CALCULATING RUNOFF FROM PAVED AND UNPAVED ANIMAL HOLDING/FEEDING AREAS AND EVAPORATION FOR WASTE STORAGE FACILITIES IN THE NORTHEASTERN STATES AND CARIBBEAN AREA

The attached runoff maps (numbered **1** through 6 of 7) were developed from a study of 48 National Weather Service Precipitation Stations in the Northeast and 5 stations in the Caribbean Area. The runoff was computed using a Runoff Curve Number (CN) of 97 which is representative of paved areas. A Runoff Curve Number of 90 (CN=90) was used for unpaved areas. The evaporation map (number 7 of 7) was developed from Weather Bureau Technical Paper No. 37.

The procedures for sizing a waste storage pond according to the requirements of Engineering Standard and Specifications for Waste Storage Pond are as follows:

1. To compute the mean monthly runoff from paved areas:

a. Obtain the mean monthly precipitation data from the weather station that is most representative of the site under consideration for the period that runoff is to be stored.

b. From the maps 1 through 6, determine the runoff for the site during the storage period. Note that the runoff is shown on the maps as a percentage of mean precipitation. If the site does not lie between two isopercentiles, do not extrapolate. Instead use the nearest map value.

c. Compute runoff values.

Example: It is proposed to construct a waste storage pond in which manure and polluted runoff are to be stored. The site is located in Blair County, Pennsylvania. Polluted runoff originates from a paved area one acre in size. The period of storage is established to be 180 days, November through April and May through October. The mean precipitation values for the storage period are determined from local Weather Service records and the percentages of mean precipitation for the months of storage are determined from the attached maps. They are:

		Runoff		
(1)	(2)	(3)	(4)	(5)
Month[1/]	Mean Precipitation - inches[2/]	Percent of Mean Precipitation[3/]	Map No.	Inches[4/]
November	2.89	51	6 of 7	1.47
December	2.40	46	1 of 7	1.10
January	2.23	46	1 of 7	1.03
February	1.99	48	2 of 7	.96
March	3.23	48	2 of 7	1.55
April	3.28	49	3 of 7	1.61
TOTALS (mean annual)	16.02			7.72
Use	16.0		Use	7.7
May	3.48	49	3 of 7	1.71
June	3.40	54	4 of 7	1.84
July	3.88	54	4 of 7	2.09
August	3.06	57	5 of 7	1.74
September	2.56	57	5 of 7	1.46
October	2.48	51	6 of 7	1.26
TOTALS (mean annual)	18.86			10.10
Use	18.9		Use	10.1

1/ Storage Periods

2/ From local National Weather Service data

3/ From attached maps

4/ $\frac{\text{Column (2) multiplied by column (3)}}{100}$

2. To determine evaporation from a pond surface during the storage period in the Northeast use the following procedure:

   a. Obtain percent of the mean annual evaporation by month from map sheet 7 of 7.

   b. Compute the total evaporation for each storage period.

   c. Obtain mean annual evaporation for site from map sheet 7 of 7.

   d. Compute evaporation for storage periods by multiplying values from step (2) by the mean annual evaporation taken from map sheet 7 of 7.

Example:

	Storage Period Nov - Apr		
Months	Percentage of Mean Annual Evaporation		
November	6	May	10
December	3	June	13
January	3	July	15
February	3	August	14
March	5	September	12
April	7	October	9
TOTALS	27		73

Mean Annual Evaporation for site is approximately 28 inches (from map sheet 7 of 7).

Evaporation for - November through April = 28" x 0.27 = 7.7"
May through October = 28" x 0.73 = 20.4

NOTE: Evaporation from ponds containing manure will be less than the above especially during the summer months when oftentimes a dry crust develops at the surface. Consequently, for conservative design the evaporation computation step can be omitted.

3. Determine adjusted storage volume in pond for runoff from the drainage area by the following procedures:

   a. Determine acceptable storage pond surface area and depth based on farmer desires, site restrictions and manure and rainfall-runoff volumes.

   b. Adjust storage volume by adding rainfall-runoff volumes.

   c. Design depth will be largest value required by individual storage periods.

