Which Data Are Important – And Why?

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Tetra Tech

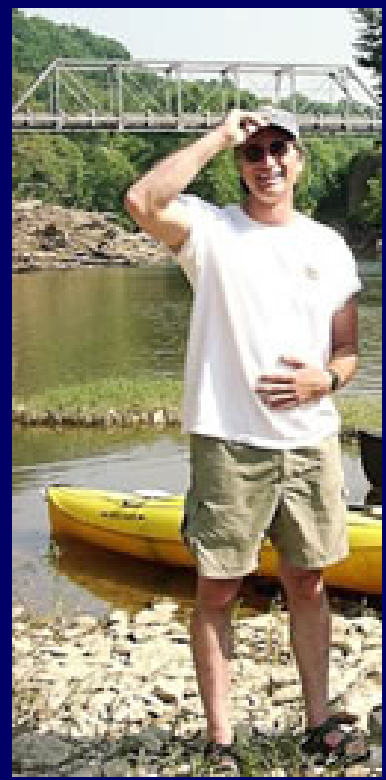
What makes your monitoring and assessment data important?

- When it:
  - Indicates if water poses a human health threat
  - Determines if it can support fish & other aquatic life
  - Identifies a significant and likely source of problems
  - Shows trends that water quality is declining . . . or improving!

A point to ponder . . .

"If you have one data point on a water body, you have infinitely more information about that water body than if you have zero data points . . . . because one is infinitely greater than zero"

Brian Reeder



Identifying and characterizing point and nonpoint pollution

- Some pollutants come from point sources
- Others come from nonpoint sources
- Some come from both . . .

How the Clean Water Act implements the public's demand for clean, healthy surface waters:

- Pollutant discharge controls and limits thru NPDES permits
- Water quality standards that specify beneficial water body uses, minimum criteria, and prevention of degradation

CWA Discharge Permits (Section 402)

If you discharge:

- Pollutants (chemical, physical, biological)
- From a man-made pipe or conveyance
- Into a regulated water body ("water of the U.S.")

You must have permit coverage under the National Pollutant Discharge Elimination System (NPDES)

NPDES Program: Coverage

- Industrial and municipal wastewater
- Industrial, urban, and construction-related storm water runoff
- Concentrated animal feeding operations (CAFOs)
- Active, inactive, and some abandoned mines
- Discharges from RCRA remedial action activity meeting point source definition

Water Quality Standards

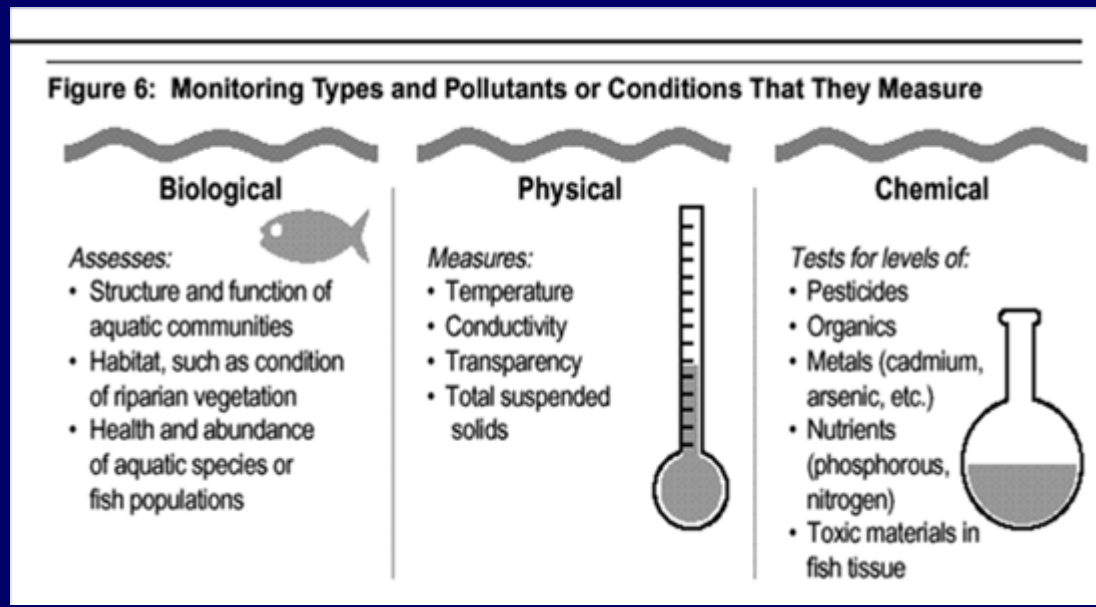
- State's yardstick to measure health of waters
- Three key elements of WQSs:
  - Designated uses
  - Water quality criteria
  - Antidegradation provisions

