

Indiana Water Quality Monitoring

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OKI



Table I. Role of the Biological Studies Section Relative to Media and Ecological Data Collected and Expressed in Terms of Environmental Stressors, Responses and Indicators

| Chemical, Physical and Biological Stresses | Environmental Responses | Environmental Indicators Used to Assess Impairment |
|--|--|--|
| Point Source Pollution and Nonpoint Source Pollution | Elevated Pollutants in Water | Water Chemical Specific Concentrations and Loadings |
| | Elevated Pollutants in Aquatic Sediments | Sediment Chemical Specific Concentrations and Loadings |
| | Elevated Pollutants in Fish Tissue | Contaminant Bioconcentration in Fish Tissue, Fish Consumption Advisories |
| | Acute and Chronic Toxicity | Effluent Toxicity Tests |
| Destructive Habitat Alterations | Decreased Aquatic Habitat Quality | Aquatic Habitat Evaluation Index |
| Collective Ecosystem Level Responses to Environmental Stress | Fish Community Impairment | Fish Community Index of Biotic Integrity (IBI) |
| | Invertebrate Community Impairment | Macroinvertebrate Index of Biotic Integrity (mIBI) |
| | | Indiana Trophic State Index |
| | Lake Eutrophication | Carlson Trophic State Index |

Fish Tissue Sampling →

← Chemical Monitoring

← Biological Monitoring

QUALITATIVE HABITAT EVALUATION INDEX (QHEI)

- Developed by the Ohio Environmental Protection Agency (OEPA) in 1989
- Provides information on a stream's ability to support fish and macroinvertebrate communities
 - Evaluates instream and surrounding habitat
- Based on 6 Metrics
- Score is given between 0-100
- Scores <51 indicate an impaired habitat



QHEI METRICS AND SCORING

- Substrate - substrate type, substrate origin, silt cover, and embeddedness.
- Instream Cover - instream cover types and the amount (availability) of instream cover
- Channel Morphology - channel sinuosity, channel development, channelization, stability, and modifications
- Riparian Zone and Bank Erosion - riparian width, floodplain quality, bank erosion
- Pool/Glide and Riffle/Run Quality - depth, morphology, diversity of current velocities, substrate stability and embeddedness
- Gradient



| <u>QHEI Metric</u> | <u>Metric Component</u> | <u>Component Scoring Range</u> | <u>Metric Max. Score</u> |
|---------------------------------|---------------------------|--------------------------------|--------------------------|
| 1) Substrate | a) Type | 0 to 20 | 20 |
| | b) Origin | -2 to 1 | |
| | c) Cover | -2 to 1 | |
| | d) Embeddedness | -2 to 1 | |
| 2) Instream Cover | a) Type | 0 to 11 | 20 |
| | b) Amount | 1 to 11 | |
| 3) Channel Morphology | a) Sinuosity | 1 to 4 | 20 |
| | b) Development | 1 to 7 | |
| | c) Channelization | 1 to 6 | |
| | d) Stability | 1 to 3 | |
| 4) Riparian Zone & Bank Erosion | a) Width | 0 to 4 | 10 |
| | b) Quality | 0 to 3 | |
| | c) Bank Erosion | 1 to 3 | |
| 5a) Pool/Glide Quality | a) Max. Depth | 0 to 6 | 12 |
| | b) Morphology | 0 to 2 | |
| | c) Current Velocity | -2 to 4 | |
| 5b) Riffle/Run Quality | a) Depth | 0 to 4 | 8 |
| | b) Substrate Stability | 0 to 2 | |
| | c) Substrate Embeddedness | -1 to 2 | |
| 6) Gradient | | 2 to 10 | 10 |
| TOTAL | | Maximum Score | 100 |

