

# TABLE AND CHARTS

**Manning Formula  
Pipe Flow Chart  
Customary and SI units**

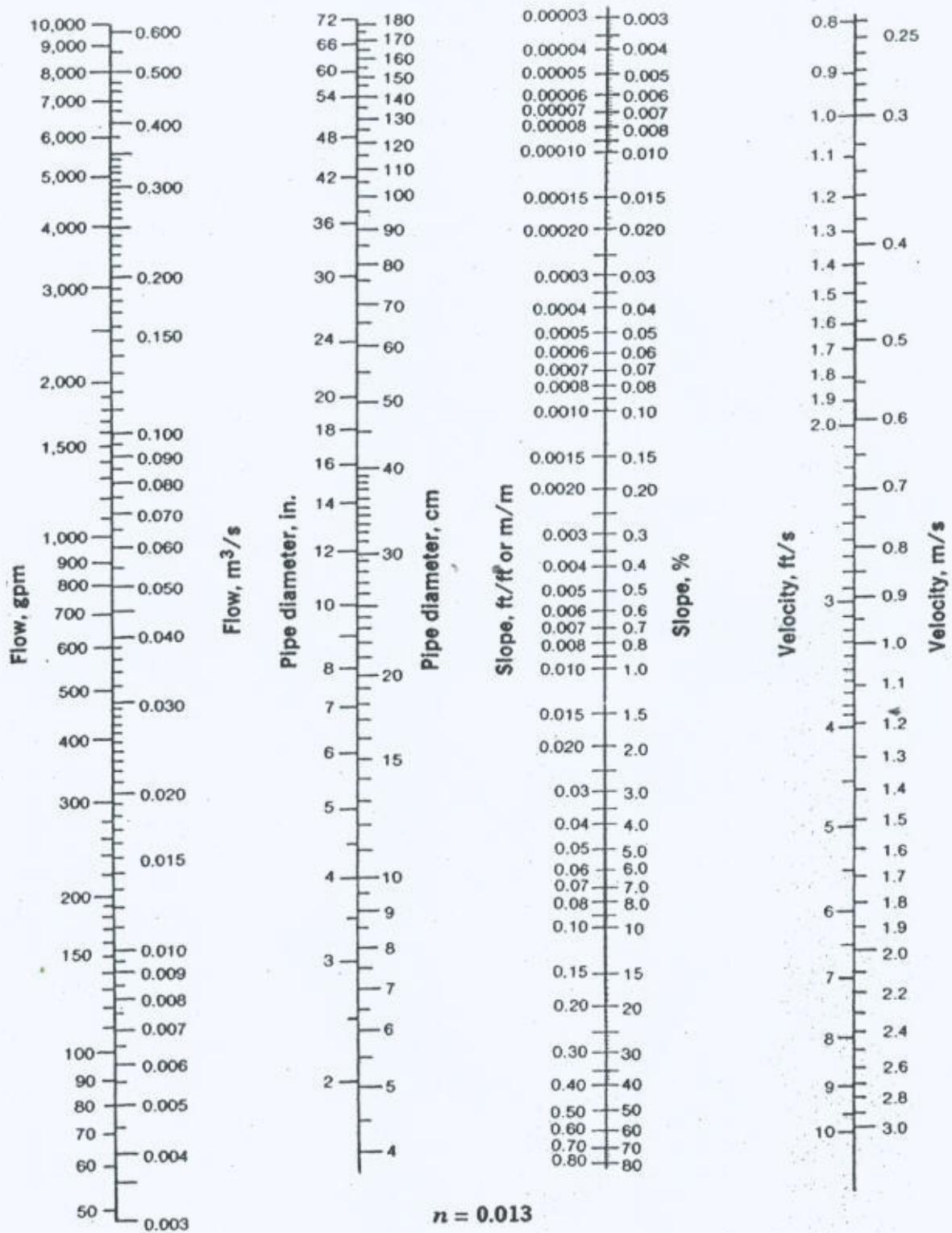
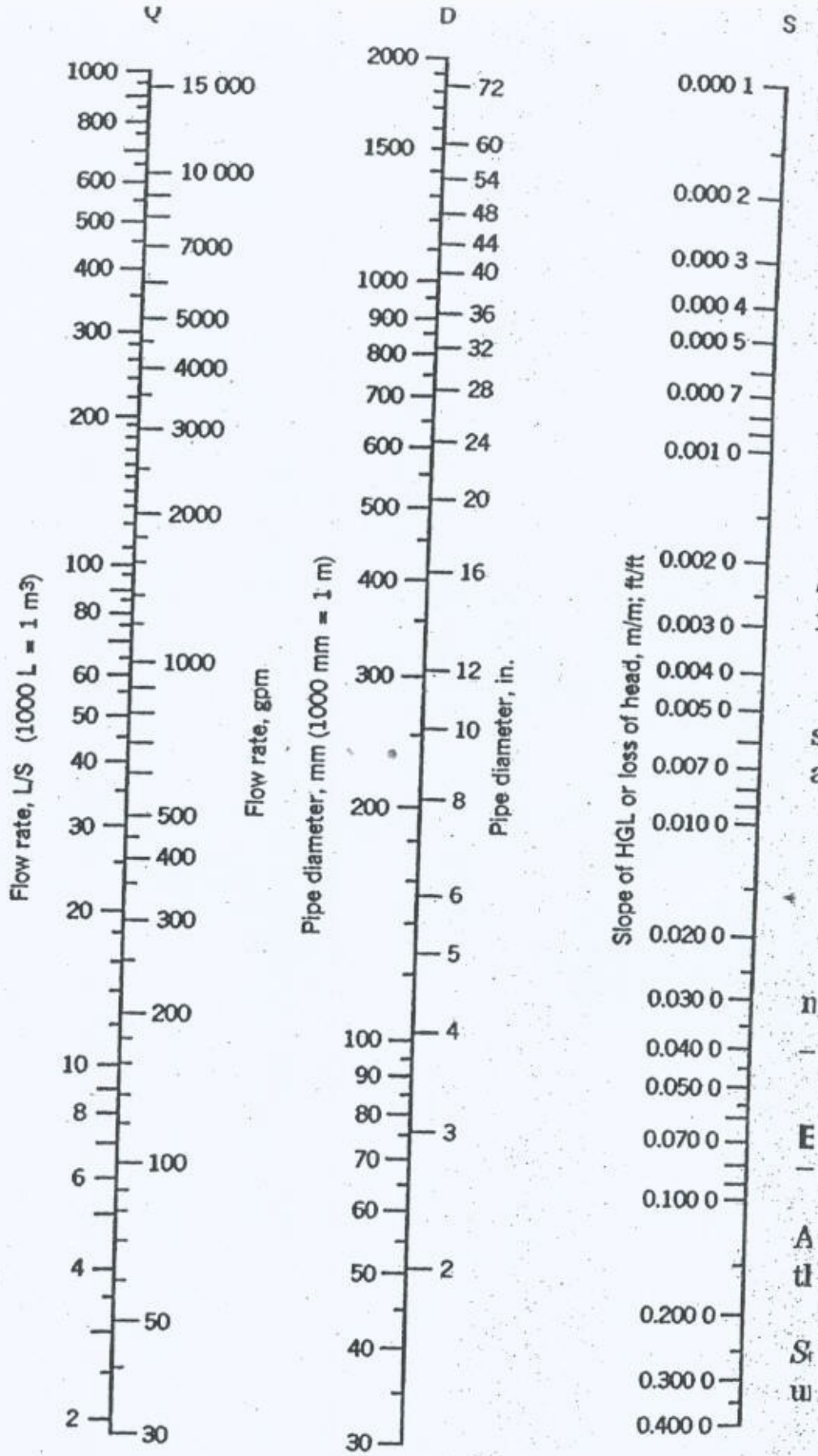


Chart based on the formula  $Q = \frac{1.0 \text{ or } 1.5}{n} \times AR^{\frac{2}{3}} \times S^{\frac{1}{2}}$  for pipe flowing full.

