Name:_____

Date/Pd:_____

Well, Well, Well, 'Water' we have Here?

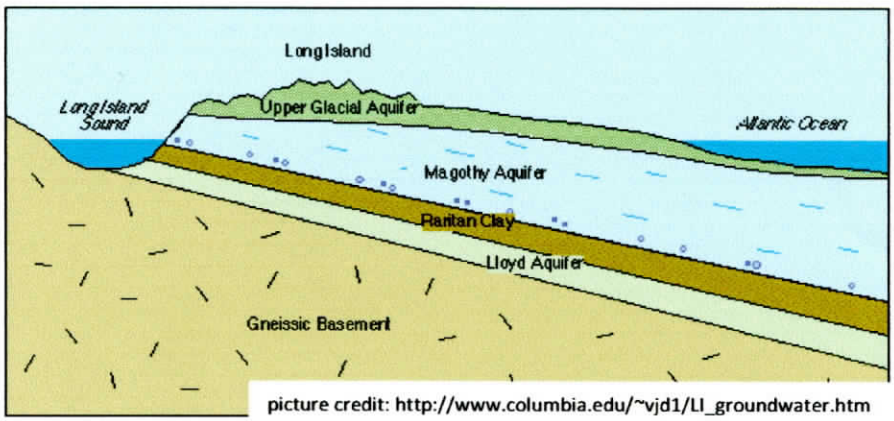
Long Island's Drinking Water

Introduction:

Long Island has a bedrock layer of metamorphic rock that formed when ancient volcanic islands slammed into what would become North America during the formation of the supercontinent Pangea. The collision formed the Appalachian Mountains. Over millions of years, sediments from the weathering and erosion of the Appalachians formed the Atlantic Coastal Plain, which included the river basin that would one day become the Long Island Sound.

The glacier that advanced 22,000 years ago deposited large amounts of unconsolidated, angular sediments along its leading edge, forming the Ronkonkoma Moraine. The glacier receded, and advanced again, gouging out the Long Island Sound Basin further, and leaving the Harbor Hills Moraine. Sediments deposited in the outwash plain of the glaciers, as well as thrust-faults caused by glacial movement, trapped fresh water in the sediments. The soil that can hold water in between its sediments is called an aquifer. Long Island has three aquifers, the Lloyd aquifer, the Magothy aquifer, and the Upper Glacial aquifer.

These aquifers supply Long Island with its drinking water. Nassau County gets its water from the Lloyd aquifer while Suffolk County gets its water from the Magothy and Upper Glacial Aquifers. The Lloyd aquifer is separated from the Magothy aquifer by a clay 'barrier' (these barriers can also occur within the aquifers -making little compartments). New York City gets its water from reservoirs upstate. Long Island aquifers are not replenished by springs, only precipitation. Human activities deplete and pollute the aquifers.



picture credit: http://www.columbia.edu/~vjd1/LI_groundwater.htm

In this lab you will:

- Calculate and compare the porosity and permeability of sand versus gravel, and relate the porosity to the composition Long Island's aquifers.
- Draw isolines to indicate the depth of the water table and determine the direction of groundwater flow.
- Identify a point-source location of pollution, based on well readings.

Name:_____ Pre-Lab Date/Pd:_____

Vocabulary:

aquifer:

permeability:

porosity:

potable:

reservoir:

saturated:

water table:

zone of aeration:

zone of saturation:

capillary fringe:

