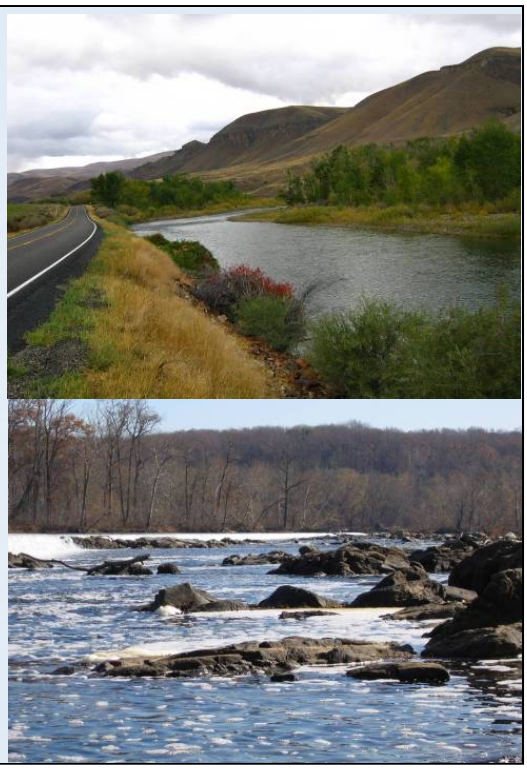
Streams, Rivers, and Nonpoint Source Pollution

Barry Tonning
Tetra Tech



Photos courtesy of Ansu John showing

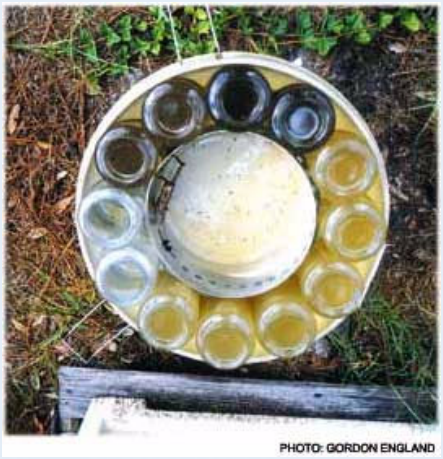
1) Salmon River, ID
2) Potomac River above Great Falls, VA

Topics for this section

- Indicators of water quality
- Common polluted runoff sources
- Impacts of polluted runoff

Water quality assessment

- We can define what we want to use the water for (designated uses)
- We can measure how clean the water has to be to support those uses (water quality criteria)
- We can measure what the water quality is now (ambient water quality conditions)
- Then, we can compare . . .



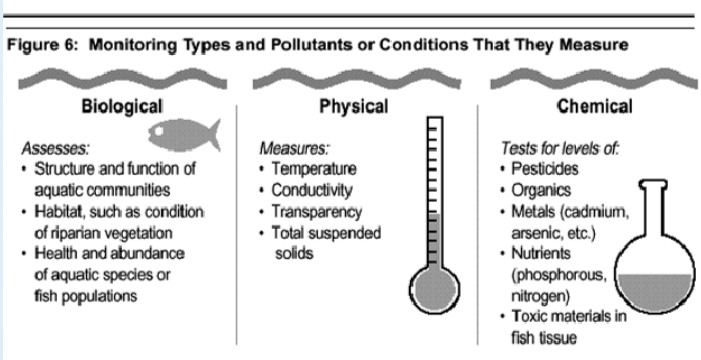
Can launch into this discussion if needed.

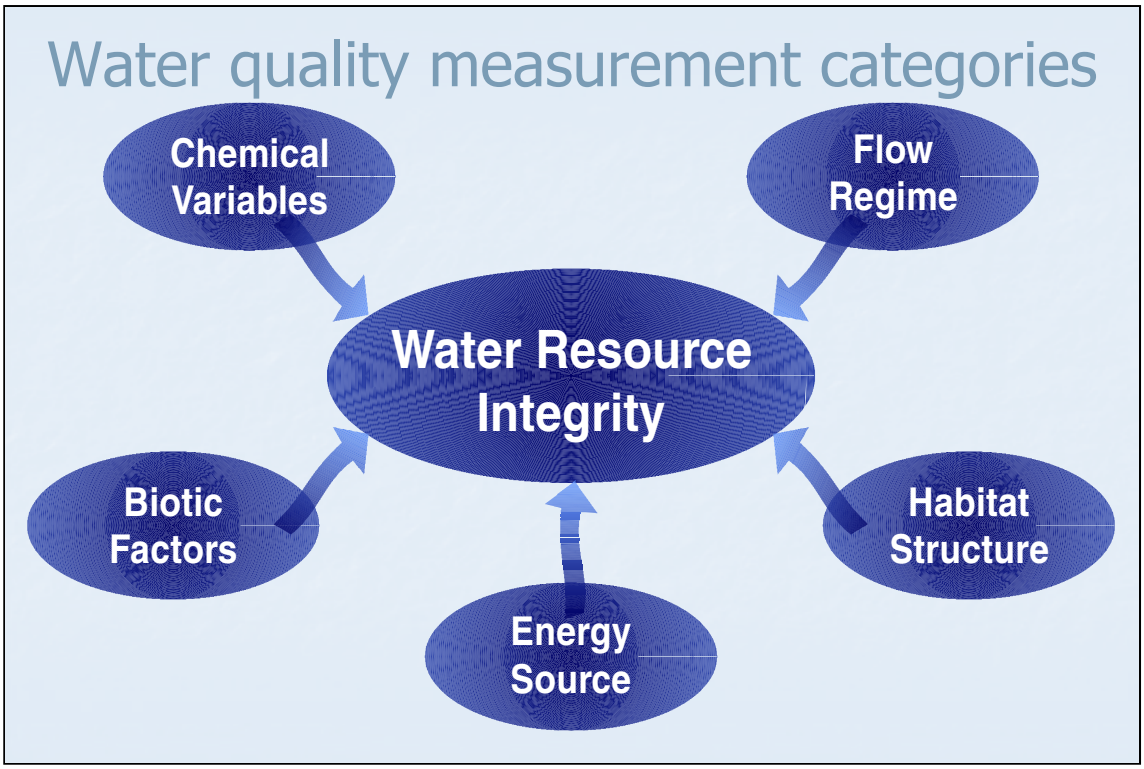
Uses of Lakes, Rivers, Streams, & Wetlands

