Glossary of Relevant Terms:

- **Saltwater Intrusion:** Movement of marine (saltwater) water into freshwater aquifers. This can occur when extraction of fresh water from an aquifer is not replaced with other freshwater sources, allowing nearby marine waters to enter the aquifer.
- **Stormwater Runoff:** Precipitation that does not percolate into the soil but travels downhill, collecting heat, debris and pollution as it makes its way to a body of water.
- **Topographic Map:** Maps that describe changes in elevation in a given location.
- **Watershed:** a watershed is a geographic area of land across which water and the sediments and dissolved materials it contains flow on their way to a single common outlet, either a stream, lake or river. This not only includes the land within its boundaries, but also the surface water of lakes, streams and wetlands as well as the groundwater moving beneath the surface.

Development of this guide was the result of a partnership between the East Stroudsburg Area School District, the Pike County Conservation District and the Pike County Office of Community Planning. Support from the Pike County Board of Commissioners and grant funding from the Pennsylvania Department of Environmental Protection's Environmental Education Grants Program contributed to the production of these materials.

Water & Watersheds

At East Stroudsburg Area School District's North Campus

Outdoor Learning Guide

How to use the Outdoor Education Guide

This Outdoor Education Guide is intended to provide faculty and staff with a background knowledge of what can be found on the North Campus Trail. While the Interpretive Trail Guide provides a brief overview of the natural features found along the North Campus Trail, the Outdoor Education Guides go into greater detail on five of the Trail's most salient features. The five Outdoor Education Guides augment the topics presented in the Interpretive Trail Guide with case studies, discussion questions, and examples found along the North Campus Trail. These guides are not meant to take the place of existing lessons and instruction; instead, this guide should be used to help draw connections between the North Campus Trail and existing classroom instruction.

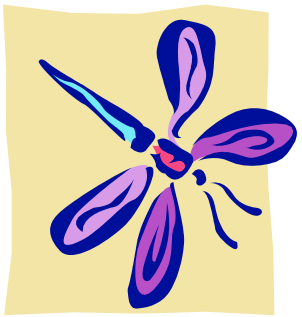
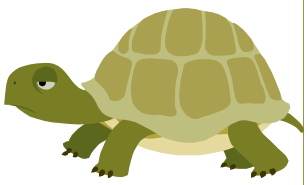
Access Road to North Campus Trail (PCCP Photo)

Outdoor Education Guide Series:

- **Green: Interpretive Trail Guide**
- **Red: Invasive Species**
- **Blue: Water and Watersheds**
- **Grey: Local Geology and Soils**
- **Brown: Trees**
- **Orange: Ecology and Species Habitat**

What can you see?

Watch for these things while on your adventure! Please don't pick up or disturb any items on your hunt. Want another challenge? Take a picture of all the items you find so you can look for them at home too!

Water  Can you name what type of water body it is?	**Frog** Can you name the species?  **(PCCP Photo)**	**Salamander**  Can you name the species?
Dragonfly 	**Something out of place that could be recycled** 	**Turtle**  TURTLES CAN BITE, DO NOT TOUCH!!!

Information Referenced

Fike, Jean. *Terrestrial and Palustrine Plant Communities of Pennsylvania.* Pennsylvania Natural Diversity Inventory, 1999.

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Pennsylvania Natural Heritage Program. *Pike County--Natural Heritage Inventory 2011.* Pittsburgh: Western Pennsylvania Conservancy, 2011.

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Wetland in Delaware State Forest , immediately adjacent to North Campus Trail (PCCP Photo)

Water Basics:

What is water?

At the most basic, water is a molecular compound of two hydrogen atoms and one oxygen atom, written as H_20. Water is commonly found in three different states of matter: solid (ice); liquid (water); and gas (water vapor). Water covers 70.9% of the earth's surface. Out of this percentage, only 3% is fresh water, and the remaining 97% is salt water.

Where can you find water?

Water is found naturally in its three different phases on earth. In its solid state, water is found in such forms as frost, ice, snow, hail, icebergs and glaciers. As a liquid, water makes up the oceans, lakes, streams, rivers, ponds, as well as groundwater. As a gas, water vapor is most commonly seen in clouds, but also noticed especially in the summer as humidity. In the Poconos and the Pike County area, you will find water as a liquid in lakes, streams, wetlands, and rivers.

