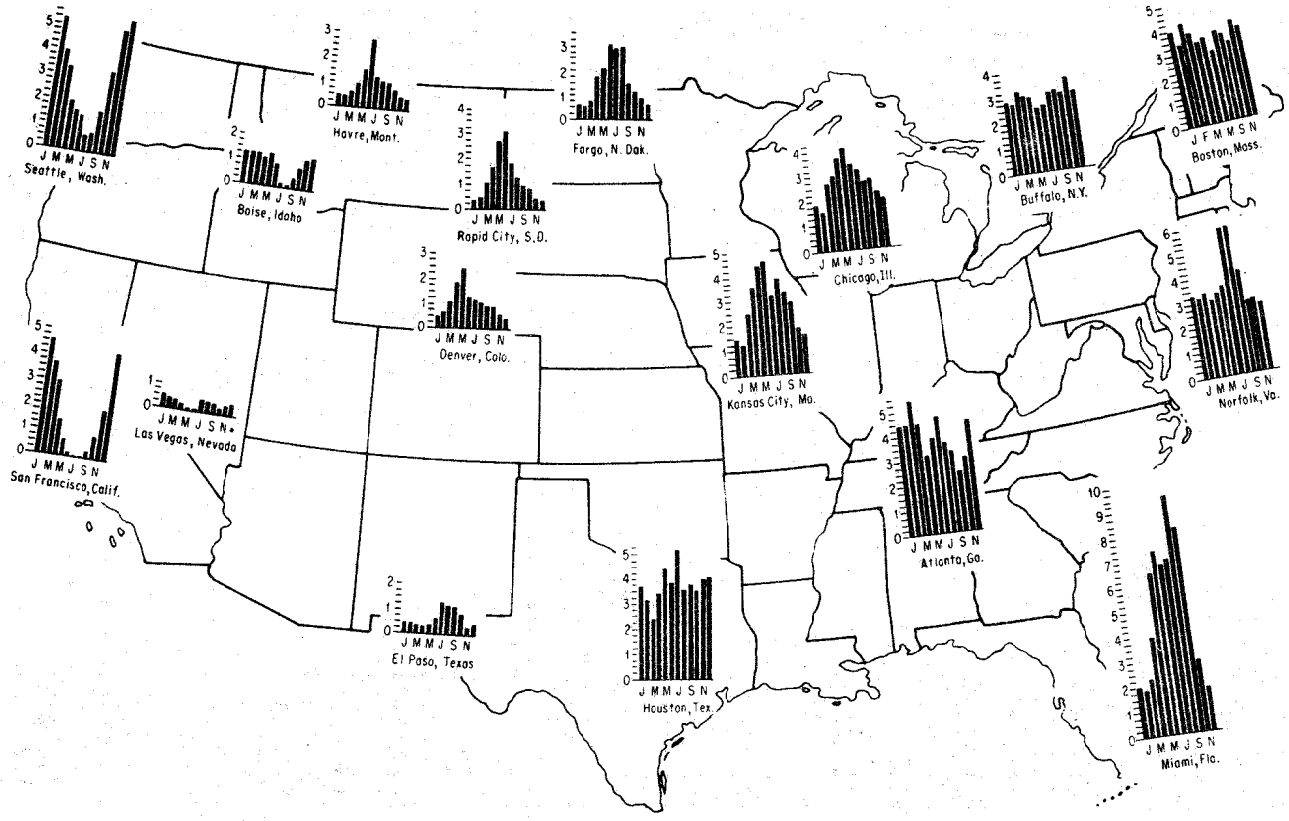

Figure IV-2. Month-to-Month Variation of Precipitation in the United States

Source: US Weather Bureau Climate Atlas of the United States, 1968

TABLE IV-1. PRECIPITATION CHARACTERISTICS OF STUDY AREAS

City	Region	Characteristics
Atlanta, Georgia	Southeast	Large volume; peaks in spring
Denver, Colorado	Rocky Mountain	Low volume
Minneapolis, Minnesota	Midwest	Large number of events; uniform distribution
San Francisco, California	West Coast	Dry summers
Washington, D. C.	Northeast	Large volume; peaks in summer and winter

When STORM is used for planning, the primary objective is to illustrate the effect of various storage-treatment combinations at the downstream end of an entire urban catchment that provide given levels of control. "Level of control" may refer to percent of runoff captured, percent BOD or other pollutant removed, number of overflows per year eliminated, quantity of overflow per year reduced, etc. Use of the model for this primary objective is described in detail in Section VI of this report, including a discussion of the methodology employed. Thus, the use of STORM in this study is deferred to that section.

RUNOFF ANALYSIS USING SWMM

The Storm Water Management Model (SWMM) was developed for the USEPA in 1969-1970 by Metcalf and Eddy, Inc., the University of Florida, and Water Resources Engineers, Inc. It was formulated as a design model, in that a detailed simulation of a single storm event was desired. This is characterized by relatively short-time steps and simulation times (i.e., minutes and hours, respectively) and a relatively high degree of detail in the catchment schematization. Recently, the SWMM has been adapted to planning purposes as well[10], but that use was not applied during this research.

The SWMM methodology, verification and usage are well documented in the original final reports[11,12,13,14] and in more recent publications[15,16] and will not be described here. In general, the SWMM provides a complete description (in both a spatial and temporal sense) of flows and pollutant concentrations from the point of rainfall, through the surface and subsurface drainage network, through storage-treatment facilities, and into the receiving waters.

During formulation of the research plan, it was felt that SWMM would play the dominant role in fulfilling the modeling needs of the study. This concept was later revised in light of altered techniques available for accomplishment of project objectives. In particular, it became apparent that detailed modeling of a few cities would not suffice when the nationwide assessment must encompass 248 urbanized areas. Consequently, much simpler means had to be developed for the overall assessment. In addition, the need for long-term simulation developed (e.g., simulation periods on the order of years) for which the SWMM, at the time, was unsuitable. STORM was later adopted for this purpose. Valuable runs of SWMM were still made on catchments in all of the five test cities as described briefly in Volume III, but they served more to enhance the model's usefulness than to aid in the assessment. Hence, these results are being incorporated into updated SWMM documentation (EPA Grant No. R-802411) and are not presented here.

RUNOFF PREDICTION FOR NATIONWIDE ASSESSMENT

Form of Equation

As discussed, techniques for prediction of runoff quantities vary from very simple methods of the Rational Method type to sophisticated models of the nature of SWMM. The technique used in STORM is relatively simple, relying on weighted average runoff coefficients and a simple loss function to predict hourly runoff volumes. Nonetheless, because of the nature of the continuous simulation involved, it is at a considerably higher level, and therefore more complex, than earlier, desk-top techniques.

Due to the complexities and data requirements of STORM, it was not possible to run the model on all cities of the nationwide assessment, or even a majority. Rather, it was run only on the five test cities discussed earlier (plus the Des Moines example of Section VII). However, in its limited application, useful information was learned regarding formulation of a simple runoff prediction method for application to all the cities of the assessment.

Runoff is a function of meteorologic, hydrologic, topographic and demographic factors. On an annual basis, many of the factors may be considered constant, so that runoff is predicted on the basis of differences between areas rather than reflecting seasonal variations

within a year. Hence, the prime meteorologic and hydrologic factor is annual precipitation, and other factors are incorporated into a conversion to annual runoff.

These considerations led directly to the use of a simple runoff coefficient method in which runoff is merely a fraction of rainfall. This approach has been used successfully by Miller and Viessman[17] for runoff prediction on an individual storm basis in urban areas. This equation was

$$AR = 1.165(I - 0.17)(P - I_a) \qquad \text{(IV-1)}$$

where AR = runoff, in.,

I = fraction imperviousness,

P = precipitation, in., and

I_a = initial abstraction, in.

The recommended value of I_a, which accounts for depression storage, interception, etc., was between 0.10 and 0.15 in. (0.25 - 0.38 cm) and the equation was deemed valid for a range of imperviousness between 35 and 80 percent. Extrapolation for use on an annual average basis, however, may be questionable, particularly in the matter of how much water should be abstracted out of the cycle on an annual basis. Hence, an equation will be used that is similar in form to equation IV-1, but which is consistent with the STORM simulation runs, described in Section VI, on which the overall assessment is based.

STORM computes a runoff coefficient, CR, weighted between pervious and impervious areas by

$$CR = 0.15(1 - I) + 0.90\ I \qquad \text{(IV-2)}$$

$$= 0.15 + 0.75\ I$$

where I is fraction imperviousness and the coefficients 0.15 and 0.90 are the default values used in STORM for runoff coefficients from pervious and impervious areas, respectively. Note that in both equations IV-1 and IV-2, the effect of demographic factors (e.g., land use, population density) is incorporated into the imperviousness, I.

Graham et al. (Washington, DC), the American Public Works Association (Volume III), and Stankowski (New Jersey) have developed equations to predict imperviousness as a function of population density.[18,19] The imperviousness is to be estimated for the developed portion of the urbanized area only. Also the weighted average imperviousness and population density were calculated for nine Ontario cities.[20] These results are plotted on Figure IV-3, Imperviousness as a Function of Developed Population Density, along with the three estimating curves. Also, a tabulation was made of the imperviousness due to streets alone for