QHEI SCORES FOR DEARBORN COUNTY

| LSITE | Sample Type | SAMPLE ID | SAMPLE DATE | STREAM NAME | Northing | Easting | ECO-REGION | QHEI |
|-------------|--------------|-----------|-------------|------------------|-------------|-------------|------------|------|
| GMW080-0010 | Macro_Invert | 940826107 | 26-Aug-94 | Whitewater River | 4346931.461 | 687797.7431 | IP 77 | 81 |
| GMW080-0010 | Macro_Invert | 970904101 | 04-Sep-97 | Whitewater River | 4346931.461 | 687797.7431 | IP 79 | 83 |
| GMW080-0017 | Fish | AA12288 | 08/27/02 | Logan Creek | 39.276826 | -84.894337 | IP 71 | 64 |
| GMW080-0034 | Macro_Invert | AA47782 | 16-Jul-07 | Whitewater River | 4350554.61 | 682954.5474 | IP 76 | 73 |
| GMW080-0034 | Fish | AA47245 | 06/13/07 | Whitewater River | 39.285049 | -84.878718 | IP 71 | 82 |
| OML030-0001 | Macro_Invert | AA00384 | 16-Aug-00 | Salt Fk | 4340650.742 | 682389.5173 | IP 72 | 68 |
| OML030-0001 | Fish | AA00384 | 08/16/00 | Salt Fork | 39.195986 | -84.887943 | IP 71 | 68 |
| OML030-0002 | Fish | AA02105 | 09/18/00 | Tanners Creek | 39.136792 | -84.857594 | IP 71 | 50 |
| OML030-0009 | Fish | AA27112 | 06/07/05 | Brushy Fork | 39.198632 | -84.906594 | ECBP 55 | 64 |
| OML030-0010 | Macro_Invert | AA27990 | 01-Aug-05 | Salt Fk | 4337870.915 | 683543.8947 | IP 73 | 68 |
| OML030-0010 | Fish | AA27129 | 06/07/05 | Salt Fork | 39.170711 | -84.875338 | IP 71 | 65 |
| OML030-0011 | Macro_Invert | AA27992 | 21-Sep-05 | Tanners Cr | 4332094.02 | 684010.8574 | IP 75 | 60 |
| OML030-0011 | Fish | AA27992 | 09/21/05 | Tanners Creek | 39.118592 | -84.871504 | IP 71 | 60 |
| OML040-0001 | Fish | AA02439 | 10/03/00 | North Hogan | 39.074195 | -84.928984 | IP 71 | 62 |
| OML040-0002 | Macro_Invert | AA00385 | 02-Aug-00 | S Hogan Cr | 4323317.696 | 668286.3733 | IP 71 | 71 |
| OML040-0002 | Fish | AA00385 | 08/02/00 | South Hogan | 39.042731 | -85.055462 | IP 71 | 71 |
| OML040-0010 | Fish | AA27119 | 06/06/05 | Allen Branch | 39.086524 | -85.057469 | ECBP 55 | 42 |
| OML070-0001 | Fish | AA00382 | 08/16/00 | Laughery Creek | 38.955581 | -85.064966 | IP 71 | 74 |
| OML070-0015 | Macro_Invert | AA27989 | 02-Aug-05 | Hayes Br | 4315561.854 | 669302.0537 | IP 74 | 55 |
| OML070-0015 | Fish | AA27127 | 06/07/05 | Hayes Branch | 38.972685 | -85.045656 | IP 71 | 70 |

INDEX OF BIOTIC INTEGRITY

- Biotic Integrity –“ The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition diversity, and functional organization comparable to the best natural habitats within a

region.”

(T.P. Simon and R. Dufour. 1997. Development of Index of Biotic Integrity Expectations for The Ecoregions of Indiana V. Eastern Corn Belt Plain. U.S. Environmental Protection Agency. Region V. Water Division. Watershed and Non-Point Source Branch. Chicago. IL. EPA 905/R-96/002.)

