



WEB Resource Guide

watershed education by bike

A guide to Camden areas for
watershed educational activities



rails-to-trails
conservancy

Contents



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Rails-to-Trails Conservancy, a nonprofit organization with more than 160,000 members and supporters, is the nation's largest trails organization dedicated to connecting people and communities by creating a nationwide network of public trails, many from former rail lines.

To learn more about Rails-to-Trails Conservancy and its role in making trails, walking and biking a part of the national transportation solution, visit railstotrails.org.



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Our hope is that this document can serve as a tool to promote water protection and conservation throughout the Circuit trail region.

Introduction

This resource guide was created to document the Watershed Education by Bike (WEB) program developed by Rails-to-Trails Conservancy. The activities and experiences included in this document are intended to help other organizations and individuals carry on the work and programming started by WEB.

WEB grew from the Camden Youth Cycling Learning and Exercising (CYCLE) program, a summer program that taught Camden public school students the basics of road riding and bike safety and led these youth on daily rides through their communities. Through CYCLE, the students became more aware of the environment around them. Their curiosity and enthusiasm for the outdoors led to many spontaneous environmental lessons. Those experiences, mixed with the unique views that bicycles allow, presented an opportunity to combine CYCLE with an education program that teaches youth to be aware of, and to understand, water health and its issues.

A program to educate and train future users and stewards of the trail systems in Camden was seen as an important endeavor as more multi-use paths are planned and built along the waterways in the urban environment. Thus, WEB was created with the explicit goal of educating youth through hands-on activities offered along these waterways at access points reachable by bike. The emerging regional system that includes Camden is called the Circuit. Find more information about the Circuit network of trails at connectthecircuit.org.

The WEB program in Camden took place in the spring and summer of 2013 at three middle schools: Hatch Family School, East Camden Middle School and H.B. Wilson Middle School. The ages of the participants ranged between 11 and 14 years. During the spring, students participated in the program twice per week for four weeks; during the summer program, the program was held twice at East Camden Middle School for six weeks and once at the North Camden Community Center for three weeks. This extensive period of riding and learning allowed the students to learn about the community, their environment and how different factors affect the watershed and, consequently, their own lives.

The students traveled by bike exclusively to access points along the waterways and within the watershed. Trips ranged from 1 to 35 miles, with the average distance totaling about 15 miles per day. Traveling to various environments and sites made it possible for students to understand the watershed and how it works, while also allowing them to see the similarities and differences of the ecosystems—giving them an appreciation for the complexity and beauty of a system that directly affected their daily lives.



Background

The water cycle, or hydrologic cycle, describes how water moves on, in and above the Earth; because the cycle is continuous, it does not have a start or end point. A good place to start, however, is the ocean. According to the National Oceanic and Atmospheric Administration (NOAA), almost 96 percent of the Earth's water is found there.¹ In the ocean, the sun's rays heat the water and turn it into vapor in a process called **evaporation**. As you cycle with students on a warm and sunny day, you might come across glass bottles that have trapped water droplets. Point this out, as it shows the process of evaporation. As the water vapor rises, the air cools it; if it is close to the ground, it might become the dew found on the ground in the morning, but most often it forms into clouds. If you are riding earlier in the day, the grass could still be wet because of the dew, demonstrating the process of **condensation**, when water vapor is cooled by the air and forms into liquid. As the wind moves the clouds over land, the clouds become larger as water vapor given off by plants—a process known as **transpiration**—combines with it. Changes in temperature start the process of **condensation**, which causes the water vapor in the clouds to form into liquid and fall out of the sky as precipitation. **Precipitation** can fall as snow, rain, sleet or hail.

As rain falls or snow melts, the resulting water will soak into the ground in a process called **percolation**. If there is too much water passing over the land quickly—it cannot seep into the ground and plants can't soak it up fast enough—the water begins to move across the top of the land as **runoff**. Materials that are picked up by the runoff and carried into waterways are called pollutants. This might include dirt, chemicals, oils, fertilizers and trash (EPA, "After the Storm"). The water that does soak, or percolate, into the ground becomes **groundwater**. While biking

around the city, it is easy to see the different reasons that water is not able to percolate into the soil. Notice the extensive parking lots, especially along the riverfront in Camden; the wide roadways and sidewalks that make the city easy to travel through; and the flat land that does not allow water to pool and collect. (In the urban environment, runoff flows off rooftops and driveways onto streets, where it then flows into sewer inlets and is carried away to streams or a sewage treatment plant.)

The runoff continues downhill until it forms a **stream**. This stream can join another stream and become a **river**. Eventually, all rivers flow to the lowest surface point, the oceans, seas and lakes, where the water cycle continues with evaporation (NGWA, "Ground Water Hydrology"). This guide contains routes that lead to a sewage treatment plant along the Delaware River, and also sewer outlets that can be seen emptying into the waterways.



Activities

The water cycle is a very general and all-encompassing topic, and many of the dioramas that have been created to show the entire water-cycle system are too large to transport by bike. Thus, a worksheet is found in the appendices to give a visual to the system. While cycling through the city, point out different locations in which water appears, where in the water cycle it is and the next possible steps the water might take in the cycle?

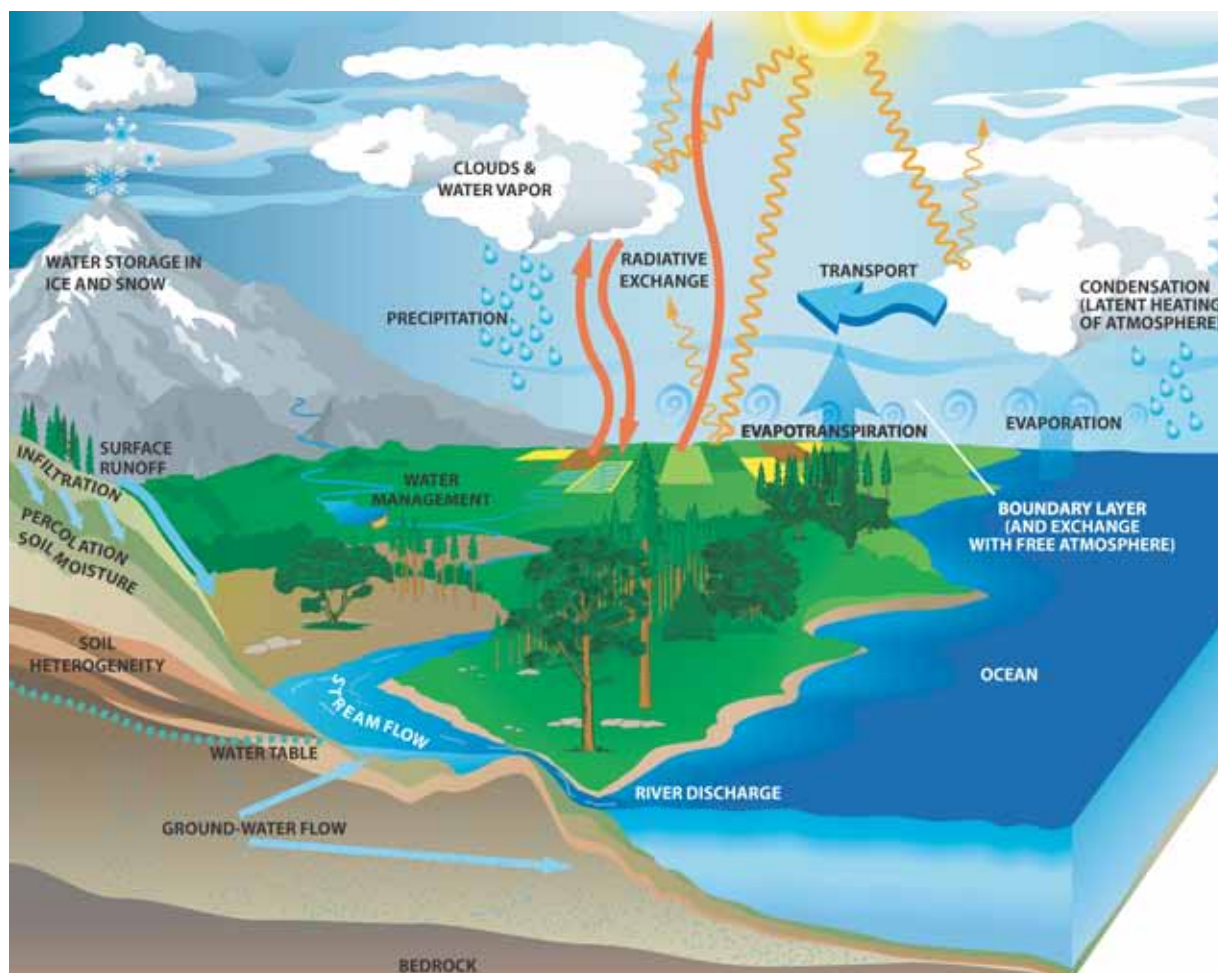
Access Points

While cycling through any neighborhood in Camden, especially along its parks and waterways, different aspects of the water cycle can be seen and explained to both youth and the community. One of the major successes of the WEB program was the ability to constantly apply lessons across multiple sites, allowing students to understand the process and not associate it with just one specific place.

Key Words

Evaporation, Condensation, Transpiration, Precipitation, Percolation, Runoff, Groundwater

1. <http://oceanservice.noaa.gov/facts/ocean-water.html>



Source: <http://news.cisc.gmu.edu/images/watergraphic.jpg>

TIPS from WEB 2013

Be ready to get your hands greasy. Flat tires will happen; make sure you have both the tools and knowledge required to do repairs. Knowledge of small bike repairs is also useful; however, most issues that arose in the 2013 WEB program were usually minor enough for the bikes to still be rideable.



Background

Not all water is located in ponds, lakes, oceans and ice caps. Water that is absorbed by the Earth is called groundwater. **Groundwater** fills in the spaces between soil and rocks, and in the fractures of rock formations that make up mountains. **Aquifers** are areas of rock or other material (such as sand or gravel) that can provide water when extracted. These are mostly found below the **water table**, which is the level at which all the spaces in soil and rocks are completely filled with water. Though we walk, drive and cycle on top of groundwater all the time, there is no easy way to witness this while cycling. Camden has no natural springs nor any open wells in which to see groundwater or the water table.

During the water cycle, water evaporates into the atmosphere and later falls onto the land as precipitation. Most of this water finds its way back into waterways, such as streams and rivers, or is used by plants to grow. Water also seeps into, or percolates, into the ground, becoming part of the groundwater. According to NOAA, groundwater accounts for roughly 30 percent of fresh water in the world²; only the polar ice caps and glaciers hold more fresh water, about 68 percent, while the other 2 percent is found in all the surface water—rivers, streams and lakes—on Earth.³ *Cycling to the Camden County Environmental Center, WEB students learned about buildings designed to allow precipitation to seep into the ground. And, by visiting nearby Cooper River, the students were able to witness water flowing into the river from the wet banks.*

Groundwater can naturally rise to the surface through **springs** and large seeps, and form **wetlands** or oases. Groundwater is used for a variety of purposes, such as for drinking and watering crops. In many places outside of cities, wells are made to reach the groundwater for drinking and home use. In Camden, there are no homes that have wells; instead, water is pumped into the city from large aquifers. *A bicycle ride to the Fairmount Water Works, located on the Schuylkill River Trail in Philadelphia, gave students a good understanding of aquifers and the process by which fresh water is pumped into large cities without the use of wells. While cycling along riverfronts, students were able to point out water flowing from the banks and retaining walls into the river, especially during low tide.*

While groundwater has a natural filtration system, there are still things that can endanger it. According to the Environmental Protection Agency (EPA), the number-one danger to groundwater health is pollution that filters into the system.⁴ *While cycling through the streets, notice the dark drip spots found in parking spaces. These chemicals and oils will get carried away with water runoff and eventually seep into the ground. In the city, rain gardens allow runoff to gather, where it slowly percolates into the soil and is absorbed by plants, limiting its movement over contaminated land and reducing pollutants in the system.*

Some of the plants found in wetlands have been known to decontaminate water by filtering out pollutants.⁵ *Cycling to the Cove Road Boardwalk to see the plants filtering the water that flows from the groundwater and sewer systems gave our students a better appreciation for the wetlands. The Palmyra Cove Nature Center is another great place to see the wetlands in action; it contains many trails that lead out through the wetland and to the river.*

Key Words

Groundwater, Aquifer, Water Table, Wetlands, Spring

2. <http://oceanservice.noaa.gov/facts/where-water.html>

3. <http://ga.water.usgs.gov/edu/earthwhere-water.html>

4. "Getting Up to Speed: Ground Water Contamination." Environmental Protection Agency: <http://www.epa.gov/region1/students/pdfs/gwc1.pdf>.

