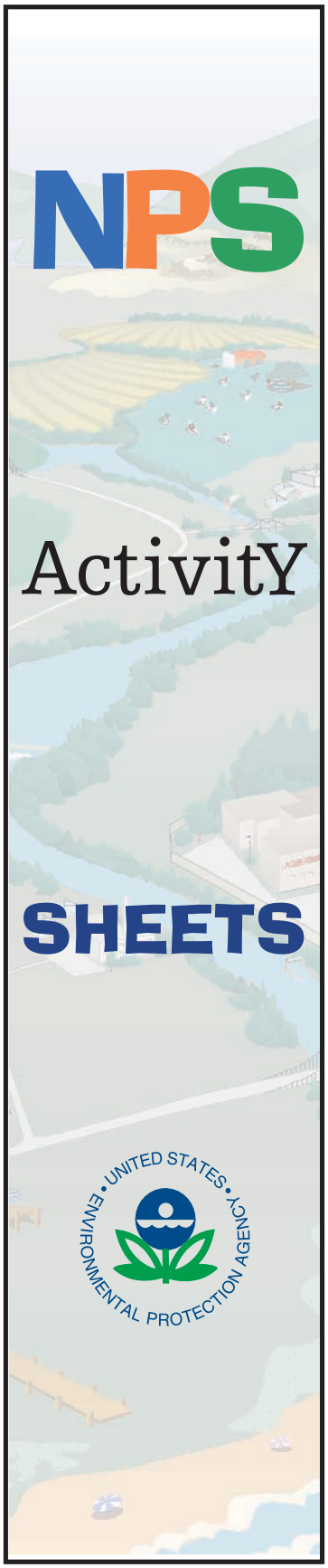


Activities to Accompany

Whatzzzzup-Stream?

For Grades 6 - 8

Objectives:
In this set of exercises, students will study rivers and waterways around them by using the Internet, maps, and their knowledge of local landscapes. The students will use an EPA Web site to investigate what is upstream and downstream of them. They will also look at graphs of flow in familiar river locations on a live U.S. Geological Survey Web site. Using small rocks and a washbasin, students will build a model that leads to extending their understanding of streams in different geographic locations. A topographic map exercise will expose students to topographic maps and allow them to look for the origins of streams. Finally, a reading exercise will illustrate the issue of the importance of lower-order streams to downstream areas, and students will be asked to implement their ideas to protect a stream on a dairy farm.

Exercises:
Exercise I. Exploring Where You Live in Your Watershed
Exercise II. Stream Discharge
Exercise III. Making a Model Watershed
Exercise IV. Map Interpretation of Streams in the Landscape
Exercise V. Stream Order and the Physical Structure of Streams
Exercise VI. The Riparian Zone and Headwaters Streams

Time Required:
Individual exercises are designed to be approximately 45 minutes to an hour long. Exercise III and IV require craft materials and maps respectively. The time to complete an exercise can be longer if the optional links to related Web sites are explored for a deeper examination of the subject.

Curricular Standards and Skills:

Natural Science:
- Watershed concept
- Using models
- Reading charts and graphs
- Interpreting charts and graphs
- Water uses
- Stream order

Civics:
- Geography
- Map reading
- Contour maps

Language Arts:
- Internet research
- Descriptive writing

Vocabulary:
catalog units
drainage basin
first-, second-, third-, and fourth-order streams
hydrologist
major river basin
network
watershed

Web sites:
EPA's Surf Your Watershed Web site
http://cfpub.epa.gov/surf/locate/index.cfm

National Geographic's Fresh Water page
http://magma.nationalgeographic.com/education/gaw/frwater/frwater_912_student.html

Exploring the Environment's Water Quality page
http://www.cotf.edu/ete/modules/waterq/wqphysmethods.html

Minnesota Shorline Management Web page
http://www.shorelandmanagement.org/depth/rivers/02.html

Exercise I.
Exploring Where You Live in Your Watershed

Everyone Lives in a Watershed!

No matter where you live in the United States, or even in the world, you live in a watershed. The rainwater that falls on your backyard drains to a stream, then into a river, and eventually into the ocean. Some people live very close to the coast and water travels only a short distance before it reaches the ocean. Others live farther inland, and rainwater will have to travel hundreds of miles before it reaches the ocean. In this exercise, you will look at where you live in your watershed. Are you near the headwaters where your watershed originates, or are you farther downstream? Visit EPA's Surf Your Watershed Web site (http://cfpub.epa.gov/surf/locate/index.cfm). Take some time to explore the different things this Web site can tell you. Below, list three things you can find out from this Web site.

