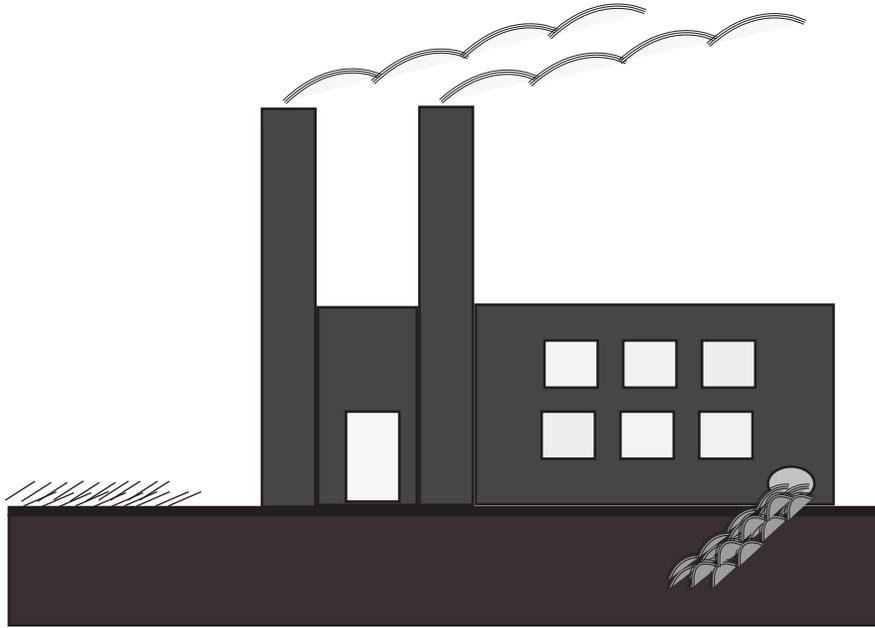


Industrial Watershed

Groundwater Simulation Tank

Lab Manual



Your Names:



Boott Cotton Mills Museum
115 John Street, Lowell, MA
www.uml.edu/tsongas
978-970-5080



An education partnership between
University of Massachusetts Lowell
Graduate School of Education and
Lowell National Historical Park.



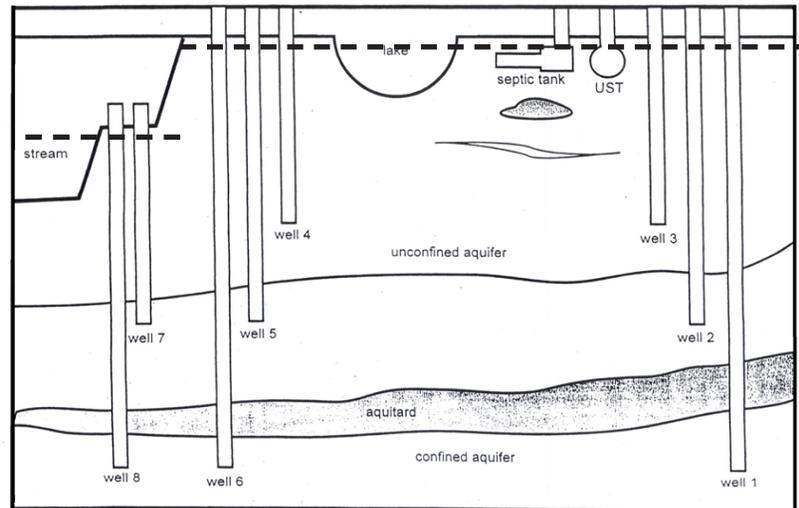
Your Task



Lead scientist Lynne Jennings has tasked you with finding the water table at the Silresim site. Your groundwater simulation tank represents a slice of the earth's crust at the site.

1. To do this, **identify and mark** the water table (level of water) on your simulation tank.
2. **Notice** the different types of soils arranged in layers.
3. **Locate** the other features, such as the wells, the UST (underground storage tank), and the septic tank.

4. Next, **find the water** levels in each WELL and the UST, SEPTIC TANK, LAKE, and STREAM. Try inserting a pipette down into the well to disturb the top of the water level if you cannot see the level clearly.
5. Use a marker to **draw a small line** at each water level location on the front surface of the tank.
6. **Sketch a line** across the tank connecting all of the water levels you have marked.



