Integrating Web-based Activities and Site-based Experiences to Investigate Environmental Issues

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Abstract

This chapter describes how the *Environmental Education* (EE) course at Lehigh University uses a hybrid approach of instruction using Web-based activities and face-to-face site-based experiences to primarily focus on the study of environmental issues in the Lehigh River watershed. Course activities are discussed to illustrate how technology can be used effectively to support EE teaching and learning with prospective and current science teachers. Site visits to areas of environmental concern support and extend the environmental education concepts and skills that are initially developed with Web-based materials. Course activities provide teachers with an in-depth content understanding of local environmental issues as well as opportunities to explore pedagogical strategies to promote issues-based approaches to learning. Course materials also take advantage of easily available geospatial information technologies to foster spatial literacy in the curriculum and support learners with the ability to make use of data visualizations for analysis and interpretation when examining environmental issues such as sprawl and land use decision-making. Advantages to using Web-enhanced learning environments for EE instruction are discussed.

Important reserves of oil, gas, and minerals lie deep beneath the seafloor; however, prospecting and drilling for these poses a major threat to sensitive marine habitats and species. Rising energy prices coupled with growing concerns about global warming have sharpened the debate over government funding for offshore drilling versus investing in renewable energy.

Dead zones where fish and most marine life can no longer survive are spreading across the continental shelves of the world's oceans at an alarming rate as oxygen vanishes from coastal waters. Scientists point to tons of nitrogen and phosphorus in fertilizers that run-off from farms and spill into rivers, streams, and bay as well as by fallout from power plants that burn fossil fuels as contributing factors to these dead zones (Diaz and Rosenberg, 2008).

These are just two of many issues related to the environment that have risen to the top of the public agenda.

Environmental issues are quite complex, involve conflicting interests and values, and are often controversial. They frequently involve inter-relationships between economic, social, cultural, scientific, and political factors. Most issues are open-ended problems in which there is rarely one correct solution to solve the problem and concern multiple stakeholders who view the issue from varying perspectives. Solving an environmental issue requires understanding the context, seeing the problem from varying perspectives, and exploring different possibilities (Environmental Literacy Council, 2007). The process involves understanding the practicality of various solutions that are proposed, evaluating scientific evidence, and critically assessing arguments that may involve economic and environmental consequences. In many cases, both the subject matter and interpretations of that subject matter are influenced by value judgments.

Developing skills for understanding and addressing environmental issues is a key component of environmental literacy and is advocated by the North American Association for Environmental Education (NAAEE) as an essential component of preparing preservice teachers (NAAEE, 2004). Studying environmental issues provides learners with meaningful contexts by connecting their daily lives and local community issues to content of study (Pennock & Bardwell, 1994). In addition to understanding underlying science, investigating environmental issues and their solutions actively involves learners in practicing and improving skills such as critical reflection, problem-solving and decision making- each important skills inherent to science teacher education programs. Providing teachers with learning experiences that challenge and enhance their conceptions of environmental issues by confronting them with alternative viewpoints can help them to better understand the viewpoints of others, and become aware of inadequacies and inconsistencies in their own conceptions of environmental issues (Ballantyne & Bain, 1995).

This chapter describes how the *Environmental Education* (EE) course at Lehigh University uses a hybrid approach of instruction using Web-based activities and face-to-face site-based experiences to primarily focus on the study of environmental issues in the Lehigh River watershed. A watershed is an ideal way to segment the environment for analysis. Watersheds are scalable, topographic and hydrologic basins that lend themselves to systems analysis. The EE course is designed to meet Pennsylvania Department of Education program standards for EE certification and preparation competencies and is offered during the summer to accommodate schedules of both inservice and preservice teachers.

The Hybrid Approach

Studies have shown that participation in outdoor site-based learning experiences is a promising technique for improving students' environmental attitudes and knowledge (Bogner, 1998; Crompton & Sellar, 1981; Lisowski & Disinger, 1991; Orion & Hofstein, 1991, 1994). Learning activities within one's local environment can have a strong effect on the students' environmental learning, enhance environmental attitudes, promote a sense of environmental stewardship, and foster environmental behavior (Bodzin, 2008; Fisman, 2005, Sobel, 2004). Outdoor field settings have also been successful in teaching awareness of environmental issues. Strategies such as field trips to selected sites with environmental problems, and case studies are among the experiences that have been most effective (Howe and Disinger, 1988). Such findings support the use of site-based activities for learning about environment issues within a defined watershed area. The local watershed provides for a locale that is a geographically familiar setting for students and is easily accessible for daylong field trips.

