Aquatic Inventory

The Stream's Story

Jill Hoffmann

IDNR – Div. Soil Cons

Why do stream assessments?

- Streams serves as a diagnostic tool – will help focus your watershed efforts
- Streams serves as measuring sticks for land conservation efforts or damaging land use changes
- Water data lends credibility to your plan – leading to additional grant $
- People have a spiritual connection to water – Keep your group connected to the water!

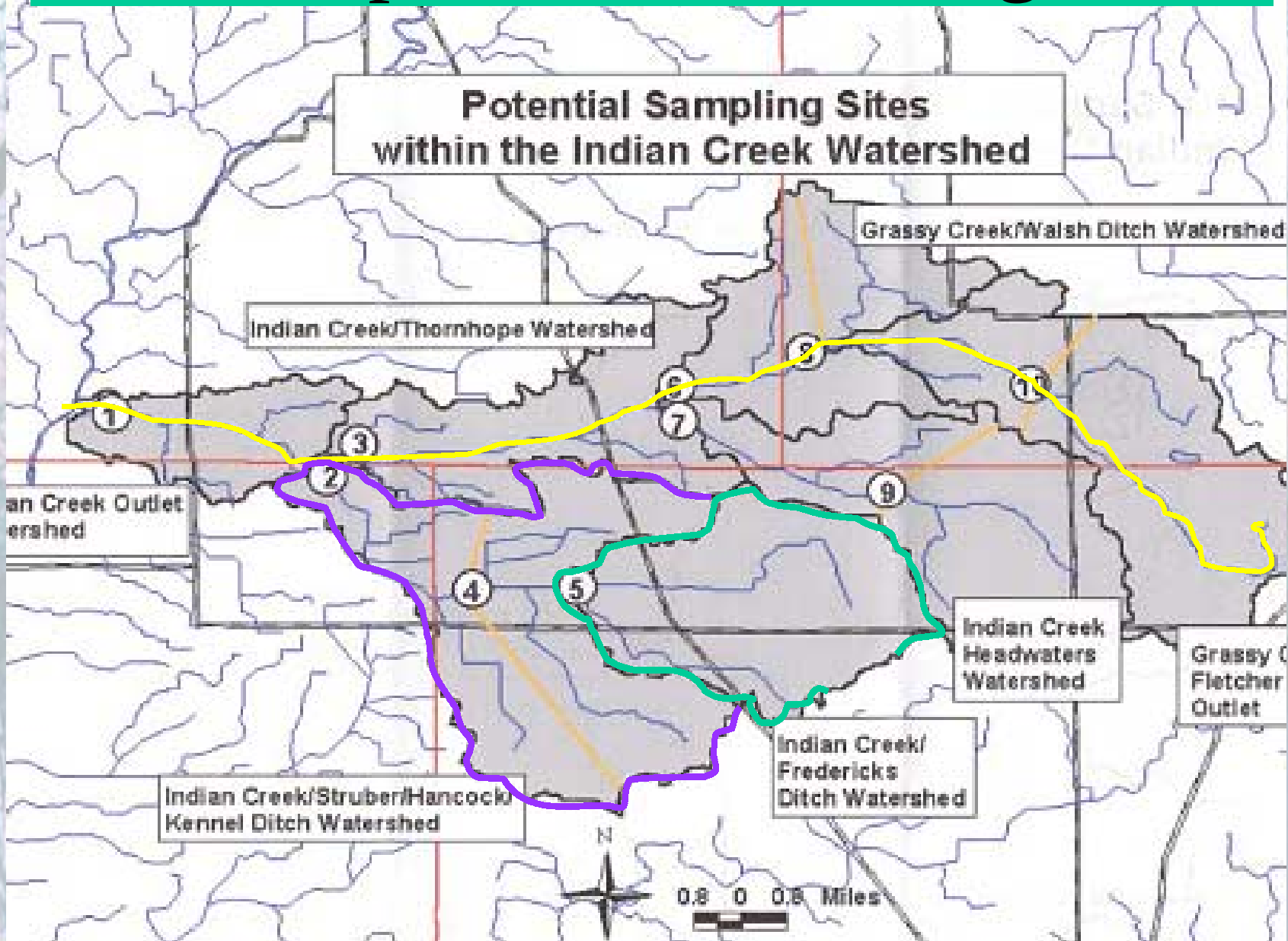
Follow Your Streams

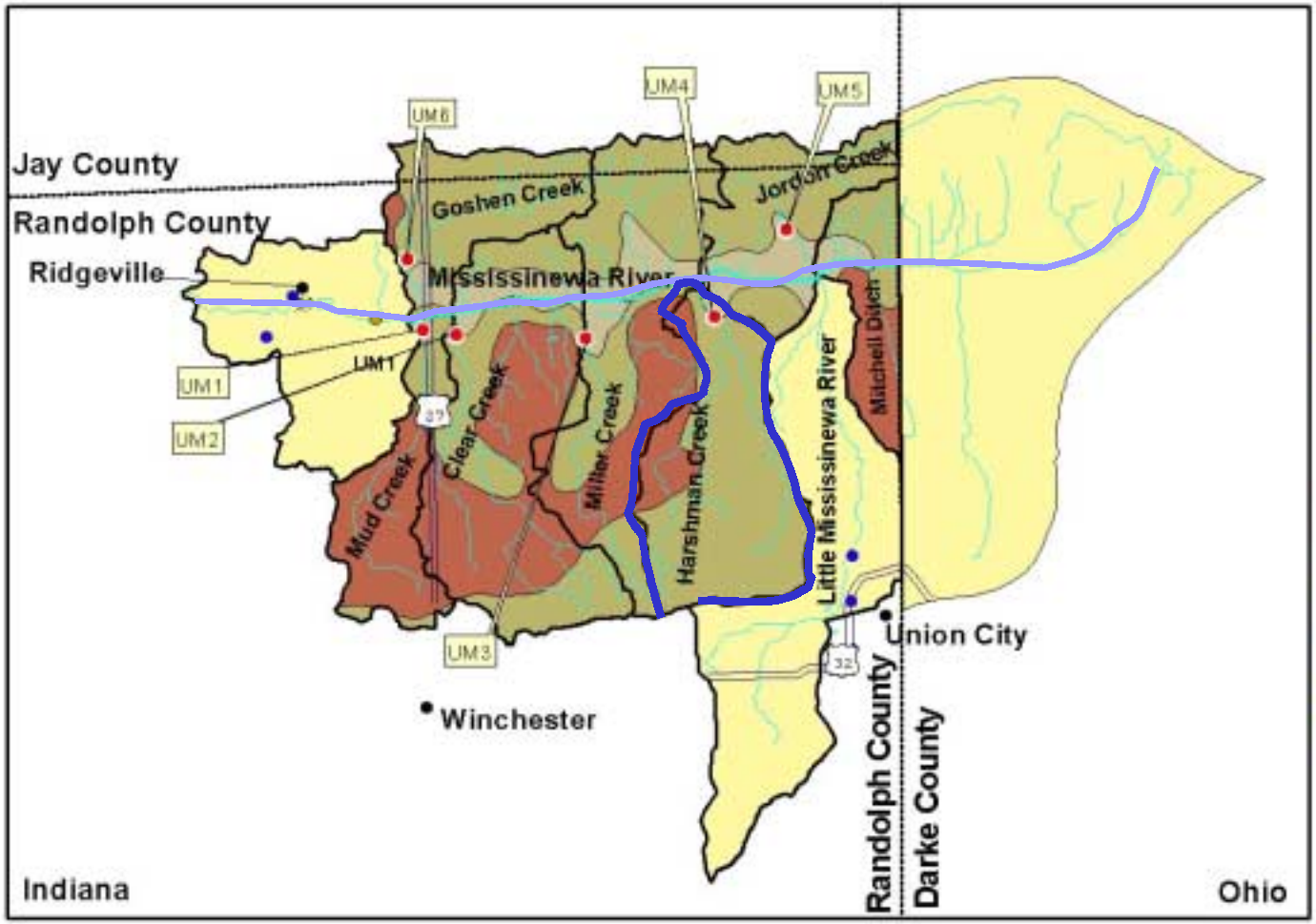
- Look at a topo map
- Follow the streams in your car
- Characterize the sub-watersheds (land use, slope, etc.)
- Note access points
- Note flow
- Observe the stream/ditches on several occasions

