

A serene sunset scene over a body of water. The sun is low on the horizon, partially obscured by dark silhouettes of trees on the left. The sky transitions from a deep orange near the horizon to a pale, hazy blue at the top. The water in the foreground is calm, reflecting the warm colors of the sunset. In the distance, dark, rolling hills or mountains are visible against the horizon line.

*Presented at:*

*Environmental Monitoring and Assessment Program*

*Great River Ecosystems*

*Biological Indicators Workshop*

*October 24-26, 2006*

*Holiday Inn - Duluth, Minnesota*



# Water Quality

**EMAP-GRE Indicator workshop**

**October 24-26, 2006**

# Water Quality and the Assessment



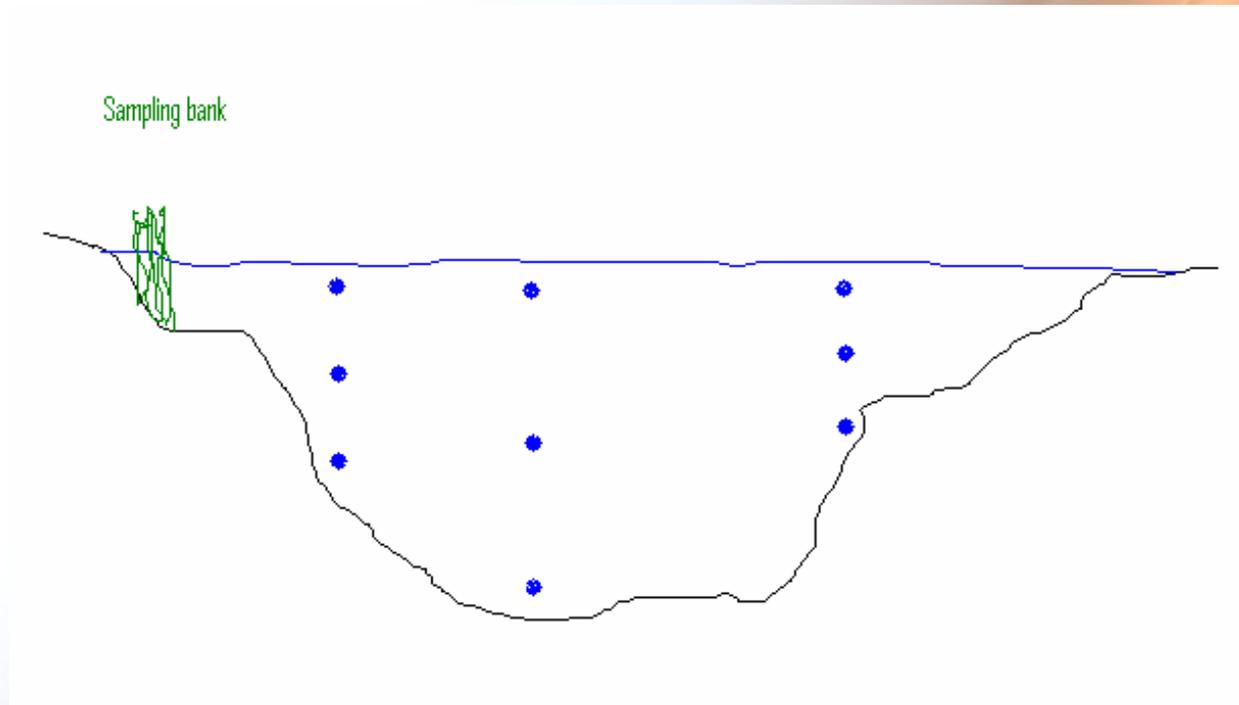
# Water Quality



09.02.2004

# Method of collection

- **Cross channel depth integrated**
  - **Field chemistry**
  - **Composite lab sample**



# Method of collection



# Water Chemistry

- **Parameters**

- **Nutrients (DIP, DIN, TP, TN, TOC)**
- **Cations (Mg, Ca, K, Na)**
- **Anions (Cl, SO<sub>4</sub>)**
- **Acid neutralizing capacity/pH**
- **Metals (Fe, Al, Zn, Cu, Se, As, Pb)**
- **Clarity (TSS, Turbidity, Secchi, Chla)**

# Water Chemistry

- **Additional metrics and checks**
  - **Stoichiometry (C:N, N:P...)**
  - **Total Dissolved Solids=  $0.6(\text{alka}) + \text{Na} + \text{K} + \text{Ca} + \text{Mg} + \text{Cl} + \text{SO} + \text{NO}$**
  - **Ion balance**
  - **Total metals**
  - **Hardness by calculation**

