
## What is the relationship between soil and drinking water quality?

**Lesson: 5**

### National Science Education Standards for Grades 9-12

**Content Standard A: Scientific Inquiry: Abilities Necessary to Do Scientific Inquiry**

- *Design and conduct scientific investigations*
- *Use technology and mathematics to improve investigations and communications.*

**Content Standard A: Scientific Inquiry: Understandings About Scientific Inquiry**

- *Scientists rely on technology to enhance the gathering and manipulation of data.*

**Content Standard C: Life Science: The Interdependence of Organisms**

- *The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.*

**Content Standard D: Earth amd Space Science: Geochemical Cycles**

- *The earth is a system containing essentially a fixed amount of each stable chemical atom or element. Each element can exist in several different chemical reservoirs. Each element on earth moves among reservoirs in solid earth, oceans, atmosphere, and organisms as part of geochemical cycles.*

### Student Learning Objectives

5.1 Explain the relationships of geology/soil types on drinking water quality and quantity.

5.2 Describe the major soil types in the agricultural areas in their county.

**Teacher Info Table Time**

Instruction time for this lesson: 90 minutes (More time will be needed for review or remedial work on basic soil science concepts).

**Resources, Tools, Equipment, and Supplies**

Resources

For an introduction to, a refresher or remedial work on soils choose one or more of the following resources:

- *Down and Dirty,* from *The Dirt on Soil*, The Discovery Channel: http://school.discoveryeducation.com/schooladventures/soil/down_dirty.html
- The *Down and Dirty* page provides an introduction to soil in general. Other links from this page cover the composition of soil (*A Recipe for Soil*), and soil identification (*Name that Soil*).
- *Just Passing Through*, GLOBE: http://www.globe.gov/tctg/passthrough.pdf?sectionId=102&lang=EN This activity (one class period) provides a good overview of the relationships between soils of different types and water.
- *Soil Education*, USDA/Natural Resources Conservation Service (NRCS): http://soils.usda.gov/education/ This site lists many soil-related educational resources including Soil Facts, Key Messages, State Soils and Resources for Grades 7-12

5.1. Resource Management: Protecting Your Drinking Water Activity

Supply

SW.5.1.SA Worksheet, Resource Management: Protecting Your Drinking Water – one copy of the worksheet for each student.

**Resources, Tools, Equipment, and Supplies**

5.2. Collecting Local Soil Survey Data Activity

Resources

- *The Twelve Orders of Soil Taxonomy,* USDA/Natural Resources Conservation Service (NRCS), http://soils.usda.gov/technical/soil_orders/—*offers photos of soil orders with short descriptions.*
- *Keys to Soil Taxonomy,* USDA/Natural Resources Conservation Service (NRCS), http://soils.usda.gov/technical/classification/tax_keys/
- NRCS Soil Survey site, http://websoilsurvey.nrcs.usda.gov/app/homepage.htm
- Soil survey application available on some mobile phones, http://ohioagmanager.osu.edu/uncategorized/soil-app-available-for-iphone-droid/

Equipment

Computers and Internet connections for students.

Supply

SW.5.2.SA Worksheet, Collecting Local Soil Survey Data – one copy of the worksheet for each student.