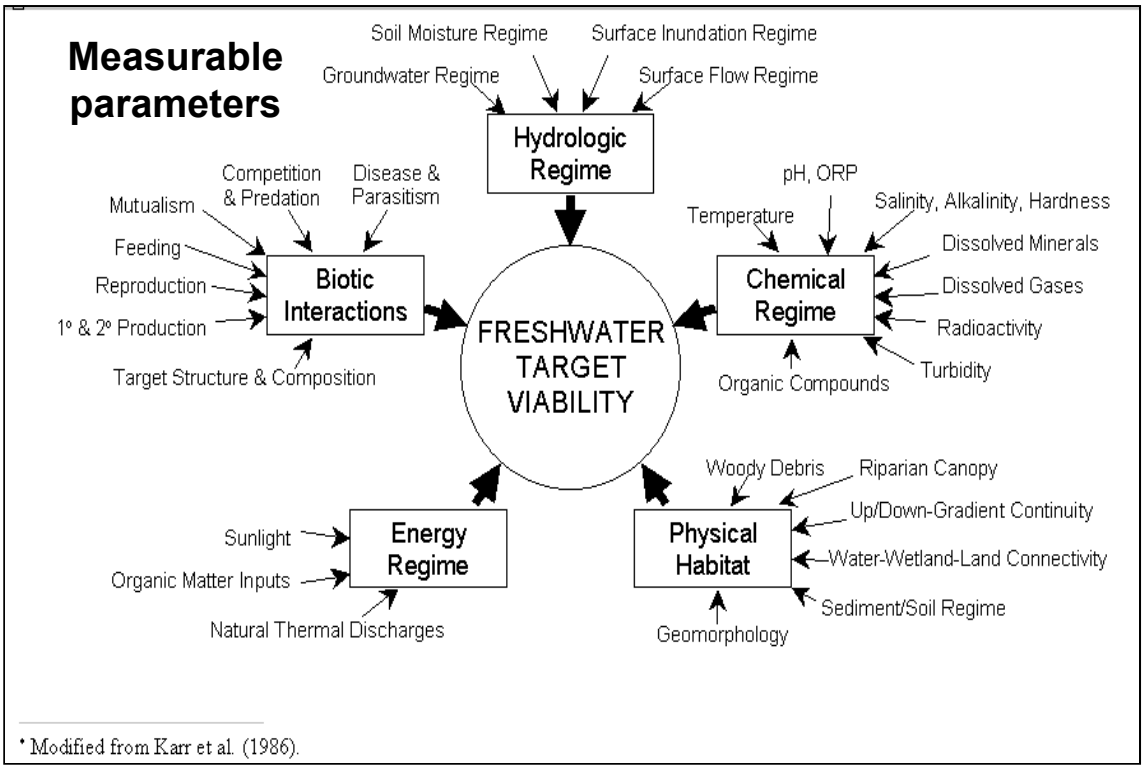
- **Common Use Designations:**
  - Cultural uses
  - Swimming (primary contact recreation)
  - Boating (secondary contact recreation)
  - Fishing (secondary contact)
  - Fish habitat (warm/cold water aquatic life support)
  - Water supply (drinking, ag, industrial, etc.)

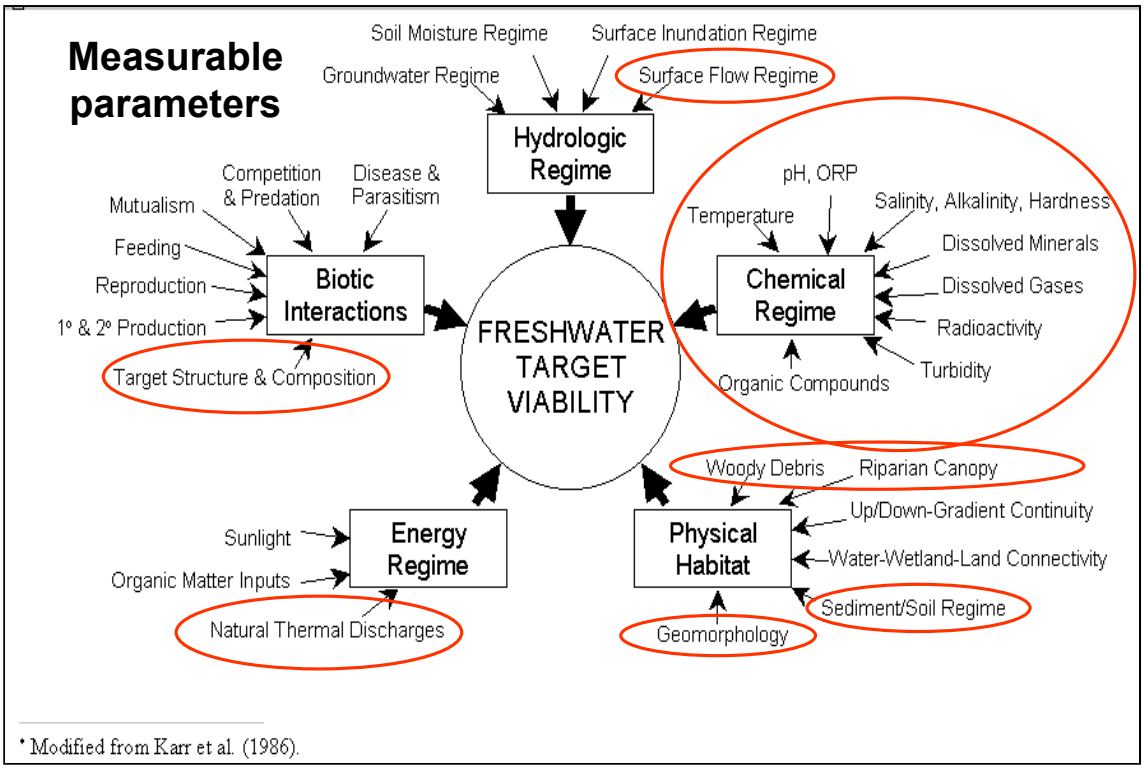
Water Quality Criteria

- Measurable or describable (narrative) characteristics related to water, sediment, fish tissue, or habitat
- Consistent <u>scientifically</u> with protecting all applicable water body uses
- Monitored and assessed by tribes & other entities




Water quality measurement categories
Chemical Variables
Flow Regime
Water Resource Integrity
Biotic Factors
Habitat Structure
Energy Source