Internet technology can be used to support and extend learning activities rooted in outdoor, site-based experiential learning (Moore & Huber, 2001). Examples of existing Web-based learning resources that may be used to promote the teaching and learning of environmental issues include descriptive photojournals for virtual watershed explorations of locations that are both accessible and inaccessible by conventional transportation, environmental databases that can be used for analyzing pollution emissions in local areas, and Web-based inquiry activities (Bodzin and Cates, 2003). More recently, geospatial information technologies and their products such as Web-based Geographic Information Systems (GIS) and Google Earth have become readily available. They are quite accessible as Internet-based interactive mapping applications with point-and-click access to numerous environmental datasets. Both tools allow for visualizing, mapping, and analyzing multiple layers of georeferenced environmental data. Most

Web-based GIS require little time to learn, drastically reducing the time it takes for educators to incorporate them into their curricula when compared to desktop-based GIS. No special software is needed to view these maps other than a Web browser with an Internet connection. The Geospatial One Stop Web site at http://gos2.geodata.gov/wps/portal/gos contains links to many national, state, and local Web-based GIS data sites that can be used by educators. Google Earth is a form of digital or virtual globe that allows users to examine satellite imagery and digital aerial photographs overlaid on a three dimensional representation of the Earth. The interface is simple and intuitive and provides a basic set of navigation controls to allow the user to zoom and pan around the view, as well as the ability to locate a specific place of interest using the search function. Similar to a Web-based GIS, Google Earth provides a means to overlay thematic data layers and allows users navigation, data retrieval and visualization functionality. Using Keyhole Markup Language (KML) or by creating a *mashup* using Google Maps (for example, see Lucking, Christmann and Whitting, 2008), data information for any location can be customized to create a resource for environmental studies and exploration. Google Earth is available via a free Internet download at http://earth.google.com. In educational settings, both Web-based GIS and Google Earth have proven to be valuable tools in the process of understanding the environment and of making responsible environmental decisions (Bodzin & Anastasio, 2006; Bodzin & Cirruci, in press; National Research Council, 2006).

The hybrid approach combines online instructional supports with in-class and outdoor face-to-face interactivity to promote learning. There are many advantages to Web-enhanced learning environments for instruction. When properly designed, students enrolled in Web-enhanced courses have access to many resources otherwise not accessible in a traditional classroom setting. Web-enhanced classes make learning more accessible and more accommodating to a variety of learners (Grasha & Yangarber-Hicks, 2000). In addition, a Web-enhanced hybrid approach to EE learning better serves the needs of students over a Web-based course since students experience the physical, sensory nature of a live classroom in outdoor field-based settings (Wright, 2008).

The EE course at Lehigh University takes advantage of using Web-based learning activities during the first face-to-face class session and also within a series of course modules that students complete asynchronously. Many of these curricular materials take advantage of using geospatial technology tools to promote EE learning. The modules include: teaching and learning about environmental issues; geospatial technologies in environmental education; designing and implementing water quality curricular projects; environmental laws and regulations; environmental education essentials; and activity selection for environmental education. The course modules take advantage of many instructional materials that have been developed at the Lehigh Environmental Initiative (EI) to promote the teaching and learning of environmental issues. These materials are primarily located on the Lehigh Earth Observatory EnviroSci Inquiry Web site (http://www.leo.lehigh.edu/envirosci) and also on other Lehigh EI project Web sites. Since these materials are both interdisciplinary and Web-based, they are flexible and portable to use in other disciplines in select secondary and college level courses that include geology, environmental science, environmental studies, Earth system science, ecology, or geography.

I have taught the EE course as a lead instructor for the past six years. Each year, the course is modified to reflect current local environmental issues in the watershed. New Web-based activities and materials are incorporated each year to keep teachers updated on emerging Web-based tools and instructional resources that can be used to promote environmental learning with classroom learners. This chapter presents and discusses select course activities that were implemented in 2008. As with other chapters in this section, my goal is to illustrate how technology can be used effectively to support EE teaching and learning with prospective and current science teachers.

