Cleaning up Lake Barcroft

Students are learning more and more about their natural environments and about the human impact on them through school, the media and local community groups. Yet they have little understanding of how engineers help our environment. The following activity is based on a real environmental problem in Virginia, outside Washington, D.C. You will find a statement of the problem and then a series of questions and suggested answers an engineer might ask as he or she leads students to solve the problem. Use "Cleaning up Lake Barcroft" as is, adapt it to a local situation, or use it as an outline to write your own scenario. You can lead the students through each step or concentrate on one or two.

The Problem

Lake Barcroft is a privately owned, man-made lake in Falls Church, Virginia. For the area homeowners, the lake provides opportunities for swimming, boating, and fishing. Unfortunately, sometimes the algae population in the lake becomes so great that swimmers come out of the water covered with green slimel Sometimes so much sediment accumulates in parts of the take that people can't use their boats and people wonder why they don't catch as many of their favorite species of game fish as they used to. Is it safe to eat the fish they do catch? An agency known as the Lake Barcroft Watershed Improvement District (WID) is responsible for improving and maintaining the quality of the lake. It collects taxes from the homeowners to carry out their responsibilities. The WID needs advice on how to put the taxpayers' money to best use.

Questions to Consider

1. **What causes the algae to grow? Where might the nutrients used by the algae be coming from?**

(Algae require light, appropriate temperature. and nutrients such as nitrogen and phosphorus. among other things, to grow. As long as all growth requirements are met, the algae will continue to grow. Nitrogen and phosphorus commonly come from the watershed itself: fertilized lawns and fields and livestock operations are some examples.)

2. **Are the algae merely an aesthetic nuisance? Do they cause other problems or provide any benefits?**

(Some species of algae serve as a food source for some species of fish and other take creatures. However, algal blooms (algal population explosions) are generally undesirable: not only is the algae unpleasant to look at and swim in, but decaying algae depletes the oxygen supply needed by fish.)

3. **Where does the sediment come from? Could nutrients or harmful substances be associated with the sediment particles?**

(The sediment is transported by storm water runoff from the surrounding watershed. Improperly managed construction sites on the watershed can contribute significantly to the sediment load to the lake. Some forms of phosphorus as well as heavy metals can be associated with the sediment.)

4. **What type of environment do "desirable" species of fish require? Is the optimum fish environment the same as the optimum swimming or boating environment?**

(The optimum fish environment [in terms of pH, dissolved oxygen. temperature, etc.] varies from species to species. Many species require aquatic vegetation for feeding, breeding, and avoiding predators. Aquatic vegetation can sometimes be an annoyance to boaters and swimmers.)

5. **How is the land which comprises the watershed (the area which drains to the lake used? Could some parts of the watershed be contributing more sediment, nutrients, or other pollutants than others?**

(Runoff and erosion are functions of land use, slope of the land. and soil type. Such information can be obtained from street maps, United States Geological Survey, USGS, topographic maps and county soil surveys. Steeply sloped areas have a higher erosion potential than flat areas. Runoff and erosion will be greater if the soils are not well drained. Runoff from fertilized lawns will have a higher concentration of nutrients than runoff from a wooded area. Runoff from shopping mall parking lots will be laden with oil and grease.

6. **What things methods or devices can be applied to control the pollution either before or after it enters the lake?**

(Riprap can be installed along stream banks to control erosion. Grease traps can be installed on parking lots. Aerators can be installed in the lake to provide direct benefit to fish as well as to keep phosphorus "locked up" (unavailable to plants) in the sediment. Wetlands can be created on the watershed to provide flood control and to trap sediments, nutrients and heavy metals.)

7. **Can the area homeowners themselves control the pollution entering Lake Barcroft, or will the cooperation of people/agencies upstream of the lake be required? What Incentives are there to encourage the cooperation of people upstream of the lake who derive no direct benefit from Lake Barcroft?**

(Area homeowners can help by not over-fertilizing their lawns. but since much of the pollution comes from upstream of the Lake Barcroft residential area, cooperation will be needed from citizens and public agencies of Fairfax County. Cooperation from non-Barcroft residents might be encouraged if the pollution control method or device

provided recreational or educational opportunities.)

8. **Once the pollution controls have been implemented, how will it be determined how well [or if] they are working?**

(Water sampling stations can be established in the take as well as upstream and downstream of the pollution control. Monitoring should begin before implementation of the control so that baseline conditions can be determined.)

9. **Assume that a wetland is to be created on the watershed. Consider the following. What issues must be considered in finding a suitable location?**

(Topographic/geographic suitability, public reaction to a potential “mosquito farm" or potential "endangered species preserve and recreational area", reaction of the owner(s) of the site property. If the created wetlands is to provide benefit to the general public, from what agencies should cooperation be sought?)
(County Park Authority. Planning District Commission. Environmental Monitoring Advisory Committee. Watershed Monitoring Laboratory, University Biology Department. County Public Schools, to name a few.)