**Key Terms**

Confined aquifer

Filtration

Infiltration

Groundwater recharge area

Groundwater vulnerability

Percolation

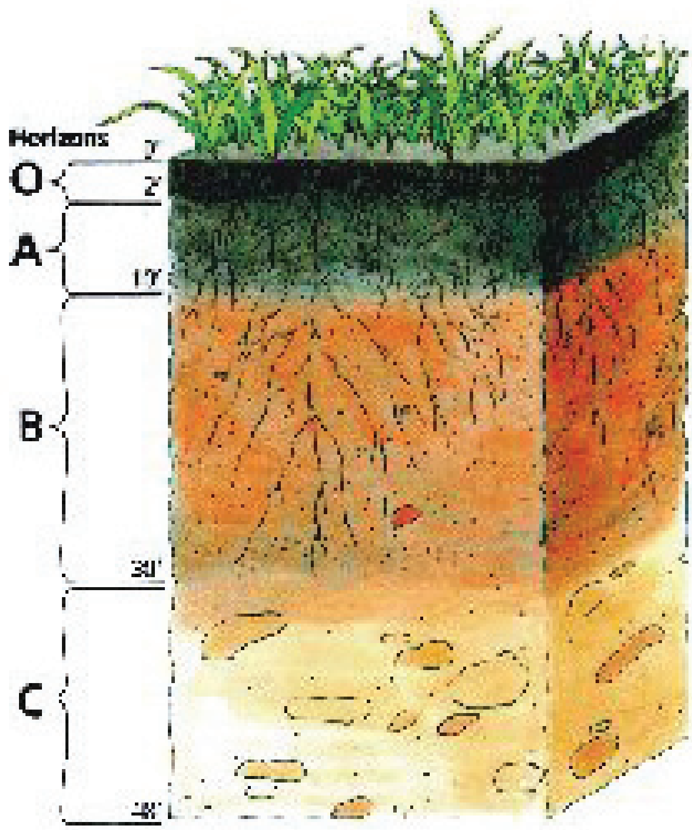
Unconfined aquifer

## SUMMARY OF CONTENT AND TEACHING STRATEGIES:

### Making Connections between Healthy Soils and Healthy Water

[1]Healthy soil is the foundation for clean air and water, bountiful crops and forests, productive rangeland, diverse wildlife and beautiful landscapes. Soil does all this by performing five essential functions:

- Regulating water - Soil helps control where rain, snowmelt, and irrigation water goes. Water and dissolved solutes flow over the land or into and through the soil.
- Sustaining plant and animal life - The diversity and productivity of living things depends on soil.
- Filtering potential pollutants - The minerals and microbes in soil are capable of filtering, buffering, degrading, immobilizing and detoxifying some organic and inorganic materials, including industrial and municipal by-products and atmospheric deposits.
- Cycling nutrients - Carbon, nitrogen, phosphorus and many other nutrients are stored, transformed and cycled through soil.
- Supporting structures - Buildings need stable soil for support, and archeological treasures associated with human habitation are protected in soils.




1 USDA/NRCS Soil Quality Concepts: http://soils.usda.gov/sqi/concepts/concepts.html

### Groundwater Recharge Area

- A land area where permeable soil or rock allows water to seep into the ground to replenish an aquifer.
- Part of a watershed; found below ground level.

## INFILTRATION AND SOIL[2]

Infiltration is the soil’s ability to allow water movement into the soil; percolation is the soil’s ability to allow water movement through the soil. Soil temporarily stores water, making it available for root uptake, plant growth and habitat for soil organisms. Water that does not move down through the soil will run over the land surface, carrying soil particles, chemicals (such as herbicides or pesticides) and nutrients (fertilizers, manure) with it. Water movement across the soil surface is referred to as runoff. Runoff may introduce pollution into surface water and degrade source water quality.

Soil organic matter affects infiltration through its positive effect on the development of stable soil aggregates, or crumbs. Highly aggregated soil has increased pore space and thus higher infiltration and percolation. Soils high in organic matter also provide good habitat for soil biota, such as earthworms, that through their burrowing activities, increase pore space and create continuous pores linking surface to subsurface soil layers.

Land management directly impacts source water quality.  Techniques that protect both surface and groundwater should include maintaining soil structure by allowing soil cover, preserving pore space, and increasing soil organic matter. While traditional tillage may initially increase the infiltration rate of soil by breaking apart the soil structure, the soil will become compacted, lose organic matter, and be at higher risk for erosion over time. Reducing tillage reduces erosion and soil compaction, builds soil organic matter, and increases the soil’s moisture-holding capacity.

Several conservation practices help maintain or improve water infiltration and absorption into soil by increasing vegetative cover, managing crop residues, and increasing soil organic matter. Generally, these practices minimize soil disturbance and compaction, protect soil from erosion, and encourage the development of good soil structure and continuous pore space. These practices include no-till or conservation tillage, planting perennials in vulnerable areas to reduce soil erosion; rotating crops to break pest cycles, increase soil quality, and reduce need for added nitrogen; and In very highly erodible areas,  taking land out of production and planting native grasses or trees.

