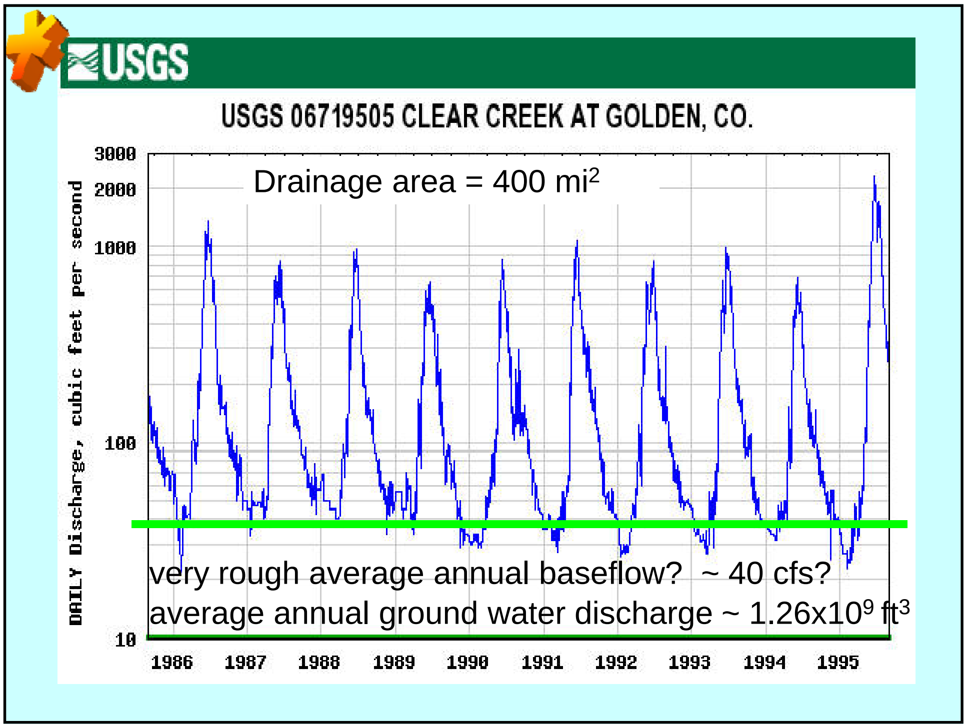
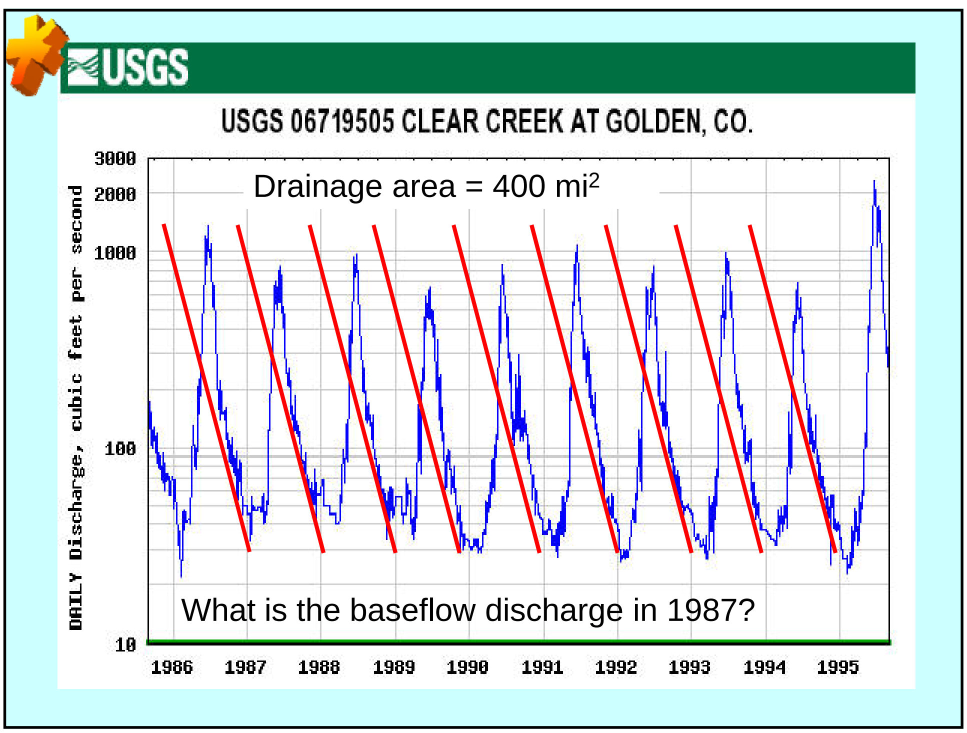