   Example:

   Using the runoff computed in step "1" and the evaporation computed in step "2", determine the adjusted storage volume in the waste storage pond for runoff from the one (1) acre holding/feeding area which excludes the pond surface area. Assume for this example that the waste storage pond is sized to have bottom dimensions of 80 ft wide and 120 ft long and an 8 ft depth of manure storage. The pond side slopes will be 2:1. The dimensions of the pond at the surface of the manure for the 8 ft depth are 112 ft wide and 152 ft long. The surface area is,

   (112' x 152') ÷ 43560 sq. ft./acre = 0.4 acre

   Therefore, to adjust the 8 ft pond manure storage depth, add the volume of runoff from the one (1) acre holding/feeding area and the direct precipitation on the pond surface and subtract the evaporation from the pond surface.

   $$\text{Adjusted depth} = 8 \text{ ft} + \frac{\qquad\qquad\qquad\qquad\qquad\qquad}{\text{direct precipitation - evaporation}}$$

   For the November-April period,

   $$= 8 \text{ ft} + \frac{\qquad\qquad\qquad\qquad}{\qquad\qquad\qquad} \qquad \qquad$$

   = 8 + 1.6 + 1.3 - 0.6 = 10.3 ft

For the May-October period.

$$8 \text{ ft} + \frac{10.1 \text{ inches} \times 1 \text{ acre}}{12 \text{ in/ft} \times 0.4 \text{ acres}} \quad \frac{18.9 \text{ in}}{12 \text{ in/ft}} - \frac{20.4}{12 \text{ in/ft}}$$

$$8 \quad +2.1+1.6 \quad 1.7 = 10.0 \text{ ft}$$

Therefore. the November-April period controls and must be used for establishing the constructed pond depth.

NOTE:Total pond design depths must also include waste water, the 25 yr-24 hr runoff from the drainage area and the 25 yr-24 hr precipitation on the pond surface. re: Engineering Standard for Waste Storage Ponds, Code 425.

4. Calculation of runoff from unpaved areas is as follows:

In the Northeast and the Caribbean Area, subtract 31 from the runoff map values and proceed as in step "1".

Example:

Using the data in step "1" above, the mean precipitation for November is 2.89 inches and the map value is 51 percent. The runoff is then

$$\frac{(51-31)}{100} \times 2.89 = 0.58 \text{ inch}$$

For the entire "control" period, the runoff volume is -

Month	Precipitation	Percentage	Adjusted	Inches
Nov.	2.89	51	20	.58
Dec.	2.40	46	15	.36
Jan.	2.23	46	15	.33
Feb.	1.99	48	17	.34
Mar.	3.23	48	17	.55
Apr.	3.28	49	18	.59
				2.75
			Use	2.8"

5. Determine evaporation in the Caribbean Area by the following method:

a. Evaporation in the Caribbean Area varies with elevation as follows:

Elevation (MSL - feet)	Mean Annual Lake Evaporation (inches)
100	55
100 - 300	45
300	35

b. The monthly percentages are obtained from map sheet 7 of 7.

c. Multiply mean annual lake evaporation by the monthly percentage.

Example:

For an elevation of 90 feet, the evaporation for the month of April is 55 inches x 10% = 5.5 inches, for May 55 x 9% = 5.0 inches, etc.

