



Coeur d'Alene, Idaho
31 March – 4 April, 2003

Case Study: Little Scioto River

Step 1 - List Candidate Causes

STEP 1

List Candidate Causes

a: Develop Initial List

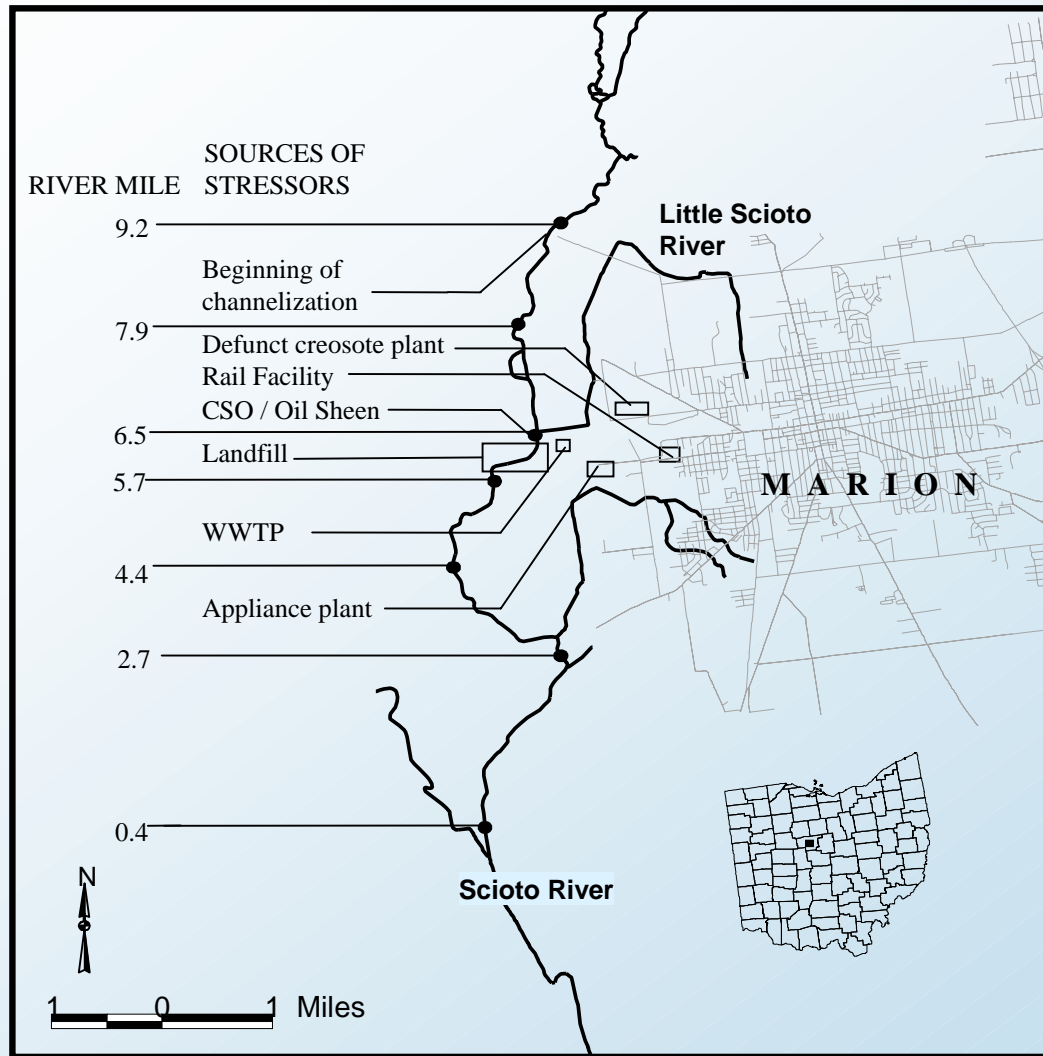
Develop Initial List of Candidate Causes

Candidate Cause	Notes

STEP 1

List Candidate Causes

b: Draw a Map



Map of the Little Scioto River, Ohio, showing sites where fish were sampled. Approximate locations of significant physical features, tributaries and point source inputs are noted. The small inset shows the location of the study area in the state of Ohio.