2 Adapted from: Infiltration, Soil Quality Indicators. USDA/NRCS http://soils.usda.gov/sqi/assessment/files/infiltration_sq_physical_indicator_sheet.pdf

## SYMPTOMS OF POOR INFILTRATION

When water is supplied at a rate that exceeds the soil's infiltration capacity, it moves downslope as runoff on sloping land or ponds on the surface of level land. When runoff occurs on bare or poorly vegetated soil, erosion takes place. Runoff carries nutrients (nitrogen, phosphorus), chemicals, and soil with it, resulting in decreased soil productivity, off-site sedimentation of water bodies and diminished water quality. Sedimentation decreases storage capacity of reservoirs and streams and can lead to flooding. Restricted infiltration and ponding of water on the soil surface results in poor soil aeration, which leads to poor root function and plant growth, as well as reduced nutrient availability and cycling by soil organisms. Ponding and soil saturation decrease soil strength, destroy soil structure, increase detachment of soil particles, and make soil more erodible. On the soil surface rather than in the soil profile, ponded water is subject to increased evaporation, which leads to increased salinity of the water as well as a decrease in the amount of water available for plant growth.

Applying more chemicals than needed or applying chemicals at an inappropriate time may contaminate source water. Inappropriate times for application include prior to rain, too early in plant growth or too late in the growing season for the plants to benefit from the application.

In agricultural areas with poorly drained soils (often clay-rich), farmers might install tile drains or create ditches along the sides of fields to drain off water that does not percolate into subsurface soils. This may seem like a good solution, but it often leads to flow of water containing farm chemicals, which may contribute to the contamination of nearby streams and other receiving water bodies.

## FILTRATION[3]

In most cases, water infiltration is beneficial for a variety of reasons, including groundwater recharge, as outlined above. Students will explore another positive aspect of infiltration: Soils can filter and clean water. The ability of a soil to filter water is largely dependent upon particle size and how fast water flows through soil. This, of course, has great implications for groundwater quality.

The relative proportions of sand, silt, clay and organic matter influence how fast water moves through soil and how well water is cleaned. The longer it takes for water to flow through soil, the more time it has to interact with the soil and the cleaner the water becomes. Water moves slowly through clayey soils because the spaces between the individual clay particles are very small. Clay particles and organic matter have charges that attract some chemicals and keep them from

3 Adapted from USDA/NRCS, *Filtration*, http://soils.usda.gov/sqi/publications/files/filtration_lesson_plan.pdf

moving through the soil. Water flows faster through sandy soils because of the large spaces between sand grains. The shorter time the water has to interact with the soil particles combined with the smaller surface area results in water that is not as clean as the water that flows through the clayey soil or soil with larger amounts of organic matter. Quick flow rates through soil means less opportunity for chemical reactions and biological breakdown of pollutants before reaching the groundwater table.

This all assumes, of course, that soil is present. Soil is not; however, always present in areas of exposed bedrock. Organic rich soils, the most protective, may not be present where sand and gravel from river or glacial deposits are present or beneath gravel bed rivers. Water that does not filter through soil, especially organic rich soil, is less likely to be as clean (and may contaminate a drinking water source).

Farmers and consumers of well water may incorrectly think their water is recharged nearby and because soil is present, their water is protected from contamination. It is possible that their water is recharged in an area where soil, or organic rich soil is thin or absent and thus groundwater is less protected and more at risk. It is important to think about where your drinking water comes from and what might influence its quality, and also to be aware of how actions in your backyard might affect the drinking water of others downstream or downgradient.

Other factors that affect groundwater vulnerability:

1. Yearly rainfall – The total amount of rain that falls in one year.
2. Depth to water – The vertical depth from surface to aquifer.
3. Aquifer type – The type of soil/rock an aquifer passes through.
4. Soil type – The main type of soil and rock above an aquifer.
5. Lay of the land – The general slope of the surface of the land.

## INTEREST APPROACH:

The homework assignments from Lesson 3, *Drinking Water Home Inventory: Analysis and Report,* set the stage for this lesson on exploring the relationships between soil characteristics and drinking water. Lesson 5 activities engage students in assessing the vulnerability of groundwater for a hypothetical small town. Students can employ a similar strategy for investigating their own county's soil types and related implications for drinking water vulnerability.

Gaining skills for evaluating the impact of point and nonpoint source pollutants in local drinking water gives students scientific tools to assess water quality and empowers them to take responsibility for their own actions.

Every day I face more risks than I can count. Will I fall and break something while cleaning the gutters? Will I eat something that has bacteria and get seriously ill? What if the stock market crashes and everything I've invested for my retirement is gone? How do I face the risks of everyday living? Pause and elicit responses.

