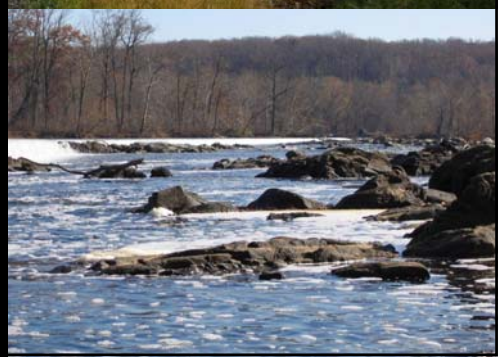
Streams, Rivers, and Nonpoint Source Pollution



Barry Tonning

Tetra Tech

Upstream

and Downstream?

Uses of Rivers

- Common Designated Uses
  - Cultural uses
  - Swimming (primary contact)
  - Boating (secondary contact)
  - Fishing (secondary contact)
  - Fish habitat (aquatic life support)
  - Water supply (drinking, ag, industrial, etc.)

Assessing Streams and Rivers:
Macroinvertebrate analysis – inexpensive & comprehensive

Helgrammite Larva

Dobsonfly Adult

Mayfly Adult

Mayfly Larva

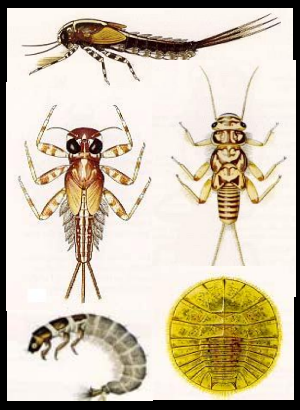
Stonefly Larva

Dragonfly Larva

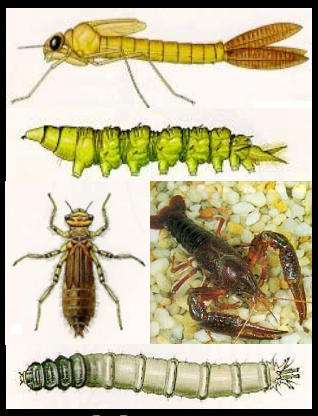
Stonefly Adult

Dragonfly Adult

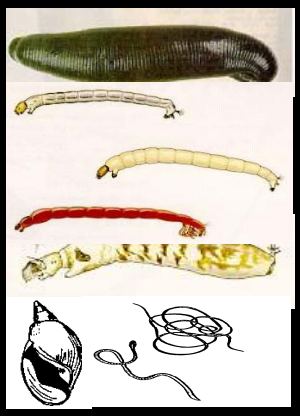
Organisms can be categorized according to their tolerance for pollution or poor habitat conditions



Good



Mid Range



Poor

See: www.epa.gov/bioindicators/html/benthosclean.html

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

POOR | FAIR | GOOD | EXCELLENT

0 5 10 15 20 25 30.

SEND REPORT FORM TO: WATER WATCH BIOLOGICAL STREAM ASSESSMENT TEAM

What about the structure of streams and rivers?

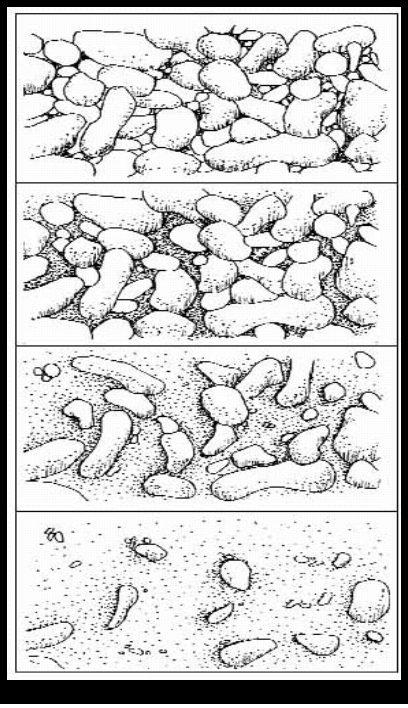
Moving from the biological to the physical: siltation and other structural (physical) aspects of the stream affects habitat

Optimal

Suboptimal

Marginal

Poor



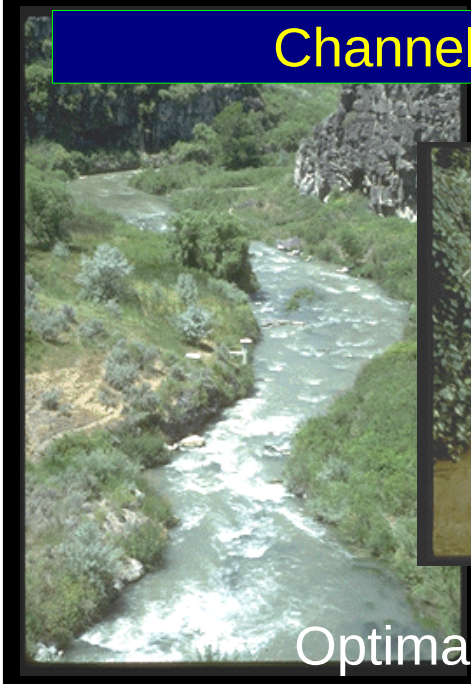
Stream Bottom Structure & Critter Cover

Embeddedness

Sediment Deposition

Poor Range

Channel Flow Status



Optimal

Poor Range

Channel Alteration

Optimal

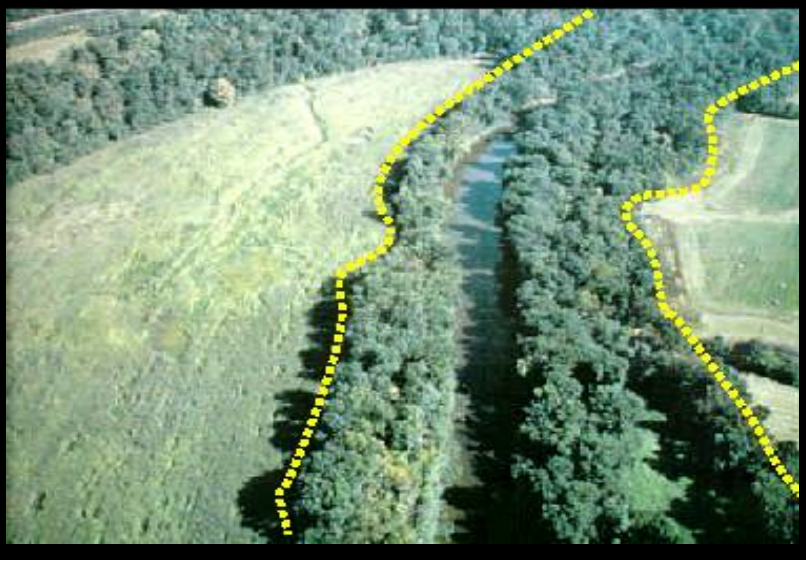
Poor Range

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
meters to be evaluated in sampling reach	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Measurable indicators for assessing conditions along the bank area



