# Resource Protection, Value and Conflict

## It'll Go With the Flow...

**Learning Objectives:** Students will: (1) construct a water table elevation contour map, (2) predict groundwater flow patterns using the water table elevation contour map and (3) evaluate a hypothetical landfill site based on the direction of groundwater flow.

**Subjects:** Environmental Education, Science, Social Studies, Health Education and Math

**WMASs: EE:** A.8.2, A.8.4, B.8.17, B.8.18, D.8.1

**SC:** A.8.1, C.8.6, D.8.6, E.8.1, H.8.3

**SS:** A.8.1, C.8.7

**HE:** A.8.2, B.8.4, C.8.3

**M:** E.8.4

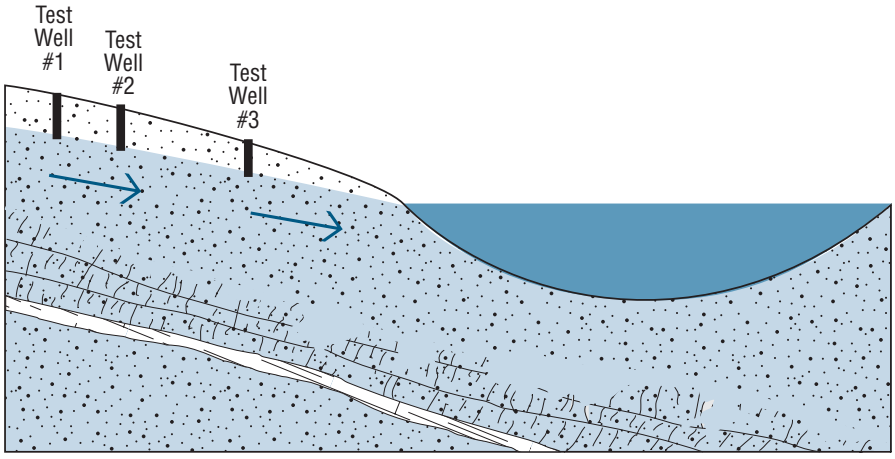
**Grades:** 7–9

**Materials:**

- It'll Go With the Flow activity sheet
- It'll Go With the Flow teachers key
- rulers
- pencils
- book and a marble for demonstration (optional)

**Background:** Groundwater usually flows in the same direction as the land slopes, often toward a nearby lake or stream. Many factors, such as rate of percolation from the surface and pumping from wells, can influence the direction and rate of groundwater flow, but it is possible to get an idea of how groundwater is moving in a given area by determining the slope or "plane" of the water table. To do this, at least three monitoring wells must be installed (three points determine a plane). By measuring the *"static water level"* (SWL), or elevation of the water table above sea level, we can estimate how groundwater will flow at a certain location.

Groundwater flows from areas of high static water levels to areas of low static water levels. This can be illustrated using a book and a marble. The marble will roll off




the book in the direction of the slope and the speed of the marble will be determined by the steepness of the slope. Groundwater moves in much the same way.

It is important to consider the direction and rate of groundwater flow when planning land development to avoid potential contamination problems. Using static water level data, students will be asked to determine the general direction and relative rate of groundwater flow on a given map, and evaluate a proposed landfill site on the basis of this information.

## Procedure:

**A)** Determine the slope of the water table and the direction of groundwater flow. The activity sheet gives land elevation/depth to water table. Ask students to subtract depth to water table from land elevation to get static water levels (SWL's). Mark SWL's on activity sheet next to each well. Remind students that SWL's are height above sea level not depth from the land surface. Point out that the water table generally follows the contour of the land surface.

Construct contour lines by doing the following for each adjacent pair of wells:

**1.** Draw a line between the two wells. Measure the length of the line.

**2.** Subtract the smaller of the two SWL's from the larger. This is the difference in water table elevation (in feet) between these two wells.

**3.** Divide the line between the two wells into units representing 10 ft. (foot) intervals.

**a)** Calculate the number of subdivisions needed by dividing the difference in water table elevations by 10.

**b)** Calculate the distance between subdivisions by dividing the distance between the wells by the number of subdivisions needed (see example).

**4.** Label each subdivision mark with the appropriate SWL as in example.

Example:

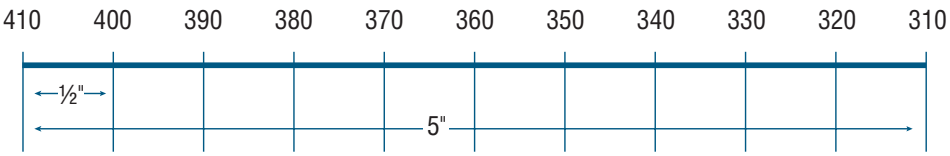
Distance between wells = 5 inches

SWL A = 410 ft. SWL B = 310 ft.

SWL difference: 410–310 = 100 ft.

Number of subdivisions: 100 ft./10 ft. intervals = 10

Distance between subdivisions: 5 inches/10 subdivisions = ½ inch per subdivision



**5.** Repeat steps 1–4 for each pair of adjacent wells.

**6.** Connect equivalent SWL's with light dashed pencil lines. These lines represent the contour of the water table elevation. (The lines are analogous to contour lines on a topographic map which connect equivalent land elevations.)

