

SOAR Project Proposal
Summer 2012

**Evaluating the Extent and Impact of Coliform Bacteria
in the Little Lehigh Creek Watershed**

Faculty Adviser: Frank T. Kuserk, Professor of Biological Sciences and
Director, Environmental Studies & Sciences Program

Student: Brett Rentzheimer
Sophomore
Environmental Science
GPA: [REDACTED]
Major GPA: [REDACTED]
E-mail: stbtr01@moravian.edu

Start & End Dates: Tuesday, May, 29, 2012 to Friday, August 3, 2012 (10 weeks)

Title: *Evaluating the Extent and Impact of Coliform Bacteria in the Little Lehigh Creek Watershed*

Project Description: For the past several years my research students and I have worked with the Wildlands Conservancy (Emmaus, PA) on several projects designed to assess the quality of the streams within the greater Lehigh River Watershed. One of these streams, the Little Lehigh Creek, has experienced a significant rise in coliform bacteria in recent years. As a result of the success of past collaborations, I was recently asked by the Dr. Abigail Pattishall, Vice President of Conservation Science at the Wildlands Conservancy and Ms. Megan Bradburn, Division of Water Quality Standards, Pennsylvania Department of Environmental Protection (PA-DEP) to conduct extensive sampling in the Little Lehigh Creek Watershed in 2012 in order to determine various factors associated with the high levels of coliform bacteria in the creek waters. High coliform numbers are associated with fecal contamination and can indicate the presence of more serious human pathogens in the water. The study design that we have developed incorporates a watershed approach where 19 sites within the Little Lehigh Creek Watershed will be monitored for these bacteria during the 2012 summer season. The sites will be sampled by employing PA-DEP's Bacteriological Sampling Protocol. The following outline describes the main objectives of the study.

1) To Determine if the Mainstem of the Little Lehigh Creek is Attaining Recreational Use Status

In order to attain Recreational Use Status, a stream cannot violate the bacteria standard as outlined in the Pennsylvania Code Chapter 93. *Water Quality Standards*. "During the swimming season (May 1 through September 30) the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples with each sample collected on different days during a 30-day period (Chapter 93)." Because we are interested in assessing a stream for chronic violations of criteria, two 30 day periods (containing 5 consecutive samples each) within a single swimming season are required by PA-DEP's Bacteriological Sampling Protocol to determine whether a particular stream is impaired for Recreational Use Status.

2) To Determine the Locations of High Bacteria in the Little Lehigh Creek Watershed Tributaries

Nineteen sites have been selected throughout the Little Lehigh Creek Watershed for bacteriological monitoring in 2012. The sites were placed to investigate the relative contribution of bacteria from the tributaries and mainstem portions of the Watershed. Twelve sites on the tributaries will be monitored

including Cedar Creek (3 sites), Little Cedar Creek (1 site), Toad Creek (1 site), Liebert Creek (2 sites), Swabia Creek (2 sites), Toad Creek (1 site), Schaefer Run (1 site), and Iron Run (1 site). Seven sites are placed on the mainstem from the City of Allentown water filtration plant intake by the mouth downstream to the Hilltop Road Bridge in Lower Macungie Township. By identifying the locations where higher levels of bacteria are originating from in the Watershed, these areas can be targeted for future investigations and/or remedial actions.

3) To Identify the Source of Bacteria in the Little Lehigh Creek Watershed

We will conduct microbial source tracking of samples collected in the Little Lehigh Creek Watershed to determine whether bacteria is originating from human or animal sources. Such information is necessary to guide remedial actions.

4) To Compare Fecal Coliform and *Escherichia coli* levels in the Little Lehigh Creek Watershed

Prior to 1986, the federally recommended water quality criteria for recreation was a geometric mean of 200 fecal coliform cfu (colony forming units) per 100 ml. Pennsylvania adopted the federal recommendation. In 1986, the US-EPA recommended a standard based on *E. coli* (a 5-day geometric mean of 126 cfu per 100 mL). The PA-DEP decided not to adopt *E. coli* as an indicator because the densities recommended by the US-EPA did not appear to offer improved health protection over the standard already in place in Pennsylvania based on fecal coliform. Additionally, approved laboratory methods for *E. coli* were not available at the time. As laboratory methods have improved and become more cost-efficient, the US-EPA 1986 recommendation can be reevaluated. More studies are required in inland waters to compare the level of protection offered by Pennsylvania's current Water Quality Criteria for recreation based on fecal coliform and the federal recommendation based on *E. coli*. For this study, both fecal coliform and *E. coli* will be analyzed at several locations (3 to 6 sites) during the two 30 day periods (10 days). A determination will be made on whether the assessment based on the US-EPA criteria which analyzes *E. coli* as the indicator for pathogens (geometric mean of 126 cfu) agrees with the assessment based on Pennsylvania's current criteria that analyzes fecal coliform as the indicator for pathogens (geometric mean of 200 cfu).

5) To Compare the Quantity of Bacteria during Storm Events and Base Flow

Previous data on the Little Lehigh Creek has indicated that bacteria levels are higher after periods of heavy rain. This may be partially due to the fact that contaminants will often build up in the soil and then be flushed into the stream during periods of heavy precipitation. This phenomenon will be studied in the Little Lehigh Creek by comparing bacteria quantities during low flow conditions to quantities immediately following a storm event. The relationship between bacteria concentrations and other variables such as discharge, upstream riparian buffer width and length, the magnitude of precipitation, and duration of the rain event will be investigated.