Where can you find water around the North Campus Trail?

Water can be found in several locations on and near the North Campus Trail. On your way to the trail, you will see the large blue water tower that helps to provide water to the North Campus, wetlands across the campus that provide habitat for numerous species as well as filter rainwater back into the water table, and a manmade pond near the entrance to the trail.

Why is water so important?

Water is important because it helps to sustain life. Plants, animals, and other organisms require water to survive. Water is necessary for cells to carry out a variety of biological processes, which in turn, allows these plants, animals, and other organisms to live. Water is important to the Pocono region because it provides drinking water for not just residents of the area but also those living downstream within the Delaware River Watershed.

Watersheds 101

What is a watershed?

Also known as a drainage basin, a watershed is a geographic area of land across which water and the sediments and dissolved materials it contains flow on their way to a single common outlet, either a stream, lake or river. This not only includes the land within its boundaries, but also the surface water of lakes, streams and wetlands as well as the groundwater moving beneath the surface.

Where do you find a watershed?

Watersheds are located wherever there is land. An easy way to determine where water will travel is to look at a topographic map. Since water cannot move uphill, one can estimate a watershed boundary based on the topography of an area in relation to nearby waterbodies.

How big is a watershed?

Watersheds vary in size based upon their ultimate drainage outlet. The two smaller watersheds that divide the North Campus property--the Saw Creek and Little Bushkill Creek--empty into the creeks that they are named after. These creeks eventually empty into the Delaware River. Small watersheds are referred to as subwatersheds. All subwatersheds eventually empty into larger watersheds, and these watersheds eventually end up draining into watershed basins. Water from Saw Creek and Little Bushkill Creek subwatersheds makes its way into the Bushkill watershed. With the many waterbodies and waterways in New York, New Jersey, Pennsylvania, and Delaware, the water empties into the Delaware River making up the Delaware River watershed.

Does a watershed have to be wet?

No. Watersheds are geographical land areas. As such, these areas include both wet and dry areas. The wet areas include many different types of waterbodies (see the next page for those found in Pike County). The “dry” areas include land masses, as well as areas beneath the earth’s surface that act to channel water, such as during a rain event, to the waterbodies.

parents, teachers, and students. These resources are available for a fee from the Project WET website (accessed January 2013) at: **http://projectwet.org/**

- PA Fish and Boat Commission’s Educators page: (**http://fishandboat.com/edind.htm**). The site includes fact sheets on water and wetlands (**http://fishandboat.com/education/catalog/wetlands.pdf**), as well as a list of videos available for educators to borrow. Sites accessed April 2013.
- The Fish and Boat Commission also has a page for Students and Kids that includes fish identification guides, as well a link to factsheets for amphibians and reptiles. Accessed January 2013: **http://fishandboat.com/students.htm**
- The US Fish and Wildlife Service has a page for kids, families, educators, and youth group leaders that includes resources for lesson planning, field trips, image galleries, and links to other helpful organizations. Accessed January 2013, this site can be accessed at: **http://www.fws.gov/letsgooutside/index.html**
- The US Environmental Protection Agency (EPA) has a site that provides a good starting point for those looking for more information on Pennsylvania watersheds. Accessed January 2013: **http://cfpub.epa.gov/surf/state.cfm?statepostal=PA**
- EPA Offers Online Training in Watershed Management. While this appears to be geared towards professionals, it may be beneficial for high school students pursuing a career in the land use field. Accessed January 2013: **http://cfpub.epa.gov/watertrain/index.cfm**
- EPA’s K-12 Education Page offers resources, activities, and information for students and educators on watersheds, water, and wetlands. Accessed January 2013: **http://water.epa.gov/learn/resources/index.cfm**
- Penn State University’s College of Agricultural Sciences has a program on Ecosystem Science and Management. This page includes educator generated lesson plans on earth science, which includes a lesson on using topographic maps to identify watersheds. Accessed January 2013: **http://ecosystems.psu.edu/youth/sftrc/lesson-plans**
- Pennsylvania Herp Identification: Online Guide to Reptiles and Amphibians of Pennsylvania. This site offers an identification and photo guide for Pennsylvania’s snakes, salamanders, frogs, toads, turtles, lizards and skinks. Accessed January 2013: **http://www.paherps.com**