Bank Stability

Bank Vegetative Protection

Optimal

Poor Range

Riparian Vegetative Zone Width

Optimal

Poor Range

8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.			Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.			Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.			Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.			70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.			50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.			Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.			Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.			Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.			Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.		
SCORE ___ (LB)	Left Bank	10	9	8	7	6	5	4	3	2	1	0
SCORE ___ (RB)	Right Bank	10	9	8	7	6	5	4	3	2	1	0

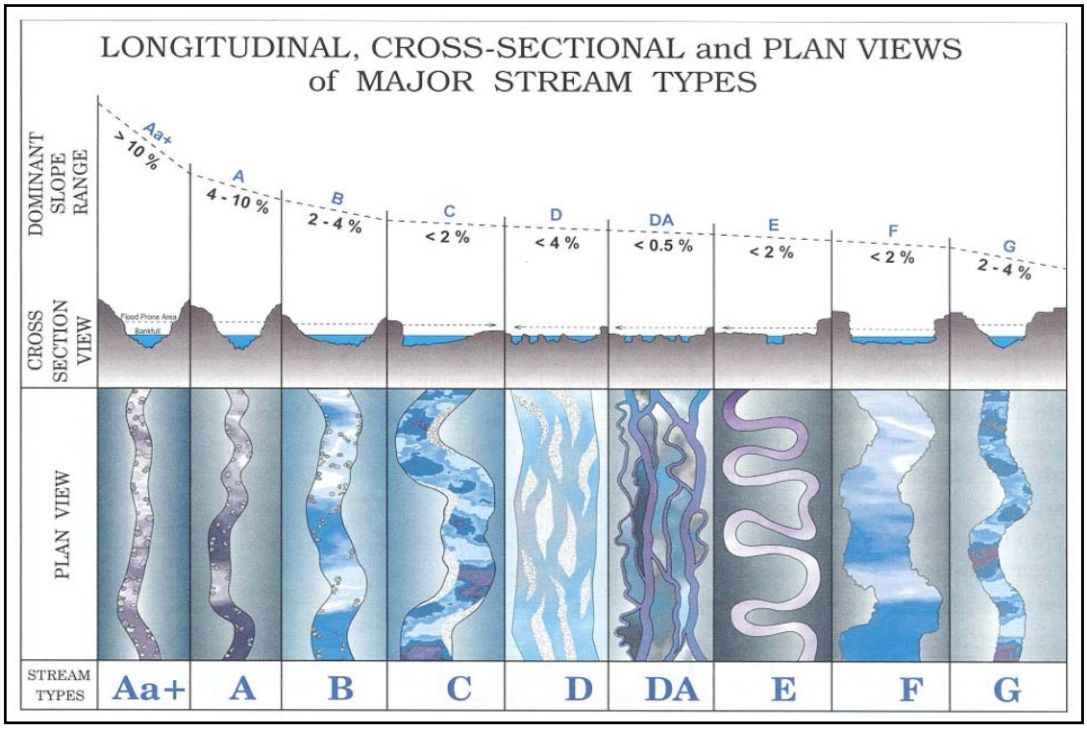
Stream Visual Assessment Protocol (NRCS)

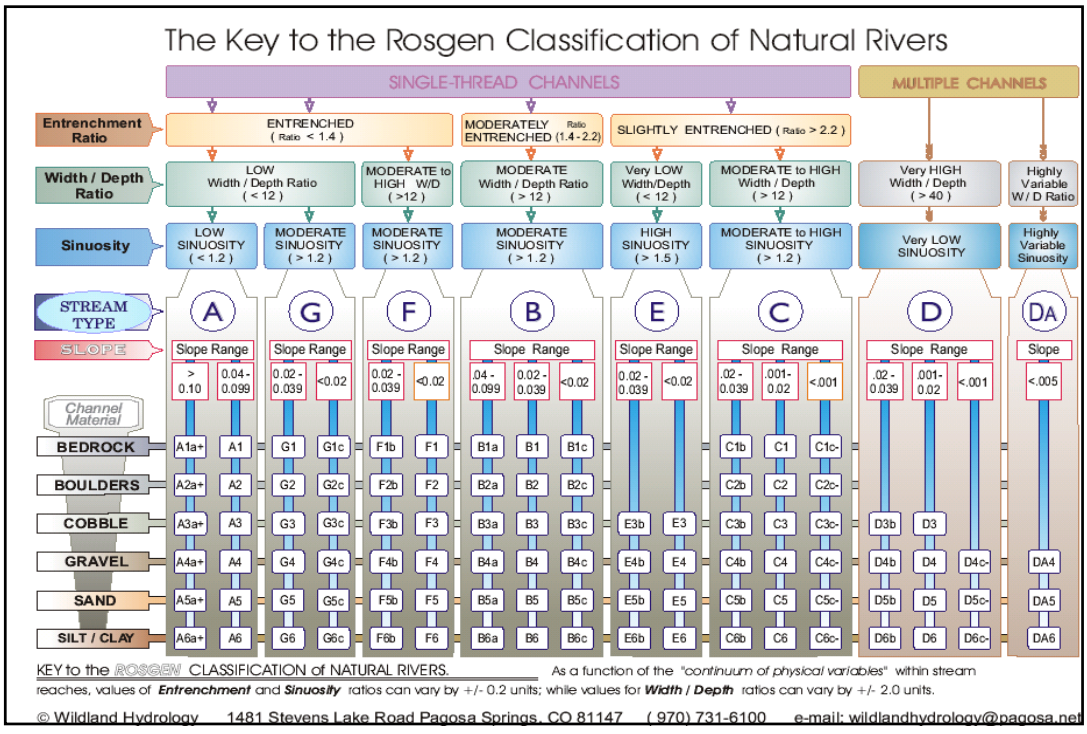
One assessment tool provides basic stream health evaluation.