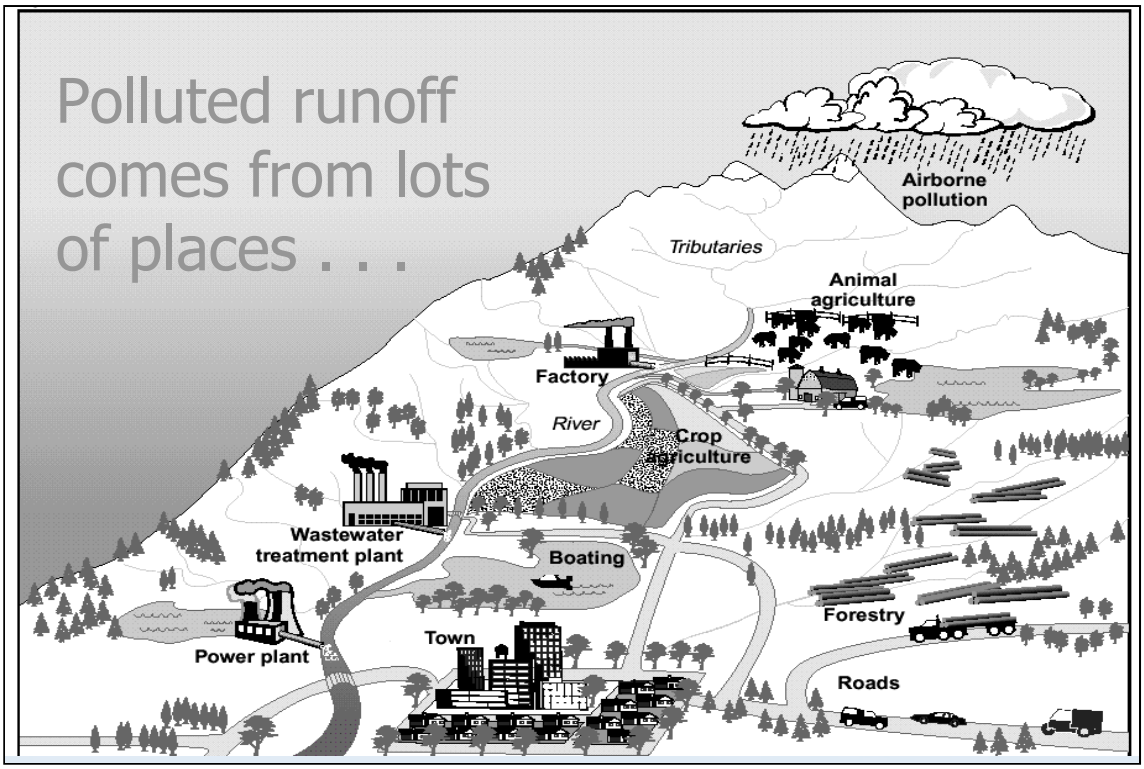

Measurable parameters
Soil Moisture Regime
Surface Inundation Regime
Groundwater Regime
Surface Flow Regime
Hydrologic Regime
Competition & Predation
Disease & Parasitism
Mutualism
Feeding
Reproduction
1° & 2° Production
Biotic Interactions
Target Structure & Composition
FRESHWATER TARGET VIABILITY
pH, ORP
Temperature
Salinity, Alkalinity, Hardness
Dissolved Minerals
Dissolved Gases
Radioactivity
Turbidity
Chemical Regime
Organic Compounds
Woody Debris
Riparian Canopy
Up/Down-Gradient Continuity
Water-Wetland-Land Connectivity
Sediment/Soil Regime
Physical Habitat
Geomorphology
Sunlight
Organic Matter Inputs
Energy Regime
Natural Thermal Discharges
* Modified from Karr et al. (1986).



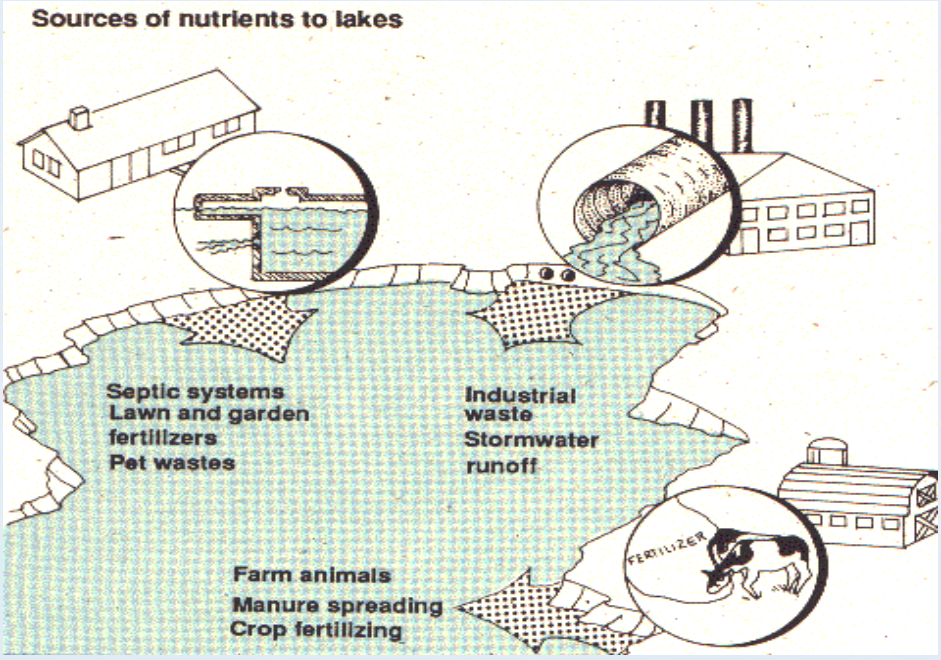
* Modified from Karr et al. (1986).

Common NPS pollutants

- Nutrients
  - From manure, fertilizers, septic systems, and soil runoff
- Pathogens
  - From livestock, pets, and human waste (septic and wastewater treatment systems)
- Sediment
  - From row crop land, construction sites, stream bank erosion, forest roads


Polluted runoff comes from lots of places . . .
Airborne pollution
Tributaries
Animal agriculture
Factory
River
Crop agriculture
Wastewater treatment plant
Boating
Forestry
Town
Power plant
Roads