Activities and Resources:

- The *Natural Enquirer*, a middle school science journal from the United States Department of Agriculture has an article on water resources that includes information and activities for students. As of January 2013 , the link to the website is: **http://www.naturalinquirer.org/The-Current-Situation-and-Possible-Future-of-Fresh-Water-in-the-United-States-a-34.html**. A sample lesson plan that can be used with this article can be found here: **http://www.naturalinquirer.org/UserFiles/File/DoWhatYouWaterLessonPlan.pdf**

- *Project WILD:* Project WILD is an interdisciplinary conservation and environmental education program emphasizing wildlife. This program periodically publishes a Curriculum and Activity guide for Grades K-12. To receive further information and materials from this program, the contact for Pennsylvania is Theresa Alberici with the Pennsylvania Game Commission. She can be reached at: (717) 787-1434 (talberici@pa.gov). While activity and curriculum information can be accessed through this contact, the Pike County Conservation District has a copy of the guide that may be accessed for reference. Relevant activities in the 2000 Edition of Project WILD include "Riparian Zone" (Page 345-348) , a lesson in environmental education and land use planning for grades 5-8 on the importance and protection of riparian zones near waterways. Accessed January 2013: **http://www.projectwild.org/**.

- *Sustaining Penn's Woods:* Produced in 2000 specifically for Pennsylvania educators, *Sustaining Penn's Woods* is a curriculum guide for forest education, grades 5-10. Every school in Pennsylvania received a copy of this program. Activity of interest for grades 5-10 "Precipitation and Temperature" for students to see how precipitation impacts the types of forests in Pennsylvania. This activity can be found as a pdf (as of January 2013) at: (**http://www.hlma.org/pennswoods/online/activities/Sec2-2.pdf**). Another activity "Branching Out" for grades 6-9 introduces students to watersheds and the water cycle. This activity can be accessed (as of January 2013) at: (**http://www.hlma.org/pennswoods/online/activities/Sec3-2.pdf**). "Tough Choices in Pennsylvania," an activity for grades 6-10 explores timber harvesting with regard to impacts on water quality. This can be accessed (as of January 2013) at: (**http://www.hlma.org/pennswoods/online/activities/Sec5-2.pdf**).

- PROJECT WET (Water Education for Teachers) offers lessons and activities for

Pike County Waterbodies

Bogs: A type of glacial lake. Unlike swamps, bogs have little contact with groundwater and other waterbodies. As a result of the limited movement of water, bogs have lower levels of dissolved oxygen and nutrients. Reduced oxygen inhibits the decomposition of leaves and other organic debris, which eventually creates peat.

Lakes: Lakes are bodies of relatively still (compared to an ocean) water. They can either be made through natural means (such from glacial activity), manmade (such as Lake Wallenpaupack, through the installation of a dam), or by animal activity (beaver dams).

Riparian Buffers: Riparian buffers are the vegetated areas along streams and other bodies of water. Riparian buffers help to filter and clean the water that enters the waterway. They reduce erosion of soil, provide habitat for wildlife, and help to control floods.

Rivers: As streams and creeks merge into each other, they form rivers. Rivers are larger systems of running water.

Streams: Streams are small bodies of running water that form from mountain brooks. Streams can also be called creeks, brooks or runs. Streams can be perennial and exist year-round, or ephemeral (also known as intermittent) and exist only part of the year.

