

Lesson 4 – Aquatic Landscapes

Authors:

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Grade Level: 5-8th

Lesson Time: 60 minutes pre trip, 40 minutes field trip, Two 50 minute post trip sessions

Suggested Class Structure: introduction--large and small group discussion and map observation, field trip—small group hands-on mapping project, optional extension--group project and presentation.

Subject Areas: Science, Language Arts, Social Studies, possibly Art



BACKGROUND

Streams and ponds are profoundly affected by the land use around them. Water that drains into streams and ponds from the surrounding land is called *runoff*. The area of land around an aquatic community where water runs off the land into the stream or pond is called the *watershed*. The lay of the land determines the boundaries of the watershed. Areas of higher elevation, called *ridges*, separate watersheds. Smaller watersheds drain into larger ones. Most of the aquatic communities in the Lehigh Valley are part of the larger Delaware River watershed, which drains into the Atlantic Ocean.

Runoff water picks up residues from the land depending on what types of land use activities are taking place in the watershed. These residues are carried into the aquatic community. They include particles of soil, inorganic chemicals from roads, households and business sites, bits of organic material from plants growing in the watershed, animal residues, and many other microscopic materials that cross the water's path. Water is the great

unifier of ecosystems and human activities. Hence the saying "We all live downstream."

GOAL

Students will be able to identify the watersheds in which they live, and become aware of how land use affects water quality. They will draw a map of an aquatic ecosystem and label significant features on the land that affect water quality. They will use this map as a unifying representation of the relationships between the abiotic and biotic features of the aquatic ecosystem they are studying.

OBJECTIVES

The students shall:

1. Define the term "watershed" and list land use practices in the watershed that can affect water quality.
2. Explain how topography creates the boundaries of a watershed.
3. Identify land and water features on a topographic map. Identify land use features on an aerial or street map.
4. Observe, identify and draw landscape features around a body of water that influence the aquatic community.
5. Draw an accurate map of an aquatic community, including the features they have identified as being significant to the water quality of the aquatic community.
6. Correctly label their map with a key and cardinal directions.

VOCABULARY

Contour interval – the difference in elevation between one contour and the next.

Contour line – a line on a topographic map indicating a certain elevation.

Elevation – the height above sea level.

Ridge – a high point of land from which a river system drains.

Runoff – rainfall not absorbed by soil.

Topographic map – a map that shows the shape of the land as determined by elevation and landforms.

Transect – a line across or through a study area.

Watershed – a region of land draining into a river, river system, or other body of water.

MATERIALS

- local topographic map samples
- local road map samples
- aerial map samples (optional)
- Delaware River watersheds map (optional)
- clear plastic transparency sheets for an overhead projector
- overhead projector
- fine-line dry erase markers
- camera (optional)
- compass for each group
- small ruler
- 50 meter tape measure
- colored marker flags
- aquatic field study landscape log book pages
- pencils
- crayons or colored pencils (optional)
- white clothesline (optional)

ADVANCE PREPARATION

- ✓ Runoff overheads of Graver topo map example, topographic features, aerial map of Graver, road map of Graver, watershed

diagram, Pennsylvania watersheds, Delaware River watersheds, Lehigh Valley Watersheds, Lehigh Valley School Districts (optional).

- ✓ Gather topographic and road map examples.
- ✓ Gather map-making materials (see materials list).
- ✓ Runoff copies of field study log book landscape pages.



How and Where to Get Topographic, Aerial and Road Maps

The best map resources for this lesson are full-size topographic maps done by the United States Geological Survey. They can be ordered from the USGS directly, (see their Web site for more information), [http://topomaps.usgs.gov/ordering_maps.html] or call them at (573)308-3500. In the Lehigh Valley topographic maps may be purchased at Nestor's Wilderness Travel Outfitters, 2510 Macarthur Road, Whitehall, PA, phone 610-433-6051.

There are also several excellent Web sites where you may go and search for maps of selected local sites and download them for use in your classroom. Listed here are two of the better ones and directions on how to access and use the mapping features.

The USGS has a directory to online aerial and topographic maps that can be found at [<http://geography.usgs.gov/partners/viewonline.html>]. There are two Web sites that are relatively easy to use to get topographic maps for downloading—Microsoft TerraServer, or TerraFly. TerraServer has a very nifty free aerial interface so you can switch back and forth between aerial and topographic views, and download both map types. When you get to the Web site you should type in the name of the closest

town/intersection near your school and then you can select the level of detail you would like. A medium sized map with a fairly high resolution will probably best suit your needs. You can also search these map databases by longitude or latitude if you know the coordinates for your school.

Road maps may be downloaded from MapQuest at [<http://www.mapquest.com>]. Type in the name of the town or intersection listed on the topographic map of your stream watershed.

PROCEDURES – Outline and Narrative

1. Explain and discuss how to read a topographic map – 20 min.

- a) Show the students the pictures of the roads, streams, blood vessels and tree branches. Ask them what these four pictures have in common? In each case, smaller entities (blood vessels, roads, streams and twigs) merge into larger entities (arteries, highways, rivers and branches). This is one of the principles behind a watershed. Because water is a liquid that can flow downhill, small rivulets of water that flow across the land drain into larger ones. The direction that the water flows is determined by the topography of the land.
- b) Next, show the students a copy of a topographical map. This is a map that shows the elevations of various landforms. Explain that in a topographical map, areas that are steep have elevation lines close together, and areas that are gently rolling have widely spaced topographic lines. Show several examples of how landforms appear on a topographic map.

2. Explain and discuss what a watershed is- 20 min.

- a) Show students the example of a typical watershed. The boundaries of a watershed are called the divide. These are ridges where water from one side of the ridge flows into one watershed, and water on the other side of a ridge flows into another watershed. In order to determine the boundaries of a watershed, students must identify where the ridges are.
- b) Show them the topographic map of Graver Arboretum or another topographic map of a stream or pond area near your school. See if the students can correctly identify the boundaries by identifying the ridges. The instructor should do this as a demonstration first, using a fine line dry erase marker to draw on a transparency sheet with a copy of the topographic map of Graver Arboretum and the Bushkill Stream, included in the Appendix of this lesson. Students can then try their hand at mapping another watershed using copies of maps provided by the teacher.