Course Activities

The class meets face-to-face for five full days. The first day is spent on-campus at the University and four other days are spent off-campus at site-based settings investigating environmental issues in the watershed. The students complete the Web-based modules prior to the off-campus field sites.

To begin the on-campus day, I ask students to draw a sketch map of the Lehigh River watershed. The sketch map task provides me with an understanding of the students' mental maps in terms of how they spatially view the watershed. Seven of nine students' watershed sketch maps included only the southern portion of the Lehigh River, omitting more than half of the watershed area. Each student accurately labeled the three largest cities - Allentown, Bethlehem and Easton – on their maps. Surprisingly, only two of the seven students who were born and raised in the watershed area had fairly detailed sketch maps that included many features and landmarks. These two students included the Delaware River, specific creek tributaries that flowed into the Lehigh River, prominent geographic features such as the Lehigh Gap and the Kittatinny Ridge /Blue Mountain, names and locations of many boroughs, towns, and smaller cities, farm areas, and industry locations that included a cement plant and Mack trucks. In addition, one student noted environmental issues on his sketch map that included: "farm-based fertilizer runoff, industry outflows, housing development runoff (too much pavement), and recreational usage (litter)". On the other students' sketch maps, only one or two such features were included in each sketch map: farms (1), the Kittatinny Ridge/Blue Mountain (1), the Lehigh Canal (1), Monocacy Creek (1), Bethlehem Steel area (2), the Lehigh Valley Mall (1), the locations of 4 different bridges over the Lehigh River (1), and the historic Bethlehem area (1).

To assist students in understanding the scope and size of the watershed, students use the Google Earth version of the *Lehigh River Photojournal* [http://www.leo.lehigh.edu/envirosci/watershed/pjournal/] (Figure 1). This virtual photojournal contains yellow pushpin placemarks that denotes specific locations of interest in the Lehigh River watershed. Clicking on a placemark provides the user with a pop-up box containing a digital image of the location and text information about the historical and geological significance about that location (Figure 2). Certain locations briefly describe environmental issues that are of interest at that location. For example, the *Rockport* placemark informs the user "Buck Mountain Creek (Indian Run) is one of four tributaries containing mine drainage entering into the Lehigh River." Students are shown how to use the drop-down menu in Google Earth's left frame to navigate from one location to the next (Figure 2). Each placemark has been developed with preset altitudes in the visualization, making specific contextual details easy to observe. In class, I use Google Earth as a virtual fieldtrip to highlight specific areas that we will later visit during the course field trips and also highlight other significant locations pertaining to environmental issues that will not be visited on-site during the course but relate to issues presented in other course materials (such as the location of sinkholes, sources of abandoned mine drainage, and the location of proposed wind turbines to be used for energy generation located in areas of raptor migratory paths). I provide students with exploration time to use the Google Earth visualizations to further develop their spatial concept of the watershed.

Insert Figure 1 about here

Insert Figure 2 about here

I build upon these initial explorations by using a series of Web-based GIS maps of the Lehigh River watershed area to specific promote aspects of scientific inquiry and environmental literacy. The GIS maps are disseminated over the Internet using a Web server and are available at: http://www.leo.lehigh.edu/envirosci/watershed/gis/investigations.html. I use four main topic areas to help learners understand the complex networks of interactions and dependencies within watersheds: *underlying science, human resources, people centers,* and *human impacts*. *Underlying science* focuses on the interdisciplinary study of the complex and interconnected issues of natural watershed processes, natural resources, populations, and pollution. *Human resources* addresses materials consumed or reused by humans to meet their needs, including air, water, minerals, fuels, building materials, and open space. *People centers* refers to societal needs for human activities, including housing, transportation, agriculture, industry, and recreation; while *human impacts* attends to how human activities affect both biotic and abiotic conditions of the environment.

As a way of illuminating these interactions and complexities, each GIS map is organized to promote inquiry with driving investigative questions about a particular aspect of the Lehigh Valley watershed. The GIS maps are designed around driving investigative questions that incorporate two main properties: *scalability* and *portability*. Scalability refers to the need for the problems addressed by the learner to be small enough that they can derive conclusions in a reasonable length of time, but also of sufficient detail that in completing them will understand concepts that apply to larger and more complex environmental problems. Portability means the problems addressed in the activities should involve concepts and practices that apply to diverse locations and situations, allowing learners to extrapolate their derived understandings to problems other than those to which they were exposed.

