

SATURDAY STREAM SNAPSHOT PARAMETER BACKGROUND INFORMATION

Turbidity: Turbidity is a measure of the relative clarity of water. It measures the amount of light that passes through a water sample. Turbidity is measured either with a turbidimeter, turbidity tube or secchi disk (transparency tubes for streams). Turbidity is a useful indicator of the effects of runoff from construction, agricultural practices, logging activity, wastewater discharges, and other sources. Turbidity is closely related to stream flow and velocity and should be correlated with these factors. Rainfall and other precipitation and discharges directly effect streamflow and velocity and should also be correlated with this measurement.

Turbidity increases with the increase of suspended solids in water that reduce the transmission of light. The greater the turbidity, the murkier the water. Suspended solids are typically 0.004 mm to 1.0 mm in size and include clay, silt, plankton, and industrial/commercial discharges. Sources of high turbidity include soil erosion, wastewater discharges, urban runoff, eroding banks, large numbers of bottom feeders (carp) that stir up the sediments, and excessive algal growth.

At higher levels of turbidity, water loses its ability to support aquatic life. Waters become warmer when suspended particles absorb heat from sunlight causing DO levels to fall. Photosynthesis decreases because less sunlight is able to penetrate the water causing further drops in DO. The combination of warmer water, less light, and oxygen depletion can make it impossible for some aquatic organisms to survive. Suspended solids affect aquatic life in other ways too. Suspended solids can clog fish gills, reduce growth rates, decrease resistance to disease, and prevent egg and larval development. Particles that settle to the bottom can smother fish eggs and aquatic insects. Materials that settle to the bottom also fill in the spaces between the rocks where aquatic life live.

Turbidity is measure with a turbidimeter. A sample is inserted into the unit and a beam of light is passed through the sample. The amount of light that can pass through the sample is measured in units of light called NTU's. Drinking water by law is required to have less than 5 NTU's with a goal of close to zero. Fish do best when turbidity is less than 20 NTU's.

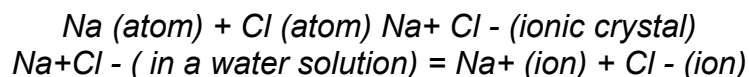
pH: pH is a term used to indicate the alkalinity or acidity of a substance and is ranked on a scale from 1 – 14 with 7. When the pH is above 7 , the water is alkaline or basic. When it is low 7 it is acidic. A pH of 7.0 is neutral. pH affects many chemical and biological processes in water. Rain tends to be slightly acidic because water in clouds reacts with carbon dioxide in the atmosphere to form a weak carbonic acid. The natural pH of rain is usually between 6.0 and 6.9.

Most organisms have adapted to a pH between 6.5 – 8.0 and even slight changes in pH can cause stress, inhibit reproduction, and even kill organisms. Low pH can allow toxic elements and compounds such as copper and aluminum

to become mobile or available for uptake in aquatic plants and animals. This can produce conditions that are toxic to aquatic life. Heavy metals can accumulate in the gills of fish or cause deformities in young fish reducing their chances for survival.

Changes in acidity can be caused by atmospheric deposition (acid rain), local geology, certain wastewater discharges, and warm water. Acid rain is caused when nitrogen oxides and sulfur dioxides, primarily from automobile emissions and coal-fired power plants, are converted to nitric acid and sulfuric acid in the atmosphere and fall to the earth as rain or snow. Acid rain is responsible for thousands of lakes and streams throughout the world becoming acidic. The natural geology of an area can have a buffering (neutralizing) effect. For example, limestone rock, or calcium carbonate, is alkaline and when it dissolves in water it can react with acids from acid rain and raise the pH. Streams or rivers with limestone bedrock tend to have slightly higher pHs. Biological processes like decomposition or organic enrichment from sewage or animal waste can also have an effect on pH. Warmer streams with no shading can have slightly higher pH's than shaded streams because the warmer waters are more chemically and biologically active.