First locate the stream or river on your map and trace over it with a brightly colored crayon or colored pencil. Using +'s (or some other mark easily visible on the map) spaced at one-inch intervals, trace the flow of the stream to its source. At every mark draw a line (imaginary if necessary) perpendicular to the stream. Follow the perpendicular line until you reach the highest elevation before cresting a major ridge and make a dot (*, ^, etc...) at this point. Do this for each side of the stream. Now connect the dots following the ridge lines and that will give you a general outline of your stream

watershed boundary. You can do something similar for a pond.

If the teacher wishes to extend this part of the lesson, s/he can hand out topographic map samples to small groups of students and see if they can find the boundaries of the stream or pond watershed using the technique they have just learned.

- c) When students are finished, show the class the map of major PA watersheds and see how many rivers they can correctly identify. An answer key is provided in the lesson appendix.

Show them a copy of the map of the Delaware River watershed and point out some of the rivers in the Delaware Valley.

Show the map of Lehigh Valley watersheds and point out some of the watersheds near the school. You can use the school district overlay to help match up your school to its corresponding watershed. If your class is coming to Muhlenberg's Graver Arboretum, they will be visiting the Bushkill Stream watershed.

3. Discuss land use features that can influence a watershed – 20 min.

- a) Next, show the students a road map and/or aerial map of the area around the arboretum. Compare the road map and topographic map and have the students write a list of features on the map that might influence the water quality. They should refer to *Lesson One – Physical and Chemical Qualities of Water* for ideas on what to look for. Key features include roads, industrial areas, subdivisions and towns, dumps, parks, farms, and wastewater treatment plants.

If the teacher wishes to extend this part of the lesson, s/he can pass out copies of sample aerial and/or road maps, downloaded from the Terra Server or MapQuest Web sites, or use maps borrowed from Muhlenberg College. Student groups should look at the maps and see if they can find the stream or pond, and then identify major land use features that will influence water quality in the aquatic community.

Point out to the students that some features will not show up on the maps, such as new construction and small disturbances coming from one specific place. That is why they will be creating a more detailed map of the smaller area around their aquatic ecosystem, to identify these very local features. Oftentimes these are the features that have the greatest combined effects on the quality of water in a watershed. The cumulative effects of many small contributions to water pollution in a watershed is called “nonpoint source pollution.” That means instead of coming from one large point on a map, a factory or farm for example, the pollution is the collective influence of many, many small contamination events spread throughout the area.

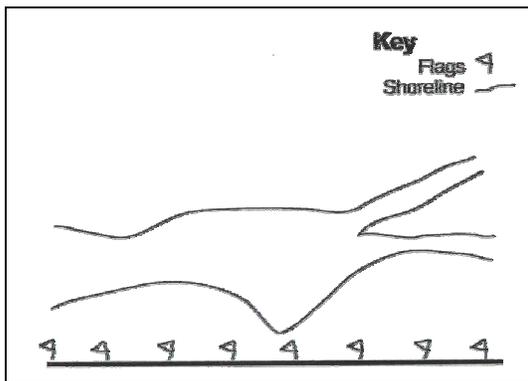
4. Outdoor field study—perimeter walk – 20 min.

- a) Fill out the field study logbook by observing an actual pond or stream watershed. When the students do their field study, they will be asked to inventory the watershed of their small aquatic community and record evidence of specific land use features that can affect the water's quality. They should walk around the watershed area, using the logbooks as a guide for their observations. Students will probably

have to be encouraged to expand their line of sight beyond areas immediately in front of them. They will also need to be encouraged to look out in all directions. Some watersheds are situated so as to make it difficult to walk around the entire area. In these cases, they should cover as much as they can in a reasonable stretch of time. A 50 meter area is ideal.

5. Draw and diagram the pond or stream – 20 min.

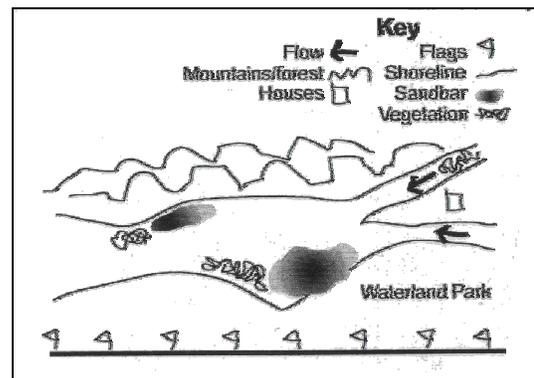
- a) After they have walked around and noted the land use features of their watershed, they will proceed to draw a map of the area. They should begin by selecting an area where they can lay out a line along one side of the water shore. The line should be located no more than ten meters away from the edge of the water. Students should use the measuring tape to measure out the line. They can then lay down a white clothesline along the section they have measured to help them visualize the transect. Next, they should measure off 3-meter sections of the line and mark them with colored flags. See diagram below.



- b) Students should then stand back and observe how the border of the water lines up against the transect. They should draw the coastline by measuring

from the transect point to the shore. One half inch equals three meters. They can create the outline of the shore by measuring from each flag and then transferring their measurement into inches and putting a dot on the map page in the logbook. They can then connect the dots to create the shore outline. They may have to estimate the shape of the far shore.

- c) Once the outline of the shore is finished, students should add features to the map that they have observed during their walk around the site. They can also add other small features that they notice and deem important to record. They should use different symbols to represent each feature and describe the symbols in the key. Students should also indicate the direction of the water flow and the water inlets and outlets if they are known. Lastly, students should note major landscape features such as hills, residential areas, forests or lawns, parking lots, etc.



ASSESSMENT

- Field study log book aquatic landscape pages
- Create a diagram of the study site. See “Aquatic Field Study Procedures--Optional Extension” page 90 for complete details on this activity.

RESOURCES



Books for the teacher:

Council for Environmental Education. *Project WET Curriculum and Activity Guide*, "Branching Out," 1995.

Books for the student:

Cushing, Colbert E. and J. David Allan. *Streams: Their Ecology and Life*. Academic Press, 2001. Excellent background information and pictures.

Fink-Martin, Patricia A. *Rivers and Streams*. Franklin Watts, Incorporated, 1999. Background information and projects.

Kjellström, Björn. *Be Expert with Map and Compass*. John Wiley and Sons, 1994. Revised classic.



Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. [<http://www.muhlenberg.edu/cultural/graver/>]

Web sites for the teacher:

Abandoned Mine Drainage Education. *Watershed Education*.

[<http://www.geocities.com/~paulstan/lesson.html>] Excellent discussion questions.

Delaware River Basin Commission - Ed. Web – <http://www.drbc.net> (choose Ed. Web) This site contains resources and lesson plans about the Delaware River watershed

and general water issues. Also maps, upcoming educational opportunities, field trip ideas, general information, and links.

