Lab Chapter 12: Location and Movement of Ground Water

Refer to Figure 12.6 (Sulphur Springs Quadrangle) and the “sketch map” on the back of this page.

A. On the sketch map, mark the elevations of water levels in the lakes (obtain this information from Figure 12.6). The elevations of Lake Magdalene and some lakes beyond the boundaries of the topographic map already are marked for you.

B. Contour the water table surface (use a 5-foot contour interval) on the sketch map. Draw only contour lines representing whole fives (40, 45, and so on). Do this in the same manner that you contoured land surfaces in the topographic maps lab.

C. The flow of shallow groundwater in the sketch map is at right angles to the contour lines. The groundwater flows from high elevations of the hydraulic gradient to lower elevations, just like a stream. Draw three or four flow lines with arrows on the sketch map to indicate the direction of shallow groundwater flow in this part of Tampa. The southeastern part of Figure 12.6 shows numerous closed depressions but very few lakes. What does this indicate about the level of the water table in this region?

D. Note the Poinsettia Sinks, a pair of sinkholes in the southeast corner of the topographic map (see Figure 12.6). Note their closely spaced hachured contour lines. Next find the cluster of five similar sinkholes, called Blue Sinks, about 1 mile northwest of Poinsettia Sinks (just west of the WHBO radio tower). Use asterisks (*) to mark their locations on Figure 12.8, and label them “Blue Sinks.”

E. On the sketch map, draw a straight arrow (vector) along the shortest path between Blue Sinks and Poinsettia Sinks. The water level in Blue Sinks is 15 feet above sea level, and the water level in Poinsettia Sinks is 10 feet above sea level. Calculate the hydraulic gradient (in ft./mi) along this arrow and write it next to the arrow on the sketch map. (Refer to the hydraulic gradient in Figure 12.1 if needed.)

F. On Figure 12.6, note the stream and valley north of Blue Sinks. This is a fairly typical disappearing stream. Draw its approximate course onto the sketch map. Make an arrowhead on one end of your drawing of the stream to indicate the direction that water flows in this stream. How does this direction compare to the general slope of the water table?

G. In March 1958, fluorescent dye was injected into the northernmost of the Blue Sinks. It was detected 28 hours later in Sulphur Springs, on the Hillsborough River to the south (see sketch map). Use these data to calculate the approximate velocity of flow in this portion of the Floridan Aquifer:

1. in feet per hour: __________
2. in miles per hour: __________
3. in meters per hour: __________

H. The velocities you just calculated are quite high, even for the Floridan Aquifer. But this portion of Tampa seems to be riddled with solution channels and caves in the underlying limestone. Sulphur Springs has an average discharge of approximately 44 cubic feet per second (cfs), and its maximum recorded discharge was 165 cfs (it once was a famous spa). During recent years, the discharge at Sulphur Springs has decreased. Water quality has also worsened substantially.

1. Examine the human-made structures on Figure 12.6. Note especially those in red, the color used to indicate new structures. Why do you think the discharge of Sulphur Springs has decreased in recent years?

2. Why do you think the water quality has decreased in recent years?

I. Name two potential groundwater-related hazards to homes and homeowners in the area that you can think of.
Sketch map of the area shown in Figure 12.6 (Sulphur Springs Quadrangle) and surrounding region.
A. On this map, solid brown contour lines show land surface elevation. Dashed blue lines represent the water-pressure surface (potentiometric surface) of a confined aquifer, as shown in Figure 12.9. This is the height to which water will rise in a well that is drilled into the aquifer.

1. Find and connect the points on the map where the two sets of contour lines have the same elevation.
2. Shade in the area on this map where wells would flow at the land surface without having to be pumped (i.e., where wells would be artesian).

B. Santa Clara Valley, California.

1. In Figure 12.10 on page 283, where are the areas of greatest subsidence in the Santa Clara Valley?

2. What was the total subsidence at San Jose (Figure 12.11) from 1934 to 1967? ________ feet

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Subsidence (feet) from 1912 level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1912</td>
<td>0.0</td>
</tr>
<tr>
<td>1920</td>
<td>0.3</td>
</tr>
<tr>
<td>1934</td>
<td>4.6</td>
</tr>
<tr>
<td>1935</td>
<td>5.0</td>
</tr>
<tr>
<td>1936</td>
<td>5.0</td>
</tr>
<tr>
<td>1937</td>
<td>5.2</td>
</tr>
<tr>
<td>1940</td>
<td>5.5</td>
</tr>
<tr>
<td>1948</td>
<td>5.8</td>
</tr>
<tr>
<td>1955</td>
<td>8.0</td>
</tr>
<tr>
<td>1960</td>
<td>9.0</td>
</tr>
<tr>
<td>1963</td>
<td>11.0</td>
</tr>
<tr>
<td>1967</td>
<td>12.7</td>
</tr>
</tbody>
</table>

**FIGURE 12.11** Subsidence at benchmark P7 in San Jose, California.
3. What was the average annual rate of subsidence for the period of 1934 to 1967 in feet per year? ___________ feet/year

4. Analyze Figure 12.10. At what places in the Santa Clara Valley would subsidence cause the most problems? Explain your reasoning.

5. Would you expect much subsidence to occur in the darker shaded areas of Figure 12.10? Explain.

6. By 1960, the total subsidence at San Jose had reached 9.0 feet (Figure 12.11). What was the average annual rate of subsidence (in feet per year) for the seven-year period from 1960 through 1967? (Show your work.)

7. Refer to Figure 12.12 below. What was the level of the water in the San Jose well in:
   a. 1915 ________ feet
   b. 1967 ________ feet

---

**FIGURE 12.12** Hydrograph showing changes of water level in a well at San Jose, California.
8. During what period would the San Jose well have been a flowing artesian well? Explain.

9. How can you explain the minor fluctuations in the hydrograph (Figure 12.12) like those between 1920 and 1925?

10. In Figure 12.12, the slope of a line joining the level of the land surface in 1915 with subsidence that had occurred by 1967 gives the average rate of subsidence for that period. How did the rate of subsidence occurring between 1938 and 1948 differ from earlier rates?

11. Adolf Hitler came into power as head of the National Socialist German Workers’ Party (Nazi Party) in 1933 and German troops invaded Austria in 1938 and Poland in 1939 to initiate World War II. Japan invaded China in 1932, withdrew, and then launched a full-scale invasion of China in 1937. The United States officially entered World War II in 1941 (when Japan attacked Pearl Harbor). Explain how these world events could have caused the change in subsidence rates noted in Question 10.

12. Subsidence was stopped by 1971. What measures might have been taken to accomplish this?