Sediment Criteria

Region 8 Tribal NPS Workshop

September 12-14, 2006

SEDIMENT – What Are We Talking About?

- Suspended Solids in the stream *water column*
  - Total suspended solids
  - Turbidity
  - Water clarity/secchi depth
- Sediment on the *stream bottom*
  - Embedded sediments/siltation
  - Bedload sediment
  - Surface/subsurface sediment
- Sediment supply, transport, and balance *within the stream*
  - Location of sediment
  - Accumulation or loss of sediment
  - Movement of sediment

SUSPENEDED SOLIDS

BEDDED/BEDLOAD SEDIMENT

SEDIMENT SUPPLY, TRANSPORT, AND BALANCE

Why Are We Concerned About Sediment?

- Impacts to recreational uses
- Impacts to agricultural uses
- Impacts to drinking water uses
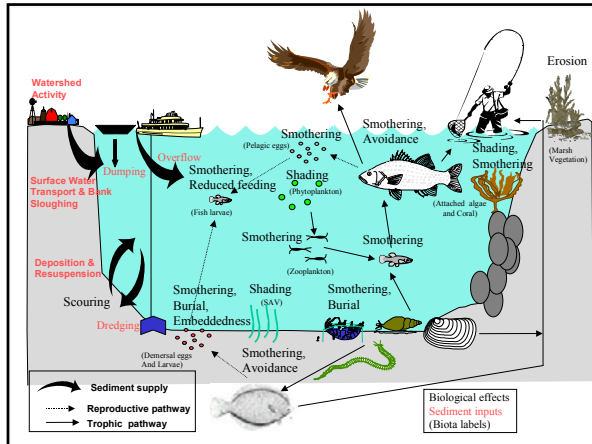- *Impacts to fish and aquatic life*

What Are the Current Sediment Standards?

- Sediment is **_HIGHLY VARIABLE_**, and therefore most sediment standards are **_narrative_** and contained in multiple "rules"
  - Prevent "harm" to fish and aquatic life
  - X increase allowed over "naturally occurring" or background levels
    - Beware – this is usually for point source discharges!
- Some states or tribes have numeric TSS standards
- Some states/tribes moving towards stream bottom or geomorphic standards
- Also more biological standards appearing

Example Turbidity and TSS Standards

State	Turbidity	Total Suspended Solids/Settleable Solids
Montana	Varies according to stream classification: • A – No increase above naturally occurring turbidity • B1 – No more than 5 NTU (instantaneous) above naturally occurring turbidity • B2/B3 – no more than 10 NTU (instantaneous) above naturally occurring turbidity.	Narrative
Utah	Varies according to stream classification: • Class 2A, 2B, 3A, & 3B watersheds – Not to exceed 10 NTU (instantaneous) above background • Class 3C & 3D watersheds – Not to exceed 15 NTU (instantaneous) above background	**Total Suspended Solids**: 35 mg/L for coldwater game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain; 90 mg/L for warmwater game and non-game fish.
South Dakota	Narrative	Varies according to stream classification: • Coldwater permanent fish life – less than 30 mg/L TSS (30-day Average); less than 53 mg/L TSS Daily Max • Warmwater permanent fish life – less than 90 mg/L TSS (30-day Average); less than 158 mg/L TSS Daily Max

Example Narrative Standards (Montana)

| Rule(s)	Standard
17.30.623(2)	No person may violate the following specific water quality standards for waters classified B-2, B-3, and C-3.
17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of **sediment or suspended sediment** (except a permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:
17.30.637(1)(a)	Settle to **form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines**.
17.30.637(1)(d)	**Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.** **The maximum allowable increase above naturally occurring turbidity is: 0 NTU for A-closed; 5 NTU for A-1, B-1, and C-1; 10 NTU for B-2, C-2, and C-3**
17.30.602(17)	**"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied.**

Narrative Sediment Standards

- Narrative standards are DIFFICULT to interpret
  - Ambiguous language, do not provide usable endpoints
- What does "background level", "natural condition", and/or "harmful impacts" mean???
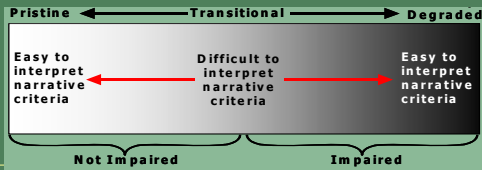
Interpretation of Narrative Sediment Standards

- It is necessary to develop *defensible, measurable, numeric interpretations* of the narrative standards
- There is no "magic number" or "cookbook" to help interpret the narrative standards.
- Sediment *indicators/criteria/targets* are needed to determine sediment impairment and/or measure success of BMPs

Sediment Indicators/Criteria/Targets

- Multiple indicators are used throughout the U.S.
- Indicators vary based on ecoregion, precipitation, soils, geology, etc.
- Tools to detect sediment impacts are further refined for mountain streams than the plains where the natural sediment load is large.