**FIGURE 2.21**

Manning's nomograph for circular pipes flowing full, with  $n = 0.013$ . Manning's equation is used for open channel or gravity flow, whereas the Hazen-Williams equation is used for flow under pressure. (Reprinted with permission from the U.S. Pipe and Foundry Company and Scranton Gillette Communications, Inc.)

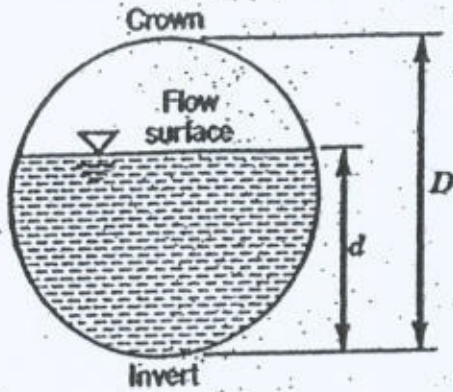


**FIGURE 2.15**

A nomograph that provides a graphical solution to the Hazen-Williams equation for water flowing in circular pipes under pressure, with  $C = 100$ .

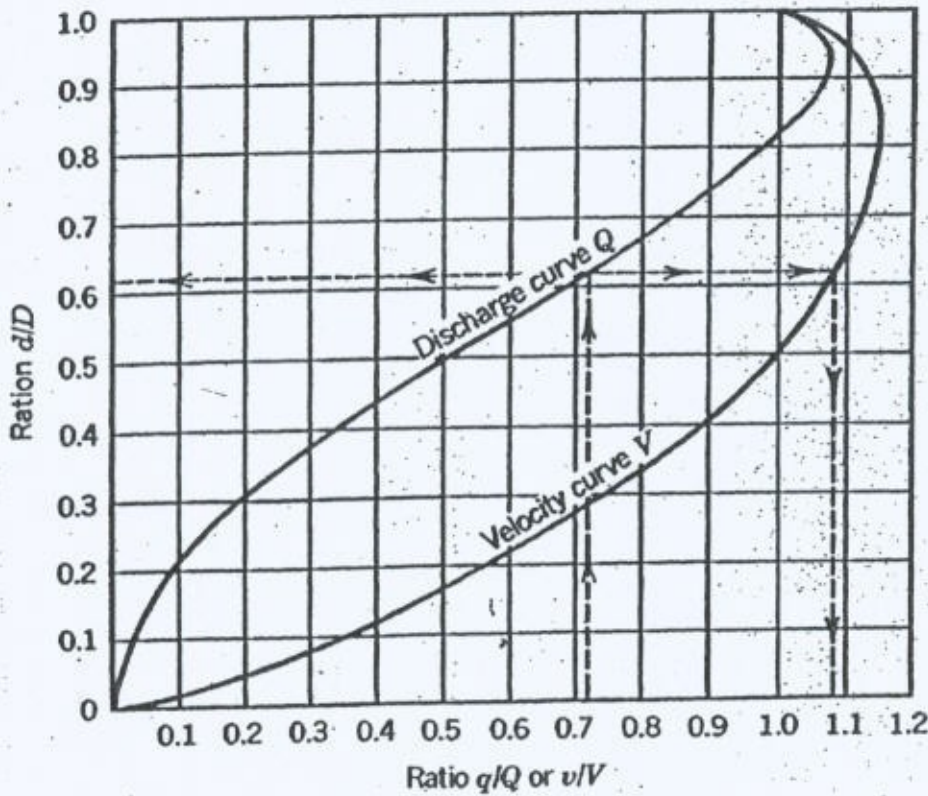
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Nomenclature:  
 $d$  = partial depth  
 $D$  = full depth or pipe diameter  
 $q$  = partial discharge  
 $Q$  = full-flow discharge  
 $v$  = velocity, partially full  
 $V$  = velocity, full