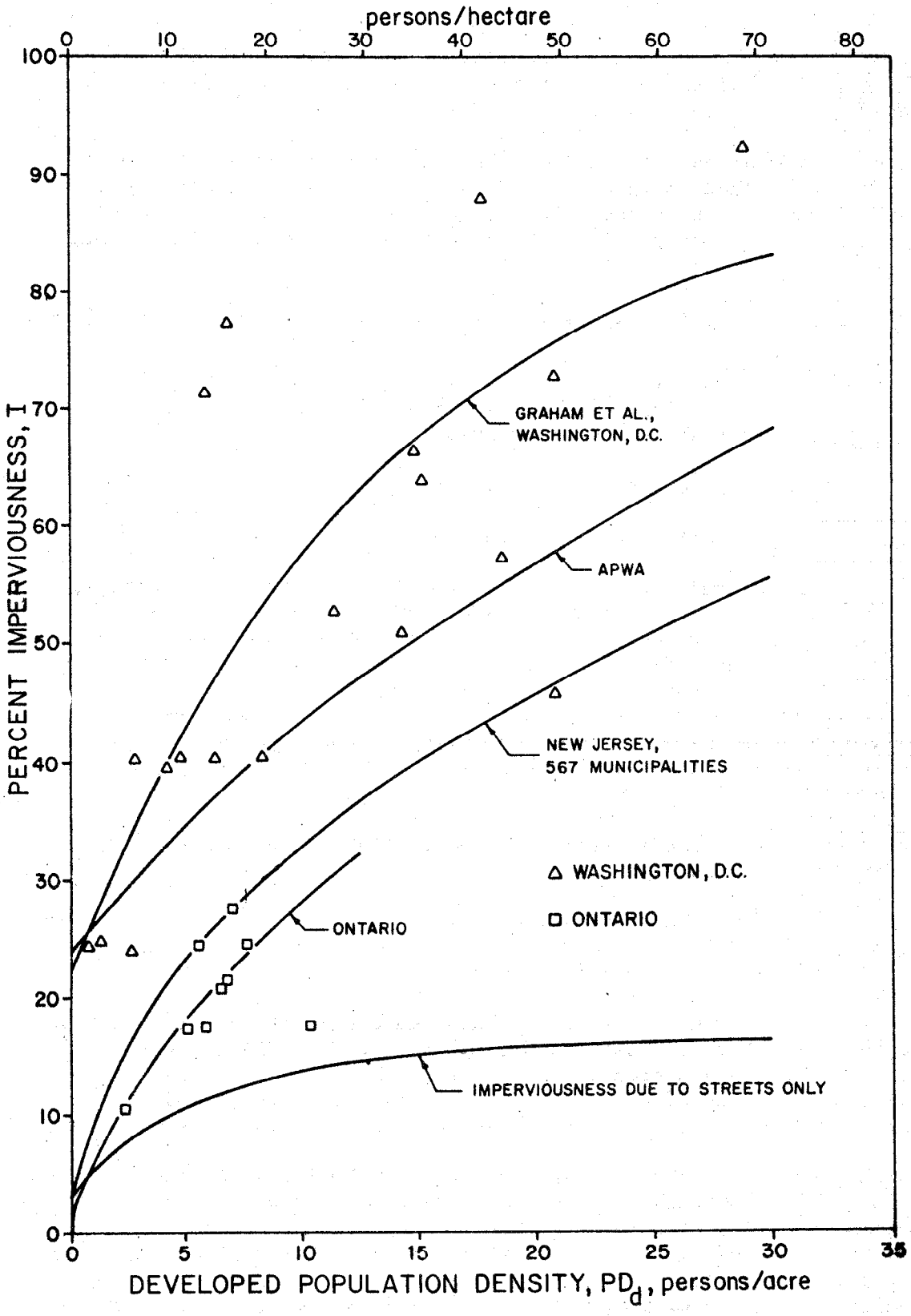

Figure IV-3. Imperviousness as a Function of Developed Population Density

various block sizes as shown in Table IV-2, Effect of Urban Block Size on Curb Length Density and Imperviousness Due to Streets. These results are also plotted on Figure IV-3. A comparison of these various plots and the actual data indicates that the New Jersey[19] equation provides a suitable predictive equation with the population density defined as developed population density. Thus, the equation used to estimate imperviousness is

$$I = 9.6\ PD_d^{(0.573-0.0391\ \log_{10} PD_d)} \qquad \text{(IV-3)}$$

where I = imperviousness, percent, and

PD_d = population density in developed portion of the urbanized area, persons per acre.

The simplified equation for estimating annual runoff (AR) is now

$$AR = (0.15 + 0.75\ I/100)P \qquad \text{(IV-4)}$$

where AR = annual runoff, inches/year,

I = imperviousness, percent, from equation IV-3, and

P = annual precipitation, inches/year.

A comparison of STORM simulated runoff versus calculated runoff for the five test cities using equation IV-4 indicated that the average difference is about 0.3 inches (0.76 cm) per year. A similar comparison in the Ontario assessment indicated a difference of 0.5 inches (1.27 cm) per year.[20] Thus, a correction factor was added to equation IV-4 to reflect this difference. The final equation is

$$AR = (0.15 + 0.75\ I/100)P - 0.3 \qquad \text{(IV-5)}$$

Based on equation IV-5, wet-weather flow estimates were made for the 248 urbanized areas for the combined, storm, and unsewered areas. The results are shown in Table IV-3, Annual Wet-Weather Runoff. Precipitation data are from reference 21.

Dry-Weather Flow Prediction

Dry-weather flow is predicted based on an average flow of 100 gallons per person-day (379 liters per person-day). Upon multiplication by population density and conversion to appropriate units,

$$DWF = 1.34\ PD_d \qquad \text{(IV-6)}$$

Table IV-2. EFFECT OF URBAN BLOCK SIZE ON CURB LENGTH DENSITY AND IMPERVIOUSNESS DUE TO STREETS

Block Size ftxft (mxm)	Area, ac (ha)	Curb Length Density ft/ac (m/ha)	Imperviousness due to Streets[a]
660 x 330 (201 x 101)	5 (2.02)	392.0 (295.0)	0.150
1320 x 660 (402 x 201)	20 (8.09)	198.0 (149.0)	0.077
2640 x 1320 (805 x 402)	80 (32.40)	99.0 (74.6)	0.039
5280 x 2640 (1609 x 805)	100 (40.50)	49.5 (37.3)	0.019

[a]Assumes 34 ft (10.4m) wide street.

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA RFG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
1	CT	BRIDGEPORT	42.0	17.8	17.8	13.0	15.5
1	CT	BRISTOL	43.0	0.0	18.9	12.4	15.4
1	CT	DANBURY	42.0	0.0	17.6	12.4	14.6
1	CT	HARTFORD	42.0	18.2	18.2	12.8	16.0
1	CT	MERIDEN	45.0	0.0	19.2	13.2	15.7
1	CT	NEW BRITAIN	43.0	0.0	17.6	13.9	16.2
1	CT	NEW HAVEN	45.0	18.8	18.8	14.2	16.9
1	CT	NORWALK	44.0	28.5	13.4	13.4	16.1
1	CT	STAMFORD	45.0	0.0	18.8	14.2	16.5
1	CT	WATERBURY	46.0	19.5	19.5	14.2	16.9
1	CT	OTHER URBAN AREAS	43.7	18.8	18.1	13.4	16.1
1	CT	AVE. FOR STATE	43.7	18.8	18.1	13.4	16.1
1	ME	LEWISTON	44.0	17.4	0.0	12.3	15.1
1	ME	PORTLAND	43.0	15.3	0.0	15.3	15.3
1	ME	OTHER URBAN AREAS	43.5	16.0	0.0	13.6	15.2
1	ME	AVE. FOR STATE	43.5	16.0	0.0	13.6	15.2
1	MA	BOSTON	43.0	19.9	19.9	12.4	16.6
1	MA	BROCKTON	45.0	0.0	19.1	14.0	16.6
1	MA	FALL RIVER	45.0	19.2	19.2	13.9	16.9
1	MA	FITCHBURG	46.0	19.4	19.4	13.5	16.0
1	MA	LAWRENCE	41.0	16.2	0.0	13.5	14.9
1	MA	LOWELL	40.0	17.6	17.6	11.8	14.8
1	MA	NEW BEDFORD	41.0	16.8	16.8	13.3	15.8
1	MA	PITTSFIELD	44.0	0.0	18.8	12.9	15.4
1	MA	SPRINGFIELD	45.0	16.2	0.0	16.2	16.2
1	MA	WORCESTER	46.0	21.5	18.7	14.6	17.1
1	MA	OTHER URBAN AREAS	43.6	17.6	19.6	13.2	16.4
1	MA	AVE. FOR STATE	43.6	17.6	19.6	13.2	16.4
1	NH	MANCHESTER	40.0	15.8	0.0	12.5	14.5
1	NH	NASHUA	42.0	14.9	0.0	14.9	14.9
1	NH	OTHER URBAN AREAS	41.0	15.4	0.0	13.5	14.7
1	NH	AVE. FOR STATE	41.0	15.4	0.0	13.5	14.7
1	RI	PROVIDENCE	40.0	18.5	16.5	12.0	15.0
1	RI	OTHER URBAN AREAS	40.0	18.5	16.5	12.0	15.0
1	RI	AVE. FOR STATE	40.0	18.5	16.5	12.0	15.0
1	VT	URBAN AREAS	35.0	13.1	0.0	12.6	12.8
1	VT	AVE. FOR STATE	35.0	13.1	0.0	12.6	12.8
1		AVE. FOR REGION 1	41.1	17.2	18.9	13.2	16.0
2	NJ	ATLANTIC CITY	42.0	0.0	18.5	12.1	15.0
2	NJ	NEW YORK CITY METRO	43.0	26.6	19.6	12.1	15.9
2	NJ	PHILADELPHIA METRO	43.0	16.8	0.0	10.3	16.7
2	NJ	TRENTON	42.0	0.0	17.2	13.6	16.4
2	NJ	VINELAND	44.0	0.0	17.7	13.3	15.1
2	NJ	AVE. FOR STATE	42.8	19.1	19.4	12.2	15.9
2	NY	ALBANY	38.0	16.8	16.8	11.2	14.2
2	NY	BINGHAMPTON	36.0	13.9	0.0	11.7	13.5
2	NY	BUFFALO	36.0	17.0	13.7	11.2	14.4
2	NY	NEW YORK CITY	43.0	35.0	24.8	0.0	29.8
2	NY	ROCHESTER	32.0	15.1	15.1	9.1	12.3
2	NY	SYRACUSE	38.0	15.9	15.9	12.0	14.6
2	NY	UTICA	44.0	18.4	18.4	13.9	16.0
2	NY	OTHER URBAN AREAS	38.1	25.8	21.4	11.0	21.1
2	NY	AVE. FOR STATE	38.1	25.8	21.4	11.0	21.1
2		AVE. FOR REGION 2	40.5	25.2	20.3	11.9	18.2