Sample Sites Selection

- Review/Consider your project goals:
  - targets vs.
  - representativeness vs.
  - watershed diagnosis
- Accessibility (property rights, safety, etc.)
- Flow
- Confounding factors such as upstream or instream structures (culverts, dams, debris)
- Plans for future projects or known changes
- Already established sites? (IDEM, Riverwatch, LARE diagnostic studies)

How to place sites for diagnosis



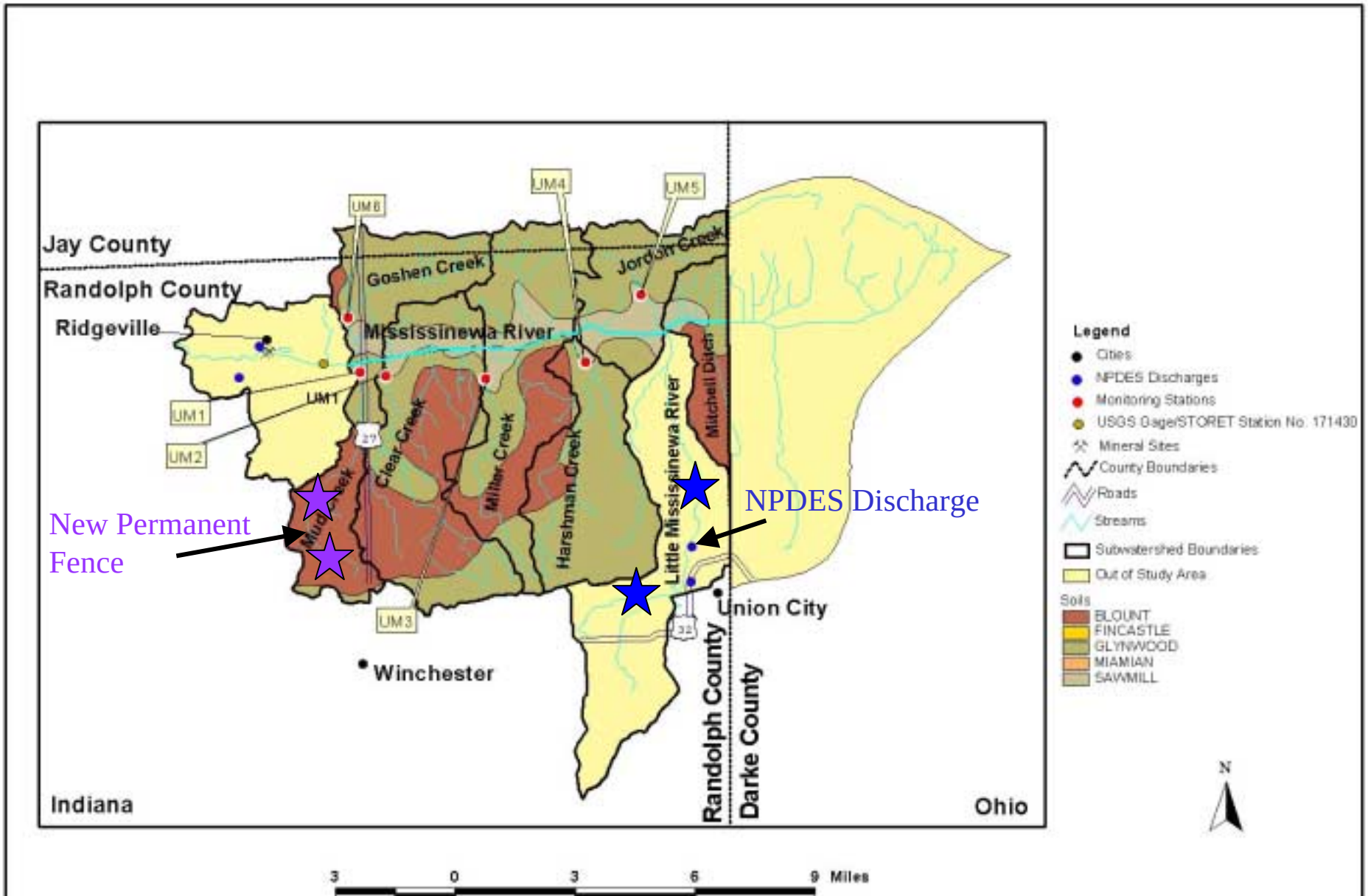


HARZA ENGINEERING COMPANY
WATER & ENVIRONMENT

SOIL ASSOCIATIONS
MISSISSINEWA WATERSHED DIAGNOSTIC STUDY

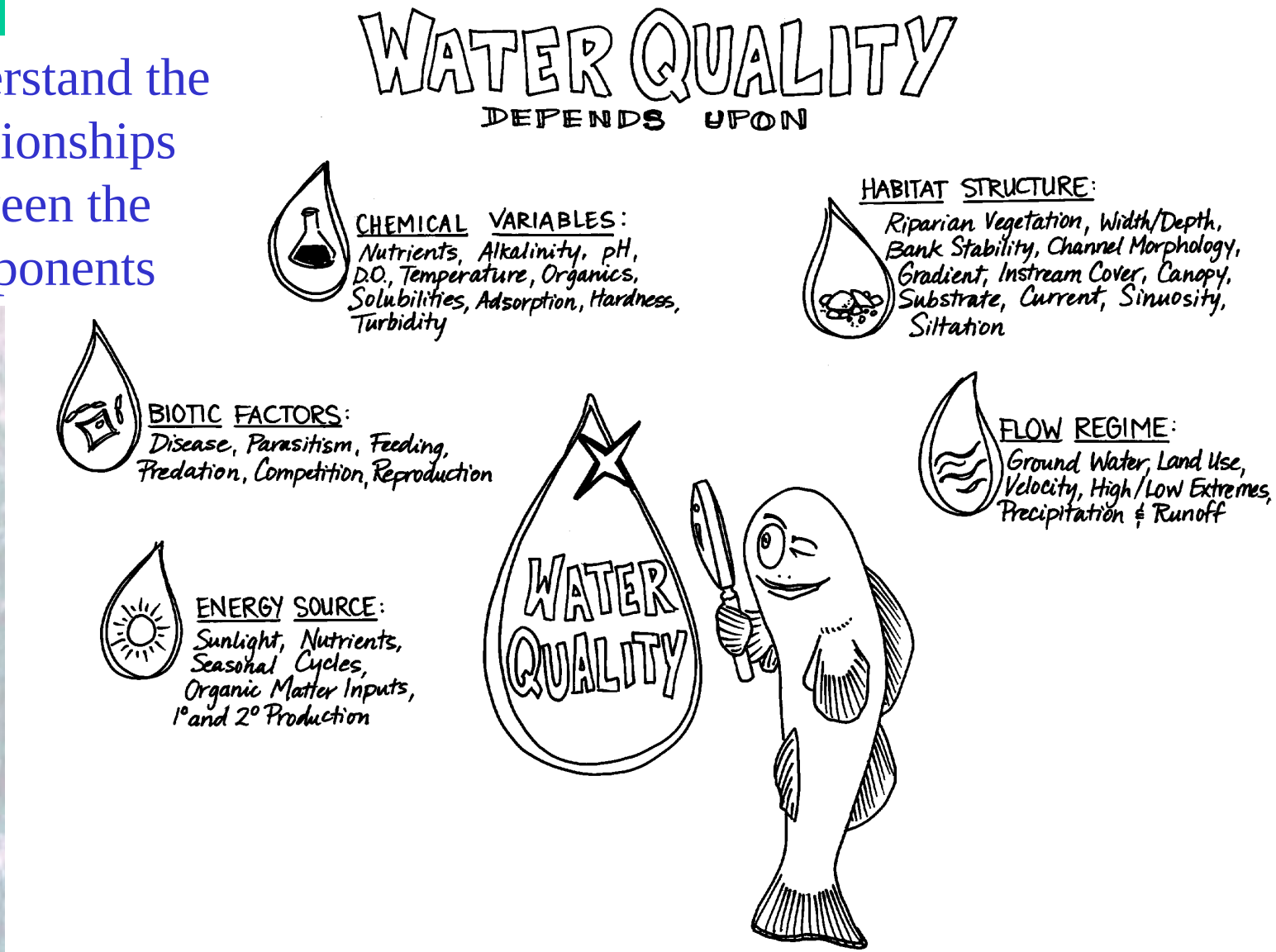
Exhibit 5

How to select sites for targeted analysis



Utilize Hoosier RiverWatch Training

Understand the Relationships Between the Components



What else to look for…..

- What do you see?

- Here's what I see…..

  & hear

  & touch

  & smell


Better habitat
Look at the make-up of the deltas – speaks to velocity


Connected shallows – good habitat, supports a variety of species
Vegetated bank – stable, filter


Diverse habitat - If these areas are impaired, you HAVE an impairment!

Things to Remember:

Consider representativeness!

You are not trying to prove you have the worst watershed.