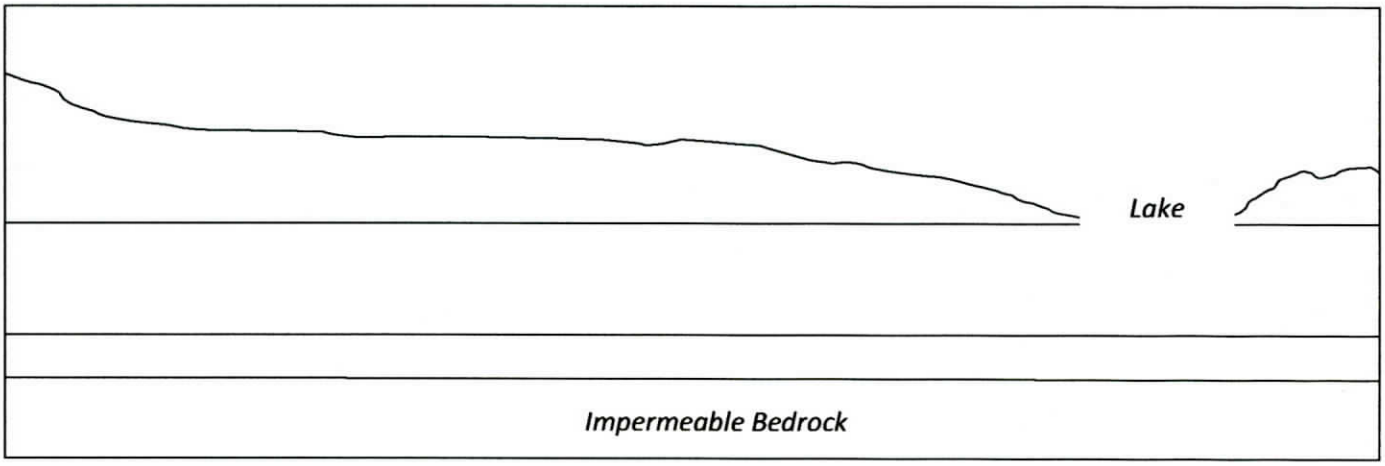
Questions:

1. List the sources of fresh drinking water for the world's population:

2. Contrast the drinking water sources for New York City to Nassau/Suffolk Counties:

3. List and explain at least three possible threats to a ground water aquifer:

4. Label the diagram below with the following parts:
ground surface, water table, zone of aeration/recharge zone, capillary fringe, zone of saturation, aquifer



Name:_____ Date/Pd:_____

Porosity and Permeability of Sand versus Gravel

Activity I: Calculate the porosity of sand:

1. Fill clear tube #1 with sand up to the 500mL fill line. This is the Total Volume of the Sample.

2. Fill the 2L plastic beaker with 1500mL water.

3. Pour water *gently* into tube #1, allowing the water to totally percolate into the sand before adding more. Stop adding water when the sand appears saturated.

4. Subtract the amount of water remaining in the 2L plastic beaker from the 1500mL starting volume to determine the amount of water stored in the pore space of the sample.

1500mL starting water volume

- _____mL ending water volume

_____ mL volume of water to fill the pore spaces.

5. Use the following equation to determine the porosity of the sand:

Porosity = Pore Space Volume (determined in step 4)/ Total Volume Sample (from step 1)

6. Record the porosity of the sand here _____

Calculate the porosity of gravel:

7. Fill clear tube #2 with gravel up to the 500mL fill line. This is the Total Volume of the Sample.

8. Repeat steps 2 through 4 using the gravel. Show your work below:

9. Record the porosity of the gravel here _____

Questions

1. Which medium allowed the water to move through it faster? (circle one) ***sand/ gravel***

2. This observation is for: (circle one) ***porosity/ permeability***

3. Write a sentence comparing sand to gravel for the variable described in question #2:

---

4. Which medium held more water in the 500mL volume? (circle one) ***sand/ gravel***

5. This observation is for (circle one) ***porosity/ permeability***

6. Write a sentence comparing sand to gravel for the variable described in question #4:

The table below compares the porosities of different soil types.