1.

2.

3.

Looking at the Map
Under the "Locate by Geographic Unit" heading on the web site, use the space provided to enter your ZIP code and then click on "Submit." Then click on the 8-digit number for the watershed where you live.

1. What is the name of your watershed?

2. Compare the outline of the watershed to the map of your city or county. Does it follow the same boundaries? If not, why not?

What's Upstream?
Determine whether your watershed is a headwaters watershed or whether other watersheds are present upstream of your watershed. To do this, scroll down to near the bottom of the Web page. Look in the left column for "Other Watersheds Upstream." Click on the name listed below this title. (If you see more than one name, just pick one of them.)

3. What is the name of the watershed upstream from yours?

4. What would it mean if the word "none" was listed under the "Other Watersheds Upstream" title?

Headwaters — What Are They?

The headwaters of a river are its source--the place where the river first starts flowing.

5. How many watersheds are upstream from you? (You can find this answer by counting the number of times you must click on an upstream watershed before you get to a watershed that has no watersheds upstream from it.)

6. Where are the headwaters of your watershed?

What's Downstream?
Now look the other way and find out where your water goes after it flows past your house. To do this, start at the Web site for your watershed listed in question 1. Find the "Other Watersheds Downstream" title and click on the name of the watershed listed there.

7. How many watersheds are between you and the ocean? (Again, count the number of Web sites you need to visit between yours and when there are no more, to choose from.)

8. What is the name of the last watershed downstream from you?

Watersheds in Your Neighborhood
Talk about waterways in your area. What streams do you cross on bridges on your way to school? What roads do you take every day that run along a river or creek? Where are places where creeks and rivers come together? Think about places you have visited where rivers or streams come together. Write a paragraph about how a river or stream changes when it comes together with another river or stream.

Added Adventure

Do you know of a small stream in your area? Try following it to its source. Write a paragraph about what the beginning of the stream looks like.

Exercise II.
Stream Discharge

Vocabulary

Before you begin this exercise, take a minute to write down the definitions of these terms.

Stream discharge:

Velocity:

Cross-sectional area:

On your watershed page (http://cfpub.epa.gov/surf/locate/index.cfm), click on "Search by Map" and click on your state. Scroll down under the "State profile" title, to the subtitle called: "Information provided by the United States Geological Survey (USGS)"

Look for the link called "Real-time Streamflow data" and click on it.

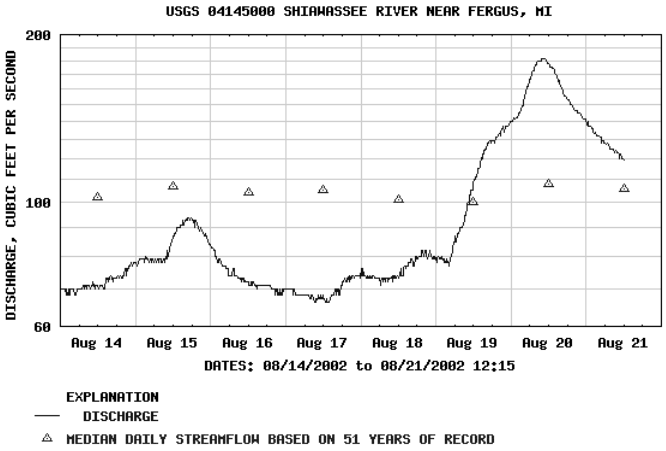
This link takes you to a USGS Web page where you can view graphs of stream-flow information for streams in your area.

Part A

Locate your river basin (it should be a bold subtitle such as "James River Basin" or "York River Basin")

Find a familiar location, or check with your teacher to find a location close to you. Click on the 8-digit number next to the gauge site near you. (There should a short description such as, "Madison River near West Yellowstone MT" or "WIND RIVER NEAR DUBOIS, WYO")

This page lets you make a graph of discharge from the stream. Under "Available Parameters" select "Discharge." Under "Output" select "Graph." Under "Days" change the number of days to 30 by typing the



The USGS Web page will generate presentation-quality graphs that you can print out.

number into the box provided. Usually a graph can be provided for information collected for the previous 31 days.

Check out the option to download a presentation-quality graph
Print out a presentation-quality graph from the Web site.

