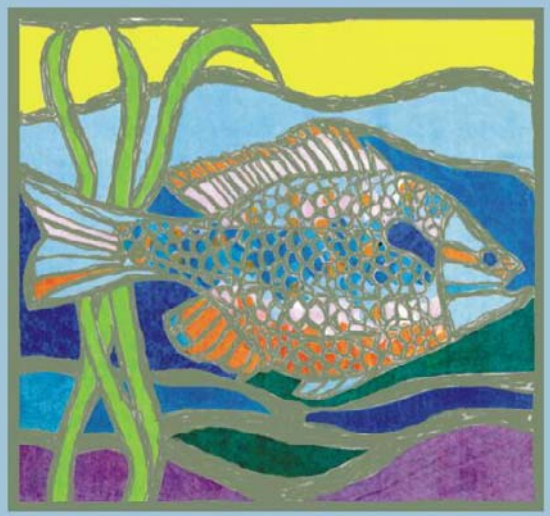
National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs



Coeur d'Alene, Idaho
31 March – 4 April, 2003

LR 101

Section 4c: Water Chemistry

Presented by

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Water Chemistry Assessment

- *What is it?*
  - Measurements of chemical concentrations and physical properties of flowing waters.

- *Why collect?*
  - To characterize surface water quality and condition by measuring a suite of analytes.

Water Chemistry Assessment

Features from 5 existing programs

- Each program has unique objectives and suite of analytes
- Some have additional protocols to further assess surface water quality
  - ground water
  - bed sediment
  - tissue analyses

Water Chemistry Assessment
USEPA-EMAP-SW

- Why collect?
  - determine acidity/alkalinity
  - identify water chemistry type
  - characterize trophic condition
  - establish presence/absence of chemical stressors
- When?
  - Collected during biological sampling
    - Field determined: specific conductance, dissolved oxygen, temperature
    - Laboratory determined: major ions, nutrients, total iron, total manganese, turbidity, color, pH, dissolved inorganic carbon, and monomeric aluminum species.

(Herlihy 1998)

Water Chemistry Assessment
USGS-NAWQA

- Feature: Tiered sampling
  - basic fixed-site: temperature, specific conductance, suspended sediment, major ions and metals, nutrients, and organic carbon
  - intensive fixed-site: addition of dissolved-pesticide analyses

(Gilliom et al. 1995)

Water Chemistry Assessment
USEPA-RBP

- Feature: All measured parameters are field collected
  - estimated measurements: stream type, water odors, water surface oils, and turbidity(or measured directly)
  - quantitative measurements: temperature, dissolved oxygen, pH , and specific conductance
- Why?
  - to provide a brief and easily-obtained analysis of water chemistry

(Barbour et al. 1999)

Water Chemistry Assessment
MDNR-MBSS

- Feature: Split sampling design
  - Spring: samples are collected from each site for lab: *pH*, *ANC*, specific conductance, *sulfate*, *nitrate*, and *DOC*.
  - Summer, *in situ* measurements are made of *DO*, *pH*, *temperature*, and *conductivity*
- Why: Minimize equipment required per visit

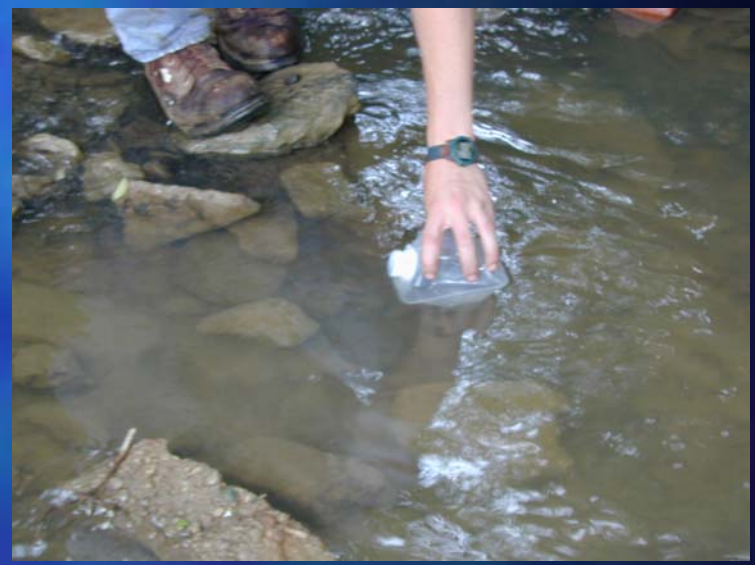
(Roth et al. 1997b)