Great Lakes Aquarium. *Mapping the Watershed*.

[<http://www.glaquarium.org/learn/lakematers/lessonplans/mappingthewatershed.html>] Online lesson with additional suggestions on how to study watershed maps.

US Geological Survey Learning Web. *What Do Maps Show?*

[<http://interactive2.usgs.gov/learningweb/teachers/mapshow.htm>] A teacher's guide with examples and lesson plans.

STATE STANDARDS FOR ENVIRONMENT AND ECOLOGY

4.1.7 Watersheds and Wetlands

B. Understand the role of the watershed.

4.3.7 Environmental Health

B. Describe how human actions affect the health of the environment.

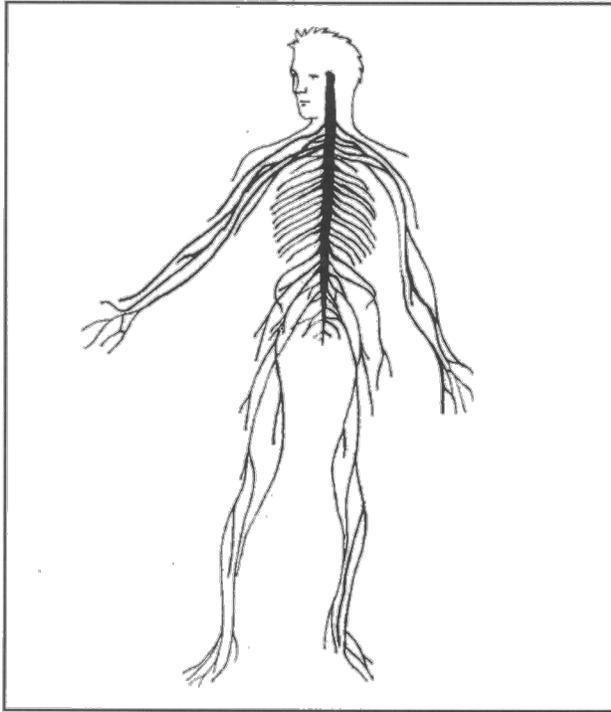
Lesson 4 – Appendix



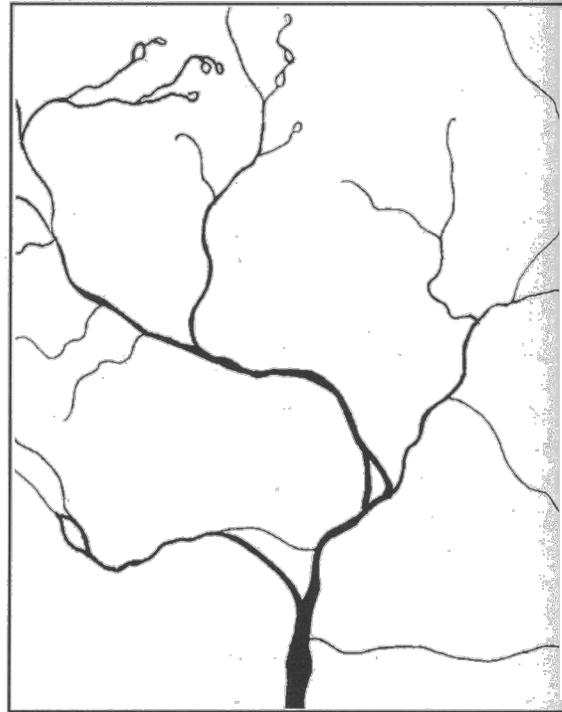
Copy Masters for:

Project WET/Branching Patterns
Diagram of a Typical Watershed
Examples of Topo Map Features
Topo Map of Graver Arboretum
Aerial Map of Graver Arboretum
Road Map of Graver Arboretum Area
Blank “Drainage Basins of PA”
“Drainage Basins of PA” Answer Key and Workheet
Delaware River Basin Watershed
Lehigh Valley Watersheds
Lehigh Valley School Districts