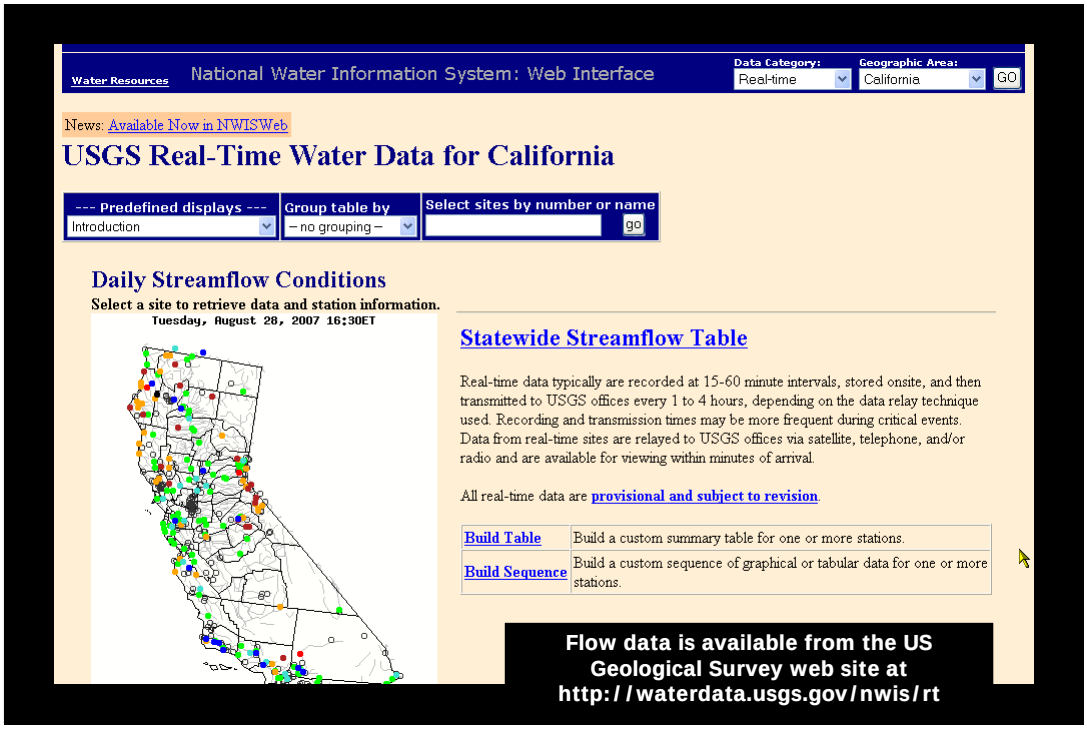
Scores are assigned for the following:

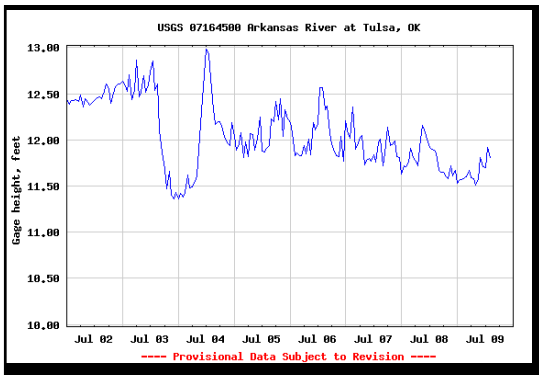
Channel condition	Hydrologic alteration
Riparian zone width	Bank stability
Canopy cover	Water appearance
Nutrient enrichment	Manure presence
Salinity	Fish movement barriers
Instream fish cover	Pools and riffles
Invertebrate habitat	Macro invertebrates

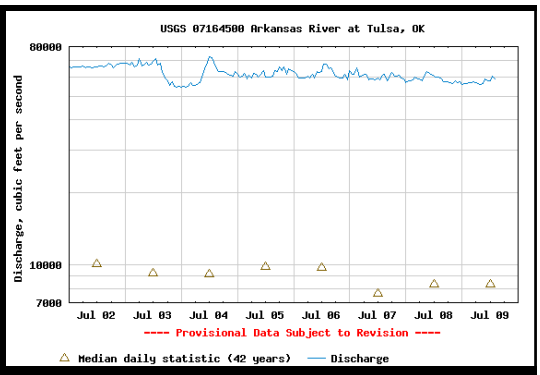
http://www.ncg.nrcs.usda.gov/pdf/svapfnl.pdf

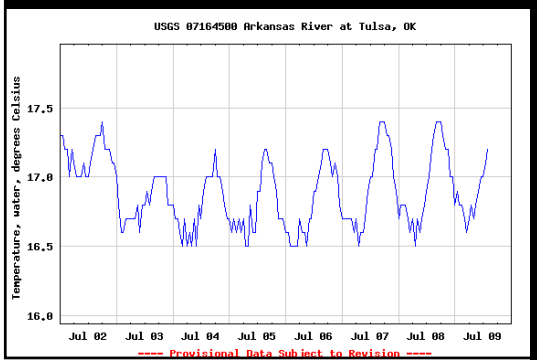

LONGITUDINAL, CROSS-SECTIONAL and PLAN VIEWS
of MAJOR STREAM TYPES
DOMINANT SLOPE RANGE
CROSS SECTION VIEW
PLAN VIEW
STREAM TYPES
Aa+
> 10 %
A
4 - 10 %
B
2 - 4 %
C
< 2 %
D
< 4 %
DA
< 0.5 %
E
< 2 %
F
< 2 %
G
2 - 4 %
Aa+
A
B
C
D
DA
E
F
G