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
3	DE	WILMINGTON	45.0	19.0	19.0	14.2	17.0
3	DE	OTHER URBAN AREAS	45.0	19.0	19.0	14.2	17.0
3	DE	AVE. FOR STATE	45.0	19.0	19.0	14.2	17.0
3	DC	WASHINGTON,D.C.	41.0	24.8	18.2	0.0	20.7
3	DC	AVE. FOR STATE	41.0	24.8	18.2	0.0	20.7
3	MD	BALTIMORE	43.0	0.0	18.7	13.4	17.3
3	MD	WASHINGTON DC METRO	41.0	0.0	18.0	12.4	15.8
3	MD	OTHER URBAN AREAS	42.0	0.0	18.5	13.1	16.9
3	MD	AVE. FOR STATE	42.0	0.0	18.5	13.1	16.9
3	PA	ALLENTOWN	44.0	19.2	19.2	13.4	16.8
3	PA	ALTOONA	44.0	18.0	18.0	14.3	17.1
3	PA	ERIE	38.0	15.7	15.4	12.3	14.6
3	PA	HARRISBURG	38.0	16.8	16.8	11.2	14.2
3	PA	JOHNSTOWN	45.0	17.7	17.7	15.4	17.0
3	PA	LANCASTER	43.0	17.5	17.5	14.0	16.0
3	PA	PHILADELPHIA	43.0	19.3	18.3	13.6	17.5
3	PA	PITTSBURGH	37.0	19.1	19.1	9.4	13.8
3	PA	READING	42.0	0.0	17.2	13.6	16.3
3	PA	SCRANTON	39.0	14.6	0.0	12.8	14.0
3	PA	WILKES-BARRE	39.0	16.3	16.3	12.2	14.3
3	PA	YORK	40.0	0.0	16.0	13.3	15.1
3	PA	OTHER URBAN AREAS	41.0	17.6	18.2	11.4	15.9
3	PA	AVE. FOR STATE	41.0	17.6	18.2	11.4	15.9
3	VA	LYNCHBERG	40.0	13.8	0.0	0.0	13.8
3	VA	NEWPORT NEWS	45.0	0.0	19.3	13.5	16.0
3	VA	NORFOLK	45.0	0.0	20.2	12.8	16.3
3	VA	PETERSBURG	43.0	0.0	19.4	12.3	15.6
3	VA	RICHMOND	44.0	18.8	18.8	13.6	16.3
3	VA	ROANOKE	42.0	17.2	17.2	13.6	15.3
3	VA	WASHINGTON DC METRO	41.0	19.0	18.2	0.0	18.2
3	VA	OTHER URBAN AREAS	42.9	16.9	18.7	13.2	16.6
3	VA	AVE. FOR STATE	42.9	16.9	18.7	13.2	16.6
3	WV	CHARLESTON	45.0	19.0	19.0	13.9	16.5
3	WV	HUNTINGTON	40.0	14.7	0.0	0.0	14.7
3	WV	STEUBENVILLE METRO	40.0	13.3	0.0	0.0	13.3
3	WV	WHEELING	39.0	15.3	15.3	13.3	14.7
3	WV	OTHER URBAN AREAS	41.0	15.4	18.6	13.8	15.2
3	WV	AVE. FOR STATE	41.0	15.4	18.6	13.8	15.2
3		AVE. FOR REGION 3	42.1	17.4	18.4	12.2	16.3

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
4	AL	BIRMINGHAM	53.0	0.0	21.9	17.1	19.4
4	AL	GADSDEN	55.0	0.0	23.2	16.3	19.2
4	AL	HUNTSVILLE	52.0	0.0	22.0	15.1	18.1
4	AL	MOBILE	68.0	0.0	28.8	20.7	24.1
4	AL	MONTGOMERY	54.0	0.0	22.8	17.0	20.0
4	AL	TUSCALOOSA	53.0	0.0	20.8	18.3	19.0
4	AL	OTHER URBAN AREAS	55.8	0.0	23.4	17.7	20.3
4	AL	AVE. FOR STATE	55.8	0.0	23.4	17.7	20.3
4	FL	FT.LAUDERDALE	60.0	0.0	26.0	18.3	22.4
4	FL	GAINESVILLE	52.0	0.0	21.3	17.0	19.0
4	FL	JACKSONVILLE	53.0	0.0	22.4	15.6	18.7
4	FL	MIAMI	60.0	0.0	25.8	18.9	23.9
4	FL	ORLANDO	51.0	22.7	22.7	14.8	18.5
4	FL	PENSACOLA	63.0	0.0	26.9	19.5	23.2
4	FL	ST.PETERSBURG	55.0	0.0	24.4	16.4	20.6
4	FL	TALLAHASSEE	57.0	0.0	24.6	17.4	21.0
4	FL	TAMPA	52.0	0.0	23.6	15.0	19.3
4	FL	WEST PALM BEACH	62.0	0.0	26.2	19.3	22.4
4	FL	OTHER URBAN AREAS	56.5	22.7	24.9	17.1	21.3
4	FL	AVE. FOR STATE	56.5	22.7	24.9	17.1	21.3
4	GA	ALBANY	48.0	16.3	0.0	0.0	16.3
4	GA	ATLANTA	47.0	19.4	19.4	15.3	17.3
4	GA	AUGUSTA	39.0	14.2	0.0	14.2	14.2
4	GA	COLUMBUS	49.0	20.0	20.0	16.0	17.6
4	GA	MACON	44.0	0.0	18.4	13.8	16.1
4	GA	SAVANNAH	52.0	23.9	16.4	16.0	19.1
4	GA	OTHER URBAN AREAS	46.5	18.1	19.2	15.3	17.1
4	GA	AVE. FOR STATE	46.5	18.1	19.2	15.3	17.1
4	KY	HUNTINGTON METRO	40.0	16.2	16.2	13.1	14.5
4	KY	LEXINGTON	44.0	0.0	18.1	14.2	17.0
4	KY	LOUISVILLE	41.0	18.2	18.2	12.2	15.6
4	KY	OWENSBORO	44.0	18.0	18.0	14.3	17.3
4	KY	OTHER URBAN AREAS	42.3	17.9	18.1	12.5	15.8
4	KY	AVE. FOR STATE	42.3	17.9	18.1	12.5	15.8
4	MS	BILOXI	58.0	0.0	23.6	19.1	20.8
4	MS	JACKSON	51.0	0.0	21.3	16.1	18.8
4	MS	OTHER URBAN AREAS	54.5	0.0	22.1	17.5	19.6
4	MS	AVE. FOR STATE	54.5	0.0	22.1	17.5	19.6
4	NC	ASHEVILLE	48.0	0.0	21.1	13.9	17.1
4	NC	CHARLOTTE	43.0	0.0	17.5	14.1	15.8
4	NC	DURHAM	43.0	0.0	17.0	14.7	15.6
4	NC	FAYETTEVILLE	47.0	0.0	19.2	15.3	17.0
4	NC	GREENSBORO	42.0	0.0	17.8	12.9	15.3
4	NC	HIGHPOINT	46.0	0.0	17.8	15.9	16.4
4	NC	RALEIGH	46.0	0.0	19.3	14.8	16.6
4	NC	WILMINGTON	52.0	0.0	23.1	14.9	18.7
4	NC	WINSTON-SALEM	47.0	0.0	19.2	15.3	17.0
4	NC	OTHER URBAN AREAS	46.0	0.0	18.6	14.6	16.4
4	NC	AVE. FOR STATE	46.0	0.0	18.6	14.6	16.4
4	SC	CHARLESTON	47.0	0.0	19.1	15.5	17.1
4	SC	COLUMBIA	47.0	0.0	19.4	15.3	17.1
4	SC	GREENVILLE	46.0	0.0	18.8	15.0	16.6
4	SC	OTHER URBAN AREAS	46.7	0.0	19.1	15.3	17.0
4	SC	AVE. FOR STATE	46.7	0.0	19.1	15.3	17.0
4	TN	CHATTANOOGA	54.0	22.4	22.4	17.2	19.3
4	TN	KNOXVILLE	46.0	0.0	18.9	14.9	16.6
4	TN	MEMPHIS	48.0	0.0	21.3	14.3	18.2
4	TN	NASHVILLE	45.0	19.0	17.6	13.4	15.7
4	TN	OTHER URBAN AREAS	48.3	19.4	20.5	14.6	17.3
4	TN	AVE. FOR STATE	48.3	19.4	20.5	14.6	17.3
4		AVE. FOR REGION 4	49.6	18.5	21.7	15.8	18.6