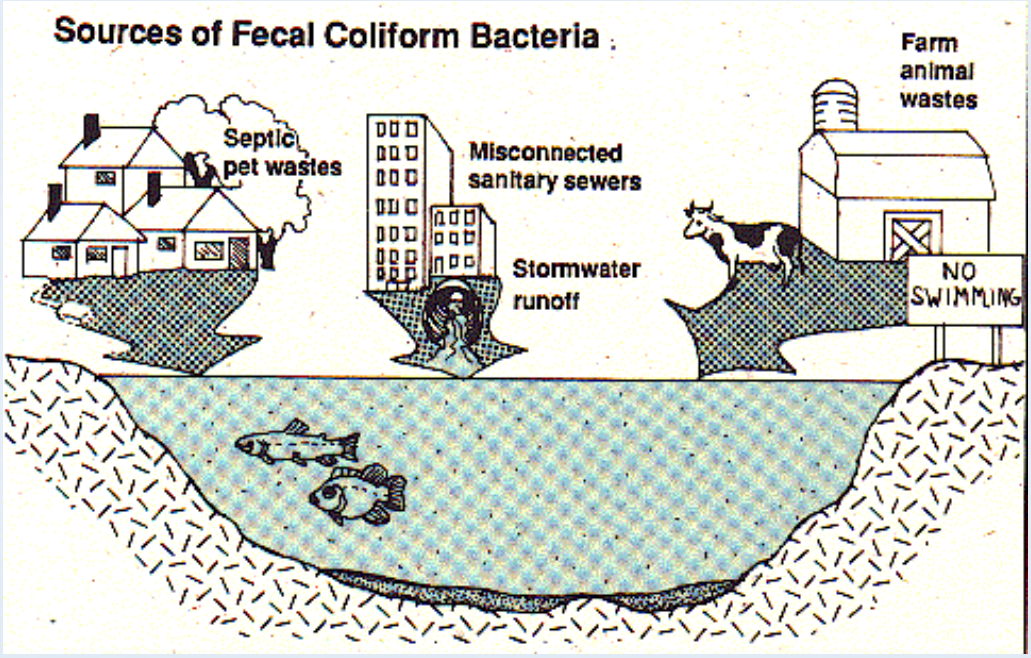
Common NPS pollutants: nutrients



Nutrient impacts

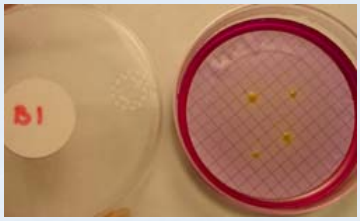
- Direct toxicity (e.g., ammonia)
- Algae growth
  - Affects water clarity
  - Die-off causes lower DO
- Drinking water effects
  - Nitrate, disinfection by-products
- Long term effects in lakes
  - Phosphorus cycling

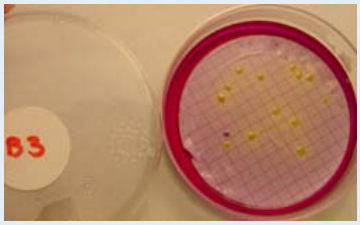
Common NPS pollutants: bacteria

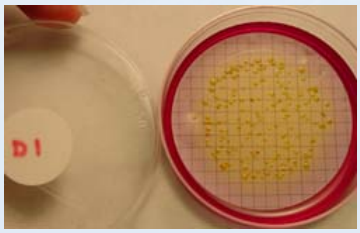


Bacteria impacts

- Human health effects
  - Impairs swimming, boating, fishing, other recreational uses
  - Shellfish bed closures
  - Drinking water treatment costs
- Economic impacts
  - Recreational, livestock