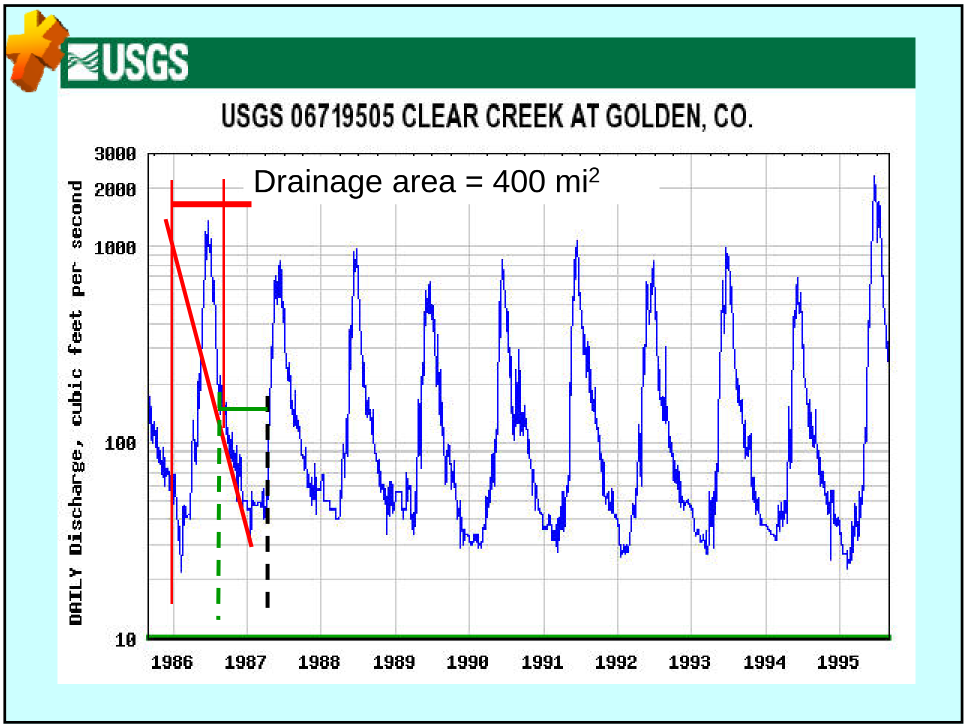

