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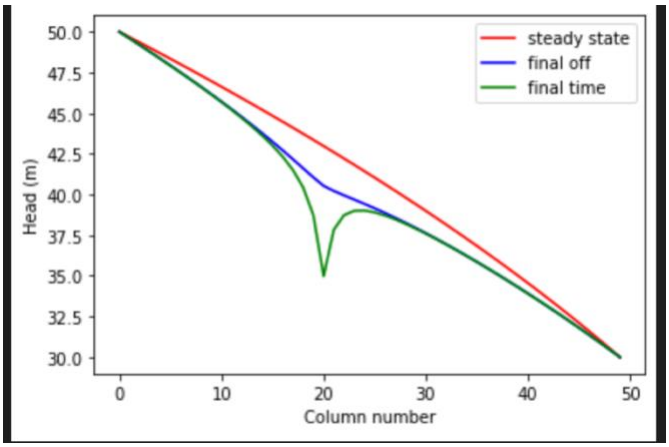
HWRS 431

March 15, 2021

The Challenge Questions

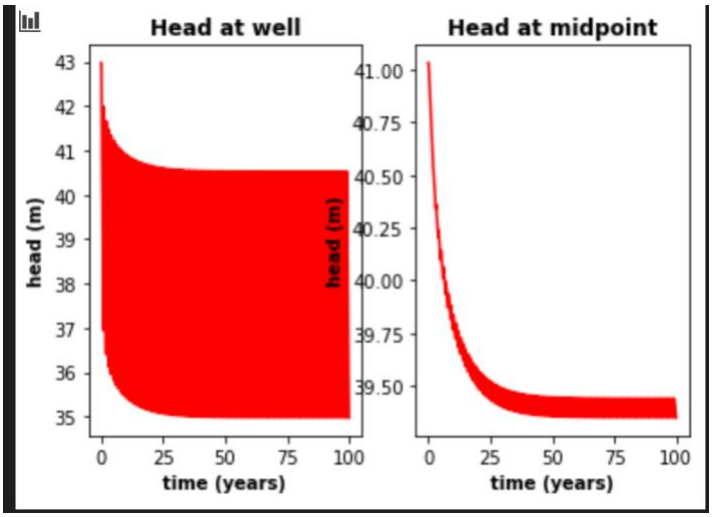
a)The gradient is not uniform for the initial steady state conditions - discuss the influences of recharge and the unconfined condition on this nonlinearity

Since the gradient (dh/dl) is not uniform for the initial steady state conditions, the recharge adds more water as the head drops from pumping being turned on, so the graph shows a bulge where the water from recharge is being added.