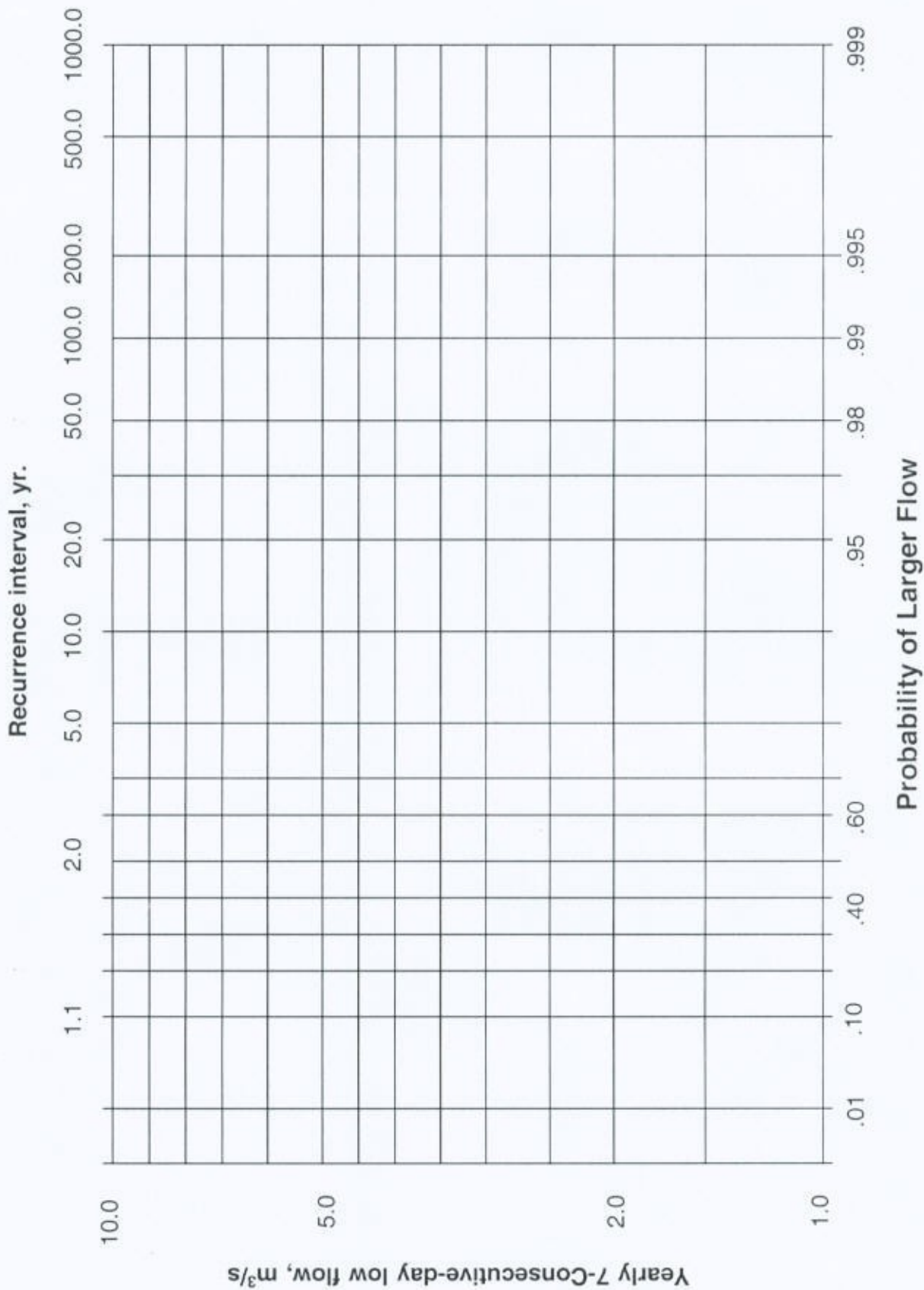


**FIGURE 2.22**

A partial-flow diagram for a circular pipe that carries flow with the water surface below the pipe crown.