TABLE 3.1 Range of Porosity Values	
Soil Type	Porosity, p_t
Unconsolidated deposits	
Gravel	0.25 - 0.40
Sand	0.25 - 0.50
Silt	0.35 - 0.50
Clay	0.40 - 0.70
Rocks	
Fractured basalt	0.05 - 0.50
Karst limestone	0.05 - 0.50
Sandstone	0.05 - 0.30
Limestone, dolomite	0.00 - 0.20
Shale	0.00 - 0.10
Fractured crystalline rock	0.00 - 0.10
Dense crystalline rock	0.00 - 0.05
Source: Freeze and Cherry (1979).	

Source: http://web.ead.anl.gov/resrad/datacoll/porosity.htm

7. Based on the data chart, explain why clay can act as a barrier in an aquifer, even though water can percolate through the clay layer.

Challenge: The average porosity of Long Island's aquifers is 30% *(McClymonds and Franke, 1972).*

In tube #3: Attempt to compose a sample with a porosity of 30%.

1. Use varying amounts of sand and gravel to Fill Tube#3 up to the 500mL fill line.
2. Fill the 200mL beaker with 1500mL water.
3. Carefully add water until the sample is saturated. (*Subtract to get the volume of water used*)
4. Calculate the porosity of the mixed sand and gravel sample. Show your work below:

Name:_____ Date/Pd:_____

Surface and Groundwater Topography

Activity II: Surface Topography versus the Groundwater Table:

1. Draw contour lines every 10 meters on MAP I topography of Selden, New York.
2. Determine the Surface Elevation, in feet, at each lettered location.

What is the highest possible elevation from MAP I? _____

A._____ **E.**_____

B._____ **F.** _____

C._____ **G.**_____

D._____ **H.**_____

3. Draw isolines every 10 meters on MAP II- Groundwater under Selden, New York.
4. Determine the Groundwater Depth, in meters, at each lettered location.

What is the greatest depth of the groundwater table from MAP II? _____

A._____ **E.**_____

B._____ **F.** _____

C._____ **G.**_____

D._____ **H.**_____

Does the highest elevation correlate with the greatest groundwater depth? _____

5. On MAP III-

a) Construct a profile (side view) of the surface topography from locations A to D to C. Use the values from step 3- Label this line ***'surface'.***

b) Construct a profile of the groundwater depths from locations A to D to C. Use the values from step 4- Label this line ***'water table'.***

c) Shade in the zone of saturation (the aquifer) with blue pencil. Label this area ***'groundwater, zone of saturation'***.

d) Label the *'zone of aeration'*

e) Indicate the capillary fringe with wavy arrows.

f) Calculate the gradient (slope) of the land surface from F to H in kilometers.
(*show equation, substitution and all work below*)

Name:_____ Date/Pd:_____

Flow of Groundwater

Activity III:

1. Use MAP II, which shows the depth to the water table, to determine the general direction of the flow of groundwater. Indicate the general direction of water flow with straight arrows on the map. Record the compass direction here _____.

2. Make a general statement about how groundwater flows:

_____

2. What is the actual depth of the water table at well-location D? _____

3. If the well at location D indicates a high concentration of contaminates, what location(s) should be monitored more closely? _____

Why?_____

Use Maps I through IV to answer the following questions:

4. Which Well# location (A through F) is most likely the point-source for the contamination plume observed?

_____

5. What evidence supports your choice for question #4?

_____

Conclusion:

Include:
Why every Long Islander should be aware of the potential threats to their drinking water (include at least three threats)
What every citizen can do to protect Long Island's drinking water (be specific) [hint: match to the threats]
What are the pros and cons of making the public aware of the threats to Long Island's drinking water?