STEP 1

List Candidate Causes

c: Gather Information

Types of Data Available for the Little Scioto River, Ohio, 1992

Sample Medium	Measurements	Site designation and sample locations (RM upstream from confluence with Scioto River)							Number of samples per location
		Upstream Site	Site A	Site B	Downstream sites				
Fish	IBI and Miwb metrics	9.2	7.9	6.5	5.7	4.4	2.7	0.3	2-3
Macroinvertebrates	ICI metrics	9.2	7.9	6.5	5.7	4.4	2.1	0.4	1
Sediment	Volatile chemicals, semivolatile chemicals, metals and cyanide, PCBs and pesticides	9.5	7.9	6.5	5.8	4.4	2.7	0.4	1-3
Water	Metals, phenolic compounds, ammonia, nitrates and nitrites (NO _x), total phosphorus (P), hardness, and BOD	9.2	7.9	6.5	5.8	4.4	2.7	0.4	1
Water	Dissolved oxygen 1992 1987	9.2 NA	7.9 7.9	NA 6.5	5.8 5.8	4.4 4.4	2.7 2.7	0.4 0.4	measured continuously over 3 days (1987)
Physical Habitat	Qualitative Habitat Evaluation Index (QHEI) Metrics (ordinal scores)	9.2	7.9	6.5	5.7	4.4	2.7	0.3	1
Fish tissue	Pesticides, PCBs, metals, semivolatile compounds, and percent lipid	9.2		6.5			2.7		2-5 composite samples
White sucker bile	PAH metabolites		7.9	6.5	5.7	4.4	2.7	0.3	5-7

Average sediment concentrations (mg/kg) of selected PAHs¹ and metals. Samples were taken from the upper 15 cm.

Chemical	Upstream Site	Site A	Site B	Downstream sites (RM)			
				5.8	4.4	2.7	0.4
Anthracene	ND	ND	ND	27.1	7.9	ND	3.3
Benzo[a]anthracene	ND	ND	8.2J	16.5	6.9	2J	15.8
Benzo[ghi]perylene	ND	ND	49.5	11.2	4.9	ND	6.9
Benzo[a]pyrene	ND	ND	14.8J	15.8	7.2	ND	11.5
Chrysene	ND	ND	16.5	20.8	9.9	1.6J	ND
Fluor-anthene	ND	ND	8.2J	37.6	13.5	ND	22.4
Fluorene	ND	ND	ND	7.0	4.0	ND	ND
Cr	7.34	13.6	208	60.9	302	71.2	48.6
Cu	7.44	17.2	79	56	76.8	42.4	24.5
Pb	12.1	19.1	172	84.6	93.4	108	38
Zn	3.06	79	173	141	226	408	96.8
Hg	ND	ND	0.33	0.24	0.79	0.12	ND

¹ PAHs shown were either significantly correlated with biological responses, or exceeded sediment quality guidelines.

ND: Not detected. J: estimated value (below quantitation limit)

Concentrations of chemicals in water.

Units are mg/l except where noted.

Chemical	Upstream Site	Site A	Site B	Downstream sites (RM)			
				5.8	4.4	2.7	0.4
BOD	1	1	2.3	4.7	4.2	3.5	2.2
Nitrate and nitrite	1.22	1.44	0.81	8.1	6.6	4.5	4.47
Ammonia	ND	ND	0.12	1.16	1.44	2.1	0.58
Total phosphorus	0.06	0.07	0.09	2.17	1.96	1.8	1.34
Dissolved oxygen (minimum)	8.8	5.7	NA	4.2	4.3	3.0	4.4
	NA	2.8	1.9	4.2	3.2	2.0	2.5
Copper *	ND	ND	15	ND	ND	ND	ND
Lead *	ND	ND	3	3	ND	ND	ND
Zinc *	ND	ND	ND	18	12	13	ND

