



Unconfined Aquifer Formulas

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List of 42 Unconfined Aquifer Formulas

Unconfined Aquifer

Aquifer Discharge 2

1) Discharge from Two Wells with Base 10

$$\mathbf{Q} = rac{1.36 \cdot \mathrm{K_{WH}} \cdot \left(\mathrm{h_2^2 - h_1^2}
ight)}{\log\left(\left(rac{\mathrm{r_2}}{\mathrm{r1}^2}
ight), 10
ight)}$$

Open Calculator

$$\boxed{ 0.699431 \text{m}^3/\text{s} = \frac{1.36 \cdot 10.00 \text{cm/s} \cdot \left((17.8644 \text{m})^2 - (17.85 \text{m})^2 \right)}{\log \left(\left(\frac{10.0 \text{m}}{0.000000001 \text{m}} \right), 10 \right)} }$$

2) Discharge given Length of Strainer

$$\mathbf{Q} = rac{2.72 \cdot \mathrm{K_{WH}} \cdot \mathrm{s_t} \cdot \left(\mathrm{L} + \left(rac{\mathrm{s_t}}{2}
ight)
ight)}{\log\left(\left(rac{\mathrm{R_w}}{\mathrm{r''}}
ight), 10
ight)}$$



3) Discharge in Unconfined Aquifer

 $\mathbf{R} = rac{\pi \cdot \mathrm{K}_{\mathrm{WH}} \cdot \left(\mathrm{H}^2 - \mathrm{h}_{\mathrm{w}}^2
ight)}{\log \left(\left(rac{\mathrm{R}_{\mathrm{w}}}{\mathrm{r}}
ight), e
ight)}$

Open Calculator 🗗

$$= \frac{\pi \cdot 10.00 \text{cm/s} \cdot \left((5\text{m})^2 - (2.44\text{m})^2 \right)}{\log \left(\left(\frac{8.6\text{m}}{7.5\text{m}} \right), e \right)}$$

4) Discharge in Unconfined Aquifer with Base 10

 $\mathbf{Q} = rac{1.36 \cdot K_{WH} \cdot \left(b_w^2 - h_w^2
ight)}{\log\left(\left(rac{R_w}{r}
ight), 10
ight)}$

Open Calculator

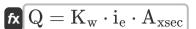
$$= \frac{1.36 \cdot 10.00 \text{cm/s} \cdot \left(\left(14.15 \text{m} \right)^2 - \left(2.44 \text{m} \right)^2 \right)}{\log \left(\left(\frac{8.6 \text{m}}{7.5 \text{m}} \right), 10 \right)}$$

5) Discharge when Two Observation Well is Taken

$$\mathbf{Q} = rac{\pi \cdot \mathrm{K}_{\mathrm{WH}} \cdot \left(\mathrm{h}_2^2 - \mathrm{h}_1^2
ight)}{\log\left(\left(rac{\mathrm{r}_2}{\mathrm{r}_1}
ight), e
ight)}$$



6) Rate of Flow given Coefficient of Permeability



Open Calculator

$$= 1.22472 \text{m}^3/\text{s} = 1125 \text{cm/s} \cdot 17.01 \cdot 6400 \text{mm}^2$$

7) Rate of Flow given Flow Velocity

fx
$$Q = (V_{wh}, \cdot A_{sec})$$

Open Calculator 🗗

ex $1.54368 \mathrm{m}^3/\mathrm{s} = (24.12 \mathrm{m/s} \cdot 64000 \mathrm{mm}^2)$

Aquifer Thickness &

8) Cross-section Area of Soil Mass given Flow Velocity

$$\mathbf{f}$$
 $\mathbf{A}_{\mathrm{xsec}} = \left(rac{\mathrm{V}_{\mathrm{aq}}}{\mathrm{V}_{\mathrm{f}}}
ight)$

Open Calculator

$$ext{ex} \left[6400 ext{mm}^2 = \left(rac{64 ext{m}^3/ ext{s}}{0.01 ext{m/s}}
ight)
ight]$$

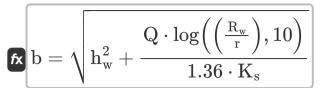
9) Length of Strainer given Discharge

$$\mathbf{R}
brace \mathbf{l}_{\mathrm{st}} = \left(rac{\mathrm{Q} \cdot \mathrm{log}\left(\left(rac{\mathrm{R}_{\mathrm{w}}}{\mathrm{r}}
ight), 10
ight)}{2.72 \cdot \mathrm{K}_{\mathrm{WH}} \cdot \mathrm{S}_{\mathrm{tw}}}
ight) - \left(rac{\mathrm{S}_{\mathrm{tw}}}{2}
ight)$$