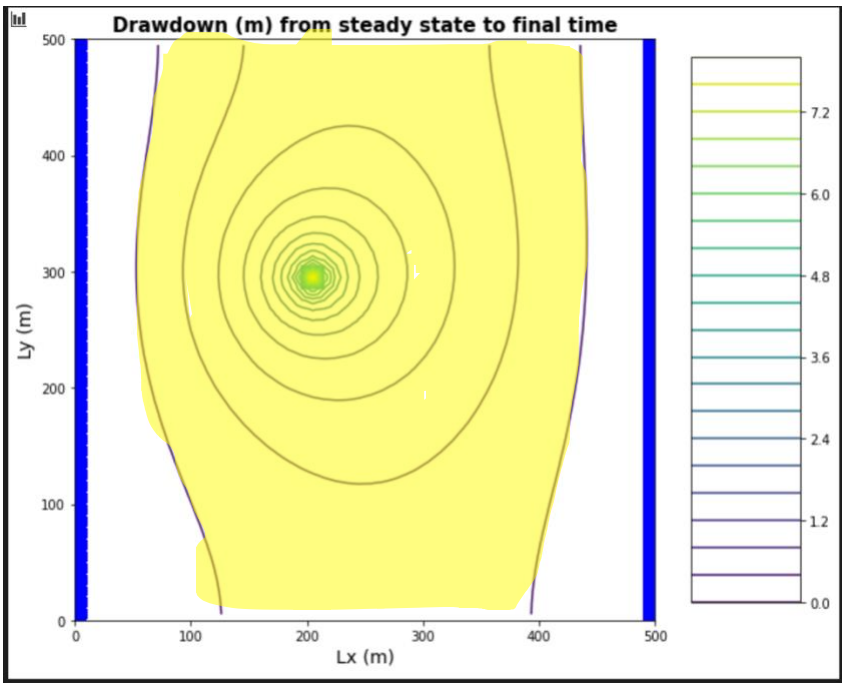


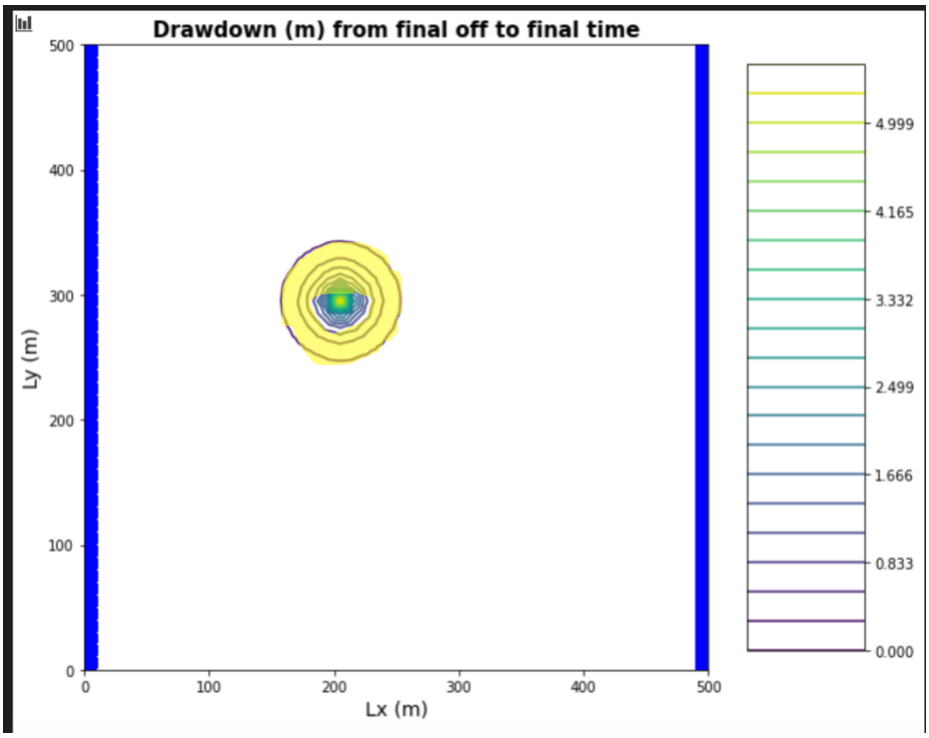
b) Determine if the system has reached steady state - consider a point at the well and another at the center of the domain.

I think the well has reached steady state by the end of 100 years because the head values are not changing with time, so I think it is safe to assume a steady state condition.



c) Find the zone of influence of the well defined in two ways: - Based on the drawdown from the initial steady state to the end of simulation time (end of final no-pumping stress period). - Based on the drawdown from the end of the last pump-on stress period to the end of simulation time.





I have highlighted the zone of influence on each diagram, which show that there is a significantly less zone of influence from the final off to final time compared to the steady state to final time diagram.

d) How long does it take a point at the center of the domain to reach steady state. At that point, explain how you could divide the domain into a steady and transient part and solve each separately.

It would take about 25 years until it reaches steady state, which for this example would be at a head value around 40 meters. The transient part of the domain would be where there is a change in storage and where the in and out flow values are different and steady state is where there is no change in storage at any time or anywhere.

e) Find a constant pumping rate (same throughout the year) that matches the head time series at the middle of the domain.

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f) Find a constant pumping rate (same throughout the year) that matches the head time series at the well, leaving only a regular, repeating seasonal residual. Are the two pumping rates the same?

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g) Discuss the sources of water captured by this well. If you're up for a challenge, calculate them for the final pump-on period!

The sources of water being captured would be the water from the recharge, the left, and also the water from the top and bottom.

h) Discuss how you would define the capture zone of the well. How is it different than our definitions of capture zone so far in the course?

The capture zone of the well would be considerably smaller because of the area of water that is being captured. In order to find the volume of the water captured we could use the equation: $Q\Delta t = V*Sy$ = Volume of the water.