* Units are ug/l

NA: No data collected

ND: Not detected

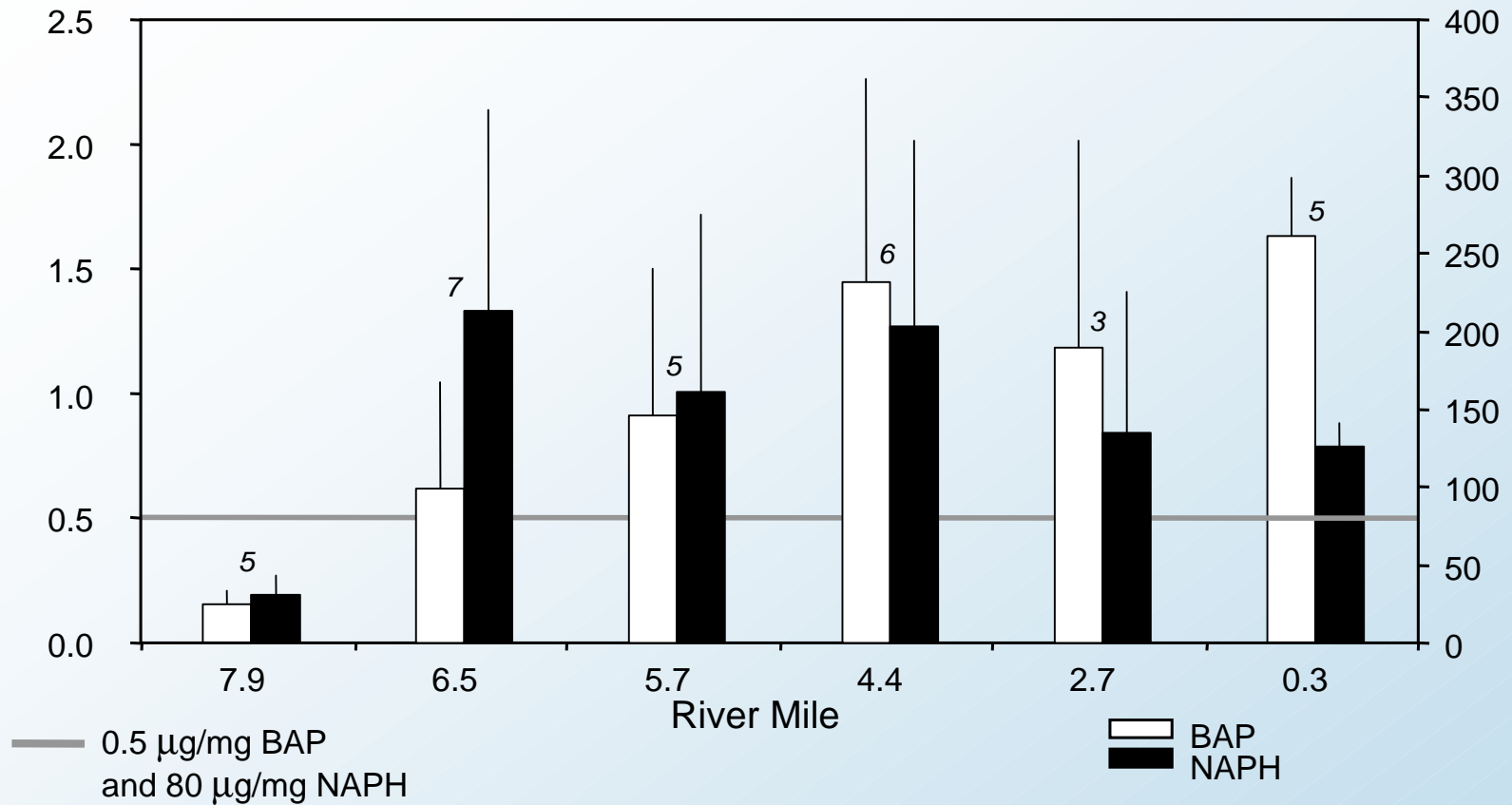
All data from 1992, except for DO, collected in 1987 over 3 days with continuous Datasonde continuous monitors

Selected physical habitat quality scores

Parameter	Upstream Site	Site A	Site B	Downstream sites (RM)			
				5.7	4.4	2.7	0.4
Channel	17	10	10	10	10	10	7
Substrate embeddedness ¹	2	1	1	1	1	1	1
Silt ²	2	1	1	1	1	1	1

¹ Levels of embeddedness were scored from most to least 1=Extreme, 2=Moderate, 3=Low, 4=None.

² Levels of silt were scored from most to least 1=Heavy, 2=Moderate, 3=Normal, 4=Free.