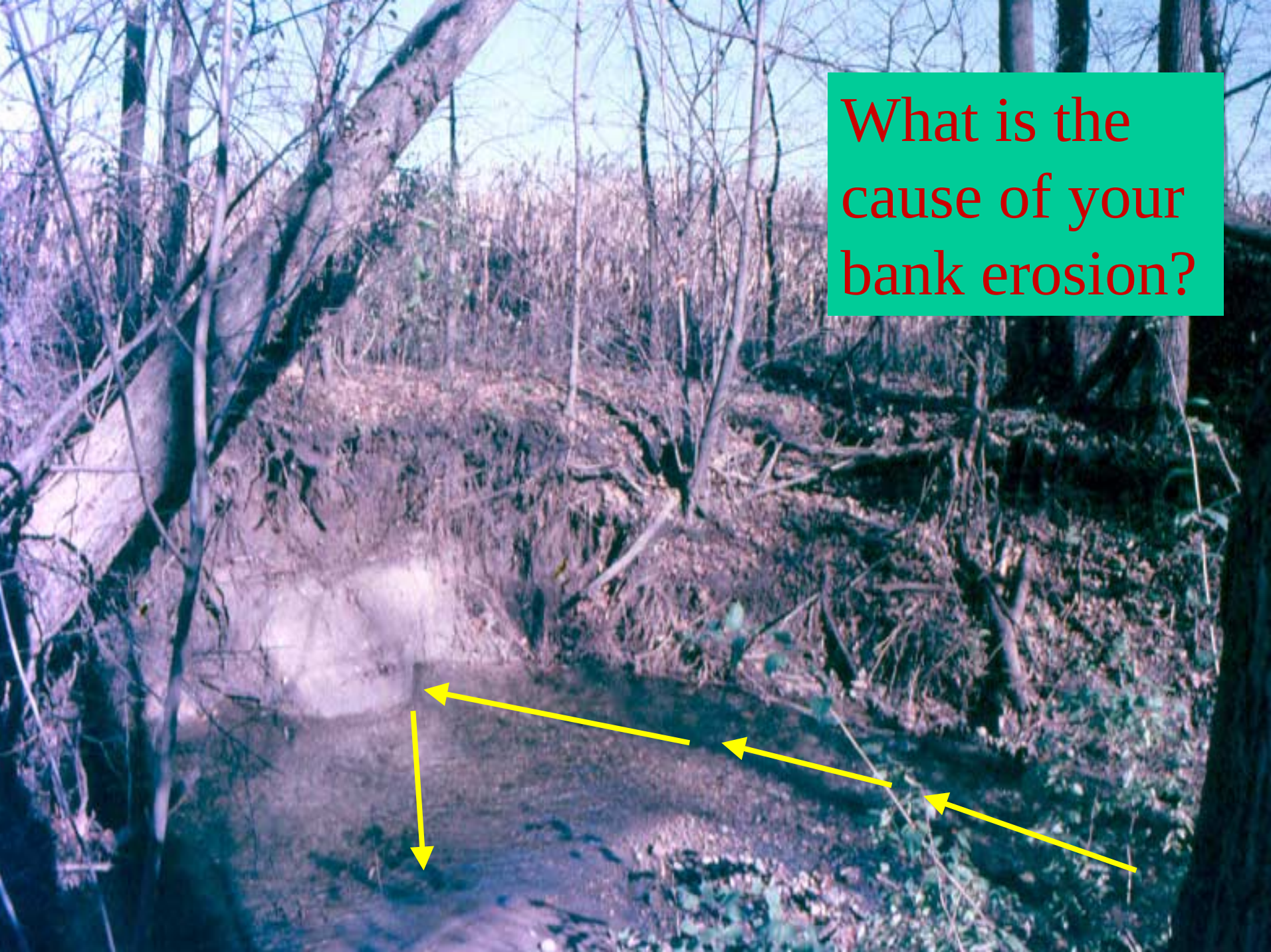

Rocks as more than habitat

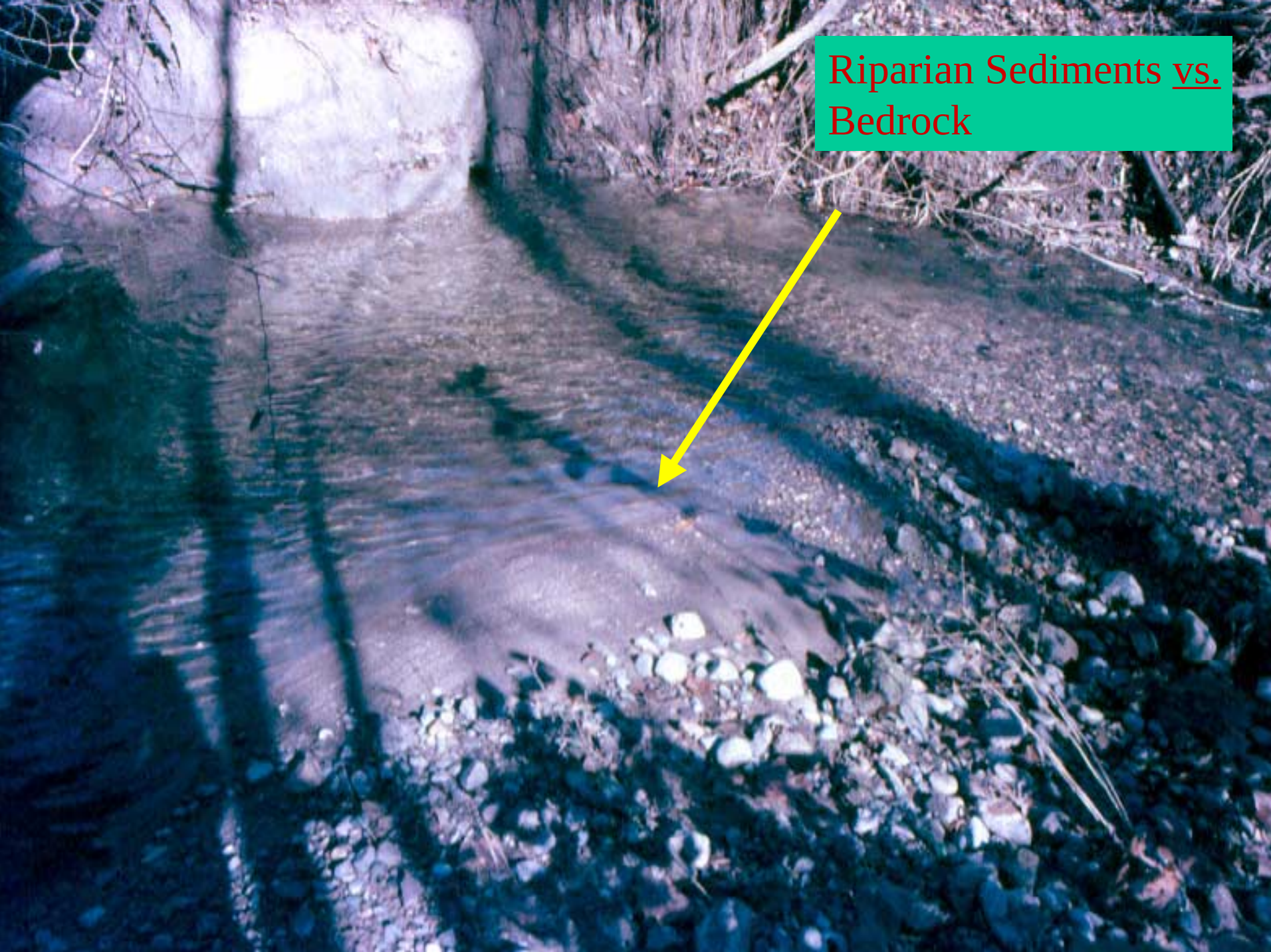

Understand how dynamic your system/sites can be


Bank Erosion, so what?