Example Use Designations

- Aquatic life support – warmwater & coldwater aquatic habitat
- Primary contact recreation – swimming
- Secondary contact recreation – boating and fishing
- Fish consumption – eating fish
- Drinking water – domestic water supply

Water Quality Criteria

- Developed to protect designated uses
- Basic types of criteria
  - Narrative/numeric
  - Water column/ sediment/fish tissue
- Criteria can relate to:
  - Aquatic life
  - Human health
  - Wildlife



Water quality criteria in Indiana code

Parameter	Target	Reference/Other Information
Total Ammonia (NH3)	Range between 0.0 and 0.21 mg/L depending upon temperature and pH	Indiana Administrative Code (IAC)
Atrazine	Max: 3.0 ppb	U.S. EPA Drinking Water Standard
Dissolved Oxygen (DO)	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code (IAC)
	Min: 6.0 mg/L in coldwater fishery streams	Indiana Administrative Code (IAC)
	Min: 7.0 mg/L in spawning areas of coldwater fishery streams	Indiana Administrative Code (IAC)
E. coli	Max: 235 CFU/ 100mL in a single sample	Indiana Administrative Code (IAC)
	Max: Geometric Mean of 125 CFU/ 100mL from 5 equally spaced samples over a 30-day period	Indiana Administrative Code (IAC)
Nitrate	Max: 10 mg/L in waters designated as a drinking water source	Indiana Administrative Code (IAC)
Nitrite	Max: 1 mg/L in waters designated as a drinking water source	Indiana Administrative Code (IAC)
Nitrate-N + Nitrate-N	Max: 10 mg/L in waters designated as a drinking water source	Indiana Administrative Code (IAC)
Temperature	Dependant on time of year and whether stream is designated as a cold water fisheries	Indiana Administrative Code (IAC)

Examples of non-regulatory water quality targets used in Indiana

Parameter	Target	Reference/Other Information
Nitrate-nitrogen (NO3)	Max: 0.633 mg/L	U.S. EPA recommendation *
	Max: 1.0 mg/L	Ohio EPA recommended criteria for Warm Water Habitat (WWH) headwater streams and Modified Warm Water Habitat (MWH) headwater streams
	1.5 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodd et al. 1998)
	10.0 mg/L	IDEM draft TMDL target
Ortho-Phosphate also known as Soluble reactive phosphorus (SRP)	Max: 0.005 mg/L	Wawasee Area Conservancy Foundation recommendation for lake systems
Suspended Sediment Concentration (SSC)	Max: 25.0 mg/L	U.S. EPA recommendation for excellent fisheries
	Range: 25.0-80.0 mg/L	U.S. EPA recommendation for good to moderate fisheries
Total Kjeldahl Nitrogen (TKN)	Max: 0.591 mg/L	U.S. EPA recommendation *
Total Phosphorus	Max: 0.076 mg/L	U.S. EPA recommendation
	0.07 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodd et al. 1998)
	Max: 0.08 mg/L	Ohio EPA recommendation to protect aquatic biotic integrity in WWH
	Max: 0.3 mg/L	IDEM draft TMDL target
Total Suspended Solids (TSS)	Max: 80.0 mg/L	Wawasee Area Conservancy Foundation recommendation to protect aquatic life in lake systems
	Max: 30.0 mg/L	IDEM draft TMDL target
	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, 1995)
	Max: 40.0 mg/L	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
Turbidity	Max: 25.0 NTU	Minnesota TMDL criteria for protection of fish/macroinvertebrate health
	Max: 10.4 NTU	U.S. EPA recommendation