One of the biggest risks we all face is getting into a car or truck. We watched public service announcements last time about drunk driving. If you rely on someone for a ride, what are some of the issues that can affect how vulnerable you are in that vehicle? *Elicit responses related to whether the driver has been drinking, whether they have a history of safe driving practices, what the weather conditions are, etc.*

So, part of my decision about whether to accept a ride has to do with determining how vulnerable I am, given the circumstances.

We looked at potential sources of pollution in our water supply in Lesson 4, too. It turns out that there are circumstances that impact how vulnerable we are to the effects of those pollutants, and today we will learn how to calculate how soil impacts drinking water quality.

## OBJECTIVE BY OBJECTIVE:
## ACTIVITY OUTLINE AND TEACHER SUPPORT INFORMATION:

**CAREER EMPHASIS – HYDROGEOLOGIST:** Hydrogeology is the study of geology and the water underground. Geology, soils science, hydrology, mathematics, chemistry, and a variety of other areas of study contribute to a hydrogeologist's overall understanding of aquifers and the movement of water, and water contaminants, through the ground.

**CAREER EMPHASIS – SOIL SCIENTIST:** A soil scientist studies the upper few meters of the Earth's crust in terms of its physical and chemical properties; distribution, genesis and morphology; and biological components. A soil scientist needs a strong background in the physical and biological sciences and mathematics.[4]

For more career information, see Careers in Soil Science, USDA/NRCS: http://soils.usda.gov/education facts/careers.html

Lesson 5, *What is the relationship between soil and drinking water quality?*, introduces five factors affecting groundwater vulnerability and brings the lesson home to students by having them examine and describe the soil of the agricultural areas in their own county. Soil quality and disturbances also affect the quality of surface water sources of drinking water, such as rivers, lakes and streams, see Lessons 4, 16 and 17.

There are many ways that agricultural operations can reduce nutrient pollution, including limiting the amount of fertilizer applied, treating polluted water on the land and broader nutrient management strategies. They include:

- Nutrient management: Applying fertilizers in the proper amount, at the right time of year and with the right method can significantly reduce how much fertilizer reaches water bodies.
- Buffers and wetlands: Planting trees, shrubs and grass around fields, especially those that border water bodies, helps filter out nutrients before they have the chance to leach into a water body. Wetlands can protect water sources by filtering out nutrients.
- Conservation tillage and crop rotation: Reducing how often fields are tilled reduces erosion and soil compaction, builds soil organic matter, and increases the soil's capacity to reduce runoff.

4 From USDA/NRCS, Careers in Soil Science: http://soils.usda.gov/education/facts/careers.html

## GROUNDWATER VULNERABILITY

[5]In almost any town, a large variety of chemicals and wastes are used or disposed of in day-to-day life. If things like fertilizer/manure, gasoline, road salt, pesticides or sewage are not stored, used or discarded wisely, they can contaminate both private wells and public drinking water supplies. Leaking fuel tanks can also pose a threat to water supplies. Some sources of water are more vulnerable to contamination than other sources. Whether or not your water supply is vulnerable depends on many different factors, such as soil characteristics, agricultural practices and local requirements to control runoff and property manage chemicals and wastes to prevent contamination. The combination of local factors may add together to protect the supply or to leave it very vulnerable to contamination.

To estimate the vulnerability of groundwater flowing under an area of land, a hydrogeologist measures several factors which affect how quickly rain moves through the ground in that area. Pollutants will usually but not always move in the same way as rain water. Once hydrogeologists and managers study a variety of factors at a particular site of concern, they decide what measures might be taken to protect the source of the water supply and/or what water treatment might be effective to the water supply to maintain safe drinking water standards. If your drinking water comes from a private well, it is your responsibility to be aware of potential water safety issues in your community and to test your well regularly.

5.1. Explain the relationships between soil types and drinking water quality and quantity.

Use slide SW.5.1.TM to start this lesson with a quick review of the material covered in Lesson 4 about groundwater recharge areas. Ask students what they think might influence the degree to which groundwater is recharged. Make a list of their answers on the board. Among those answers, highlight the ideas that relate to soils such as soil characteristics, impervious surfaces or permeability.

Students will explore the relationship between soils and drinking water vulnerability in Activity SW.5.1.AS, *Resource Management: Protecting Your Drinking Water.* They will evaluate soil types and geology of a local agricultural area and use a mathematical model to estimate the vulnerability of a small town's water supply. This may be an individual or small group activity.