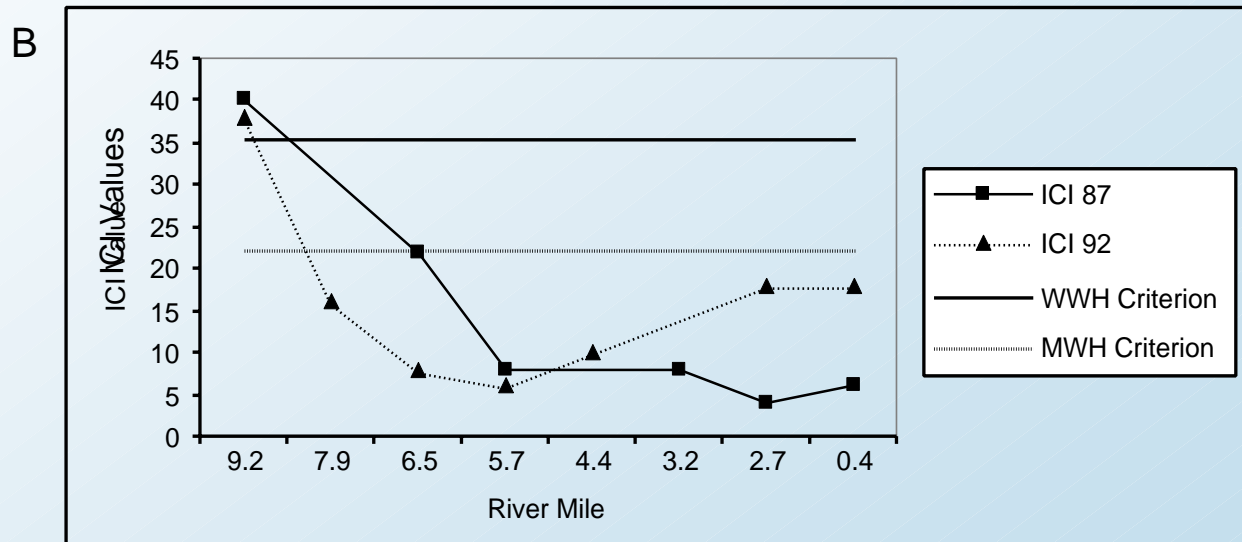
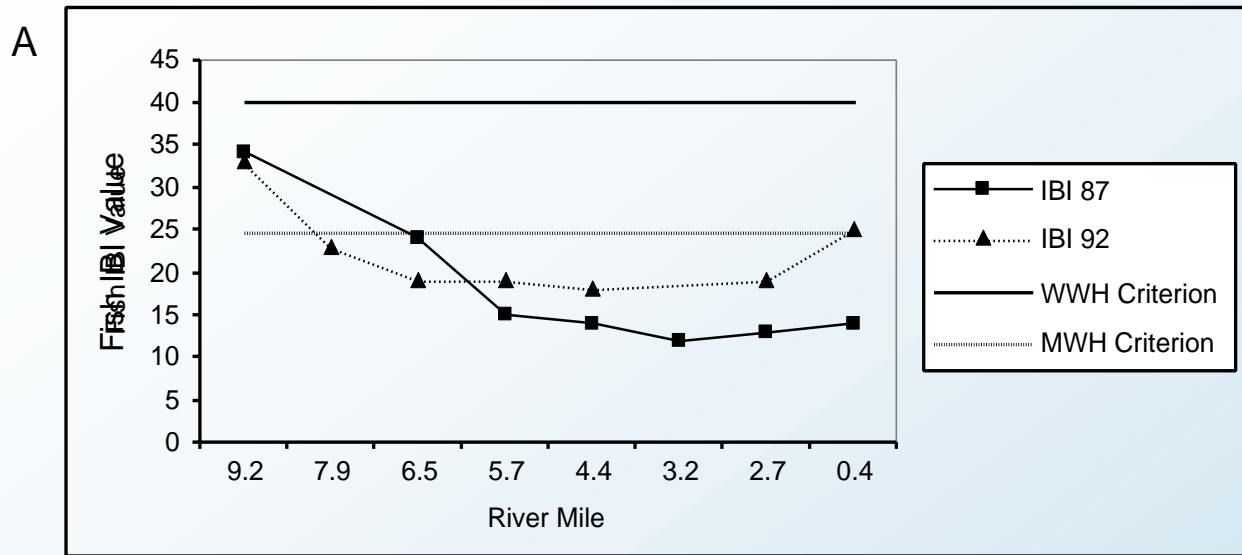


Bile metabolites ($\mu\text{g}/\text{mg}$ protein) of benzo[a]pyrene (BAP) and naphthalene (NAPH) type metabolites measured in white suckers from the Little Scioto River in 1992. Median levels of PAH metabolites below RM 7.9 were up as much as 4 times the Exposure Criteria, levels above background for the state of Ohio. The numbers above the bars equal number of fish sampled. Vertical lines are standard error.