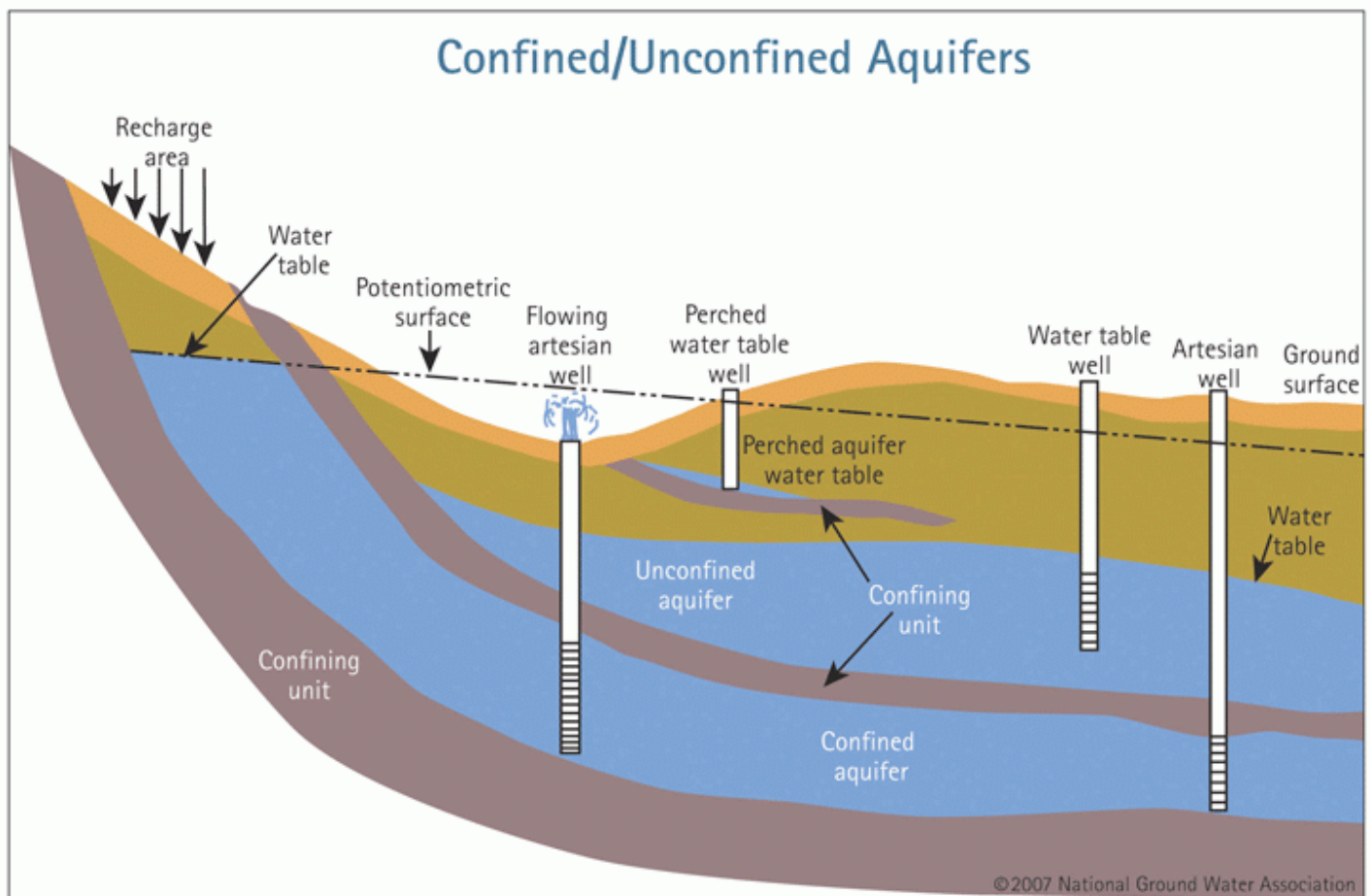
5. <http://www.bbc.com/future/story/20120925-natures-water-purifiers>

Activities

Complete "Common Water," Project WET, p. 232

Access Points

Camden County Environmental Center, Farnham Park, Cove Road Boardwalks, Fairmount Water Works, Palmyra Cove Nature Center, Crow's Woods



Source: <http://www.ngwa.org/Fundamentals/use/Pages/Groundwater-facts.aspx>



Background

Rain that falls to the Earth does a few different things: it evaporates into the atmosphere, it is used by plants, or it seeps down through the soil into the groundwater. The remainder of the rainfall flows into gutters, drains, streams, rivers and lakes as stormwater **runoff**. In the urban environment, there is less percolation because there are less **permeable** surfaces. As the rain moves over the land's surface, it collects pollutants and carries these contaminants into local waterways. The pollution carried by stormwater runoff into our waterways is called **nonpoint source pollution**. *As you cycle around, it is very easy to see this future pollution. Notices the dark stains that appear under parked cars; these are especially apparent in parking lots near schools and large buildings. For example, near the Camden Greenway, students noticed potential pollutants in the parking lot of a pub and, further along, the trash located on the parking lots of schools.*

Stormwater runoff that carries nonpoint source pollution to our waterways is the major reason many of our streams, rivers, estuaries, ponds and lakes are filled with trash and other pollution. According to the New Jersey Department of Environmental Protection (NJDEP), nonpoint source pollution in stormwater runoff is the cause of up to 60 percent of the region's existing water pollution problems, making it the largest source of pollution in New Jersey waters.⁶



Source: <http://clean-water.uwex.edu/pubs/clipart/lakesign.lakeart.htm>

This pollution is quite apparent when visiting sites along the riverfronts. Note the trash that accumulates in the rivers, especially on the Camden Waterfront, and which is even more apparent in Wiggins Park and its marina. When bicycling on the Jail Trail along the old prison site, or at Pyne Poynt Park, note the trash that has accumulated along the river banks and washes up with the tides. During low tide at the old prison site, note the large concrete pipes jutting out into the mudflats. These pipes carry stormwater from the street inlets into the waterways. While cycling on the trails behind the Camden County Environmental Center and the State Street Bridge, the students can easily see outlets flowing into the river. It is important to point out where the water from these outlets is coming from: the streets.

Activities

Complete “A-MAZE-ING Water,” Project WET, p. 219

Discuss ways to control runoff and pollution throughout the city, including urban rain gardens, rain barrel usage, and keeping streets clean from trash that can get washed into the sewer system and washed out into rivers and streams.

Another activity to drive home the point of how our actions affect water quality is to split the students into different groups who would then take an inventory of trash around storm drains at different street corners. Then, ride to one of the locations below and note the trash in the water, pointing out that the same trash on the streets is brought into the rivers through runoff.

Access Points

Camden County Environmental Center, CCMUA Rain Garden, Park Avenue Rain Garden, Magnolia Avenue Rain Garden, Farnham Park, Camden Children’s Garden, Old Prison Site, Wiggins Park

Key Words

Runoff, Permeable, Nonpoint Source Pollution

TIPS from WEB 2013

During the first couple days of riding, make sure to teach all participants proper bike safety skills. Find a League Certified Instructor (LCI) in your area to lead these classes, focusing on how to ride on roadways, the proper use of hand signals and transportation rules. Note: Ensuring the students know how to properly shift their bikes and come to a full stop is paramount to your success.



Background

A watershed is the area between two high points on land where precipitation and snowmelt run down into streams. More than one watershed can combine to form an even larger watershed. If many join together, they form a basin. The area of land where the runoff flows to a common stream is called a watershed, and every one of us lives in a watershed. As two streams join together to form a larger stream, the two areas of land that drain to these streams join together to form an even larger watershed. Because smaller watersheds join to form larger watersheds, most people live in more than one watershed.

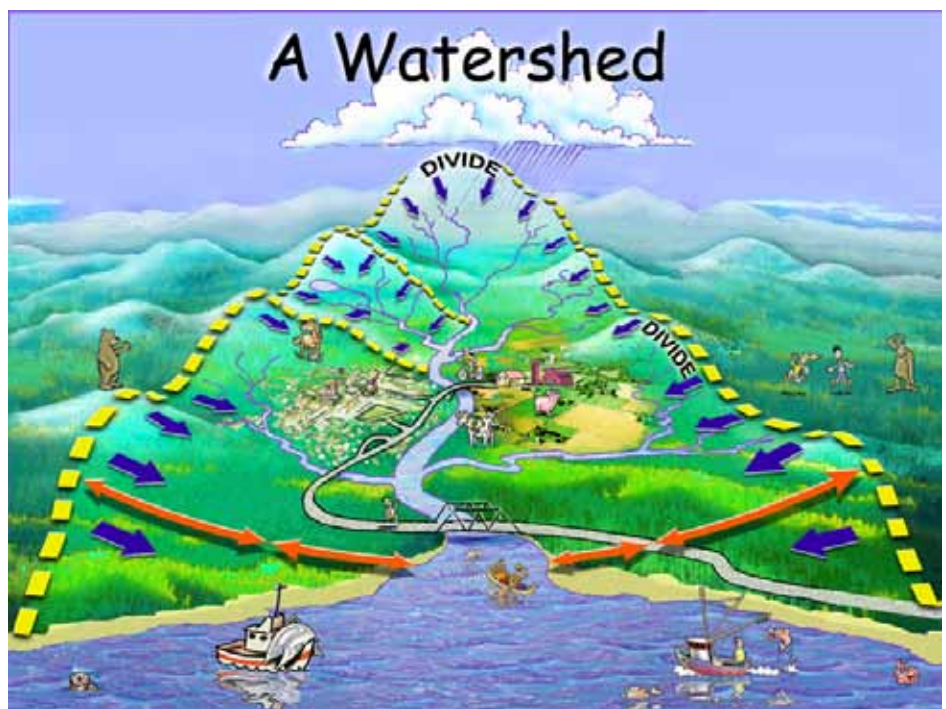
There are many combined natural factors that distinguish watersheds. These include geology (rock types), soil type, slope, land surface features, climate, etc.⁷ The different combinations of these factors determine the types of animals and plants that live in the watersheds. Where a plant or animal lives is called a habitat; the plants, animals and their habitats are called an ecosystem.

Local Watersheds

The following geographic and historical information has been provided for background information for the three local watersheds through which the WEB program cycles. This information is being reprinted from “A Teacher’s Guide to the Watersheds of Camden County,” prepared by the Delaware Valley Regional Planning Commission for the Environmental Commission of Camden County and Camden County Board of Freeholders.

Cooper River Watershed The Cooper River watershed drains an area of 40 square miles, all in Camden County (NJDEP, “Watershed Restoration”). The river is 16 miles long and empties into the Delaware River in Camden City. It is tidal up to the Cooper River Lake dam at Kaighn Avenue in Camden. The Cooper River has two main branches. The North Branch starts in Voorhees Township and flows northwest through Cherry Hill. The South Branch starts as three tributaries in Voorhees, Gibbsboro and Lindenwold (Nicholson Branch, Hilliard Creek and Slab Cabin Branch) and flows northward toward Camden City. It meets the North Branch at a point just west of Kings Highway in Cherry Hill to form the main channel. Other Camden County towns that are partially in the watershed are Camden, Collingswood, Haddonfield, Haddon Township, Lawnside, Magnolia, Pennsauken, Stratford, Somerdale and Tavistock. Merchantville is entirely within the Cooper River watershed.

Two of the largest tributaries of the Cooper River are Woodcrest Creek and



7. “Watershed Basics.” Environmental Protection Agency, 2001.

Source: <http://www.raritanbasin.org/watershed101.html>

Tindale Run. There are also a large number of lakes along the Cooper River; the major ones are Cooper River Lake, Evans Pond, Kirkwood Lake, Linden Lake, Bridgewood Lake, Clement Lake and Silver Lake (in Gibbsboro).

The Cooper River is named for William Cooper, who acquired land in what is now Camden City in 1682, and for his descendants who settled the land. Cooper's Point, Cooper Hospital and Cooper Street are also named after the influential Cooper family.

Included with the Cooper River on the watershed map is Pochak Creek in Pennsauken Township, which flows directly into the Delaware River. Other small streams that once ran across Pennsauken are not shown on the map because they have been "ensewered." Ensewering a stream means that it is no longer on the surface, but flows through stormwater pipes in a larger river, in this case the Delaware. Diverting streams into storm sewers also occurred in cities such as Camden. By the 19th century, small streams had often become heavily polluted and noxious, some causing flooding problems. Space was a valuable commodity in bustling, developing towns. Ensewering a stream allowed people to build on dry land.