One example that I use in the course focused on the question:

Which part of the Lehigh River watershed is the best place to build your new home?

This GIS map (see Figure 3) provides learners with a variety of different data layers one may wish to examine when selecting a site to build a new home. Learners can display land use types to determine locations of urban, forested, and agricultural areas in the watershed. Map layers of major, state, and local roads can be shown to determine transportation patterns throughout the watershed. The map also contains data about sites that may be prone to natural hazards. A *limestone* data layer may be displayed to consider locations that may be prone to sinkhole occurrences, and a *flood plains* data layer may be viewed to identify areas where flooding may occur. Industries that release regulated toxic chemicals into the environment can also be located. The *toxic chemical release inventory* data layer provides the name, address, and location of specific industries, and a complete list of chemicals that each site discharges. Recreational and preserved land areas including County and PA State Parks and State Game Lands areas may also be displayed. Census data for each municipality in the watershed for the years 1990 and 2000 are included and can be explored to determine population growth trends in the area. Using this GIS activity, students learn there are many factors one must consider when selecting a location to build a new home. Such factors involve natural hazards while others involve anthropogenic influences that have environmental consequences to a once natural landscape.

Insert Figure 3 about here

Another core on-campus activity involves student groups analyzing and discussing Web-based environmental education curricular activities that focus on specific environmental issues in the Lehigh River watershed area. The activity involves the analysis of key characteristics of high quality environmental education materials (see NAAEE, 2000) with a primary focus on examining pedagogical features and supports to promote the learning of environmental issues. This activity is also used to discuss the complexities of particular environmental issues that will later be revisited during the course field trips and in the course modules. Summaries of the four Web-based activities are described below.

Sprawl in the Lehigh River Watershed activity

Land use and development in the form of urban or suburban sprawl has always been a problem in the minds of many people. This activity (http://www.leo.lehigh.edu/envirosci/enviroissue/sprawl/) uses Web-based GIS maps to explore sprawl issues in the Lehigh River watershed. Learners are first introduced to historical population growth patterns in the Lehigh Valley watershed. Next, they are prompted to use a GIS map to explore trends in population change in the watershed area. The impacts of zoning laws created by multiple municipalities are then presented. Learners are prompted to use a GIS map to explore the effects of transportation infrastructure on land use. Information on the effects of sprawl on human and environmental health is then presented in the activity. Environmental issues that include pollution, effects of creating impervious surfaces, deforestation of riparian buffers, and the reduction of open spaces and farmlands are discussed. Learners are then guided to use GIS maps to examine patterns of land use and population centers. Best practices in land use including smart growth initiatives, brownfield redevelopment, and the creation of conservation easements are discussed. As a culminating activity, learners are presented with two differing viewpoints about creating a new highway extension in the area. They are prompted to select a viewpoint and write a position statement with supporting facts to either favor the highway extension construction or encourage land preservation.

The Land Use Change Unit

The Land Use Change (LUC) unit (http://www.ei.lehigh.edu/eli/luc) is designed to assist students in understanding land use change issues by investigating land use features and issues in the greater Lehigh Valley area. The LUC activities use Google Earth in conjunction with NASA and USGS images to assist learners with enhanced qualitative analysis of land use on the earth's surface. To understand concepts involved in the formation of urban heat islands, students investigate how shopping malls change natural environments. They learn how communities can use certain heat island reduction strategies to reduce the impact of an urban heat island effect. Students complete a case study of the greater Atlanta area to understand environmental issues that are typically associated with sprawl. Their investigations continue with a case study of the Lehigh Valley area in Pennsylvania to identify area land features. They then compare land use types around five different shopping mall areas using Google Earth to examine the significance of mall locations. Students then analyze and interpret satellite data images and aerial photographs to examine landscape changes over time in different locations around the world. In the culminating *Where should we build the new Wal-Mart Supercenter?* activity, students take on the role of a Lehigh Valley Planning Commission employee and recommend a plan for locating a new Wal-Mart Supercenter in the greater metropolitan Lehigh Valley area to have minimal impact on the environment. They use Google Earth to analyze and evaluate features of different land areas for proposed development sites and then develop a proposal to apply "smart growth" principles to their planning decisions and communicate their plan in a simulated planning commission meeting.