The Key to the Rosgen Classification of Natural Rivers
SINGLE-THREAD CHANNELS
MULTIPLE CHANNELS
Entrenchment Ratio
ENTRENCHED (Ratio < 1.4)
MODERATELY ENTRENCHED (1.4 - 2.2)
SLIGHTLY ENTRENCHED (Ratio > 2.2)
Width / Depth Ratio
LOW Width / Depth Ratio (< 12)
MODERATE to HIGH W/D (>12)
MODERATE Width / Depth Ratio (> 12)
Very LOW Width/Depth (< 12)
MODERATE to HIGH Width / Depth (> 12)
Very HIGH Width / Depth (> 40)
Highly Variable W / D Ratio
Sinuosity
LOW SINUOSITY (< 1.2)
MODERATE SINUOSITY (> 1.2)
MODERATE SINUOSITY (> 1.2)
MODERATE SINUOSITY (> 1.2)
HIGH SINUOSITY (> 1.5)
MODERATE to HIGH SINUOSITY (> 1.2)
Very LOW SINUOSITY
Highly Variable Sinuosity
STREAM TYPE
A
G
F
B
E
C
D
DA
SLOPE
Slope Range
> 0.10
0.04 - 0.099
0.02 - 0.039
<0.02
0.02 - 0.039
<0.02
.04 - 0.099
0.02 - 0.039
<0.02
0.02 - 0.039
<0.02
.02 - 0.039
.001 - 0.02
<.001
.02 - 0.039
.001 - 0.02
<.001
Slope
<.005
Channel Material
BEDROCK
BOULDERS
COBBLE
GRAVEL
SAND
SILT / CLAY
A1a+ A1
A2a+ A2
A3a+ A3
A4a+ A4
A5a+ A5
A6a+ A6
G1 G1c
G2 G2c
G3 G3c
G4 G4c
G5 G5c
G6 G6c
F1b F1
F2b F2
F3b F3
F4b F4
F5b F5
F6b F6
B1a B1 B1c
B2a B2 B2c
B3a B3 B3c
B4a B4 B4c
B5a B5 B5c
B6a B6 B6c
E3b E3
E4b E4
E5b E5
E6b E6
C1b C1 C1c-
C2b C2 C2c-
C3b C3 C3c-
C4b C4 C4c-
C5b C5 C5c-
C6b C6 C6c-
D3b D3
D4b D4 D4c-
D5b D5 D5c-
D6b D6 D6c-
DA4
DA5
DA6
KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS.
As a function of the "continuum of physical variables" within stream reaches, values of Entrenchment and Sinuosity ratios can vary by +/- 0.2 units; while values for Width / Depth ratios can vary by +/- 2.0 units.
© Wildland Hydrology 1481 Stevens Lake Road Pagosa Springs, CO 81147 (970) 731-6100 e-mail: wildlandhydrology@pagosa.net









Click on established monitoring sites for info on flow and other parameters for specific streams and rivers

Measuring Water Quality Indicators

- 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 . . .

Physical, chemical, and biological factors are most often measured, but flow and energy (mostly sunlight) can be important considerations

Figure 6: Monitoring Types and Pollutants or Conditions That They Measure

Biological

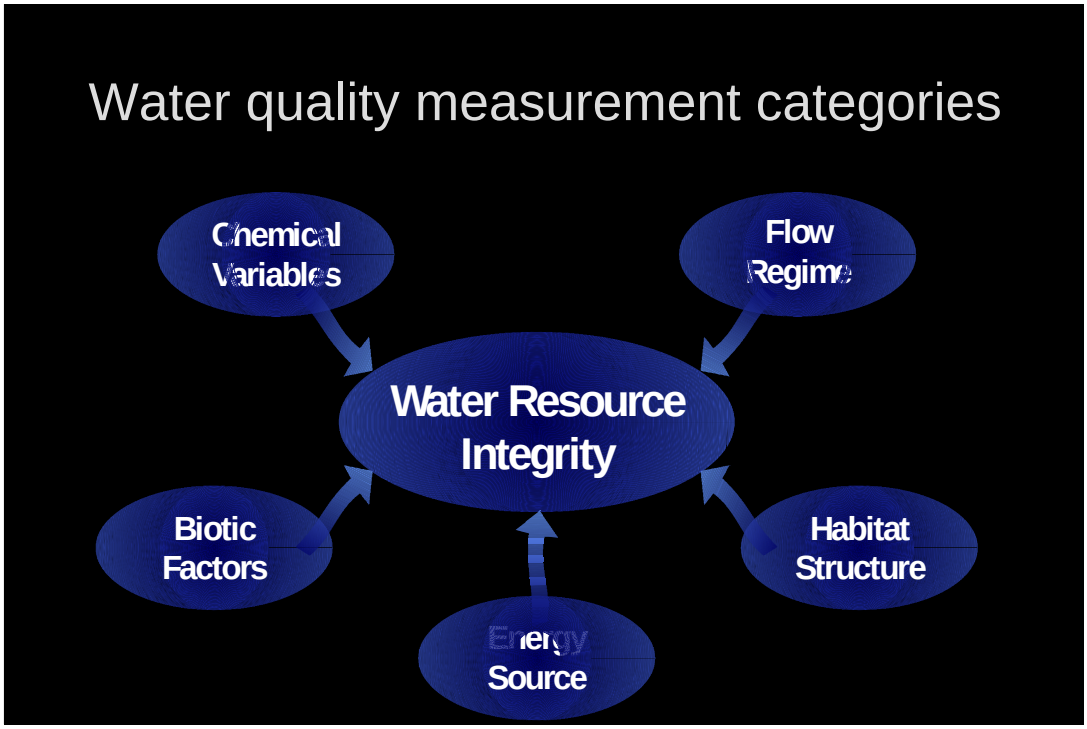
Assesses:
- Structure and function of aquatic communities
- Habitat, such as condition of riparian vegetation
- Health and abundance of aquatic species or fish populations