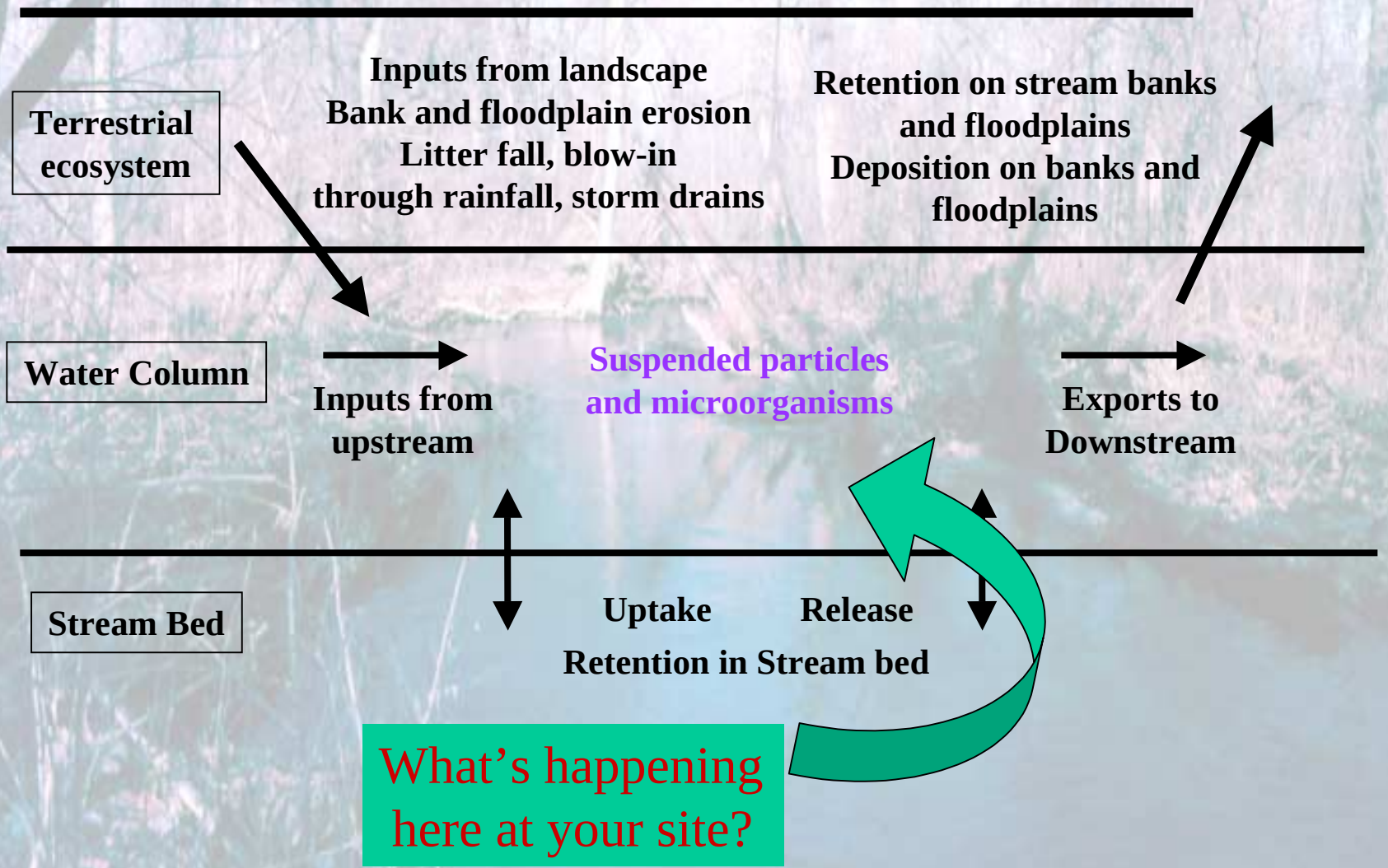

What is the cause of your bank erosion?

Lake Lemon


What is the cause of your bank erosion?


Riparian Sediments vs.
Bedrock

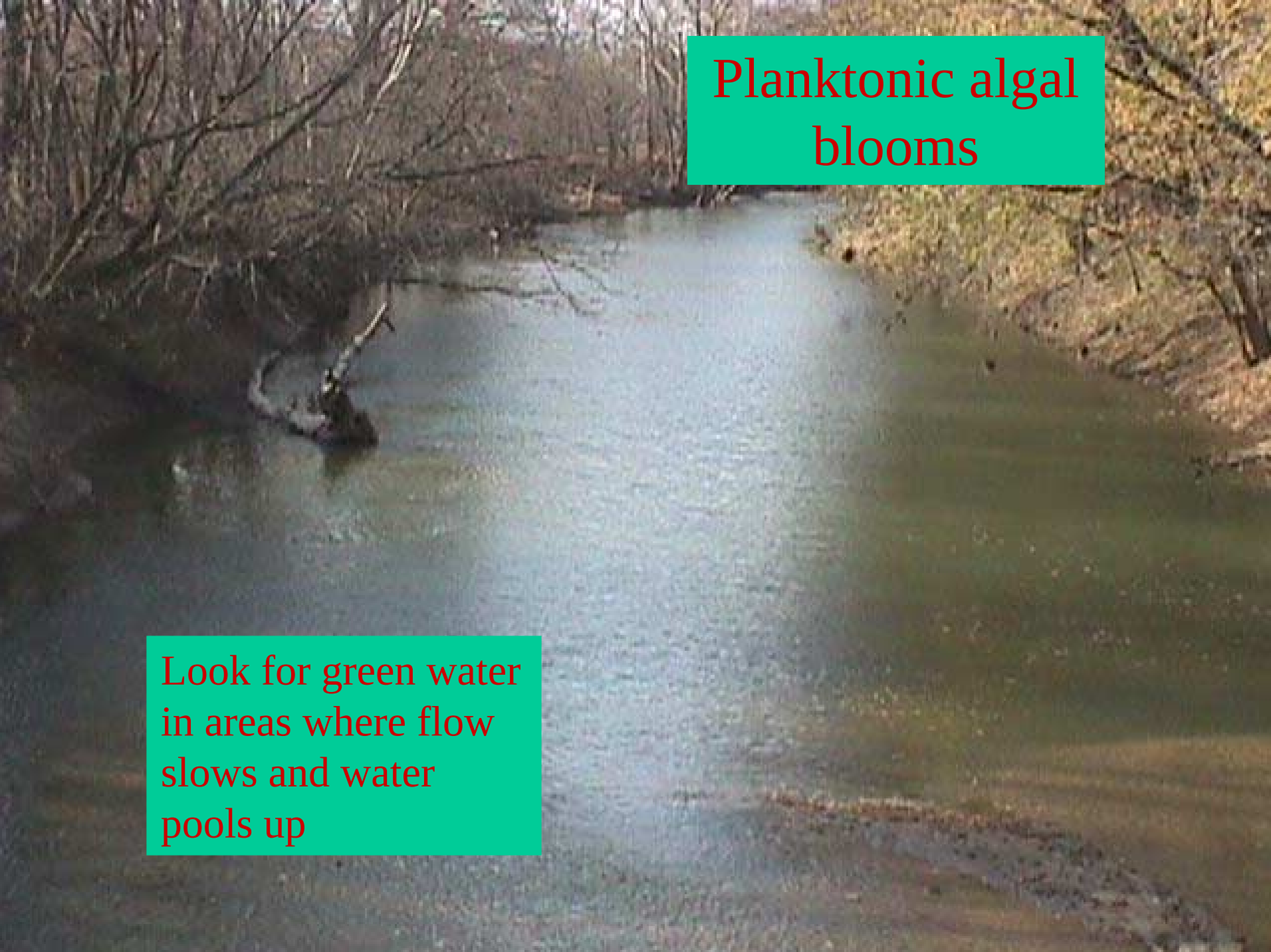
The Fate of Pollutants in a Stream



Water Quality – What are we concerned about that is related to sediment inputs?