Water Chemistry Assessment
Idaho DEQ

- Feature: River Physiochemical Index (RPI)
  - Based on the Oregon Water Quality Index (OWQI)
    - 8 parameters scored 10-100 then average for index score
  - Data from U.S.G.S. (river chemistry network)
- Results:
  - Correlates with measures of human disturbance
    - Particularly agriculture and forest percentages within a watershed
  - Correlates with professional opinion regarding the status of river

Water Chemistry Assessment

Common Parameters



- Field determined
  - Dissolved oxygen
  - Temperature
  - Specific conductance
  - pH
- Laboratory determined
  - Nutrients: Nitrogen, Phosphorus
  - Alkalinity / Acid Neutralizing Capacity (ANC)
  - Turbidity
  - Chloride
  - Sulfate

Water Chemistry Assessment

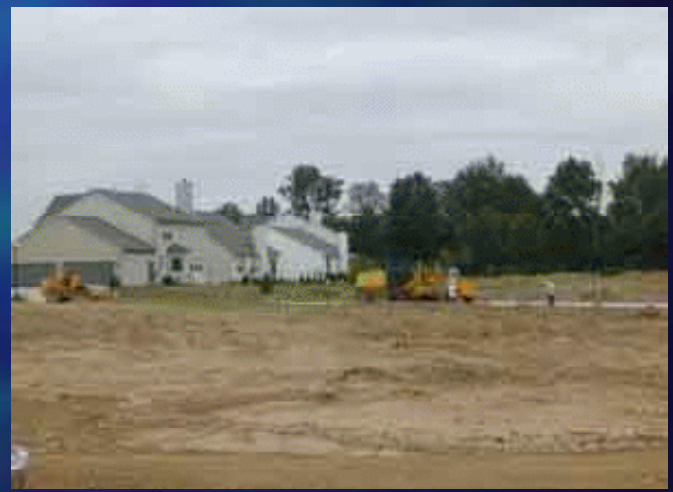
Common Parameters: Dissolved Oxygen

- ***"the most important of all chemical methods available for the investigation of the aquatic environment"*** Wetzel and Likens 1979
- Why collect it?
  - Necessary for the survival of many aquatic organisms
  - Many chemical and biological reactions depend on the amount of D.O. present
  - Needed to support other water chemistry measures
- Why low D.O.?
  - decomposing organic material (high bacteria), e.g. algae, manure
  - wastewater discharges
  - high ammonia discharges
  - warmer temperatures
- D.O. cyclic (diel cycle), but a single data point has value

Water Chemistry Assessment

Common Parameters: Temperature

- Why Collect?
  - Needed to support other measures
    - Dissolved oxygen, conductivity, pH, rate and equilibria of chemical reactions, biological activity, fluid properties
  - Essential to document thermal alterations
    - natural phenomena
    - human activities
  - Useful for classifying streams
    - Coldwater vs. Warmwater



Water Chemistry Assessment

Common Parameters: Specific Conductance

- What is it?
  - Measure of capacity of water to conduct an electrical current
  - A function of the types and quantities of dissolved substances in water
- Why collect it?
  - Rough measure of ground water intrusion
  - Correlates with nutrients
  - Indicator of mine waste or waste water

Water Chemistry Assessment

Common Parameters: pH

- What is it?
  - A measure representing the hydrogen-ion activity of water
  - Can be natural
- Why collect it?
  - Useful for stream classification
    - Blackwater systems vs Other
  - Can increase with
    - agriculture (runoff from liming)
    - acid rain
      - can decrease pH
      - reduce buffering capacity

Water Chemistry Assessment
Common Parameter: Nutrients (Nitrogen and Phosphorus)

- Common sources:
  - Agricultural and urban uses of fertilizer
  - Agricultural use of manure
  - Combustion of fossil fuels
    - Increased levels of total nitrogen and total phosphorus