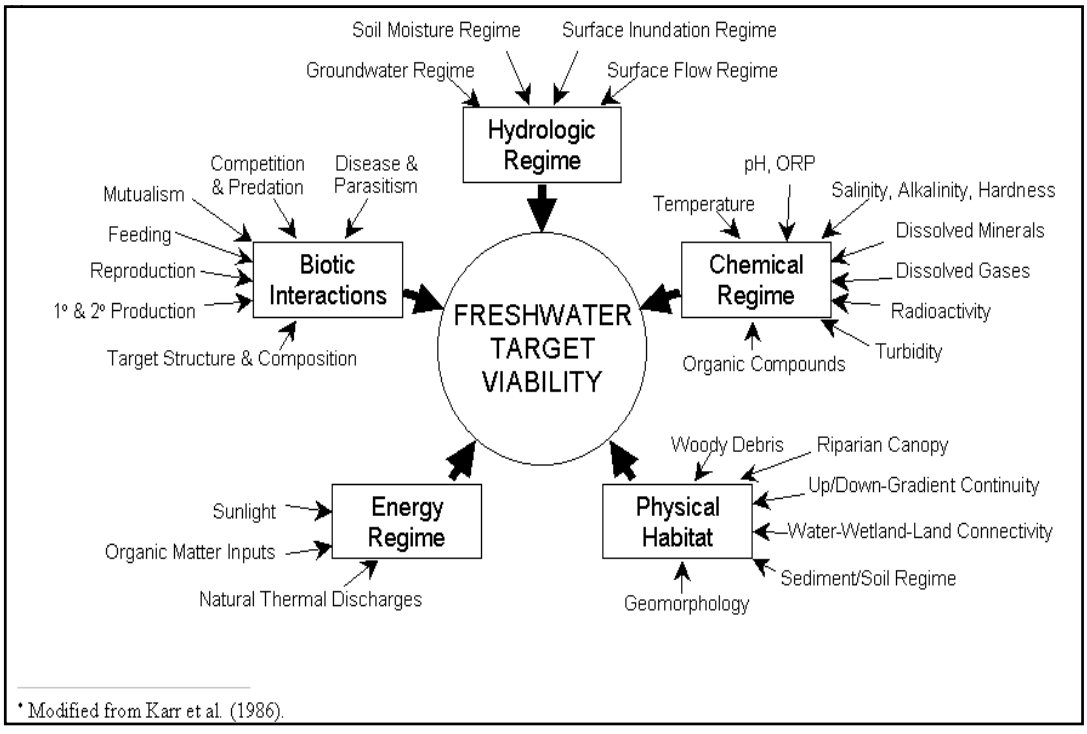
Physical

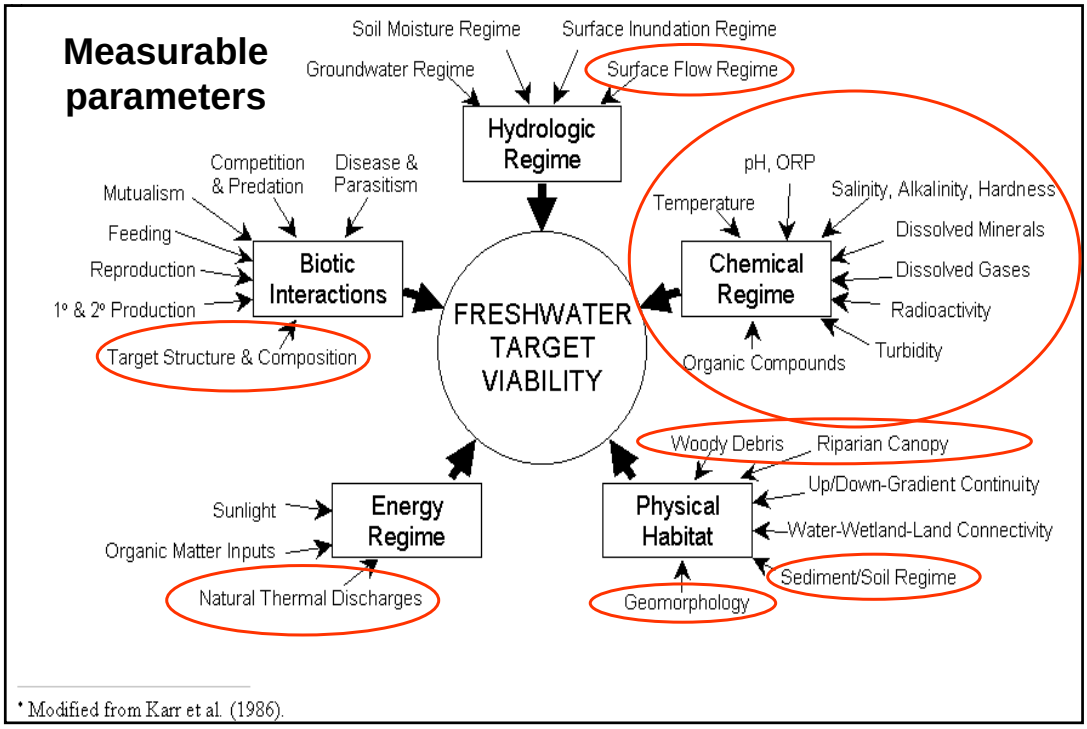
Measures:
- Temperature
- Conductivity
- Transparency
- Total suspended solids

Chemical

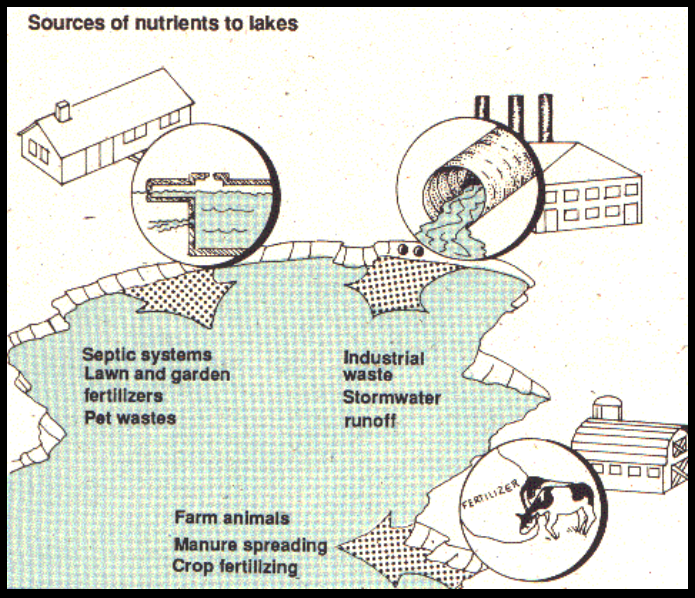
Tests for levels of:
- Pesticides
- Organics
- Metals (cadmium, arsenic, etc.)
- Nutrients (phosphorous, nitrogen)
- Toxic materials in fish tissue