Newton Creek Watershed The Newton Creek watershed is the smallest watershed entirely within Camden County, draining an area of only 13.6 square miles. There are three branches of Newton Creek. The North Branch begins at the border between Camden City and Woodlynne and flows southwest toward Gloucester City. The Middle or Main Branch begins as unnamed tributaries in Haddonfield and Audubon and flows west toward Gloucester City. The South Branch begins in Haddon Lake Park in Haddon Heights and flows northwest toward Gloucester City. Together, these three branches flow through a total of 11 municipalities before joining together and then emptying into the Delaware River between Camden City and Gloucester City. Other towns either partly or wholly in the Newton Creek watershed are Audubon Park, Collingswood, Haddon Township, Mount Ephraim and Oaklyn.

The Newton Creek watershed was the location of the first permanent settlement in Camden County.

Pennsauken Creek Watershed The Pennsauken Creek watershed drains an area of 33 square miles in northern Camden County and southwestern Burlington County, and flows into the Delaware River between Pennsauken and Palmyra (NJDEP, "Watershed Restoration"). Pennsauken creek has two main branches: the South Branch, which forms a good portion of the border between Camden and Burlington Counties, and the North Branch, which is located wholly within Burlington County. The South and North Branches join together at the north end of Maple Shade in Burlington County, just east of the Route 130 and Route 73 interchange. The tide affects the three-mile main channel and the first few miles of the two branches.

Cherry Hill and Pennsauken are the only two townships in Camden County that have areas within the Pennsauken Creek watershed. There are five communities on the Burlington County side. The only lake along Pennsauken Creek is Strawbridge Lake, located on the North Branch in Burlington County.

Activities

Quick Watershed Diorama: The best method to visually show the path of the water in a watershed after precipitation would be to use a watershed diorama. If none can be found, a simple piece of foil will suffice. Crumple a 10" by 10" piece of aluminum foil, and then open it up. With your peaks and valleys, you have now constructed a rough watershed. Smooth out spots to replicate lakes. As you drop water onto the model, ask the students where they think the water will go and what body of water it would be moving in: feeder stream, river or lake. Also, ask what else could happen to the water as it moves through the watershed, such as evaporate or seep into soil to become groundwater.

Access Points

CCMUA Rain Garden, Pyne Poynt Park, Palmyra Cove Nature Center, Camden Children's Garden, Old Prison Site, Wiggins Park, Cove Road Boardwalks, Newton Creek Community Gardens, Camden County Environmental Center, Amico Island, Pompeston Park, Farnham Park, Kaighn Avenue Dam, State Street Bridge, Fairmount Water Works

TIPS from WEB 2013

Off-road trails provided both a great change of scenery and convenient access to waterways, as well as a nice break from the heat of road riding—especially during the summer months. The students found them very fun to ride, and muddy trails were not a concern!

Background

A **river** is a natural watercourse, usually freshwater, flowing toward an ocean, lake, sea or another river. In a few cases, a river simply flows into the ground or dries up completely at the end of its course, and does not reach another body of water. Small rivers may be called by several other names, including **stream**, creek and brook.

The river can be described as a system that is continuously changing its physical parameters, the availability of food particles and the composition of the **ecosystem**. The food (energy) leftover from the upstream area will be used downstream. The general pattern is that the smaller streams contain particulate matter (decaying leaves from the surrounding forests), which is processed there by shredders like Plecoptera larvae (WRC, “Water Quality and Macroinvertebrates”). As the river flows, different organisms consume each other, making for a rich ecosystem.

Rivers are used for transport, as a defensive measure, as a source of hydropower to drive machinery, for bathing and as a means of disposing waste. They are also used to obtain food and can provide a rich source of fish and other edible aquatic life. Rivers serve as a major source of fresh surface water for drinking and irrigation. It is therefore no surprise that many major cities are situated on rivers. Rivers help to determine the urban boundaries of cities and neighborhoods, and their corridors often present opportunities for urban renewal through the development of riverwalks and trails.



This will be quite apparent as you cycle to different waterfronts, noting the development that exists in each area. On the Delaware River, both industry and recreation exist on the waterway. On the Schuylkill River and Cooper River, the waterways are used for recreation.

Activities

Point out the different uses of rivers in surrounding communities, including Camden. Trails throughout the area are found along the rivers, and this should be brought to the forefront.

Speak to fishermen at Kaighn Avenue Dam, and visit the riverfront along several places, as noted below.

This guide contains an activity that demonstrates macroinvertebrates. This is an opportunity to do a stream study, which can be basic or could become an all-day event, especially during a summer program. You will need a net, a bucket, plastic

spoons and some ice cube trays. The goal is for students to understand the direct link between water quality and aquatic life. If the water is polluted, bugs can't live in the water. Different bugs tolerate different levels of pollution, which allows us to find out how clean a body of water is by what lives there. Use the net to scrape the bottom, and then scoop out some contents and dump it into the bucket. Then, sort through the contents (using the spoons and ice cube trays).

For a guide to different kinds of insects, visit: raritanbasin.org/Presentations/WPUPapers/Macroinvertebrate%20Identification%20Presentation.pdf.

Access Points

Pyne Poynt Park, Palmyra Cove Nature Center, Camden Children's Garden, Old Prison Site, Wiggins Park, Newton Creek Community Gardens, Newtown Creek Park, Camden County Environmental Center, Farnham Park, Kaighn Avenue Dam, State Street Bridge, Amico Island, Fairmount Water Works

Key Words

River, Stream, Ecosystem



Source: http://mostreamteam.org/activity_guide/flood_plains/floodPlains_functions.htm

TIPS from WEB 2013

An assortment of bike sizes is paramount to fit the students properly. Most bikes used in the 2013 WEB program were mediums, with a few small and large frames. Regardless of the size of the frames, try to keep a fleet of bikes with the same tire size, as it will make flat-tire changes easier and quicker. In the same vein, always carry a patch kit, a few tubes and a hand pump; flat tires were the main cause of unexpected, but welcome, breaks in riding.

Background

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. Primarily, the factor that distinguishes wetlands from other landforms or water bodies is the characteristic vegetation that is adapted to its unique soil conditions; wetlands consist primarily of hydric soil, which supports aquatic plants.⁸ Wetlands are highly productive communities and provide habitat and food resources for a wide range of species. Wetlands have a high level of nutrients, and coupled with the availability of water, they provide an ideal habitat for fish, amphibians, shellfish and insects. Additionally, many birds and mammals rely on wetlands for food, water, breeding grounds and shelter.

When you cycle to the wetlands or ride near them, point out the birds that are seen floating and flying. The Cove Road Boardwalk will also allow for the students to get into the wetland; here students have been able to spot fish, turtles and aquatic life. Water sampling was also conducted at the site, with the addition of a rope to lower the bucket into the water.

Another important aspect of wetlands is that they can filter and clean water; thus, they are nicknamed the kidneys of the water cycle.⁹ Certain wetland plants such as bulrushes, cattails and water hyacinths can actually “suck up” the contamination like a straw.¹⁰

Wetlands are also being used for storm water controls. Rather than allowing muddy water to run directly into streams and cause sediment problems, water is directed into a wetland area, filtered naturally and then slowly discharged back into the stream. Throughout each wetland you visit, point out the surroundings. Developed housing and some industry result in increased runoff, which carries pollutants. Additionally, point out how the wetlands are situated between these developed areas and the river. Many times, the view of the river is blocked by the tall grasses of the wetlands. This serves an important role of cleaning the water flowing from our developed areas before it reaches the river.



Activities

Ask the students: “Now that we know what wetlands are, what are some reasons that they are important?” Students should come up with a lot of different answers; these should include:

Biological diversity (providing a home for specific plants and animals)

A place to fish or hunt

Flood control

A place for migrating waterfowl

Beauty

A protected area or park

8. Macquarie Concise Dictionary, 5th ed. Butler, S., ed., 2010.

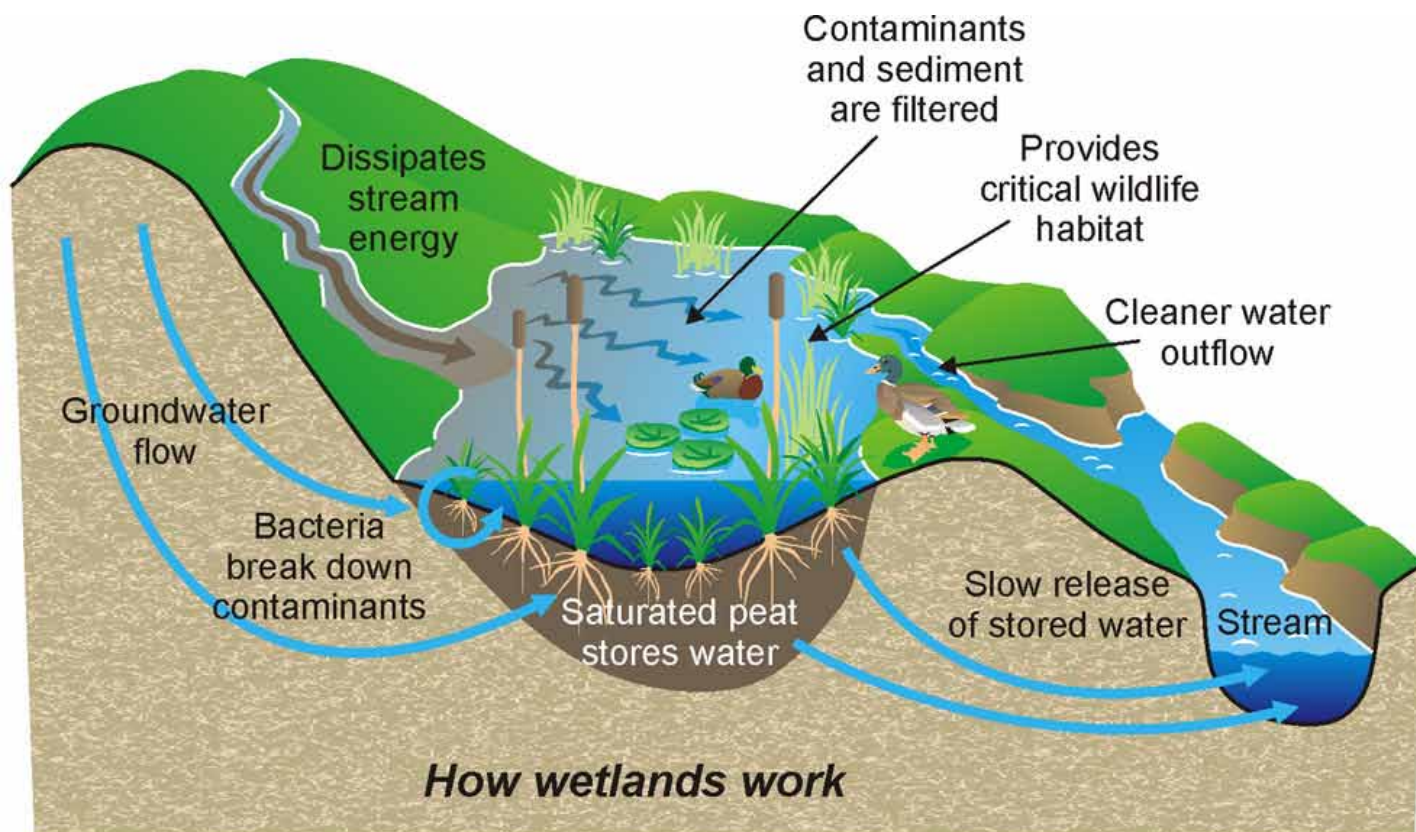
9. “Getting Up to Speed: Ground Water Contamination.” Environmental Protection Agency: <http://www.epa.gov/region1/students/pdfs/gwc1.pdf>.

10. “The Importance of Wetlands.” Mullen, Kimberly: <http://www.ngwa.org/Fundamentals/teachers/Pages/The-importance-of-wetlands.aspx>.

Complete “Capture, Store, and Release,” Project WET, p. 133

Access Points

Palmyra Cove Nature Center, Old Prison Site, Newton Creek Community Gardens, Newtown Creek Park, Cove Road Boardwalks, Amico Island, Farnham Park



Source: http://myweb.rollins.edu/jsiry/wetlands_e.jpg Locations



Background

In developed areas such as cities and suburbs, rain can pose problems for the surrounding areas. The problem is caused by impermeable surfaces: Water is unable to be absorbed into the soil and is instead routed into storm drains, which empty into local streams and rivers. This runoff is bad for those ecosystems due to both the larger amount of water that can lead to flooding and the pollutants that are carried as the runoff travels to streams.