Branching Patterns



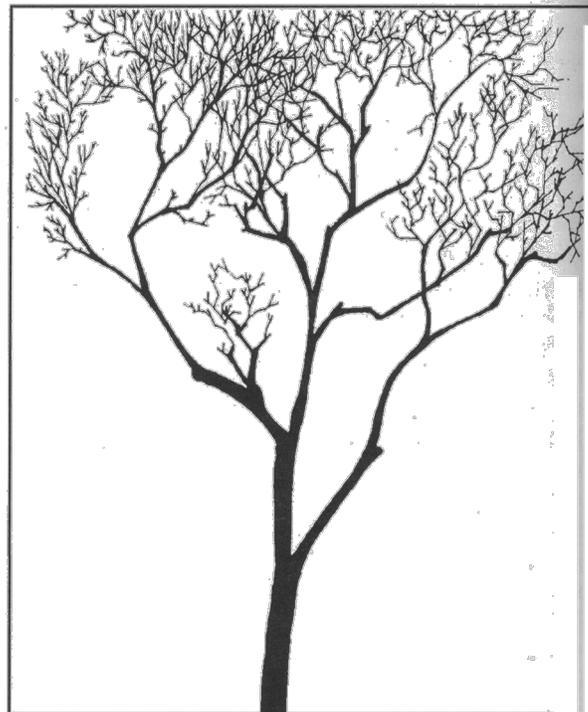
Human nervous system



Watershed drainage pattern



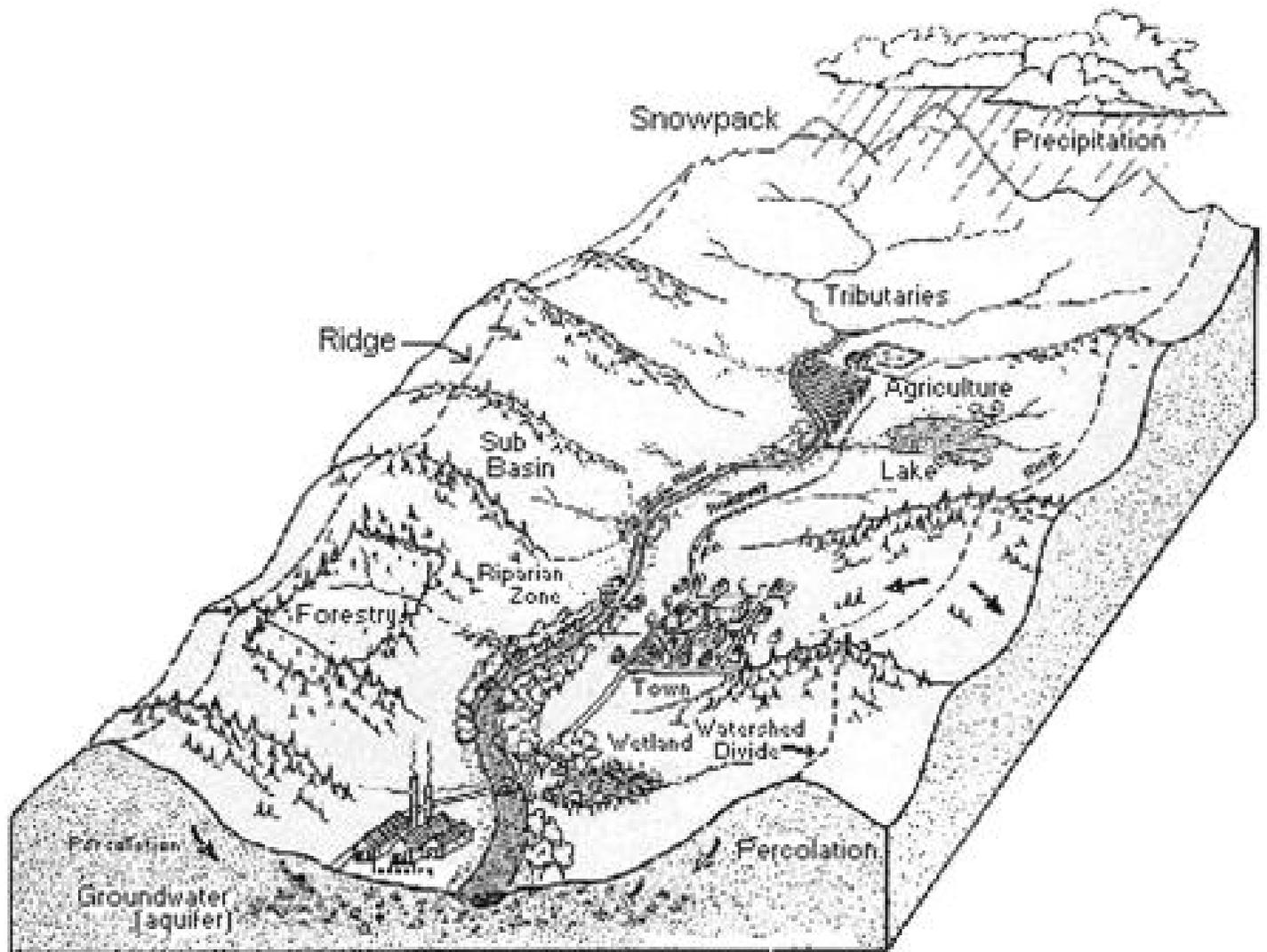
Road system



Tree in winter



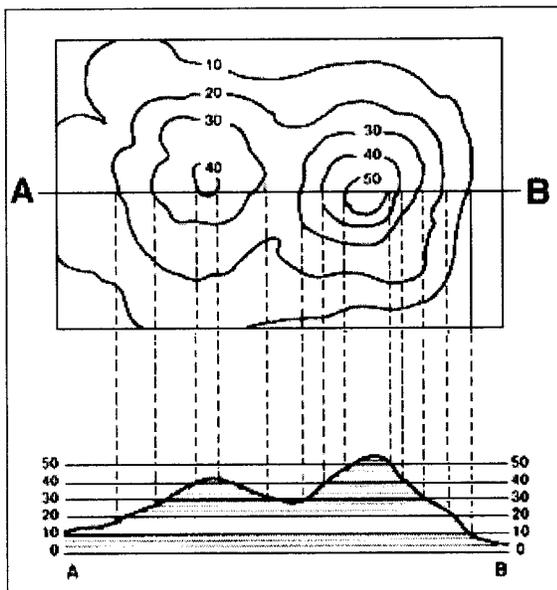
Diagram of a Typical Watershed



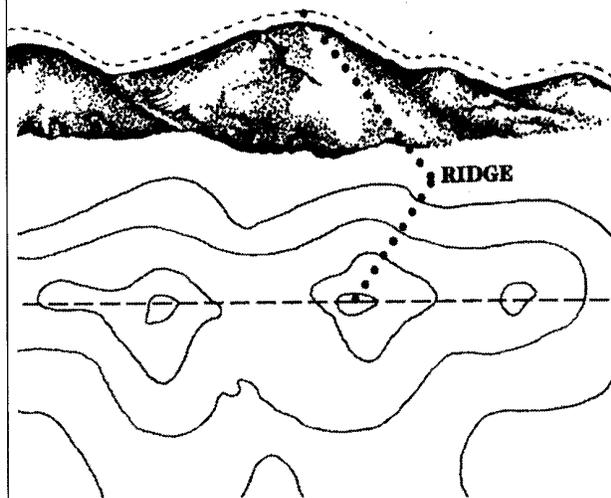
Produced by Lane Council of Governments

Examples of Topo Map Features