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
5	IL	AURORA	34.0	0.0	15.0	10.0	12.6
5	IL	BLOOMINGTON	36.0	0.0	15.6	10.9	13.6
5	IL	CHAMPAIGN	37.0	0.0	15.8	11.7	15.1
5	IL	CHICAGO	33.0	17.1	10.1	9.9	13.6
5	IL	DAVENPORT METRO	34.0	13.2	13.2	11.7	12.7
5	IL	DECATUR	37.0	13.6	0.0	13.6	13.6
5	IL	JOLIET	33.0	0.0	14.0	10.1	12.1
5	IL	PEORIA	35.0	12.6	0.0	12.6	12.6
5	IL	ROCKFORD	36.0	0.0	16.0	10.6	13.5
5	IL	SPRINGFIELD	35.0	14.3	14.3	11.3	13.3
5	IL	OTHER URBAN AREAS	35.0	16.6	11.6	10.3	13.4
5	IL	AVE. FOR STATE	35.0	16.6	11.6	10.3	13.4
5	IN	ANDERSON	36.0	10.6	0.0	0.0	10.6
5	IN	CHICAGO METRO	33.0	14.5	14.5	9.8	12.4
5	IN	EVANSVILLE	41.0	15.5	0.0	0.0	15.5
5	IN	FORT WAYNE	34.0	15.0	15.0	10.0	12.7
5	IN	INDIANAPOLIS	40.0	17.4	17.4	11.3	14.4
5	IN	LAFAYETTE	35.0	15.6	8.7	0.0	13.6
5	IN	MUNCIE	39.0	15.2	15.2	13.3	14.8
5	IN	SOUTH BEND	36.0	13.4	0.0	13.0	13.2
5	IN	TERRA HAUTE	41.0	0.0	16.1	14.2	15.0
5	IN	OTHER URBAN AREAS	37.2	14.7	15.1	10.9	13.3
5	IN	AVE. FOR STATE	37.2	14.7	15.1	10.9	13.3
5	MI	ANN ARBOR	31.0	0.0	12.6	10.0	11.9
5	MI	BAY CITY	28.0	10.3	0.0	10.3	10.3
5	MI	DETROIT	31.0	13.9	12.9	9.3	12.1
5	MI	FLINT	30.0	12.5	12.5	9.4	11.3
5	MI	GRAND RAPIDS	31.0	13.4	13.4	9.1	11.2
5	MI	JACKSON	34.0	12.7	0.0	11.8	12.2
5	MI	KALAMAZOO	34.0	0.0	14.3	10.4	12.1
5	MI	LANSING	31.0	12.8	12.8	9.8	11.5
5	MI	MUSKEGON	32.0	0.0	13.7	9.5	11.4
5	MI	SAGINAW	28.0	10.5	0.0	10.5	10.5
5	MI	OTHER URBAN AREAS	31.0	13.6	12.9	9.5	11.9
5	MI	AVE. FOR STATE	31.0	13.6	12.9	9.5	11.9
5	MN	DULUTH	29.0	12.1	12.1	8.7	10.1
5	MN	FARGO METRO	21.0	8.1	8.1	7.0	7.8
5	MN	MINNEAPOLIS	25.0	10.5	10.5	7.3	9.0
5	MN	ROCHESTER	29.0	0.0	11.5	9.6	11.0
5	MN	OTHER URBAN AREAS	26.0	10.5	10.6	7.4	9.1
5	MN	AVE. FOR STATE	26.0	10.5	10.6	7.4	9.1
5	OH	AKRON	38.0	0.0	16.6	11.3	13.9
5	OH	CANTON	38.0	17.4	16.7	11.2	14.2
5	OH	CINCINNATI	34.0	13.6	13.6	11.3	12.7
5	OH	CLEVELAND	32.0	15.1	15.1	8.5	11.8
5	OH	COLUMBUS	36.0	16.6	16.6	10.2	13.5
5	OH	DAYTON	35.0	0.0	15.1	10.6	13.0
5	OH	HAMILTON	40.0	18.0	18.0	11.4	14.5
5	OH	LIMA	36.0	12.5	0.0	0.0	12.5
5	OH	LORAIN	35.0	25.8	14.7	10.4	12.4
5	OH	MANSFIELD	43.0	0.0	16.7	14.8	15.3
5	OH	SPRINGFIELD	40.0	15.6	15.6	13.6	15.3
5	OH	STEUBENVILLE	40.0	16.1	0.0	0.0	15.2
5	OH	TOLEDO	32.0	13.6	13.3	9.9	11.8
5	OH	YOUNGSTOWN	42.0	17.8	17.8	13.0	15.7
5	OH	OTHER URBAN AREAS	37.2	14.6	15.6	10.2	12.9
5	OH	AVE. FOR STATE	37.2	14.6	15.6	10.2	12.9
5	WI	APPLETON	29.0	12.8	12.8	8.5	10.9
5	WI	DULUTH METRO	29.0	0.0	11.5	8.7	9.8
5	WI	GREEN BAY	27.0	10.8	10.8	8.8	9.4
5	WI	KENOSHA	32.0	14.1	12.3	0.0	12.6
5	WI	LA CROSSE	31.0	12.6	12.6	10.0	11.3
5	WI	MADISON	31.0	0.0	13.5	9.2	11.4
5	WI	MILWAUKEE	28.0	15.0	9.4	9.2	10.2
5	WI	OSHKOSH	28.0	0.0	10.8	0.0	10.8
5	WI	RACINE	32.0	0.0	13.0	10.3	12.4
5	WI	OTHER URBAN AREAS	29.7	14.5	10.8	9.2	10.5
5	WI	AVE. FOR STATE	29.7	14.5	10.8	9.2	10.5
5		AVE. FOR REGION 5	32.7	14.8	12.9	9.8	12.3

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER.
6	AR	FORT SMITH	43.0	15.0	0.0	15.0	15.0
6	AR	LITTLE ROCK	49.0	0.0	20.5	16.7	17.8
6	AR	PINE BLUFF	52.0	0.0	21.0	17.4	19.3
6	AR	OTHER URBAN AREAS	48.0	15.0	20.6	16.4	17.4
6	AR	AVE. FOR STATE	48.0	15.0	20.6	16.4	17.4
6	LA	BATON ROUGE	60.0	0.0	25.3	19.1	22.4
6	LA	LAFAYETTE	59.0	0.0	23.8	19.7	22.2
6	LA	LAKE CHARLES	58.0	0.0	23.7	19.1	21.4
6	LA	MONROE	50.0	0.0	19.9	17.1	18.1
6	LA	NEW ORLEANS	64.0	0.0	31.8	0.0	31.8
6	LA	SHREVEPORT	45.0	0.0	18.3	14.8	16.4
6	LA	OTHER URBAN AREAS	56.0	0.0	27.5	17.4	24.1
6	LA	AVE. FOR STATE	56.0	0.0	27.5	17.4	24.1
6	NM	ALBUQUERQUE	9.0	0.0	3.6	2.5	3.1
6	NM	OTHER URBAN AREAS	9.0	0.0	3.6	2.5	3.1
6	NM	AVE. FOR STATE	9.0	0.0	3.6	2.5	3.1
6	OK	LAWTON	30.0	0.0	11.7	10.2	10.7
6	OK	OKLAHOMA CITY	31.0	0.0	13.5	8.8	10.9
6	OK	TULSA	37.0	0.0	15.9	11.0	13.2
6	OK	OTHER URBAN AREAS	32.7	0.0	14.2	9.7	11.7
6	OK	AVE. FOR STATE	32.7	0.0	14.2	9.7	11.7
6	TX	ABILENE	24.0	0.0	10.0	6.8	8.2
6	TX	AMARILLO	20.0	0.0	8.5	5.8	7.0
6	TX	AUSTIN	33.0	0.0	13.7	10.4	12.2
6	TX	BEAUMONT	54.0	23.5	23.5	15.6	19.1
6	TX	BROWNSVILLE	27.0	0.0	10.5	9.1	10.1
6	TX	BRYAN	39.0	0.0	16.9	11.2	13.7
6	TX	CORPUS CHRISTI	28.0	0.0	12.1	7.9	9.8
6	TX	DALLAS	35.0	0.0	15.3	9.7	12.5
6	TX	EL PASO	8.0	0.0	3.3	2.1	2.7
6	TX	FORT WORTH	30.0	0.0	13.1	8.5	10.5
6	TX	GALVESTON	43.0	27.7	0.0	14.0	15.8
6	TX	HARLINGEN	26.0	0.0	9.4	8.9	9.0
6	TX	HOUSTON	46.0	25.4	18.7	15.0	17.2
6	TX	LAREDO	19.0	0.0	7.5	6.1	7.0
6	TX	LUBBOCK	18.0	0.0	7.1	5.7	6.3
6	TX	MCALLEN	21.0	0.0	8.1	7.1	7.6
6	TX	MIDLAND	14.0	0.0	5.2	4.6	4.8
6	TX	ODESSA	14.0	0.0	5.4	4.5	5.1
6	TX	PORT ARTHUR	54.0	0.0	21.7	17.8	19.1
6	TX	SAN ANGELO	19.0	0.0	7.2	6.4	6.6
6	TX	SAN ANTONIO	28.0	0.0	12.3	8.2	10.5
6	TX	SHERMAN	39.0	0.0	14.6	13.5	13.7
6	TX	TEXARKANA	46.0	0.0	17.9	15.9	16.4
6	TX	TEXAS CITY	45.0	0.0	18.5	13.5	15.5
6	TX	TYLER	45.0	0.0	18.4	14.7	16.4
6	TX	WACO	32.0	0.0	13.5	9.3	11.1
6	TX	WICHITA FALL	29.0	0.0	11.4	9.9	10.4
6	TX	OTHER URBAN AREAS	31.0	24.7	14.2	10.1	12.3
6	TX	AVE. FOR STATE	31.0	24.7	14.2	10.1	12.3
6		AVE. FOR REGION 6.	35.3	17.9	16.2	10.7	13.4

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA RFG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMP	STORM	UNSEW	AVER
7	IA	CEDAR RAPIDS	33.0	0.0	13.4	10.7	11.8
7	IA	DAVENPORT	34.0	14.1	14.1	10.2	11.8
7	IA	DES MOINES	31.0	18.2	10.2	9.3	11.2
7	IA	DUBUQUE	33.0	0.0	12.9	11.2	12.4
7	IA	SIOUX CITY	25.0	0.0	10.7	7.1	8.7
7	IA	WATERLOO	32.0	0.0	12.8	10.4	11.2
7	IA	OTHER URBAN AREAS	31.3	18.0	12.1	9.7	11.1
7	IA	AVE. FOR STATE	31.3	18.0	12.1	9.7	11.1
7	KS	KANSAS CITY METRO	34.0	14.1	14.1	10.7	12.7
7	KS	TOPEKA	34.0	14.2	14.2	10.6	12.3
7	KS	WICHITA	31.0	0.0	12.6	10.0	11.4
7	KS	OTHER URBAN AREAS	33.0	14.1	13.2	10.4	12.1
7	KS	AVE. FOR STATE	33.0	14.1	13.2	10.4	12.1
7	MO	COLUMBIA	37.0	0.0	15.7	10.8	12.9
7	MO	KANSAS CITY	34.0	15.2	11.6	11.1	12.1
7	MO	SPRINGFIELD	41.0	0.0	17.2	12.7	14.6
7	MO	ST.JOSEPH	35.0	11.2	0.0	0.0	11.2
7	MO	ST.LOUIS	37.0	14.3	0.0	14.2	14.3
7	MO	OTHER URBAN AREAS	36.8	14.2	13.3	12.7	13.5
7	MO	AVE. FOR STATE	36.8	14.2	13.3	12.7	13.5
7	NE	LINCOLN	27.0	0.0	11.5	8.2	9.9
7	NE	OMAHA	26.0	11.4	11.4	7.6	9.7
7	NE	OTHER URBAN AREAS	26.5	11.4	11.5	7.7	9.7
7	NE	AVE. FOR STATE	26.5	11.4	11.5	7.7	9.7
7		AVE. FOR REGION 7	31.9	14.0	12.6	10.8	12.2
8	CO	BOULDER	19.0	0.0	8.0	5.8	7.4
8	CO	COLORADO SPRINGS	13.0	0.0	5.1	4.0	4.5
8	CO	DENVER	14.0	7.7	5.9	4.0	5.1
8	CO	PUEBLO	12.0	5.7	4.4	3.7	4.3
8	CO	OTHER URBAN AREAS	14.5	6.1	5.8	4.0	5.1
8	CO	AVE. FOR STATE	14.5	6.1	5.8	4.0	5.1
8	MT	BILLINGS	13.0	0.0	5.1	4.0	4.6
8	MT	GREAT FALLS	15.0	0.0	5.7	4.9	5.4
8	MT	OTHER URBAN AREAS	14.0	0.0	5.4	4.3	5.0
8	MT	AVE. FOR STATE	14.0	0.0	5.4	4.3	5.0
8	ND	FARGO	21.0	8.3	8.3	6.9	7.8
8	ND	OTHER URBAN AREAS	21.0	8.3	8.3	6.9	7.8
8	ND	AVE. FOR STATE	21.0	8.3	8.3	6.9	7.8
8	SD	SIOUX FALLS	25.0	10.4	10.4	7.9	9.1
8	SD	OTHER URBAN AREAS	25.0	10.4	10.4	7.9	9.1
8	SD	AVE. FOR STATE	25.0	10.4	10.4	7.9	9.1
8	UT	OGDEN	17.0	0.0	7.0	5.0	6.0
8	UT	PROVO	13.0	0.0	5.4	3.6	4.4
8	UT	SALT LAKE CITY	15.0	0.0	6.2	4.4	5.3
8	UT	OTHER URBAN AREAS	15.0	0.0	6.3	4.4	5.3
8	UT	AVE. FOR STATE	15.0	0.0	6.3	4.4	5.3
8	WY	URBAN AREAS	15.0	0.0	5.9	4.7	5.3
8	WY	AVE. FOR STATE	15.0	0.0	5.9	4.7	5.3
8		AVE. FOR REGION 8	17.4	7.5	6.4	4.7	5.6