USGS
USGS 06719505 CLEAR CREEK AT GOLDEN, CO.
Drainage area = 400 mi2
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
very rough average annual baseflow? ~ 40 cfs?
average annual ground water discharge ~ 1.26x109 ft3
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995


USGS
USGS 06719505 CLEAR CREEK AT GOLDEN, CO.
Drainage area = 400 mi2
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
What is the baseflow discharge in 1987?
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995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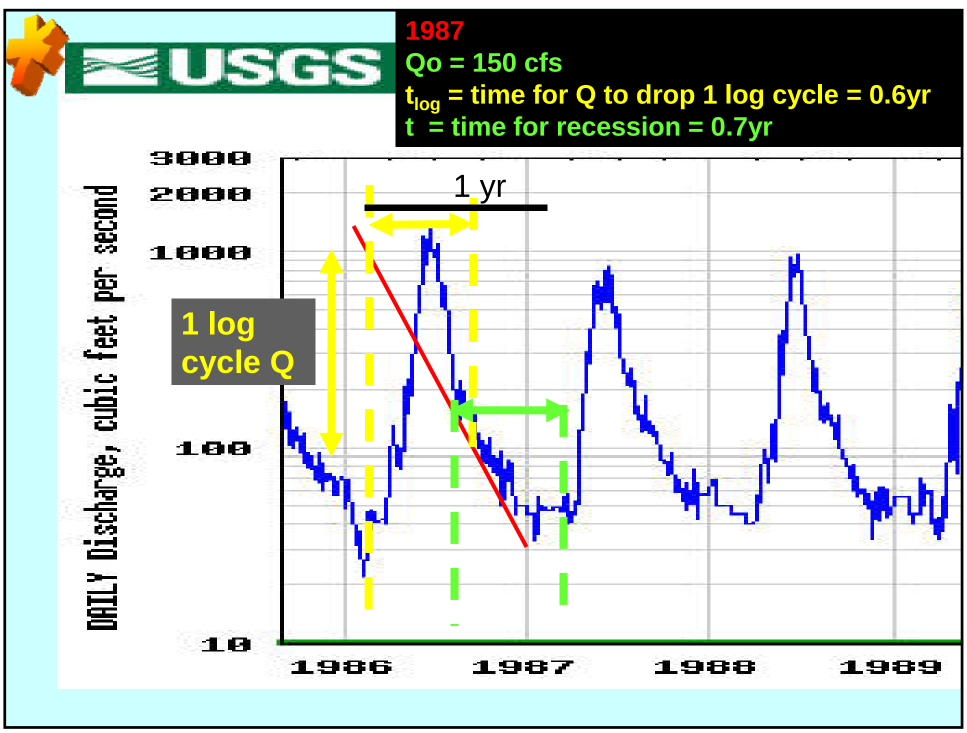

USGS
1987
Qo = 150 cfs
t_log = time for Q to drop 1 log cycle = 0.6yr
t = time for recession = 0.7yr
1 yr
1 log cycle Q
DAILY Discharge, cubic feet per second
3000
2000
1000
100
10
1986
1987
1988
1989

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 ~ 1.2×10^9 ft^3
V_R ~ 8.4×10^7 ft^3
Vdischarged ~ 1.2×10^9 ft^3 ~26,000 AF

Given:
Wet Bulk Density = 2.24 g/cm^3
Particle Density = 2.65 g/cm^3
Fluid Density (FD) = 1.0 g/cm^3
What is:
Porosity = ?

BD = (1- ϕ) PD + ϕ (FD)

$$\phi = \frac{SW - DW}{V_T} \qquad \frac{\mathbf{DW}}{\mathbf{V_T}} = \mathbf{PD(1-\phi)} \qquad \phi = 1 - \frac{\mathbf{DW}}{\mathbf{PD * V_T}}$$

BD = (1- ϕ) PD + ϕ (FD)
BD = PD - ϕ PD + ϕ FD
BD = PD + ϕ (FD - PD)
BD – PD = ϕ (FD - PD)

$$\frac{\text{BD – PD}}{\text{(FD - PD)}} = \phi$$

We have wet bulk density so use fluid density for water

$$\frac{2.24 - 2.65}{1 - 2.65} = \frac{-0.41}{-1.65} \sim 0.25 = \phi$$

Knowing:

Wet Bulk Density = 2.24 g/cm^3
Particle Density = 2.65 g/cm^3
Fluid Density (FD) = 1.0 g/cm^3
Porosity = 0.25

And If:
Total Volume = 25cm^3
What is:
Saturated Weight = ?
Dry Weight = ?