Stockertown Sinkhole Dilemma

In this activity (http://www.leo.lehigh.edu/envirosci/enviroissue/sinkholes), students learn about the Stockertown sinkholes and decide who should be responsible for compensating property damage caused by a sinkhole. Students adopt different stakeholder roles and access a variety of resources that they will use to develop a position statement about who should be responsible for the investigation and remediation of the sinkholes. They decide what should be done to solve the sinkhole problem, what might be causing the sinkholes, and what new policies should be created to protect the interest of homeowners affected by sinkholes. In this activity, students are responsible for presenting a long-term action plan to prevent and/or remediate sinkhole destruction during a simulated town hall meeting.

Abandoned Mine Drainage in Pennsylvania

Abandoned Mine Drainage in Pennsylvania (http://www.leo.lehigh.edu/envirosci/enviroissue/amd/) is a science-technology-society role-playing debate simulation. In this activity, learners investigate the abandoned mine drainage (AMD) issue from differing perspectives. In their investigation, they identify AMD problems caused by Pennsylvania's long history of coal mining, search for a solution by learning about active and passive treatment systems, and prepare a statement indicating what they believe is the best course of action for treating abandoned mine drainage in Pennsylvania. In class, a debate is held in the form of a town meeting for the commonwealth of Pennsylvania. Students evaluate active and passive treatment options and decide on a course of action to treat and clean up AMD in Pennsylvania.

Field Trip Site Visits

The course field trips consist of site visits to a variety of locations related to environmental issues in the watershed area. The first trip is spent with a local conservancy organization that works to preserve, protect, restore, and enhance the land, water, ecological, and recreational resources in the Lehigh Valley watershed area. Environmental issues pertaining to agricultural practices serve as case studies for this day. These include allowing unrestricted livestock access to streams and the placement of crop fields that extend out to a waterway making the banks more susceptible to erosion due to a lack of root structure, thus causing increased sedimentation, which is harmful to fish and aquatic macro-invertebrate habitats. Land use practices that seek education and compromise with landowners are highlighted. These include the importance of establishing riparian buffers, in-stream habitat improvement, and streambank stabilization efforts to minimize erosion and restore the stream to a more "natural" condition.

The second site visit is to the Lehigh Gap Nature Refuge (LGNF), the location of the largest EPA Superfund site east of the Mississippi River. At this site, students learn the historical significance and environmental consequences of two large zinc-smelting plants that emitted large amounts of sulfur dioxide for over 80 years. The sulfur dioxide emissions reacted with moisture and gasses in the atmosphere to produce sulfuric acid, which destroyed the plant and microbial life on the nearby Kittatinny Ridge and surrounding areas. When the vegetation died, approximately 2 feet of topsoil washed off about 2000 acres of the mountain creating a barren environment with soil containing high concentrations of zinc, cadmium, and lead with a subsoil devoid of microbes and organic matter (Kunkle, 2004). Since these metals are a potential human health threat this area was designated a Superfund Site in 1983. At a tour of the site, students learn how the non-profit LGNF was formed, and the political issues involved with working collaboratively with the Environmental Protection Agency to consider novel re-vegetation ideas to restore the ecologically degraded mountainside with mixtures of warm season grasses.

The third field trip focuses on recycling initiatives in manufacturing and energy production. The first stop is at a cement manufacturing plant that uses tire derived fuel and plastic derived fuel - the burning of plastic types 4-7 (that are currently landfilled) - to offset 50% of coal-burning produced energy and reduce nitrogen oxide emissions. At the plant, students learn about the many state legislative issues involved in obtaining permits for recycling used in a manufacturing process. The issues and concerns that were raised during public forums during the three-year permitting process are discussed. The second stop is at a power generating plant that uses culm (anthracite waste coal) in addition to other alternative fuel sources to generate electricity. The site itself is quite unique since it resides on land that once belonged to one of the largest operating cement plants in world. Environmental permitting issues are highlighted as students become aware of the legislation involved for using the plant's ash byproduct to fill abandoned mine strip pits in order to reclaim the land for other commercial purposes.