- From 1990-1995, over 1000 sites in Indiana were sampled to develop IBI expectations for the six different Ecoregions in Indiana



INDEX OF BIOTIC INTEGRITY

- 12 metrics that assess the communities:
 - species and trophic composition (feeding and reproductive guilds)
 - fish condition and health
- Maximum score is 60
- Stream segment is non-supporting for Aquatic Life
Use when the monitored fish community receives an IBI score of less than 35 which is considered "Poor" or "Very Poor"



| Total IBI Score | Integrity Class | Attributes |
|-----------------|-----------------|---|
| 53-60 | Excellent | Comparable to “least impacted” conditions, exceptional assemblage of species. |
| 45-52 | Good | Decreased species richness (intolerant species in particular), sensitive species present. |
| 35-44 | Fair | Intolerant and sensitive species absent, skewed trophic structure. |
| 23-34 | Poor | Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant. |
| 12-22 | Very Poor | Few species and individuals present, tolerant species dominant, diseased fish frequent. |
| <12 | No Fish | No fish captured during sampling. |

IBI METRICS

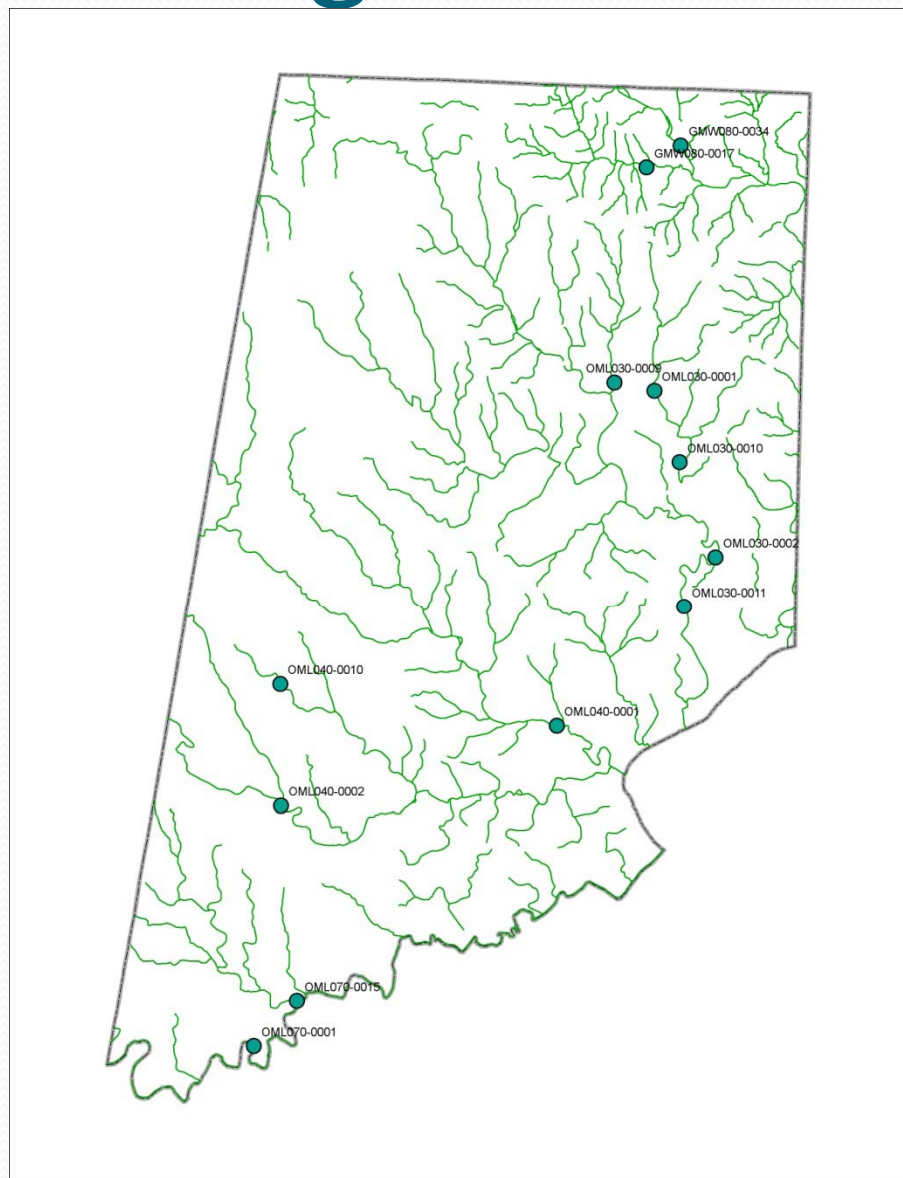
1. Species Richness and Composition
 - Total Number of Fish Species
 - Number of Catostomidae Species
 - Number of Darter Species
 - Number of Sunfish Species
2. Indicator Species
 - Number of Intolerant or Sensitive Species
 - Percent of Individuals that Are *Lepomis cyanellus* (Centrarchidae)
3. Trophic Function
 - Percent of Individuals that Are Omnivores
 - Percent of Individuals that Are Insectivorous Cyprinidae
 - Percent of Individuals that Are Top Carnivores or Piscivores
4. Reproductive Function
 - Percent of Individuals that Are Hybrids
5. Abundance and Condition
 - Abundance or Catch per Effort of Fish
 - Percent of Individuals that are Diseased, Deformed, or Have Eroded Fins, Lesions, or Tumors