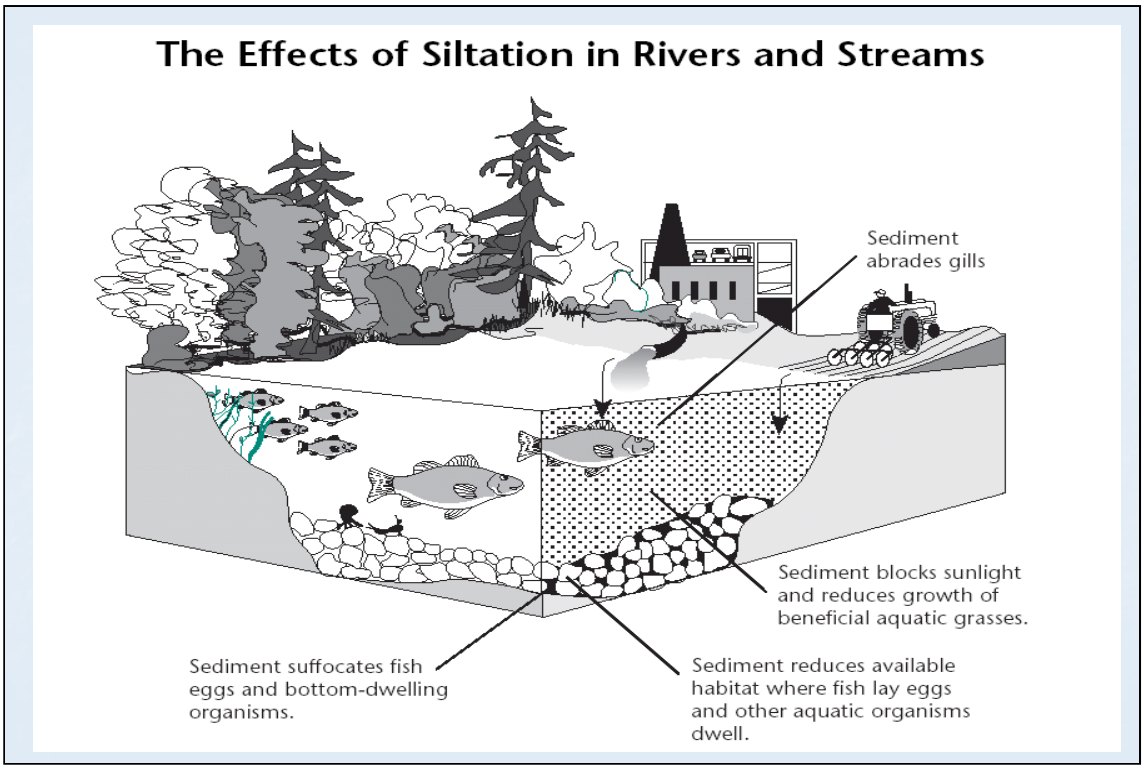


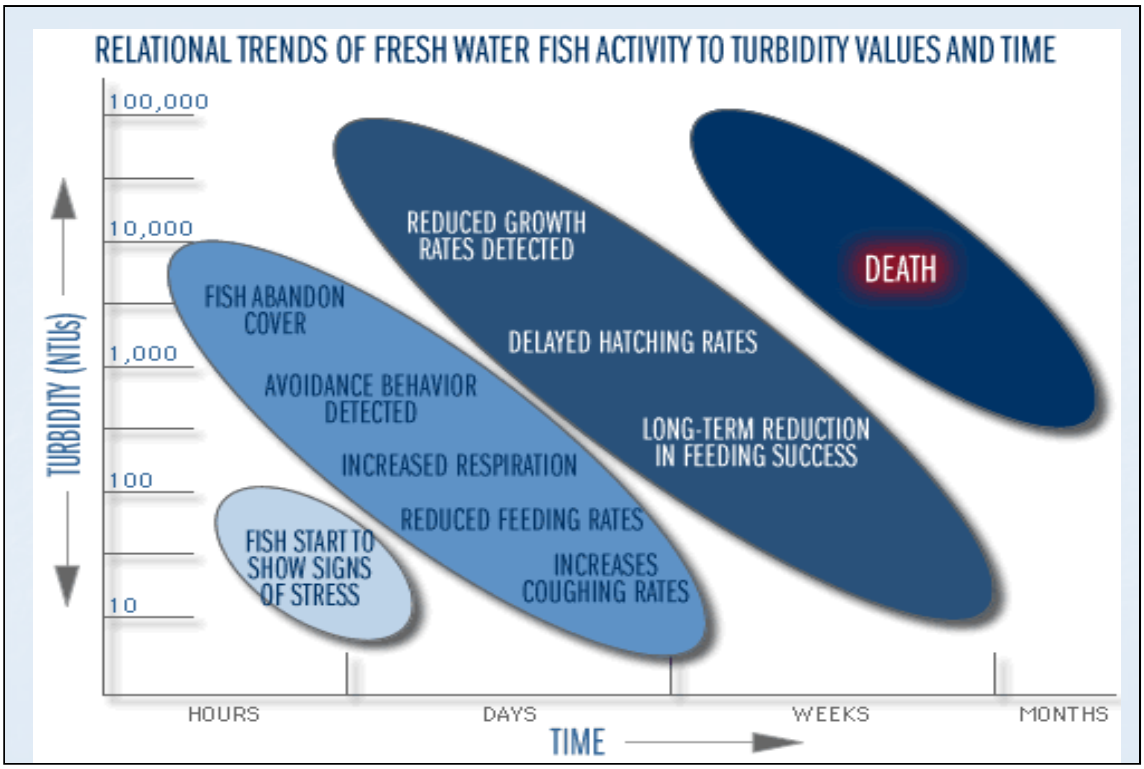




Sediment impacts

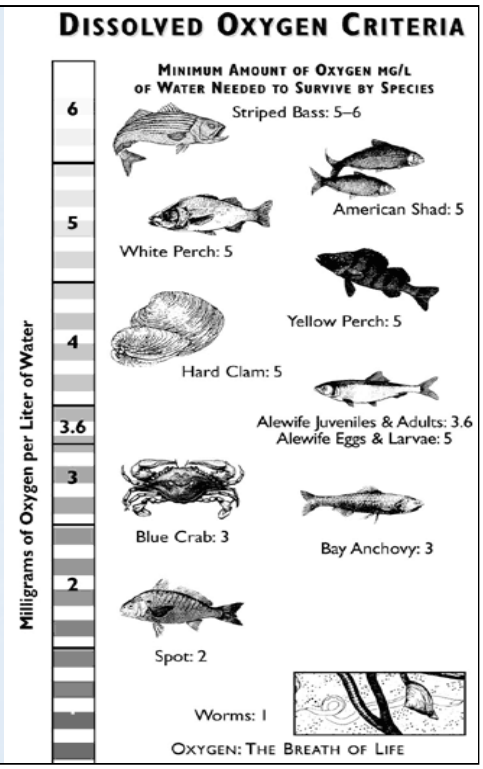
- Fish & aquatic life effects
  - Gills, sight feeding
- Loss of habitat
  - Filling of pools, interstitial spaces
- Drinking water impacts
  - Pump wear & tear
  - Filtration
  - Taste & odor
- Recreational impacts
  - Channel instability, sedimentation


The Effects of Siltation in Rivers and Streams
Sediment abrades gills
Sediment blocks sunlight and reduces growth of beneficial aquatic grasses.
Sediment suffocates fish eggs and bottom-dwelling organisms.
Sediment reduces available habitat where fish lay eggs and other aquatic organisms dwell.


RELATIONAL TRENDS OF FRESH WATER FISH ACTIVITY TO TURBIDITY VALUES AND TIME
TURBIDITY (NTUs)
100,000
10,000
1,000
100
10
FISH ABANDON COVER
AVOIDANCE BEHAVIOR DETECTED
INCREASED RESPIRATION
REDUCED FEEDING RATES
INCREASES COUGHING RATES
FISH START TO SHOW SIGNS OF STRESS
REDUCED GROWTH RATES DETECTED
DELAYED HATCHING RATES
LONG-TERM REDUCTION IN FEEDING SUCCESS
DEATH
HOURS
DAYS
WEEKS
MONTHS
TIME

Other measures: dissolved oxygen

Helps to detect sewage, organic loading, oxidizing chemical inputs

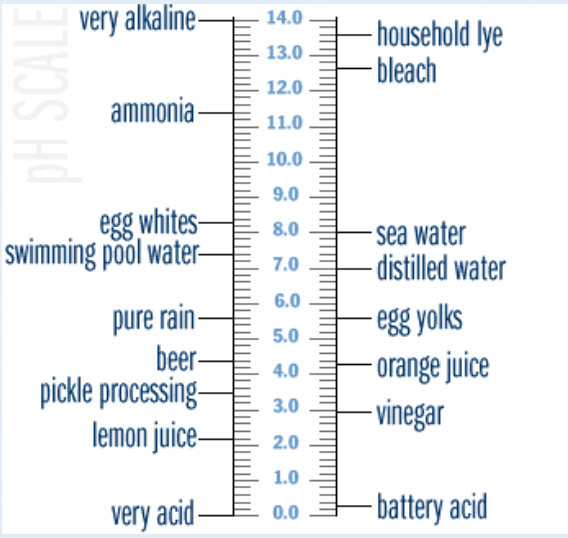


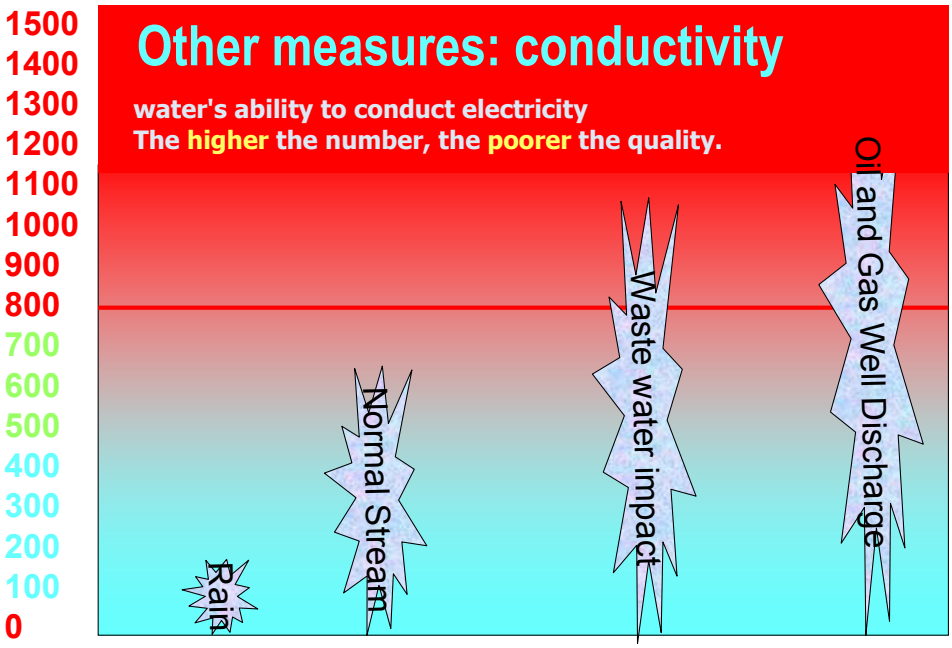
Metals and other chemicals

- Aquatic life impacts
  - Direct toxicity, metabolic and reproduction impacts
- Drinking water effects
  - Increased treatment costs
- Human health impacts
  - Fish tissue (e.g., mercury)
  - Contact recreation effects

