Dissolved Oxygen (DO)

Dissolved oxygen (DO) refers to microscopic bubbles of oxygen that are mixed in water. DO is used by almost all aquatic organisms for respiration, and, thus, is necessary for their survival. Underwater plants and algae produce dissolved oxygen. It also is increased by wavy and moving water.

The amount of dissolved oxygen in water bodies is reduced:

- When the water is cloudy or muddy — as less light can reach plants, photosynthesis declines.
- When algae blooms (overabundant algae growth) die and decompose — as the process uses oxygen.
- The water temperature is high — as water holds less oxygen at higher temperatures. (See chart. 25C = 77°F.)

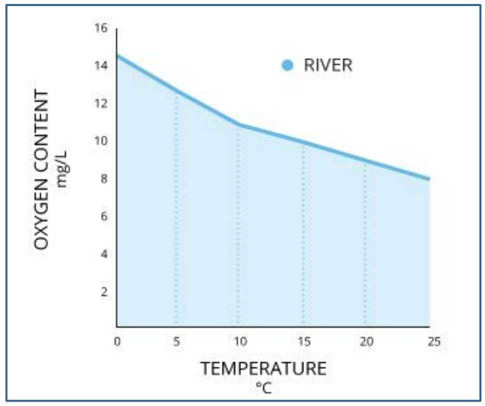


Chart: Nate Christopher, Fondriest Environmental

Significant levels of oxygen for aquatic life:

- **1-2 ppm (parts per million), or mg/L will not support fish.**
- **<3 ppm, or mg/L, is stressful to most aquatic organisms.**
- **5-6 ppm, or mg/L, is usually required for growth spawning.**

Turbidity

Turbidity is the measure of the cloudiness or murkiness of water. The cloudier the water, the greater the turbidity. Human activities that lead to increased water turbidity include:

- Soil runoff from crop fields, construction sites, pavement
- Streambank erosion
- Runoff containing fertilizer, because this increases algae growth in the water (see photo).

Photo: MN Pollution Control Agency

High turbidity results in lower amounts of sunlight reaching underwater plants called Submerged Aquatic Vegetation (SAV). Less sunlight results in less plant growth, and because plants produce oxygen, this reduces the oxygen available to aquatic life. High turbidity also clogs fish gills, destroys fish habitat, and impairs water for drinking use.

Significant levels for aquatic plants and animals:

- **Turbidity is measured with a turbidity meter. Turbidity above 150 NTUs at any time or 50 NTUs as a monthly average is harmful to aquatic life.**
- **Water clarity is a measure with a Secchi disk. When the disk cannot be seen lower than 1 meter, turbidity can clog gills and interfere with fish finding food.**

Phosphates

Phosphate is an essential nutrient for plant life. However, when excessive phosphates enter waterways, this sets off the harmful cycle of *eutrophication.* The cycle begins when phosphate pollution causes algae in the water to grow overabundantly. Because large blooms of algae block sunlight from underwater plants, the plants produce less oxygen. When the algae die, they decompose. Decomposition requires oxygen, and this further lowers oxygen levels. Low oxygen levels are a primary cause of the deaths of fish, oysters, and other aquatic life in our rivers and the Chesapeake Bay.

In most cases, elevated levels of phosphates are introduced through human activities. The greatest portion of phosphates comes from farms that use extra fertilizer or manure. Other sources include runoff from lawn fertilizer and pet waste, washing detergents, industrial wastes, and older wastewater treatment plants.

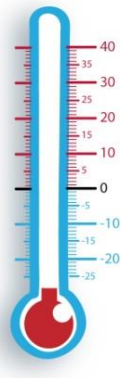
Significant levels for aquatic organisms and humans:

- **>0.1 ppm or mg/L contributes to increased plant growth.**
- **>7 ppm or mg/L is considered unsafe for drinking water.**

Temperature

Many chemical, physical, and biological characteristics of a stream are directly affected by water temperature. For example, higher temperatures:

- increase fish metabolism and lower fish reproduction,
- increase plant photosynthesis,
- increase algae growth,
- reduce the amount of dissolved oxygen in the water, and
- increase the growth of bacteria.



Human activities that can adversely raise water temperature include:

- warmed water that enters water bodies from stormwater runoff and industrial discharges,
- the loss of shaded banks along waterways,
- cloudy or dark water (from sediment deposits) that can absorb more sunlight.

Significant levels:

- **>32°C or 90°F is unhealthy for swimming and aquatic life.**
- **Average temperatures vary with the time of year and size of the body of water.**

Nitrogen (Nitrates/Nitrites)

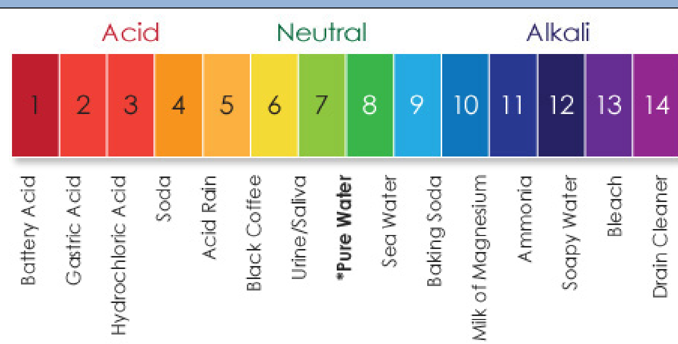
Nitrogen is an essential nutrient for plant life, but too much nitrogen (in the form of nitrates) in a water body sets off a harmful cycle, called eutrophication. Excess nitrogen in the water causes algae to grow excessively; then as the algae dies and decomposes, the process uses dissolved oxygen in the water. The lowered oxygen levels cause deaths of fish and oysters. Other factors are also involved, but because nitrogen is a main catalyst for this process and because it is found in high amounts in waterways throughout the Chesapeake Bay watershed, it is considered a major pollutant.

Nitrates come from fertilizers in agricultural runoff, animal waste, human sewage, and decomposing plants.

Significant levels to aquatic life and humans:

- **<1 ppm, or mg/L is considered unpolluted water.**
- **>10 ppm, or mg/L is considered unsafe for drinking water.**

pH



pH represents the acidity (or baseness) of a substance, as measured by pH units on a scale of 0 to 14. A water body's pH is influenced naturally by soils and bedrock. Rain normally is slightly acidic (pH between 5.0 and 5.5), but human activities can raise the pH of rain, and consequently, streams. Emissions from coal-burning power plants, oil refineries, and gas-burning vehicles react with the atmosphere, causing acidic precipitation (Acid Rain). Drainage from mines also leads to the acidification of streams. Acidic water is harmful to aquatic communities. It also can cause toxic substances, such as aluminum, to leach from the soil into the water.

Significant levels: A pH range of 6.5-8.2 is required for most aquatic organisms to survive.

Alkalinity

The "alkalinity" of a water body represents the water's ability to resist or "buffer" against changes in pH when acid is added.

A body of water, such as a river, contains minerals eroded from the surrounding rocks and soil. If the rocks contain buffering minerals, the water will have high alkalinity and be more resistant to changes in pH. For instance, limestone contains calcium carbonate — the same compound used in Tums or Rolaids to neutralize stomach acid. In a stream running through limestone, calcium carbonate in the water would help protect the aquatic life from acid rain or acid mine drainage. On the other hand, a river running through granite likely would have low alkalinity and be more susceptible to acid rain, because granite does not include buffering minerals.

Significant levels: A total alkalinity of 100 to 200 ppm will stabilize the pH level in a stream.