TABLE IV-3 ANNUAL WET-WEATHER RUNOFF

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	WET-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
9	AK	URBAN AREAS	30.0	13.1	13.1	8.6	10.6
9	AK	AVE. FOR STATE	30.0	13.1	13.1	8.6	10.6
9	AZ	PHOENIX	7.0	0.0	2.7	1.8	2.3
9	AZ	TUCSON	11.0	0.0	4.3	3.3	3.8
9	AZ	OTHER URBAN AREAS	9.0	0.0	3.1	2.2	2.7
9	AZ	AVE. FOR STATE	9.0	0.0	3.1	2.2	2.7
9	CA	BAKERSFIELD	11.0	0.0	4.5	3.1	3.9
9	CA	FRESNO	11.0	0.0	4.4	3.3	3.9
9	CA	LOS ANGELES	13.0	0.0	5.3	3.9	5.1
9	CA	MODESTO	25.0	0.0	10.1	8.0	9.2
9	CA	OXNARD	15.0	0.0	6.3	4.3	5.2
9	CA	SACRAMENTO	18.0	7.5	7.5	5.3	6.4
9	CA	SALINAS	15.0	0.0	5.9	4.7	5.6
9	CA	SAN BERNANDINO	18.0	0.0	7.8	4.9	6.2
9	CA	SAN DIEGO	11.0	0.0	4.5	3.1	3.9
9	CA	SAN FRANCISCO	21.0	11.6	9.0	5.6	8.1
9	CA	SAN JOSE	14.0	0.0	6.0	4.0	5.1
9	CA	SANTA BARBARA	18.0	0.0	7.2	5.7	6.7
9	CA	SANTA ROSA	30.0	0.0	11.6	10.2	10.6
9	CA	SEASIDE	16.0	0.0	6.1	5.3	6.0
9	CA	SIMI VALLEY	25.0	0.0	10.0	8.1	8.9
9	CA	STOCKTON	14.0	0.0	5.5	4.3	5.1
9	CA	OTHER URBAN AREAS	17.2	11.3	5.9	4.6	5.7
9	CA	AVE. FOR STATE	17.2	11.3	5.9	4.6	5.7
9	HI	HONOLULU	23.0	0.0	9.9	6.9	8.7
9	HI	OTHER URBAN AREAS	23.0	0.0	9.9	6.9	8.7
9	HI	AVE. FOR STATE	23.0	0.0	9.9	6.9	8.7
9	NV	LAS VEGAS	4.0	0.0	1.4	0.9	1.2
9	NV	RENO	7.0	2.9	2.6	2.0	2.3
9	NV	OTHER URBAN AREAS	5.5	2.9	1.6	1.2	1.5
9	NV	AVE. FOR STATE	5.5	2.9	1.6	1.2	1.5
9		AVE. FOR REGION 9	16.9	10.9	5.8	4.3	5.5
10	ID	BOISE	11.0	0.0	4.2	3.5	3.9
10	ID	OTHER URBAN AREAS	11.0	0.0	4.2	3.5	3.9
10	ID	AVE. FOR STATE	11.0	0.0	4.2	3.5	3.9
10	OR	EUGENE	38.0	15.9	15.9	11.9	13.9
10	OR	PORTLAND	40.0	17.2	17.2	12.1	14.9
10	OR	SALEM	40.0	0.0	16.3	13.1	14.6
10	OR	OTHER URBAN AREAS	39.3	17.2	16.8	12.2	14.7
10	OR	AVE. FOR STATE	39.3	17.2	16.8	12.2	14.7
10	WA	SEATTLE	35.0	14.9	14.9	10.7	13.0
10	WA	SPOKANE	17.0	6.1	0.0	6.1	6.1
10	WA	TACOMA	39.0	16.5	16.5	12.0	14.3
10	WA	OTHER URBAN AREAS	30.3	12.0	15.5	10.6	12.3
10	WA	AVE. FOR STATE	30.3	12.0	15.5	10.6	12.3
10		AVE. FOR REGION 10	26.9	13.5	14.1	10.5	12.4
		AVERAGE FOR THE U.S.	33.4	16.5	14.8	10.8	13.4

where DWF = annual dry-weather flow, inches per year, and

PD_d = developed population density, persons per acre.

Results of these runoff calculations are shown in Table IV-4, Annual Dry-Weather Flow.

Dry-weather flow and wet-weather flow for the developed portion of an urbanized area with a precipitation of 15, 30, or 45 inches per year are shown in Figure IV-4, Comparative Magnitude of Annual Wet- and Dry-Weather Flows. Note that dry-weather flow predominates at higher population densities which have historically prevailed in cities. However, with the trend towards lower density urban living, wet-weather flows take on greater relative importance. Indeed, they are larger than dry-weather flows at the lower population densities.

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
1	CT	BRIDGEPORT	42.0	16.6	16.6	6.4	11.2
1	CT	BRISTOL	43.0	0.0	18.6	4.9	10.1
1	CT	DANBURY	42.0	0.0	16.2	5.3	9.3
1	CT	HARTFORD	42.0	17.8	17.8	6.0	12.2
1	CT	MERIDEN	45.0	0.0	16.9	5.2	9.4
1	CT	NEW BRITAIN	43.0	0.0	15.2	7.4	12.0
1	CT	NEW HAVEN	45.0	16.1	16.1	6.8	11.8
1	CT	NORWALK	44.0	49.3	6.0	6.0	10.9
1	CT	STAMFORD	45.0	0.0	16.1	6.7	11.0
1	CT	WATERBURY	46.0	16.7	16.7	6.3	11.0
1	CT	OTHER URBAN AREAS	43.7	18.1	15.9	6.2	11.3
1	CT	AVE. FOR STATE	43.7	18.1	15.9	6.2	11.3
1	ME	LEWISTON	44.0	13.8	0.0	4.4	9.0
1	ME	PORTLAND	43.0	10.1	0.0	10.1	10.1
1	ME	OTHER URBAN AREAS	43.5	11.2	0.0	6.9	9.6
1	ME	AVE. FOR STATE	43.5	11.2	0.0	6.9	9.6
1	MA	BOSTON	43.0	21.2	21.2	4.9	12.8
1	MA	BROCKTON	45.0	0.0	16.7	6.4	11.2
1	MA	FALL RIVER	45.0	17.1	17.1	6.3	11.8
1	MA	FITCHBURG	46.0	16.5	16.5	5.3	9.3
1	MA	LAWRENCE	41.0	13.8	0.0	7.8	10.7
1	MA	LOWELL	40.0	18.7	18.7	5.5	11.4
1	MA	NEW BEDFORD	41.0	15.1	15.1	7.4	12.8
1	MA	PITTSFIELD	44.0	0.0	17.1	5.2	9.5
1	MA	SPRINGFIELD	45.0	10.4	0.0	10.4	10.4
1	MA	WORCESTER	46.0	21.9	14.8	6.9	11.4
1	MA	OTHER URBAN AREAS	43.6	15.2	20.1	6.1	12.0
1	MA	AVE. FOR STATE	43.6	15.2	20.1	6.1	12.0
1	NH	MANCHESTER	40.0	13.6	0.0	6.6	10.7
1	NH	NASHUA	42.0	9.9	0.0	9.9	9.9
1	NH	OTHER URBAN AREAS	41.0	12.1	0.0	8.0	10.4
1	NH	AVE. FOR STATE	41.0	12.1	0.0	8.0	10.4
1	RI	PROVIDENCE	40.0	21.3	15.6	5.6	11.8
1	RI	OTHER URBAN AREAS	40.0	21.3	15.6	5.6	11.8
1	RI	AVE. FOR STATE	40.0	21.3	15.6	5.6	11.8
1	VT	URBAN AREAS	35.0	11.8	0.0	10.4	11.0
1	VT	AVE. FOR STATE	35.0	11.8	0.0	10.4	11.0
1		AVE. FOR REGION 1	41.1	15.1	18.4	6.3	11.5
2	NJ	ATLANTIC CITY	42.0	0.0	18.7	4.9	10.2
2	NJ	NEW YORK CITY METRO	43.0	44.1	20.4	4.6	14.2
2	NJ	PHILADELPHIA METRO	43.0	13.3	0.0	2.4	15.0
2	NJ	TRENTON	42.0	0.0	15.1	7.5	13.1
2	NJ	VINELAND	44.0	0.0	14.4	5.9	8.9
2	NJ	AVE. FOR STATE	42.8	20.5	19.9	4.6	11.2
2	NY	ALBANY	38.0	18.9	18.9	5.5	11.8
2	NY	BINGHAMPTON	36.0	12.8	0.0	7.5	11.8
2	NY	BUFFALO	36.0	22.5	12.3	6.5	14.4
2	NY	NEW YORK CITY	43.0	83.9	37.5	0.0	58.2
2	NY	ROCHESTER	32.0	22.6	22.6	4.7	13.0
2	NY	SYRACUSE	38.0	16.2	16.2	6.9	12.7
2	NY	UTICA	44.0	16.0	16.0	6.7	10.7
2	NY	OTHER URBAN AREAS	38.1	52.5	29.9	5.9	33.2
2	NY	AVE. FOR STATE	38.1	52.5	29.9	5.9	33.2
2		AVE. FOR REGION 2	40.5	49.4	24.4	5.0	21.2