# FREQUENCY ANALYSIS FOR MA7CD10 DROUGHT FLOW

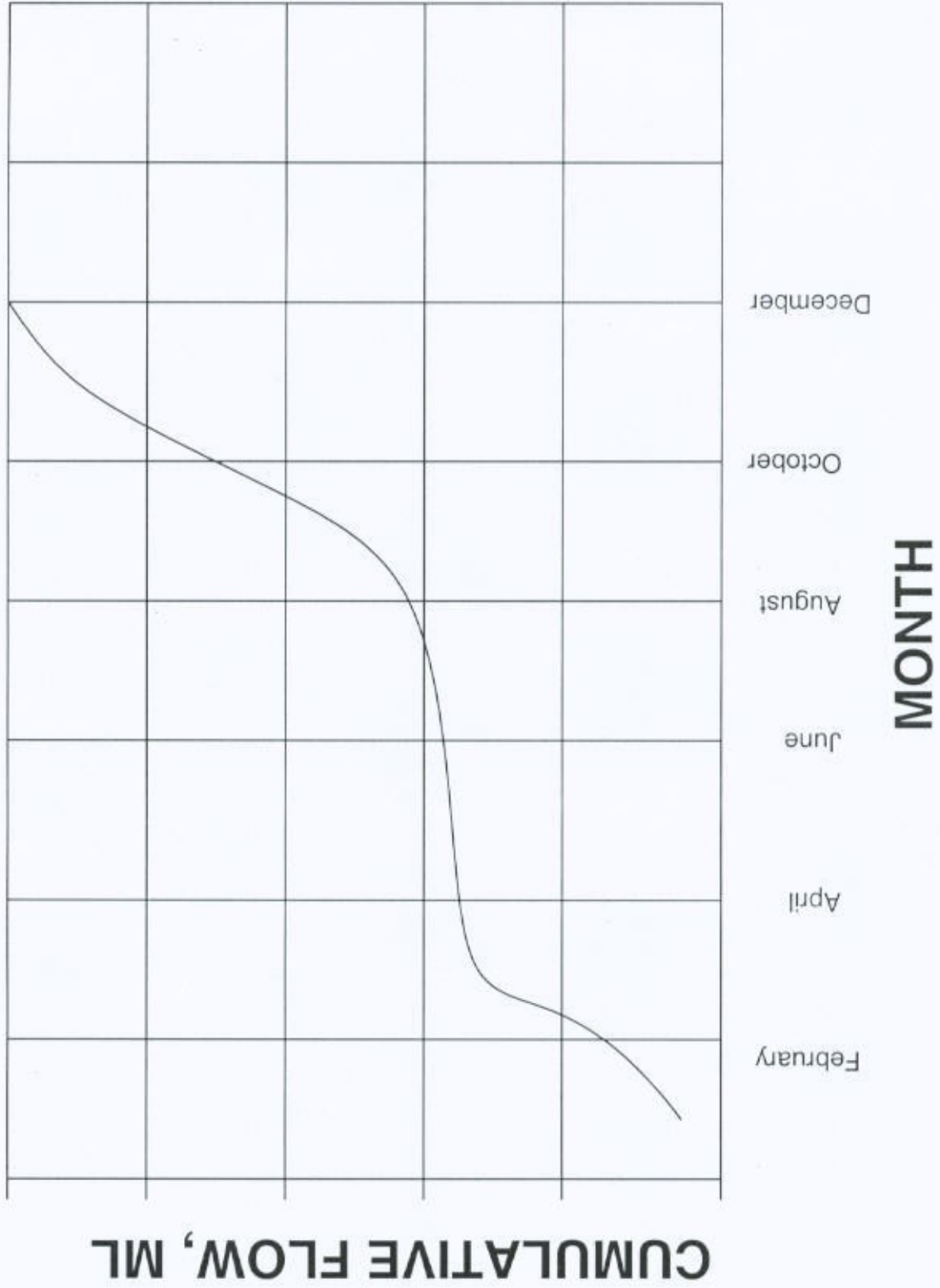


# SUMMATION HYDROGRAPH


CUMULATIVE FLOW, ML

February  
April  
June  
August  
October  
December

MONTH



## Unit conversions and equivalencies

### SI metric to U.S. Customary equivalencies

#### Length

$$1 \text{ mm} = 0.03937 \text{ in.}$$

$$1 \text{ m} = 3.281 \text{ ft}$$

$$1 \text{ km} = 0.6214 \text{ mi}$$

#### Area

$$1 \text{ m}^2 = 10.76 \text{ ft}^2$$

$$1 \text{ ha} = 10\,000 \text{ m}^2 = 2.471 \text{ ac}$$

$$1 \text{ km}^2 = 0.3861 \text{ mi}^2$$

#### Volume

$$1 \text{ L} = 0.2642 \text{ gal} = 0.03531 \text{ ft}^3$$

$$1 \text{ m}^3 = 264.2 \text{ gal} = 35.31 \text{ ft}^3$$

#### Volume flow rate

$$1 \text{ L/s} = 15.85 \text{ gpm} = 0.02282 \text{ mgd} = 0.03531 \text{ cfs}$$

$$1 \text{ m}^3/\text{s} = 15,850 \text{ gpm} = 22.82 \text{ mgd} = 35.31 \text{ cfs}$$

$$1 \text{ ML/d} = 1000 \text{ m}^3/\text{d} = 0.264 \text{ mgd}$$

#### Mass and weight (force)

$$1 \text{ kg} = 2.205 \text{ lb}$$

$$1 \text{ N} = 0.2248 \text{ lb}$$

$$1 \text{ ton (metric)} = 1000 \text{ kg} = 2205 \text{ lb}$$

$$1 \text{ kg/L} = 8.345 \text{ lb/gal}$$

$$1 \text{ kN/m}^2 = 172 \text{ lb/yd}^2$$