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


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



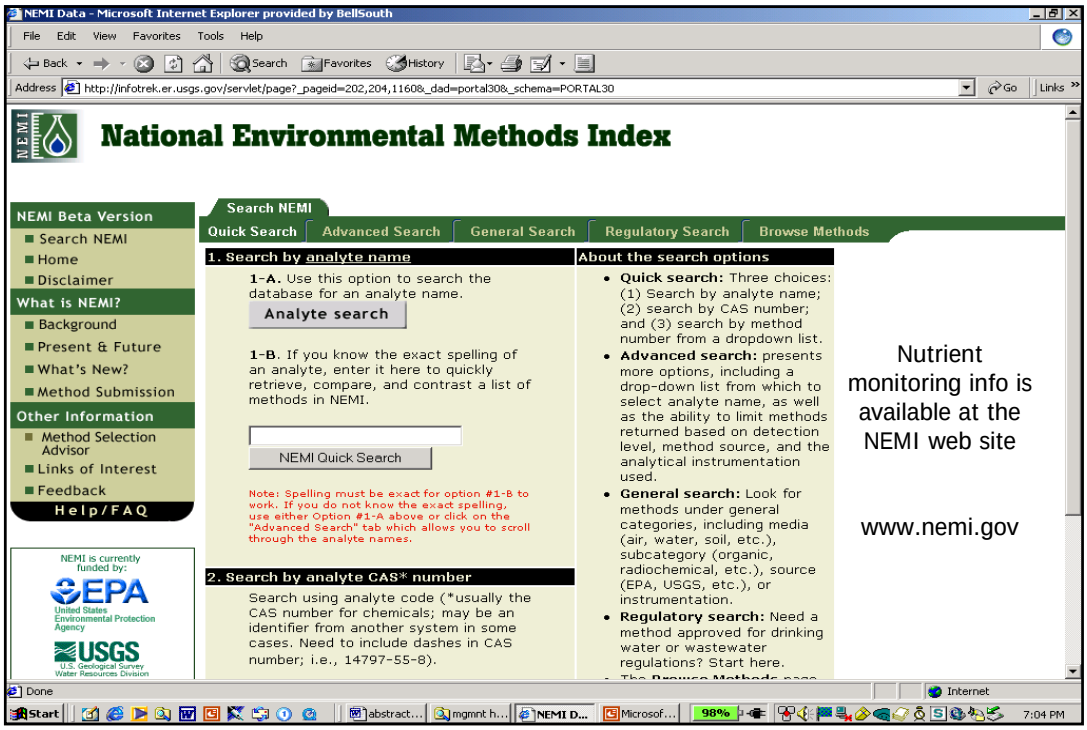
Common NPS pollutants: nutrients



Nutrients

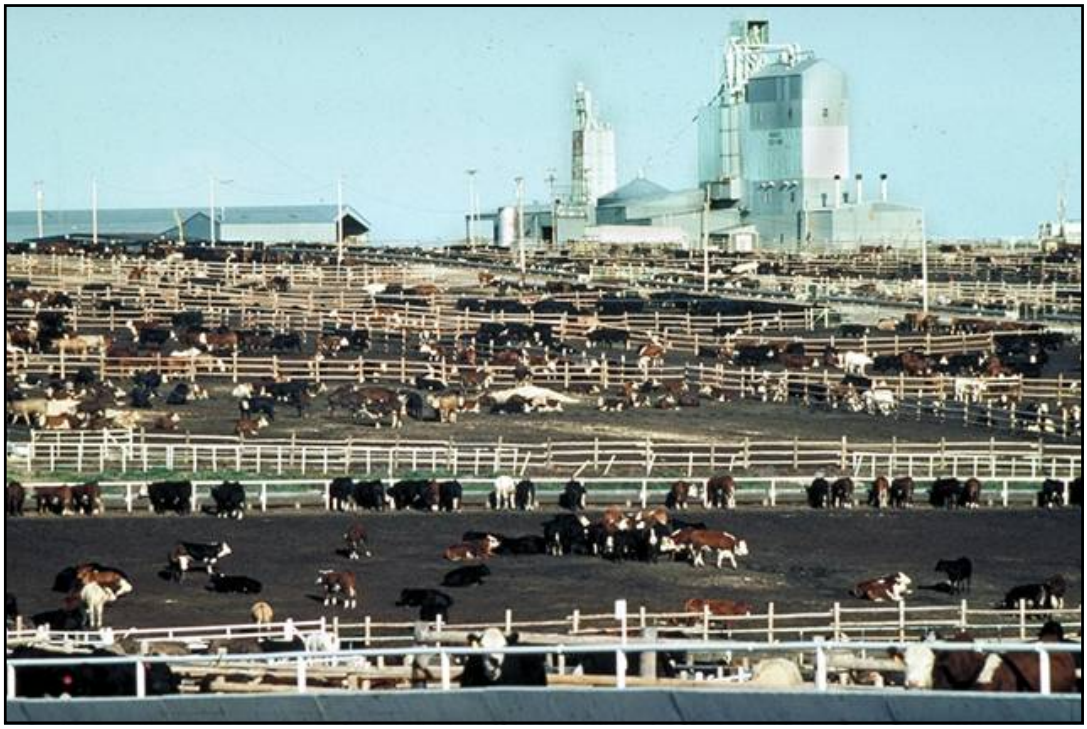
Most inland fresh waters will “bloom” with algae when phosphorus is added.