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
3	DE	WILMINGTON	45.0	16.4	16.4	6.7	12.0
3	DE	OTHER URBAN AREAS	45.0	16.4	16.4	6.7	12.0
3	DE	AVE. FOR STATE	45.0	16.4	16.4	6.7	12.0
3	DC	WASHINGTON,D.C.	41.0	42.2	19.1	0.0	26.9
3	DC	AVE. FOR STATE	41.0	42.2	19.1	0.0	26.9
3	MD	BALTIMORE	43.0	0.0	17.8	6.5	14.4
3	MD	WASHINGTON DC METRO	41.0	0.0	18.4	5.9	12.8
3	MD	OTHER URBAN AREAS	42.0	0.0	18.0	6.3	14.0
3	MD	AVE. FOR STATE	42.0	0.0	18.0	6.3	14.0
3	PA	ALLENTOWN	44.0	18.1	18.1	6.0	12.4
3	PA	ALTOONA	44.0	15.2	15.2	7.4	13.0
3	PA	ERIE	38.0	15.6	14.9	7.4	12.8
3	PA	HARRISBURG	38.0	18.9	18.9	5.5	11.6
3	PA	JOHNSTOWN	45.0	13.4	13.4	8.8	12.0
3	PA	LANCASTER	43.0	14.9	14.9	7.6	11.5
3	PA	PHILADELPHIA	43.0	19.6	17.0	6.9	14.9
3	PA	PITTSBURGH	37.0	28.4	28.4	3.1	11.6
3	PA	READING	42.0	0.0	15.1	7.5	13.0
3	PA	SCRANTON	39.0	11.7	0.0	7.8	10.3
3	PA	WILKES-BARRE	39.0	16.2	16.2	6.7	11.1
3	PA	YORK	40.0	0.0	14.3	8.1	11.9
3	PA	OTHER URBAN AREAS	41.0	20.4	18.0	5.1	13.2
3	PA	AVE. FOR STATE	41.0	20.4	18.0	5.1	13.2
3	VA	LYNCHBERG	40.0	9.2	0.0	0.0	9.2
3	VA	NEWPORT NEWS	45.0	0.0	17.1	5.6	10.0
3	VA	NORFOLK	45.0	0.0	19.5	4.7	10.5
3	VA	PETERSBURG	43.0	0.0	19.8	4.7	10.7
3	VA	RICHMOND	44.0	16.9	16.9	6.3	11.3
3	VA	ROANOKE	42.0	15.1	15.1	7.5	10.7
3	VA	WASHINGTON DC METRO	41.0	21.5	19.0	0.0	19.0
3	VA	OTHER URBAN AREAS	42.9	14.3	18.7	5.5	13.0
3	VA	AVE. FOR STATE	42.9	14.3	18.7	5.5	13.0
3	WV	CHARLESTON	45.0	16.6	16.6	6.3	10.9
3	WV	HUNTINGTON	40.0	11.0	0.0	0.0	11.0
3	WV	STEUBENVILLE METRO	40.0	8.1	0.0	0.0	8.1
3	WV	WHEELING	39.0	13.5	13.5	8.8	11.9
3	WV	OTHER URBAN AREAS	41.0	12.0	16.2	6.9	10.8
3	WV	AVE. FOR STATE	41.0	12.0	16.2	6.9	10.8
3		AVE. FOR REGION 3.	42.1	18.3	18.1	5.5	13.5

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
4	AL	BIRMINGHAM	53.0	0.0	15.5	7.1	10.8
4	AL	GADSDEN	55.0	0.0	16.3	5.3	9.3
4	AL	HUNTSVILLE	52.0	0.0	16.6	5.0	9.2
4	AL	MOBILE	68.0	0.0	16.4	5.8	9.6
4	AL	MONTGOMERY	54.0	0.0	16.3	6.6	11.1
4	AL	TUSCALOOSA	53.0	0.0	13.2	9.0	10.1
4	AL	OTHER URBAN AREAS	55.8	0.0	15.8	6.5	10.2
4	AL	AVE. FOR STATE	55.8	0.0	15.8	6.5	10.2
4	FL	FT.LAUDERDALE	60.0	0.0	17.6	5.9	11.3
4	FL	GAINESVILLE	52.0	0.0	15.0	7.6	10.7
4	FL	JACKSONVILLE	53.0	0.0	16.4	5.2	9.6
4	FL	MIAMI	60.0	0.0	17.2	6.6	13.9
4	FL	ORLANDO	51.0	19.1	19.1	5.0	10.6
4	FL	PENSACOLA	63.0	0.0	16.9	6.2	10.9
4	FL	ST.PETERSBURG	55.0	0.0	18.9	5.4	11.6
4	FL	TALLAHASSEE	57.0	0.0	17.4	5.9	10.9
4	FL	TAMPA	52.0	0.0	20.0	4.9	11.2
4	FL	WEST PALM BEACH	62.0	0.0	16.4	6.4	10.3
4	FL	OTHER URBAN AREAS	56.5	19.1	17.6	5.7	11.5
4	FL	AVE. FOR STATE	56.5	19.1	17.6	5.7	11.5
4	GA	ALBANY	48.0	8.5	0.0	0.0	8.5
4	GA	ATLANTA	47.0	15.4	15.4	7.5	11.1
4	GA	AUGUSTA	39.0	10.9	0.0	10.9	10.9
4	GA	COLUMBUS	49.0	14.9	14.9	7.6	10.2
4	GA	MACON	44.0	0.0	16.2	6.6	10.8
4	GA	SAVANNAH	52.0	20.7	6.7	6.2	10.9
4	GA	OTHER URBAN AREAS	46.5	13.2	15.1	7.6	10.8
4	GA	AVE. FOR STATE	46.5	13.2	15.1	7.6	10.8
4	KY	HUNTINGTON METRO	40.0	14.8	14.8	7.7	10.7
4	KY	LEXINGTON	44.0	0.0	15.4	7.3	12.8
4	KY	LOUISVILLE	41.0	19.1	19.1	5.5	12.2
4	KY	OWENSBORO	44.0	15.1	15.1	7.5	13.4
4	KY	OTHER URBAN AREAS	42.3	16.2	18.1	5.9	12.3
4	KY	AVE. FOR STATE	42.3	16.2	18.1	5.9	12.3
4	MS	BILOXI	58.0	0.0	14.8	7.6	10.1
4	MS	JACKSON	51.0	0.0	15.9	6.8	11.0
4	MS	OTHER URBAN AREAS	54.5	0.0	15.6	7.1	10.6
4	MS	AVE. FOR STATE	54.5	0.0	15.6	7.1	10.6
4	NC	ASHEVILLE	48.0	0.0	18.4	4.9	10.1
4	NC	CHARLOTTE	43.0	0.0	14.9	7.7	11.0
4	NC	DURHAM	43.0	0.0	13.7	8.9	10.6
4	NC	FAYETTEVILLE	47.0	0.0	15.0	7.5	10.4
4	NC	GREENSBORO	42.0	0.0	16.8	6.2	10.8
4	NC	HIGHPOINT	46.0	0.0	12.8	9.1	10.0
4	NC	RALEIGH	46.0	0.0	16.2	7.2	10.4
4	NC	WILMINGTON	52.0	0.0	18.9	4.8	10.2
4	NC	WINSTON-SALEM	47.0	0.0	15.0	7.5	10.4
4	NC	OTHER URBAN AREAS	46.0	0.0	15.5	7.3	10.5
4	NC	AVE. FOR STATE	46.0	0.0	15.5	7.3	10.5
4	SC	CHARLESTON	47.0	0.0	14.8	7.7	10.6
4	SC	COLUMBIA	47.0	0.0	15.4	7.5	10.6
4	SC	GREENVILLE	46.0	0.0	15.0	7.5	10.5
4	SC	OTHER URBAN AREAS	46.7	0.0	15.1	7.6	10.6
4	SC	AVE. FOR STATE	46.7	0.0	15.1	7.6	10.6
4	TN	CHATTANOOGA	54.0	15.6	15.6	6.8	10.1
4	TN	KNOXVILLE	46.0	0.0	15.3	7.4	10.5
4	TN	MEMPHIS	48.0	0.0	19.0	5.5	12.0
4	TN	NASHVILLE	45.0	16.5	13.2	5.5	9.4
4	TN	OTHER URBAN AREAS	48.3	16.3	17.0	6.0	10.6
4	TN	AVE. FOR STATE	48.3	16.3	17.0	6.0	10.6
4		AVE. FOR REGION 4	49.6	14.4	16.6	6.6	11.0