The fourth field trip is a canoe trip through ten miles of the Lehigh River to examine land use practices. Throughout the trip, we discuss environmental issues pertaining to zoning, industrial water discharges, invasive species, pollution and water quality related to urban development. During the trip, stops are made to gather water quality data to assess the health of the river.

Discussion

The hybrid approach of using Web-based modules and materials in conjunction with site-based experiences to investigate environmental issues in the watershed appears to be an effective course delivery design. The EE course activities provide teachers with an in-depth content understanding of local environmental issues as well as opportunities to explore pedagogical strategies to promote issues-based approaches to learning that hopefully will be adopted for later classroom implementation. The EE course modules are Web-based, making learning quite accessible and accommodating for the students. A key feature of the EE course design is that it is “Web-enhanced” and not entirely “Web-based”. An advantage of using a Web-enhanced course is that learners experience many interactive dynamics with the course instructor in face-to-face settings at the university and field trip sites. These interactions are highly valuable and cannot be completely replicated in typical Web-based learning courseware environments (such as Blackboard or WebCT). Furthermore, learning about an environmental issue at a site-based location with first-hand accounts from people who are intricately involved with an issue is a powerful learning experience. While video and Web-base media can be used to learn about environmental issues, physically being at a location where an issue takes place provides for a more compelling setting to promote learning and understanding.

Previous chapters in this book emphasize the importance on incorporating inquiry teaching and learning to promote environmental literacy. It is important that classroom science teachers gain a theoretical and practical understanding on how to take advantage of both Web-enhanced and Web-based instructional materials to promote essential skill development for understanding and addressing environmental issues in classroom contexts. The EE course takes advantage of existing Web-based curricular materials that highlights the complexity of environmental issues that entail conflicting interests and values and involve understanding the inter-relationships between economic, social, cultural, scientific, and political factors. The role-playing simulations described in this chapter highlight the open-endedness of environmental problems that concern multiple stakeholders who view the issue from varying perspectives. Well-designed Web-based curricular materials can help learners view a problem or issue from varying perspectives, prompt learners to evaluate scientific evidence, and critically assess arguments that may involve economic consequences. When learners critically examine a local environmental issue with inquiry-based methods, they develop conceptual understandings and practices that can be transferred to related issues in different geographical areas. The Web-based materials and activities described in this chapter have such geographical portability. For example, the concepts and understandings one learns from the *Stockertown Sinkhole Dilemma* can be transferred to understand geoenvironmental engineering and policy issues in other areas of the United States that contain limestone geology that might be prone to sinkhole occurrences.

Geospatial information technologies can be used to spatially support learners in environmental education learning activities. Web-based GIS and Google Earth visualizations are interactive images that are *information-rich* (they include layers representing various types of information) and *dynamic* (learners can explore them by observing spatial patterns and by selecting more or less detail). These applications support learners with the ability to make use of data visualizations for analysis and interpretation when examining environmental issues such as sprawl and land use decision-making.

The incorporation of geospatial information technologies in the course activities appears to be an effective strategy to assist teachers with enhancing their spatial concept of the watershed. Watershed sketch maps that were produced by the students at the end of the course were much more expansive and highly detailed compared to their initial sketch maps that were constructed at the beginning of the course. The end-of-the-course sketch maps included many geographical features and landmarks (such as sinkhole locations and the limestone belt), numerous tributaries of the Lehigh River including those with mine drainage in the northern portion of the watershed, the locations of all sites visited during the field trips, and the names of many boroughs, towns, and small cities throughout the watershed.

Conclusion

This chapter describes how a hybrid approach to environmental education instruction using Web-based activities and site-based experiences can be used to promote the teaching and learning of environmental issues in a local watershed with preservice and inservice teachers. In the course activities presented, teachers learn essential skills for linking environmental education methods and interdisciplinary content of the natural and social sciences to understand the complexities of environmental issues based in a local watershed. Developing skills for understanding and addressing environmental issues is a key component of environmental literacy. Teacher professional development courses can take advantage of well-designed Web-based curricular materials to have learners participate in real-world environmental problem solving. Such materials present environmental issues in appropriate and engaging ways for learners. Instruction may also take advantage of easily available geospatial information technologies to foster spatial literacy in the curriculum. In a hybrid course, site visits to areas of environmental concern can support and extend the environmental education concepts and skills that are initially developed with Web-based materials.