BD = (1- ϕ) PD + ϕ (FD)

$$\phi = \frac{SW - DW}{V_T}$$

$$\frac{DW}{V_T} = PD(1-\phi)$$

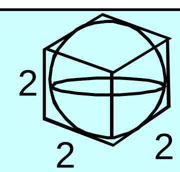
$$\phi = 1 - \frac{DW}{PD * V_T}$$

Saturated "Weight" = Vol * WBD = 25cm^3 * 2.24 $\frac{g}{cm^3}$ = 56g (MASS)

Dry Weight = SatWgt – WaterWgt = SatWgt – ϕ TotVol * FD

= 56g – (0.25*25cm^3) * 1 $\frac{g}{cm^3}$ = 56g – 6.25g = 49.75g ~ 50g (MASS)

$$\phi = \frac{V_V}{V_T} = \frac{2^3 - \left(m\frac{4}{3}\pi r^3\right)}{2^3}$$



m is # spheres r is their radius

m	r	r^3	mr^3
1	1	1	1
8	1/2	1/8	1
64	1/4	1/64	1

$$\phi = \frac{2^3 - \left(\frac{4}{3}\pi\right)(1)}{2^3} = 0.476 \qquad \text{A constant!}$$

HENCE MAX ϕ FOR UNIFORM, CUBIC PACKED SPHERES IS ~ 48%

MIN ϕ WOULD RESULT FROM RHOMBEHEDRAL PACKING ~ 26%

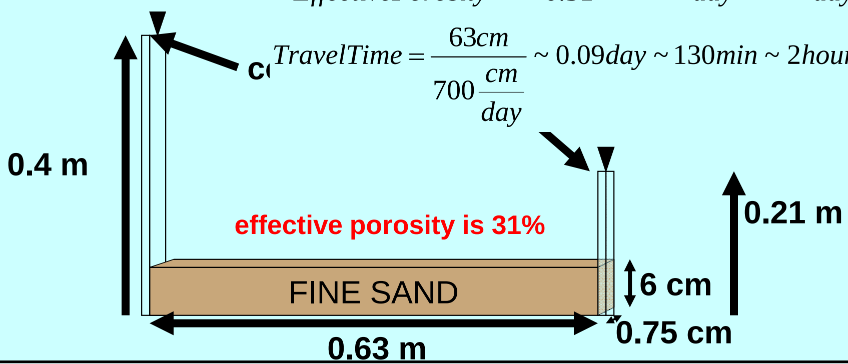
IN GENERAL, IRREGULAR PACKING & ANGULAR PARTICLES YIELD HIGHER ϕ

$$Q = \frac{1\ liter}{day} = \frac{1\ liter}{day}\frac{1000cm^3}{1\ liter} = \frac{1000cm^3}{day}$$

$$Darcy\ Velocity = \frac{Q}{Area} = \frac{\frac{1000cm^3}{day}}{6cm0.75cm} = 222\frac{cm}{day}$$

$$Average\ Linear\ Velocity = \frac{DarcyVelocity}{EffectivePorosity} = \frac{222\frac{cm}{day}}{0.31} = 716\frac{cm}{day} \sim 700\frac{cm}{day}$$

$$TravelTime = \frac{63cm}{700\frac{cm}{day}} \sim 0.09day \sim 130min \sim 2hours$$

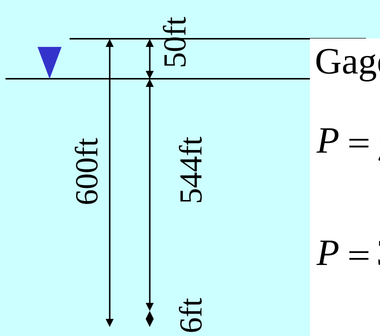


pressure on your head (6ft tall) at the bottom of a well

surface at sea level

bottom at 600 ft

water level 50 ft below the surface



Gage Pressure

$$P = \gamma h = 62.4\frac{lb}{ft^3}544\,ft = 33945.6\frac{lb}{ft^2}$$

$$P = 33945.6\frac{lb}{ft^2}\frac{1}{144}\frac{ft^2}{in^2}$$

$$= 235.7\frac{lb}{in^2} = 235.7\,psi$$

Absolute Pressure ~ 235.7psi + 14.7psi

~ 250.4psi