To Manage Water, We Want to Know How Often a Flow Is Equaled or Exceeded

DURATION CURVE - % of Time a Flow Is Equaled or Exceeded

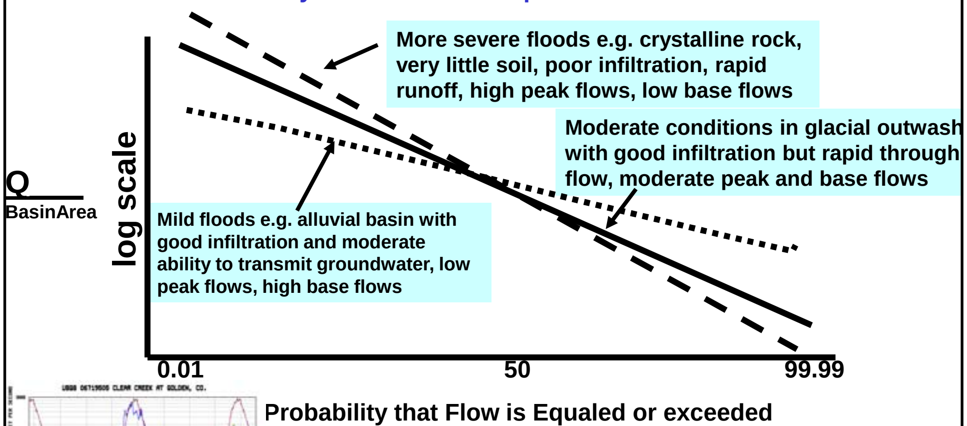
Plot of Discharge vs Probability of Occurrence

To create: Rank Flows, as m, From Highest to Lowest 1 to N

If 2 Values Are Equal, Assign Separate Rank

P = 100 * (m/(n+1))

Normalize flow by basin area to compare basins of different size




Steeper curve indicates more severe floods

## Estimate Velocity With Manning Equation

$$V = \frac{1.49\, R^{2/3} S^{1/2}}{n}$$

where: V = average velocity in fps

R = hydraulic radius (flow area [ft$^2$]/wetted perimeter[ft])

S = slope of energy gradient

n = Manning friction factor

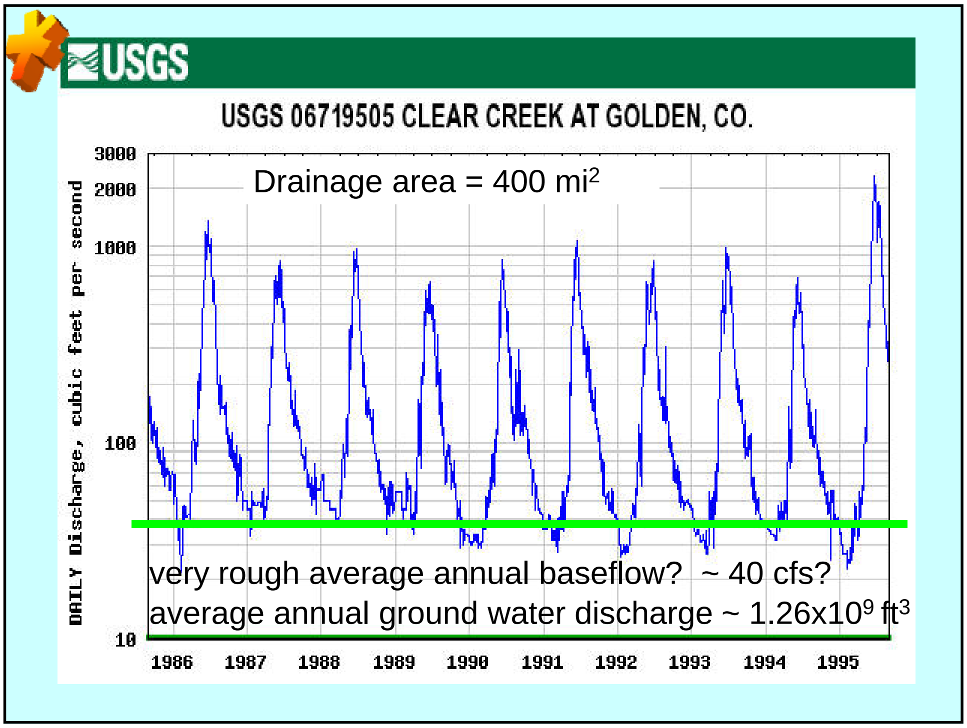
R = (40ft * 0.75ft) / (40ft + 0.75ft + 0.75ft) = 0.72