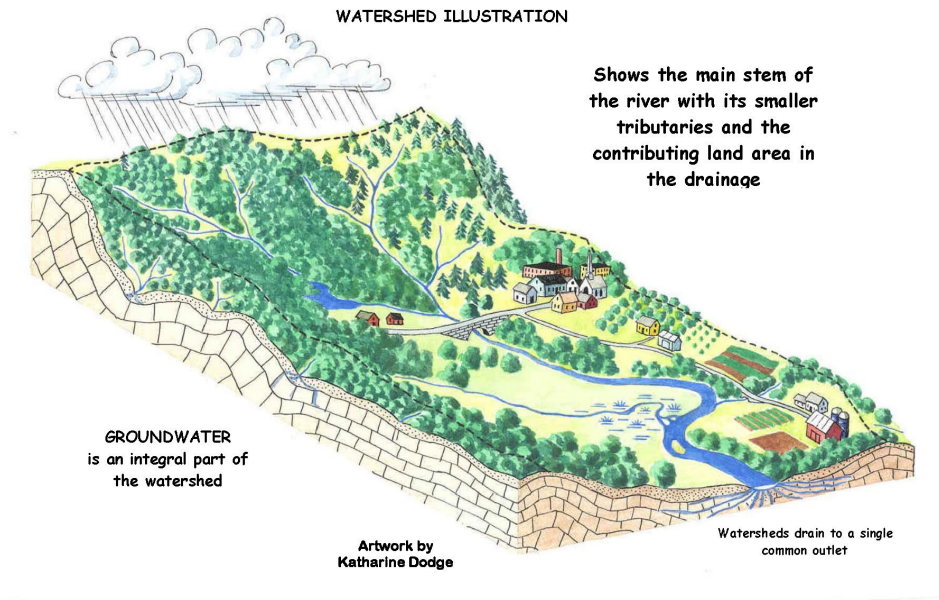
Swamps: Similar to bogs, swamps were created through depressions in the earth's surface. Unlike bogs, swamps have greater contact with groundwater and other waterbodies in the watershed, creating an environment that has higher levels of nutrients and oxygen. As a result, organic debris is able to decompose and does not accumulate.

Wetlands: Transitional lands between terrestrial and aquatic systems. Wetlands are dominated by water for some part of the growing season throughout each year. Wetlands will range from flooded marshes, to forested seeps that will see water only after heavy precipitation raises the water table.

Vernal Pools: Vernal pools are temporary wetlands that annually fill with water, but will dry up in the summer months.

Water Quality in the Poconos

Water quality receives significant media attention in the Pocono region of Pennsylvania due to the fact it forms the headwaters of the Delaware River. Water from Pike County, upstate New York, and northern New Jersey makes its way into the Delaware River; it provides drinking water for people living downstream, in towns such as Easton, Camden, Trenton, and Philadelphia. Protection of water quality in the headwaters area ensures that people downstream have access to safe drinking water. Since water can enter the Delaware River through the different avenues illustrated in the graphic below, it is important for us to protect quality of our water and thus the water of those living downstream. This means protecting what goes into our soils as well as how we treat our **stormwater runoff**. Ensuring that adequate water makes its way to downstream users in Philadelphia also ensures that saltwater from Delaware Bay does not enter their drinking water, an event known as **saltwater intrusion**. Water quality is important to Pike County and the Poconos because it provides drinking water to 5% of the United States population (Kauffman 2011). We all live downstream of someone else so protecting water quality is important to all of us!



Watershed graphic courtesy of the Pike County Conservation District. Artwork by Katherine Dodge.

Resident Species

While a visit to the trail may not take you close to some of the nearby water features on the North Campus, there are several creatures that require periodic contact with water, but spend other times living in the surrounding forest community. For example, the salamander is nocturnal, so it is unlikely that you will spot one along the trail, but keep your eyes and ears open, you may just discover one!

Salamander

The name “Salamander” is a general term that refers to the Caudata (Salamander) order of amphibians. Several salamander families, genera, species are known to inhabit the Pike County area. While all salamanders depend upon a moist environment for survival, not all salamanders live near water. The redback salamander (*Plethodon cinereus*) pictured left lives underneath logs and leaf litter in the forest. While living underneath stones, logs, and other flat objects, the redback will lay its eggs in clusters, also seen in the picture on the preceding page. Others live in or near streams and other waterways. Some salamanders require moist areas for important stages in their life cycle, such as a vernal pool that is free of fish, for reproduction. Salamanders in Pennsylvania range from 20 inches in length (Eastern Hellbender), to the Four-Toed Salamander (*Hemidactylium scutatum*—found in Pike County) at 3 inches in length. Salamanders will feed upon insects, worms, and other invertebrates.