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Figure 1. Google Earth display showing the Lehigh River watershed. Yellow pushpin placemarks denote specific locations of interest in the watershed. Source Web address: http://www.leo.lehigh.edu/envirosci/watershed/pjournal/kml/Lehigh River Watershed.kml

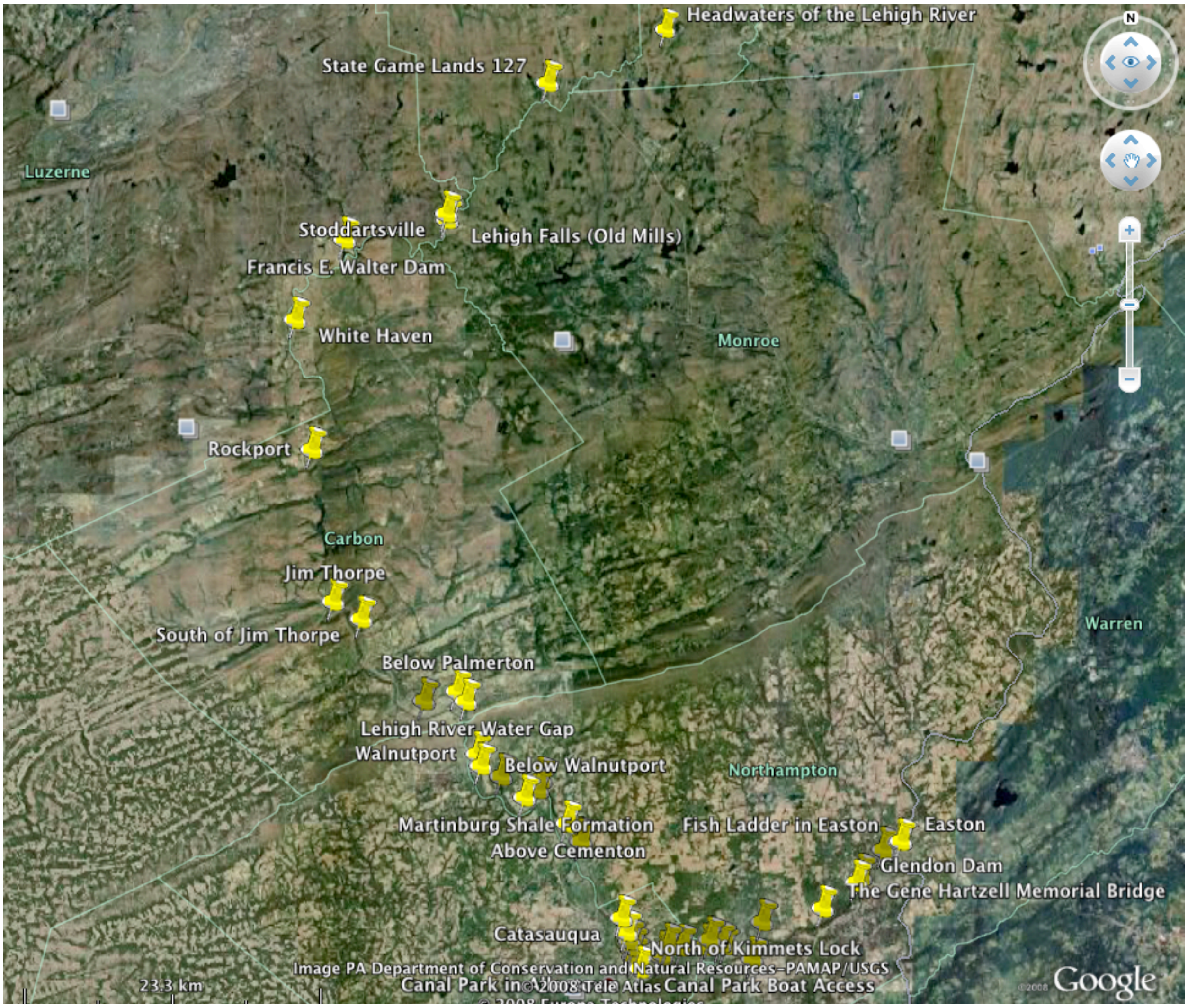

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Figure 2. Google Earth display highlighting the Monocacy Creek Confluence placemark. The drop-down menu in Google Earth's left frame can be used to navigate from one location to the next. Source Web address: http://www.leo.lehigh.edu/envirosci/watershed/pjournal/kml/Lehigh River Watershed.kml