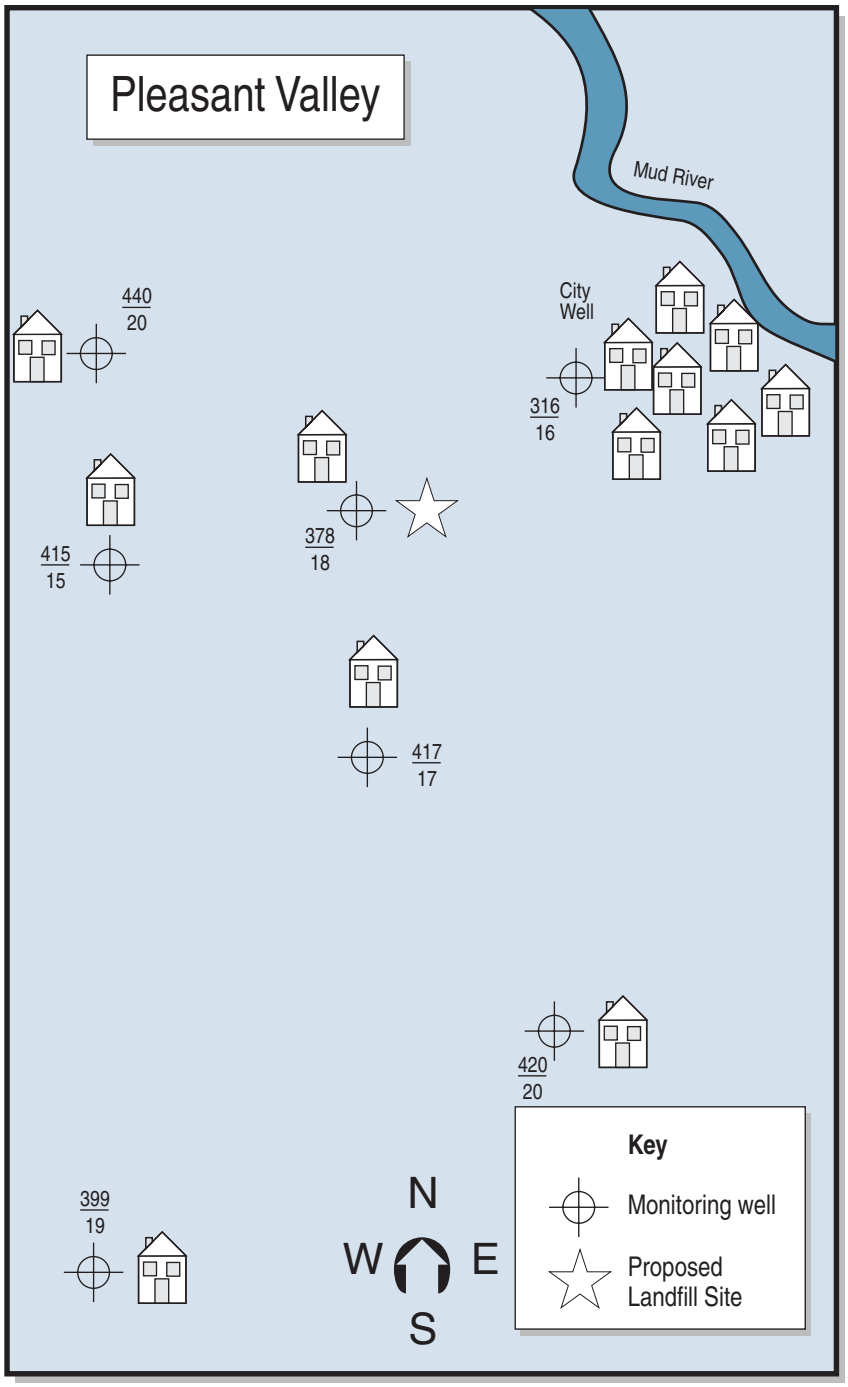
**7.** After all contour lines have been drawn, round sharp "corners" and draw solid lines over the original dashed lines. The groundwater flow at any point on your maps is perpendicular to the contour lines at that location. (See Teacher's Key)

**B)** Evaluate the proposed landfill site, marked "☆," using groundwater flow information from your contour maps.

**1.** Write a paragraph evaluating the proposed landfill site based on groundwater flow at "☆." (Note locations of the private wells.) If you think that locating the landfill at "☆" is not advisable, suggest two locations that might be better suited for a landfill. Support your choices by comparing rate and direction of groundwater movement at your proposed sites with that at "☆."

**C)** Discuss your findings.

- ❖ What is "static water level?" How is it different from water table depth?
- ❖ How are SWL's used to determine the slope or plane of the water table? How does the plane of the water table affect groundwater flow (direction and rate)? What other factors might influence groundwater flow?
- ❖ What do the contour lines on your map show?
- ❖ In what general direction does groundwater flow in Pleasant Valley?
- ❖ Can we make assumptions about the speed of groundwater movement at certain locations?
- ❖ Would the contour lines change if you had SWL information from more wells? Fewer wells?
- ❖ What is the level of Mud River as it passes by town?
- ❖ Is "X" a good location for the landfill? Why?
- ❖ Can you suggest better locations for the landfill, based on groundwater flow? If so, why do you think these sites are better than "X"?




## Going Beyond:

Conduct a hearing to decide where to locate a landfill in your community. Take on roles of people involved in making the decision: local landowners, politicians, industry representatives, geologists, environmentalists, waste managers and others. The *Groundwater Contamination Susceptibility in Wisconsin* map (in your packet) and topographic maps of your area may be helpful.

Adapted from: *Groundwater: Michigan's Hidden Resource Workbook,* 1989, Michigan Department of Natural Resources, Environmental Response Division, P O Box 30028, Lansing, MI 48909.