- Nitrogen (nitrate & ammonium)
  - Algae + nitrate = algal growth and ammonium.
  - Algae + ammonium = more algal growth and algal death.
  - Dead algae + bacteria = ammonium and loss of oxygen
- Phosphorus (dissolved and particulate) – Often the limiting nutrient
- Dissolved Oxygen (important for all aquatic organisms and for chemical reactions)
- Total Suspended Solids (clarity)
- Temperature

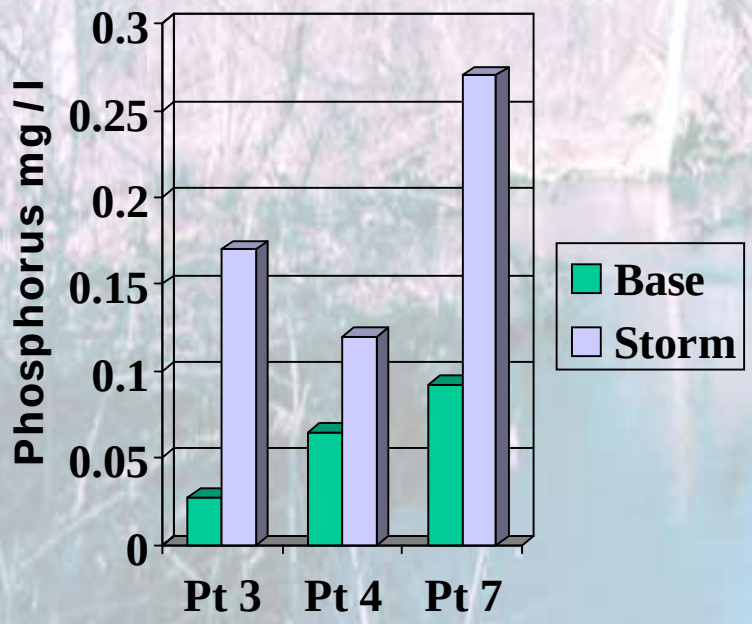

Amount is
Everything !


Planktonic algal blooms
Look for green water in areas where flow slows and water pools up


Sight and smell can
tell more of the story


What are the symptoms telling us?
Are they really symptoms?

Use the stream inventory hand-in-hand with the land inventory



Land Use	TotSusSolids (lb/acre/yr)	TotPhos (lb/acre/yr)
Rural		
Cropland	18-4550	0.18-4.1
Imp Pasture	27-71	0.1-0.4
Forest	1-730	0.02-0.6
Idle	6-730	0.02-0.6
Urban		
Residential	550-2050	0.4-1.2
Commercial	45-740	0.1-0.8
Industrial	400-1517	0.8-3.7
Devl Urban	24,500	20

Source: Sonzogni et al., 1980

In Review…

- Know your sampling/assessment goals
- Always consider how the components are interacting
- Survey your sites for any confounding factors
- Survey your sites or streams for any telling signs (high water marks, sediment deposits, algae, etc.)

Know Your Resources

- Consult text resources (Hoosier Riverwatch Manual, LARE Quick Guide, EPA websites, countless bug manual/guides, etc.)
- Any unusual observations – check with a biologist (IDNR, IDEM, NRCS, university professors, etc.)

Questions?

Discussion?

Jill Hoffmann

317-233-5468

Jhoffmann@dnr.state.in.us

IDNR DIVISION OF SOIL CONSERVATION'S

QUICK GUIDE TO WATER QUALITY
For
THE LAKE AND RIVER ENHANCEMENT (LARE) PROGRAM

INTERPRETING WATER QUALITY PARAMETERS FOR LARE BASELINE AND DIAGNOSTIC STUDIES

PARAMETERS	WHAT IT IS…	IMPORTANCE	SOURCE/CAUSE OF IMPAIRMENT	ACCEPTABLE LEVEL
Dissolved Oxygen (DO)	The amount of oxygen dissolved in water that is readily available for use by all aquatic life (the higher the water temperature, the less DO it can hold)	-Necessary for fish and most other aquatic organisms to survive -Most sport fish suffer in low DO levels	-Excess loads of organic matter resulting in increased decomposition -Sources: nutrient runoff from construction, intensive tillage, improper manure application, and poor silviculture practices	DO concentrations should never fall below 4 mg/L. Indiana's standard is set at 5 mg/L. Ideal values should be substantially higher than 5, not to exceed 10.
pH	A measure of hydrogen ions present in the water; indicates if water is acidic, neutral, or basic (alkaline). Distilled water: pH=7 Lemon juice: pH=2 Bleach: pH=13	-Many biological processes such as reproduction cannot occur in highly acidic or basic conditions -Extremely acidic conditions can lead to the release of toxic chemicals stored in stream sediments	-Algal blooms can cause pH to become more basic -Higher temperatures can lower pH values -Acid mine drainage from abandoned mine lands -Natural sources such as bogs and acid seeps	In order for aquatic organisms to survive, pH should be between 6 and 9. Neutral pH is 7, pH lower than 7 is acidic, and a pH higher than 7 is alkaline.
Conductivity	The ability of water to carry an electric current due to the presence of dissolved ions	At the proper level, dissolved ions of nutrients are essential for growth of organisms. Fish are very sensitive to changes in the concentration of salts (chloride ions) in the water	Nutrient runoff from: -Agricultural practices -construction sites -runoff from urban areas -factory and municipal effluents (discharges)	Standards for Indiana have been set at 1200 mS/m which equals 12000 micromhos/cm (equivalent dissolved solids value is 750 mg/L. Ideal range is 200-500 mg/L)
Turbidity	A measure of the intensity of light scattering by dissolved and suspended materials in the water	High turbidity: -can clog fish gills -decreases biological diversity -lowers DO as it causes an increase in temperature	-Soil erosion -Particulate matter from aquatic life -Resuspension of bottom sediments due to wind, wave action, and aquatic animals	Surface water standards are < 50 NTU (Nephelometric Turbidity Units) Ideal value should be substantially lower than this standard.

