Drainage area = 400 mi$^2$

very rough average annual baseflow? $\sim 40$ cfs?

average annual ground water discharge $\sim 1.26 \times 10^9$ ft$^3$

What is the baseflow discharge in 1987?
Drainage area = 400 mi$^2$

Qo = 150 cfs

$\log_t = \text{time for Q to drop 1 log cycle} = 0.6$yr

$\tau = \text{time for recession} = 0.7$yr
TOTAL GW THAT COULD DISCHARGE AT START OF RECESSION, \( V_{tp} \):

\[
V_{tp} \text{ is evaluated } \int_0^\infty V_{tp} = \frac{Q_0 t_{log}}{2.3}
\]

TOTAL GW THAT COULD DISCHARGE AT END OF RECESSION, \( V_R \):

\[
V_R \text{ is evaluated } \int_{t@end}^{\infty} V_R = \frac{Q_o t_{log}}{2.3(10^{10^{log}})}
\]


\( Q_o \sim 150 \text{ cfs} \)

\( t_{log} = \text{time for } Q \text{ to drop 1 log cycle } \sim 0.6 \text{ yr} \)

\( t = \text{time for recession } \sim 0.7 \text{ yr} \)

\( V_{tp} \sim 1.2 \times 10^9 \text{ ft}^3 \)

\( V_R \sim 8.4 \times 10^7 \text{ ft}^3 \)

\( V_{discharged} \sim 1.2 \times 10^9 \text{ ft}^3 \sim 26,000 \text{ AF} \)

**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 = ?

\[
\phi = \frac{SW - DW}{V_T} \quad \text{BD} = (1- \phi) \text{ PD} + \phi \text{ (FD)}
\]

\[
\phi = 1 - \frac{\text{DW}}{\text{PD} \times V_T}
\]

We have wet bulk density so

\[
\frac{2.24 - 2.65}{1.0} = -0.41 \sim 0.25 = \phi
\]

use fluid density for water

\[
1 - 2.65 = -1.65
\]
Knowing:
Wet Bulk Density = 2.24 g/cm³
Particle Density = 2.65 g/cm³
Fluid Density (FD) = 1.0 g/cm³
Porosity = 0.25

And If:
Total Volume = 25 cm³

What is:
Saturated Weight = ?
Dry Weight = ?

BD = (1 - φ) PD + φ (FD)

\[ \phi = \frac{SW - DW}{VT} \]
\[ DW = PD(1 - \phi) \]
\[ \phi = 1 - \frac{DW}{PD * VT} \]

Saturated “Weight” = Vol * WBD = 25 cm³ * 2.24 g/cm³ = 56 g (MASS)

Dry Weight = SatWgt – WaterWgt = SatWgt – φ TotVol * FD
= 56 g – (0.25 * 25 cm³) * 1 g/cm³ = 56 g – 6.25 g = 49.75 g ~ 50 g (MASS)

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

<table>
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<tr>
<th>m</th>
<th>r</th>
<th>r³</th>
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<tr>
<td>64</td>
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\[ \phi = \frac{2^3 - \left( \frac{4}{3} \pi \right) (1)}{2^3} = 0.476 \]  
A constant!

HENCE MAX \( \phi \) FOR UNIFORM, CUBIC PACKED SPHERES IS \(~ 48\%\)

MIN \( \phi \) WOULD RESULT FROM RHOMBEHEDRAL PACKING \(~ 26\%\)

IN GENERAL, IRREGULAR PACKING & ANGULAR PARTICLES YIELD HIGHER \( \phi \)
Q = 1 liter/day = 1 liter/day 1000 cm³ = 1000 cm³/day

Darcy Velocity = \( \frac{Q}{\text{Area}} = \frac{1000 \text{ cm}^3}{6 \text{ cm} \times 0.75 \text{ cm}} = 222 \text{ cm/day} \)

Average Linear Velocity = \( \frac{\text{DarcyVelocity}}{\text{EffectivePorosity}} = \frac{222 \text{ cm/day}}{0.31} = 716 \text{ cm/day} \approx 700 \text{ cm/day} \)

\[ \text{Travel Time} = \frac{63 \text{ cm}}{700 \text{ cm/day}} \approx 0.09 \text{ day} \approx 130 \text{ min} \approx 2 \text{ hours} \]

Effective porosity is 31%

FINE SAND

0.4 m

0.21 m

6 cm

0.63 m

0.75 cm

Pressure on your head (6 ft tall) at the bottom of a well
surface at sea level
bottom at 600 ft
water level 50 ft below the surface

Gage Pressure

\[ P = \gamma h = 62.4 \frac{\text{lb}}{\text{ft}^3} \times 544 \text{ ft} = 33945.6 \frac{\text{lb}}{\text{ft}^2} \]

\[ P = 33945.6 \frac{\text{lb}}{\text{ft}^2} \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} \]

\[ = 235.7 \frac{\text{lb}}{\text{in}^2} = 235.7 \text{ psi} \]

Absolute Pressure \( \approx 235.7 \text{ psi} + 14.7 \text{ psi} \)

\( \approx 250.4 \text{ psi} \)