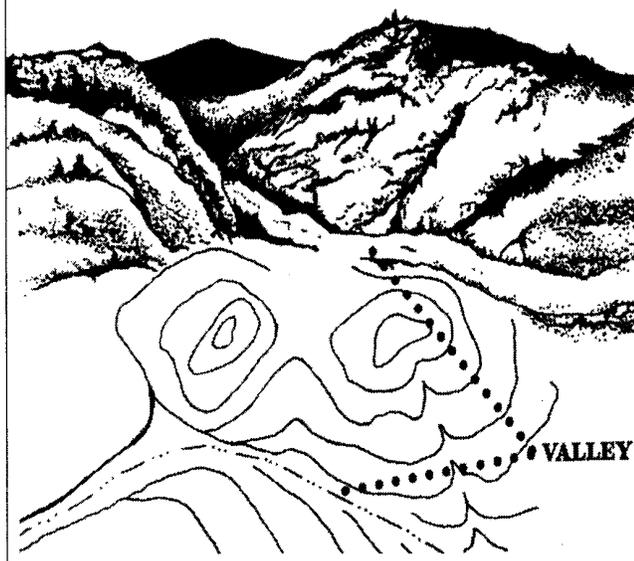
Hills



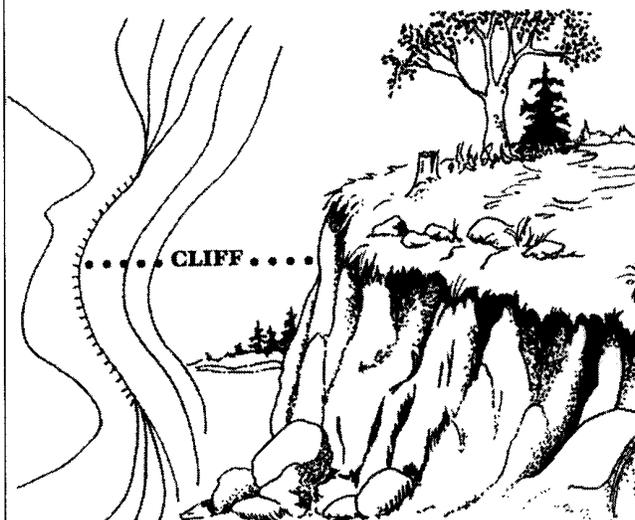
Ridge



Valley



Cliff

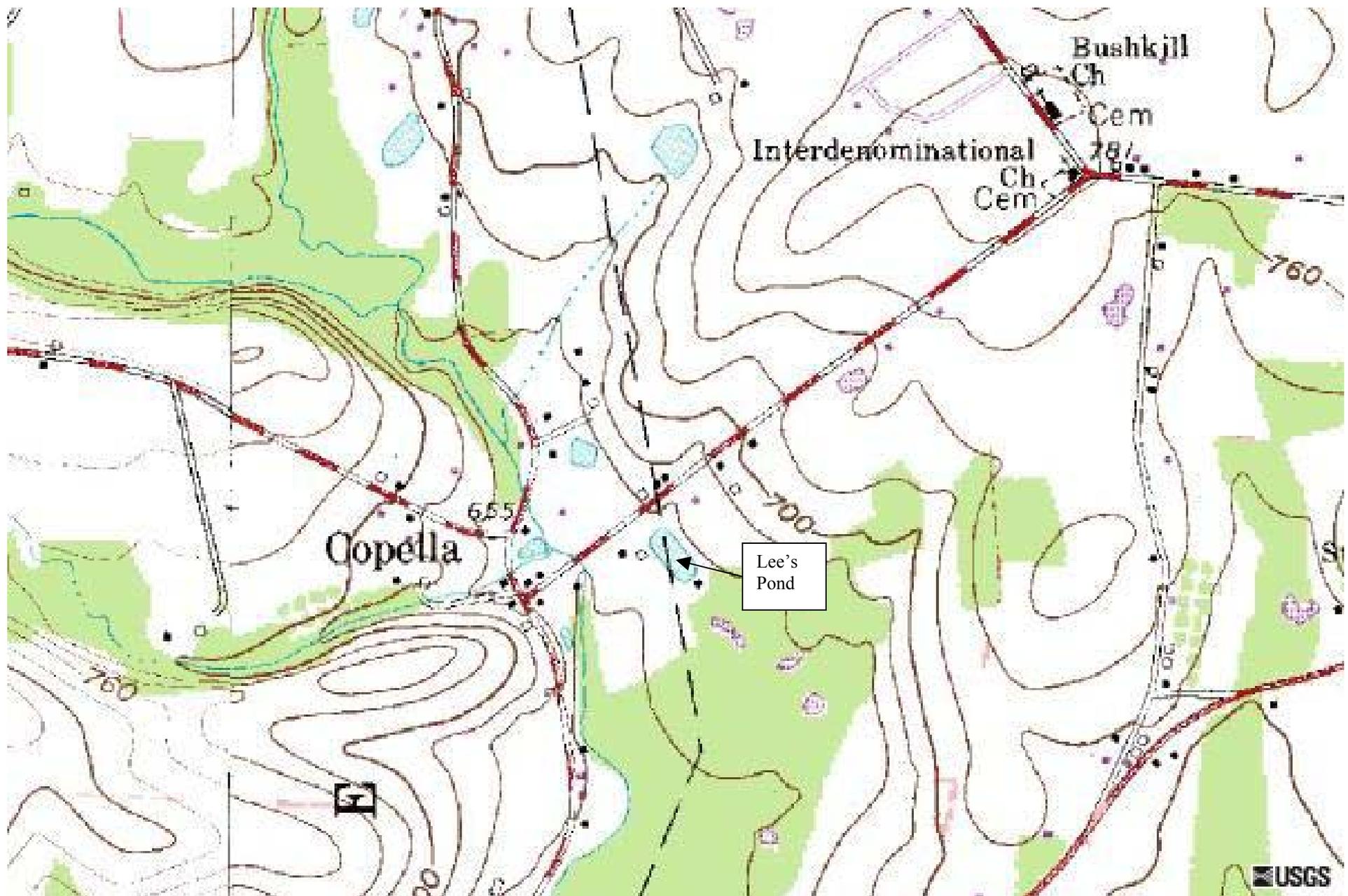


The ridge, valley and cliff pictures reprinted with permission from *Learning About Our Place*, a curriculum developed by the Roger Tory Peterson Institute of Natural History, <http://www.rtpi.org>