Conductivity: Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current. An ion is an atom of an element that has gained or lost an electron that will create a negative or positive state. For example, sodium chloride (table salt) consists of sodium ions (Na⁺) and chloride ions (Cl⁻) held together in a crystal. In water it breaks apart into an aqueous solution of sodium and chloride ions. This solution will conduct an electrical current. An equation that shows this is:



There are several factors that determine the degree to which water will carry an electrical current. These include: 1) the concentration or number of ions; 2) mobility of the ion; 3) oxidation state (valence) and; 4) temperature of the water.

Resistance, which is an electrical measurement expressed in ohms, is the opposite of conductivity. Conductivity is then expressed in reciprocal ohms. A more convenient unit of measurement in the chemical analysis of water is micromhos. The specific conductance or conductivity measurement is related to ionic strength and does not tell us what specific ions are present. The specific conductance of a sample is measured by a self-contained conductivity electrode.

Conductivity is a measurement used to determine a number of applications related to water quality. These are as follows: 1) determining mineralization: this is commonly called total dissolved solids. Total dissolved solids information is used to determine the overall ionic effect in a water source. Certain physiological effects on plants and animals are often affected by the number of available ions in the water; 2) noting variation or changes in natural water and wastewaters

quickly; 3) estimating the sample size necessary for other chemical analyses; and 4) determining amounts of chemical reagents or treatment chemicals to be added to a water sample.

Elevated dissolved solids can cause "mineral tastes" in drinking water. Corrosion or encrustation of metallic surfaces by waters high in dissolved solids causes problems with industrial equipment and boilers as well as domestic plumbing, hot water heaters, toilet flushing mechanisms, faucets, and washing machines and dishwashers.

Indirect effects of excess dissolved solids are primarily the elimination of desirable food plants and habitat-forming plant species. Agricultural use of water for livestock watering is limited by excessive dissolved solids and high dissolved solids can be a problem in water used for irrigation. Water quality criteria have been established only for the mainstem of the Ohio River. The limit is 800 micromhos/cm or 500 mg/L total dissolved solids.

Nitrates, Nitrites, and Ammonia: Nitrogen is an essential element needed by all living plants and animals. In aquatic ecosystems, nitrogen is present in many forms: nitrate, nitrite, and ammonia. It is usually found in very small amounts in fresh water systems. Most aquatic animals get the nitrogen they need by eating aquatic plants or eating organisms that eat aquatic plants. Plants get nitrogen through the decomposition of dead plants and animals, and through the excretions of living animals. Bacteria break down large protein molecules into ammonia that oxidizes to form nitrates and nitrites.

Ammonia and nitrates both act as fertilizers to living plants. Excess nitrate and ammonia can accelerate plant growth, and along with phosphorus, cause a phenomenon called eutrophication. Eutrophication is a condition where excess nutrients cause dramatic increases in plant growth followed by death, decay, oxygen depletion, and changes the types of plants and animals that live in the stream. When eutrophication is caused primarily by human activities, it is called cultural eutrophication. Sources of nitrates include wastewater treatment plants, CSOs & SSOs, runoff from fertilized lawns and cropland, failing on-site septic systems, runoff from animal manure storage areas, and industrial discharges that contain corrosion inhibitors. The natural level of nitrate and ammonia in surface water is less than 1 mg/l.

Nitrites come from the breakdown of ammonia. High concentrations of nitrites can cause hypoxia (low levels of dissolved oxygen) and can become toxic to warm-blooded animals at concentrations (10 mg/l or higher). Drinking water containing high nitrite concentrations can cause a condition in infants called methemoglobinemia or blue baby syndrome. Ducks and geese where plentiful can contribute a heavy load of ammonia from excrement. High nitrites have been found in well water in agricultural areas due to excessive fertilizer use and seepage from feedlots into groundwater. Stormwater runoff in urban areas can

carry nitrite fertilizers to streams. Excess nitrites also come from failing septic systems, nitrite containing fertilizers, and other animal waste.