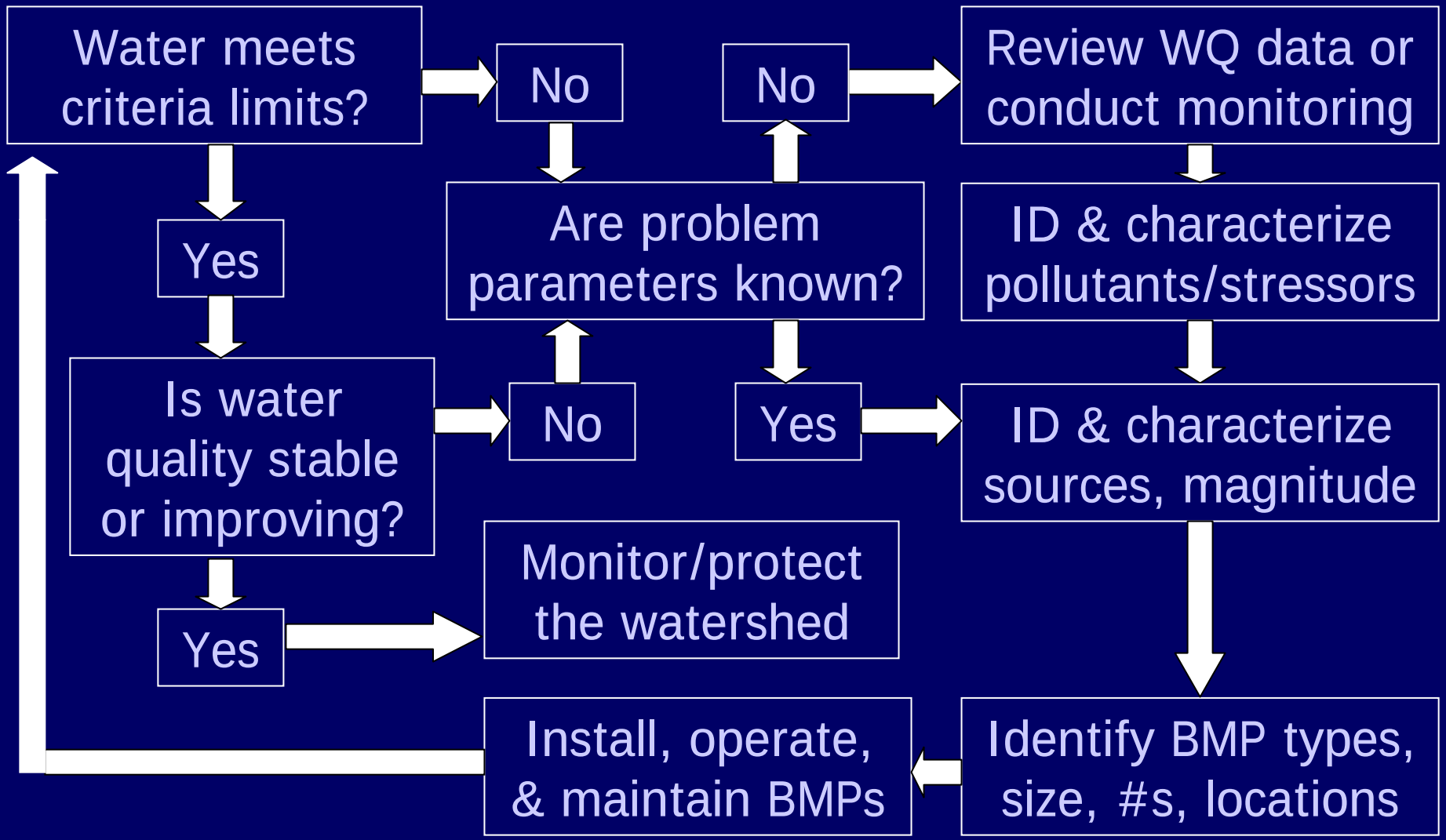
What we're trying to do:

- Identify problems
  - Water quality impairments, threats, trends downward
- Characterize problems
  - Use indicators to ID stressors, sources, and relative magnitude
- Fix problems
  - BMPs selected, sited, sized, and operated to address specific issues
- Check up on the fix
  - Post implementation monitoring & adjustment

Screening for problems & threats

- What do you know about water quality, land use, land cover, and management?
- Does the water body meet the numeric and narrative criteria for its designated uses?
- If not, what are the problems & sources?
- If so, what are the trends – improving, or declining?

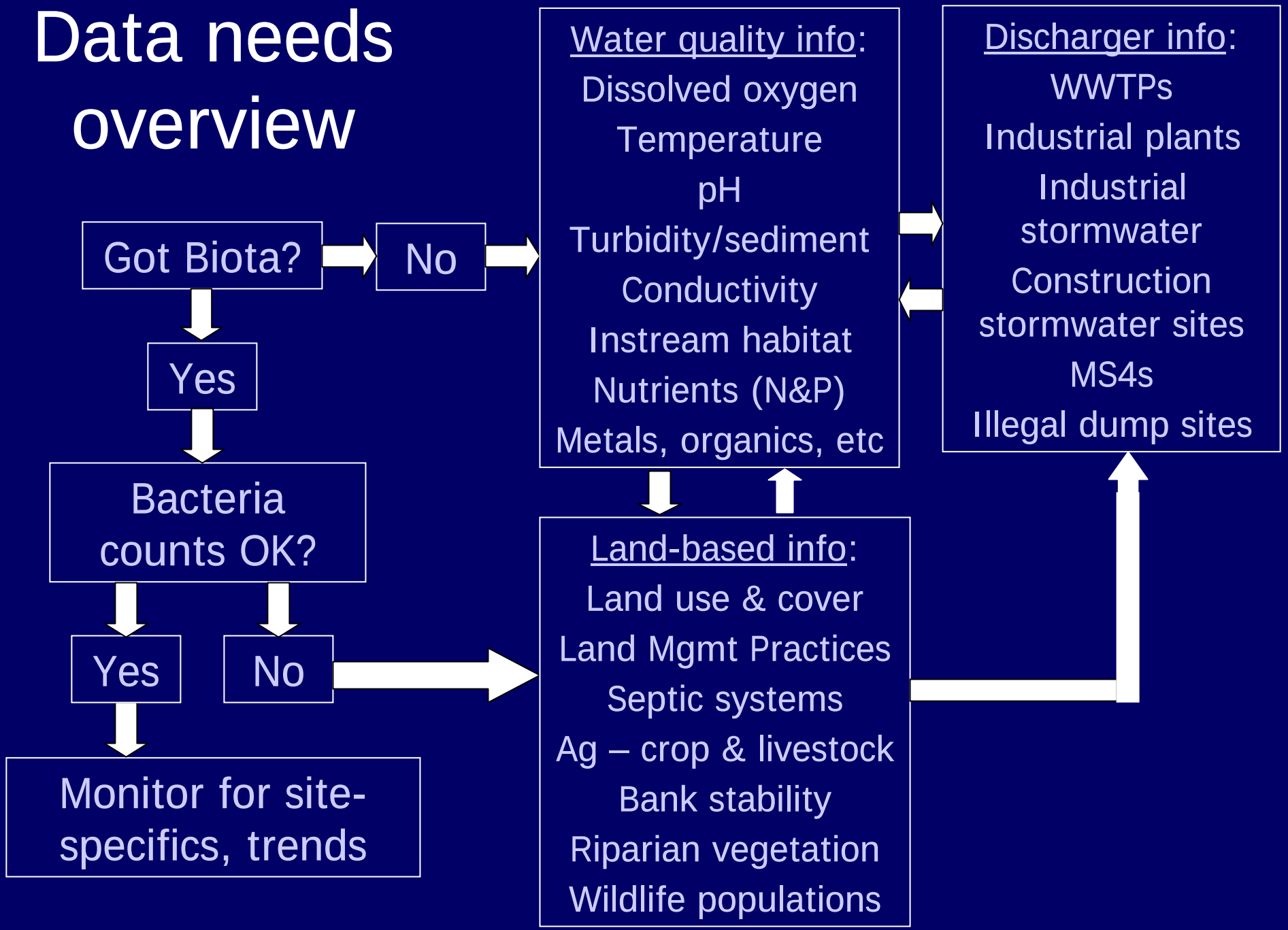
Summary of the overall process



We can’t monitor for everything

- We need to focus our efforts
  - Use existing data to get started
  - Biological & visual assessments are good for screening purposes
  - If necessary, follow up with instream (or upland) assessments

Data needs overview



Which data are most important?

- Water quality data
  - Defined to support use(s)
- Land use information
  - Clues to pollutant sources
- Land cover mapping
  - IDs rapid runoff areas
- Land management practices
  - Tips on where BMPs needed

Water quality data

- Key monitoring info includes
  - Dissolved oxygen, pH, temperature, nutrients, sediment, bacteria, pesticides, herbicides, metals
  - Biological assessments can help screen out healthy sites
- Look at your results as compared to the water quality criteria and targets

Land “quality” data . . .

- Land use
  - Percentage in row crops, pasture, animal feeding operations, residential, commercial, urban
- Land cover
  - Matches land use; key info is what’s impervious (paved, buildings, etc.), what’s well vegetated, what’s not
- Land management
  - Are potential pollutants associated with the land uses managed, to prevent polluted runoff?