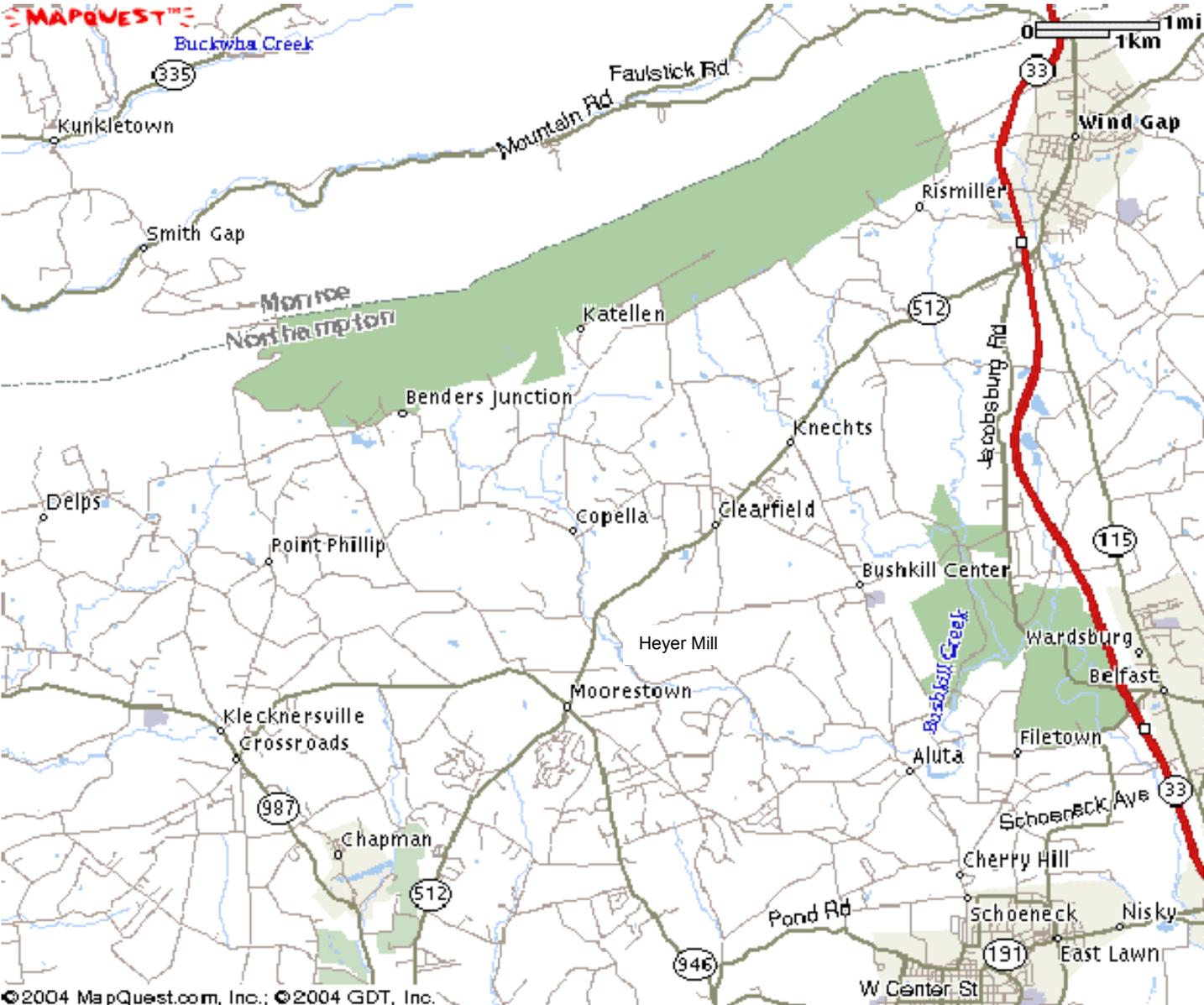
Aerial Map of the Area Surrounding Graver