- 1..
- 2.. Categories
- 3..

• - Metrics



IBI Monitoring Sites



DEARBORN COUNTY IBI SCORES

| Site | Lsite | Lat | Long | Sample_Num | Sample_Date | Ecoregion | IBI |
|-------------------|-------------|-----------|------------|------------|-------------|-----------|-----|
| Allen Branch | OML040-0010 | 39.086524 | -85.057469 | AA27119 | 06/06/05 | ECBP | 16 |
| Brushy Fork | OML030-0009 | 39.198632 | -84.906594 | AA27112 | 06/07/05 | ECBP | 46 |
| Hayes Branch | OML070-0015 | 38.972685 | -85.045656 | AA27127 | 06/07/05 | IP | 32 |
| Laughery Creek | OML070-0001 | 38.955581 | -85.064966 | AA00382 | 08/16/00 | IP | 50 |
| Logan Creek | GMW080-0017 | 39.276826 | -84.894337 | AA12288 | 08/27/02 | IP | 48 |
| North Hogan Creek | OML040-0001 | 39.074195 | -84.928984 | AA02439 | 10/03/00 | IP | 46 |
| Salt Fork | OML030-0001 | 39.195986 | -84.887943 | AA00384 | 08/16/00 | IP | 34 |
| Salt Fork | OML030-0010 | 39.170711 | -84.875338 | AA27129 | 06/07/05 | IP | 32 |
| South Hogan Creek | OML040-0002 | 39.042731 | -85.055462 | AA00385 | 08/02/00 | IP | 20 |
| Tanners Creek | OML030-0002 | 39.136792 | -84.857594 | AA02105 | 09/18/00 | IP | 30 |
| Tanners Creek | OML030-0011 | 39.118592 | -84.871504 | AA27992 | 09/21/05 | IP | 44 |
| Whitewater River | GMW080-0034 | 39.285049 | -84.878718 | AA47245 | 06/13/07 | IP | 48 |



MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY

- Similar to IBI concept.
- 12 metrics that assess the communities :
 - Structural
 - Functional
 - And compositional integrity
- From 1990-1995, IDEM sampled 737 sites in Indiana to develop mIBI expectations for the entire State of Indiana
- Single or multi habitat (MHAB) sampling methods can be used, but multi habitat is usually most appropriate