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d: Examine Effects

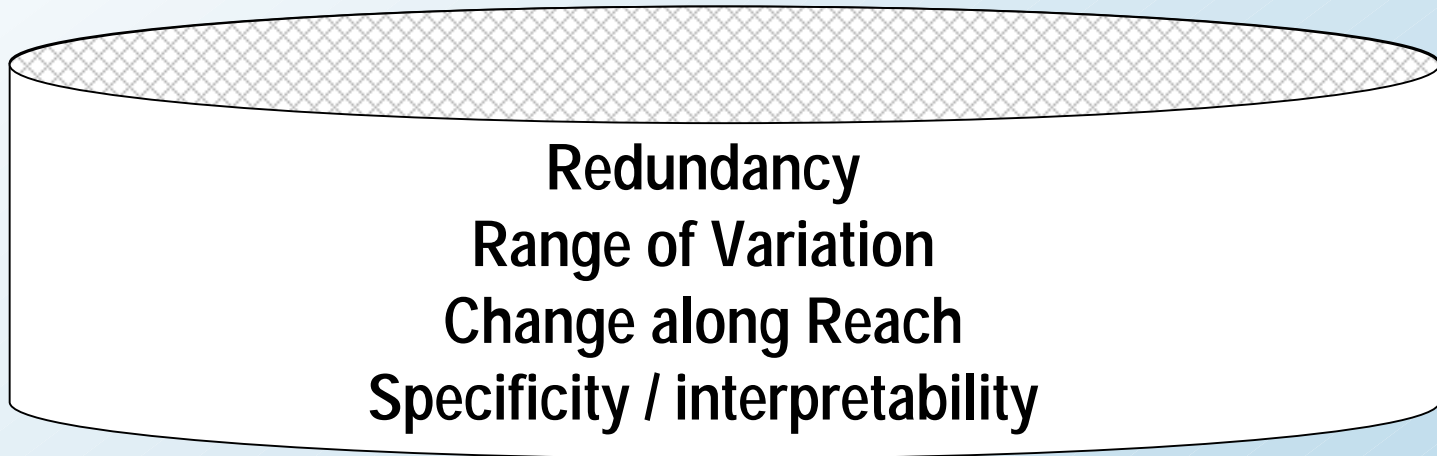


Spatial changes in fish IBI , (A) and benthic macroinvertebrate ICI (B) values in the Little Scioto River in 1987 (OEPA 1988) and 1992 (OEPA, 1994)

IBI and ICI

- % Omnivores
- Relative Fish Weight
- Invertebrate Taxa Richness
- % Mayflies
- Number of Sunfish Species
- % Shredders
- % Intolerant Invertebrates
- % Oligochaetes
- Invertebrate Abundance
- Fish Species Richness
- % Caddisflies
- % DELT Anomalies
- % Round Bodied Suckers

Reduce metrics by considering:

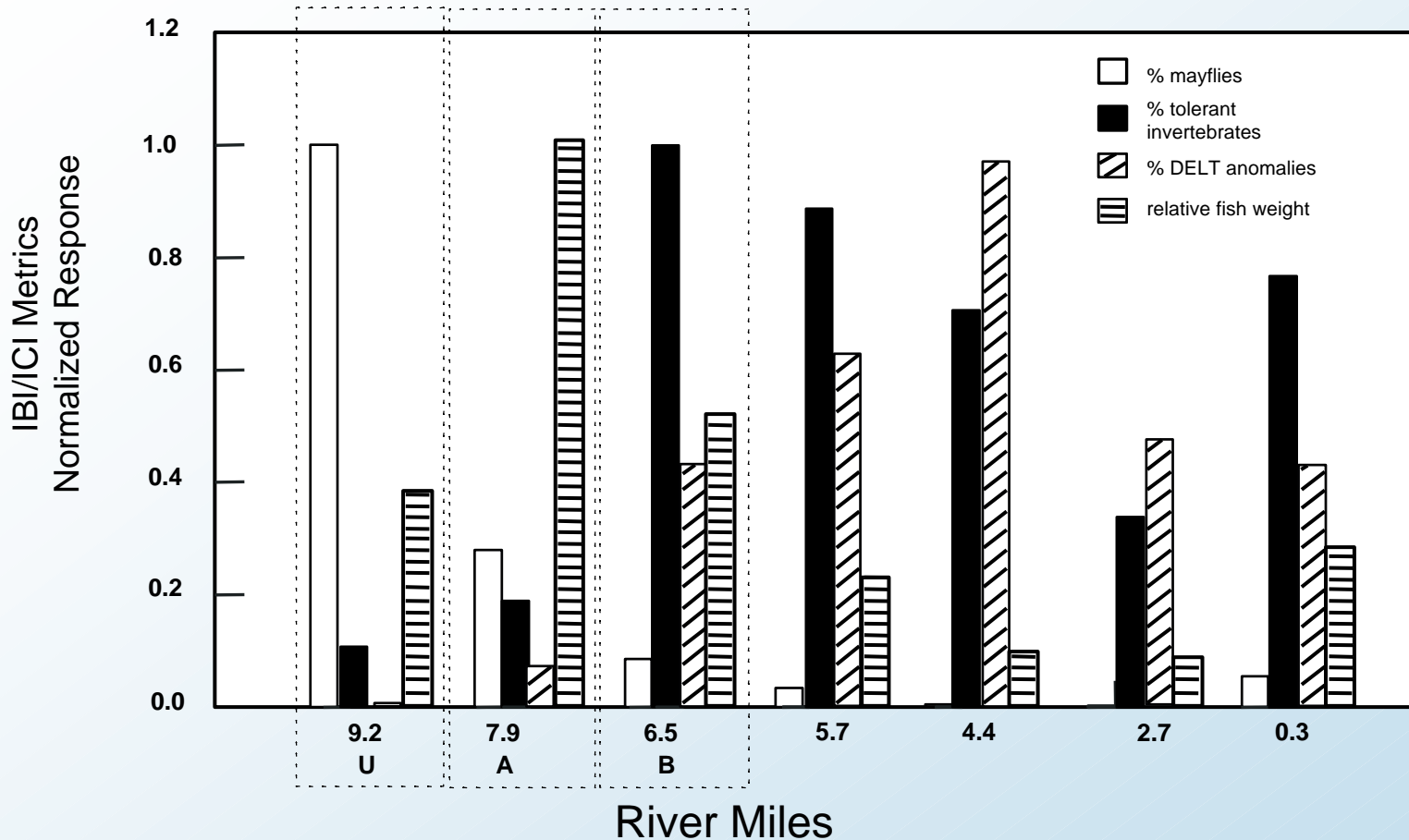


Relative Fish Weight

% Mayflies

% Tolerant Invertebrates

% DELT Anomalies



Changes in fish and macroinvertebrate metrics in the lower 15 km of the Little Scioto River, 1992. Normalized values were calculated by dividing the value at each site by the highest value for all sites.

Summary of the three impairments that were considered in the Little Scioto River. The location is scored relative to the location immediately upstream.

Response	Impairment A: Change in assemblage at Site A Relative to Upstream Site
<i>Fish</i>	
Relative Weight	increased
% DELT Anomalies	increased
<i>Invertebrates</i>	
% Mayflies	decreased
% Tolerant taxa	increased

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e: Engage Stakeholders

Stakeholder Engagement

Great for:

- Local knowledge
- Buy-in on results
- Reaching the ultimate customer

BUT

- Time consuming
- May raise concerns outside the scope of investigation
- Gaming

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f: Construct a Conceptual Model

STEP 1

List Candidate Causes

g: Finalize list and

h: Crosswalk available
measurements relevant to each
candidate cause

Crosswalk available measurements relevant to each candidate cause.

Candidate Cause	Relevant Measurements
1. Habitat alteration	
2. PAH toxicity	
3. Metal toxicity	
4. Ammonia toxicity	
5. Low dissolved oxygen/high biological oxygen demand	
6. Nutrient enrichment	