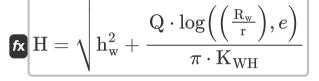
10) Thickness of Aquifer for Discharge in Unconfined Aquifer with Base 10 🖒



Open Calculator

 $= \sqrt{ \left(2.44 \mathrm{m} \right)^2 + \frac{1.01 \mathrm{m}^3 / \mathrm{s} \cdot \log \left(\left(\frac{8.6 \mathrm{m}}{7.5 \mathrm{m}} \right), 10 \right) }{1.36 \cdot 8.34 } }$

11) Thickness of Aquifer given Discharge in Unconfined Aquifer



Open Calculator

 $extbf{ex} \left[5.426268 ext{m} = \sqrt{\left(2.44 ext{m}
ight)^2 + rac{1.01 ext{m}^3/ ext{s} \cdot ext{log}\left(\left(rac{8.6 ext{m}}{7.5 ext{m}}
ight), e
ight)}{\pi \cdot 10.00 ext{cm/s}}
ight]$

12) Thickness of Aquifer given Drawdown Value measured at Well

 $\mathbf{f} \mathbf{x} \left[\mathbf{b} = \mathbf{s}_{\mathrm{t}} + \mathbf{h}_{\mathrm{w}}
ight]$

Open Calculator 🗗

 $|3.27 \mathrm{m} = 0.83 \mathrm{m} + 2.44 \mathrm{m}$



Coefficient of Permeability 🗗

13) Coefficient of Permeability given Discharge and Length of Strainer

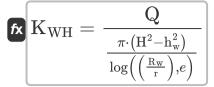


$$m K_{WH} = rac{Q}{rac{2.72 \cdot S_{tw} \cdot \left(l_{st} + \left(rac{S_{tw}}{2}
ight)
ight)}{log\left(\left(rac{R_{w}}{r}
ight),10
ight)}}$$

14) Coefficient of Permeability given Discharge from Two Wells with Base 10



15) Coefficient of Permeability given Discharge in Unconfined Aquifer



Open Calculator

$$\boxed{ 12.33345 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{\pi \cdot \left((5\text{m})^2 - (2.44\text{m})^2 \right)}{\log \left(\left(\frac{8.6\text{m}}{7.5\text{m}} \right), e \right)} } }$$

16) Coefficient of Permeability given Discharge in Unconfined Aquifer with Base 10

$$\kappa_{WH} = \frac{Q}{\frac{1.36 \cdot \left(b_w^2 - h_{well}^2\right)}{\log\left(\left(\frac{R_w}{r}\right), 10\right)}}$$

Open Calculator

17) Coefficient of Permeability given Discharge of Two Wells under Consideration

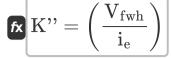
$$\mathbf{K}_{\mathrm{WH}} = rac{\mathrm{Q}}{rac{\pi \cdot \left(\mathrm{h}_2^2 - \mathrm{h}_1^2
ight)}{\log\left(\left(rac{\mathrm{r}_2}{\mathrm{r}_1},
ight),e
ight)}}$$

ex
$$10.76102 \mathrm{cm/s} = rac{1.01 \mathrm{m^3/s}}{rac{\pi \cdot \left((17.8644 \mathrm{m})^2 - (17.85 \mathrm{m})^2
ight)}{\log \left(\left(rac{10.0 \mathrm{m}}{0.03 \mathrm{m}}
ight), e
ight)}}$$





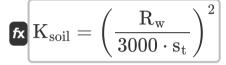
18) Coefficient of Permeability given Flow Velocity 🚰



Open Calculator

ex $6.584362 ext{cm/s} = \left(\frac{1.12 ext{m/s}}{17.01} \right)$

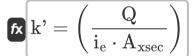
19) Coefficient of Permeability given Radius of Influence



Open Calculator

ex $0.001193 \mathrm{cm/s} = \left(\frac{8.6 \mathrm{m}}{3000 \cdot 0.83 \mathrm{m}}\right)^2$

20) Coefficient of Permeability given Rate of Flow



Open Calculator

 $= 27.7631 \text{cm/s} = \left(\frac{1.01 \text{m}^3/\text{s}}{17.01 \cdot 6400 \text{mm}^2} \right)$