INTERPRETING WATER QUALITY PARAMETERS FOR LARE BASELINE AND DIAGNOSTIC STUDIES

PARAMETERS	WHAT IT IS…	IMPORTANCE	SOURCE/CAUSE OF IMPAIRMENT	ACCEPTABLE LEVEL
Temperature	A measure of the degree of hotness or coldness of a water body	-An increase in temperature causes a decrease in DO -Increased temperatures can increase metabolic and reproductive rates in organisms such as algae	-Stormwater/urban runoff -Power plant effluents -Lack of shade and riparian vegetation -Increased turbidity	-Not a set standard for propagation of warm water fish -Criteria for propagation of cold water fish is $<20^0$ C (Indiana has a few cold water fisheries in the northern part of the state.)
Total Suspended Solids (TSS)	A measure of the solid materials in the stream water that are capable of settling out on the stream bottom when stream velocities are slowed	"Solid materials" include soil particles and therefore TSS is dependent upon the amount of erosion from the watershed.	-Stormwater/urban runoff -Soil erosion -Construction site runoff	-No set standard -However, concentrations greater than 80 mg/L have been shown to reduce benthic populations of aquatic organisms in lakes.
Coliform Bacteria (*Escherichia Coli*, aka E. coli)	Bacteria abundant in fecal matter	Used as an indicator of sanitary discharges and pathogenic organisms. Some strains of E. coli are a public health hazard if they are ingested.	-Excess amounts of fecal matter from sources such as failing septic systems, combined sewer overflows, and animal wastes	Indiana standard for recreational waters is 235 cfu/100 mL of sample per any ONE sample
Phosphorus (P)	**Total phosphorus**- measure of particulate and dissolved phosphorous **Orthophosphate**- phosphorus available to organisms inhabiting the stream at any point in time.	A nutrient needed for plant and animal growth. In aquatic ecosystems, P is in the shortest supply, so even a slight increase can set off a chain of undesirable events such as algal blooms.	-SOIL EROSION as P binds to soil particles -Lawn and crop fertilizers -Human and animal waste -Yard wastes-leaves & grass -Resuspension of bottom sediments	-No set standard in Indiana -However, total P concentrations greater than .03 mg/L are known to cause algal blooms.

INTERPRETING WATER QUALITY PARAMETERS FOR LARE BASELINE AND DIAGNOSTIC STUDIES

PARAMETERS	WHAT IT IS…	IMPORTANCE	SOURCE/CAUSE OF IMPAIRMENT	ACCEPTABLE LEVEL
Nitrogen (N) (All forms of N are biochemically interchangeable and part of the N cycle)	**Nitrate-**oxidized form of N **Nitrite-**intermediate oxidation state of N. Toxic to fish **Ammonia-** form of N that is converted from nitrate by algae. Preferred form utilized by algae, also a by-product of decomposition **Total Kjeldahl-** measure of both organic (bound up N) & inorganic N (namely ammonia)	An essential nutrient in plant and animal growth. In high concentrations, it can inhibit some plant & animal growth and promote blue-green algal blooms.	-Stormwater runoff -Lawn and crop fertilizers -Human and animal waste -Atmospheric transfer to water (nitrogen gas) -Industrial discharge (nitrite) -Wastewater/sewage treatment plant effluents (nitrate & ammonia)	-No set standards in Indiana for warmwater habitat (WWH). Ohio EPA found the median nitrate-nitrogen concentration in wadeable streams that support Modified Warmwater Habitat (MWH) was 1.6 mg/L. Nitrate levels exceeding 10 mg/L in DRINKING WATER are considered hazardous to infants.
Benthic Macroinvertebrates;	Aquatic animals that lack backbones, live at least part of their lives in or on the bottom of a body of water, and are big enough to be seen with the naked eye.	Macroinvertebrates are good indicators of water quality impairment as some species (mayflies, stoneflies, and caddisflies) are very sensitive to pollution. They are also an important part of aquatic food chains.	Water pollution and its effects such as low DO, increased temperature, and degraded habitat.	-No set standard -The more diverse, the better -See "Scoring Criteria for the Family Level Macroinvertebrate Index of Biotic Integrity (mIBI) chart on the following page.
Qualitative Habitat Evaluation Index (QHEI)	An estimate of the suitability of a stream segment to meet warmwater habitat (WWH) requirements. Some of the items evaluated are: substrate, instream cover (logs, etc.), and pool and riffle quality.	Reflects the quality of a water body's physical habitat. IF THERE IS NOT SUITABLE HABITAT, EVEN THE CLEANEST LAKE OR RIVER WILL NOT HAVE HEALTHY MACROINVERTEBRATE COMMUNITIES	-Sedimentation -Channelization -Loss of riparian zone -Streambank erosion -Lack of vegetation on banks adjacent to water bodies -Dredging -Stream cleaning	A higher score indicates a higher quality habitat. QHEI greater than or equal to 60 (on a 100 point scale) is a suitable score for a warmwater habitat without use impairment.

TYPES OF CONTAMINANTS IN NON-AGRICULTURAL STORM WATER RUNOFF

CONTAMINANT	SOURCE	IMPACT
Bacteria and viruses	Animal/human wastes, failing septic systems, marinas	Health risks, use of beaches, consumption of shellfish
Metals (lead, copper, cadmium, zinc, mercury, chromium)	Industrial/commercial activities, illicit sewage connection, cars, boats	Accumulates in animal tissue, genetic defects, reproductive abnormalities, increased mortality
Hydrocarbons (oil, grease, other petroleum products, PAHs)	Parking lots, roadways, oil leaks, auto emissions, illicit sewage connections, poor waste disposal	Toxic to sensitive animals, impairs habitat
Toxic organics (pesticides and PCBs)	Use of pesticides, industrial activities, illicit sewage connection	Loss of oxygen in water, release of other pollutants, accumulates in animal tissue
Humic Substances (grass clippings, leaves)	Urban, suburban, and rural landscapes	Loss of oxygen in water, release of other pollutants such as N and P
Salt	Road salting	Endangers aquatic plants and animals, degrades fishery, contaminates water

SCORING CRITERIA FOR THE FAMILY LEVEL MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY (mIBI)

INDIVIDUAL TESTS	INDIVIDUAL TEST RESULTS				
Family Level Hilsenhoff Biotic Index	≥5.63	5.62-5.06	5.05-4.55	4.54-4.09	≤4.08
Number of Taxa	≤7.0	8.0-10.0	11.0-14.0	15.0-17.0	≥18.0
Number of Individuals	≤79.0	80.0-129.0	130.0-212.0	213.0-349.0	≥350.0
Percent Dominant Taxa	≥61.6	61.5-43.9	43.8-31.2	31.1-22.2	≤22.1
EPT Index	≤2.0	3	4.0-5.0	6.0-7.0	≥8.0
EPT Count	≤19.0	20.0-42.0	43.0-91.0	92.0-194.0	≥195
EPT Count to Total Number of Individuals	≤0.13	0.14-0.29	0.30-0.46	0.47-0.68	≥0.69
EPT Count to Chironomid Count	≤0.88	0.89-2.55	2.56-5.70	5.71-11.65	≥11.66
Chironomid Count	≥147	146.0-55.0	54.0-20.0	19.0-7.0	≤6.0
Classification Score of Individual Test Results	**0**	**2**	**4**	**6**	**8**
INTERPRETING THE CLASSIFICATION SCORES	**0-2.0 Severely Impaired**	**2.0-4.0 Moderately Impaired**	**4.0-6.0 Slightly Impaired**	**6.0-8.0 Non-Impaired**	

IDEM developed the classification criteria based on five years (1990-1995) of wadeable riffle-pool data collected in Indiana. Given that many of Indiana's streams are negatively impacted by nutrient pollution and sedimentation, these ranges are listed for comparative purposes only. Values that exceed the range in the 'Score 8' column are encouraged.