  - Includes crop & livestock practices, stormwater management, lawn & garden measures

Table 2-2. Summary of Common Pollutants and Sources

Pollutant	Potential Sources		Impacts on Waterbody Uses
	Point Sources	Nonpoint Sources	
Pathogens	• WWTPs • CSOs/SSOs • Permitted CAFOs • Discharges from meat processing facilities • Landfills	• Animals (domestic, wildlife, livestock) • Malfunctioning septic systems • Pastures • Boat pumpout facilities • Land application of manure • Land application of wastewater	• Primarily human health risks • Risk of illness from ingestion or from contact with contaminated water through recreation • Increased cost of treatment of drinking water supplies • Shellfish bed closures
Metals	• Urban runoff • WWTPs • CSO/SSOs • Landfills • Industrial facilities • Mine discharges	• Abandoned mine drainage • Hazardous waste sites (unknown or partially treated sources) • Marinas	• Aquatic life impairments (e.g., reduced fish populations due to acute/chronic concentrations or contaminated sediment) • Drinking water supplies (elevated concentrations in source water) • Fish contamination (e.g., mercury)
Nutrients	• WWTPs • CSOs/SSOs • CAFOs • Discharge from food- processing facilities • Landfills	• Cropland (fertilizer application) • Landscaped spaces in developed areas (e.g., lawns, golf courses) • Animals (domestic, wildlife, livestock) • Malfunctioning septic systems • Pastures • Boat pumpout • Land application of manure or wastewater	• Aquatic life impairments (e.g., effects from excess plant growth, low DO) • Direct drinking water supply impacts (e.g., dangers to human health from high levels of nitrates) • Indirect drinking water supply impacts (e.g., effects from excess plant growth clogging drinking water facility filters) • Recreational impacts (indirect impacts from excess plant growth on fisheries, boat/swimming access, appearance, and odors) • Human health impacts