Topographic Map of the Area Surrounding Graver

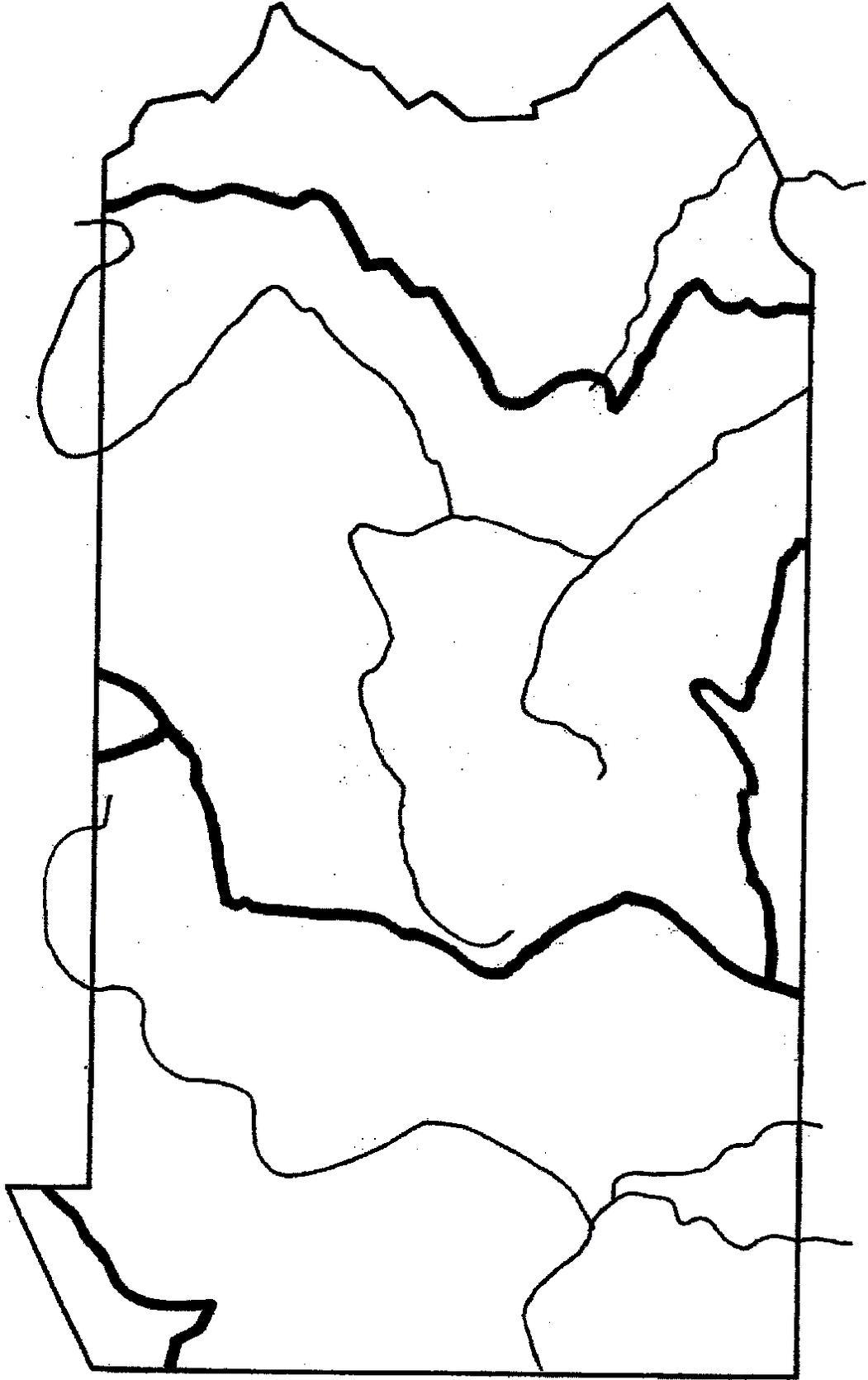


Road Map of the Area Around Graver Arboretum

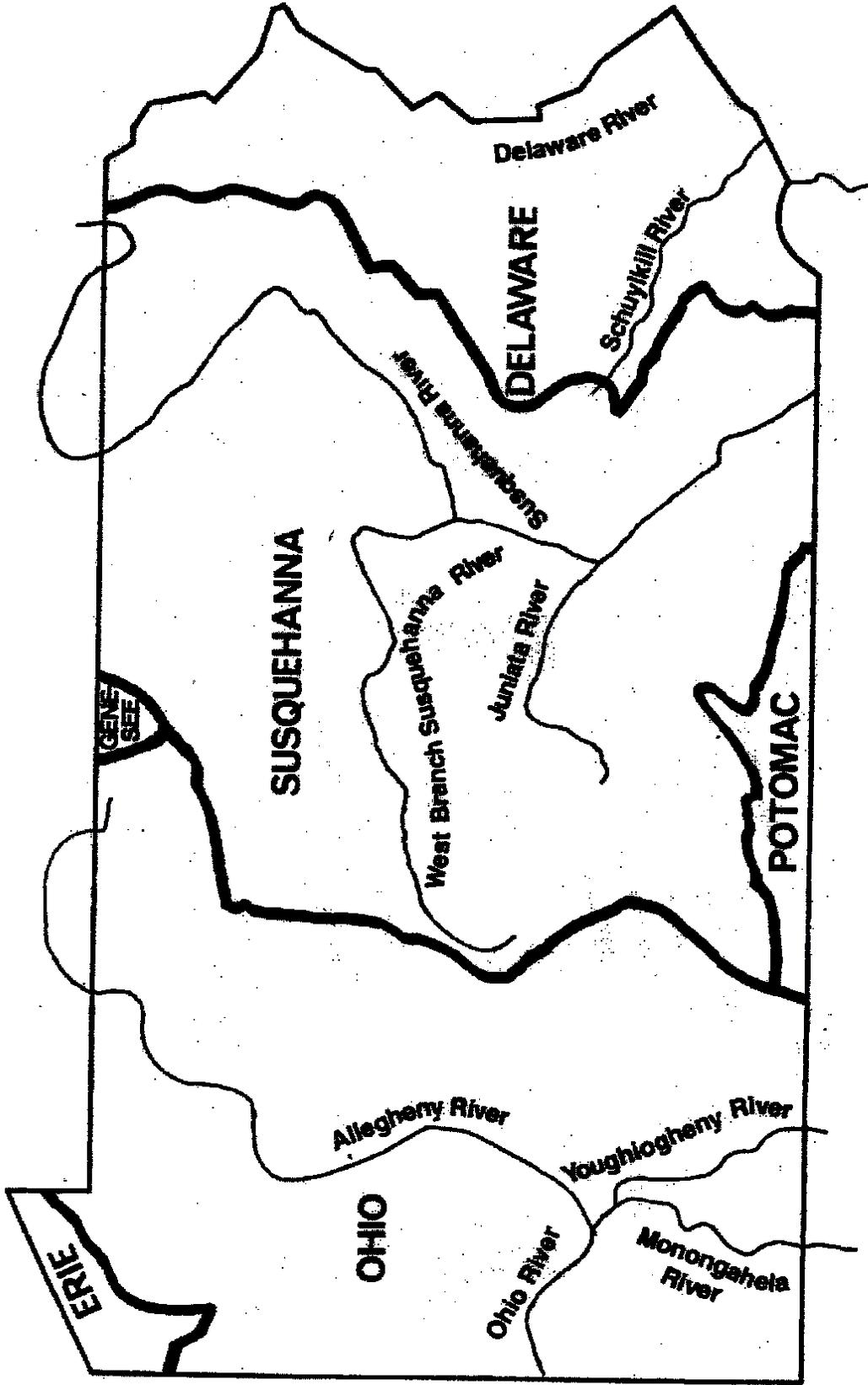


Note: Graver Arboretum is located under the letter “p” in the “Copella” label.

