Purpose

Learning Goal
Students will relate the principles of environmental testing to decisions pertaining to release of industrial waste waters into sensitive habitats.

Overview (Strategy)
Students will read the background for a case study and consider the data from environmental testing along several points on Five Mile Creek to determine if a permit should be granted to allow industrial discharge waste water into the creek.

In addition to the background information of land use and analysis of water quality reports, students will perform quality tests on locally collected creek samples and make determinations about the water quality from each site. They will plot the results of the water quality tests on physical maps and identify any deleterious patterns.

Time
One lab period
Level
Introductory non-majors Biology BIOL102/105

Prerequisites and Concurrent Lectures
Students will have learned some basic characteristic of water in previous labs. In addition, those attending Biology 102 lectures will have received information in lecture and film format relative to the impact of pollutants into water systems.

Concurrent Lectures will include:
Global Climate Patterns
Major Biomes: Structure, Function, and Change
Human Impact on ecosystems

Key Concepts and Skills

Concepts
Human activities often intrude in biogeochemical cycles by removing nutrients from one location and adding them to another.
Sewage treatment facilities and fertilizers (farm, homeowners, golf courses) add large amounts of nitrogen and phosphorus to aquatic systems.
Observation, experiments, and computer models can be used to test and predict ecological interactions

Water chemistry:
High ammonia levels can be toxic to fish and other aquatic organisms. Medium levels of ammonia may be associated with gill damage and reduced growth due to suppressed appetite.
High levels of nitrates can cause fish to lose their color, gasp at the surface and increase susceptibility to disease.
Nitrates promote plant growth but high levels may lead to an undesirable accumulation of algae.
Acidic water can aid in increasing pollutants and result in a decrease in the amount of oxygen. Highly alkaline waters can harm fish, plants and other aquatic organisms.

Skills
Critical Thinking
Water quality assessment

Background

PART I - FIVE MILE ACTION COMMITTEE INC. FACT SHEET

In the fall of 1990 Osborn Coal Enterprise approached the Jefferson County Planning and Zoning Commission and the County Commission to have the site of the former DuPont Birmingham Works explosives plant zoned to allow strip mining. Citizens of the nearby communities of Mt Olive, Gardendale, and Brookside united in presenting their concerns. The County Commission rejected the rezoning request.

The coal company continued with the application for a State surface mining permit, pending receipt of proper zoning. Legally putting the cart before the horse. This helped in avoiding renewed public opposition. After all, why would anyone pay for a useless permit now?

In the summer of 1991 Osborn approached the Town of Brookside with an offer which would allow the town to increase in area by 349 acres, approximately 4 times its existing land mass. With a series of secret unannounced council meetings a plan was formed to bypass the County decision. Fortunately with the ever watchful eyes of the citizen neighborhood and an inside track to the Council, the public remained on top of the evolving situation. The Council was ready to annex the property until the citizens' protest and media coverage abounded.
The Council voted to shelve the annexation discussion.

Upon the rejection by Brookside, Osborn approached the Town of Cardiff with a similar offer, and the threat that Birmingham would love to "grab" the land and would allow mining with no benefit to the local communities.

Hearing that Cardiff was about to make a move, the Mayor approached the coal company with an offer for reconsideration. With "bootleg" style politics rolling once again, a flurry of secret Council meetings were held, and the property was finally annexed.

The stipulation was that land owned by United Land and DuPont could be annexed conditionally upon the allowance of strip mining and exclusion of property and occupational tax for a period of 10 years. (Reference: Brookside Ordinance 315 dated November 5 1991, Probate Vol. 4151 pp. 92-98) Additionally, Osborn would make a "contribution" of $0.05 per ton of mined coal to the town, because under State law, municipalities may not levy a tax on coal production.

The supplied test kit provides for analysis of:
- pH
- Temperature
- Turbidity
- Alkalinity
- Hardness
- Dissolved Oxygen

In addition, AWWA provides a macroinvertebrate community assessment program for the determination of relative stream quality. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, they provide a more complete and comprehensive picture of ecological quality of the watershed.

Continued supply of AWWA chemical reagents, annual requalification training and quality assurance is provided by a partnership with the Storm Water Management Authority of Jefferson County and the United States Department of Agriculture.

More specific chemical species testing is also performed. Testing is conducted at established sample sites and occurs at random timings to allow for detection of illegal discharges.

Tests include but are not limited to:
- Phenol
- Cyanide
- Phosphate
- Sulfate
- Copper
- Nitrate
- Chlorine
- Iodine
- Bromine
- Chromium

Additional information to consider:

**Water quality and nonpoint sources in urban watersheds**

Key findings (applicable to Alabama) from the first decade of NAWQA (National Association of Water Quality Assurance) studies

**Contaminants are widespread in urban streams, and biological communities are stressed**

Concentrations of total phosphorus exceeded the desired goal of the U.S. Environmental Protection Agency (USEPA) to control nuisance plant growth in more than 70 percent of urban streams. Excessive plant growth can lead to low levels of dissolved oxygen (hypoxia).

Hypoxic conditions can be harmful to fish and other aquatic life.

Insecticides are widespread and usually at higher concentrations than in agricultural areas. Two popular insecticides--diazinon and chlorpyrifos--are often found mixed together. Herbicides are in 99 percent of urban streams sampled; simazine and prometon commonly are found together.
Pesticide concentrations rarely exceeded USEPA drinking-water standards, but every stream sampled exceeded at least one guideline for protecting aquatic life. Moreover, standards do not exist for many pesticides or for mixtures of pesticides.