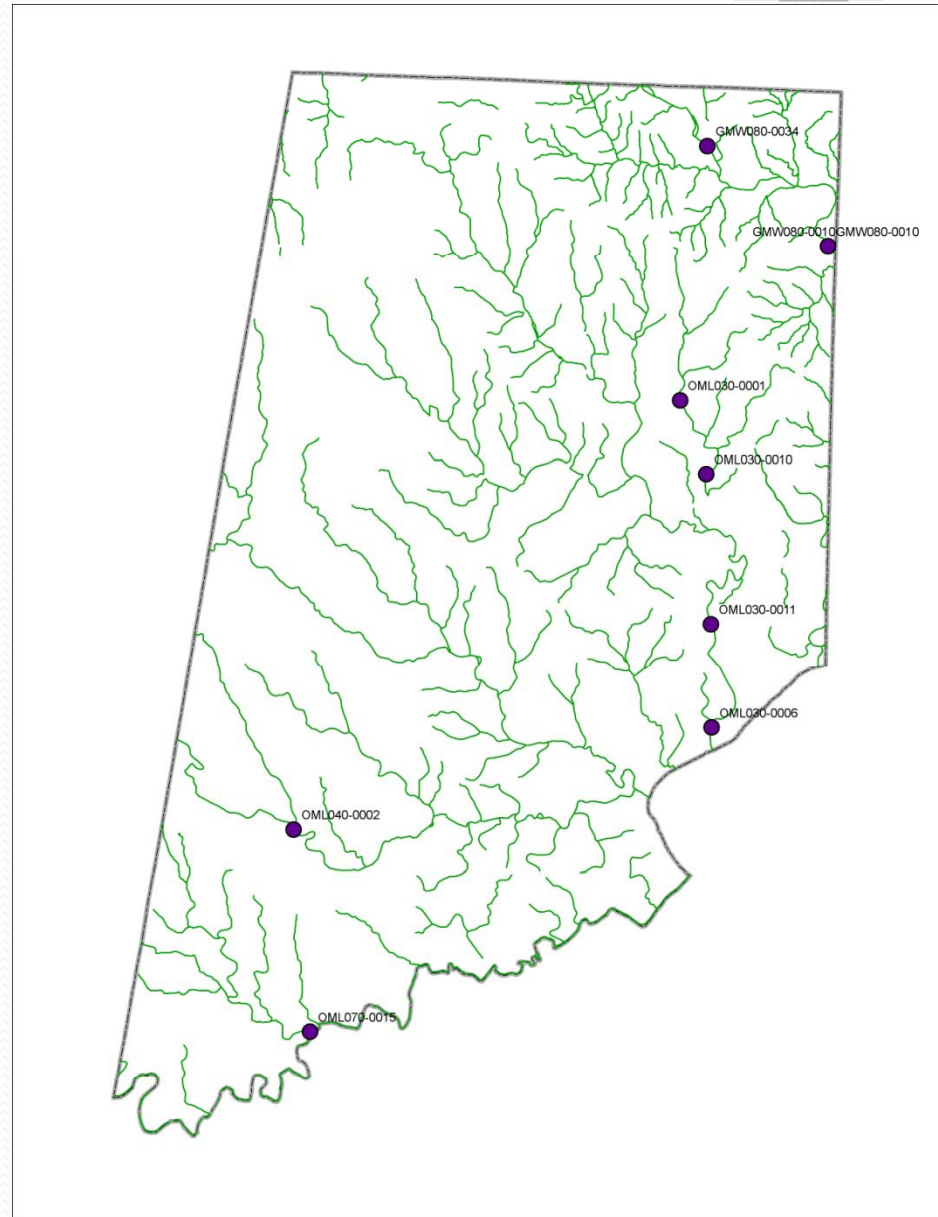


mIBI METRICS

- Total Number of Taxa
- Total Abundance of Individuals
- Number of EPT Taxa
- Number of Diptera Taxa
- % Orthocladinae + Tanytarsinii of Chironomidae
- % Non-Insects - Crayfish
- % Intolerant Taxa
- % Tolerant Taxa
- % Predators
- % Shredders + Scrapers
- % Collector-Filterers
- % Sprawlers