Other measures: pH

- Measure of hydrogen ion concentration
- Typically 6.5 s.u. to 9.0 s.u. needed for most biota
- Determines the solubility and bioavailability of various chemicals
- Useful for detecting acid mine drainage, poor wastewater treatment



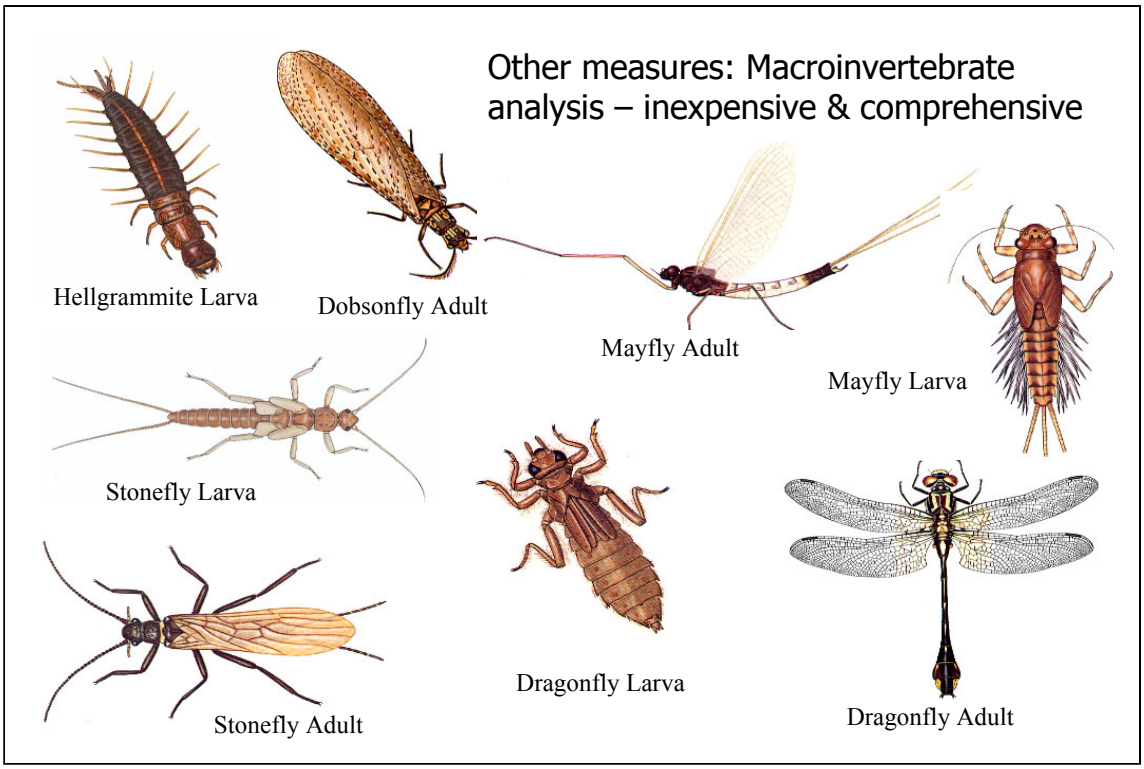

Other measures: conductivity
water's ability to conduct electricity
The higher the number, the poorer the quality.
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Rain
Normal Stream
Waste water impact
Oil and Gas Well Discharge

Effects of Non-Native Species on Rivers and Streams

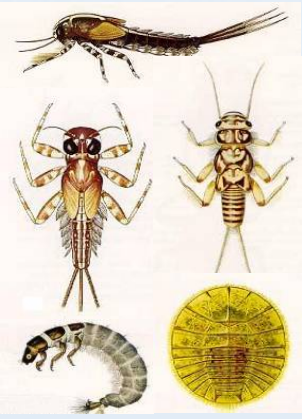
- Crowd-out native riparian vegetation
- Increased wildfire hazards
- Impacts to native wildlife habitat
- Rapid growth and reproduction rates cause a change in stream structures
- Decrease in recreational use of streams and rivers
- Changes in stream structure can lead to changes in flow

Increased temperature

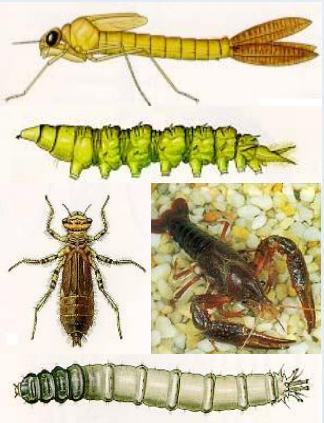
- Warmer water affects aquatic organisms
  - Metabolism increase / higher oxygen demand
  - Increased food requirements
  - Decreased growth
  - Increased sensitivity to disease
  - Migration / life cycle impacts
- Lower instream DO
- Excessive plant growth


Other measures: Macroinvertebrate analysis – inexpensive & comprehensive
Hellgrammite Larva
Dobsonfly Adult
Mayfly Adult
Mayfly Larva
Stonefly Larva
Dragonfly Larva
Stonefly Adult
Dragonfly Adult

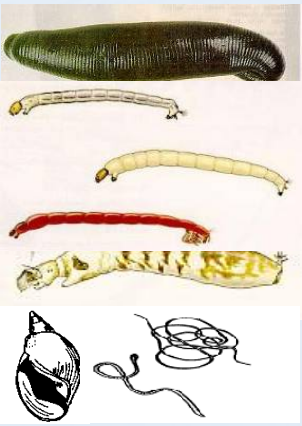
Organisms can be categorized according to their tolerance for pollution or poor habitat conditions