Fecal coliform bacteria commonly exceeded recommended standards for water recreation.

Biological communities are dominated by algae and aquatic invertebrates that can tolerate pollution, such as worms and midges, and omnivorous fish, such as catfish and largescale suckers.

Volatile organic compounds (VOCs) are widespread in shallow ground water in urban areas.

Most frequently detected are the solvents trichloroethene (TCE), tetrachloroethene (PCE), and methylene chloride; the gasoline additive methyl tert-butyl ether (MTBE); and chloroform, the solvent and disinfection by-product of water treatment.

Sediment and fish tissue in urban areas reflect past chemical use as well as current trends.

Banned insecticides such as DDT, chlordane, and dieldrin still persist in sediment and fish tissue. Concentrations exceeded guidelines to protect wildlife at more than 10 percent of urban sites. High concentrations of polychlorinated biphenyls (PCBs), which were used in insulation and as a lubricant but have not been sold since 1979, were also found in most fish tissue; guidelines were exceeded at nearly 70 percent of urban sites. Some states have issued fish-consumption advisories.

Lead, mercury, cadmium, and zinc are elevated above background levels in sediment, most likely caused by emissions from industrial activities and motor vehicles. Lead concentrations have been decreasing, however, since being removed from gasoline in the 1970s.

In addition to current and potential discharges into Five Mile Creek from Industry, improper maintenance and over-utilization of the County sanitary sewerage system results in routine discharges of untreated sewage into Five Mile Creek. The County has spent excessive amounts of cash to construct a new entry road to the Five Mile Creek Waste Water Treatment Plant at Coalburg, yet the leaky trunk lines that enter the plant have received low priorities.

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<td><em>(DOES NOT INCLUDE FREQUENT LEAKS FROM SYSTEM DUE TO IMPROPER MAINTENANCE OF TRUNK LINES.)</em></td>
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Source: Jefferson County report to USEPA in response to the 1996 sewer settlement action.
Alabama Endangered and Threatened Species

The species listed below have been identified, through project information, to have habitat potential within the Five Mile Creek Basin.

### Animals – 87
(Only those classified as endangered or threatened have been listed)

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<th>Species Name</th>
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<tr>
<td>Endangered</td>
<td>Woodpecker, red-cockaded (<em>Picoides borealis</em>)</td>
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Watershed of concern: Locust
USGS Cataloging Unit: 03160111
In the End…

Fearing at least 10 years of continued mining activities along the creek, and its tributaries, and having the prior experience of a lifetime of mining impacts, a group of citizens vowed that the mining "might" be allowed, but the prior destruction of the stream ecosystem would not. One sunny spring afternoon it was decided that an ongoing environmental group would be formed to monitor and protect the watershed.

On June 18, 1992 Five Mile Action Committee, Inc. was chartered and incorporated with the gracious donation of assistance from a local law office and input from the Cahaba River Society.

Materials and Tools
Part I - Background information from “Five Mile River Action Case Study”
Part II - Pond test kits for Ammonia, Nitrites, Nitrates, and pH.

What to Do and How to Do It (Students)

PART I – FIVE MILE CREEK CASE STUDY
After reviewing the background information and data sheets, discuss the case with your table group and make recommendations according to the questions asked on your case study review sheet.

PART II – WATER TESTING
Water testing using the “Rapitest® Pond Test Kit:
The pond test kit utilizes four specially designed testers – one each for pH, ammonia, Nitrite, and Nitrate. Each tester has a removable color chart and coded color top.

The color key is as follows:
Green: Ammonia
Yellow: Nitrite
Blue: Nitrate
Red: pH

Select the appropriate tester according to the test you wish to conduct.
Remove the cap and take out the capsules which are also coded in the appropriate color. Make sure the color chart is in place. Avoid interchanging color charts between testers.
Rinse the test and reference chambers with pond water to the level arks on the color chart. The water should be at room temperature for best results.

NOTE: The ammonia test contains 2 packets of capsules color-coded light and dark green. One capsule from each packet is required for the test. Remove the capsules and empty both into the test chamber, following directions below. All other tests require only one capsule.
1. Take one of the capsules and holding it vertically with the lid pointing upwards, gently tap the bottom of the capsule against a hard surface to settle the contents. Carefully open the capsule over the test chamber by twisting the two halves apart.
2. Pour the powder into the test chamber.
3. Fit the cap onto the tester making sure the individual seals are properly seated. Shake thoroughly until the powder is completely dispersed.
4. Allow the color to develop in the test chamber for five minutes for pH, Nitrate, and Nitrite tests. Allow 30 minutes for color development on the ammonia test.
5. Compare the colored solution in the test chamber with the color chart alongside.
6. Select the colors against a white background (1” away) using natural daylight. Avoid direct sunlight. Judge in-between colors if necessary.

Read your results and record them under the appropriate sample number of the class record data sheet.

References and Resources
Product Information – Rapitest Pond Test Kit #1900. Distributed by Luster Leaf Products, Inc. 2220 Techcourt, Woodstock, Illinois
Five Mile Creek Action Committee, Inc.
Jefferson County report to USEPA in response to the 1996 sewer settlement action
Maps from USGS – “Know your Watershed”