Pollutant	Potential Sources		Impacts on Waterbody Uses
	Point Sources	Nonpoint Sources	
Sediment	• WWTPs • Urban stormwater systems	• Agriculture (cropland and pastureland erosion) • Silviculture and timber harvesting • Rangeland erosion • Excessive streambank erosion • Construction • Roads • Urban runoff • Landslides • Abandoned mine drainage • Stream channel modification	• Fills pools used for refuge and rearing • Fills interstitial spaces between gravel (reduces spawning habitat by trapping emerging fish and reducing oxygen exchange) • When suspended, prevents fish from seeing food and can clog gills; high levels of suspended sediment can cause fish to avoid the stream • Taste/odor problems in drinking water • Impairs swimming/boating because of physical alteration of the channel • Indirect impacts on recreational fishing
Temperature	• WWTPs • Cooling water discharges (power plants and other industrial sources) • Urban stormwater systems	• Lack of riparian shading • Shallow or wide channels (due to hydrologic modification) • Hydroelectric dams • Urban runoff (warmer runoff from impervious surfaces) • Sediment (cloudy water absorbs more heat than clear water) • Abandoned mine drainage	• Causes lethal effects when temperature exceeds tolerance limit • Increases metabolism (results in higher oxygen demand for aquatic organisms) • Increases food requirements • Decreases growth rates and DO • Influences timing of migration • Increases sensitivity to disease • Increases rates of photosynthesis (increases algal growth, depletes oxygen through plant decomposition) • Causes excess plant growth

Note: WWTP = wastewater treatment plant; CSO = combined sewer overflow; SSO = sanitary sewer overflow; CAFO = concentrated animal feeding operation; DO = dissolved oxygen.

ESC Practices, Sediment Removal Efficiencies, and Resulting Sediment Loads

Erosion/Sediment Control Practice	Application Details	Removal Efficiency	Estimated Load (Tons/Acre/Yr)
None: No controls	RUSLE results with 50% delivery to waterbodies, averaged with state agency estimates	0%	17.5
Existing Approach: Silt fencing, poorly sited, installed, and maintained; few or no other site controls	Direct observation of existing sites, accounts for some sediment trapping via silt fence and other controls	5%	16.6
Silt Fence Only: Silt fencing, correctly sited, installed, and maintained; other minimum controls (i.e., inlet/outlet protection, rock exit pad)	Large particle trapping by fencing, inlet & outlet protection, rock exit pad, etc.	40%	10.5
Silt Fence and Basins: Silt fencing with sediment basins, transitioned to permanent stormwater basins after construction (includes)	Additional trapping of mid-sized particles by sediment basin for sites > 5 acres	60%	7.0
Silt Fence, Basins, Phasing: Silt fencing and basins as cited above, plus project phasing with rapid seeding of disturbed areas after final grade is reached	Silt fence and basin particle trapping, plus lowered erosion through smaller exposed area, shorter exposure times	75%	4.4
Silt Fence, Basins, and Polymers: Silt fencing and sediment basins above, with polymer flocculent treatment and extended settling period in basins	Same as fencing and basins approach, with small particle flocculation and settling via use of coagulants in sediment basins	85%	2.6

Sources: Estimates extrapolated from US EPA (2008); US EPA (2005); Edwards (2009); Daniels et al (undated); NRCS (2002); Mason (2009); Wisconsin DNR (2001); Claytor (1997); Missouri Department of Conservation (undated); Knoxville/Knox County (2006); Huitink (1998).

We want a lot from our data!

- We want it to be:
  - Inclusive: covering key parameters of concern
  - Credible: to accurately reflect water quality conditions
  - Robust: to reflect conditions under a variety of rainfall/flow regimes
  - Useful: helping us identify appropriate solutions
  - Efficient: the least cost for the most benefit!

The All-In-One Hammer Flask

After lunch: scoping and engaging others

- Somebody probably has data for your watershed
- Including water quality data, land use/cover info, ag stats, etc.
- A data search is always a good first step

Lunch Time!

Eat, Meet, Greet, and Be Back
In Your Seat By 1:00 pm!