San Juan Watershed
Monitoring Program

WATER QUALITY AND SEDIMENT

WHY DO WE EVALUATE WATER QUALITY AND SEDIMENT?[1]

Water quality is the backbone of water monitoring. Monitoring different physical, chemical, and biological parameters allows us to create a snapshot in time of observed water quality, characterize waters, and identify trends over time. These data may also allow us to identify emerging problems, determine whether pollution control programs are effective, direct pollution control efforts to where they are most needed, and respond appropriately to emergencies such as floods and spills. In addition, these data can inform regulatory decisions around water quality criteria (allowable limits of pollutants in waterbodies) and how a waterbody is maintained for its intended use(s), such as fishing, swimming, or drinking.

Sediment monitoring (that is, sampling deposits on the bottom of the river) provides information on metal-sediment chemistry. Metals bind to sediment particles and are distributed and transported throughout the watershed. We measure sediment grain size to determine the surface area of these particles. Surface area indicates the amount of chemicals that can bind with the sediment and is important for phosphorus and metals, which are particularly attracted to small clay particles. Generally, sediment metal loads increase as sediment grain size decreases.

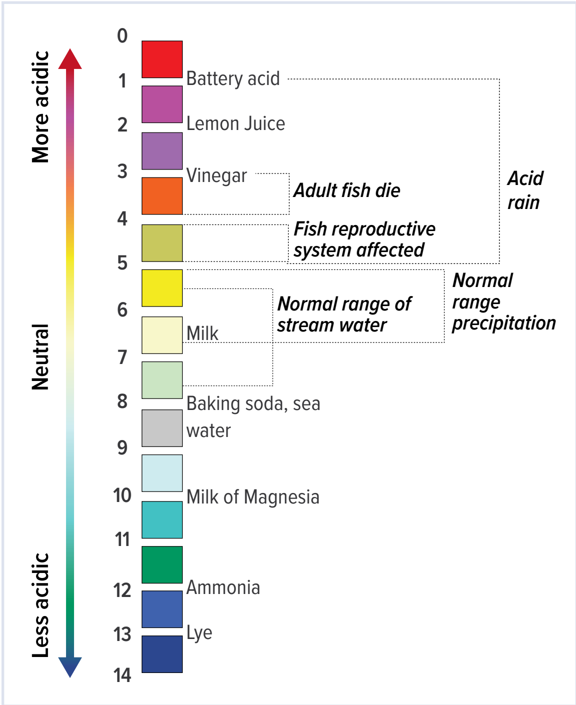

Figure 1. pH Scale (Source: Environment Canada)

WATER QUALITY INDICATORS[2]

Many important physical and chemical indicators of water quality are evaluated in waterbodies like the Animas River and San Juan River. These are described in detail below.

Acidification: Aquatic ecosystems become more acidic during a process known as acidification. Acid rain and acid mine drainage are major sources of acidifying compounds, which lower the pH below the range most living organisms need to function. Some aquatic ecosystems can also be acidic due to natural causes—e.g., high levels of organic compounds or the presence of acid-producing vegetation in bogs. Low pH can also allow toxic elements and compounds to become mobile and "available" for uptake by aquatic plants and animals (see Figure 1).

Dissolved oxygen: Dissolved oxygen (DO) is the amount of oxygen that is present in water. Running water dissolves more oxygen than the still water of a pond or lake. All aquatic animals need DO to breathe. Low or no oxygen levels (anoxia) can occur when microorganisms decompose excess organic materials, such as large algal blooms. Low oxygen levels often occur in the bottom of the water column and affect organisms that live in the sediments. In some waterbodies, DO levels fluctuate periodically, seasonally, and even as part of the natural daily ecology of the aquatic resource. As DO levels drop, some sensitive animals may move away, decline in health, or die.

Metals: Certain metals, including manganese, zinc, and copper, are essential to biochemical processes that sustain life. However, these and other metals can be severely toxic to aquatic organisms in high concentrations. They can also be toxic if we ingest them directly in water, or if they accumulate in organisms that we consume. The toxicity and bioavailability of many metals depends on their oxidation state and the form in which they occur. Dissolved metals are generally more bioavailable and toxic than metals bound with other molecules or adsorbed to sediment particles. These characteristics of metals—oxidation state, form, solubility, and toxicity—are influenced by chemical characteristics of water such as pH, dissolved oxygen levels, and hardness.

Nutrients: While nutrients like nitrogen and phosphorus are critical for all life, an excess of these nutrients can be detrimental to a waterbody. Increased nitrogen can stimulate excess growth of algae, which leads to low DO levels, potential for harmful algal toxins, blockage of sunlight that organisms and plants need in the water, and degraded habitat conditions for benthic macroinvertebrates and other aquatic life. Sources of excess nitrogen to rivers and streams, lakes, and coastal waters include fertilizers, wastewater, animal wastes, and atmospheric deposition. High concentrations of phosphorus may result from poor agricultural practices, runoff from urban areas and lawns, leaking septic systems, or discharges from sewage treatment plants. Too much phosphorus can cause increased growth of algae and large aquatic plants, which can result in decreased levels of DO—a process called eutrophication. High levels of phosphorus can also lead to algae blooms that produce algal toxins, which can harm human and animal health.

COLLECTING WATER QUALITY AND SEDIMENT CHEMISTRY SAMPLES

Water quality and sediment samples are analyzed by certified laboratories. Specific requirements around sampling containers, volumes, storage techniques, preservatives, and holding times differ by analyte.

We also use a water quality meter to measure "physio-chemical parameters," including temperature, pH, specific conductance, and DO. We measure turbidity—the cloudiness of water—with a device called a turbidimeter.

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[1] U.S. Geological Survey. A Primer on Trace Metal-Sediment Chemistry. Water-Supply Paper 2277. Available at: https://pubs.usgs.gov/wsp/2277/report.pdf; Edwin D. Ongley. Control of water pollution from agriculture. FAO Irrigation and Drainage Paper 55. Chapter 2. Available at: http://www.fao.org/3/w2598e/w2598e00.htm; U.S. EPA. Monitoring and Assessing Water Quality. Available at: https://archive.epa.gov/water/archive/web/html/index-19.html.

[2] U.S. EPA. Indicators Used in the National Aquatic Resource Surveys. Available at: https://www.epa.gov/national-aquatic-resource-surveys/indicators-used-national-aquatic-resource-surveys.

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