Roles and Responsibilities of Faculty and Student:

Faculty Role: For over twelve years I have been working with the Wildlands Conservancy, the Lehigh Gap Nature Center, and the Fry's Run Watershed Association on stream monitoring and restoration projects in the Lehigh River Watershed. As a result, I have engaged many Moravian College students in assessment projects because of these collaborations. My previous work at the Stroud Water Research Center (Academy of Natural Sciences of Philadelphia) provides both theoretical and applied knowledge of the dynamics of stream ecosystems. I have published papers in the *Canadian Journal of Fisheries and Aquatic Sciences* and

Microbial Ecology on the carbon dynamics of streams. I have also authored several technical reports for the Wildlands Conservancy based on collaborative projects and have published an article in *The American Biology Teacher* in which I describe how techniques developed as part of my research can be used in an undergraduate ecology class. For this project I will assist my research student, Brett Rentzheimer, to develop a background literature search, provide expertise in how to conduct bacteriological assessments, assist in collection and analyses, and guide him in the preparation of results for presentation and publication.

Student Role: Brett Rentzheimer will participate in pre-project planning with Dr. Abigail Pattishall, Ms. Kristie Fach, Ms. Megan Bradburn and me, collect, and analyze water samples using established bacteriological protocols. Brett will assist me in the analysis of the data that we collect and in writing the final report that will be given to the Wildlands Conservancy and the PA-DEP. Finally, Brett will prepare a presentation or poster for presentation at a scientific meeting. Over the past five years I have had 12 of my SOAR and Honors research students present their findings at the annual National Conference on Undergraduate Research.

Benefits to the Student, Faculty Member and Moravian College:

Student Benefits: Brett will benefit by being part of a long-term ecological study that has great environmental importance. They will become part of a team of researchers and conservation scientists dedicated to improving stream quality. In this way they will experience how modern ecological research is a collaborative effort involving many people, each contributing in a specific way according to their expertise. More importantly, their work will assist the PA-DEP in determining whether currently accepted techniques are still appropriate or require modification. Brett will need to operate both as a team player and as an individual charged with the responsibility of learning accepted sampling protocols, performing appropriate assessments, and conducting statistical analyses on the results. Additionally, he will gain experience in the writing of scientific reports and papers. He will additionally present his work at Moravian College's Annual Student Scholarship and Creative Arts Day and at a scientific meeting such as the National Conference on Undergraduate Research or Undergraduate Posters at the Capitol-PA next spring.

Faculty Benefits: I am eager to continue a research program that actively involves undergraduates and collaborates with local and state environmental organizations and individuals.

College Benefits: Continued cooperation with the Wildlands Conservancy and the PA-DEP will assist us in providing our students with meaningful field experiences. These organizations can provide opportunities for students engaging in scientific research, environmental policy, environmental management, and environmental education. Our Biology and Environmental Studies & Sciences Programs rely on our ability to develop strong relationships with environmental organizations.

Budget:

\$3000	Summer stipend (\$3000) for Brett Rentzheimer (10 weeks x 40 hr/week x \$7.50/hr)
\$1000	Faculty stipend for Frank Kuserk (10 weeks x \$100.00/week)
\$500	Expendable supplies to enumerate coliform bacteria (bacteriological media, petri plates, collecting containers, membrane filters). Since we will be using cars to travel to field sites we request travel funds based on the current 55¢ per mile. We will keep a log of travel mileage and submit it for reimbursement at the end of the project.

\$4500	Total
--------	-------

SOAR Project Proposal Summer 2012

Student Statement of Purpose

Project title: *Evaluating the Extent and Impact of Coliform Bacteria in the Little Lehigh Creek Watershed*

Student name: Brett Rentzheimer
Major: Environmental Science
Graduation Date: May 2014
Faculty Mentor: Dr. Frank T. Kuserk
Campus Housing: No

Participation Rationale & Expected Outcomes:

There are several reasons why I want to participate in this summer SOAR project with Dr. Kuserk. The first is the opportunity that it will give me to engage in the process of science. Learning in the classroom provides me with the foundation that I need but actually engaging in scientific research will allow me to apply the knowledge that I have learned in the classroom to solving real world problems. This project especially intrigues me since I will have the opportunity to work with scientists with the Pennsylvania Department of Environmental Protection and the Wildlands Conservancy to try and solve some actual problems associated with water quality in the Little Lehigh Creek and its tributaries. The practical experience that I will gain will provide me with experience working with instruments, equipment and techniques that environmental professionals use. Learning to use appropriate statistical techniques and putting together a scientific report are also valuable skills that I will learn. Having the opportunity to present my research at a scientific meeting will enable me to gain practice in public speaking.

Another reason why I want to participate in this research project is that it may lead to further opportunities for other research projects in the future, such as an Honors project, that I might want to engage in during my Senior year. I want to find out if I really enjoy doing research and discovering new things. Learning how scientific research is conducted now will help me later to become more independent if I decide that this is what I want to do.

Finally, participating in this SOAR project will allow me to gain experience toward my future career goal. As of now I am interested in attending graduate school and then pursuing a career in an environmental science. This project will allow me to explore what aquatic microbial ecologists do. I may find that it is an intriguing area that I would like to pursue further, or perhaps I may decide to continue looking into other environmental areas. In any event, participating in such an endeavor now will allow me to mature as a young scientist.