1. Does the graph have any sharp increases or decreases? What might these mean?

2. Does the graph have gradual increases or decreases? What might these mean?

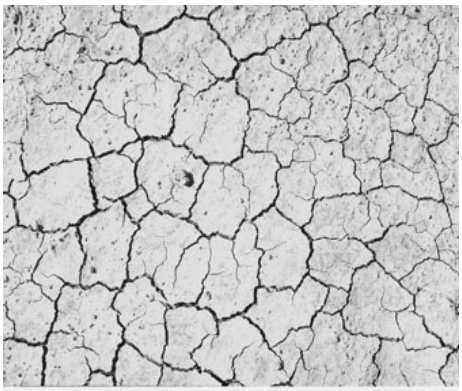
Part B
Repeat the steps in part A but this time choose a gage location upstream or downstream (on the same river) from the first gage location. Print out a presentation-quality graph for this gage also. Compare the two graphs.

3. Do you see any relationship between increases and decreases in water flow on the two graphs?

Part C
Identify a small stream that leads to your river (or identify a larger river that is downstream of you). Print out a discharge volume graph for this river and compare it with your graph from part A.

4. Which graph shows a larger discharge?

Floods and droughts both have major economic effects on the areas they affect.



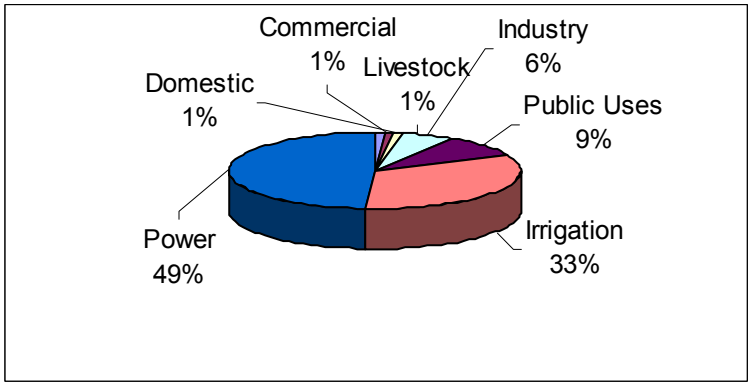
Cracked mud of a lake bottom exposed by drought

5. Can you find anything on your graph that might indicate that a drought or a flood has taken place?

Part D

Return to the "Surf Your Watershed" page for your watershed. Just below the Stream Flow link is a Water Use link. Click on this link to see a listing of water withdrawals and returns from various sources.

6. In your watershed, what water use withdraws most of the water?



7. In your watershed, what water uses return water that could possibly contain pollutants?

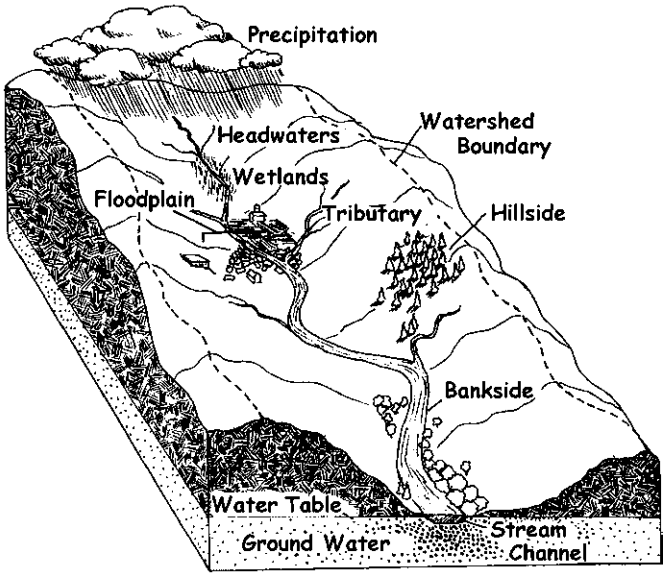
8. Look at the water use data for watersheds upstream and downstream from where you live. How do water uses upstream and downstream of the river differ?

9. How can water use upstream affect water use downstream?

The United States uses 100 billion gallons of water per day to irrigate crops.

The average person in the United States uses 70 gallons of water per day. Usually 2.5 quarts of that water is for drinking.