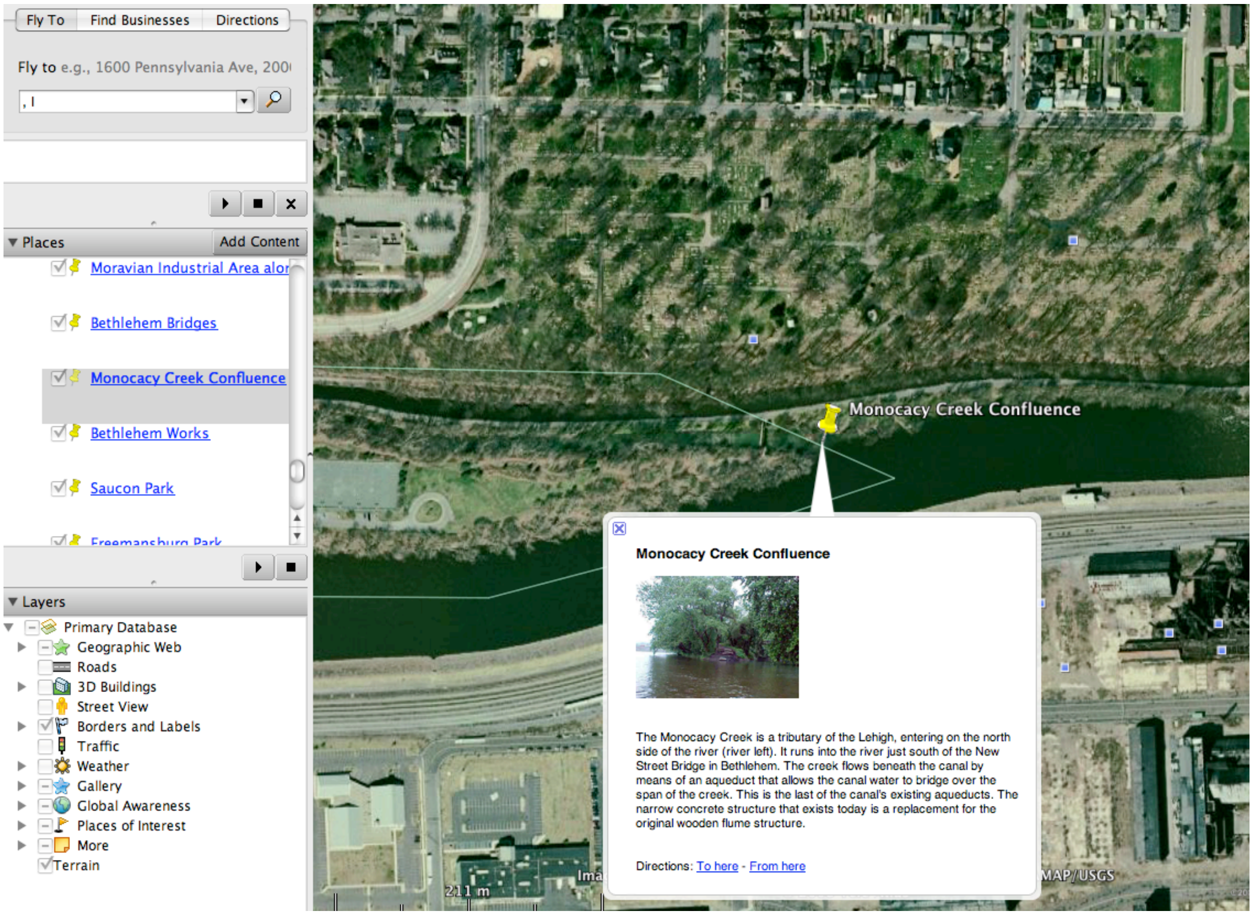

Figure 3. GIS map of the Lehigh River watershed displaying the location of recreational and preserved lands, limestone areas, and industries discharging toxic chemicals. Source Web address: http://128.180.10.97/website/activity3/viewer.htm