# As an indicator



# Water Chemistry as an Indicator

## Data form

- Concentration
- Flow weighted
- Watershed area weighted



# Indicator

- **Individual concentrations**
  - **WSA: TP, TN, salinity, acidification**
  - **WEST: 20 constituents**
- **Carlson's trophic status index**
  - **Total Phosphorus, chl<sub>a</sub>, secchi disk**
- **Water Quality index (NCA)**
  - **Uses DO, chl<sub>a</sub>, nitrogen, phosphorus, and water clarity**

# Indicator

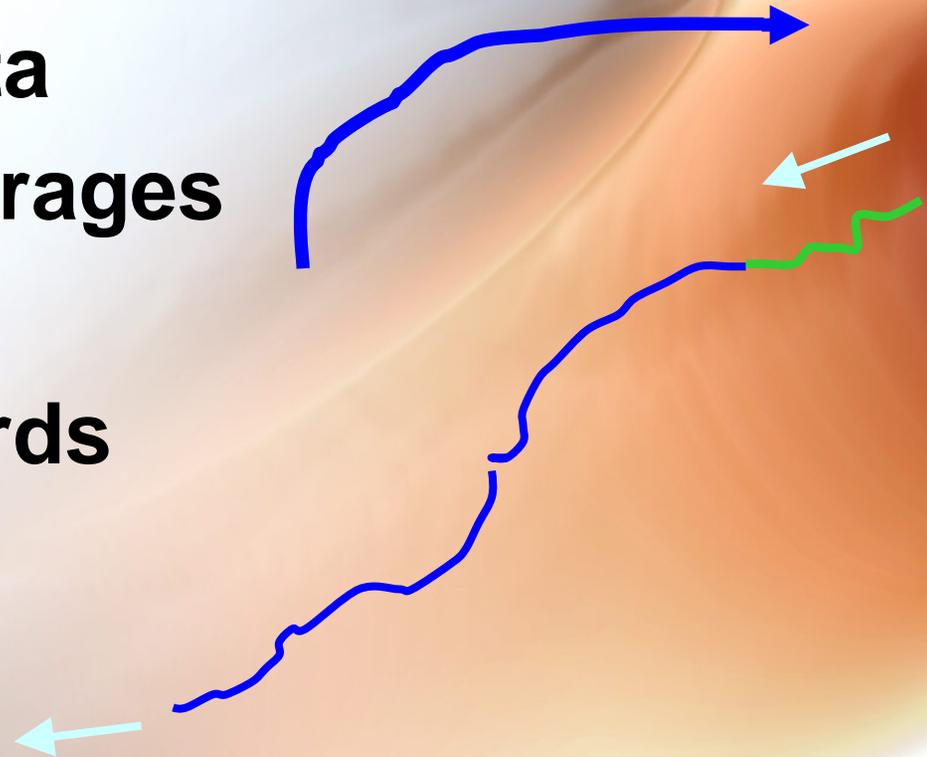
- **Riparian inundation/runoff potential index:**