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5 Adapted from Resource Management: Protecting your Drinking Water: http://water.epa.gov/learn/kids/ drinkingwater/upload/ 2009_04_29_kids_activity_grades_9-12_resourcemanagement.pdf_

5.2. Describe the major soil types in the agricultural areas in their county.

Have students use the Natural Resources Conservation Service's Web Soil Survey Soil Maps, http://websoilsurvey.nrcs.usda.gov, to describe the soil types in a farm community (area) in their county. Ask them to use the soil information to predict the vulnerability of groundwater resources in that area. Students should compare their soil characteristics data with each other to create a composite view. Have them predict what the vulnerability of groundwater resources in the county might be. Students will learn more about the resources on this site, and how they apply to their local soils, if they have time to explore how the site works on their own. For a more structured lesson, ask them to follow the instructions in worksheet SW.5.2.SA.

## REVIEW / SUMMARY:

In your journal, describe how water quality issues would be different if we had the following conditions: (Select parameters from the choices that differ from your local conditions.)

- Yearly rainfall (>40 ft., 15-40 ft., <15 ft.)
- Depth to Water (<10 ft., 10-75 ft., >75 ft.)
- Aquifer Type (sand, gravel, limestone, bedrock)
- Soil Type (sand, gravel, limestone, loam, silt, clay, shale well-drained loamy sand, poorly drained silty clay loam, karst topography)
- Lay of the Land (flat, gently rolling hills, steep, hills/mountains)

## APPLICATION:

*Filtration,* USDA/Natural Resource Conservation Service http://soils.usda.gov/sqi/publications/files/filtration_lesson_plan.pdf

This hands-on activity from the US Department of Agriculture will get students thinking about soil, filtration and infiltration issues.

*Porosity? Permeability?,* The Water Sourcebook, EPA, pp. 4-23 to 4-26

http://water.epa.gov/learn/kids/drinkingwater/upload/The-Water-Sourcebooks-Grade-Level-6-8.pdf

This 50 minute activity will help students explore the relationships between the volume of water that soil can hold (porosity) and the rates at which water passes through different soils (permeability).

## EVALUATION AND ANSWERS:

**SW.5.ASSESS**

True/False

1. Sandy soils do a poorer job of filtering water than clay soils.
2. Some sources of water are more vulnerable to contamination than others.
3. The vertical depth of the water from the soil surface to the aquifer is one of the factors that affects groundwater vulnerability.

Name the three types of soil that are most common in your rural community? Which of these (if any) do the best job of filtering particles out of water?

## Answers to SW.5.ASSESS

True/False

1. T
2. T
3. T

## ACTIVITY WORKSHEET(S) – AS NEEDED

**SW.5.1.SA**

**ACTIVITY – Resource Management: Protecting Your Drinking Water**[6]

INTRODUCTION:

In almost any town, a large variety of chemicals and wastes are used or disposed of in day-to-day life. We are now learning that if things like gasoline, road salt, pesticides, fertilizer or sewage are not used or discarded wisely, they can contaminate a town's water supply.

Some sources of water are easier to contaminate than other sources. Whether or not your town's supply is vulnerable to contamination depends on many different factors. These factors may add together to protect the supply, or to leave it very vulnerable to contamination.

To estimate the vulnerability of the groundwater flowing under an area of land, a hydrogeologist measures several factors which affect how quickly rain water moves through the ground in that area. Pollutants will usually move in the same way as rain water.

Once you know something about each of these factors, you will be able to decide what must be done to be sure your drinking water will always be safe.

**Table 1**
**Estimated Value of Five Factors Affecting Groundwater Vulnerability**

| FACTOR | VALUE |
|---|---|
| 1. Yearly Rainfall (Total amount of rain that falls in one year) | 3 = if more than 40 in.<br>2 = if from 15-40 in.<br>1 = if < 15 in. |
| 2. Depth to Water (Vertical depth from surface to aquifer) | 3 = if less than 10 ft.<br>2 = if from 10-75 ft.<br>1 = if > 75 ft. |
| 3. Aquifer Type (Type of soil/rock aquifer passes through) | 3 = if sand or gravel<br>2 = if limestone<br>1 = if bedrock |
| 4. Soil Type (Main type of soil and rock above aquifer) | 4 = if sand or gravel<br>3 = if limestone<br>2 = if loam or silt<br>1 = if clay or shale |
| 5. Lay of the Land (The general slope of surface of the land) | 3 = if flat<br>2 = if gently rolling hills<br>1 = if steep hill/ mountains |

6 Protecting your Drinking Water Resource Management, 9-12: Office of Water (4606M) • EPA 816F08024 • 06 / 2008 • http://water.epa.gov/learn/kids/drinkingwater/upload/2009_04_29_kids_activity_grades_9-12_resourcemanagement.pdf

**SW.5.1.SA** *(continued)*

OBJECTIVE:

In this activity, you will use a simple mathematical model of groundwater vulnerability to estimate the vulnerability of the groundwater in four small towns in Priceford County.