Exercise III. Making a Model Watershed



(Adapted from National Geographic Web education modules at http://magma.nationalgeographic.com/education/gaw/frwater/frwater_912_teacher.html#top)

Materials Needed
Each group of students will need:

- Bucket
- Blue marker
- Aluminum foil
- Water in a sprinkling can or spray bottle
- Shallow washbasin or dishpan
- Large and small rocks, chunks of wood, and/or boxes

Procedure
In the shallow basin, arrange rocks, wood, or boxes higher on one end of the basin than on the other. Cover the rocks with aluminum foil, pressing the foil against the rocks to create a miniature landscape within the washbasin. Make sure the edges of the foil remain inside the tub—or you'll create a waterfall! Your model should look like you filled a basin to the rim with lumpy mashed potatoes, then shoved half the potatoes to one end into a lumpy mountain. Make different folds, routes, ridges, and valleys to force the "rainwater" to flow down different paths. Use a blue marker to draw the place where you believe the main rivers will flow.

Once your teacher gives you the word, use the spray bottle to make it "rain" over the land. Observe what happens when it rains. Once you have written down your observations, remove the foil from the rocks, remove the rocks from the tub, and empty the "rainwater" into a bucket.

Observations
What happens to the water as it begins to rain?

How do streams form?

How many streams form?

Where do they form?

Where does all the water end up after the rainstorm?

Analysis
Where do streams form?

How many watersheds drained into your main river?

Fun Facts about Water

In a 100-year period, a water molecule spends 98 years in the ocean, 20 months as ice, about 2 weeks in lakes and rivers, and less than 1 week in the atmosphere.

All the freshwater flowing in rivers and held in lakes is only 1 percent of the water on Earth.

There is the same amount of water on Earth as there was when Earth was formed. The water from your faucet could contain molecules that dinosaurs drank.

The bathroom is the room in the house where the most water is used.

What caused the water to flow in a certain direction?

Where were the first-order streams located in your watershed?

What happened to your main river as other streams joined it?

If this were a real watershed, where would all the water end up at the conclusion of the experiment?

Conclusions
Write a brief paragraph about how water collects in a watershed.

Example IV.
Map Interpretation of Streams in the Landscape

What are all these lines anyway?

Contour line: A line on a map that connects points on the land's surface that have the same elevation. If you were to walk along a contour line, you would not go uphill or downhill at all.

Transect: A line that runs perpendicular to a contour line. If you were to walk on a transect line, you would walk either straight up or straight down a slope.

Understanding Contour Lines and Landforms
As a class, discuss how the following landforms would be indicated by contour lines on a topographic map.

A cliff

A flat meadow

A mountain

A river

Getting Started With the Map
Get acquainted with your map. Find the map legend. What part of the country is represented by your map?

Find the scale on the map. What distance is represented by an inch?

Locate a cliff, a mountain or hill, a river, and a meadow on your map. If you do not believe one of the these landforms appears on your map, explain why.

Locate as many first-order streams on your map as you can. How can you tell whether a stream is a first-order stream?

Are the streams you located intermittent or perennial? Show how each is represented on the map.

Types of Streams

Intermittent streams: Streams that flow only during wet periods.

Perennial streams: Streams that contain water year-round.

Thinking It Through
Where do you find first-order streams on your maps?

What are possible sources of water for first-order streams in mountains, low-lying swamp areas, desert areas, and areas close to the lower reaches of a river?

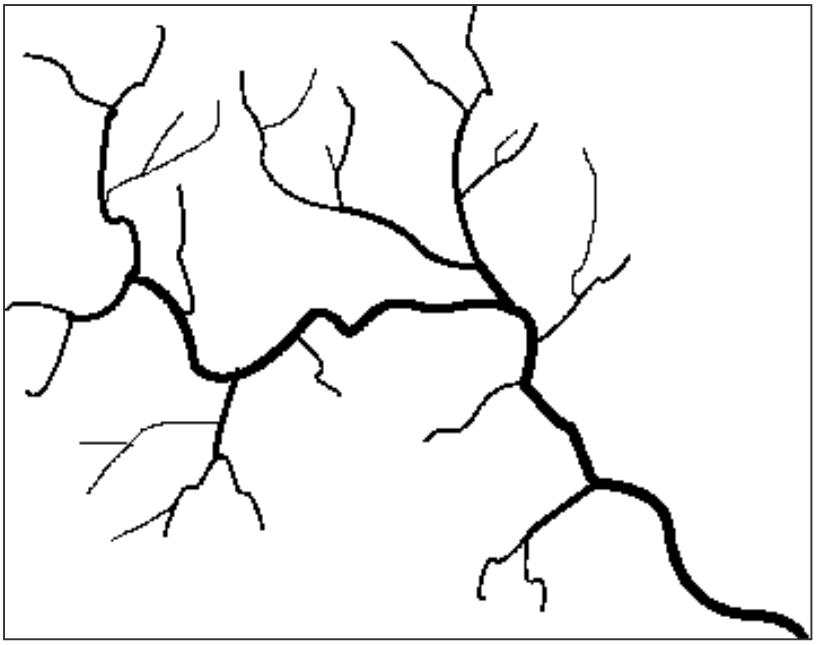
Going a Bit Further
Can you find places where water could flow as if in a stream, if it rained, but no stream has been indicated? These are the places where contours indicate a fold or a dip between slopes.