Water Column Measurements
Total Suspended Solids (TSS)
Suspended Sediment Concentration (SSC)
Turbidity
Secchi Depth

Stream Bottom Substrate
% Surface Fines < 2 mm
% Subsurface Fines < 6.35 mm
% Subsurface Fines < 0.85 mm
Substrate Score
Embeddedness

ion Curves

Bank Condition
Presence/Absence of Bank Er
Quantified Extent of Bank Eros
percent of reach, etc.)
Quantified Bank Erosion Load
Bank Angle/Frequency of Und
BEHI
Bank Stability

Stream Channel Condition
Large Woody Debris (LWD)
Riffle Stability Index (RSI)
Width to Depth (W/D) Ratio
Entrenchment Ratio
Sinuosity
Bank full Width
Pool Frequency
Residual Pool Depth
Residual Pool Volume (V*)
Relative Bed Stability
Channel Alterations

ce of Sources
/Diversions/ Reservoirs/Other

unt/ Type)
Animal Unit Month
s

Riparian Condition
Riparian and Bank Condition I
Pfankuch Survey
Proper Functioning Condition (PFC)
NRCS Stream Habitat Survey Scores
Rapid Habitat Assessment Score
Effective Ground Cover
Greenline Composition
Vegetation Cross-sections
Utilization

Timber Harvest History
Equivalent Clear-cut Area (ECA)
Water Yield Increase
Culverts/ Culvert Failure Rate
Road Density
Riparian Road Density
Mining history, type, and extent

Total Suspended Solids / Turbidity

- Everyone's favorite sediment indicator
- Easy to measure
- Can be used to calculate loads.
- Direct linkage to fish and aquatic life impairment (abrasion, altered feeding, etc.)
- TSS data collected at an upstream/downstream site or a reference site can be used for comparison. Also historical versus current data.
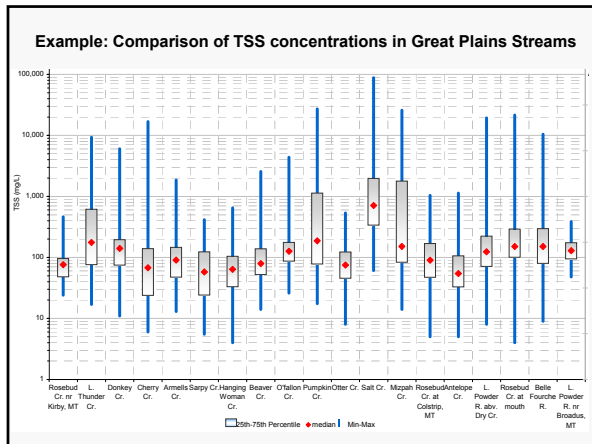
Example: Comparison of TSS concentrations in Great Plains Streams

Total Suspended Solids / Turbidity

- Ideally, you would have a robust TSS or turbidity dataset that provides adequate temporal and spatial coverage and incorporates *storm event sampling*.
- Storm event sampling is difficult to capture, but necessary
- USFS found that you need HUNDREDS of samples to determine a *statistically significant* change in TSS!
- Results from a single TSS sample have *limited* application.
- Doesn't provide any indication about natural versus anthropogenic sources

Surface Sediment – Percent Fines < 2mm

- Percent surface fines less than 2 mm is a measurement of the fine sediment on the surface of a stream bed.
- A substrate sampling method (generally Wolman pebble counts) is used to obtain particle sizes at various points in the stream.
- The percentage of "fine sediments" can then be calculated and compared to reference conditions, literature values, temporal trends, and spatial trends.

Surface Sediment – Percent Fines < 2mm

- Literature values *directly link* percent surface fines to fish and aquatic life impairment, however, this doesn't tell you if its natural or anthropogenic sediment!
- Most studies conducted in mountain streams/trout habitat
- > 20-35% indicates impairment
  - Recent studies suggest that impacts to habitat conditions and macroinvertebrate begin to occur above 20% for percent fines less than 2mm.
  - Impacts to fisheries have been shown to occur above 32% for percent fines less than 6.35 mm.
- Not much literature for prairie streams

Sources

- Sources and/or source loads can be used as sediment targets
  - Bank Erosion
  - Road Density
  - Harvest History
  - Riparian cover/stability
  - Etc…
- Target/criteria/indicator can be a % improvement, reduction in load, increase in riparian cover, etc

Sources

- Sources provide an indication of natural versus anthropogenic sediment
- Sources are a necessary indicator because you can't have an impairment without an anthropogenic source
- Doesn't provide a linkage to aquatic life impairment
- *Use in conjunction with other indicators*

Sources

Your stream isn't necessarily impaired just because you have a source!!!

Your stream isn't necessarily meeting standards just because you reduce a source load!!!

Other Sediment Tools on the Horizon

- Toxicological dose-response
- Relative bed stability
- Sedimentation conditional probability
- Thresholds state-by-state reference
- Fluvial Geomorphologic Approach
- % Fines

Biological Indicators

- Use biological measures to determine whether the aquatic life use is supported
  - Multimetric indices
  - Predictive models
- Defensible diagnostic tools to help discern sediment impacts are under development
  - Individual metrics
  - Sediment-specific tolerance values

Plains Sediment Thresholds

- EPA Region 8 is working with the USDA National Sediment Lab to develop sediment targets for plains streams
- Rapid Geomorphic Assessments will be conducted at >200 sites throughout the plains in 2007
  - Measure relative stability and channel processes in streams to determine "Stable" versus "not stable" sites
  - Eventually translates into impaired/not impaired streams
  - Expect results in 2007/ 2008

Summary: Determining Sediment Impairment

1. What are your goals/expectations?
2. What data do you have?
3. Do you have time, money, and the need to collect more data?
4. Based on the data available to you, your region, stream characteristics, etc, pick a *suite of indicators/criteria* that is right for your stream
5. Assess the *weight of evidence* to determine sediment impairment or improvement

Helpful Documents

- Developing Water Quality Criteria For Suspended And Bedded Sediments (SABS) [DRAFT] (USEPA, 2003)
  - *Appendix – Guide to Selection of Sediment Targets for Use in Idaho TMDLs*
- USEPA Sediment TMDL Guidance
- USEPA Biocriteria Website