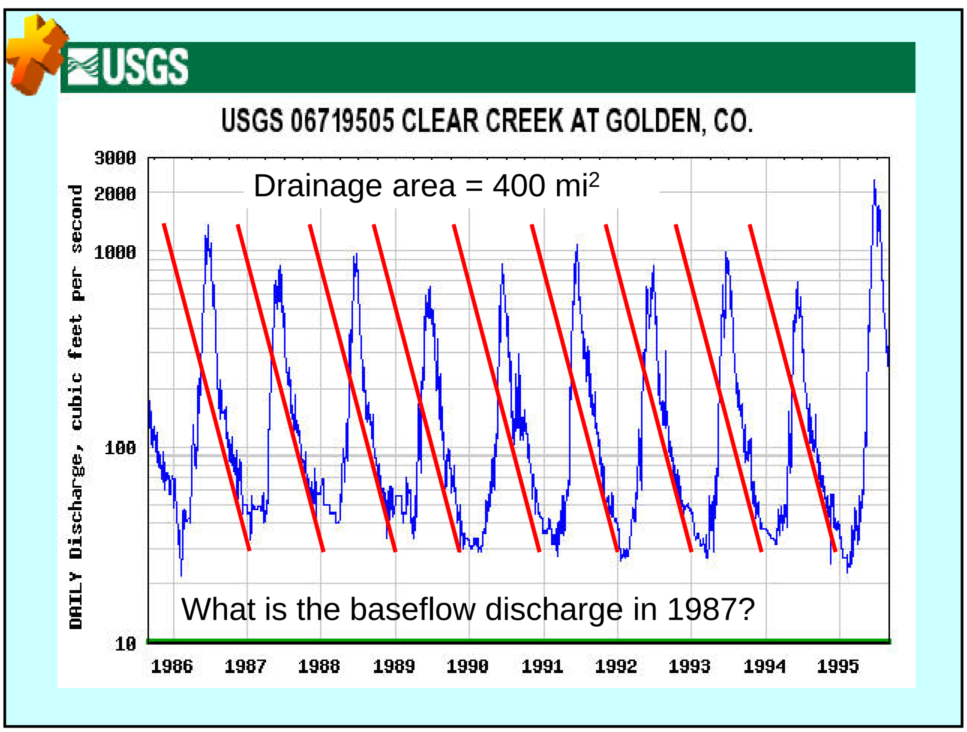
$$S = \frac{(5816\text{ft} - 5775\text{ft})}{550\text{m}\ \frac{1\text{ ft}}{12\text{in}}\ \frac{39.3\text{in}}{1\text{m}}} = 0.02276$$

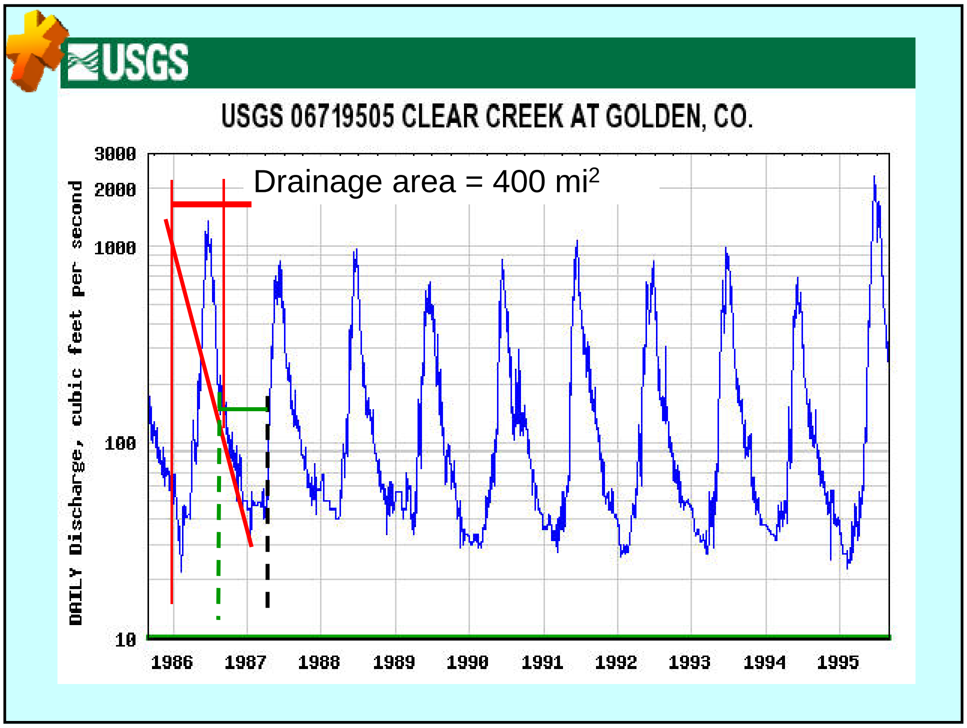
n ~ 0.05

V ~ 3.6 ft/sec

Q ~ 109 cfs


USGS
USGS 06719505 CLEAR CREEK AT GOLDEN, CO.
Drainage area = 400 mi$^2$
very rough average annual baseflow? ~ 40 cfs?
average annual ground water discharge ~ 1.26x10$^9$ ft$^3$
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995