Good



Mid Range



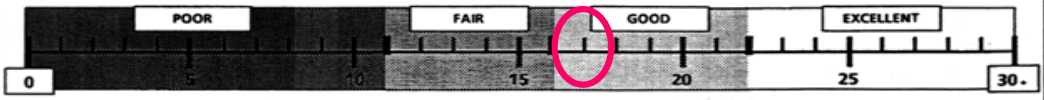
Poor

MACROINVERTEBRATE TALLY

GROUP 1 TAXA	CODE	GROUP 2 TAXA	CODE	GROUP 3 TAXA	CODE
WATER PENNY LARVAE	X	DAMSELFLY NYMPHS		BLACKFLY LARVAE	
MAYFLY NYMPHS		DRAGONFLY NYMPHS	X	AQUATIC WORMS	X
STONEFLY NYMPHS		CRANE FLY LARVAE		MIDGE LARVAE	
DOBSONFLY LARVE	X	BEETLE LARVAE		POUCH SNAILS	X
CADDISFLY LARVAE		CRAYFISH	X	LEECHES	
RIFFLE BEETLE ADULTS		SCUDS			
OTHER SNAILS	X	CLAMS	X		
		SOW BUGS / ISOPODS			
Number of taxa present	3	Number of taxa present	3	Number of taxa present	2
Times index value of (3) =	9	Times index value of (2) =	6	Times index value of (1) =	2

Cumulative Index Value	17

BIOLOGICAL QUALITY ASSESSMENT SCALE

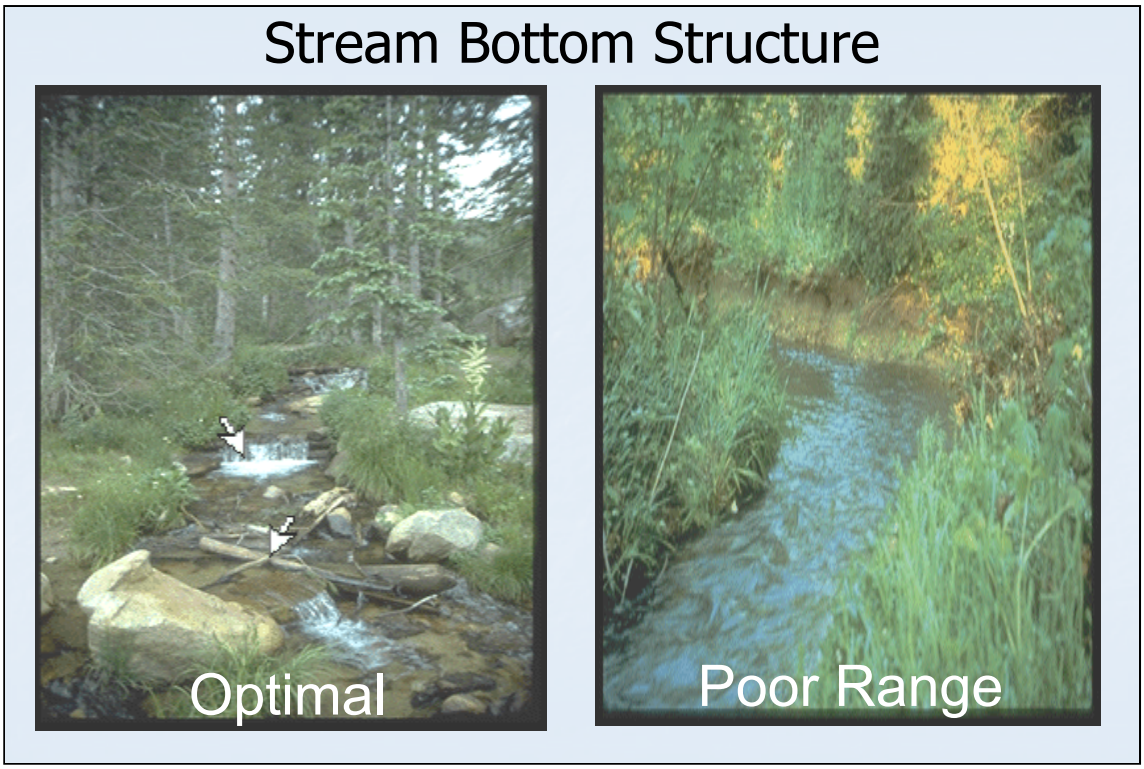


SEND REPORT FORM TO: **WATER WATCH BIOLOGICAL STREAM ASSESSMENT TEAM**

How can we assess the quality of streams and rivers?

1) Looking at the structure of the river provides insight to the quality of the river or stream.
    a) Stream bottom structure
    b) Sediment Deposition
    c) Channel Flow
    d) Riparian Coverage
    e) Bank Stabilization

    These are all issues that can be tracked by an environmental program to help determine the quality of a waterbody.



Optimal picture: Natural debris, elevation changes, and riparian coverage are all shown. The water flow is naturally regulated and the water is clear. The streambed can be seen.

Poor Range: The water flow is much more dramatic (not regulated by debris). Stream is cutting into the riparian zone and stream banks are eroding. Water has a muddy appearance and the streambed can't be seen.