Why do you think no streams have been marked?

Example V.
Stream Order and the Physical Structure of Streams

Stream Order
Visit the Exploring the Environment Web page on Water Quality (http://www.cotf.edu/ete/modules/waterq/wqphysmethods.html) and answer the following questions.

1. What is stream order?



2. Determine the order of streams on the stream network picture to the right. Indicate stream order by writing a 1, 2, 3, 4, or 5.

3. Look at the pictures of a first-, second-, third-, and fourth- order stream at the bottom of the Web page. Fill out the chart comparing the stream types.

Comparing Stream Order

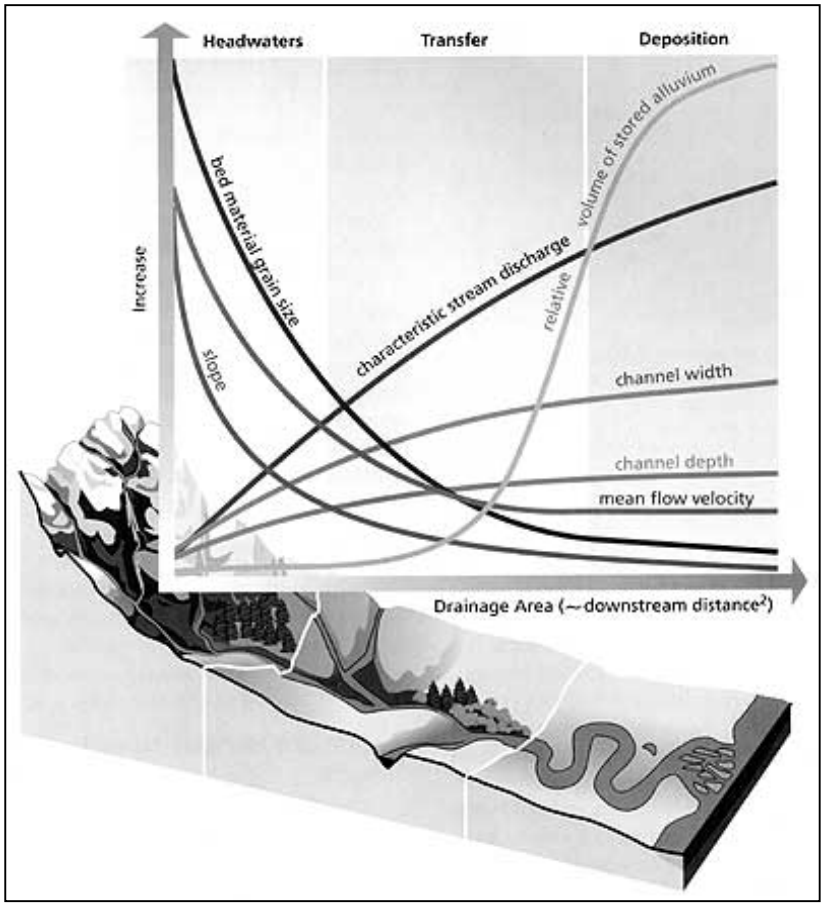
Stream Order	First-Order	Second-Order	Third-Order	Fourth-Order
Shade (full, partial, or no shade)				
Width (narrow, very narrow, wide, very wide)				
Shape (straight, curvy)				

Physical Structure

Look at the chart you filled out above. This chart looks at some ways streams change as they combine and form larger and larger rivers. Visit the Minnesota Shoreline Management Web page (http://www.shorelandmanagement.org/depth/rivers/02.html) and read about how a stream's structure changes as it flows from its headwaters to its outlet.