_____

_____

_____

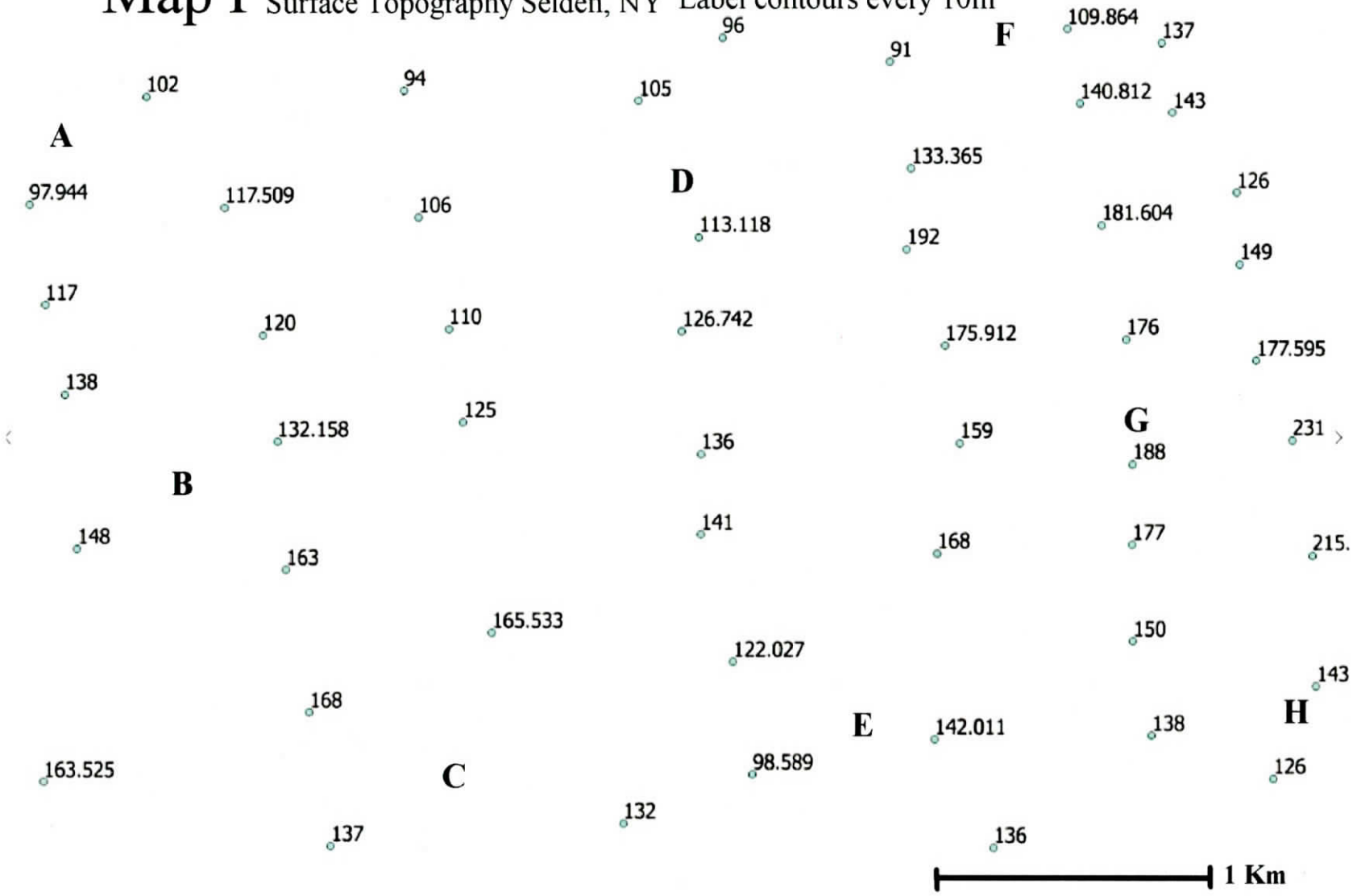
_____

_____

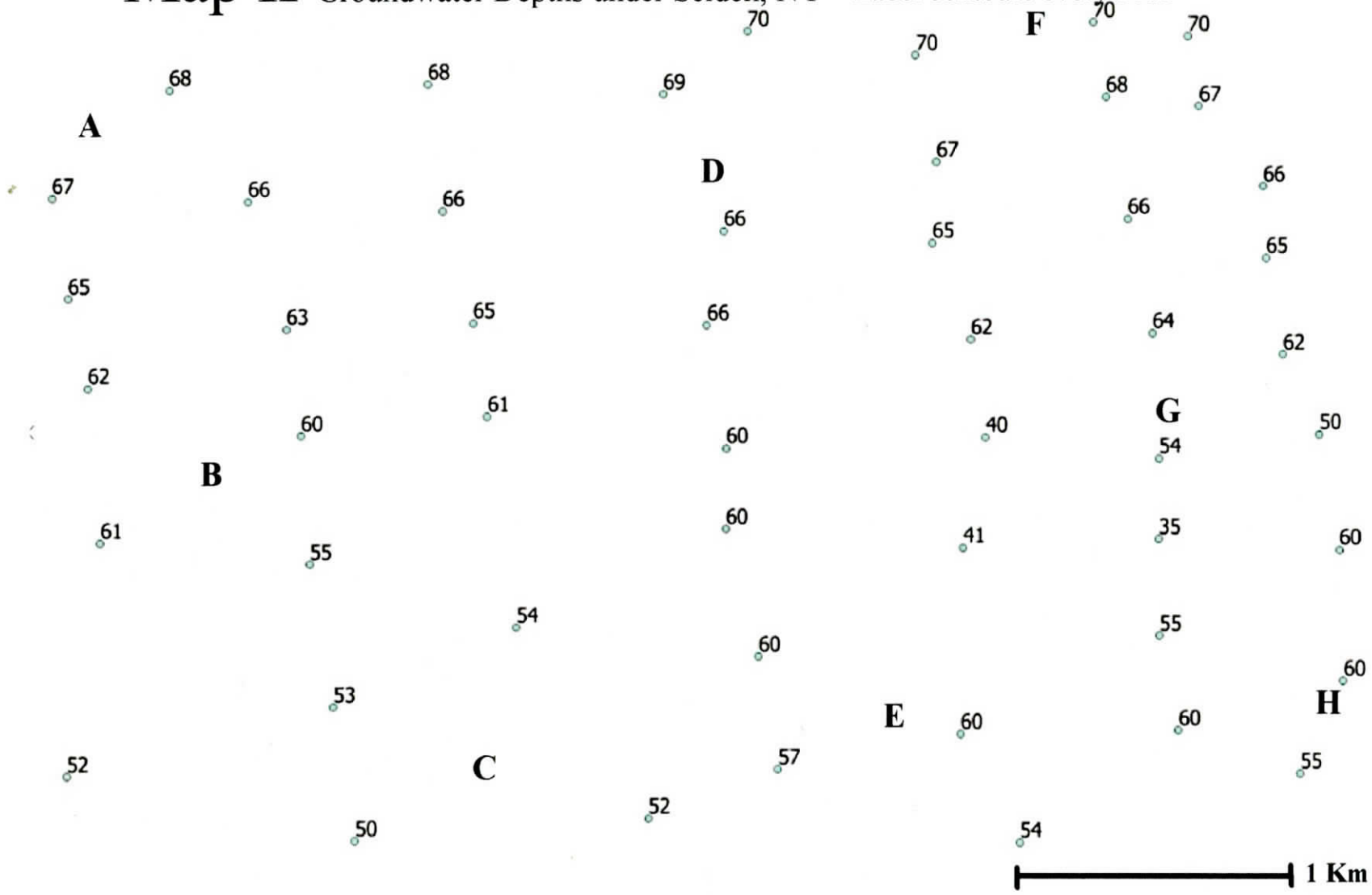