mIBI Monitoring Sites



DEARBORN COUNTY mIBI SCORES

MHAB < 36 = poor

Kick < 2.2 = poor

| LSITE | MACRO SAMPLE TYPE | SAMPLE ID | SAMPLE TYPE | SAMPLE DATE | STREAM NAME | DESCRIP SHORT | HUC 14 | Northing | Easting | ECO-REGION | mIBI |
|--------------|-------------------|-----------|-------------|-------------|------------------|------------------|----------------|----------|---------|------------|------|
| OML040-0002 | KICK | AA00385 | KICK | 02-Aug-00 | S Hogan Cr | Windsor Cemetery | 05090203040090 | 4323318 | 668286 | 71 | 3.2 |
| OML030-0001 | KICK | AA00384 | KICK | 16-Aug-00 | Salt Fk | Mt Pleasant Rd | 05090203030080 | 4340651 | 682390 | 71 | 2.2 |
| OML030-0010 | MHAB | AA27990 | MHAB | 01-Aug-05 | Salt Fk | Salt Fork Rd | 05090203030080 | 4337871 | 683544 | 71 | 38 |
| OML070-0015 | MHAB | AA27989 | MHAB | 02-Aug-05 | Hayes Br | Laughery Cr Rd | 05090203070070 | 4315562 | 669302 | 71 | 36 |
| OML030-0011 | MHAB | AA27992 | MHAB | 21-Sep-05 | Tanners Cr | Parkside Rd | 05090203030090 | 4332094 | 684011 | 71 | 32 |
| GMW08 0-0034 | MHAB | AA47782 | MHAB | 16-Jul-07 | Whitewater River | Barber Rd | 05080003080090 | 4350555 | 682955 | 71 | 40 |
| GMW08 0-0010 | KICK | 940826107 | KICK | 26-Aug-94 | Whitewater River | Harrison Rd | 05080003080120 | 4346931 | 687798 | 71 | 4.2 |
| GMW08 0-0010 | KICK | 970904101 | KICK | 04-Sep-97 | Whitewater River | Harrison Rd | 05080003080120 | 4346931 | 687798 | 71 | 5.6 |