Dragonfly

The term “dragonfly” is a general term that refers to a wide variety (several thousand known) of species in the Odonata order of insects. In this area, there are a number of different dragonflies, including the mottled darner, halloween pennant, mustached clubtail, slaty skimmer, and the rare elfin skimmer. Many dragonfly species live near water and wetland habitats to lay their eggs, but will move to other habitats during their adult stage. Dragonflies are beneficial insects to have in the area because they will feed on mosquitoes.

Your Watershed "Address"

What is your watershed address? As mentioned earlier, a watershed is an area where water drains into a common outlet, which then combines with more and more watersheds to drain into increasingly larger common outlets. It is possible to determine the subwatershed and its encompassing watersheds and basins for a given area. The US Environmental Protection Agency (EPA) has a site "Surf Your Watershed" to determine your watershed address based upon your zip code or other political boundary. The "address" is a HUC (Hydrologic Unit Code) that consists of a series of numbers that describe each of the watersheds that encompass that area. If the HUC address is short, it is indicating that it represents a larger general area. It is similar to a phone number, more digits explain a greater area, such as an area code or even a country code. With the HUC number, a larger HUC address represents a smaller, and more precise location. For example, the address for the North Campus Trail is: 020401040604. What does this translate to?

The first two numbers, "02" indicate that the school falls into the Mid Atlantic hydro region.

The next six numbers "040104" indicate that the school is part of the Middle Delaware-Mongaup-Bushkill watershed.

The next four numbers "0604" indicate that the school falls into the Saw Creek subwatershed.

For the north campus trail, the entire watershed address would be: Atlantic Ocean-Delaware River-Bushkill-Saw Creek.

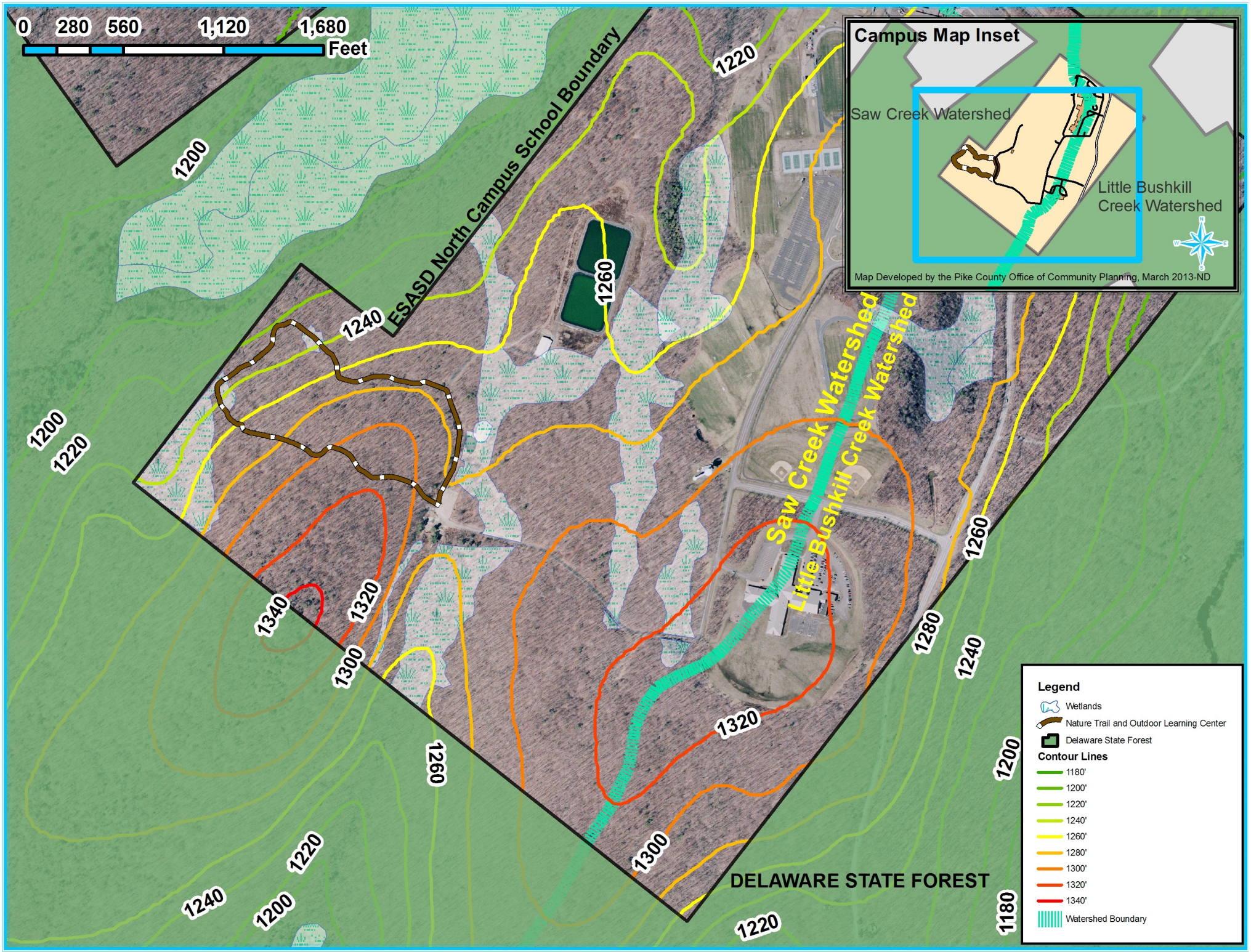
Photo Captions/Credits from left to right: Redback salamander found near Promised Land State Park (PCCP Photo). Egg cluster for redback salamander (PCCP Photo). Opposite: Dragonfly found along North Campus Trail (PCCP Photo).