After reading the article, take some time to look at the graph "Three Longitudinal Zones and Channel Characteristics." Answer the questions about how a stream changes as it flows down its course.

Three Longitudinal Zones and Channel Characteristics



Bed material grain size: The size of the rocks, sand, and dirt that make up the bottom of the stream.

Channel depth: A measure of how deep the stream is.

Channel width: A measure of how wide the stream is.

Drainage area: The amount of land from which a stream gets its water.

Mean flow velocity: The average speed at which water moves in a stream.

Slope: How steep the land is where the stream is flowing.

Stream discharge: The amount of water in a stream.

1. What are the three river zones represented on the graph?

2. In what zone would you probably find a first-order stream? What about a second-, third-, and fourth order stream?

3. On the horizontal axis, label where you think each order of stream is most likely to be found.

4. As stream order increases, what happens to the drainage area of the stream?

5. As stream order increases, what happens to the slope of the stream?

6. As stream order increases, what happens to the speed at which water flows in a stream?

7. As stream order increases, what happens to the width of the stream?

8. As stream order increases, what happens to the amount of water in a stream?

9. As stream order increases, what happens to the stream's channel depth?

Example VI.
The Riparian Zone and Headwaters Streams

Riparian Zones
Riparian zones are the areas that border streams, rivers, lakes, and wetlands. They can be floodplains, streamside forests, or just plain streambanks. They are usually different from surrounding lands because they have unique soil and vegetation characteristics and are strongly influenced by water. Riparian zones are basically the interface between the water and the land, and they serve many functions, that make them valuable to people.

The riparian zone in this photo can be easily identified by the trees growing in it.

What Riparian Zones Do
Water storage. Riparian zones are able to hold water during a flood when the water rises out and over the banks of the stream. This function prevents further flooding downstream and also traps sediments and nutrients, making the riparian area a very fertile place.

Sediment retention. Sediment from upland erosion can be trapped and retained in the riparian zone, preventing it from reaching local waterways, where it is detrimental to stream habitat, fish, and downstream drinking water supplies.

Nonpoint source pollution buffer. Although riparian buffers can't absorb unlimited pollution runoff, they are effective at removing or storing a large amount of nutrients (nitrogen and phosphorus) and other contaminants. Riparian zones in agricultural areas have been shown to be extremely effective at reducing the amount of nutrients that reach local streams.

Streambank stabilization. The root mass of trees, grasses, and shrubs helps to stabilize streambanks and prevent them from eroding.

Habitat. Riparian areas are often more diverse than the adjacent upstream areas because this unique environment represents a gradient in vegetation, moisture, and soils that creates a number of habitats. Twigs, branches, and leaves falling from the riparian vegetation into the water also provide important in-stream habitat for aquatic organisms like insects and fish. This vegetation also provides a food or energy source that is important to the entire aquatic food web.

Riparian zones affect biota and the health of a lower-order or a headwaters stream to a great extent. We'll explore this relationship more in the following section.



Restoring a First-Order Stream: The Soque River
Streams that are out of balance with their surroundings can be restored. The Soque River is a good example. Changes in land use resulted in an unhealthy stream that was washing away farmland at an alarming rate. An article on the Soque River restoration is provided at
http://www.epa.gov/region04/water/wetlands/projects/soque.html
Pictures of the stages of restoration are at
http://www.epa.gov/region04/water/wetlands/projects/soqueepa.html

What happened in the riparian zone of the Soque River that caused it to become unhealthy?

First-order Streams and Their Surroundings

First-order streams have a very strong relationship with their riparian zones. Because headwaters streams are narrower in general than higher-order streams, their banks influence the quality of the stream water and the amount of sunlight in the water. This in turn affects the biotic community in the water, which determines the health of the stream as it goes down its course.

Rapidly Expanding Cities Affect Streams
If you live in a headwaters watershed and your city is expanding rapidly—paving over fields and open spaces for new developments like roads, malls, residences, housing estates—how do you think the expansion will affect:

The volume of water flowing into the headwaters streams?

The quality of water flowing into the headwaters streams?

The fish and other organisms currently living in headwaters streams?

The temperature of the headwaters streams?

The level of sediment in the headwaters streams?

What does that mean?

Use this Web site to look up any words on river structure that you don't know: www.amrivers.org/glossary/default.htm.