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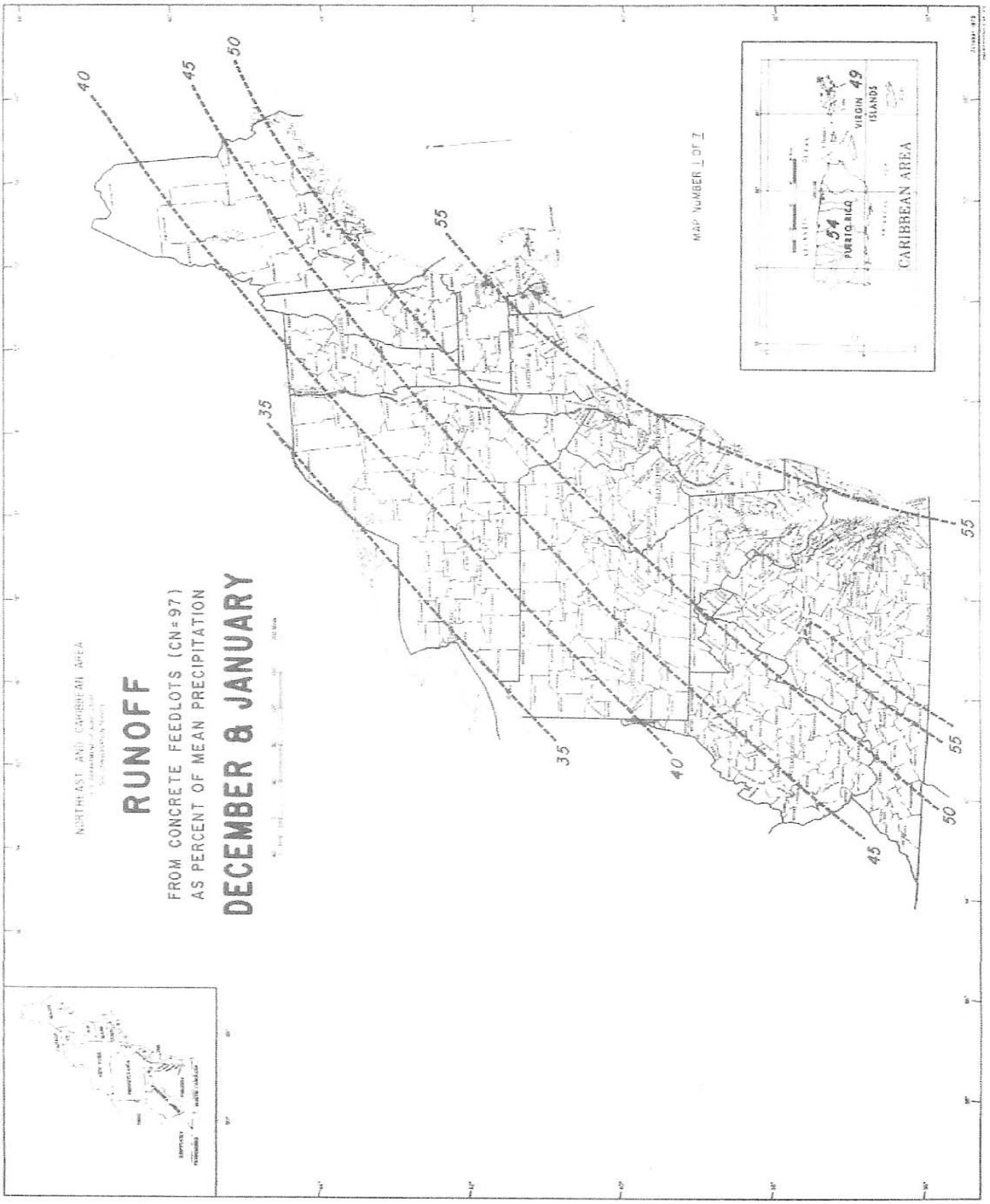