DRAINAGE BASINS OF PENNSYLVANIA



DRAINAGE BASINS OF PENNSYLVANIA

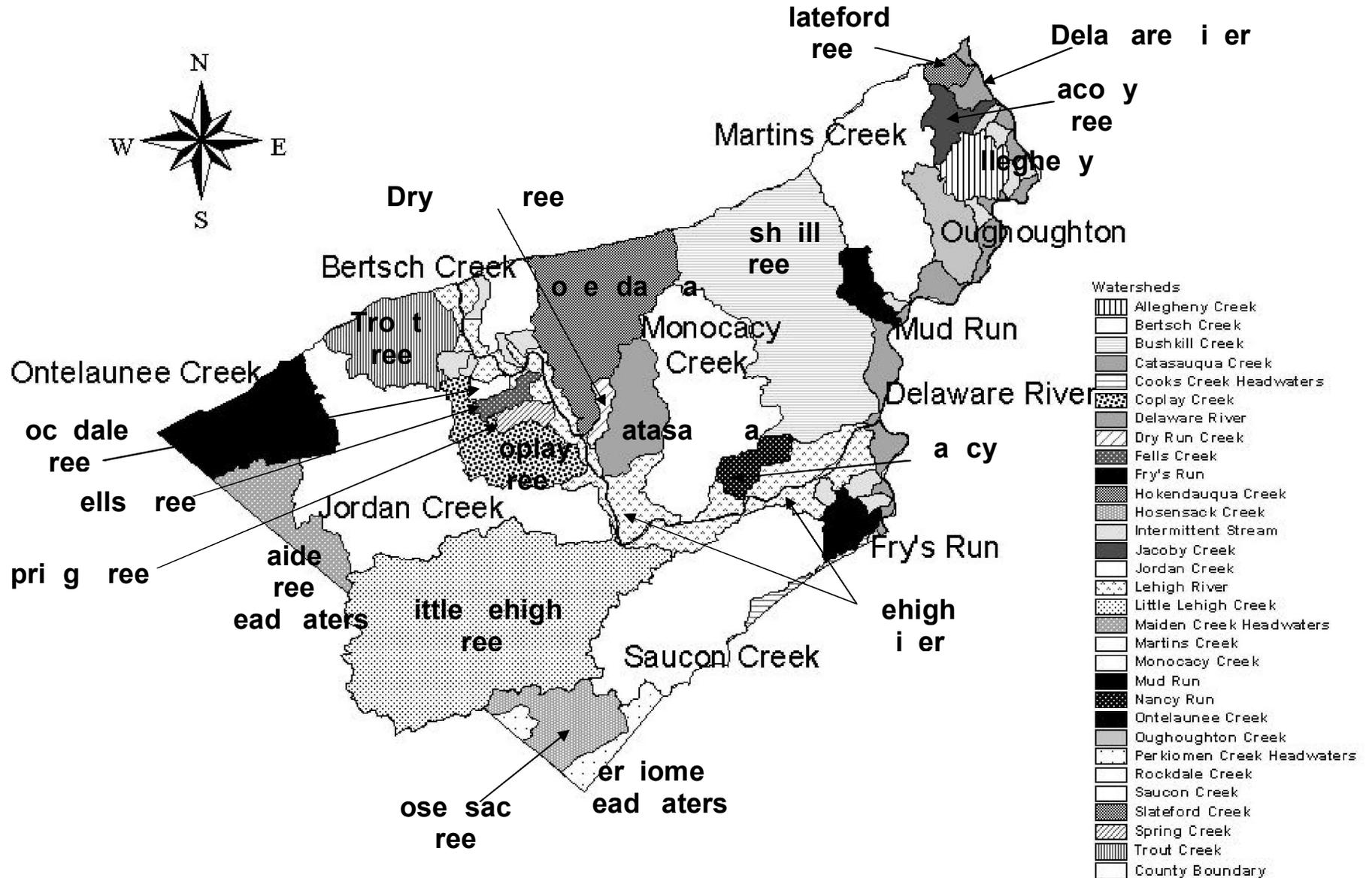


- Color the Lake Erie Drainage Basin Yellow
- Color the Susquehanna River Basin Red
- Color the Ohio River Drainage Basin Green
- Color the Delaware River Basin Blue
- Color the Potomac River Drainage Basin Orange
- Color the Genesee River Basin Purple

Delaware River Basin

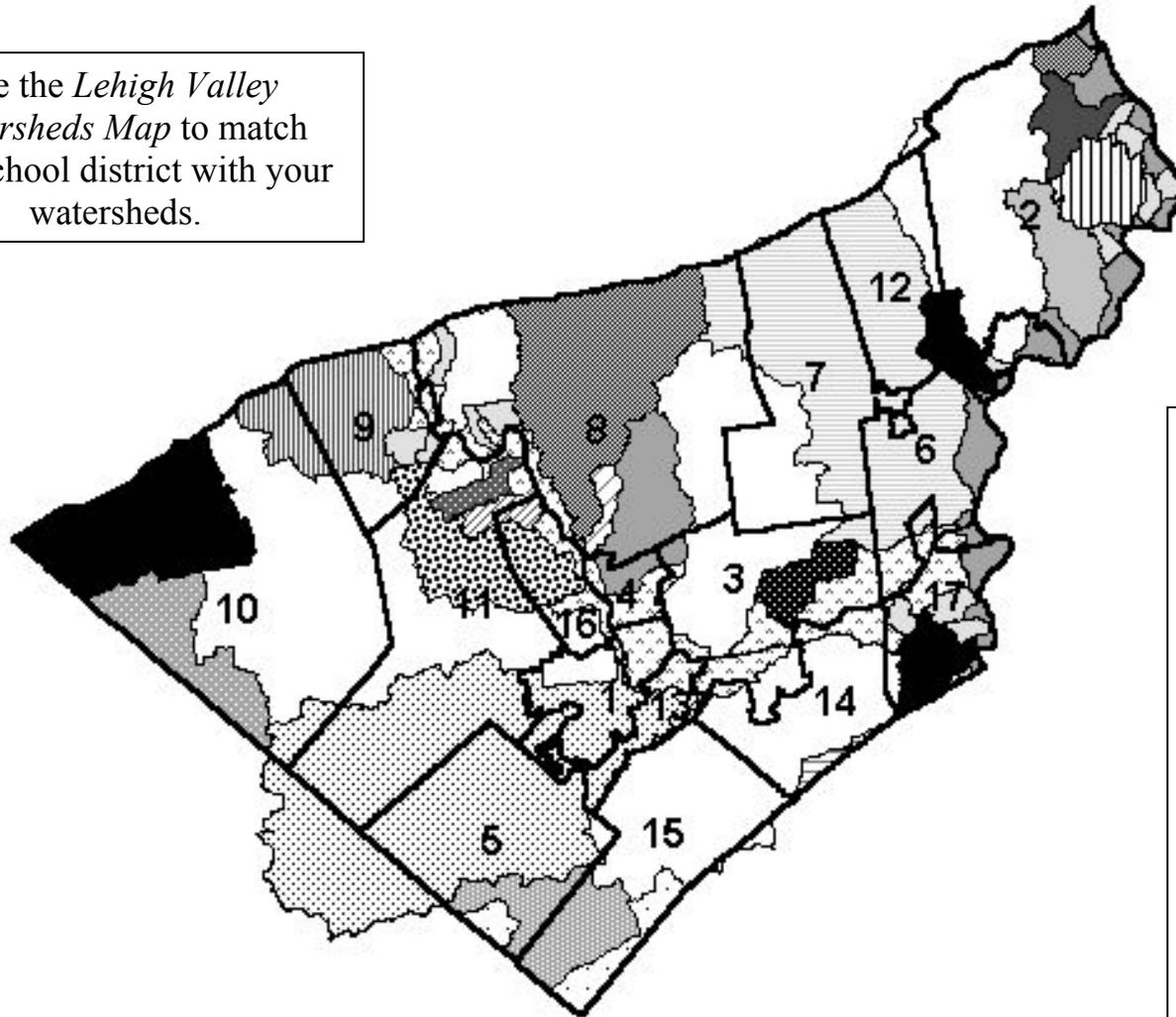


Lehigh Valley Watersheds



Lehigh Valley School Districts

Use the *Lehigh Valley Watersheds Map* to match your school district with your watersheds.



School Districts

- 1 -- Allentown City
- 2 -- Bangor Area
- 3 -- Bethlehem Area
- 4 -- Catasqua Area
- 5 -- East Penn
- 6 -- Easton Area
- 7 -- Nazareth Area
- 8 -- Northampton Area
- 9 -- Northern Lehigh
- 10 -- Northwestern Lehigh
- 11 -- Parkland
- 12 -- Pen Argyl
- 13 -- Salisbury Township
- 14 -- Saucon Valley
- 15 -- Southern Lehigh
- 16 -- Whitehall Coplay
- 17 -- Wilson Area