Fish and Water Quality **Week 1**

The Safe Drinking Water Act (SDWA), passed in 1974 and amended in 1986 and 1996, gives the Environmental Protection Agency (EPA) the authority to set drinking water standards. This document describes how EPA establishes these standards.

Drinking water standards are regulations that EPA sets to control the level of contaminants in the nation's drinking water. These standards are part of the Safe Drinking Water Act's "multiple barrier" approach to drinking water protection, which includes assessing and protecting drinking water sources; protecting wells and collection systems; making sure water is treated by qualified operators; ensuring the integrity of distribution systems; and making information available to the public on the quality of their drinking water. With the involvement of EPA, states, tribes, drinking water utilities, communities and citizens, these multiple barriers ensure that tap water in the United States and territories is safe to drink. In most cases, EPA delegates responsibility for implementing drinking water standards to states and tribes.

States are authorized to grant variances from standards for systems serving up to 3,300 people if the system cannot afford to comply with a rule (through treatment, an alternative source of water, or other restructuring) and the system installs EPA-approved variance technology. States can grant variances to systems serving 3,301-10,000 people with EPA approval. SDWA does not allow small systems to have variances for microbial contaminants.

Florida’s drinking water standards are contained in Chapter 62-550, Florida Administrative Code (F.A.C.). The primary drinking water standards, which are health based, are described in Rule 62-550.310, F.A.C., and specific numeric limits are listed in a series of tables contained in this chapter.

The Florida Department of Environmental Protection (FLDEP) is responsible for protecting the quality of Florida’s drinking water as well as its rivers, lakes and wetlands, and for reclaiming lands after they’ve been mined for phosphate and other minerals. They establish the technical basis for setting the state’s surface water and ground water quality standards, and also implement a variety of programs to monitor the quality of those water resources.

pH

Please Also Read: 3-20

The pH of a sample of water is a measure of the concentration of hydrogen ions. It is the negative logarithm of the hydrogen ion (H+) concentration. At higher pHs, there are fewer free hydrogen ions, and that a change of one pH unit reflects a tenfold change in the concentration of the hydrogen ion.
The pH scale ranges from 0 to 14. A pH of 7 is considered to be neutral. Substances with pH less than 7 are acidic; substances with pH greater than 7 are basic.

The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). In addition to affecting how much and what form of phosphorus is most abundant in the water, pH also determines whether aquatic life can use it. In the case of heavy metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic at lower pH because they are more soluble.

Photosynthesis uses up hydrogen molecules, which causes the concentration of hydrogen ions to decrease and therefore the pH to increase. For this reason, pH may be higher during daylight hours and during the growing season, when photosynthesis is at a maximum. Respiration and decomposition processes lower pH. Like dissolved oxygen concentrations, pH may change with depth in a lake, due again to changes in photosynthesis and other chemical reactions.

If water pollution results in higher productivity (e.g., from increased temperature or excess nutrients), pH levels may increase. Although these small changes in pH are not likely to have a direct impact on aquatic life, they greatly influence the availability and solubility of all chemical forms in the lake and may aggravate nutrient problems. For example, a change in pH may increase the solubility of phosphorus, making it more available for plant growth and resulting in a greater long-term demand for dissolved oxygen.

Values for pH are reported in standard pH units, usually to one or two decimal places depending upon the accuracy of the equipment used. Since pH represents the negative logarithm of a number, it is not mathematically correct to calculate simple averages or other summary statistics. Instead, pH should be reported as a median and range of values. The standard reads there will be "no measurable change from natural conditions." (A pH of 5-6 or lower has been found to be directly toxic to fish, according to the EPA.

Generally, during the summer months in the upper portion of a productive or euthrophic lake, pH will range between 7.5 and 8.5. In the bottom of the lake or in less productive lakes, pH will be lower, 6.5 to 7.5 perhaps. This is a very general statement to provide an example of the differences you might measure.

The acceptable range for drinking water pH of 6.5-8.5 as given in the current Canadian guidelines (Health and Welfare Canada 1979a) is primarily based on minimizing corrosion and encrustation with consideration of the effectiveness of chlorine disinfection and formation of trihalomehtanes.