Bacteria that decompose algae suck dissolved oxygen out of the water, and can lead to fish kills

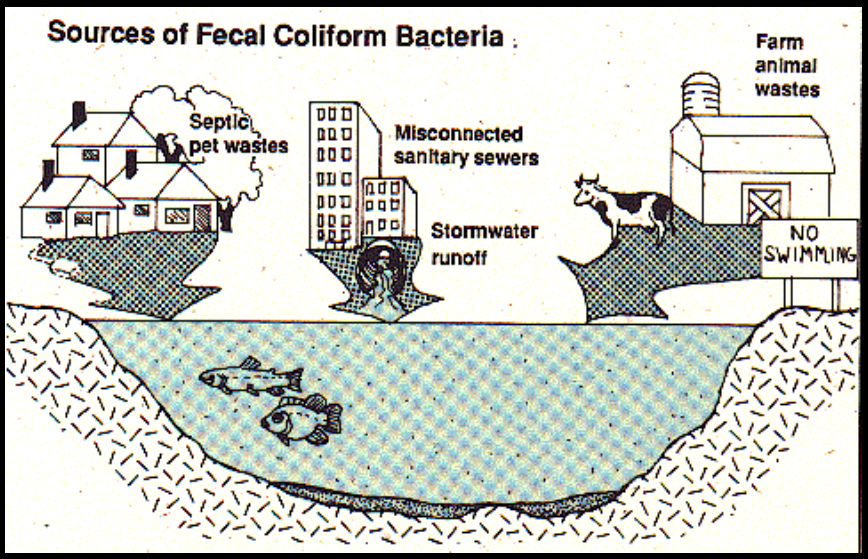


Nutrient monitoring info is available at the NEMI web site

www.nemi.gov



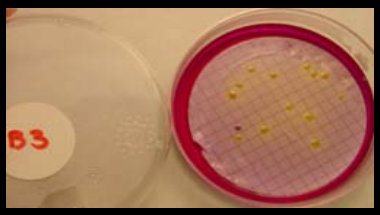
Common NPS pollutants: bacteria

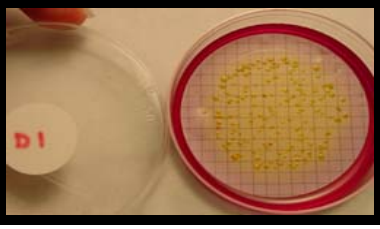


Failing Septic Systems

- Pipe from septic tank to ditch
- Fairly common for older, rural homes
- Direct discharges to creeks, field tiles/drains, ditches should have NPDES permit coverage

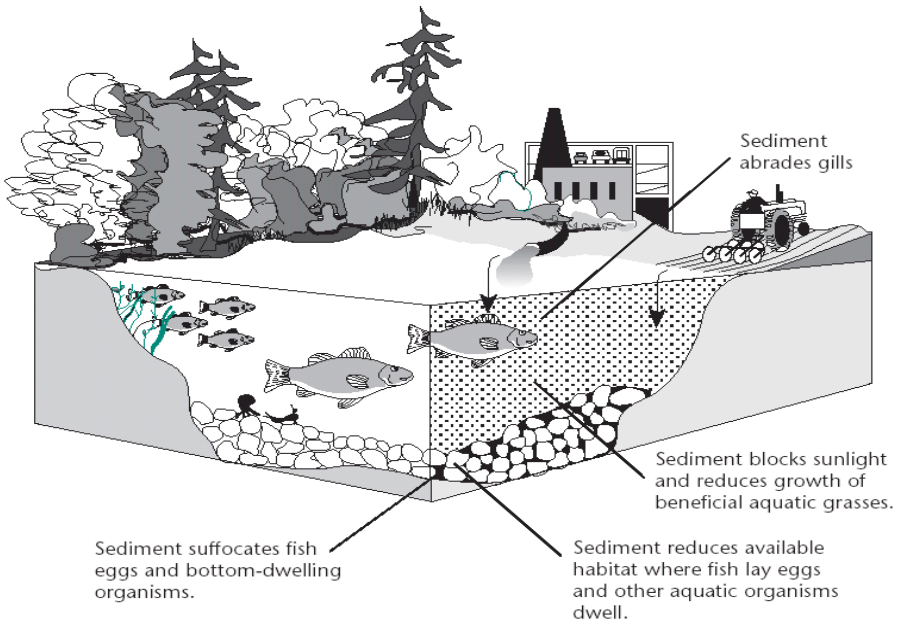
Most programs measure fecal coliform bacteria “colony-forming units” per 100 milliliters of raw water, or E. coli counts