Embeddedness

Optimal

Poor Range

Sediment Deposition

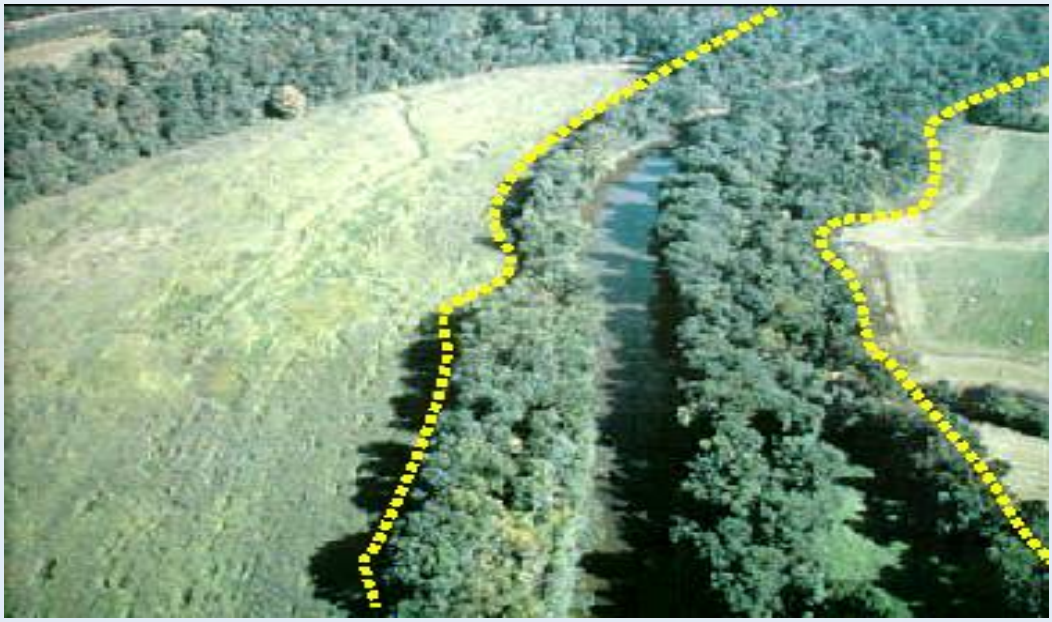
Channel Flow Status

Channel Alteration

Optimal

Poor Range

Measurable indicators for assessing conditions along the bank area



Bank Stability

Bank Vegetative Protection

Optimal

Poor Range

Riparian Vegetative Zone Width

Optimal

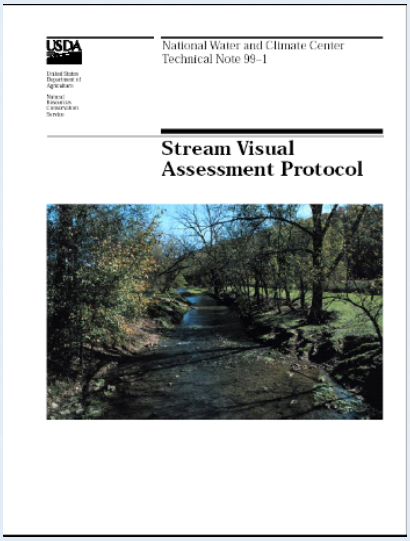
Poor Range

Stream Visual Assessment Protocol (NRCS)

One assessment tool provides basic stream health evaluation. Scores are assigned for the following:

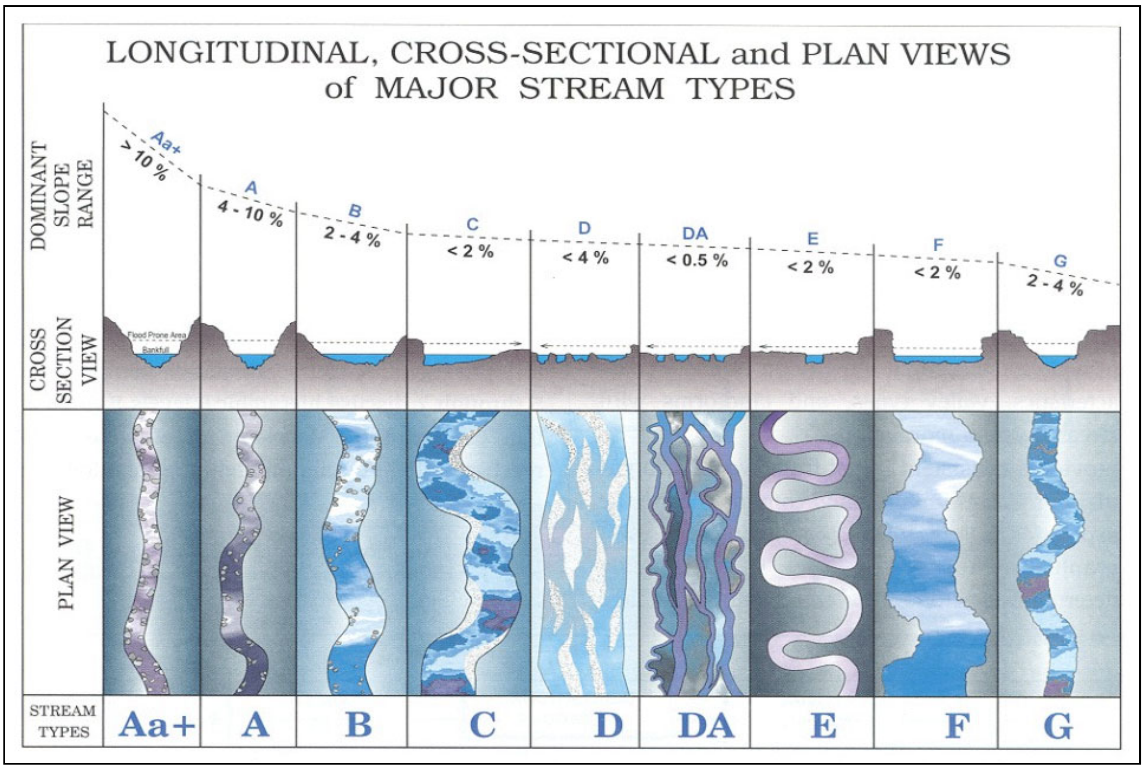
Channel condition	Hydrologic alteration
Riparian zone width	Bank stability
Canopy cover	Water appearance
Nutrient enrichment	Manure presence
Salinity	Fish movement barriers
Instream fish cover	Pools and riffles
Invertebrate habitat	Macro invertebrates

http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf


USDA

National Water and Climate Center
Technical Note 99-1

Stream Visual Assessment Protocol


LONGITUDINAL, CROSS-SECTIONAL and PLAN VIEWS
of MAJOR STREAM TYPES
DOMINANT SLOPE RANGE
CROSS SECTION VIEW
PLAN VIEW
STREAM TYPES
Aa+
> 10 %
A
4 - 10 %
B
2 - 4 %
C
< 2 %
D
< 4 %
DA
< 0.5 %
E
< 2 %
F
< 2 %
G
2 - 4 %
Flood Prone Area
Bankfull
Aa+
A
B
C
D
DA
E
F
G

Nonpoint Source Assessment Report: Methodology

Describe:

- How and where was the data obtained (ie., CWA 106)
- How was the study conducted
- Any assumptions made in analysis
- Any uncommon software or evaluation techniques

In the methodology section, describe how and where the data were obtained, how the study was conducted, and what uncommon software or evaluation techniques were used.

Whenever possible, use existing data sources such as

- Tribal water quality monitoring
- Tribal volunteer monitoring
- USGS
- State sources

Details to be included in this section include

- The type and purpose of the sampling
- Explanations of abbreviations or classifications developed specifically for this assessment, such as division of drainage areas into subunits for more precise analysis
- Assumptions made during the course of the analysis

Remember to references to all documents used and environmental specialists contacted

Nonpoint Source Assessment Report:
Land Use Summary

Describe:

- Existing condition of tribal lands
- Land uses and socioeconomic conditions
- Include Maps

The purpose of this section is to generally describe existing conditions on the tribal lands. This section should include a description of the tribal lands, land uses, and socioeconomic conditions. Include a map of the area and a regional location map.

Describe the existing conditions on tribal lands

-Tribal land maps
-Acreage/square miles
-Land use types
-Topography (USGS quadrangle maps)
-Regional location map
-Political boundaries
-Land Ownership

Questions?