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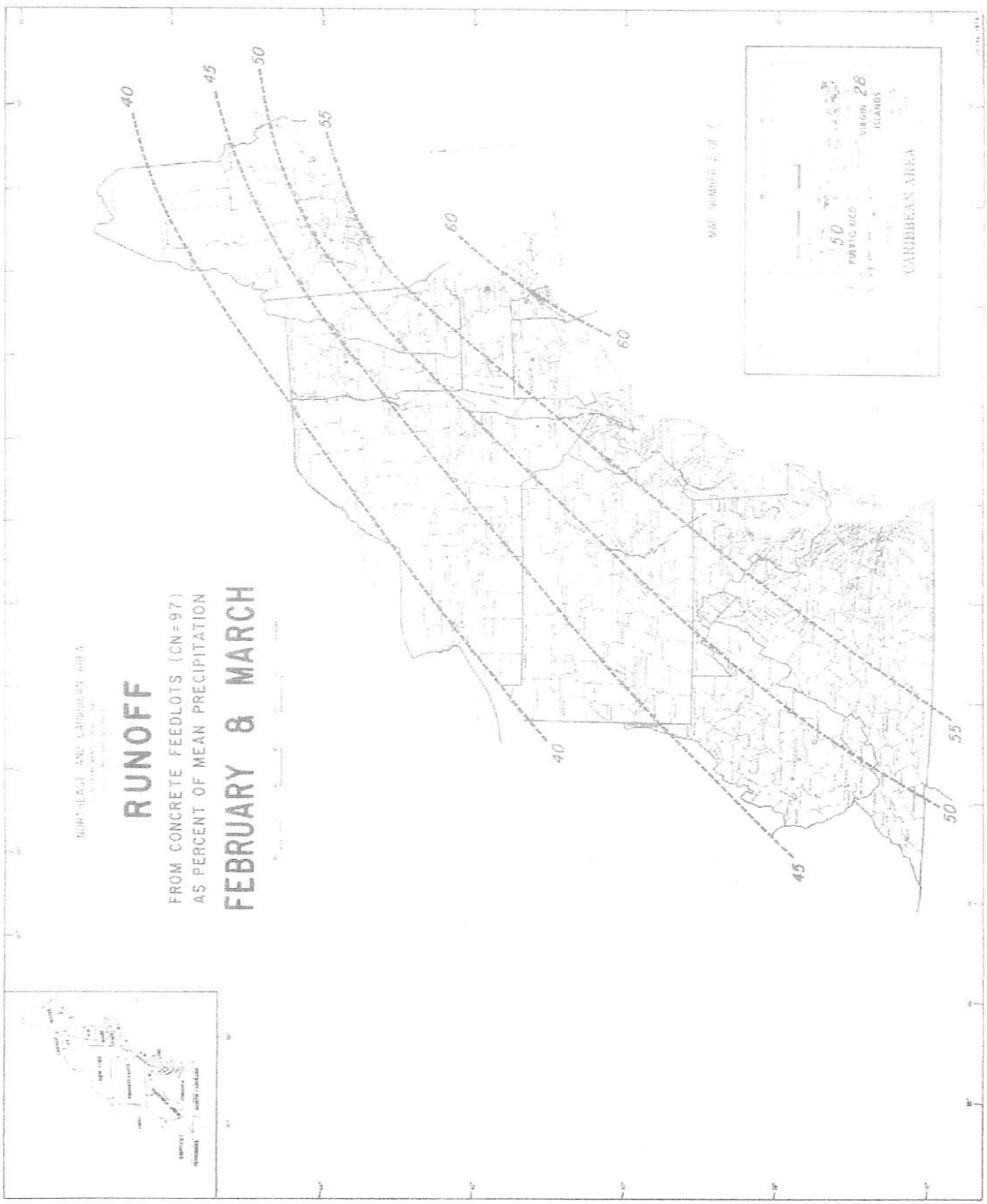

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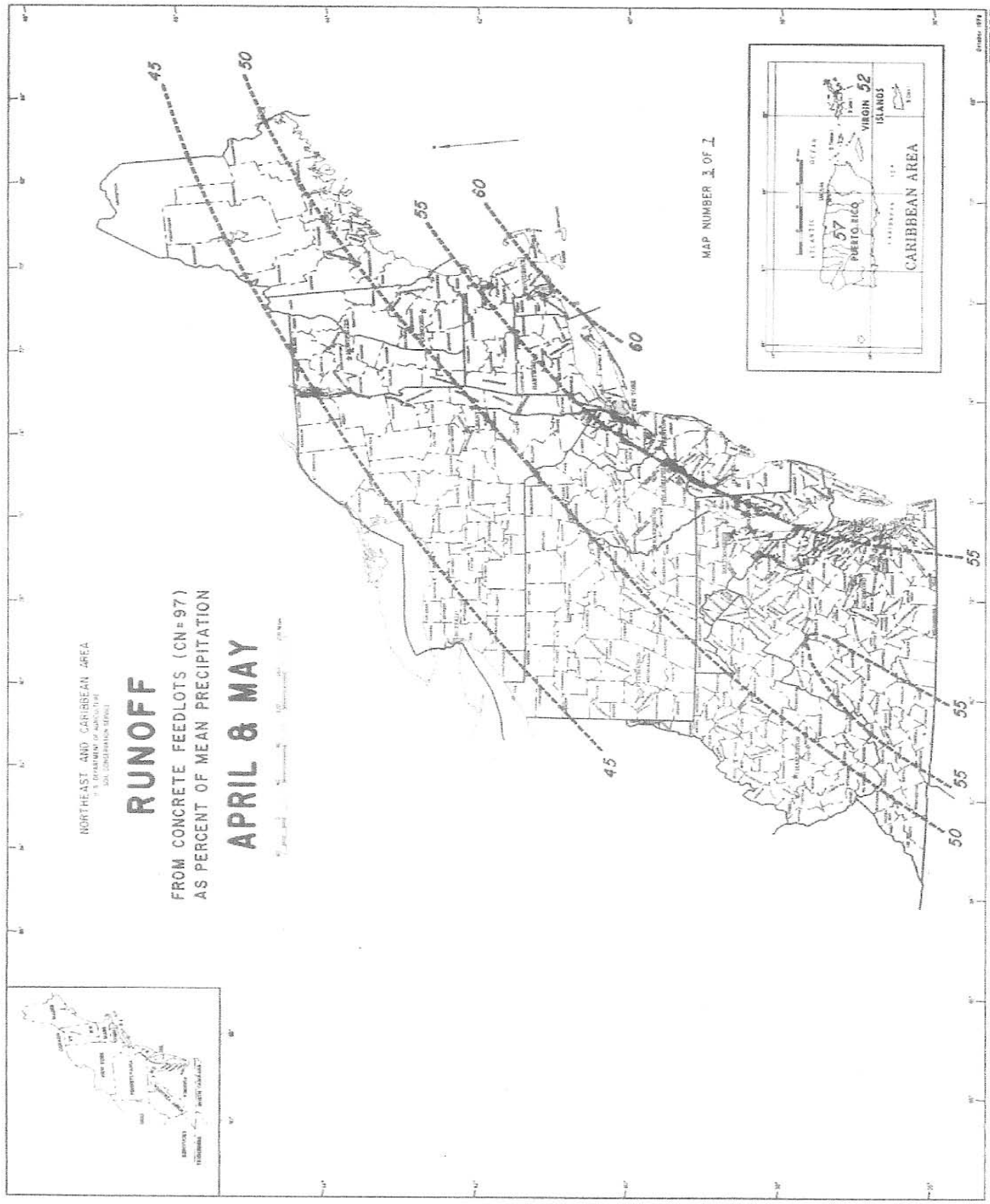