**EMAP-GRE field data**

**GIS landscape coverages**

**USGS records**

**Climatological records**

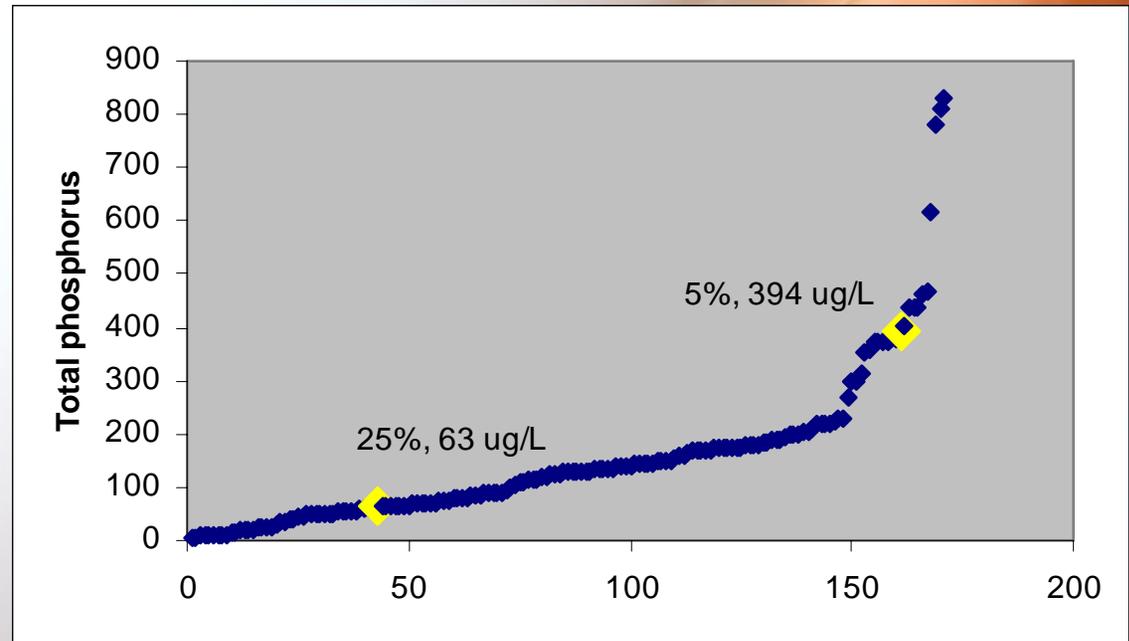


# Water Chemistry as an Indicator

- **Some hard number standard**
- **Reference condition**
  - Percentiles

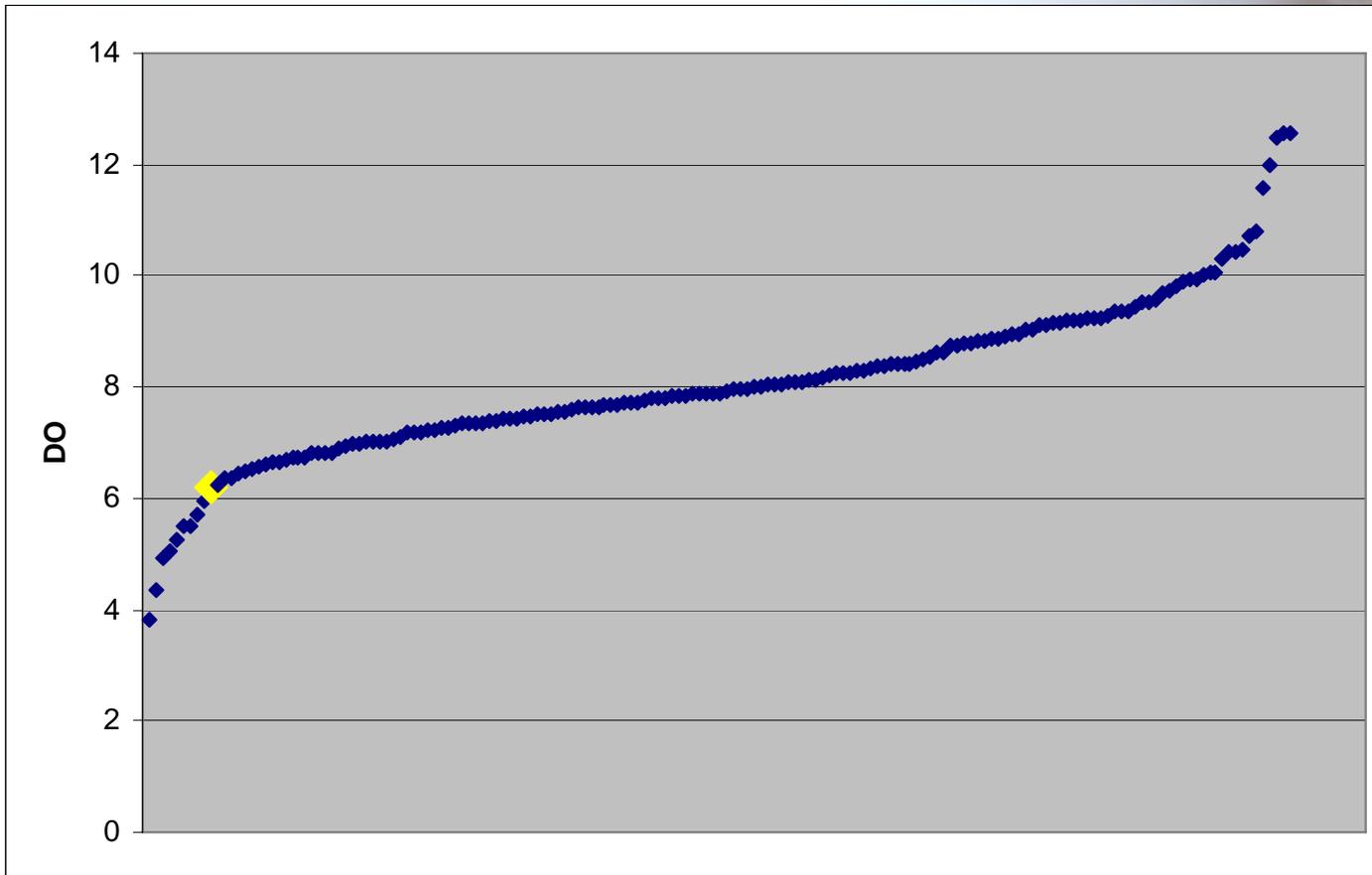
LD of 2004, 25th  
percentile <63 ug/L

MD of 2004, 5th  
percentile >394 ug/L



# Extent DO

- 9 of 169 sites in 2004 (5.3%) were less than 6 mg/L
- 3 of 169 sites in 2004 (1.8%) were less than 5 mg/L