Depth of Water in Well

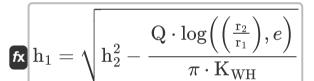
21) Depth of Water at Point 1 given Discharge from Two Wells with Base 10

$$\mathbf{h}_1 = \sqrt{\mathbf{h}_2^2 - rac{\mathbf{Q} \cdot \log\left(\left(rac{\mathbf{r}_2}{\mathbf{r}_1}
ight), 10
ight)}{1.36 \cdot \mathbf{K}_{\mathrm{WH}}}}$$

Open Calculator 2

 $= \sqrt{(17.8644 \mathrm{m})^2 - \frac{1.01 \mathrm{m}^3/\mathrm{s} \cdot \log\left(\left(\frac{10.0 \mathrm{m}}{1.07 \mathrm{m}}\right), 10\right)}{1.36 \cdot 10.00 \mathrm{cm/s}} }$

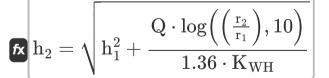
22) Depth of Water at Point 1 given Discharge of Two Wells under Consideration



Open Calculator 🗗

 $\boxed{ 17.82409 \mathrm{m} = \sqrt{ \left(17.8644 \mathrm{m} \right)^2 - \frac{1.01 \mathrm{m}^3/\mathrm{s} \cdot \log \left(\left(\frac{10.0 \mathrm{m}}{1.07 \mathrm{m}} \right), e \right)}{\pi \cdot 10.00 \mathrm{cm/s}} }$

23) Depth of Water at Point 2 given Discharge from Two Wells with Base 10



Open Calculator

 $= \sqrt{ (17.85 \mathrm{m})^2 + \frac{1.01 \mathrm{m}^3 / \mathrm{s} \cdot \log \left(\left(\frac{10.0 \mathrm{m}}{1.07 \mathrm{m}} \right), 10 \right) }{1.36 \cdot 10.00 \mathrm{cm/s} } }$





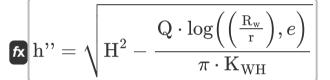
24) Depth of Water at Point 2 given Discharge of Two Wells under Consideration

 \mathbf{f} $\mathbf{h}_2 = \sqrt{\mathbf{h}_1^2 + rac{\mathbf{Q} \cdot \log\left(\left(rac{\mathbf{r}_2}{\mathbf{r}_1}
ight), e
ight)}{\pi \cdot \mathbf{K}_{\mathrm{WH}}}}$

Open Calculator

ex $17.89025 \mathrm{m} = \sqrt{\left(17.85 \mathrm{m}\right)^2 + \frac{1.01 \mathrm{m}^3/\mathrm{s} \cdot \log\left(\left(\frac{10.0 \mathrm{m}}{1.07 \mathrm{m}}\right), e\right)}{\pi \cdot 10.00 \mathrm{cm/s}}}$

25) Depth of Water in Well given Discharge in Unconfined Aquifer



Open Calculator

$$\boxed{1.2285 \mathrm{m} = \sqrt{\left(5 \mathrm{m}\right)^2 - \frac{1.01 \mathrm{m}^3/\mathrm{s} \cdot \log\left(\left(\frac{8.6 \mathrm{m}}{7.5 \mathrm{m}}\right), e\right)}{\pi \cdot 10.00 \mathrm{cm/s}}}$$

26) Depth of Water in Well given Drawdown Value measured at Well

fx
$$m [h_{d'} = H - s_t]$$

$$4.17 \mathrm{m} = 5 \mathrm{m} - 0.83 \mathrm{m}$$



Open Calculator

Open Calculator

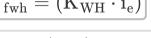
Open Calculator

27) Drawdown at Well given Radius of Influence

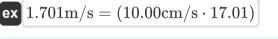
$\left|\mathbf{K} ight|\mathbf{s}_{\mathrm{t}}=rac{\mathbf{K}_{\mathrm{w}}}{3000\cdot\sqrt{\mathrm{K}_{\mathrm{dec}}}}$

Flow Velocity

28) Flow Velocity given Coefficient of Permeability fx $V_{\mathrm{fwh}} = (\mathrm{K}_{\mathrm{WH}} \cdot \mathrm{i}_{\mathrm{e}})$

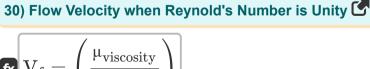


29) Flow Velocity given Rate of Flow



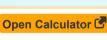


$$oxed{ex} 25 \mathrm{m/s} = \left(rac{0.16 \mathrm{m^3/s}}{6400 \mathrm{mm^2}}
ight)$$



$$V_f = \left(\frac{\mu_{viscosity}}{\rho \cdot D_p}\right)$$
 ex $0.003665 m/s = \left(\frac{0.19 P}{997 kg/m^3 \cdot 0.0052 m}\right)$