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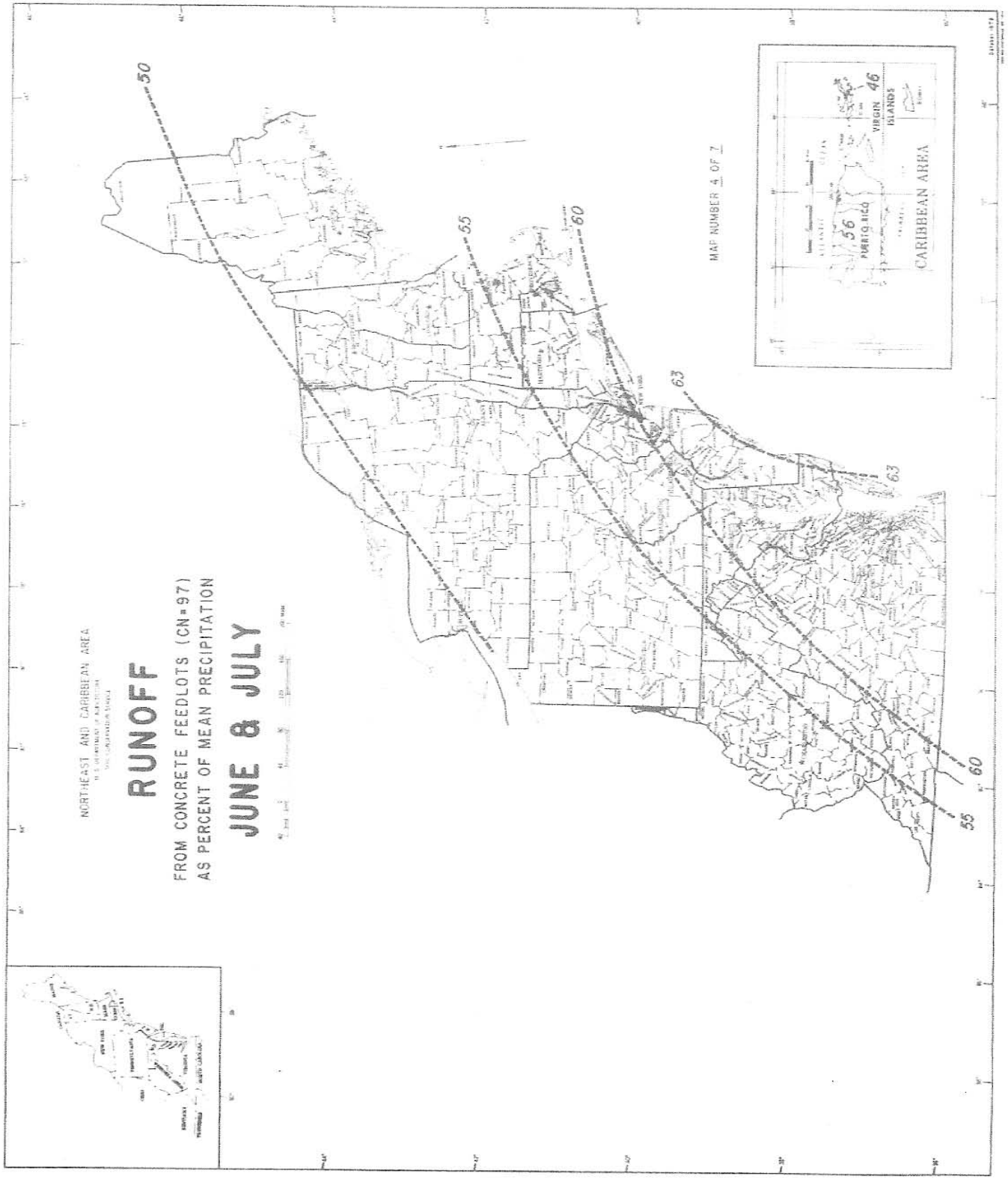

