Lakes and Their Watersheds

A FACT SHEET OF THE PENNSYLVANIA LAKE MANAGEMENT SOCIETY

Lakes and Reservoirs make up some of the most valuable and utilized water resources of Pennsylvania. There are over 5,000 Lakes and Reservoirs over 5 acres in the State. A ***Lake*** is any naturally impounded body of water, while a ***Reservoir*** is a body of water that is created as a result of excavation or damming.

In order to properly understand and manage your lake, you should understand lake ecosystem components and their interactions. Important components include: the ***watershed*** that contributes water to your lake; and the ***physical, chemical,*** and ***biological components and cycles*** of your lake.

The purpose of this Fact Sheet is to provide a brief overview of each of these components. Details and assistance in developing information for all these components are available from a number of sources, including those listed at the end of this Fact Sheet.

THE LAKE'S WATERSHED

A *watershed* is that area of land that drains directly into a lake, either through rivers, streams, surface runoff, or groundwater. A *watershed* is best envisioned as a funnel with a glass at the bottom representing a lake. Anything that falls into the funnel will find its way into the glass. Much the same occurs in a watershed, therefore watershed characteristics such as ***size, land use, slope,*** and ***soils*** play an important role in determining both the quality and quantity of the water that drains to a lake. For this reason, getting to know your lake's watershed and the activities that go on in it are of primary concern to the individuals that manage and enjoy the lake.

A good place to begin to gain a better knowledge of your lake's watershed is by obtaining 7.5 minute, 1:24,000 scale U.S. Geological Survey (USGS) topographic maps for the area, available locally either from the Conservation District or sporting goods store. Reference copies are also available at most USDA and Planning Commission offices.

Topographic maps contain valuable information about the area that drains into your lake, such as steepness of the land, physical characteristics, roads and trails, and some general land use. By outlining the watershed that drains to your lake, you can begin to survey that area for possible water quality influences. The *watershed size*, along with the *land use, slope, soils* and *precipitation* will enable you to determine runoff characteristics of your lake's water source.

The ***land use*** in a *watershed* affects the type of materials, such as sediment, nutrients and other pollutants, that will wash from those areas and potentially into your lake. One may expect oils and salts from roadways, sediments and fertilizers from farms and gardens, nutrients from on-site septic systems, etc. The **permeability** of the *land use* affects how much and how quickly water will travel. For example, rain falling on closely mowed grass will travel faster and move more nutrients than if it were to fall onto a wooded area.

The ***slope*** of land within the *watershed*, together with land use, determines how fast water and pollutants are carried to the lake.

Watersheds are made up of many types of ***soils***. *Soil type* affects the rate and quantity at which precipitation soaks into the ground. A rich organic soil absorbs much of the rainfall, while a rocky clay soil may shed most of its rainfall. *Soil types* also have differing chemical make-ups and erodibility that affect water quality.

THE LAKE'S PHYSICAL ASPECTS

A lake's *depth, length, width and physical shape* all combine to influence how the water from the *watershed* moves through and reacts with the lake. The longer water remains in a lake, the longer it has to deposit the materials it has carried from the watershed and to interact with the water already in the lake.

A lake's ***depth*** affects the volume of the lake and determines to some extent how water will flow through the lake. A lake's *depth* also determines whether or not a lake becomes thermally stratified in the summer, with a layer of warm water at the top and a layer of cold water at the bottom. Therefore, *depth* affects lake water quality by determining the fate (dilution and transport) of incoming pollutants.

A lake's ***length, width and physical shape*** also determine flow patterns and characteristics. A short uniformly-shaped lake will have a relatively short water detention time. A long lake with many arms and bays will have a much longer detention time, with many areas of slow or isolated water movement.

Additional *physical aspects* of a lake that are important are: the locations of water control structures such as beaver dams or dikes; the location of submerged structures; and the location and characteristics of aquatic plant beds. The preparation of a detailed bathymetric (lake depth) map would provide a useful tool for lake management.

Chemical/Physical Properties & Cycles

The many chemicals that enter the lake from the watershed and the atmosphere go through cycles that affect the overall quality of a lake's water. Some chemicals may flow through the lake unchanged, while others settle to the bottom, possibly to be reused again. Still others remain in solution. Understanding these cycles is often the key to managing or correcting water quality problems.

The plant nutrients *phosphorus* and *nitrogen* play a major role in plant growth, including macrophytes (aquatic vegetation) and algae. These nutrients enter a lake through atmospheric deposition (directly falling on the lake's surface as dust and as rain), dissolved in groundwater, or attached to sediment particles in streams that drain the watershed. Under conditions of low oxygen, phosphorus may be released from the bottom sediments.

The effect of *acid precipitation* on runoff is largely determined by the ability of the watershed and lake to neutralize the acidity. This varies by watershed and is determined largely by the parent rock material and subsequently the buffering capacity of the soil and type of dissolved materials in the water.

Sediments directly affect water clarity and also carry chemicals that may alter the lake water chemistry.

Deeper lakes often experience *thermal stratification*. This is the condition where stable water layers develop, most notably during the summer with warm water at the surface and colder, denser water at the bottom. This denser water at the bottom is essentially isolated from atmospheric sources of oxygen. The store of oxygen in the bottom water can be depleted by biological activity in the sediments, causing a number of reactions that affect chemicals in the water and sediments.

Seasonal measurements of nutrients, oxygen and temperature will aid in understanding a lake's water quality status, in diagnosing problems, and in developing a lake management plan.

Biological Cycles & Components

As with the chemical and physical aspects of a lake, the biological cycles and components of a lake play an important role in determining water quality. Food chains directly affect the fisheries and wildlife capacity of the lake. The type and abundance of plants and algae can and do affect the planned uses of a lake.

As with the chemical and physical aspects of a lake, monitoring biological components is important to understanding and managing lakes.

Lake Management References

EPA: www.epa.gov
NALMS: www.nalms.org/
Penn State Extension: http://extension.psu.edu/natural-resources/water

For More Information, Contact:

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