If you walk around outside and look at the roads, you can see dirt, oil from cars and trash; imagine these things being swept up by rain and getting dumped into a waterway, polluting it and the surrounding area. Rain gardens are used to help mitigate this problem. Going to a large shopping area (or strip malls), you will probably find a pond or other large water feature. This is a version of a retention pond in which all the water that hits the parking lot and buildings gets routed to the pond to be filtered through the soil without harming another ecosystem. *There are no examples of these types of retention ponds in Camden, but all the students in the spring and summer programs saw them, or became aware of them, during their trips outside the city to large shipping areas, such as the Cherry Hill Mall.*

To increase their effectiveness, plants that are native to the area are placed in these retention ponds. Native plants are a better choice than foreign plants because they are more tolerant of local conditions such as soil type, climate and rainfall. For rain gardens, plants usually found near wetland edges are optimal because they are already accustomed to large amounts of water, and are able to absorb more and filter it better.¹¹ These types of plants include wild flowers, rushes, ferns, shrubs and smaller trees. They also help the soil in the retention ponds to not erode since the roots keep it in place—allowing the water to remain long enough to go through the soil. The different soil layers also work as a filtration system before the rain-water can enter the groundwater.

Rain gardens stimulate the local ecosystem by creating a habitable space for a variety of animals. Simple examples are the worms and insects that are attracted to the plants and higher water saturation. This, in turn, leads birds and other predatory animals to use the space as a hunting ground.

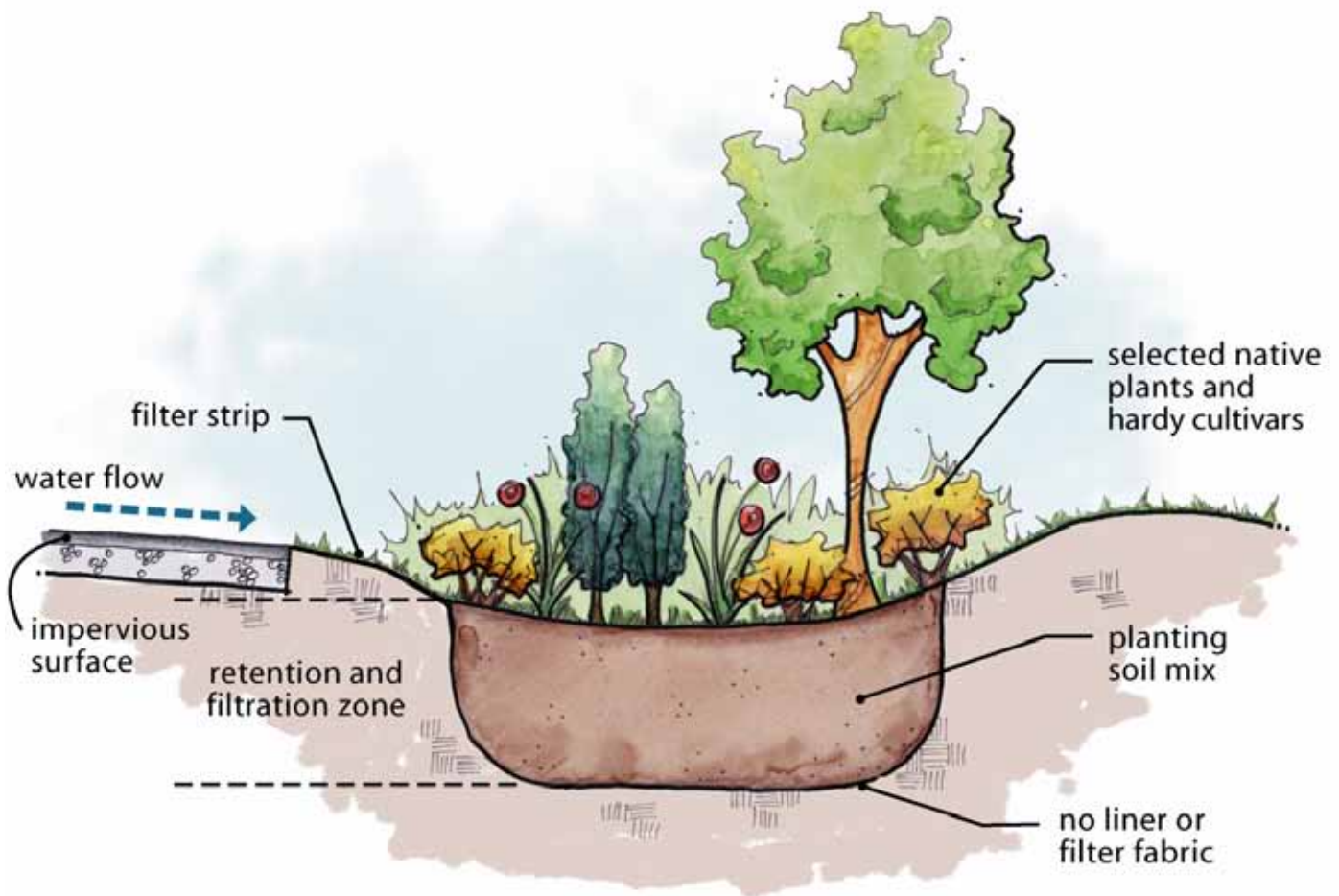
Activities

Complete “Thirsty Plants,” Project WET, p. 116

Access Points

CCMUA Rain Garden, Park Avenue Rain Garden, Magnolia Avenue Rain Garden, Newton Creek Community Gardens

11. "Rain Gardens: A Way to Improve Water Quality in Your Community."
University of Massachusetts, Amherst.



Source: <http://www.betterground.org/rain-gardens>



Background

Every 12 hours or so, the water of seas and rivers rises and then falls back again. This process is referred to as the tides. When water is rising, we say the tide is **flowing**. When water is falling, we say the tide is **ebbing**.

The movement of ocean waters is caused by the Moon and by the Earth's rotation. Gravity pulls the Moon and Earth together, and as the Earth turns, the Moon pulls at the water directly beneath it, causing the water to rise.¹² A similar rise in sea level occurs on the opposite side of the Earth, where the water bulges out as a result of the Earth's spinning. At these locations, there is a high tide. Some six hours later, the Earth has turned 90 degrees. The water then falls to its lowest point, and there is a low tide.

The only waterway not affected by the tides in our area is the Cooper River. The river here is non-tidal because of the Kaighn Avenue Dam, which maintains the water at a constant height, allowing it to be used for recreational activities such as sailing and rowing. When riding to the Kaighn Avenue Dam, note the different water heights on either side. Also note the fish ladder located within the dam that allows fish to pass through it. There is a very educational sign that describes the process and includes images.

All other waterways are affected by the tides, including the wetlands, the banks of the Cooper and Delaware rivers, and Newton Creek. While riding over State Street Bridge, note the relatively fast movement of the water in either direction. The smaller channel increases the speed at which water flows. At Pyne Poynt Park, note the water level, and if coming back at a different time or different day, it might be possible to walk on the bank where it was once submerged. Similarly, teaching a lesson on mudflats at the Old Prison Site is only useful if the students can see the mudflats, which will occur during low tide.

Tides were one of the most interesting topics, both to see and learn about, for the students of the spring and summer programs. However, they were also one of the hardest to explain. Diagrams helped, and note that the focus can be shifted from what causes tides to the effects and benefits of tides on the ecosystem.

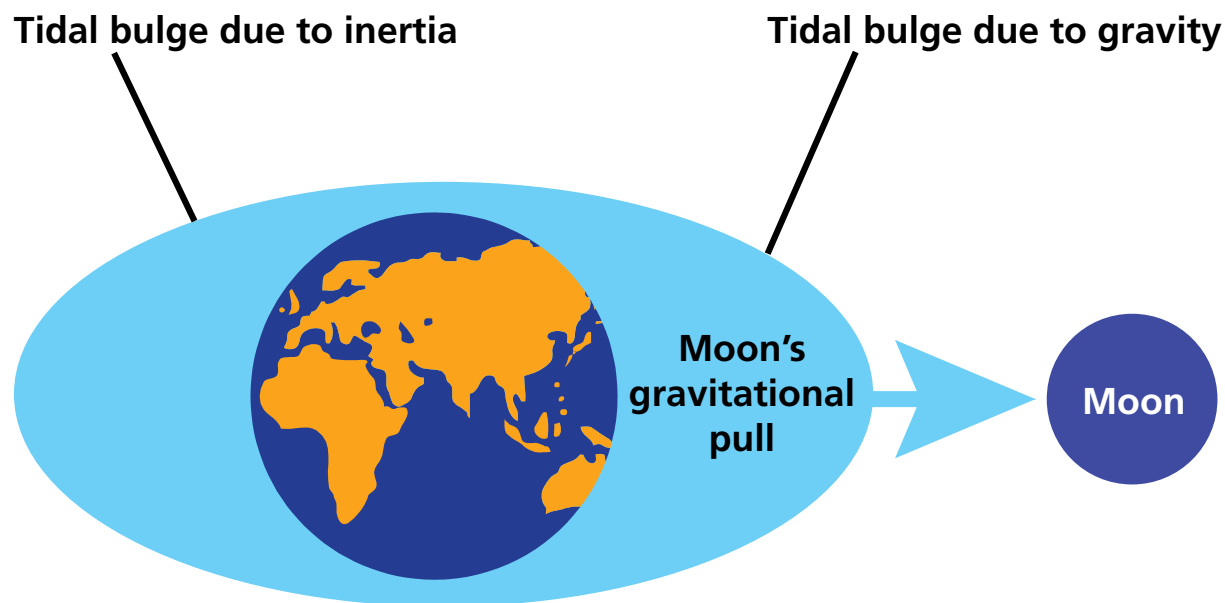
Activities

On different days, ride to the locations listed below and note the height of the water. What animals and birds are present during low tide? What do they do during high tide? Note the direction the water is flowing, and ask whether this means the tide is flowing or ebbing. Think about how the movement of the tides affects water quality: the movement of silt and trash in the waterway, trash being washed up on river banks, etc.

Access Points

State Street Bridge, Kaighn Avenue Dam, Old Prison Site, Newton Creek Community Gardens, Newtown Creek Park, Pyne Poynt Park

12. "Tides and Water Levels." NOAA:
http://oceanservice.noaa.gov/education/tutorial_tides/welcome.html.



Source: http://oceanservice.noaa.gov/education/tutorial_tides/tides03_gravity.html

Select Tours and Routes

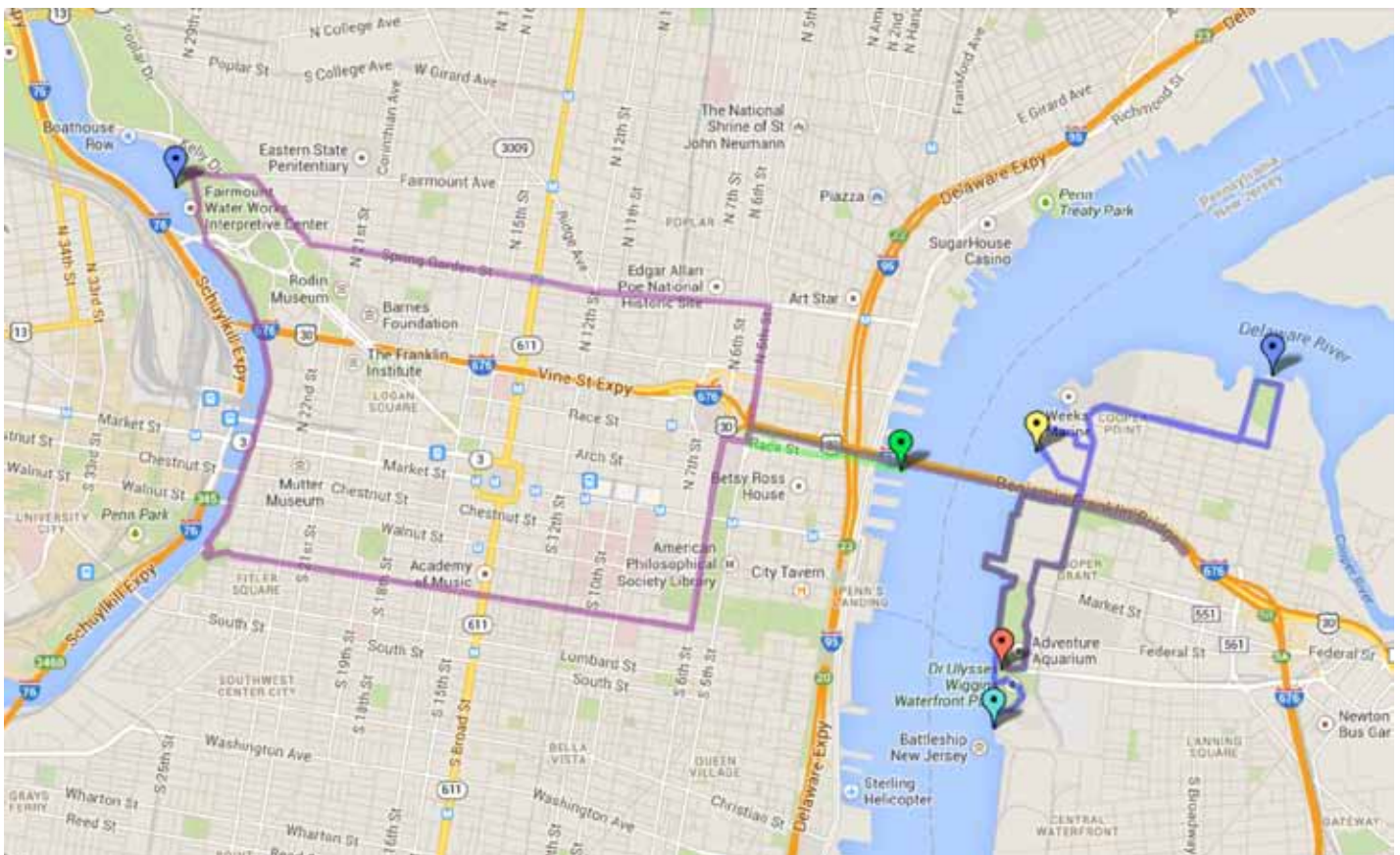
Riverfront Tours

Some of the most interesting conversations, and a sense of how rivers can be used and enjoyed by many different groups, have come from this short tour. At Pyne Poynt Park, the water is easily accessible for water sampling activities and learning about daily tides.