_____

_____

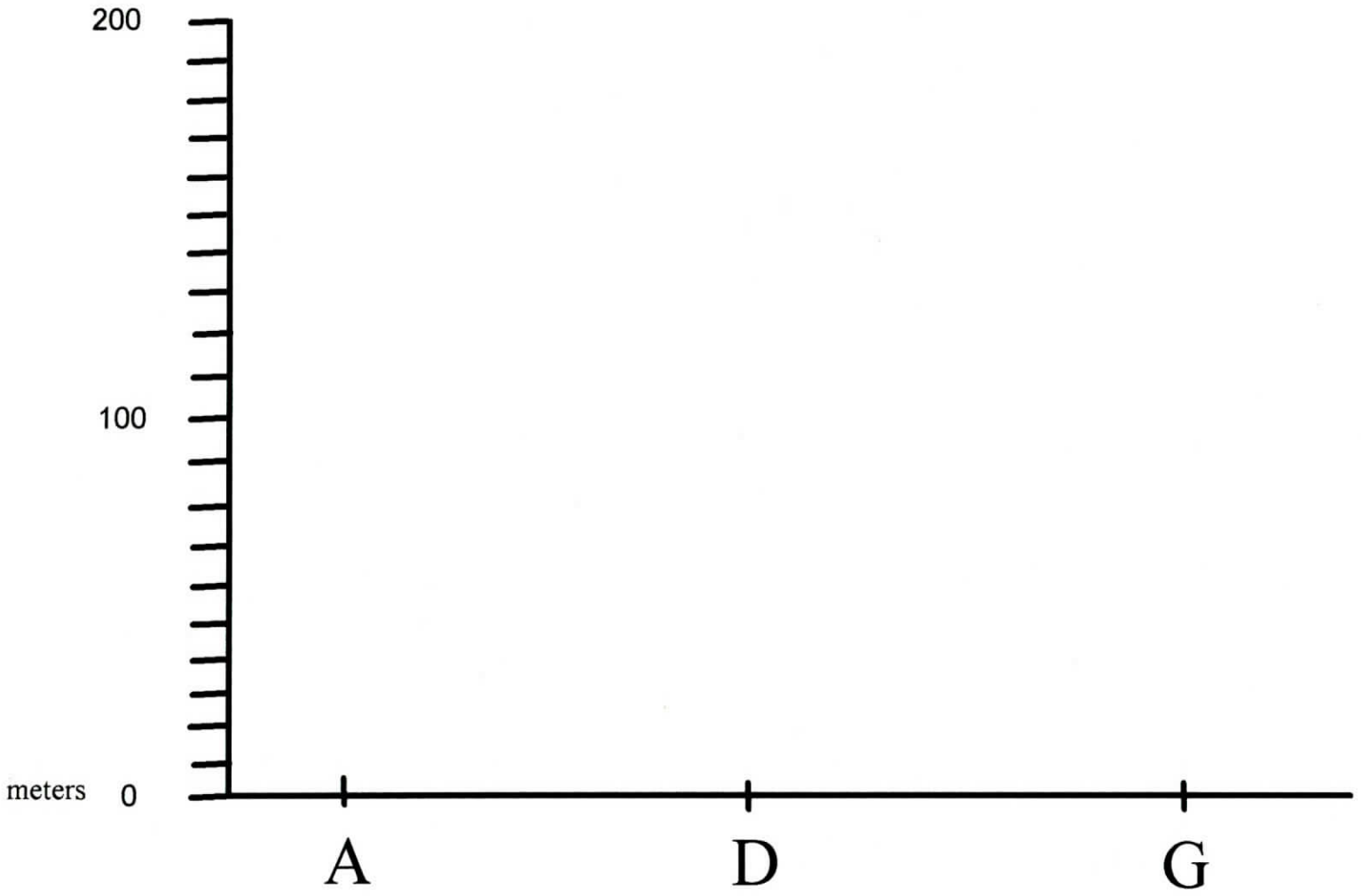
Map I Surface Topography Selden, NY Label contours every 10m



Map II Groundwater Depths under Selden, NY Label contours every 10m



Map III Profile of Topography and Groundwater Depth



Map IV Point source readings