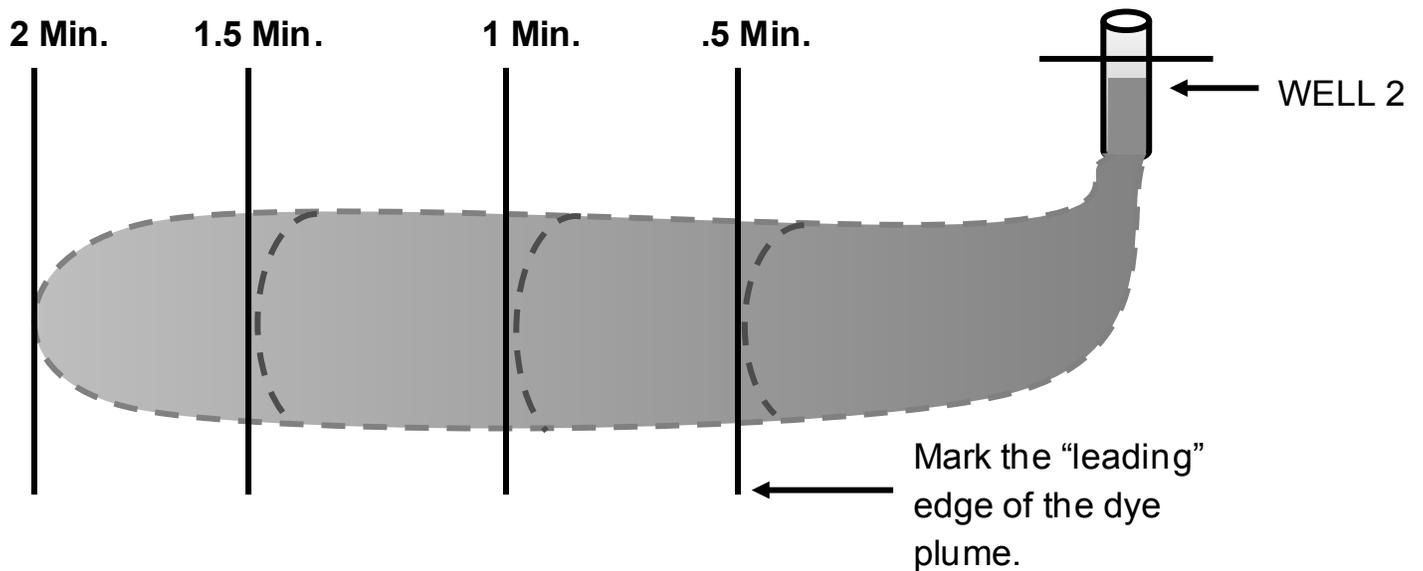
7. You now have a picture of the water table in your tank under normal flowing conditions.
8. **On the tank diagram, draw a line** that matches the line you drew on the tank.



Show this to your Museum Teacher or Ranger before continuing.

Pollute & Observe

1. **Fill** the pipette with red dye. **Put the pipette** into WELL 2 and make sure the pipette goes to the bottom of the well, but do not push on the yellow sponge. **Slowly squeeze** the bulb until the red dye appears in the sand at the bottom of the well. With the bulb still squeezed, remove the pipette and put it in the sink.
2. As soon as you remove the pipette, begin **timing the flow rate** of the pollution. On the front of your tank, use a marker to draw a vertical (up and down) line across the leading edge of the pollution every 30 seconds for a total of 2 minutes (you will have a total of 4 marks). See the example below.
3. **Stop marking** the tank after 2 minutes.
4. **Make a sketch** of the red plume on your tank diagram.



Use the space below to describe what you notice about how the pollution is behaving and moving (direction of travel: up, down, right, left or into any other area in the tank).

→
Go on to the next page.

Calculate the Flow Rate

Calculate the flow rate of the pollution to figure out how fast it's moving through the groundwater. Scientists calculate flow rate by dividing distance by time.

#1

Calculate the flow rate in meters per minute:

Use a ruler to measure the distance in centimeters from the bottom of WELL 2 to the two minute mark.

_____ cm

Divide by 200 to find the rate of flow in meters per minute.

_____ meters per minute

#2

Now that you know the flow rate in meters per minute, calculate meters per day - the daily flow rate.

Multiply the minutes in one day (1440), and the meters per minute.

_____ meters per day

Why is it important for scientists to know the flow rate of polluted groundwater?