10. **What types of experts should be consulted to address the various facets of the problem?**

(Civil/environmental/agricultural engineers. hydrologists. biologists. chemists [to perform laboratory analyses of water samples], wetlands specialists. fish and wildlife specialists, to name a few.)

Classroom Activities

Role-playing

Students take on the parts of: the engineer: the WID Trustee: the citizen who likes the idea of wetlands, but not in his backyard and the Park Authority representative.

Watershed delineation

The engineer could demonstrate how to locate a watershed boundary on a topographic map.

Brainstorming

Students think of educational and recreational uses of a created wetland in an urban area.

Erosion estimating

The engineer leads students through the steps of computing estimated sediment yield from a watershed. He or she challenges students to solve the problem then compare their ideas with the following real life scenario.

Real-Life Progress

If you or the students would like to know the fate of Lake Barcroft read on:

A water sampling program has been initiated for the lake. Water samples are collected monthly and analyzed for bacteria, nutrients, pH, dissolved oxygen, temperature, and total alkalinity. Fish flesh and sediments are analyzed on an annual basis for heavy metals. A computer database has been developed to store and process the data.

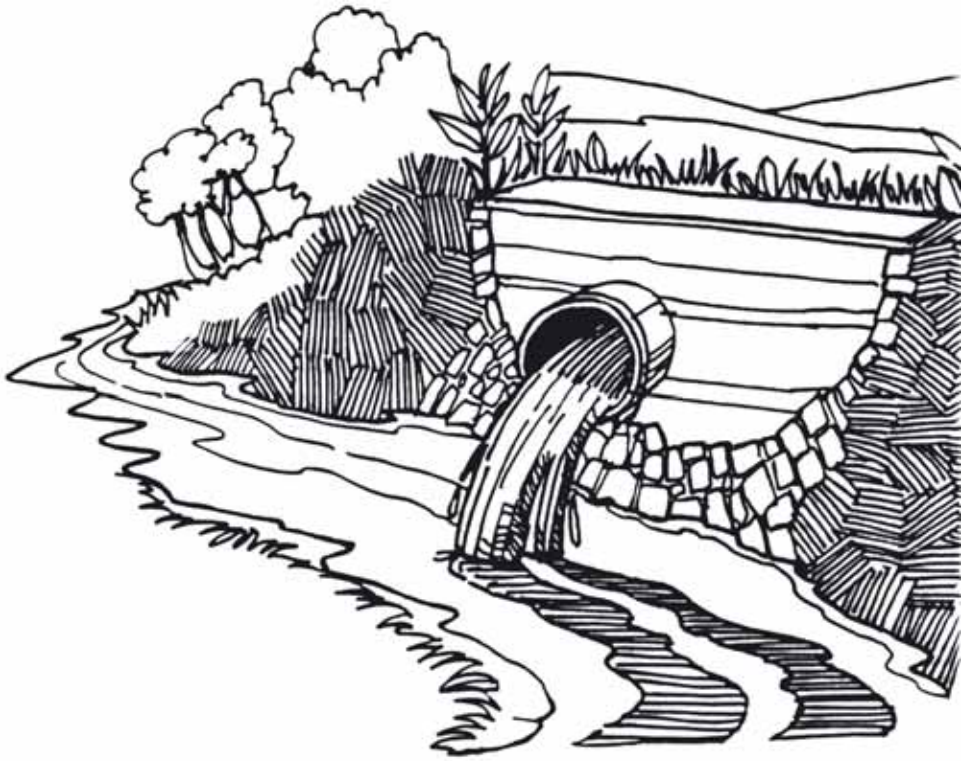
A bathymetric survey of the lake has been made to establish a baseline for monitoring sediment accumulation.

The Lake Barcroft watershed was divided into several sub-watersheds. A computer analysis was performed to determine which sub-watersheds have the highest potential for erosion

Search has begun for an appropriate site for created wetlands.

(For more current information on this lake visit http://www.gky.com/barcroft/

Engineering Glossary



Best Management Practices - methods or devices for controlling runoff and erosion.
Erosion - the wearing away of soil by forces such as rainfall and gravity.
Eutrophication - the process by which the concentration of plant nutrients in a body of water becomes excessive such that the dissolved oxygen supply for aquatic animal life is threatened.
Non-point source pollution - sediment, nutrients, or toxins that are washed from the land in general rather than discharged from a particular source. (Industrial waste coming out of a pipe from Plant X would be considered point-source pollution: phosphorus washing off of an unknown number of lawns from various locations within a watershed would be considered non-point source pollution.)
Runoff - precipitation (rain or melted snow which flows along the surface of the land rather than down into the soil.
Watershed - the area which drains to a particular point. (The "point" in this case is the dam of Lake Barcroft.)
Wetlands - a lowland area which is frequently, but not necessarily constantly, saturated with water, which can serve as a habitat for a diverse population of plants and animals.

Equipment

- Topographic map
- Sails map
- Planimeter
- Map wheel
- Depth finder
- Water quality analysis equipment:
  - pH meter
  - Dissolved oxygen meter
  - Secchi disk
  - Water sample bottles