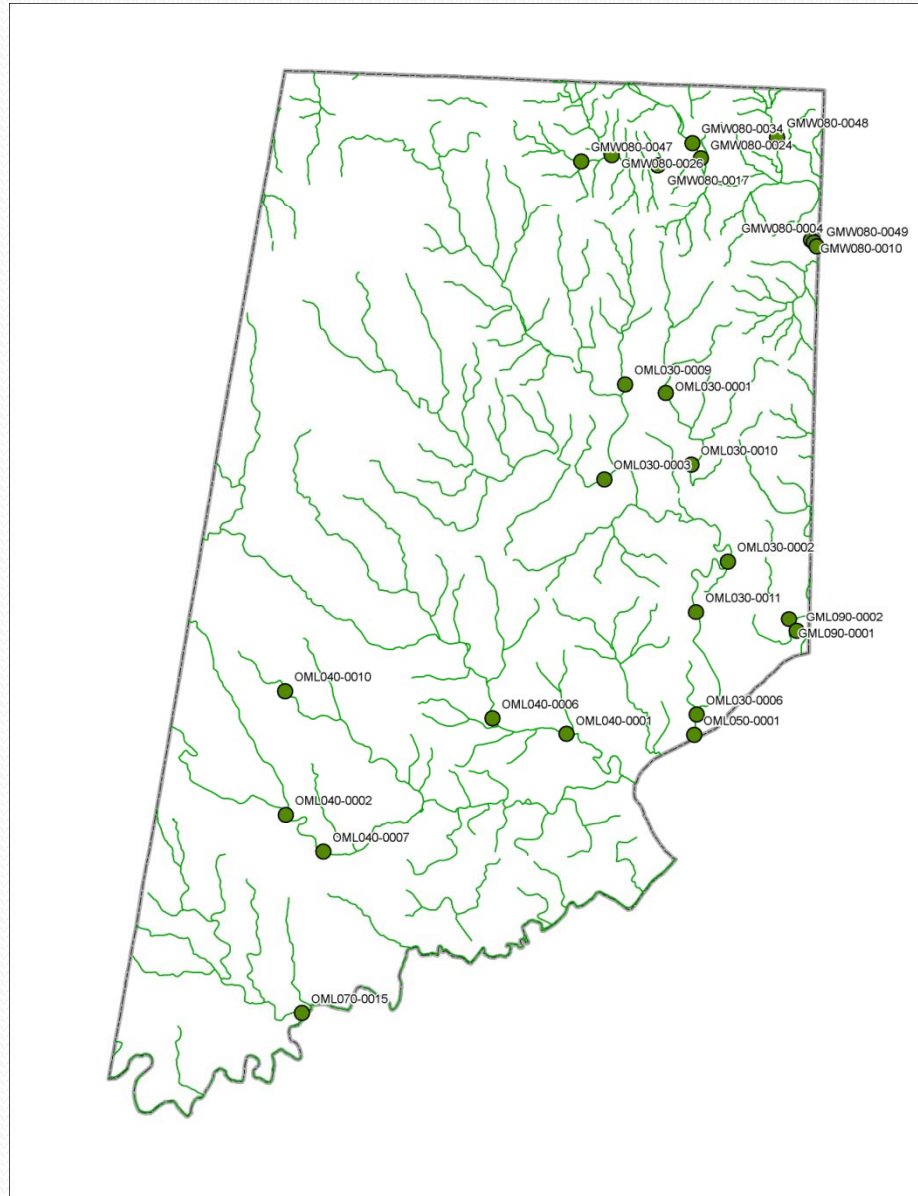


CHEMICAL MONITORING

- Monitoring includes:
 - Metals
 - Organic Compounds
 - Dissolved Oxygen
 - Dissolved Solids
 - Suspended Solids
 - pH
 - E. Coli
 - Chlorophyll
 - etc.



CHEMICAL MONITORING SITES



FISH TISSUE SAMPLING

- Provides data used to support Indiana's Fish Consumption Advisories (FCA) for the protection of sport and subsistence anglers.
- Some environmental contaminants have greater concentrations in animal tissue than in sediments and water due to bioaccumulation
- Two major contaminants of concern are mercury and polychlorinated biphenyls (PCBs)



Grouping Categories of the Indiana Fish Consumption Advisory:

| Total PCB | | | Mercury | |
|------------------|----------------------------------|-------------------------|----------------|-----------------|
| <i>Group</i> | <i>Skin-On Scaleless Fillets</i> | <i>Skin-Off Fillets</i> | <i>Group</i> | |
| 1 | 0 - 0.05 ppm | 0 - 0.036 ppm | 1 | <0.16 ppm |
| 2 | 0.06 – 0.2 ppm | 0.037 – 0.156 ppm | 2 | 0.16 - 0.65 ppm |
| 3 | 0.2 – 1.0 ppm | 0.157 – 0.676 ppm | 3 | 0.66 - 2.80 ppm |
| 4 | 1.1 – 1.9 ppm | 0.667 – 1.35 ppm | 4 | 2.81 – 5.6 ppm |
| 5 | >1.9 ppm | >1.36 ppm | 5 | >5.6 ppm |

ppm=parts per million (mg/kg) wet weight

Advisory Groups of the Indiana Fish Consumption Advisory:

- Group 1 Unrestricted consumption. **One meal per week for women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15.**

- Group 2 Limit to one meal per week (52 meals per year) for adult males and females. **One meal per month for women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15.**

- Group 3 Limit to one meal per month (12 meals per year) for adult males and females. **Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 do not eat.**

- Group 4 Limit to one meal every two months (6 meals per year) for adult males and females. **Women who are pregnant or breast-feeding, women who plan to have children, and children under the age of 15 do not eat.**

- Group 5 **No consumption (DO NOT EAT)**

Questions?