USGS
USGS 06719505 CLEAR CREEK AT GOLDEN, CO.
Drainage area = 400 mi$^2$
What is the baseflow discharge in 1987?
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995


USGS
USGS 06719505 CLEAR CREEK AT GOLDEN, CO.
Drainage area = 400 mi²
DAILY Discharge, cubic feet per second
3000
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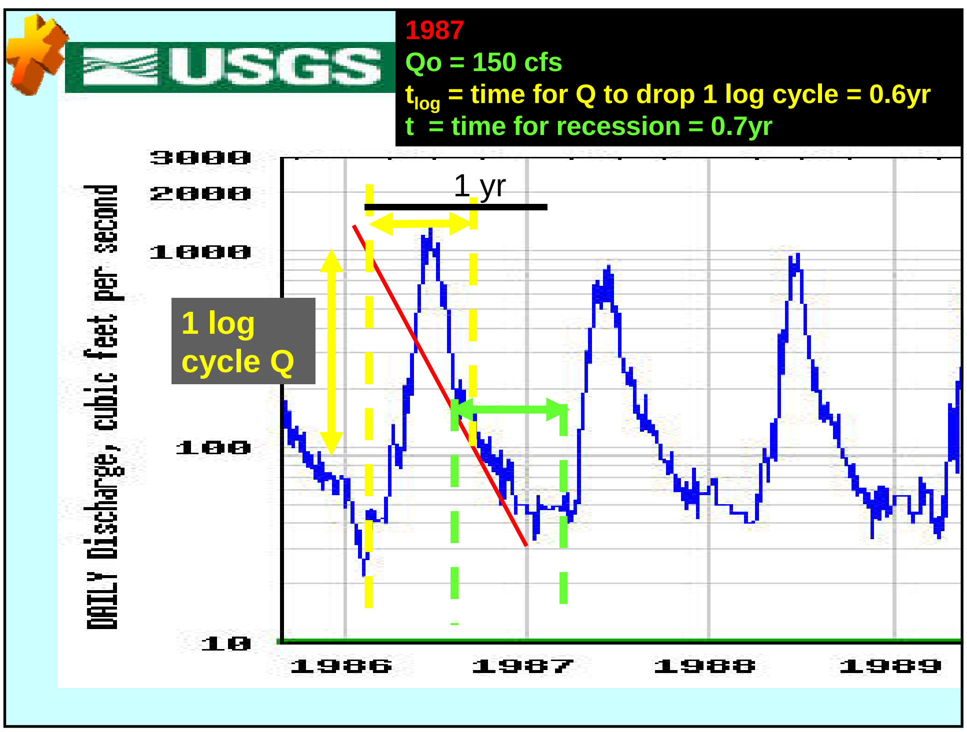
USGS
1987
Qo = 150 cfs
tlog = time for Q to drop 1 log cycle = 0.6yr
t = time for recession = 0.7yr
1 yr
1 log cycle Q
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
1986
1987
1988
1989

TOTAL GW THAT COULD DISCHARGE AT START OF RECESSION, $V_{tp}$:

$$V_{tp} \text{ is evaluated } \int_0^\infty \qquad V_{tp} = \frac{Q_o t_{\log}}{2.3}$$

TOTAL GW THAT COULD DISCHARGE AT END OF RECESSION, $V_R$:

$$V_R \text{ is evaluated } \int_{t@end}^\infty \qquad V_R = \frac{Q_o t_{\log}}{2.3\left(10^{\frac{t}{t_{\log}}}\right)}$$

1987, 1988, 1989, 1993

Qo ~ 150 cfs

$t_{log}$ = time for Q to drop 1 log cycle ~ 0.6 yr

t = time for recession ~ 0.7 yr

Vtp ~ $1.2 \times 10^9$ $ft^3$

$V_R$ ~ $8.4 \times 10^7$ $ft^3$

Vdischarged ~ $1.2 \times 10^9$ $ft^3$ ~26,000 AF