Canfield et al. (1988), found based on a survey of 165 lakes within Florida that the mineral composition of the lakes was strongly related to Florida's geologic and physiographic development. The study (Canfield 1988) was a limnological survey of 165 lakes within Florida. They found, with the exception of iron and color, pH values and chemical concentrations generally increased as one moved from northwest to southeast across the state of Florida. This indicates that pH may be geologically regulated.

Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current (EC). It is an indirect measure of the ion concentration. The more ions present, the more electricity can be conducted by the water. This measurement is expressed in microsiemens per centimeter (µS/cm) at 25°C. Conductivity can be used as a measure of total dissolved solids (TDS).

Conductivity levels in water are controlled by:

1. Geology (rock types) - The rock composition determines the chemistry of the watershed soil and ultimately the lake. For example, limestone leads to higher EC because of the dissolution of carbonate minerals in the basin.

2. The size of the watershed (lake basin) relative to the area of the lake - A bigger watershed to lake surface area means relatively more water draining into the lake because of a bigger catchment area, and more contact with soil before reaching the lake.

3. "Other" sources of ions to lakes - There are a number of sources of pollutants which may be signaled by increased EC:

a. Wastewater from sewage treatment plants (point source pollutants; see: links)
b. Wastewater from septic systems and drainfield on-site wastewater treatment and disposal systems (nonpoint source pollutants; see: links)
c. Urban runoff from roads (especially road salt; see: links). This source has a particularly episodic nature with pulsed inputs when it rains or during more prolonged snowmelt periods. It may "shock" organisms with intermittent extreme concentrations of pollutants which seem low when averaged over a week or month.
d. Agricultural runoff of water draining agricultural fields typically has extremely high levels of dissolved salts (another major nonpoint source of pollutants; see: links). Although a minor fraction of the total dissolved solids, nutrients (ammonium-nitrogen, nitrate-nitrogen and phosphate from fertilizers) and pesticides (insecticides and herbicides mostly) typically have significant negative impacts on streams and lakes receiving agricultural drainage water. If soils are also washed into receiving waters, the organic

matter in the soil is decomposed by natural aquatic bacteria which can severely deplete dissolved oxygen concentrations (see above).

e. Atmospheric inputs of ions are typically relatively minor except in ocean coastal zones where ocean water increases the salt load ("salinity") of dry aerosols and wet (precipitation) deposition. This oceanic effect can extend inland about 50-100 kilometers and be predicted with reasonable accuracy.

4. Evaporation of water from the surface of a lake concentrates the dissolved solids in the remaining water - and so it has a higher EC. This is a very noticeable effect in reservoirs in the southwestern US (the major type of lake in arid climates), and is, of course, the reason why the Great Salt Lake in Utah and Mono Lake, California and Pyramid Lake, Nevada are so salty.

5. Bacterial metabolism in the hypolimnion when lakes are thermally stratified for long periods of time

Elevated total dissolved solids can result in your water having a bitter or salty taste; result in incrustations, films, or precipitates on fixtures; corrosion of fixtures, and reduced efficiency of water filters.

Resources:
General Information on How the USEPA Sets Drinking Water Standards:
http://www.epa.gov/safewater/standards.html

Current National Recommended Water Quality Criteria (USEPA):
http://www.epa.gov/waterscience/criteria/wqcriteria.html

Canadian Water Quality Guidelines from the Canadian Council of Resource and Environment Ministers

Maximum Contaminant Levels for Drinking Water in Florida:
http://www.dep.state.fl.us/water/drinkingwater/standard.htm

General Information on pH as a water quality parameter:
http://www.ecy.wa.gov/programs/WQ/plants/management/joysmanual/ph.html

General Information on Specific Conductance as a Water Quality Parameter:
http://lakeaccess.org/russ/conductivity.htm

NALMS management guide for lakes and reservoirs. North American Lake Management Society, P.O. Box 5443, Madison, WI, 53705-5443, USA (http://www.nalms.org).

Suggested Readings:

Canfield, D.E. Jr., and M.V. Hoyer. 1988. Regional geology and the chemical and trophic state characteristics of Florida lakes. Lake and Reservoir Management 4:21-31.

Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy By National Research Council (U.S.). Commission on Geosciences, Environment, and Resources, National Research Council (U.S.). Water Science and Technology Board, National Research Council (U.S.).
(This book is available online through the University of Florida Library Website as an ebook)