Water Quality Monitoring

Background

Water monitoring requires:

1. Knowledge and proper use of equipment, safely working out-of-doors and in water and properly collecting samples
2. Understanding the purposes of sampling prior to monitoring, knowing the correct type of data to collect, selecting the best site and determining the frequency for sampling. Sampling design for learning and understanding may include baseline conditions, before/after change, above & below, trend analysis, etc.
3. Determining a hypothesis and following the scientific method which is critical to data analysis
4. Making connections to river/ watershed land use to select monitoring parameters and analyze data
5. Researching climatic conditions/data before and during sampling to understand runoff pollution dynamics.

WQM Test	What is It?	How Measured?	Why Important?	How Done?	Results - Meaning
Macroinvertebrates (insects, crustaceans & gastropods)	Biological assessment tool used to develop stream quality performance and "bio-criteria"	Biological Indices • Pollution tolerance • Community composition (%) • Diversity • Richness • EPT Ratio	Bugs present reflect stream health or water quality conditions. Function as "Biological indicator" e.g. sediment from NPS pollution covers or impairs habitat	Bug Collection Methods • Rock Rub • Kick Seine • Dip Net • Artificial substrate ID bugs from order to family level taxonomy	• Index Value 0-30 Poor WQ = <11 Fair = 11-16 Good = 12-22 Excellent =>22 • Scenic Rivers > 22 • Ditches/Canals < 11
Temperature	Measure of water molecule movement through heat capacity	Thermometer degrees F or C	• Affects aquatic life feeding, reproduction & metabolism = life • Triggers biological processes e.g. runoff from urban areas (parking lots, roads, rooftops and utility plants) are frequent sources	Submerge thermometer in water for 1-2 minutes. Compare with air temp & source of water	• Cold water fish species require avg. annual temp < 70 F • Warm water fish species require avg annual temp < 80 F • Macroinvertebrates live in many temperature conditions
pH	Measure of hydrogen ion activity or acid and bases	Units: Logarithmic Scale of 0-14 with 7 = neutral	• Affects solubility of metals in solution • Affect aquatic life reproduction & life flow process e.g. runoff from unreclaimed strip mines and refuse piles adds toxic acidity	Paper/dry indication Liquid color comparison Electronic	< 7 acidic > 7 basic >3.0 lethal to fish >10.0 • Unglaciated Ohio surface water 6 -7 • Glaciated Ohio surface water 7– 9+ • AMD affected water 2-6+

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Dissolved Oxygen (D.O.)	Form of oxygen all aquatic life needs to live. Fish invertebrates, plants and aerobic bacteria all require oxygen for respiration.	Units: 0-15 ppm or mg/l • Related to temperature (inversely prop.) • Related to percent saturation • measured DO X 100 / Potential DO = % Saturation	Oxygen supports aquatic life. Loss of small amounts of DO is detrimental. e.g. "daylighting" streams by removing stream side forests increases sunlight, temp. & decreases DO	• Color comparison • Winkler titration • Colorimeter • Photo & Spectro-photometer	3 ppm will severely stress most aquatic life >5 ppm needed for most game fish & macroinvertebrates >6-7 ppm needed for cold water fish species & sensitive macros
Biological Oxygen Demand (BOD)	Oxygen required to decompose organic matter. Used to determine the amount of sewage effluent discharged in surface water.	Units: 0-150+ mg/l	Not cost effective to remove all organic matter, so some "loading" is discharged. That amount must not degrade WQ below std. e.g. WWTP affluent discharges of solids are threats to stream WQ	Measured by immediate DO compared with DO after sample is incubated @ 20 C for 5-days	Unpolluted natural water has BOD of 0-1 mg/l • 1 = excellent • 2 = good • 3-4 = fair • 5 or > = poor Wastewater treatment plants (WWTP) discharge often has BOD 8-150 mg/l

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Phosphorus	Organic nutrients like total phosphorus (TP) or phosphate (PO4) are found naturally and from human activities	Units: mg/l	Phosphorus grows aquatic plants, esp. algae that may degrade WQ. Pt. Sources (WWTP) and NPSs (fertilizer and animal waste) of P account for the largest loadings.	Organic P can't be readily measured directly, so TP samples must be digested with heat or acid. Ortho P then can be measured by color comparison (colorimeter) or electronic means (spectrophotometer).	• Significant amounts 0.01 mg/l • 0.03 mg/l will start plant growth • 0.1 mg/l starts eutrophication process
Nitrogen	Nitrogen occurs naturally in water in various forms: Nitrate (NO3) Nitrite (NO2) and Ammonia (NH3)	Units: mg/l	Nitrates measure nutrient impacts from human activities Excessive nitrates from agric. fertilizers may adversely affect public and livestock water supplies.	• Dry paper • Liquid color comparison • Colorimeter • Spectrophoto-meter	Public water supply std. = 10 mg/l Livestock water supply std. (Used for milk) = 100 mg/l
Habitat	Inventory of instream physical features and adjacent land uses	Various protocols include geographical location, width, depth, velocity, stream shape, instream cover, substrate quality	It measures the ability of aquatic life, like fish, to survive Estimates the ability of streams to "clean" water by preserving or generating oxygen	Simple to complex inventories collect quantitative and qualitative data	Quantitative scores are compared with state standards to independently rate health e.g. QHEI > 75 = exceptional warm water habitat
Flow	Measure of the volume of water in the stream	Units: Cubic feet per second (cfs)	Chemical testing measures concentration; but add flow and a pollution load can be determined. This way problem areas can be better identified	Typically done by measuring cross sectional area and multiplying it by the velocity. Velocity is the distance over time.	• Results are relative as all stream's water-sheds vary in size, land use and rainfall. • Often flows are compared with average, minimum and maximum.
Turbidity	Physical measure of cloudiness in water. Turbidity may be organic (phyto & zoo plankton and organic matter) or inorganic. Both aesthetic and physical values may determine quality.	• Inches/centimeter • Jackson Turbidity Units (JTUs) • Nephlometric Turbidity Units (NTUs) Related to Total Suspended Solids (TSS)	It is the easiest measure of WQ impact of soil erosion via sedimentation. Agricultural and construction site erosion contribute the most pollution by volume of any pollutant.	Visual and electronic methods include: • Secchi disk • Turbidity tube • Clarity comparison • Meters	Surface water results are often relative and best used for comparison.