MODEL OF Groundwater VULNERABILITY:

There are many factors affecting the vulnerability of a water supply, but we will only look at the five factors described in Table 1. A value of 1 means it is harder for rain water (and pollutants) to reach the supply, while a value of 3 means it is easier. It may be easy to see that the greater the depth to water, the longer it will take rain water to reach the supply. But how does a steep slope make the area less vulnerable? Figure 1 shows how some of these factors affect the vulnerability of various aquifers.

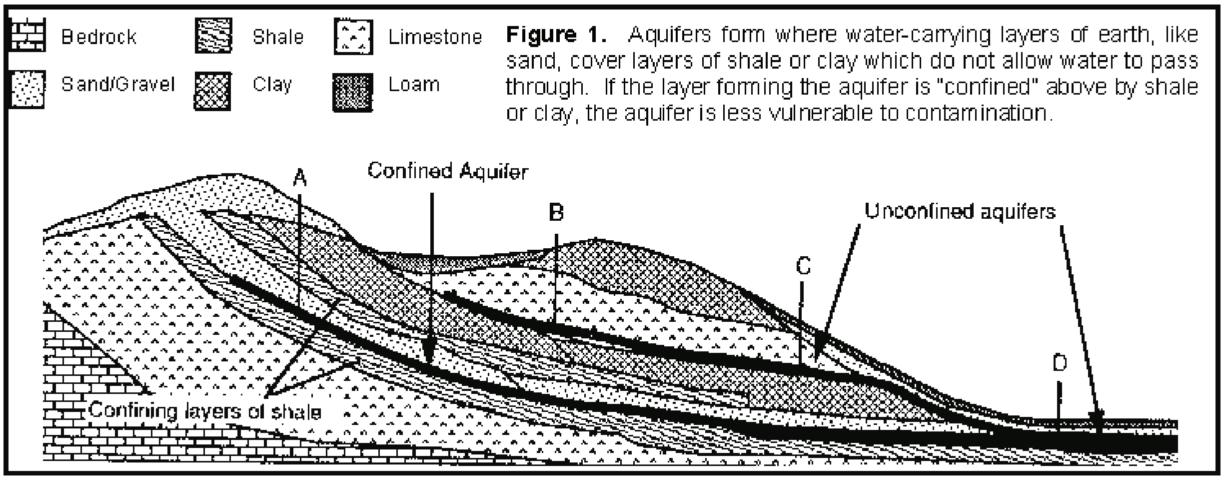



**Figure 1.** Aquifers form where water-carrying layers of earth, like sand, cover layers of shale or clay which do not allow water to pass through. If the layer forming the aquifer is "confined" above by shale or clay, the aquifer is less vulnerable to contamination.

DIRECTIONS :