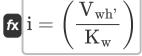








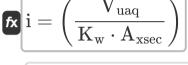
31) Hydraulic Gradient given Flow Velocity



Open Calculator

 $2.144 = \left(\frac{24.12 \text{m/s}}{1125 \text{cm/s}}\right)$

32) Hydraulic Gradient given Rate of Flow

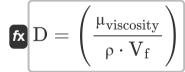


Open Calculator &

 $oxed{egin{align*} egin{align*} \mathbf{ex} \ 2.222222 = \left(rac{0.16 \mathrm{m}^3/\mathrm{s}}{1125 \mathrm{cm/s} \cdot 6400 \mathrm{mm}^2}
ight) \end{aligned}}$

Radial Distance and Radius of well

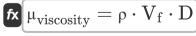
33) Diameter or Particle Size when Reynold's Number is Unity



Open Calculator

 $oxed{ex} 0.019057 \mathrm{m} = \left(rac{0.19 \mathrm{P}}{997 \mathrm{kg/m^3 \cdot 0.01 m/s}}
ight)$

34) Dynamic Viscosity when Reynold's Number is Unity



Open Calculator

 $0.1994P = 997kg/m^3 \cdot 0.01m/s \cdot 0.02m$



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35) Mass Density when Reynold's Number is Unity

 $ho = rac{\mu_{
m viscosity}}{V_{
m f} \cdot D}$

Open Calculator 🗗

$$m ex = rac{0.19P}{0.01m/s \cdot 0.02m}$$

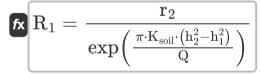
36) Radial Distance of Well 1 based on Discharge from Two Wells with Base

 $m R_1 = rac{r_2}{10^{rac{1.36\cdot K_{soil}\cdot \left(h_2^2-h_1^2
ight)}{Q}}}$

Open Calculator

$$= \frac{10.0 \text{m}}{10^{\frac{1.36 \cdot 0.001 \text{cm/s} \cdot \left((17.8644 \text{m})^2 - (17.85 \text{m})^2\right)}{1.01 \text{m}^3/\text{s}}} }$$

37) Radial Distance of Well 1 based on Discharge of Two Wells under Consideration



$$= \frac{10.0 \mathrm{m}}{\exp \left(\frac{\pi \cdot 0.001 \mathrm{cm/s} \cdot \left((17.8644 \mathrm{m})^2 - (17.85 \mathrm{m})^2\right)}{1.01 \mathrm{m}^3 / \mathrm{s}}\right)}$$



38) Radial Distance of Well 2 based on Discharge from Two Wells with Base

 $m R_2 = r_1 \cdot 10^{rac{1.36 \cdot K_{soil} \cdot \left(h_2^2 - h_1^2
ight)}{Q}}$

Open Calculator

$$\mathbf{R}_2 = \mathbf{r}_1 \cdot \mathbf{10}$$

ex
$$1.070017 \mathrm{m} = 1.07 \mathrm{m} \cdot 10^{rac{1.36 \cdot 0.001 \mathrm{cm/s} \cdot \left((17.8644 \mathrm{m})^2 - (17.85 \mathrm{m})^2
ight)}{1.01 \mathrm{m}^3/\mathrm{s}}}$$

39) Radial Distance of Well 2 based on Discharge of Two Wells under Consideration

 $\mathbf{R}_2 = \mathbf{r}_1 \cdot \exp \left(rac{\pi \cdot \mathbf{K}_{\mathrm{soil}} \cdot \left(\mathbf{h}_2^2 - \mathbf{h}_1^2
ight)}{\mathbf{Q}}
ight)$

Open Calculator

$$1.070017 \mathrm{m} = 1.07 \mathrm{m} \cdot \mathrm{exp} \Bigg(rac{\pi \cdot 0.001 \mathrm{cm/s} \cdot \left(\left(17.8644 \mathrm{m}
ight)^2 - \left(17.85 \mathrm{m}
ight)^2
ight)}{1.01 \mathrm{m}^3 / \mathrm{s}} \Bigg)$$

40) Radius of Well based on Discharge in Unconfined Aquifer

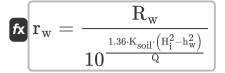
$$\mathbf{r}_{\mathrm{w}} = rac{\mathrm{R}_{\mathrm{w}}}{\mathrm{exp}\left(rac{\pi\cdot\mathrm{K}_{\mathrm{soil}}\cdot\left(\mathrm{H}_{\mathrm{i}}^{2}-\mathrm{h}_{\mathrm{w}}^{2}
ight)}{\mathrm{Q}}
ight)}$$

$$=$$
 $\frac{8.6 \mathrm{m}}{\mathrm{exp} igg(rac{\pi \cdot 0.001 \mathrm{cm/s} \cdot ig((2.48 \mathrm{m})^2 - (2.44 \mathrm{m})^2 ig)}{1.01 \mathrm{m}^3 / \mathrm{s}} igg)}$