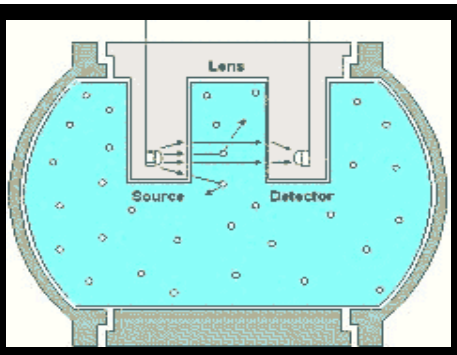




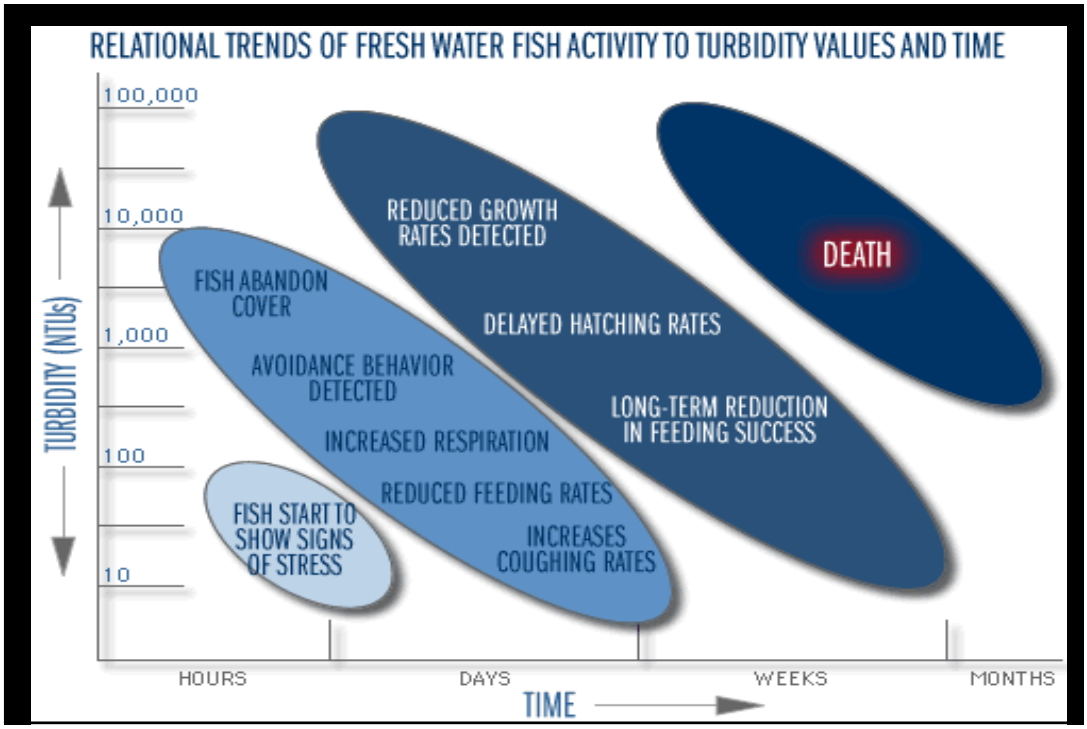
Common NPS pollutants: sediment

The Effects of Siltation in Rivers and Streams

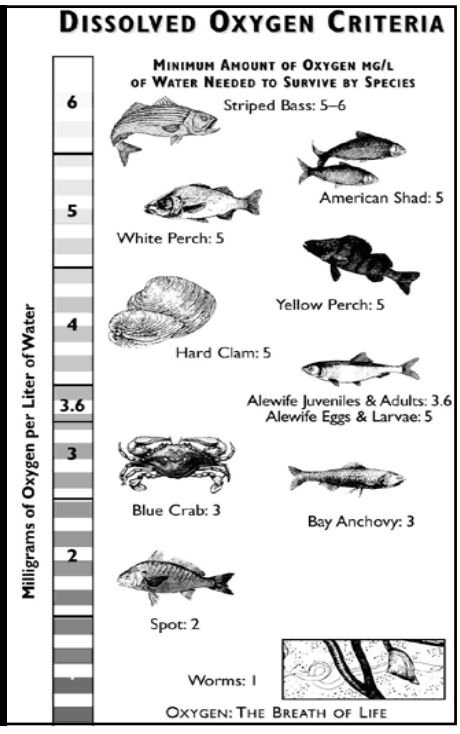




Turbidity meter, imhoff cones, and secchi disk for measuring suspended solids & water clarity

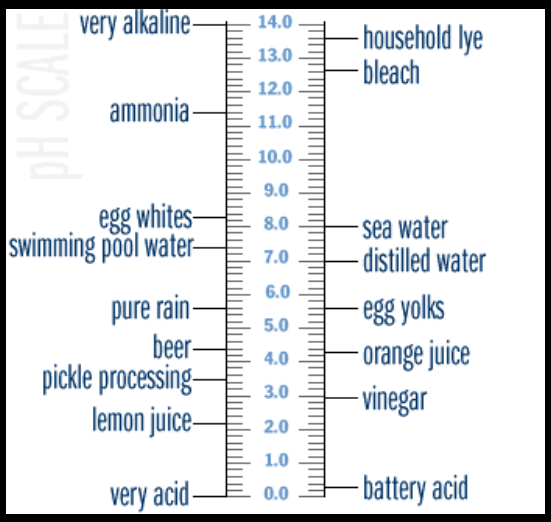


Other measures: dissolved oxygen

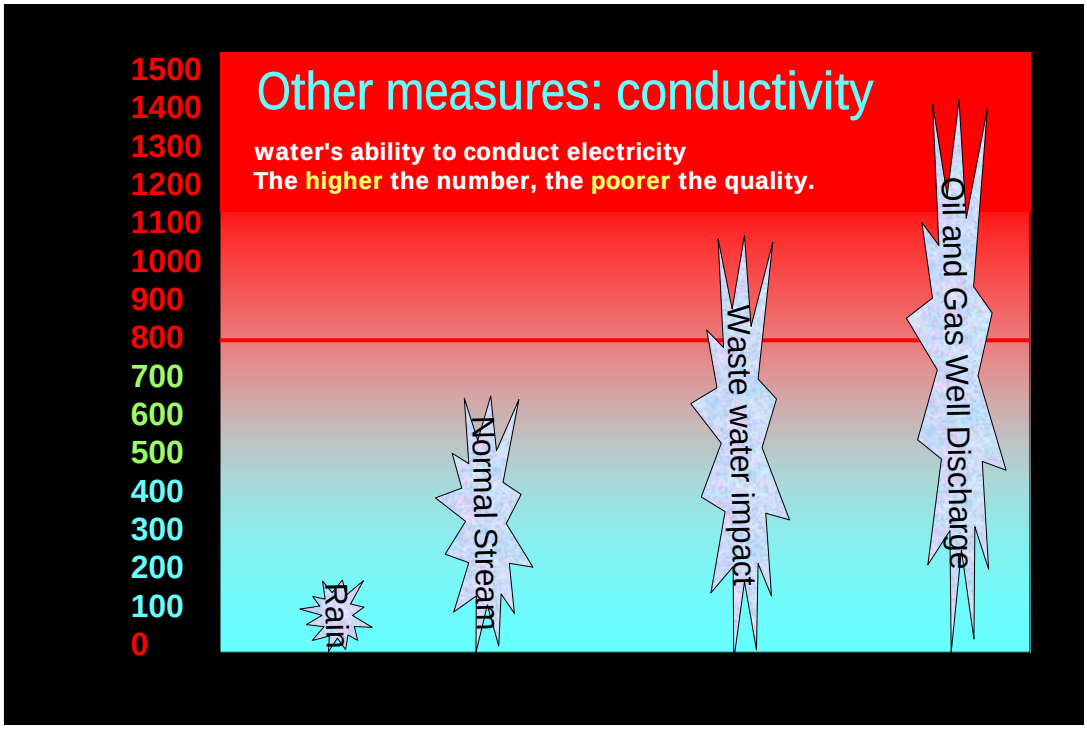


Other measures: pH

- 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



pH testers



Conductivity meter (and you get a thermometer!)

Summary

- Lots of ways to characterize water bodies
  - Biological indicators
  - Habitat surveys
  - Geomorphic assessments
  - Chemical parameters
- Polluted (nonpoint source) runoff is one of the biggest problems in California and nationwide
  - Nutrients: cause algae growth & oxygen depletion
  - Pathogens: bacteria can cause illnesses
  - Sediment: smothers habitat, muddies the water, lots of sources