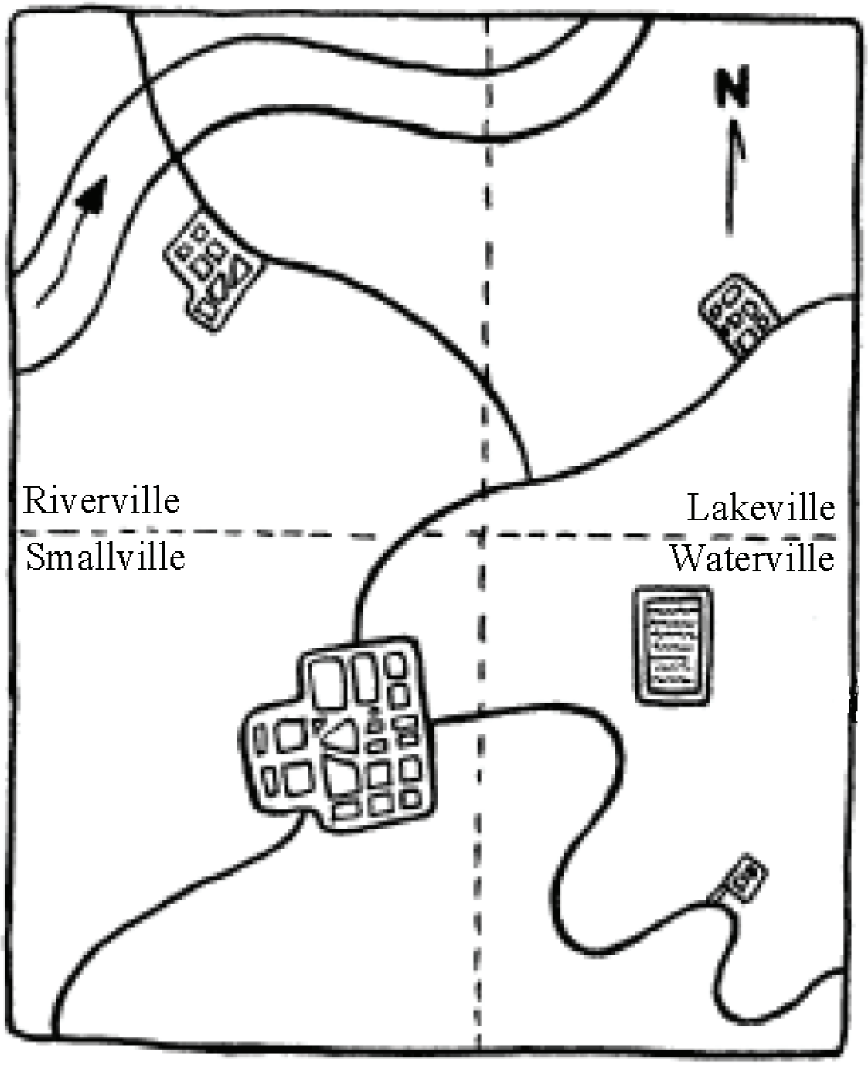
Use Table 1 to find out how many points should be given for each of the five factors. Use Table 2 to calculate a vulnerability score for each of the four towns. For example, Table 1 tells you that if the depth to water is less than 15 ft, you should give 3 points for this factor in Town 1. Values from Table 1 may be averaged.

You can get a rough idea of the vulnerability of the underlying aquifer in each of Priceford County's four towns by using these five factors to give each town a "score" on how easy it would be for a pollutant to pass through the ground to contaminate the aquifer.

For extra credit, factor surface water vulnerability into your analysis.

**SW.5.1.SA** *(continued)*

**Priceford quadrants: Riverville, Lakeville, Smallville, Waterville]**



**SW.5.1.SA** *(continued)*

Fill in the rest of the blanks for each factor, then add them up to find the vulnerability of each Town. Use your data along with the map of the Priceford area to answer the questions at the bottom of the page. Give your reasons for each answer!

| Table 2<br>Priceford County Quadrant Data Calculations | |
|---|---|
| **Town Data** | **You fill in the values here.** |
| **Riverville**<br>Depth to Water = 12ft<br>Yearly Rainfall = 45"<br>Aquifer Type = Sand/Gravel<br>Soil Type = Loam/Sand<br>Lay of the Land = Flat | Value = 3 (example)<br>Value =<br>Value =<br>Value =<br>Value =<br>VULNERABILITY SCORE = |
| **Lakeville 2**<br>Depth to Water = 40ft<br>Yearly Rainfall = 45"<br>Aquifer Type = Limestone<br>Soil Type = Limestone/ Loam<br>Lay of the Land = Gentle Slope | Value =<br>Value =<br>Value =<br>Value =<br>Value =<br>VULNERABILITY SCORE = |
| **Smallville 3**<br>Depth to Water = 60ft<br>Yearly Rainfall = 38"<br>Aquifer Type = Limestone<br>Soil Type = Limestone/Clay<br>Lay of the Land = Rolling Hills | Value =<br>Value =<br>Value =<br>Value =<br>Value =<br>VULNERABILITY SCORE = |

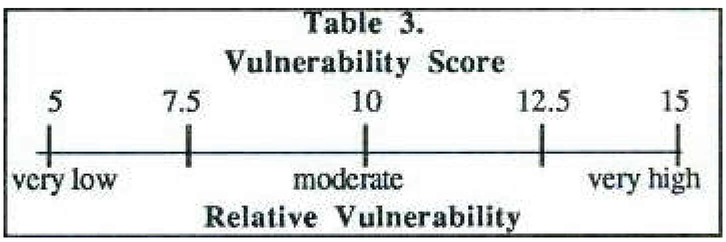
QUESTIONS :

1. Discuss how factors 2-5 described in Table 1 affect the vulnerability of water supplies at Points B, C and D in Figure 1. If three towns get their water supplies at Points B, C and D, which supply would be the most vulnerable? The least vulnerable?