Short Tour • 4.5 miles | 1 hour

This cycling tour takes place entirely in Camden. This is a short route, but one in which city development, water use for industry and recreation, water health and aquatic species can be taught and understood. Starting at Wiggins Park, interesting sites include the Ferry, Adventure Aquarium and the piers used by community members for fishing and relaxing. The Promenade is a well-maintained path that has large views of the Philadelphia riverfront. (But look out for broken glass.) As you continue the ride to the Old Prison Site, the landscape along the river fills with more vegetation and wildlife. Industrial uses of the water are now more apparent here, including the marine yard adjacent to the trail. Continuing the ride to Pyne Poynt Park, the students are able to see a completely recreational riverfront that is much less developed, especially when taking into account Petty's Island across the channel.

Directions: Starting at Battleship New Jersey, continue along the Waterfront Promenade to Pearl Street. Make a left on Pearl Street, and ride in the bike lanes until Delaware Avenue. Make a left on Delaware Avenue, and then, shortly after passing under the bridge, make a left onto Elm Street. The Jail Trail begins on the right, at the end of the road. Follow the road around the property, and then,



after exiting, make a right onto the street. After reaching Delaware Avenue, make a left to continue to Pyne Poynt Park. The road merges with Erie Street, and the Park will be located on the left at 7th Street. Return the same way, or omit the Jail Trail and continue down Delaware Avenue to Cooper Street. Then, make a left onto Delaware Avenue to continue to Wiggins Park. If you choose the latter option, be very cautious of the railroad tracks.

Medium Tour • 6.75 miles | 2.5 hours

Though not many access points are located on this tour, it is nonetheless a very interesting one for the students. For almost all the students that have taken part in the WEB program, riding over the bridge brought great joy and a feeling of accomplishment. This tour will again emphasize the riverfronts of two cities, enabling the students to see their differences while understanding how very similar they are. The students will be riding along the pedestrian walkway and also on bike lanes in both cities. When you reach your destination in Philadelphia, the recently completed Race Street Pier, feel free to take a break to sit and enjoy the view of Camden. During the summer months, the Duck Tours are operational, and the ramp used to drive into the water is located next to the Race Street Pier. This has always been of great fascination to the students.

The ride is great fun, but it also presents a great opportunity to explain how waterways are used and why it is important to keep them free of trash and pollutants. Note: It is safe to continue into Philadelphia from this point using the bike lanes leading from the Pier. The river, however, cannot be directly accessed from this site.

Directions: Starting at the Camden Riverfront and pedaling along the Promenade to Pearl Street, head east to ride along the Ben Franklin Bridge pedestrian walkway. At the end of the walkway, make a hard right, and continue down the closed cobblestone street toward 5th Street. Make a right onto 5th Street and then a left onto Race Street. Continue biking along the bike paths, and carefully cross Columbus Boulevard to reach the Race Street Pier.

Long Tour • 12 miles | 4.5 hours

The long tour should be reserved for a day when there is ample time to cycle to the destination and enjoy it, as well as cycle back through the city safely. It can be done in as little as three hours with a very small group; the 4.5 hours assumes a larger group that would require more frequent stops. This tour of the riverfronts includes a short tour through Camden, an exciting ride over the Ben Franklin Bridge where you can stop to regroup and hold very quick lessons at the overlooks. Then, continue the ride through Center City Philadelphia using the bike lanes.

The ride on the Schuylkill River Trail is fascinating for students, who are exposed to a heavily used and well-maintained trail. For many, a trip into Philadelphia allows them to understand the possibilities for transport and recreation by bicycle, as Camden is still growing in that area. It is important to point out the different uses of the rivers in the areas in which they are cycling. When you reach the Fairmount Waterworks, take a moment to discuss the reasons it was built as well as where we get our drinking water now. From here, the students can witness more recreational activity in the river, primarily rowing and fishing.

Directions: Starting at the Camden Riverfront and pedaling along the Promenade to Pearl Street, head east to the stair tower, where you will have to push bikes up the stairs to reach the beginning of the Ben Franklin Bridge pedestrian walkway. At the end of the walkway, walk bikes to 6th street, and ride until Spruce Street, where you will make a right. The bike lanes exist all the way to the Schuylkill River Trail. Head north; the Fairmount Waterworks will be on the left. To head home, take Fairmount Avenue to Pennsylvania Avenue, and make a left onto Spring Garden Street. The bike lanes will continue until you make a right onto 5th street, heading toward the bridge and the pedestrian walkway to return to Camden.

Select Tours and Routes

Greenway Route

This 17-mile tour should be done on a day when there is ample time for both stopping and exploring, though it could be shortened for quicker rides. One good turnaround point would be the Kaighn Avenue dam, allowing you to avoid crossing Route 130. Another turnaround point would be Cuthbert Boulevard, from which you'll return on South Park Drive and create a loop.

Long Tour • 17 miles | 5 hours

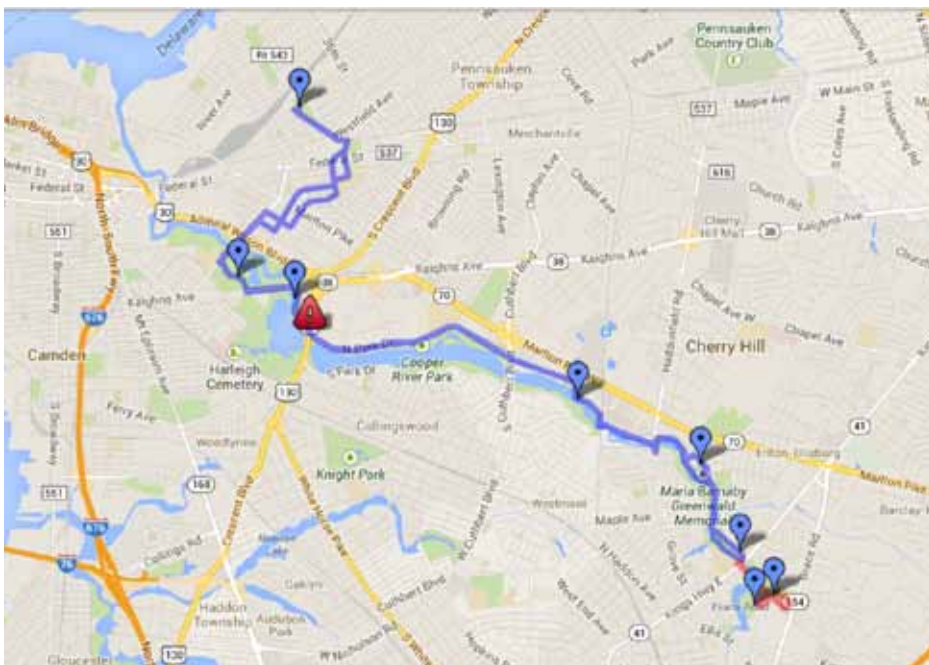
The Greenway Route—primarily taking place on trails—begins on Camden's only rail-trail in the East Camden neighborhood and continues for 17 miles along the Cooper River. The Stockton Station Trail and park is a great start and end point, and riding through the park along city streets to reach Farnham was always a favorite for students, as drivers admired their riding. Once in Farnham Park, feel free to take a break to regroup and discuss the park's history, and wetland mudflats and tides. The park is also home to a large rain garden, and discussions about permeable surfaces and runoff have been well understood at this location.

Ride along the trail on Kaighn Avenue to reach Kaighn Avenue Dam. Here, discussions can be centered on tides, as the dam is the terminus point for the tidal Cooper River and the cause of the non-tidal Cooper River that you will soon be exploring. It is possible to start paddle trips at this point, canoeing down the Cooper River to Pyne Poynt Park with UrbanTrekks, a Camden-based experiential learning program that introduces students to the outdoors. Continue your ride, crossing Route 130 while following all traffic laws; it is possible to cross easily in groups of up to 15 students. North Park Drive sees heavy use by cyclists, and you will continue along this road to the Camden Environmental Center.

Continue along the off-road trails of Penny Pack Park, where students will be riding along the river banks and over bridges to reach the final bridge near Kings Highway. This location has a large, flat, grassy area for you to relax and eat after your ride and before you begin different activities. Water testing is easily accomplished at this site, as well as the macroinvertebrates activity, and along the stream

it is easy to see the inlet pipes from the street drains. Pointing these out to students will complete the cycle of rain-water, runoff, storm drains and flows into waterways taught along this tour.

If you would like to extend the day by riding just two more miles, Challenge Grove Park is found further down the trail. Cross safely over Kings Highway and continue on the trail, riding over bridges and up a very short but steep hill. Water fountains, bathrooms and playground equipment can be found in the park. This also makes for an easy place to eat or wash up after your water activities. To return to Stockton Park, follow the same route in reverse.



Wetland Routes

Both tours begin in Farnham Park and serve to give an understanding of how wetlands can look different but serve the same purpose. Both routes, although on calmer streets, should be attempted with more confident and experienced students, perhaps toward the end of a session.

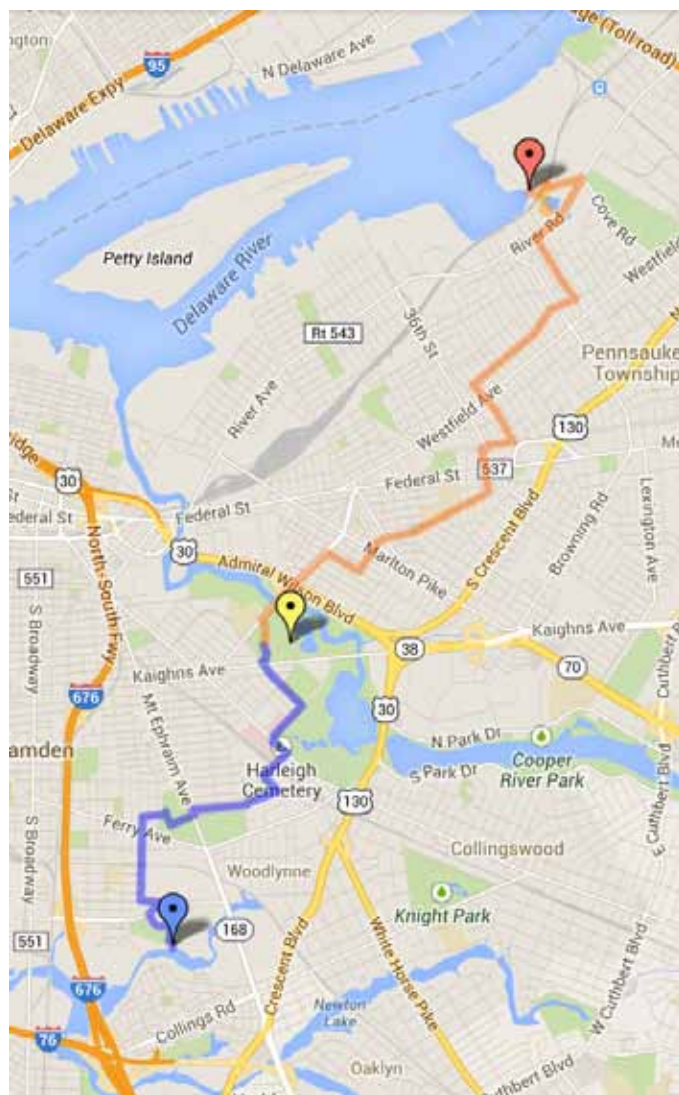
Farnham to Newton Creek • 5.5 miles | 3 hours

From Farnham Park, follow the route through the city along the road network. This ride should be reserved for a smaller group of students, no more than 7, and those able to handle narrower roads and busier streets. Along the ride, you will be travelling on internal cemetery roadways. Once you reach the Newton Creek site, explore the adjacent community gardens. Community gardeners have been more than welcoming and have given many tours to students upon their arrival. They have addressed topics such as the tide—certain high tides inundate their crops—the use of fertilizer and animals in the area. After touring the gardens, walk to the edge of the creek, where you will not only see the gently flowing river, but also marshes on the adjacent river bank. Water testing and shell collecting have been popular with the students, along with discussions regarding litter in the waterways and possible solutions to limit the litter from entering the water.

