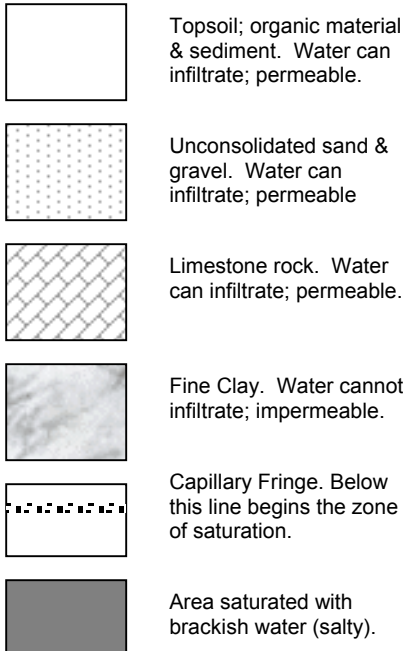


# Chesapeake County Groundwater Problem

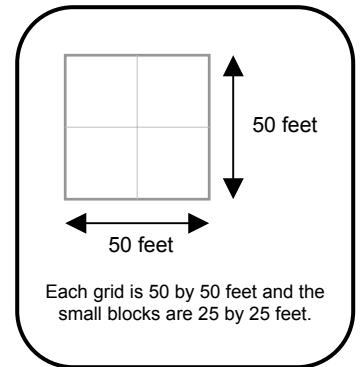
## Answer Sheet

A Farmer and a new Lighthouse Keeper have hired you to solve the problems they are having with their water. The new Lighthouse Keeper recently had his well drilled deeper to help during the dry spells. However within a few months his water became undrinkable. About the same time all his wife's houseplants started to die. Our Farmer would like you to figure out why his house well has just enough water in it to wash the dishes and yet the well over by his barn has never run dry. The Farmers wife is also concerned about the quality of the water as she recently watched a special on Oprah about how more American's are using bottled water instead of tap water. Cut out, construct and assemble the six models attached and answer the following questions to assess the situation.

### Key for Model Profiles



1. From the models we have constructed pull the blocks apart so you can compare Well #1 to Well #2. Which well goes down deeper? Well #1
2. Using our scale to the right how deep is Well #1? 100 ft. How many feet of water is available in Well #1? 10 to 25 ft.
3. Before the wells became operational the zone of saturation (Capillary Fringe) was about 37 feet below the surface. What has happened to the groundwater near the farmer's wells? The water has been drawn down (depleted) by the wells
4. Which of these two wells has been able to pump more water and why? Well #1, not only is it deeper but it has access to more of the zone of saturation

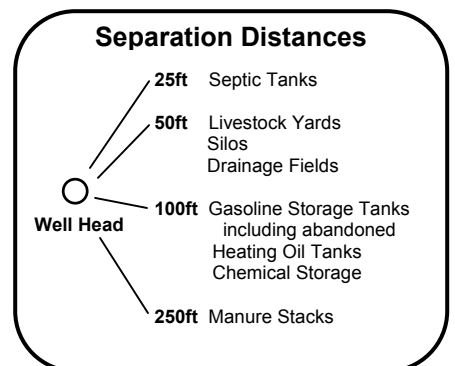


*As a well draws water from the saturated ground below it is slowly replaced by surrounding water in the ground. If an excessive amount of water is pumped from the well the surrounding water in the ground cannot flow quickly enough to replace the water in the well. This is indicated by what is called a **Cone of Depression**. During dry seasons when rain does not infiltrate into the ground many shallow wells run dry.*

5. Draw a circle representing the area for the cone of depression of Well #1 on the map on the back of this page. Do this by locating where the Capillary Fringe begins to slope downward in your profile of Well #1 and then measure the distance to Well #1. This will be the radius of your circle from center of Well #1. Generally anything that infiltrates the ground in this circled area will over time flow down the cone of depression and be pumped out of Well #1.

6. What would be some solutions for our farmer to increase the productivity out of Well #2? The farmer could drill well #2 deeper to receive access to more water or he could not draw so much water out of well #1 which would raise the water level.

7. The chart to the right shows the minimum distance an object must be located away from a well head. Using the Separation Distances chart to the right check which of the farmer's property might be a hazard to his two wells. List the following hazards that are located to close to well heads #1 and #2. Livestock Yards, Gasoline Storage Tank, Heating Oil, and Chemical Storage



*The Lighthouse Keeper has been going into town for the past month buying bottled water because of all the problems discussed earlier. Originally Well #3 went down 50ft but before the Lighthouse Keeper moved in he had them drill another 40ft.*

8. From observing the models constructed what has caused the water in well #3 to become undrinkable? When they drilled the well deeper they started to draw brackish groundwater from the Bay into his well also called Saltwater Intrusion

9. The Lighthouse Keeper's wife seems to think the farmer has leaked some poisonous chemicals into the groundwater which has managed to kill her house plants. From the models what do you think might have cause the plants to die? The plants were watered with water from the well and died most likely from the salt in the brackish water

10. What solutions might you offer to the lighthouse keepers problem with his groundwater since his well has come victim to saltwater intrusion? The best solution might be to drill a new well not so deep in another location or to reverse pump water back into the well which might push the brackish water back away from the well screen.

**Extra Credit:** Small tropical islands such as Bermuda, Bahamas, and Caymans are unable to drill wells to gain access to groundwater because of saltwater intrusion. How do you think these islands get fresh water? Most small islands collect rain water through water catches such as roofs and hillsides covered with cement



