Fetkovich Aquifer Water Influx over Time Steps

Cumulative water influx from a finite radial aquifer by Fetkovich's method over up to four equal time steps of falling reservoir boundary pressure.

Input parameters

Unit system: SI

Parameter	Value	Unit
Reservoir radius	5,000.0	ft
Aquifer outer radius	30,000	ft
Aquifer thickness	60.000	ft
Aquifer porosity	20.000	%
Aquifer total compressibility (c_w + c_f)	6.0000e-06	1/psi
Encroachment angle	360.00	°
Aquifer permeability	80.000	mD
Water viscosity	0.50000	cP
Aquifer outer boundary	Constant pressure	
Initial pressure	3,500.0	psi
Length of each time step	182.50	d
Boundary pressure at the end of step 1	3,400.0	psi
At the end of step 2 (0 if unused)	3,280.0	psi
At the end of step 3 (0 if unused)	0	psi
At the end of step 4 (0 if unused)	0	psi

Calculated results

Parameter	Value	Unit
Initial water in the aquifer	5,875.2	MMbbl
Maximum possible influx	123.38	MMbbl
Aquifer productivity index	37.944	bbl/(d·psi)
Cumulative influx after step 1	0.31435	MMbbl
After step 2	1.2642	MMbbl
After step 3	1.2642	MMbbl
After step 4	1.2642	MMbbl

Notes for this case

• Fetkovich treats the aquifer as a tank feeding the reservoir through a productivity index, so no superposition tables are needed. Each step uses the mean boundary pressure over the step and the aquifer pressure left by the previous one. Unused steps repeat the last cumulative value.

Formula and method

$$W_{e,max} = c_t W_i p_i f, \quad J = \frac{2\pi khf}{\mu_w[\ln(r_a/r_e) - 0.75]}, \quad \Delta W_{e,n} = \frac{W_{e,max}}{p_i}(\bar{p}_{a,n-1} - \bar{p}_{r,n})\left(1 - e^{-Jp_i\Delta t/W_{e,max}}\right)$$

Variables

r_e	Reservoir radius	m
r_a	Aquifer outer radius	m

h	Aquifer thickness	m
ϕ	Aquifer porosity	-
c_t	Aquifer total compressibility (c_w + c_f)	1/Pa
θ	Encroachment angle	rad
k	Aquifer permeability	m²
μ_w	Water viscosity	Pa·s
outer boundary	Aquifer outer boundary	-
p_i	Initial pressure	Pa
Δt	Length of each time step	s
p_1	Boundary pressure at the end of step 1	Pa
p_2	At the end of step 2 (0 if unused)	Pa
p_3	At the end of step 3 (0 if unused)	Pa
p_4	At the end of step 4 (0 if unused)	Pa
W_i	Initial water in the aquifer	m³
$W_{e,max}$	Maximum possible influx	m³
J	Aquifer productivity index	m³/(s·Pa)
$W_{e,1}$	Cumulative influx after step 1	m³
$W_{e,2}$	After step 2	m³
$W_{e,3}$	After step 3	m³
$W_{e,4}$	After step 4	m³

Method and standards

Fetkovich pseudo-steady aquifer.

Assumptions and limits

- Radial aquifer; pseudo-steady aquifer flow.

Report details

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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

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Reopens the calculator with the inputs of this report.