Farnham to Cove Road Wetlands • 9 miles | 4 hours

In Farnham Park, start again by exploring the park: its terrain, permeable and non-permeable surfaces, and how the tides affect the wetlands. Start the cycling trip on Baird Boulevard, and follow the map for quieter and less-trafficked back streets to reach the Cove Road Boardwalk. This ride is best suited for a smaller class, as the boardwalk and the various trails through the park will be much easier to navigate with fewer students who are more eager to discover. The pond found in the park is also home to many snapping turtles, which can sometimes be seen from the banks. Hiking through the park also allows for discussions about other animals that live in or near the park and the ways in which better water quality affects their lives.

The students who traveled to this location really enjoyed the experience, and were able to spot many aquatic animals and birds in the wetlands and in the pond. They enjoyed the short hike along the pond edge and into the woods and were very eager to undertake water-collection studies.



TIPS from WEB 2013

The River Line, running between Camden and Trenton, was a useful tool for reaching farther-away destinations without having to ride the entire distance. Make sure to cut the group in half and neatly stack the participants' bikes away from doors. Riders of the River Line never had an issue with us coming on board, but it's still advisable to avoid rush hour. In this way, the students were able to cycle to Trenton and return home in time for dismissal.

Camden County

Delaware River

CCMUA Rain Garden

The Camden County Municipal Utility Authority is currently part of many water-health-related projects, among them, rain gardens. Recently, a rain garden was placed near their offices; this would be a great place to discuss rain gardens and their uses, providing a prime example of rain gardens in the urban environment.

Pyne Poynt Park

Discuss the habitat, which not only includes the park, but also Petty's Island directly across the channel. From the park, you will be able to see an important habitat for nesting bald eagles, a very rare mussel recently found in the area and a lot of other more common animals. While here, also discuss the importance of water for commerce and city growth/development. Talk about historical uses for water, including why cities are located nearby and who uses water. (See supplemental activity about water uses; "Common Water," Project WET, p. 232.)

Palmyra Cove Nature Center

Contact the center at 856.829.1900 to determine if a representative is able to meet with the group. If they aren't able to do so, this is still a good open area for activities. Introduce water pollution here; discuss how the water picks up trash as it flows downstream from the upper Delaware River, and how that pollution accumulates in the lower Delaware River where people live. Important note: While you will be able to cycle to the center, bicycles are not permitted on the nature center's trails, so always add extra time for walking through the site.

Camden Children's Garden

The Camden Children's Garden is located on the Camden Riverfront. It provides a place to learn about water use throughout the community and for gardening and farms. The Camden Children's Garden is also a great place to learn about watershed health and water quality, and how these things affect our daily lives.

Old Prison Site

Discuss mud flats and the tide. If the tide is low enough, you may be able to walk out into the mud flats. This is the only publicly accessible spot on the Delaware River that does not restrict access with a barrier; be cautious. The trail surrounding the site is also a great place for youth to bike or even race in a closed circuit.





Wiggins Park

This is a great place to stop and talk about the waterfront and the uses of water for city development. Discuss how, in the past, cities needed rivers and other bodies of water for transportation and population growth, and how, in present day, those same needs have to be balanced for water health and recreation. Notice the speed boats, sail boats, fishing boats and kayakers that use the marina located in the park. Philadelphia is a major port city, and Camden still has a few industries along the waterway to take advantage of easy shipping.

The ferry is also located nearby, and Camden has a rich history with ferries. Before the bridges were built, ferries carried people and goods across the river; include this in discussions about waterways and city economies.

Overview Map

TIPS from WEB 2013

Keep your slowest riders in the front of the group, and keep the pace so that the slowest rider can handle the ride. This also helps to keep the group contained and not stretched out over the road.



Bald Eagle Nesting Area

There is no access from January to October; however, from February to September, feel free to take a walk through the woods and view the six-foot eagle's nest. Email Akram Abed at akram@railstotrails.org for a tour of the area.

Beckett Street Farm

The Camden Children's Garden runs a large plot of land where they grow vegetables in an urban farm setting. They would be more than happy to give you a tour of the farm and have the kids help in any way possible. Make sure to contact the Children's Garden beforehand if you'd like a walk-through. This site is a great place to discuss how water quality affects us through our foods.

Cove Road Boardwalks

Once you turn off River Road onto Cove Road, there are railroad tracks. To the left, after crossing the tracks, is the entrance to the Cove Road Boardwalk, which leads out into the wetlands of the Delaware River. This is a fantastic opportunity to get out into the wetland environment and have it completely surround you. If the tracks are inaccessible, make a left into the parking lot and you'll be on the lake, which has a small deck going into the water. Feel free to explore the trails, which surround the lake and are very family friendly.

Newton Creek

Newton Creek Community Gardens

The community gardens found along Newton Creek are great examples of agricultural use of water in the urban environment. Feel free to explore the gardens and enjoy the unfettered access to the water's edge, where you'll be able to see various plants and animals. Be sure to note the broken mollusk shells as well as the rocks used by birds to break the shells' hard exteriors.

Newtown Creek Park

There are a few things you can do here. Bike around the lake and talk about what lives in the water. Introduce insects by asking students what the fish eat.

Here, you have the opportunity to do a stream study (this can be a basic or all-day lesson). The idea is that if the water is polluted, bugs can't live in the water. Different bugs tolerate different levels of pollution, which allows us to find out how clean the water is by observing what lives there. To conduct the test, you will need a net, a bucket, plastic spoons and some ice cube trays. Use the net to scrape the

bottom of the creek, and then out the mud into the bucket; sort through the mud with plastic spoons. Included in this document is an activity that explains macro-invertebrates, many of which will be seen during this activity.

For a guide to different kinds of insects, visit: raritanbasin.org/Presentations/WPUPapers/Macroinvertebrate%20Identification%20Presentation.pdf.

Macroinvertebrates Mayhem, Project WET, p. 322, is another activity that gives students a chance to move around and hear the names of different kinds of macro-invertebrates. As you cruise around the lake, you have a great opportunity to talk about riparian zones, which use trees and plants to soak up stormwater and filter out pollutants. Riparian zones also provide habitats for insects, birds and worms.

Link to riparian zones: blm.gov/wo/st/en/res/Education_in_BLM/riparian_module.html.

Cooper River

Camden County Environmental Center

There is a brand-new, energy-efficient environmental center at 1301 Park Blvd. The very way in which the building was constructed presents an educational opportunity for the group. Point out some of the environmental aspects of the building, such as the “living” roof. Additionally, the sidewalks and pavement are pervious, allowing water to seep into the ground, limiting runoff. Behind the building is a branch of the Cooper River as well as many dirt trails. The trails are easily bikeable and allow easy access to the slow-moving river for water-sampling activities. You have to order kits, but you may be able to find them for a low cost or for free at the following website: worldwatermonitoringday.org.

Farnham Park

Discuss rain gardens and their ability to help manage runoff from streets and surrounding buildings. The rain garden is found near the children’s playground, and in the summer, the park provides a refreshing relief from the heat, especially when the fountains are turned on. A special treat is being able to ride the bikes through the fountain to cool down. The back of Farnham Park is now a wetland, where tides and mud flats can be discussed. This area is easily seen from above, using the trail for access.

Park Avenue Rain Garden

Discuss rain gardens and their uses. This is a prime example of rain gardens in the urban environment, nestled in the grassy area between two streets.



Overview Map



Magnolia Avenue Rain Garden

Discuss rain gardens and their uses. This is also a good example of a rain garden in the urban environment, directly across the street from a corner store.

Kaighn Avenue Dam

A fish ladder is located here. Discuss how dams are used to create lakes for recreation but also to control water and flooding. Before the surrounding areas were developed, water was able to seep into the ground at a much higher rate of volume. After the development of the suburbs, much of the water that would have permeated into the ground remained on the surface as runoff, and this runoff was channeled into the existing streams and rivers. This huge increase in rainwater contributed to flooding, which needed to be controlled.

State Street Bridge

This new pedestrian bridge and trail provides good views of the wooded Cooper River.

Discuss the discovery of rare clam species at the mouth of the river. This is also a good place to talk about tides, as you can usually see a marked difference in the level of the tide from day to day, and even hour to hour.

Crow's Woods (Haddonfield)

This is a good place to introduce the basics of watersheds. Start with how water travels. The site may be far, but it has some topography (slopes), so kids can picture how water moves. You could ask what direction water flows when it rains. Get them to understand that it flows downhill until it reaches a stream.

Also introduce pervious versus impervious surfaces. Simply bring water and pour it on the soil and see it percolate, and then dump it on cement where it will not percolate. Simple but important. (See supplemental activity about how rain travels after it hits the ground; “A-MAZE-ING Water,” Project WET, p. 219.)

While you are there, it’s important to talk about habitats. There will be birds and signs of wildlife. A good habitat/human-impact fun game is “OH DEER.” Directions for this activity are attached. You can use any animal. If you are talking about water, you will want to use something everyone will know, such as fish or ducks. A lot of animals here (possums, mice, squirrels, etc.) also live in cities.

riverventure.org/charleston/resources/pdf/population%20study%20game.pdf

Burlington County

Amico Island

Take the River Line to Riverside and ride 1.3 miles through the community to reach Amico Island, a 55-acre peninsula featuring a diverse collection of habitats and terrain. The park also offers river vistas and wildlife observation opportunities. While hiking the trails, you might also see white-tailed deer, red foxes, cottontail rabbits and a wide variety of birds, including waterfowl, raptors, songbirds and great blue herons. This is a great place to bike around and really get kids excited about what they have learned.

Pompeston Park

The site provides a great way to walk along a stream and see how humans can change it. It is a wooded area, but the stream is starting to change with the development around it. You can walk along this stream almost back to the Delaware River. Notice that the stream seems straight in spots (this is not natural), such as where stormwater pipes empty into it. No doubt, kids have seen a drain on the street; this is a chance to see where it empties. Also, there is usually erosion near the drain. Introduce sediment (soil, or “dirt”) pollution.

Philadelphia County

Fairmount Water Works

Situated on the east bank of the Schuylkill River between historic Boat House Row and the Philadelphia Museum of Art, the Fairmount Water Works opened its doors in 1815 as the nation’s first major urban water supply system. Today, it houses an interpretive center dedicated to educating the public about clean water and preserving the health of the watershed.

TIPS from WEB 2013

For city riding, hybrids are sufficient and quite easy to pedal and shift. Mountain bikes are also quite easy to pedal, as well. Try to use bicycles that have a more upright position as opposed to the aggressive position of road bikes. It is important that students are able to take in, and understand, their surroundings.



Lessons Learned

What Worked Well

TIPS from WEB 2013

When looking for student participants, seek out individuals interested in hands-on learning and individuals who are excited about the possibilities of the program—and not just athletic students who want to ride a bike. The students who added the most to the 2013 WEB program were those who were interested in riding but might not have done it on their own, and—especially—those whose main motivations were not speed and competition.

Summer sessions with longer days—about five or six hours in duration—enabled students to ride farther distances and also allowed more time for activities at nearby water-access sites. On very hot days, or on days when most of the students seem more tired than usual, less-intensive rides and more time off bikes helped to boost morale.

Activities with community groups and the students' families were also very well received—but only after the students had learned the routes and material and could relate it back to others. Consider an event in which the students take a special ride with community members, or even other students and teachers.

Having partners in the community who were willing to share their special knowledge of a subject-area with the students was always well received. When we visited certain locations and received a tour, students were generally more likely to ask questions and incorporate other information they learned previously into their question. At times, the change of instructors was helpful, especially during the longer summer sessions.



What Didn't Work Well

Programs of short length were not extremely successful. In the spring of 2013, sessions were offered twice-per-week over a four-week time period. This length seemed quite short, particularly if a day or two was missed due to holidays. Consider holding sessions of a longer duration; this gives students a chance to build up their fitness levels and build upon their environmental knowledge through repetition.

Riding with the students required no less than three riding adults. Having any less, regardless of the amount of students, posed many issues. Always have at least three adults who are also very good riders. The students will look up to the adults during their rides and will mimic their actions no matter what they were taught to do in previous riding skill sessions.