Phosphates: Phosphorus is a plant nutrient needed for growth and it is essential in metabolic reactions in both plants and animals. Phosphorus cycles through the environment, changing forms as it does. In aquatic systems, phosphorus occurs in organic or inorganic forms. Organic phosphorus has a phosphate molecule associated with a carbon-based molecule such as plant or animal tissue. Phosphate without an organic molecule is inorganic phosphorus. Inorganic phosphorus is the form required by plants. Plants or animals can take up either form. Aquatic plants convert inorganic phosphorus to organic phosphorus. Animals get the organic phosphorus they need by eating plants, eating animals that eat plants, or consuming decomposing plant and animal matter (detritus). Bacteria convert organic phosphorus to inorganic phosphorus and it enters the water column where it is taken back up by plants.

There are many tests for phosphorus because it is present in so many forms in aquatic ecosystems. Two of the most common tests are orthophosphate and total phosphate. The term orthophosphate is a chemistry-based term that refers to reactive phosphate or the inorganic phosphate readily available in the water column. More complex inorganic phosphates that you have to digest with acids to measure are called condensed phosphates. Total phosphate is a measure of all the forms of phosphate including orthophosphates, condensed phosphates, and organic phosphates.

Plant growth is limited by the amount of phosphorus available. In most waters, phosphorus is a growth-limiting factor, because it is usually present in very low concentrations because it quickly binds with organic matter and soil particles. Free or unattached phosphorus in the form of inorganic phosphorus is quickly taken up by algae and larger aquatic plants. Because phosphorus is the nutrient in shortest supply even small increase in phosphorus can set off a whole chain of undesirable events including accelerated plant growth, algae blooms, low dissolved oxygen, and the death of certain fish, invertebrates, and other aquatic animals. Sources of phosphorus include soil and rocks, wastewater treatment plant discharges, runoff from fertilized lawns and cropland, failing septic systems, runoff from animal waste storage areas, disturbed land areas, drained wetlands, water treatment plants, commercial cleaning operations, and home or car cleaning. Many detergents and cleaning products contain phosphates because they bind with dirt and enhance cleaning ability.

In small wadable streams, total phosphorus levels in excess of 0.03-0.06 can cause algal blooms and other problems. There is no standard in Ohio for total phosphorus.

Recommended Guidelines for Wadable Streams*

Streamflow: 10-30 cfs is the average

Temperature: 10-16 degrees Celsius is typical for spring fed, summer temperatures range from 24 degrees Celsius average for good canopy – 32 degrees Celsius for no canopy; >30 degrees Celsius is unsatisfactory; <20 degrees Celsius is a cold water fishery (Trout); > 21 degrees Celsius is a warm water fishery (Bass)

Turbidity: typically ranges from <20 NTUs; after storm events is usually >50 NTUs; consistently muddy streams are undesirable and may range between 50-100; < 0.05 NTUs is the standard for drinking water

Conductivity: 50-500 umhos/cm is a normal range in streams; 0.5-2 umhos/cm is the range for distilled water

Total Solids: ranges between 5-10mg/L in most streams; >10 mg/L is undesirable

Total Dissolved Solids (TDS): <500 mg/L is desirable in streams

pH: ranges between 6.5-8.5; with no canopy and go as high as 9; less than 6 is undesirable for fish

Dissolved Oxygen (DO): DO is dependent on temperature; 5-10 mg/L is typical in summer; trout require >6 mg/L; other fish require >3 mg/L

Biochemical Oxygen Demand (BOD): usually ranges between 1-5 mg/L; >10 in natural streams is undesirable; wastewater treatment plants are permitted to discharge 30 mg/L

Phosphorus: 30-60 ugm/L (or 0.03 – 0.06 mg/L) is the typical range; >60 ugm/L (0.06 mg/L) can cause problems such as algal blooms in streams with low flow

Nitrates: .05-0.5 mg/L is the typical range; >0.5 can cause problems if the stream also has high phosphorus levels; >10 mg/L is a health hazard in drinking water

Fecal Coliform: standards vary depending on water use; drinking water is 0 colonies per 100 mL; body contact recreation is <200 colonies per 100 mL; cattle watering is <1000 colonies per 100 mL; fish and aquatic life is <1000 colonies per 100 mL

***Source:** Tennessee Valley Authority Fall Workshop Guide

