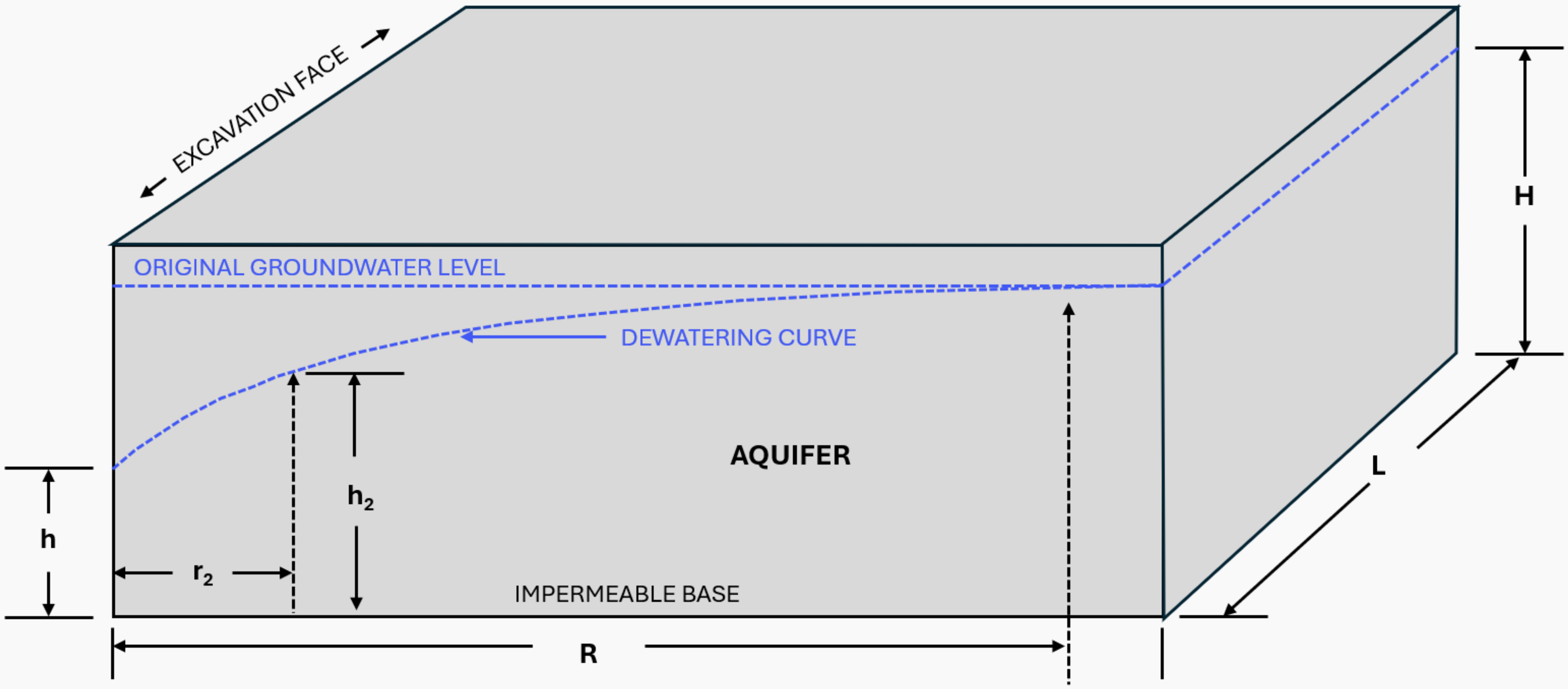
Aquifer Dewatering Model by Slot Method

Application: Unconfined Aquifer



$$Q = \frac{KL}{2R}\left(H^2 - h^2\right)$$

Flow Rate (Q)

Estimate the pumping rate needed to lower groundwater along one side of an excavation.

Groundwater Head (h_2)

Approximate the new aquifer head at any distance (r_2) beyond the excavation face.

$$h_2 = \sqrt{H^2 - \frac{R - r_2}{R}\left(H^2 - h^2\right)}$$

ANAQSIM

Slot Method

This method simplifies a long excavation face as a pumped slot, where groundwater flow is treated as linear.

The equation estimates flow to one side of the excavation, so the result should be doubled to estimate flow from both sides. End effects can be modelled separately using a radial-flow equation.

These equations are commonly attributed to Chapman (1959).

Model Variables

Symbol	Units	Description
H	L	The initial aquifer head above the aquifer base
h_2	L	Groundwater head at distance r_2 from the excavation face
h	L	Target groundwater head at the excavation face
L	L	Length of the excavation face
r_2	L	Distance from the excavation face to the point where h_2 is calculated
R	L	Distance of influence due to pumping measured perpendicular to the excavation face
K	L/T	Hydraulic conductivity of the aquifer
Q	L^3/T	Pumping rate to one side of the excavation

When to use it

Use this method when you need a quick estimate of dewatering flow and groundwater head change perpendicular to a long narrow excavation.

Typical applications include:

- Trench dewatering
- Long narrow quarries
- Proxy for streams

What you need

Aquifer properties:

- Hydraulic conductivity
- Initial groundwater head (H) and target groundwater head (h)

Excavation properties:

- Length, width, and depth

Limitations

- It is best suited to long and narrow excavations where the flow on the ends can be reasonably ignored.
- It can estimate groundwater head change around the excavation, but not inside it.
- A distance of influence must be estimated (see notes).
- The equation is steady state, so it does not account for aquifer storage effects, which can be important for short-term dewatering.

Notes

Distance of influence (R)

There are many equations available to estimate the distance over which dewatering effects extend. For radial flow, this is often called the radius of influence. For this linear slot-flow model, it is better understood as a distance of influence measured perpendicular to the excavation face.

What this distance represents in the real world is debatable, but in this model it is simply a mathematical boundary required for the calculation.

For this equation, the commonly suggested estimate is Sichardt's formula.

$$\textit{Sichardt Equation}\ [\textit{steady state}]:\ R = C(H - h)\sqrt{K}$$

Where C is typically 1500 to 2000 for slot-flow calculations when K is expressed in m/s.

Further Reading:

Chapman, T. G. (1959). Groundwater flow to trenches and wellpoints. Journal of the Institution of Engineers, Australia, October–November, 275–280.