Not having the ability to give homework to maintain understanding and exposure to the material hindered the learning growth of the students. If possible, try to forge connections and partnerships with the science or social studies teachers at the schools you are working with, or distribute light homework to build upon students' knowledge. Another suggestion is to distribute and recollect the explanatory diagrams during the rides, and then to redistribute the diagrams after the days' sessions are over.

TIPS from WEB 2013

Bananas and Fig Newtons along with plenty of water went a long way in keeping the students energized. Picnics in parks were also a welcome distraction, especially when the parks were shaded. Picnics in Philadelphia—possible on longer days—were always very well received and definite mood boosters.



Questions & Interviews



Before beginning the session, the students who took part in WEB were asked to complete a test to gauge how much they understood about active transportation infrastructure in Camden and the surrounding areas, their knowledge of bicycle safety, and the watershed. After each session, the students completed the same test, with a selected analysis included below. Educators familiar with the students, a selection of parents and students were also interviewed about their experiences during the bike program.

A common theme presented itself in the responses of parents and teachers: the students spoke with great enthusiasm about their adventures during the program, and they gained a sense of independence and freedom from being able to explore by bike. These sentiments were echoed time and again, especially by students who started the program as weaker riders and improved with time.

Students also enjoyed interacting with others their age while biking through the city; the attention they received served as positive reinforcement and made them more inclined to associate themselves with the program.

The Ben Franklin Bridge is the only pedestrian link between Camden and Philadelphia; therefore, it is key for linking the communities on either side of the Delaware River. Yet, none of the 77 students that participated in WEB had ever ridden their bikes on the pedestrian walkway, and only two had ever walked any distance on the bridge. While fear was an emotion many students felt while riding on the bridge, all the students made it across successfully (though many stated that it was “exhausting”).

For many of the students in the North Camden neighborhood, the Ben Franklin Bridge is part of a skyline they had not interacted with prior to WEB. But after participating in the program, three students stated that they now ride on the walkway with their parents and siblings on a regular basis, and five more stated having ridden it alone.

Before starting WEB, only five students were aware that trails existed in Camden, with most other students unsure what pedestrian trails or pathways would look like. After the sessions, every one of the 77 students was able to not only describe a trail in Camden, but also to name one and point it out on a map. This was one of the greatest successes: introducing the students and their families to existing trails, and having them know where the trails are located in relation to their homes.

During the pre-test, 58 students responded to the question “Where would you like to ride?” by stating places found in their neighborhood: the park, store, school and home. Perhaps comically, but most likely with enthusiasm, 12 students responded with “everywhere” to the question, while two respond with “the beach.”



In post-tests, the students showed great interest in the destinations they had ridden to or past. Forty students responded with “Cooper River Park,” 14 responded with “a trail,” and 3 responded with “Philly.” Other answers perhaps came from a sense of greater self-confidence; at least one student wrote in each of the following: “Atlantic City,” “New York” and “Paris.”

During the pre-test, no student was able to answer 10 questions correctly about the watershed, and 46 students were only able to answer 3 questions correctly. Only two students answered five questions correctly—scoring the highest. The average number of correct answers was 2.4.

The post-test showed greater improvement, with 30 students able to answer 8 questions correctly. The resultant average number of correct answers was 5.5. The highest score, which one student received, was nine. The low scores could be attributed to the test, which may have had some design flaws, but even when the same test was used, improvement was noted.

After the sessions were over, students were asked to informally discuss their thoughts on the program. They indicated reaching destinations they never thought possible before, namely those in Philadelphia or outside of Camden City. Others were shocked to see so many different bikes and commented on how trails outside of Camden were used by many more people than trails in Camden; it excited them to think of the possibilities in their city.

For some, the environmental lessons were eye opening. Students discussed their satisfaction of knowing the names of the rivers flowing underneath them at bridges throughout the city, and knowing that there was more than one river. None of the students had ever stood in a wetland prior to the program, and only five had ever set foot in a Camden waterway; that changed for most of the students during WEB. Suffice it to say that some students refused to enter the water, but the majority enjoyed stepping in and taking part in the varied activities.





Fill-in-the-Blank Questions. Complete them as best as you can.

How old are you? _____ Does your family own a car? _____

Do you own a bike? _____ Does anyone in your family own a bike? _____

Are all the bikes working? _____ If not, what is wrong with them? _____

Do your parents ride a bike? _____

If you have a bike, how many days a week do you ride? _____

Do you ride your bike to school? _____

To the store? _____

Where do you ride your bike? _____

Where would you want to ride your bike? _____

Do you know what a trail is? _____

Describe it: _____

How many do you think are in Camden City? _____

Do you ever ride on a trail? _____

Where to? _____

Have you ever walked or biked on the Ben Franklin Bridge? _____

Do you know how to fix a flat? _____

Do you know how to fix a bike chain? _____

What would you like to learn during WEB? _____

True or False? Write true or false on each line.

When I come to a red light, I should only stop if there are no cars. _____

A bicycle rider should always ride with the flow of traffic. _____

Bicyclists should always stay to the left when riding on a street. _____

Stops signs are only for cars; bicycles can go right through them. _____

The most important equipment to wear when riding a bike is a properly fitting helmet. _____

When I stop, I should put my foot down only after the bike has completely stopped. _____

I should ride on a sidewalk because it is safer. _____

I should check my brakes before I start riding my bike each time. _____

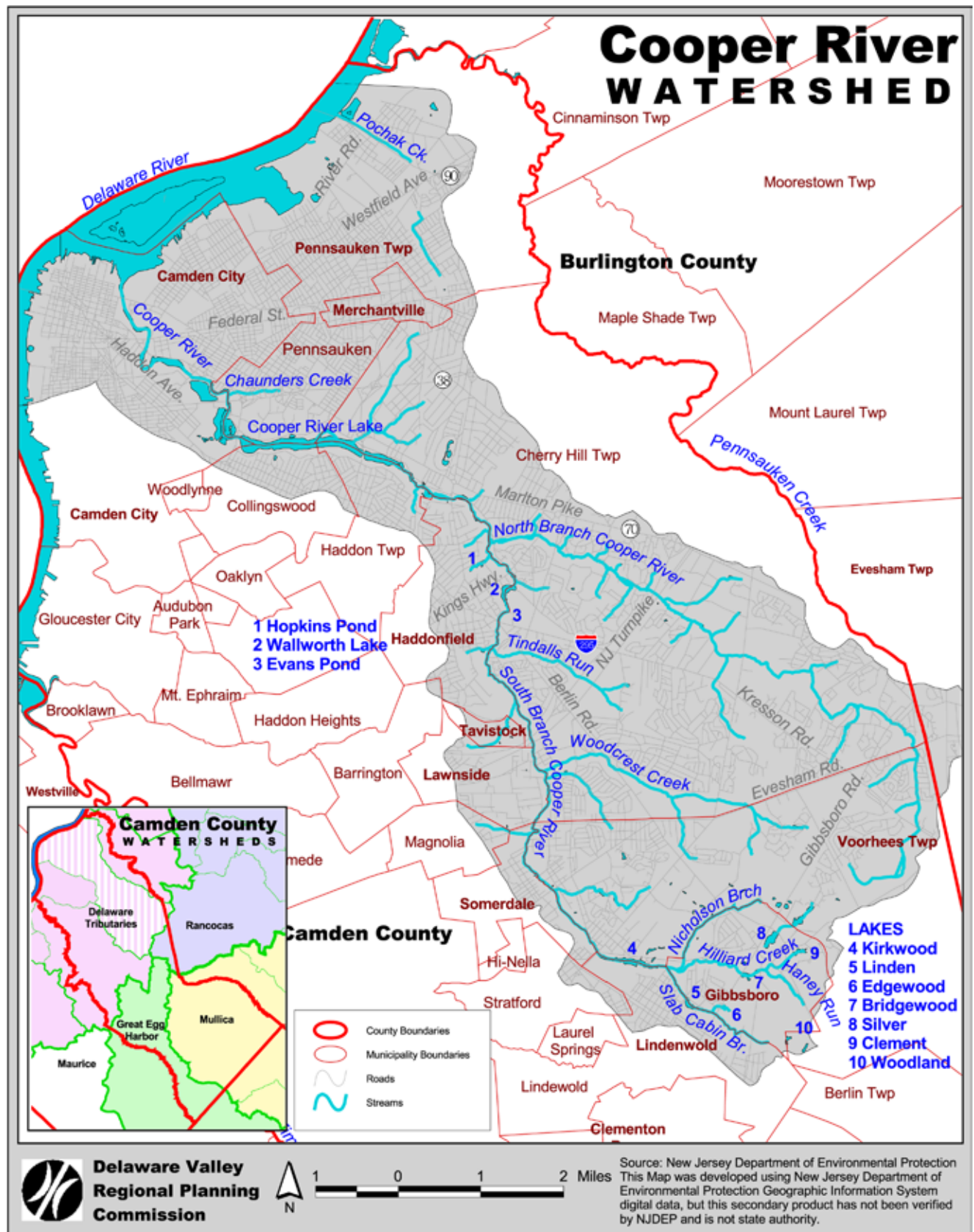
There are bike trails in Camden. _____

The best bikers are the ones who move in and out of traffic lanes. _____

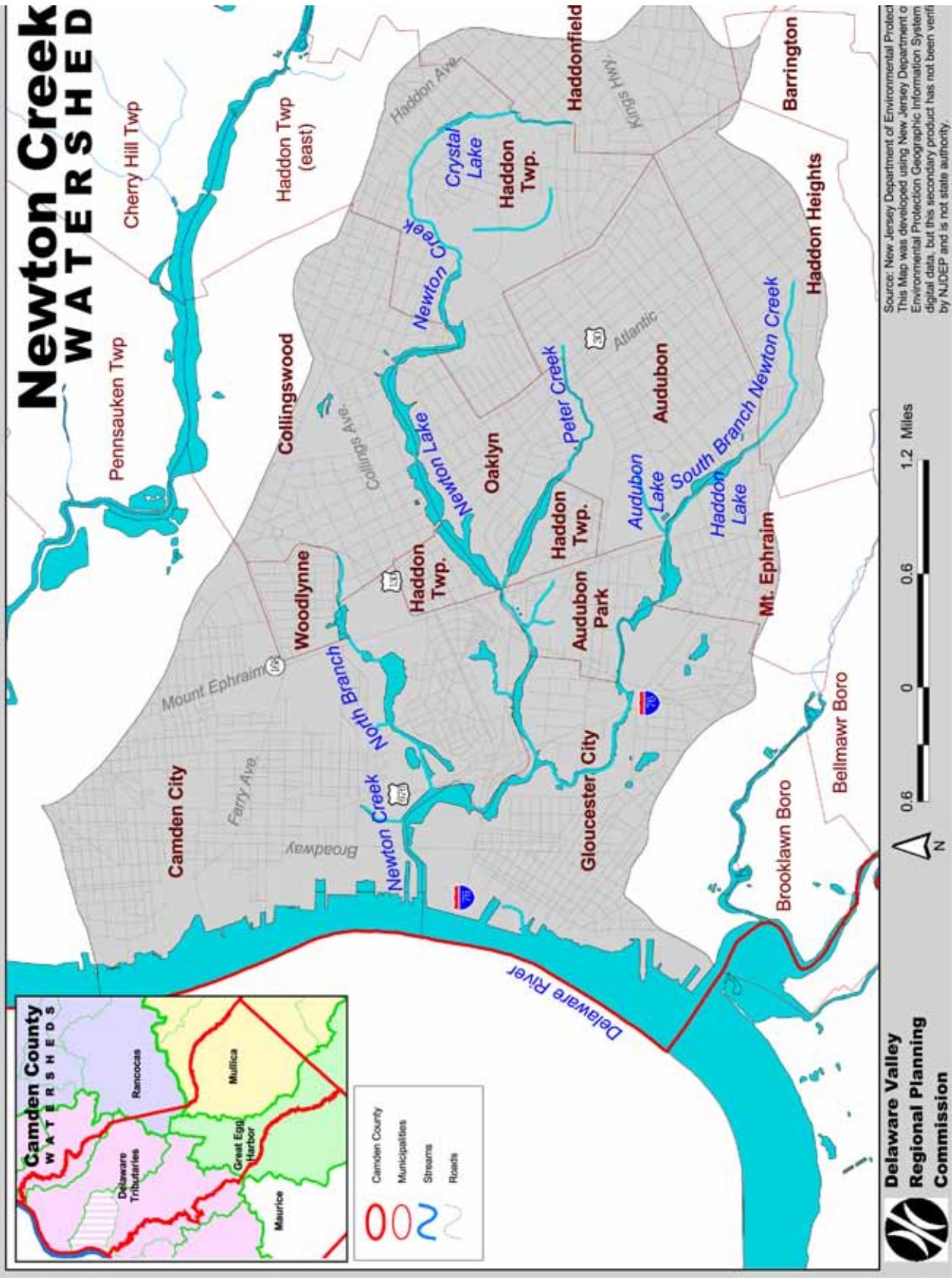
The best way to stop is to skid, or drift, the bike. _____