Note: Chlorophyll can serve as a surrogate for nutrients

Water Chemistry Assessment

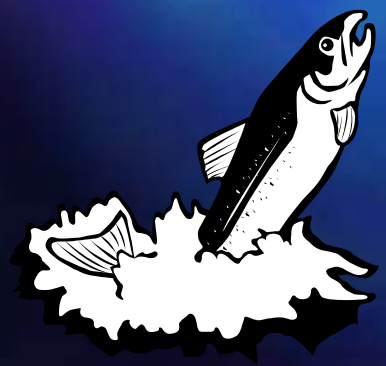
Common Parameter: Nutrients (Nitrogen and Phosphorus)

- Potential effects on systems:
  - can alter trophic dynamics
  - increase algal and macrophyte production
  - increase turbidity
  - decrease average D.O. concentrations
  - increase fluctuations in diel D.O. and pH.

Water Chemistry Assessment

Common Parameter: Nutrients (Nitrogen and Phosphorus)

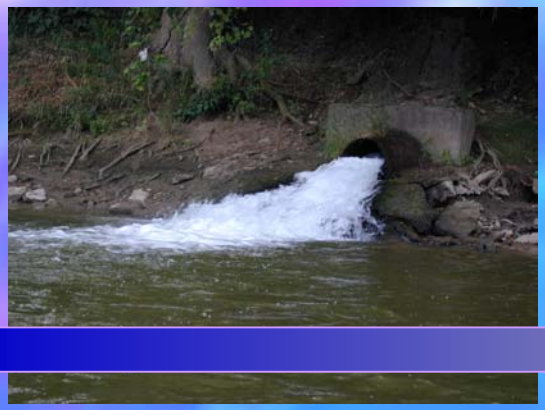
- Specific effects
  - Nitrogen - Ammonia is toxic to fish
  - Phosphorus
    - High - excessive plant growth (eutrophication)
    - Low - can be culturally oligotrophic
      - Harvest of migrating salmon removes potential nutrient contributions of post-spawn salmon carcass'



Water Chemistry Assessment

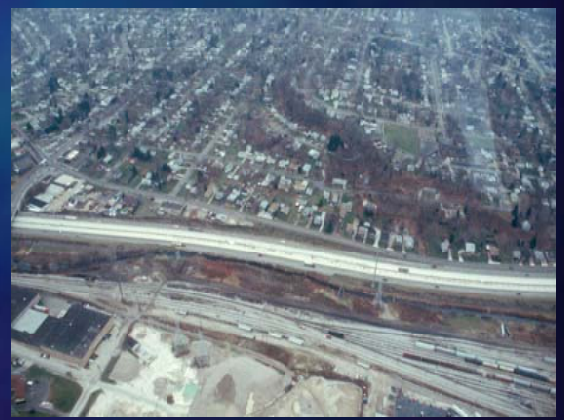
Common Parameters: Alkalinity / ANC

- What is it?
  - measures of the ability of a sample to neutralize strong acid
- Why collect it?
  - Can provide information on
    - efficiency of wastewater processing
    - presence of contamination by anthropogenic wastes
    - maintaining ecosystem health
  - Useful for stream classification
    - geologic nature of stream
  - Determining susceptibility to acid deposition



Water Chemistry Assessment
Common Parameter: Chloride

- Source:
  - Water used by sewage treatment plants
    - Indicator of sewage input
    - Low-flow chloride concentration
      - Increase with population density
      - Decline with increase discharge
        - Good measure of discharge
  - Salt from roads (also adds sodium)
    - Urban and rural areas
  - Can be concentrated by irrigation
  - Impact: fish kills and changes in water chemistry



Water Chemistry Assessment

Common Parameters: Turbidity

- What is it?
  - clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton, and microscopic organisms

    American Public Health Association 1992
- Why collect it?
  - Indicator of the condition and productivity of a system

Water Chemistry Assessment

Common Parameter: Sulfate

- Sources:
  - Mining activity
  - Naturally occurring
    - Coal seam
    - Sulfur containing rock or soils
  - Component of acid rain
  - Concentrated by irrigation practices
- Effects
  - Taste and odor
  - Changes in surface water, chemistry and aquatic biota