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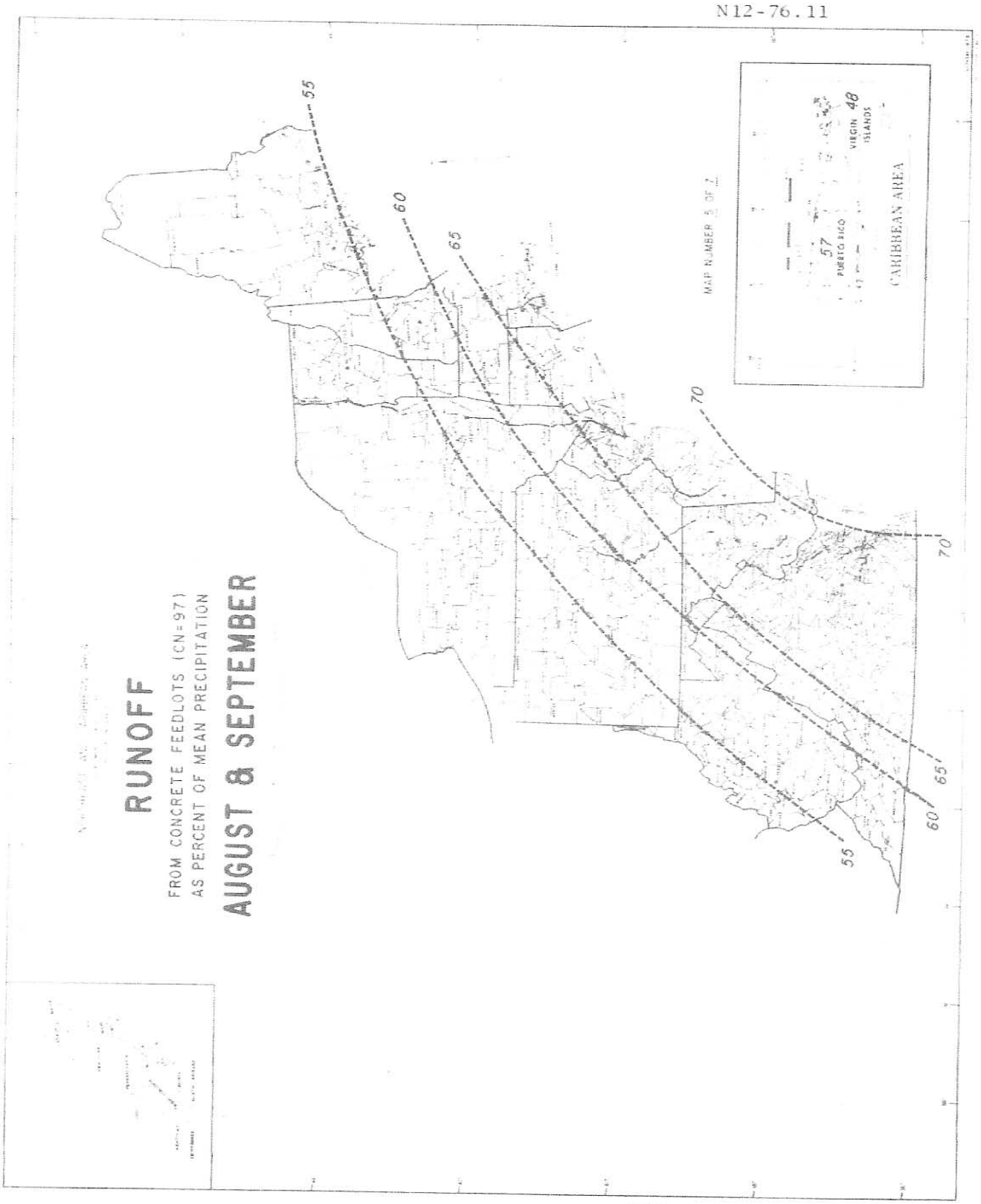