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA REG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
5	IL	AURORA	34.0	0.0	18.8	5.5	11.5
5	IL	BLOOMINGTON	36.0	0.0	18.0	6.0	12.1
5	IL	CHAMPAIGN	37.0	0.0	17.1	6.9	15.1
5	IL	CHICAGO	33.0	29.0	6.3	5.9	15.6
5	IL	DAVENPORT METRO	34.0	13.2	13.2	9.1	11.7
5	IL	DECATUR	37.0	11.1	0.0	11.1	11.1
5	IL	JOLIET	33.0	0.0	16.9	6.3	11.3
5	IL	PEORIA	35.0	10.6	0.0	10.6	10.6
5	IL	ROCKFORD	36.0	0.0	19.1	5.5	12.0
5	IL	SPRINGFIELD	35.0	15.2	15.2	7.4	12.2
5	IL	OTHER URBAN AREAS	35.0	26.8	9.7	6.4	14.6
5	IL	AVE. FOR STATE	35.0	26.8	9.7	6.4	14.6
5	IN	ANDERSON	36.0	5.4	0.0	0.0	5.4
5	IN	CHICAGO METRO	33.0	18.8	18.8	5.6	11.9
5	IN	EVANSVILLE	41.0	12.1	0.0	0.0	12.1
5	IN	FORT WAYNE	34.0	19.0	19.0	5.5	11.8
5	IN	INDIANAPOLIS	40.0	18.0	18.0	4.6	10.4
5	IN	LAFAYETTE	35.0	19.5	2.8	0.0	13.1
5	IN	MUNCIE	39.0	13.3	13.3	8.8	12.3
5	IN	SOUTH BEND	36.0	11.6	0.0	10.6	11.2
5	IN	TERRA HAUTE	41.0	0.0	13.4	9.2	10.9
5	IN	OTHER URBAN AREAS	37.2	14.8	16.8	5.8	11.0
5	IN	AVE. FOR STATE	37.2	14.8	16.8	5.8	11.0
5	MI	ANN ARBOR	31.0	0.0	15.1	7.4	12.8
5	MI	BAY CITY	28.0	11.5	0.0	11.5	11.5
5	MI	DETROIT	31.0	20.0	16.0	5.9	13.6
5	MI	FLINT	30.0	16.1	16.1	6.8	12.1
5	MI	GRAND RAPIDS	31.0	18.1	18.1	5.5	10.7
5	MI	JACKSON	34.0	11.8	0.0	9.3	10.4
5	MI	KALAMAZOO	34.0	0.0	16.4	6.3	10.3
5	MI	LANSING	31.0	15.9	15.9	6.9	11.7
5	MI	MUSKEGON	32.0	0.0	17.4	5.6	10.2
5	MI	SAGINAW	28.0	12.0	0.0	12.0	12.0
5	MI	OTHER URBAN AREAS	31.0	18.9	16.2	6.3	12.9
5	MI	AVE. FOR STATE	31.0	18.9	16.2	6.3	12.9
5	MN	DULUTH	29.0	16.3	16.3	5.8	9.6
5	MN	FARGO METRO	21.0	13.3	13.3	8.8	12.2
5	MN	MINNEAPOLIS	25.0	16.9	16.9	5.5	10.6
5	MN	ROCHESTER	29.0	0.0	14.1	8.1	12.6
5	MN	OTHER URBAN AREAS	26.0	16.6	16.7	5.6	10.6
5	MN	AVE. FOR STATE	26.0	16.6	16.7	5.6	10.6
5	OH	AKRON	38.0	0.0	18.3	5.5	11.0
5	OH	CANTON	38.0	20.9	18.7	5.5	11.7
5	OH	CINCINNATI	34.0	14.2	14.2	8.1	11.9
5	OH	CLEVELAND	32.0	22.8	22.8	3.7	11.5
5	OH	COLUMBUS	36.0	21.2	21.2	4.8	12.0
5	OH	DAYTON	35.0	0.0	17.8	5.9	11.6
5	OH	HAMILTON	40.0	19.8	19.8	4.7	10.7
5	OH	LIMA	36.0	9.3	0.0	0.0	9.3
5	OH	LORAIN	35.0	67.2	16.5	5.6	10.0
5	OH	MANSFIELD	43.0	0.0	13.1	9.0	10.1
5	OH	SPRYNGFIELD	40.0	13.2	13.2	8.8	12.5
5	OH	STEUBENVILLE	40.0	14.4	0.0	0.0	12.4
5	OH	TOLEDO	32.0	17.3	16.0	6.4	11.4
5	OH	YOUNGSTOWN	42.0	16.8	16.8	6.4	11.6
5	OH	OTHER URBAN AREAS	37.2	16.8	19.4	5.3	11.5
5	OH	AVE. FOR STATE	37.2	16.8	19.4	5.3	11.5
5	WI	APPLETON	29.0	19.3	19.3	5.5	12.2
5	WI	DULUTH METRO	29.0	0.0	14.1	6.0	8.8
5	WI	GREEN BAY	27.0	14.4	14.4	7.7	9.8
5	WI	KENOSHA	32.0	18.7	12.8	0.0	13.8
5	WI	LA CROSSE	31.0	15.0	15.0	7.6	11.0
5	WI	MADISON	31.0	0.0	18.2	5.6	11.4
5	WI	MILWAUKEE	28.0	31.6	8.7	8.2	11.1
5	WI	OSHKOSH	28.0	0.0	13.2	0.0	13.2
5	WI	RACINE	32.0	0.0	15.1	7.5	13.1
5	WI	OTHER URBAN AREAS	29.7	28.7	11.8	7.6	11.3
5	WI	AVE. FOR STATE	29.7	28.7	11.8	7.6	11.3
5		AVE. FOR REGION 5.	32.7	20.4	14.9	6.0	12.4

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA RFG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
6	AR	FORT SMITH	43.0	9.3	0.0	9.3	9.3
6	AR	LITTLE ROCK	49.0	0.0	15.9	8.7	10.6
6	AR	PINE BLUFF	52.0	0.0	14.4	8.1	11.3
6	AR	OTHER URBAN AREAS	48.0	9.3	15.4	8.8	10.4
6	AR	AVE. FOR STATE	48.0	9.3	15.4	8.8	10.4
6	LA	BATON ROUGE	60.0	0.0	16.2	6.8	11.4
6	LA	LAFAYETTE	59.0	0.0	14.3	8.1	11.6
6	LA	LAKE CHARLES	58.0	0.0	14.9	7.6	10.9
6	LA	MONROE	50.0	0.0	13.9	8.8	10.5
6	LA	NEW ORLEANS	64.0	0.0	25.3	0.0	25.3
6	LA	SHREVEPORT	45.0	0.0	14.8	7.7	10.8
6	LA	OTHER URBAN AREAS	56.0	0.0	20.8	7.6	16.2
6	LA	AVE. FOR STATE	56.0	0.0	20.8	7.6	16.2
6	NM	ALBUQUERQUE	9.0	0.0	17.0	6.2	11.0
6	NM	OTHER URBAN AREAS	9.0	0.0	17.0	6.2	11.0
6	NM	AVE. FOR STATE	9.0	0.0	17.0	6.2	11.0
6	OK	LAWTON	30.0	0.0	13.6	9.0	10.4
6	OK	OKLAHOMA CITY	31.0	0.0	18.4	4.8	9.8
6	OK	TULSA	37.0	0.0	17.3	5.6	10.3
6	OK	OTHER URBAN AREAS	32.7	0.0	17.6	5.5	10.0
6	OK	AVE. FOR STATE	32.7	0.0	17.6	5.5	10.0
6	TX	ABILENE	24.0	0.0	16.4	5.0	9.2
6	TX	AMARILLO	20.0	0.0	17.5	5.6	10.3
6	TX	AUSTIN	33.0	0.0	15.9	6.9	11.6
6	TX	BEAUMONT	54.0	17.8	17.8	4.8	9.6
6	TX	BROWNSVILLE	27.0	0.0	13.4	8.8	12.2
6	TX	BRYAN	39.0	0.0	17.8	4.8	9.6
6	TX	CORPUS CHRISTI	28.0	0.0	18.1	4.8	9.8
6	TX	DALLAS	35.0	0.0	18.3	4.3	10.2
6	TX	EL PASO	8.0	0.0	18.6	5.2	11.2
6	TX	FORT WORTH	30.0	0.0	18.4	4.8	9.8
6	TX	GALVESTON	43.0	48.9	0.0	7.4	11.1
6	TX	HARLINGEN	26.0	0.0	10.9	9.3	9.6
6	TX	HOUSTON	46.0	33.6	14.9	7.6	11.6
6	TX	LAREDO	19.0	0.0	14.3	8.1	11.7
6	TX	LUBBOCK	18.0	0.0	14.8	7.6	10.1
6	TX	MCALLEN	21.0	0.0	13.4	9.1	11.2
6	TX	MIDLAND	14.0	0.0	13.0	9.1	10.0
6	TX	ODESSA	14.0	0.0	14.3	8.1	11.8
6	TX	PORT ARTHUR	54.0	0.0	14.3	7.8	9.7
6	TX	SAN ANGELO	19.0	0.0	13.1	9.1	10.0
6	TX	SAN ANTONIO	28.0	0.0	19.1	5.5	12.1
6	TX	SHERMAN	39.0	0.0	11.7	9.2	9.7
6	TX	TEXARKANA	46.0	0.0	13.0	9.1	10.0
6	TX	TEXAS CITY	45.0	0.0	15.2	5.6	9.0
6	TX	TYLER	45.0	0.0	15.0	7.6	10.7
6	TX	WACO	32.0	0.0	16.7	5.2	9.4
6	TX	WICHITA FALL	29.0	0.0	13.7	8.9	10.6
6	TX	OTHER URBAN AREAS	31.0	26.6	16.6	6.0	10.7
6	TX	AVE. FOR STATE	31.0	26.6	16.6	6.0	10.7
6		AVE. FOR REGION 6.	35.3	14.6	17.4	6.3	11.2

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA RFG	STATE ID	URBANIZED AREA	IN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
7	IA	CEDAR RAPIDS	33.0	0.0	15.0	7.5	10.4
7	IA	DAVENPORT	34.0	16.0	16.0	5.9	9.4
7	IA	DES MOINES	31.0	39.5	7.9	5.8	10.6
7	IA	DUBUQUE	33.0	0.0	13.4	8.8	12.0
7	IA	SIOUX CITY	25.0	0.0	17.6	5.1	9.7
7	IA	WATERLOO	32.0	0.0	14.4	7.7	9.7
7	IA	OTHER URBAN AREAS	31.3	38.1	13.2	6.5	10.2
7	IA	AVE. FOR STATE	31.3	38.1	13.2	6.5	10.2
7	KS	KANSAS CITY METRO	34.0	15.9	15.9	6.9	11.7
7	KS	TOPEKA	34.0	16.3	16.3	6.6	10.8
7	KS	WICHITA	31.0	0.0	15.0	7.5	11.3
7	KS	OTHER URBAN AREAS	33.0	16.0	15.5	7.1	11.4
7	KS	AVE. FOR STATE	33.0	16.0	15.5	7.1	11.4
7	MO	COLUMBIA	37.0	0.0	17.0	5.2	9.5
7	MO	KANSAS CITY	34.0	19.7	8.9	7.7	10.2
7	MO	SPRINGFIELD	41.0	0.0	16.2	6.3	10.1
7	MO	ST.JOSEPH	35.0	7.2	0.0	0.0	7.2
7	MO	ST.LOUIS	37.0	13.1	0.0	12.8	13.0
7	MO	OTHER URBAN AREAS	36.8	13.4	11.4	10.1	11.6
7	MO	AVE. FOR STATE	36.8	13.4	11.4	10.1	11.6
7	NE	LINCOLN	27.0	0.0	17.4	6.2	11.4
7	NE	OMAHA	26.0	19.0	19.0	5.5	11.8
7	NE	OTHER URBAN AREAS	26.5	19.0	18.0	5.6	11.7
7	NE	AVE. FOR STATE	26.5	19.0	18.0	5.6	11.7
7		AVE. FOR REGION 7	31.9	15.4	14.2	8.0	11.2
8	CO	BOULDER	19.0	0.0	17.4	6.6	14.2
8	CO	COLORADO SPRINGS	13.0	0.0	15.1	7.5	10.5
8	CO	DENVER	14.0	35.4	18.1	5.8	12.2
8	CO	PUEBLO	12.0	24.6	12.8	7.6	11.8
8	CO	OTHER URBAN AREAS	14.5	26.8	17.3	6.3	12.0
8	CO	AVE. FOR STATE	14.5	26.8	17.3	6.3	12.0
8	MT	BILLINGS	13.0	0.0	15.0	7.6	11.0
8	MT	GREAT FALLS	15.0	0.0	13.6	8.4	11.8
8	MT	OTHER URBAN AREAS	14.0	0.0	14.2	7.9	11.4
8	MT	AVE. FOR STATE	14.0	0.0	14.2	7.9	11.4
8	ND	FARGO	21.0	14.3	14.3	8.3	12.2
8	ND	OTHER URBAN AREAS	21.0	14.3	14.3	8.3	12.2
8	ND	AVE. FOR STATE	21.0	14.3	14.3	8.3	12.2
8	SD	SIOUX FALLS	25.0	16.4	16.4	7.1	11.2
8	SD	OTHER URBAN AREAS	25.0	16.4	16.4	7.1	11.2
8	SD	AVE. FOR STATE	25.0	16.4	16.4	7.1	11.2
8	UT	OGDEN	17.0	0.0	16.8	6.2	10.8
8	UT	PROVO	13.0	0.0	17.6	5.1	9.7
8	UT	SALT LAKE CITY	15.0	0.0	17.1	6.0	11.0
8	UT	OTHER URBAN AREAS	15.0	0.0	17.1	5.9	10.7
8	UT	AVE. FOR STATE	15.0	0.0	17.1	5.9	10.7
8	WY	URBAN AREAS	15.0	0.0	15.0	7.6	11.0
8	WY	AVE. FOR STATE	15.0	0.0	15.0	7.6	11.0
8		AVE. FOR REGION 8	17.4	21.4	16.4	6.6	11.5