#### Pressure

$$1 \text{ kPa} = 0.147 \text{ psi}$$

$$1 \text{ atm} = 100 \text{ kPa} = 14.7 \text{ psi}$$

#### Chemical concentrations

$$1 \text{ mg/L} = 1 \text{ ppm} = 0.0584 \text{ gpg} = 8.345 \text{ lb/million gal}$$

$$1 \mu\text{g/L} = 1 \text{ ppb}$$

$$1\% = 10\,000 \text{ ppm}$$

#### Power

$$1 \text{ kW} = 1.341 \text{ hp}$$

$$1 \text{ hp} = 550 \text{ ft} \cdot \text{lb/s}$$

### Unit abbreviations

ac = acre

atm = atmosphere

cfs = cubic feet per second

ft = feet

ft<sup>2</sup> = square feet

ft<sup>3</sup> = cubic feet

gal = gallon

gpg = grains per gallon

gpm = gallons per minute

ha = hectare

hp = horsepower

in. = inch

kg = kilogram

km = kilometer

km<sup>2</sup> = square kilometer

kN = kilonewton

kPa = kilopascal

kW = kilowatt

L = liter

L/s = liters per second

lb = pound

m = meter

m<sup>2</sup> = square meter

m<sup>3</sup> = cubic meter

m<sup>3</sup>/s = cubic meters per second

mg/L = milligrams per liter

mgd = million gallons per day

mi = mile

mi<sup>2</sup> = square mile

ML/d = megaliters per day

mm = millimeter

N = newton

ppb = parts per billion

ppm = parts per million

% = percent

psi = pound per square inch

yd<sup>3</sup> = cubic yard

μg/L = micrograms per liter