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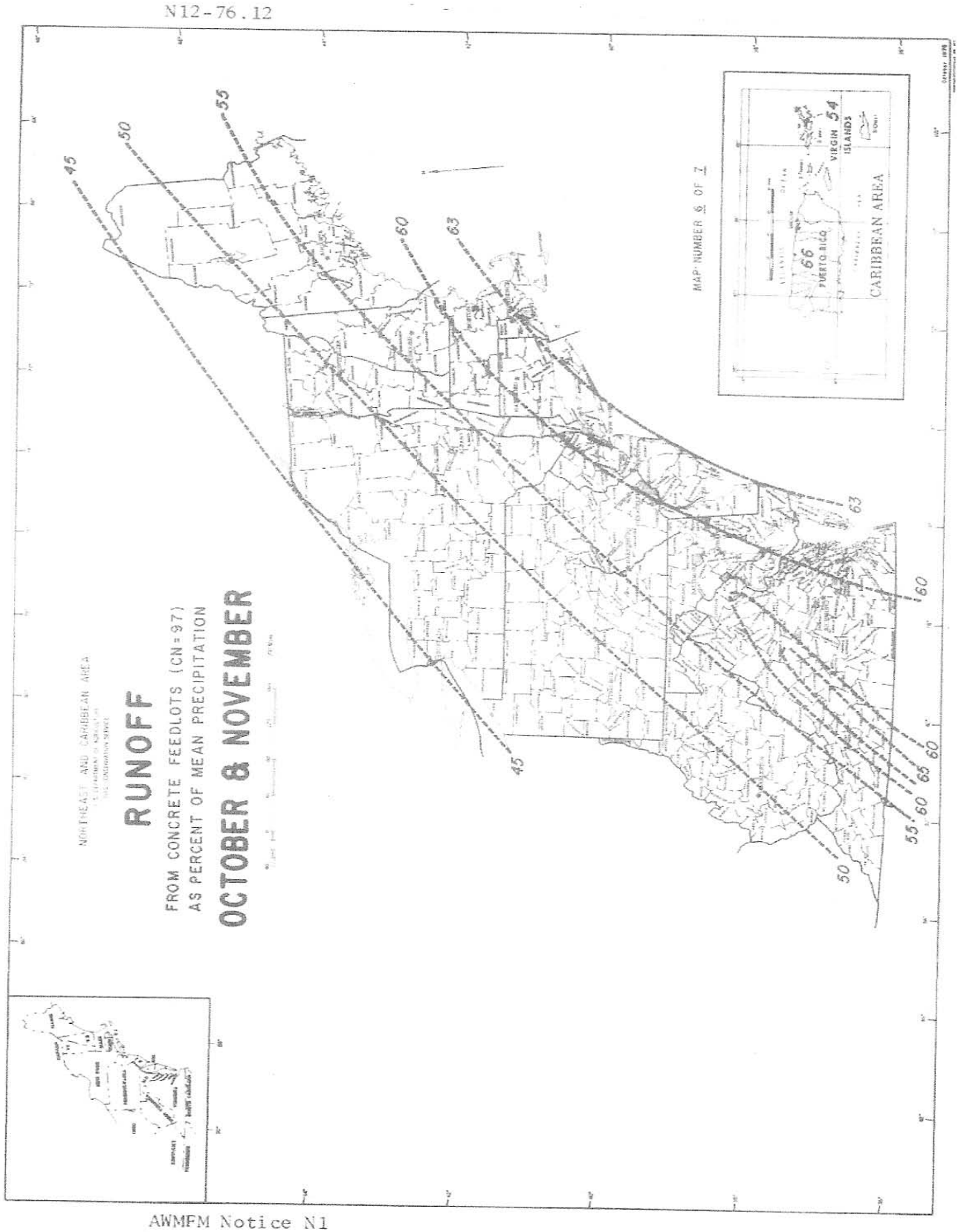