The numbers NOT in bold type are the scores/results you would see in a report of water quality data from a consultant. The classification scores (in bold type) will then tell you the condition of the aquatic community, whether it is in good condition (non-impaired) or in poor condition (severely impaired).

*See the Glossary of Water Quality Terms for definitions of terms on this page.

GLOSSARY OF WATER QUALITY TERMS

Acidic- a substance with a pH lower than 7 (e.g. lemon juice, battery acid, cola, vinegar)

Acid seep- a groundwater spring with a low pH

Algal bloom- a sudden growth of algae caused by an excess of nutrients

Aquatic- living or growing in or on the water

Basic (alkaline)- a substance with a pH higher than 7 (e.g. baking soda, ammonia, bleach, lye)

Benthic- bottom dwelling, organisms living on a lake or river bottom

Biochemical Oxygen Demand (BOD)- the amount of dissolved oxygen required to meet the metabolic needs of microorganisms in a water environment

Bog- an area of ground that once was a small lake, pond, or marsh/wetland that has been slowly covered by encroaching land. The ground is waterlogged and soggy as there is still water underneath it. A specific type of wetland often characterized by low pH and unique vegetation.

Cfu- colony forming units

Chironomidae- midge family, very pollution tolerant

Chironomid count- number of individual chironomids in a sample

Combined Sewer Overflow (CSO)- an overflow from wastewater treatment plants that allows a percentage of Untreated water (both storm and sewage) to flow into rivers, lakes, and streams during large rain storms. This often occurs due to the fact that the plant cannot handle the excess water.

Community Loss Index- measures the loss of benthic species between a reference station and the station of comparison. Index values increase as the degree of dissimilarity from the reference station increases.

CPOM (Coarse Particulate Organic Matter)- Larger pieces of organic matter that have not fully decomposed such as leaf litter, small twigs, plants, etc.

Decomposition- decay of organic matter

Dissolved- in solution

Diversity- variety

Effluent- an outflow or discharge of waste

Embeddedness- a measure of how much the rocks and other materials are covered or surrounded by sand/sediment

Ephemeroptera- mayfly family, pollution sensitive

EPT count- number of ephemeroptera, plecoptera, and tricoptera individuals in a sample

EPT count to Chironomid count- An indication of community balance. If Chironomidae have a disproportionately large number of individuals in comparison to the sensitive EPT groups, this indicates environmental stress.

EPT count to total number of individuals- EPT count/number of all individuals collected in a sample

EPT (Ephemeroptera, Plecoptera, and Tricoptera) Index- Summarizes taxa richness within the insect groups that are considered pollution sensitive. This index increases as water quality increases.

Family Level Hilsenhoff Biotic Index- An index designed to detect organic pollution, based on the idea that each family of organisms is assigned a pollution tolerance value from 0 to 10. Organisms with a low pollution tolerance rate low on this scale while pollution tolerant organisms rate very high (closer to 10).

Habitat- the area or type of environment in which an organism or biological population normally lives or occurs

Impairment- something that diminishes the value, quantity, or quality of waters in streams, rivers, and lakes

Inhibit- to prevent

Inorganic- non-living

Ion- an atom or molecule that has acquired a net electric charge

Macroinvertebrates- aquatic animals that lack backbones, live at least part of their lives in or on the bottom of a body of water, and are big enough to be seen with the naked eye

Macrophytes- plants in aquatic environments that are big enough to be seen with the naked eye

Metabolic- pertaining to the complex of physical and chemical processes involved in the maintenance of life

Mg/L- milligrams per liter

Moderately Impaired- aquatic habitat with fewer species due to the loss of most pollution intolerant forms leading to a decrease in the EPT Index

Modified Warmwater Habitat (MWH)- aquatic life use assigned to streams that have irretrievable, extensive, man-introduced modifications that preclude attainment of the warmwater habitat (WWH) use designation

Morphology- structure and form

MS/m- millisiemens/meter (unit of measurement). MS/m = micromhos/cm (ϖmhos/cm) divided by 10

Neutral- neither acidic nor alkaline

Non-Impaired- comparable to the best situation to be expected within an ecoregion. Balanced trophic structure and optimum community structure (composition and dominance) for stream size and habitat quality.

Organic matter- matter derived from living organisms

Oxidized- combined with oxygen

Particulate matter- matter formed of separate particles

Pathogenic- capable of causing disease

Percent dominant taxa- percent of the numerically dominant taxon to the total number of organisms which is an indication of community balance. A community dominated by relatively few species would indicate environmental stress.

Periphyton- sessile organisms that live attached to surfaces projecting from the bottom in a freshwater aquatic environment

Plecoptera- stonefly family, sensitive to pollution

Pool/glide- a deep, slower moving place in a river or stream

Propagation- increase or spread, as by natural reproduction

Ratio of scrapers/filterers- reflects the riffle/run community foodbase and provides insight into the nature of potential disturbance factors. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. Scrapers decrease as filamentous algae and aquatic mosses increase.

Riffle/run- a stretch of choppy water caused by a rocky shoal or sandbar lying just below the surface of a stream or river; rapids. Riffle areas generally have more dissolved oxygen.

Riparian- of, on, or pertaining to the bank of a natural course of water

Sanitary- free from elements, such as filth and bacteria, that endanger health

Sessile- stalkless and attached directly at the base (e.g. algae)

Severely impaired- few species present. If a high density of organisms is present, it is normally dominated by one or two taxa. Only pollution tolerant organisms are present.

Silviculture- the care and cultivation of forest trees

Slightly impaired- community structure less than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.

Substrate- a surface on which a plant or animal grows or is attached

Suspended- particles that are supported or kept from falling without apparent attachment, as by buoyancy (in water)

Taxa- Number of families present, generally increases with higher water quality, habitat diversity, and habitat suitability.

Toxic- harmful

Tricoptera- caddisfly family, pollution sensitive