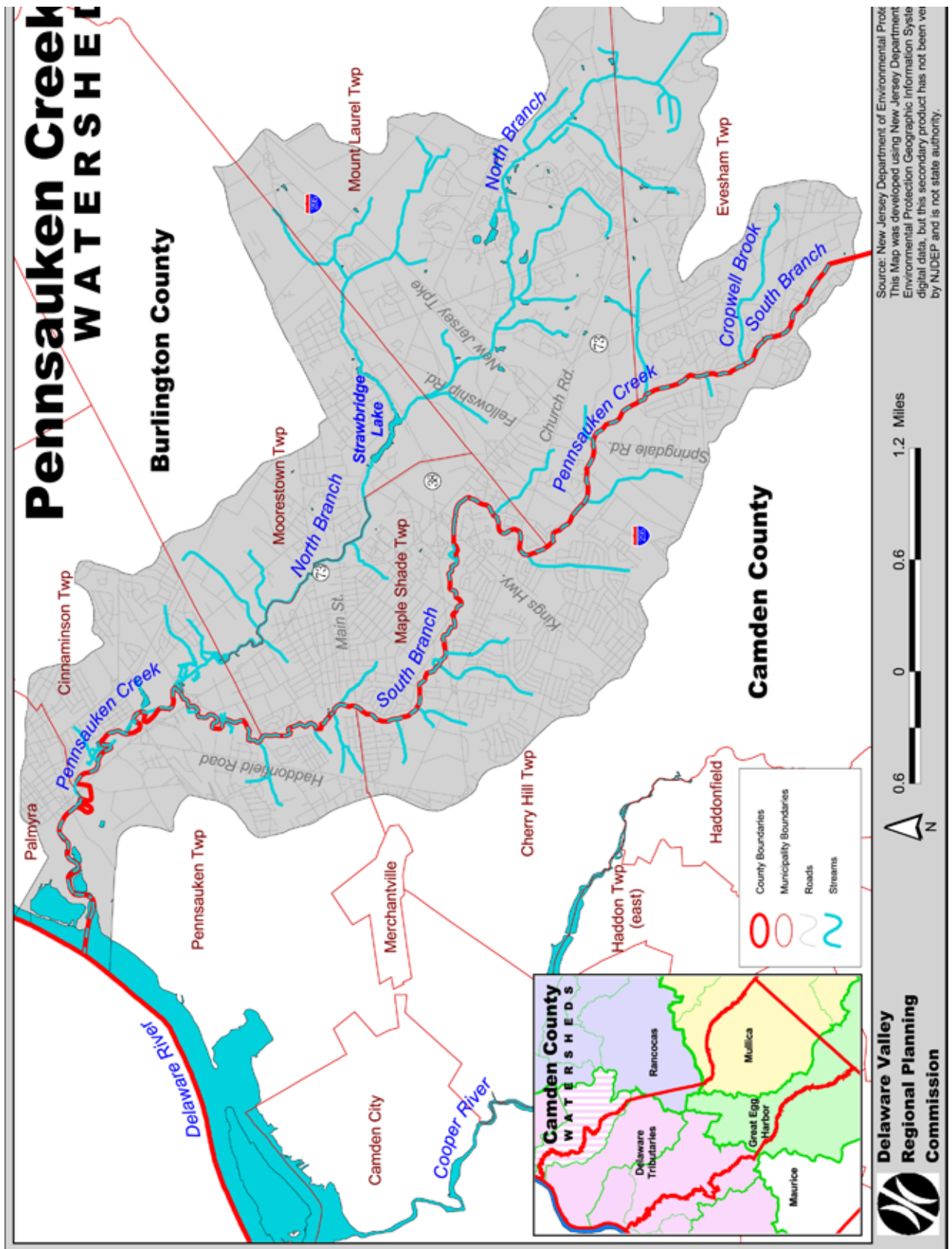
When riding a bike, I should act like a car and follow all the road rules. _____





Newton Creek WATERSHED





Glossary

Acid Rain: Rain with a pH of less than 5.6; results from atmospheric moisture mixing with sulfur and nitrogen oxides emitted from burning fossil fuels or from volcanic activity; may cause damage to buildings, monuments, car finishes, crops, forests, wildlife habitats and aquatic life.

Aeration: The process of exposing to circulating air.

Anaerobic Bacteria: Any bacteria that can survive in the complete or partial absence of air.

Aquifer: An underground bed of saturated sediment or rock that yields significant quantities of water.

Branch: A smaller stream that flows into (“branches” off from) a larger one.

Catchment: The smallest watershed area, usually defined as the area that drains an individual site, such as a school or small neighborhood, to its first intersection with a stream.

Drainage Basin: A large watershed encompassing the watersheds of many smaller rivers and streams and draining to a major river, estuary or lake.

Ecosystem: A community of living organisms and their interrelated physical and chemical environment; also, a land area within a climate.

Evapotranspiration: The return of moisture to the atmosphere by the evaporation of water from the surface and by transpiration from vegetation.

Fecal Coliform Bacteria: A group of bacteria that are used as indicators of possible sewage or waste contamination because they are commonly found in human and animal feces.

Floodplain: The land areas adjacent to a river or stream that are flooded during storm events.

Flooding: An overflowing of water, especially over land not usually submerged.

Gaining Streams: Streams that appear from the ground or cracks in rocks because they are flowing directly out of an aquifer.

Groundwater: Water found in spaces between sediment particles underground (located in the zone of saturation).

Headwaters: The small streams from which a creek or river “rises” or begins.

Hydrologic Cycle: Also known as the water cycle, this refers to the paths that water takes in its various states—vapor, liquid and solid—as it moves throughout Earth’s systems (oceans, atmosphere, groundwater, streams, etc.).

Impaired Waterways: Stream segments or lakes that do not meet the water quality standards set for them by federal and state agencies.

Impervious Surface Coverage: Surfaces that do not allow stormwater runoff (rain-water and snowmelt) to seep into the ground (sidewalks, roadways, driveways and rooftops).

Integrated Pest Management (IPM): A system of reducing pest problems using environmental information along with variable pest control methods. These methods include physical, mechanical, biological, cultural and chemical means of controlling pests.

Macroinvertebrates: Animals that lack backbones (invertebrates) and are large enough to be seen with the naked eye (macro). Includes insects, crustaceans (such as crayfish), mollusks (clams, mussels and snails) and worms. They are good indica-

tors of water quality because the most sensitive can only survive in areas of high water quality.

Nonpoint Source Pollution: Widespread overland runoff containing pollutants. The contamination does not originate from one specific location but is pollution discharged over a broad land area. Water pollution that cannot be traced to a specific source.

Outcrop: The area where an aquifer is present at or near the land surface; where it "crops out."

Pesticides: Chemical compounds designed to control and kill pests. The term pesticides includes herbicides (chemicals to kill weeds), insecticides (chemicals to kill insects) and fungicides (chemicals to kill fungus).

Physiography: The study of a location in relation to its underlying geology.

Point Source Pollution: Pollutants discharged from an identifiable point, including pipes, ditches, channels, sewers, tunnels and containers of various types.

Run: A smaller stream that flows into ("runs" to) a larger one.

Saturated Zone: The underground area in which water is held in the pores and spaces within the sediments or rock. Sediments in southern-New Jersey aquifers are made up of sand, silt, clay and gravel particles. The water within the saturated zone is groundwater.

Sedimentation: The settling of soil particles (sediment) to the bottom of a waterway.

Sewage: The waste and wastewater produced by residential and commercial sources, and discharged into sewers or septic systems.

Stormwater Runoff: Precipitation that flows over land to surface streams, rivers and lakes, either directly or through storm sewers.

Sub-watershed: The land area draining to the point where two smaller streams combine together to form a larger, single stream.

Transpiration: The process by which water that is absorbed through plant roots is returned to the atmosphere from the leaves.

Tributary: A stream or river flowing into a larger stream or river.

Water Cycle: See Hydrologic Cycle.

Water Table: The top of the saturated zone (see definition) in an unconfined aquifer (see definition under "aquifer").

Watershed: The land area from which surface runoff drains into a particular stream channel, lake, reservoir or other body of water.

Resources

Local Organizations

Camden County Division of Environmental Affairs

The Camden County Division of Environmental Affairs, a division of the Department of Parks, is responsible for a number of environmental programs and services, including Recycling and Solid Waste Management, Household Special Waste Collections, Litter Clean-Up and Enforcement, Open Space and Historic Preservation, and Watershed Protection: 856.858.5241 or camdencounty.com/government/offices/environment.

Camden County Environmental Education Center

The Environmental Education Center (EEC) offers a variety of educational programs and informational services to county residents. Resources and assistance are available for teachers who wish to integrate environmental lessons into curriculum, develop school-site environmental study areas and conduct on-site nature programs. For more information, call 856.767.PARK.

Camden County Historical Society

Founded in 1899, and located on the border of Camden and Collingswood, the Historical Society regularly publishes informational books, houses an extensive research library, maintains colonial Pomona Hall and the county museum, and offers public and educational programs. The Historical Society offers very affordable tours for county school groups that focus on colonial lifestyles. For more information, call 856.964.3333 or visit cchsnj.com.

Delaware Riverkeeper Network

The Riverkeeper is a nonprofit membership organization founded in 1988 to strengthen citizen protection of the Delaware River and its tributary watersheds. The organization works throughout the entire 13,000-square-mile watershed area, which includes portions of New York, New Jersey, Pennsylvania and Delaware. Programs include an advocacy program, restoration projects, volunteer-based monitoring programs, pollution hotlines and an enforcement task force. Learn more at delawareriverkeeper.org.

Delaware Valley Regional Planning Commission

This Regional Planning Commission (DVRPC) is a governmental organization serving nine counties in the New Jersey/Pennsylvania area. DVRPC works to foster regional cooperation between city, county and state governments and focuses on transportation, land use, and environmental and economic development issues. DVRPC also provides services and advice to member governments through planning analysis, data collection and mapping services. Aerial photographs, maps and a variety of publications are available to the public and private sector. For more information, call 215.592.1800 or visit dvrpc.org.

Educational Information Resource Center

The Educational Information Resource Center (EIRC) is a public agency specializing in education-related programs and services for parents, schools, communities and

Appendices

nonprofit organizations throughout New Jersey. It offers a great many resources for teachers under one roof, including a resource library, programs and training sessions on a wide variety of topics. Their website offers lesson plans and templates directly, as well as 5,000 links to lesson plans and educational resources that support national, state and local standards for Language Arts, Science, Social Studies and Math in the K-12 curriculum. Learn more at eirc.org.

Environmental Commission of Camden County

The Environmental Commission is a citizen-based advisory board reporting to the County Board of Chosen Freeholders. The commission advocates for and conducts projects to benefit Camden County's environment, and is responsible for informing county citizens about environmental issues affecting their communities through informational publications and educational programs. The public is invited to attend monthly meetings, usually held on the first Tuesday of every month. To confirm locations and times, contact the Division of Environmental Affairs at 856.858.5241.

New Jersey Department of Environmental Protection

For information on water quality, visit the Division of Water Quality at state.nj.us/dep/dwq or call 609.633.1208.

New Jersey Watershed Management Ambassadors Program

Invite a Watershed Ambassador to your class! AmeriCorps and the New Jersey Department of Environmental Protection (NJDEP) sponsor the Watershed Ambassadors Program, employing individuals committed to environmental and watershed education. There are 20 ambassadors for the 20 Watershed Management Areas in New Jersey. Ambassadors do school presentations on various watershed subjects, bring students out to local water bodies and organize community members into River Assessment Teams (RATs) and Biological Assessment Teams (BATs). Four Watershed Ambassadors serve the watersheds of Camden County. Read more about the Watershed Management Ambassadors Program at state.nj.us/dep/watershedmgt/. Below is the contact information for the Ambassadors serving Camden County: WMA 18 Lower Delaware c/o NJDEP Southern Enforcement Office, 856.614.3657.

Partnership for the Delaware Estuary

This nonprofit organization works to increase awareness and understanding of the Delaware River estuary—that portion of the Delaware River watershed that is tidal, starting at Trenton and through the Delaware Bay. The partnership offers numerous free print materials and a free bi-monthly newsletter, and runs a yearly, week-long Teacher Institute with stipends and professional development credits. Contact the Wilmington office at 800.445.4935 or visit delawareestuary.org.

Rutgers Cooperative Extension

Rutgers University, working with county agencies, offers research-based information and advice to improve people's daily lives. Read more about improving Camden County at rce.rutgers.edu or co.camden.nj.us/government/offices/rutgers, or contact the Clementon office at 856.566.2910.

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