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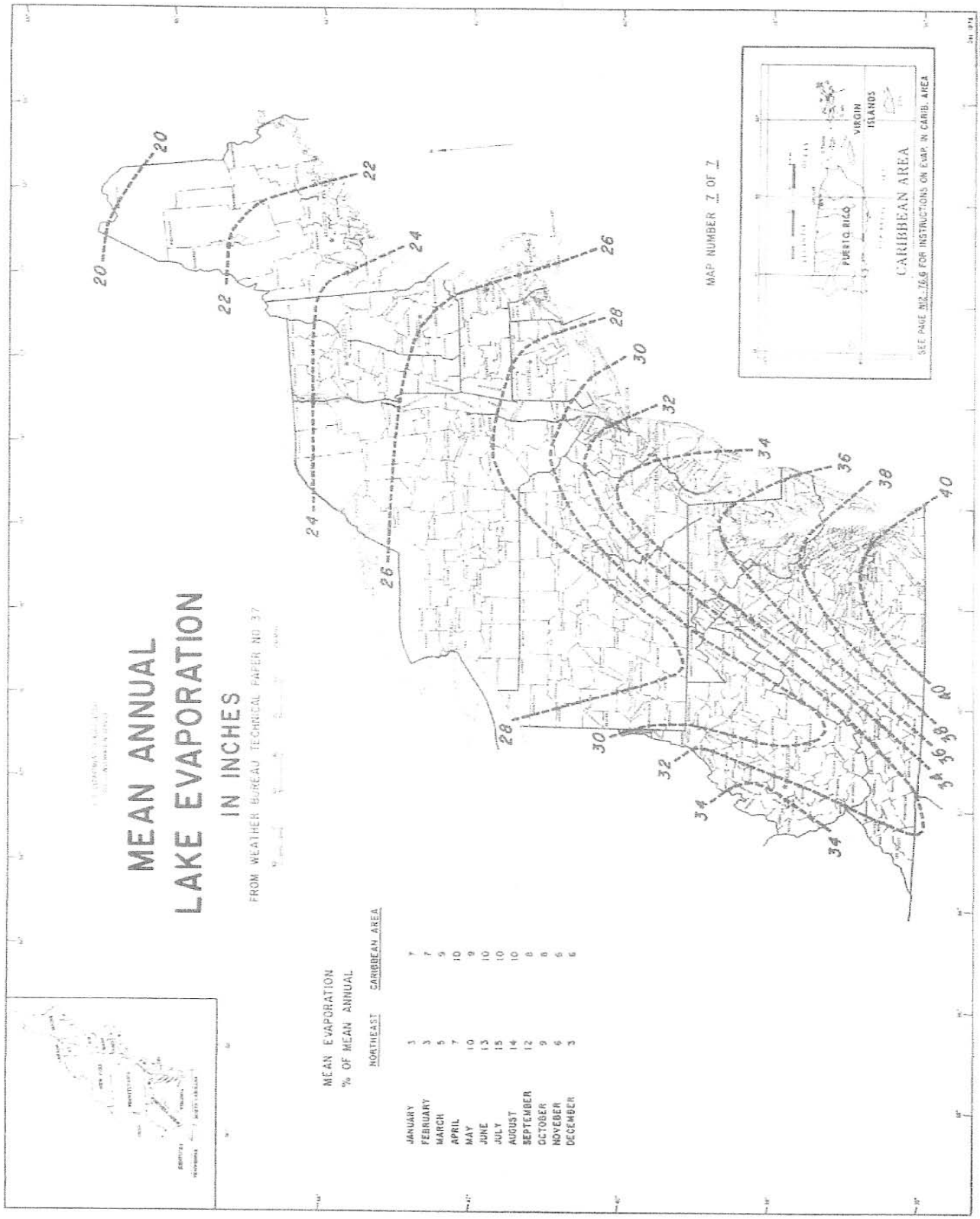

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