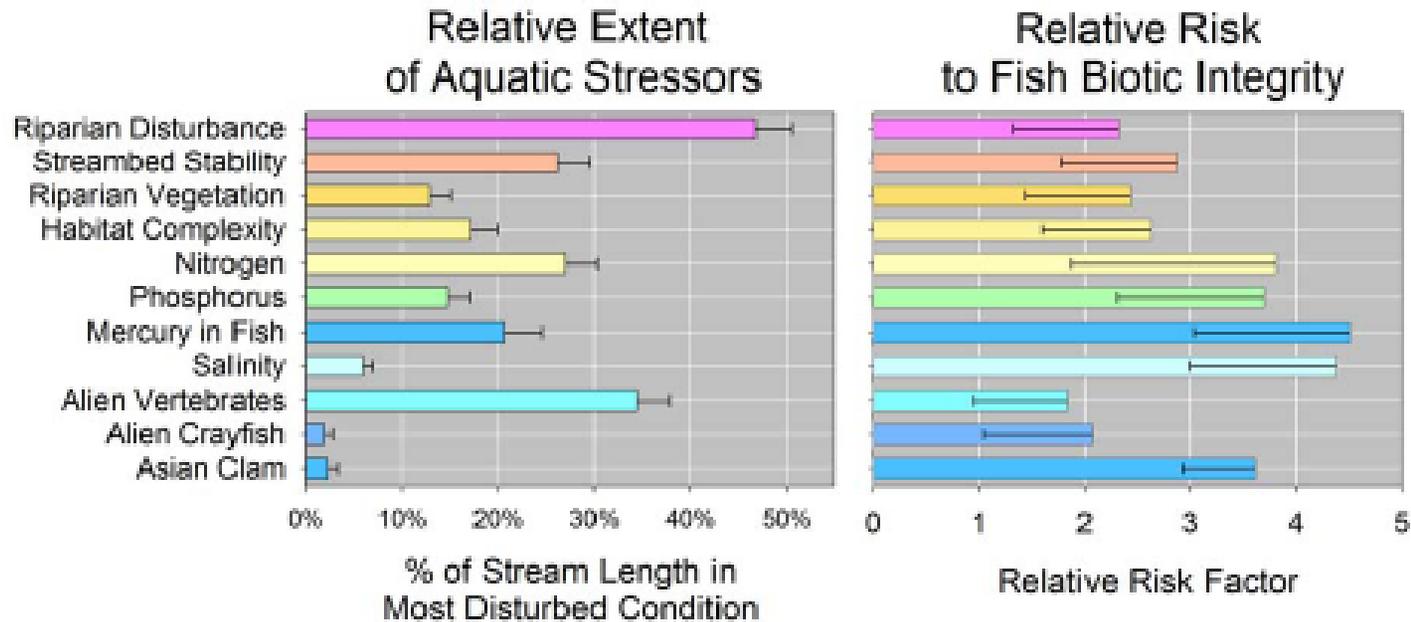
# As a stressor



# Relative Risk



# Relative Risk



# Points for discussion

- **How to best describe overall condition of water quality?**
- **Missing metrics? redundant metrics?**
- **Do we need to transform the concentration? if so, how?**
- **What approach should define criteria?**
- **For each biological indicator: How would they like to use the water quality data?**

# Parameters

Metals	Nutrients	Water clarity
Arsenic	Dissolved Nitrogen (NO <sub>2</sub> + NO <sub>3</sub> )	Total suspended solids
Aluminum	Ammonia	d13C
Lead	Total Nitrogen	d15N
Nickel	Dissolved phosphorus	Particulate organic carbon
Iron	Total Phosphorus	Suspended solids Carbon percent weight
Cooper	Dissolved Inorganic Carbon	Particulate C:N
Selenium	Dissolved Organic Carbon	Particulate organic nitrogen
Zinc	Total Organic Carbon	Suspended solids Nitrogen percent weight
<b>Total metals</b>	Silica	Turbidity
	<b>Si:C</b>	
<b>ION BALANCE</b>	<b>Si:N</b>	Chlorophyll a
<b>SUM BASE CATIONS</b>	<b>Si:P</b>	Pheophytin a
Calcium	<b>N:P</b>	
Magnesium	<b>C:N</b>	<b>Field measures</b>
Potassium	<b>C:P</b>	Mean field conductivity
Sodium		Mean field dissolved oxygen
<b>SUM ANIONS</b>	pH	Mean field pH
Chloride	Acid neutralizing capacity	Mean field temperature
Sulfate		Mean bottom dissolved oxygen
Ammonia		Mean bottom Temperature
<b>TDS</b>		Average Secchi
<b>Hardness by calculation</b>		