2. Look at the map of Priceford County. Use Table 3 below to interpret the vulnerability scores you calculated in Table 2. Which town's water supply would be most likely to be contaminated if a larger tanker truck full of a toxic chemical spilled its contents during a traffic accident in that township?

3. Compare the vulnerability values you calculated in the four town quadrants in the above map with points A, B, C and D in Figure Which of these towns is most likely to be located at which of these points?

4. How would one town's pollutants affect the other town's supplies? If a wood preserving chemical is found in Smallville's water, but not in Riverville's, where is the most likely area where the source of contamination might be found?



**SW.5.2.SA**

**Collecting Local Soil Survey Data**

Go to the USDA/NRCS Web Soil Survey page at http://websoilsurvey.nrcs.usda.gov.

Click on the “Start WSS” button.

Under the “Area of Interest” tab (dark red when active) on the left, find the “Quick Navigation” area. Choose “Soil Survey Area.” Enter your state and county in the appropriate entry boxes. Click “View.”

The map of your county should appear in the “Area of Interest Interactive Map” area on the right. Click the yellow “Legend” tab at the top left side of the map. Click the following so arrows appear in these boxes: Soil Survey Area; Political Features – Counties, Urban Areas, Cities; Water Features – water (and oceans if applicable); Transportation and Background. Close the Legend box.

Next choose a rural area of interest within your county to explore. You do this by placing the cursor, which should now be a cross, on the map. Hold the button of your mouse down and draw a small box over your area of interest. Repeat this process to zoom in on a particular area of interest. Try to choose an area that is within the watershed you mapped in Lesson 1.

Click the box next to “Show Soil Survey Areas Layer in Map” so a check appears. Then click the “Set AOI” button in the navigation area. You will see blue diagonal lines indicating the area you’ve chosen for soil data, in this case your county. Hold the button of your mouse down and draw a small box over your area of interest as you did above. Repeat this process to zoom in on a particular area of interest. Then click on the yellow “Soil Map” tab at the top of the page.

The orange lines indicate the edges or boundaries among the various types of soil. The letters are abbreviations used to describe the soil types. (If you have numerous orange lines and no abbreviations, zoom in to decrease the size of the area viewed). The “Map Unit Legend” on the left explains the abbreviations and describes the soil type. For more detail, click on the soil description or “Map Unit Name.” The legend also describes the number of acres of each soil type in the AOI and what percentage of the total soil in the area of interest that soil type represents. Click on the zoom in/zoom out symbols at the top of the map to customize your results.

Now answer the questions on the following page.

**SW.5.2.SA** *(continued)*

SOIL DATA QUESTIONS:

1. What are the three most common soil types in the area you surveyed?

_______________________________

_______________________________

_______________________________

2. How many acres are covered by each of the three types?

_______________________________

3. Were there any bodies of water in the area you surveyed? If so, write down the names of the water bodies.

______________________________________________________________________________

______________________________________________________________________________

4. Considering the soil types you've discovered in your area of interest, predict the vulnerability of both surface and ground drinking water resources in that area: (circle one) low medium high

5. What other factors would you measure to help you define both surface and groundwater vulnerability in your area of interest?

______________________________________________________________________________

______________________________________________________________________________

## Answers to SW.5.2.SA

## Collecting Local Soil Survey Data

For Question #5: What other factors would you measure to help you define the groundwater vulnerability in your area of interest (AOI)?

Yearly rainfall, depth to water, aquifer type land use, lay of the land, distance to contaminant sources, groundwater rate of flow

## POWERPOINT SLIDES – AS NEEDED:

**SW.5.1.TM**

Definition of ***groundwater recharge area***

- A land area where permeable soil or rock allows water to seep into the ground to replenish an aquifer.
- Part of a ***watershed;*** found below ground level.