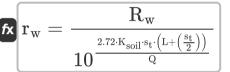


41) Radius of Well based on Discharge in Unconfined Aquifer with Base 10



Open Calculator

42) Radius of Well given Discharge and Length of Strainer



$$= rac{8.6 ext{m}}{10^{rac{2.72 \cdot 0.001 ext{cm} \cdot \left(2 ext{m} + \left(rac{0.83 ext{m}}{2}
ight)
ight)}{1.01 ext{m}^3 / ext{s}}}$$



Variables Used

- A_{sec} Area of Cross Section (Square Millimeter)
- A_{xsec} Area of Cross Section in Enviro. Engin. (Square Millimeter)
- **b** Thickness of Aquifer (Meter)
- **b**_w Aquifer Thickness (Meter)
- **D** Diameter for Unconfined Aguifer (*Meter*)
- D_D Diameter of Particle (Meter)
- h" Depth of Water in Well given Discharge (Meter)
- H Thickness of Unconfined Aguifer (Meter)
- h₁ Depth of Water 1 (Meter)
- h₂ Depth of Water 2 (Meter)
- h_d Depth of Water in Well given Drawdown (Meter)
- **H**i Initial Aquifer Thickness (Meter)
- h_w Depth of Water (Meter)
- hwell Depth of Water in Well (Meter)
- i Hydraulic Gradient
- **i**_e Hydraulic Gradient in Envi. Engi.
- **k'** Coefficient of Permeability given Rate of Flow (Centimeter per Second)
- K" Coefficient of Permeability given Flow Velocity (Centimeter per Second)
- K_{dw} Coefficient of Permeability at Drawdown (Centimeter per Second)
- K_s Standard Coefficient of Permeability at 20°C
- K_{soil} Coefficient of Permeability of Soil Particle (Centimeter per Second)
- **K**_w Coefficient of Permeability (Centimeter per Second)





- K_{WH} Coefficient of Permeability in Well Hydraulics (Centimeter per Second)
- L Length of Strainer (Meter)
- Ist Strainer Length (Meter)
- Q Discharge (Cubic Meter per Second)
- r Radius of Well (Meter)
- r₁ Radial Distance at Observation Well 1 (Meter)
- R₁ Radial Distance 1 (Meter)
- r₂ Radial Distance at Observation Well 2 (Meter)
- R₂ Radial Distance at Well 2 (Meter)
- r_w Radius of Well given Discharge (Meter)
- R_w Radius of Influence (Meter)
- r" Radius of Well in Well Hydraulics (Meter)
- r1 Radial Distance at Well 1 (Meter)
- r1" Observation Well 1 Radial Distance (Meter)
- St Total Drawdown (Meter)
- S_{tw} Total Drawdown in Well (Meter)
- Vag Rate of Flow in Aquifer (Cubic Meter per Second)
- V_f Flow Velocity for Unconfined Aquifer (Meter per Second)
- V_{fwh} Flow Velocity (Meter per Second)
- V_{uaq} Rate of Flow in Unconfined Aquifer (Cubic Meter per Second)
- V_{wh} Velocity of Flow (Meter per Second)
- µ_{viscosity} Dynamic Viscosity for Aquifer (Poise)
- p Mass Density (Kilogram per Cubic Meter)





Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- Constant: e, 2.71828182845904523536028747135266249
 Napier's constant
- Function: exp, exp(Number)

 n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: log, log(Base, Number)

 Logarithmic function is an inverse function to exponentiation.
- Function: sqrt, sqrt(Number)

 A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: Length in Meter (m)
 Length Unit Conversion
- Measurement: Area in Square Millimeter (mm²)
 Area Unit Conversion
- Measurement: Speed in Centimeter per Second (cm/s), Meter per Second (m/s)
 - Speed Unit Conversion
- Measurement: Volumetric Flow Rate in Cubic Meter per Second (m³/s)

 Volumetric Flow Rate Unit Conversion
- Measurement: Dynamic Viscosity in Poise (P)
 Dynamic Viscosity Unit Conversion
- Measurement: Mass Concentration in Kilogram per Cubic Meter (kg/m³)
 Mass Concentration Unit Conversion





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