Historical Perspective: The Importance of Water to the Poconos

While the local tourism economy currently depends upon the rivers for fishing, kayaking and tubing, water historically served as a means of transportation in the Pocono region. The Lackawaxen and Delaware Rivers historically were used in the transport of anthracite coal. In the 1800's, coal was used to power factories and heat homes. The Delaware and Hudson Canal began operating in 1828. Coal mined in northeast Pennsylvania was transported to Honesdale, Pennsylvania via the gravity railroad, and then loaded into a canal boat. These boats transported the coal via the canal from Honesdale to Rondout, New York. From there, ships could transport the coal down along the Hudson River to New York City.

How To Read a Topographic Map

Topographic (or Contour) maps describe changes in elevation in a given location. These maps are developed by recording a series of elevation points on a specific property, and then using these points to estimate the elevation and layout for the rest of the site. The estimates are displayed through a series of contour lines that indicate elevation intervals on the property. While there is some math involved in determining the approximate locations of each interval, the process is similar to a game of connect -the-dots. Since each contour line is considered to represent a specific elevation, lines cannot cross. When the lines are far from each other, the property has little change in elevation and few steep slopes. When the lines are close together, steep slopes exist. By examining these lines and determining the slope and direction of the slope, one can estimate where a drop of water would travel. High elevation ridgelines that divide two lower elevation areas may indicate a watershed boundary. The site map on the following page includes a contour map of the North Campus. On a topographic map from the United States Geological Survey (USGS), topographic lines are typically brown in color. To aid in display over the aerial photograph, the map on the next page uses a series of colors to denote changing contour intervals.


0 280 560 1,120 1,680
Feet
ESASD North Campus School Boundary
Campus Map Inset
Saw Creek Watershed
Little Bushkill Creek Watershed
Map Developed by the Pike County Office of Community Planning, March 2013-ND
Saw Creek Watershed
Little Bushkill Creek Watershed
DELAWARE STATE FOREST
1200
1220
1240
1260
1280
1300
1320
1340
1180
Legend
Wetlands
Nature Trail and Outdoor Learning Center
Delaware State Forest
Contour Lines
1180'
1200'
1220'
1240'
1260'
1280'
1300'
1320'
1340'
Watershed Boundary