TABLE IV-4 ANNUAL DRY-WEATHER FLOW

EPA RFG	STATE ID	URBANIZED AREA	TN/YR ANNL. PRECP	DRY-WEATHER FLOW (INCHES PER YEAR) COMB	STORM	UNSEW	AVER
9	AK	URBAN AREAS	30.0	18.5	18.5	4.9	10.1
9	AK	AVE. FOR STATE	30.0	18.5	18.5	4.9	10.1
9	AZ	PHOENIX	7.0	0.0	16.8	5.3	10.5
9	AZ	TUCSON	11.0	0.0	15.5	7.4	11.2
9	AZ	OTHER URBAN AREAS	9.0	0.0	16.5	5.8	10.6
9	AZ	AVE. FOR STATE	9.0	0.0	16.5	5.8	10.6
9	CA	BAKERSFIELD	11.0	0.0	17.8	5.9	11.6
9	CA	FRESNO	11.0	0.0	15.9	6.9	11.9
9	CA	LOS ANGELES	13.0	0.0	17.1	6.8	14.8
9	CA	MODESTO	25.0	0.0	14.9	7.6	11.6
9	CA	OXNARD	15.0	0.0	17.7	5.5	10.4
9	CA	SACRAMENTO	18.0	16.8	16.8	6.1	10.9
9	CA	SALINAS	15.0	0.0	15.1	7.5	13.0
9	CA	SAN BERNANDINO	18.0	0.0	18.9	4.7	10.0
9	CA	SAN DIEGO	11.0	0.0	17.6	6.0	11.7
9	CA	SAN FRANCISCO	21.0	35.0	18.2	4.0	13.4
9	CA	SAN JOSE	14.0	0.0	19.2	5.6	12.4
9	CA	SANTA BARBARA	18.0	0.0	15.2	7.4	12.2
9	CA	SANTA ROSA	30.0	0.0	13.3	9.0	10.2
9	CA	SEASIDE	16.0	0.0	13.2	8.8	12.7
9	CA	SIMI VALLEY	25.0	0.0	14.9	7.7	10.5
9	CA	STOCKTON	14.0	0.0	15.2	7.4	12.0
9	CA	OTHER URBAN AREAS	17.2	33.3	17.3	5.7	13.4
9	CA	AVE. FOR STATE	17.2	33.3	17.3	5.7	13.4
9	HI	HONOLULU	23.0	0.0	18.2	6.0	12.6
9	HI	OTHER URBAN AREAS	23.0	0.0	18.2	6.0	12.6
9	HI	AVE. FOR STATE	23.0	0.0	18.2	6.0	12.6
9	NV	LAS VEGAS	4.0	0.0	17.3	5.6	10.1
9	NV	RENO	7.0	19.3	14.3	7.1	11.0
9	NV	OTHER URBAN AREAS	5.5	19.3	16.8	6.0	10.4
9	NV	AVE. FOR STATE	5.5	19.3	16.8	6.0	10.4
9		AVE. FOR REGION 9	16.9	32.6	17.2	5.7	13.0
10	ID	BOISE	11.0	0.0	14.2	8.8	11.4
10	ID	OTHER URBAN AREAS	11.0	0.0	14.2	8.8	11.4
10	ID	AVE. FOR STATE	11.0	0.0	14.2	8.8	11.4
10	OR	EUGENE	38.0	16.2	16.2	6.6	10.9
10	OR	PORTLAND	40.0	17.6	17.6	6.0	11.6
10	OR	SALEM	40.0	0.0	14.9	7.6	10.8
10	OR	OTHER URBAN AREAS	39.3	17.5	16.9	6.2	11.4
10	OR	AVE. FOR STATE	39.3	17.5	16.9	6.2	11.4
10	WA	SEATTLE	35.0	17.1	17.1	6.1	11.5
10	WA	SPOKANE	17.0	11.4	0.0	11.4	11.4
10	WA	TACOMA	39.0	16.8	16.8	6.3	10.9
10	WA	OTHER URBAN AREAS	30.3	15.2	17.0	6.5	11.4
10	WA	AVE. FOR STATE	30.3	15.2	17.0	6.5	11.4
10		AVE. FOR REGION 10	26.9	15.9	16.5	6.6	11.4
		AVERAGE FOR THE U.S.	33.4	22.5	17.5	6.2	12.8

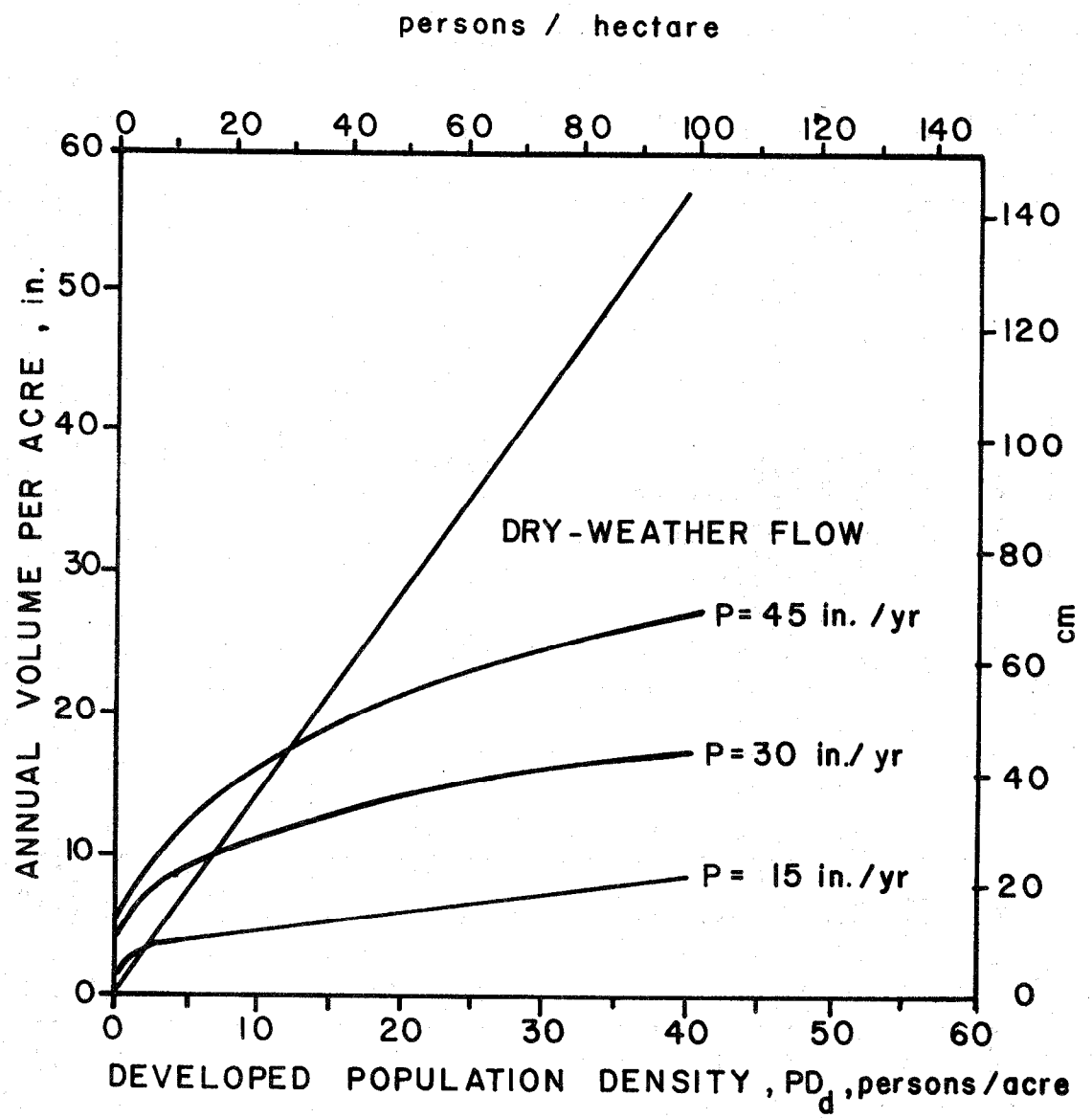

Figure IV-4. Comparative Magnitude of Annual Wet- and Dry-Weather Flows

ABBREVIATIONS AND SYMBOLS

AR	Wet-weather runoff, inches per year
CR	Runoff coefficient
DWF	Abbreviation for dry-weather flow and dry-weather flow runoff, inches per year
I	Imperviousness as a fraction or percent
I_a	Initial abstraction (loss) from precipitation, inches
P	Precipitation, inches per year
PD	Population density, persons per acre
PD_d	Developed population density, persons per acre

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