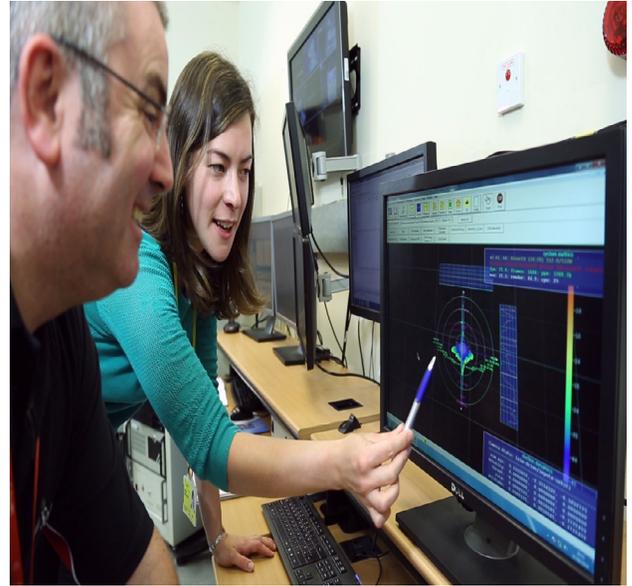


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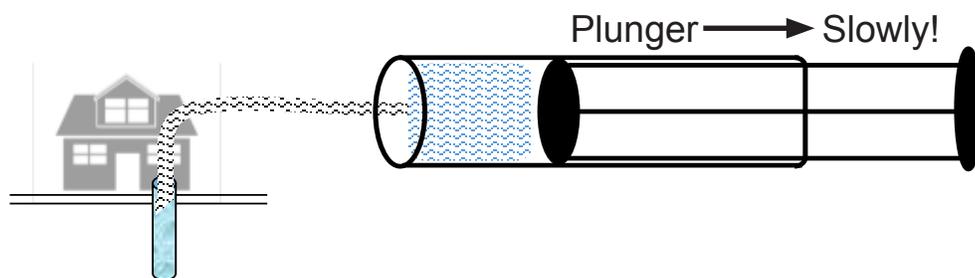
Who is affected by the pollution from Well 2?

Your next task is to find out who is affected by the groundwater pollution from the Silresim site. You will help Kelsey O'Neill, who leads the clean-up team.

Your team will pull water from WELL 5, at the home of a neighbor on Tanner Street, so that it can be tested later for pollutants.



1. **Add another pipette** of red dye to WELL 2.
2. Use the large syringe to **pull water out** of WELL 5 to simulate water being pumped out of the well and into the family's house.
3. **Insert the flexible plastic tube** of the syringe into the top of WELL 5. Pull on the plunger. **Do NOT pull the plunger all the way out of the syringe.** When you've pulled the plunger as far as you safely can, empty the syringe into the back of the tank. **Do not push the water back into the well.**
4. You may need to **pull water out** of WELL 5 several times before you see pollution in WELL 5.



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Go on to the next page.

Analysis

1. What changes did you see to the water you drew out of WELL 5?

2. As you pulled water from WELL 5, what changes did you see in the WELLS 4, 6, and 7?
Circle what you see happening in each well.

WELL 4	WELL 6	WELL 7
Water level goes up	Water level goes up	Water level goes up
Water level does down	Water level does down	Water level does down
A large amount of pollution	A large amount of pollution	A large amount of pollution
A small amount of pollution	A small amount of pollution	A small amount of pollution
• List anything else you see:	• List anything else you see:	• List anything else you see:



Show this to your Museum Teacher or Ranger before continuing.

Cause and Effect

1. Why does the pulling of water from WELL 5 affect WELLS 4, 6, and 7?

2. Suppose you are the owner of WELLS 4, 6, or 7. How might you feel about what is happening to *your* well when the owners of WELL 5 are drawing water from *their* well?



Show this to your Museum Teacher or Ranger before continuing.

Launch Your Own Investigation

1. **Choose one feature** in the tank to pollute. Circle it on the list below.

WELL 1	WELL 3	WELL 4	WELL 5	WELL 6	UST	Septic Tank	Lake
--------	--------	--------	--------	--------	-----	-------------	------

2. Based on your knowledge from previous experiments, **write down your prediction** as to where the pollution will go and what areas of the tank it will affect:



3. Select a dye and **pollute** the feature you chose. **Observe** where the dye goes and what it affects.

4. What happened? Did anything happen that you didn't expect? **Record your observations** below. You can also draw a picture of your results on the tank diagram.



Check in with your Museum Teacher or Ranger before continuing.

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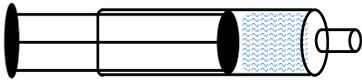
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Clean-up Procedure



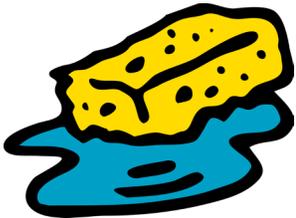
Use the syringe to pull any dye out of WELLS 1, 2, 3, 4, 5, or 6. Don't bother trying to pump WELLS 7 or 8. Empty the syringe into the back of the tank.



Use the pipettes to pull any dye out of the UST and Septic Tank. Empty the pipettes into the back of the tank.



Place all used pipettes and the syringe in the sink at the end of your lab table.



Use a damp sponge to wipe off the front of the tank and to clean any dye off the lab table.



Bring safety glasses to the white sanitizer cabinet. Fold your apron and put it neatly over the back of your chair.

**Lab
Manual**

NAMES:

Make sure your names are on your lab manual and bring it to your teacher.