Microcystin and Taste and Odor Compound Occurrence, Fate and Transport in central Indiana Surface Waters

- Dr. Lenore P. Tedesco
  Associate Professor, Earth Sciences
  Director, Center for Earth and Environmental Science
- N. Clercin, Angie Cowan, Michael Stouder
  Center for Earth and Environmental Science
- M. Gray
  Veolia Water Indianapolis
Indianapolis Drinking Water Supply
2008-2009 MIB and Geosmin: Central Indiana Reservoirs

MIB (ng/L)

<table>
<thead>
<tr>
<th>Eagle Creek</th>
<th>Geist</th>
<th>Morse</th>
</tr>
</thead>
</table>

Geosmin (ng/L)

<table>
<thead>
<tr>
<th>Eagle Creek</th>
<th>Geist</th>
<th>Morse</th>
</tr>
</thead>
</table>

Eagles Creek | Geist | Morse
Taste and Odor and Cyanobacteria: Eagle Creek Reservoir 2009

- **Geosmin (GE)**
  - Cyanobacteria peak Sept, 17th (491,880 cells/mL)
  - Geosmin peak Nov, 16th (136.8 ng/L)
  - No correlation due to lag time \( R^2 = 0.1284 \) in biosynthesis and release of geosmin

- **2-MIB**:
  - Two seasonal peaks of 2-MIB
  - In early spring during high flow period, with no/few cyanobacteria
  - In late summer/fall when cyanobacteria are present
  - Whole year \( R^2 = 0.3403 \)
  - Growing period of cyanobacteria \( R^2 = 0.6512 \), no/low reservoir inflows, from June, 1st
Goals

- Document MC and T&O sources outside of drinking water supply reservoirs
- Understand transport and dilution of transported metabolites and their impact to drinking water supplies
- Isolate reservoir production on MC and T&O from foreign sources

Poor correlations between cyanobacterial blooms and taste and odor episodes led to questions of sources.
Approach

- High-frequency storm sampling of streams upstream of drinking water assets
- Small lake and stormwater basin reconnaissance sampling
- Stormflow monitoring of outflows to drinking water source streams
- Downstream sampling of reservoir outflows

Funded by Veolia Water Indianapolis through CIWRP

2008-2010 Microcystin and T&O Source and Transport Tracking in central Indiana
Indianapolis Drinking Water Supply

Legend:
- Surface Intake
- Highly Urban
- Service Area

Map showing locations of Indianapolis Drinking Water Supply including Eagle Creek, White River, and surrounding counties.
MIB & Geosmin: High-frequency Sampling through Spring Storms

White River
Eagle Creek Watershed: Taste and Odor
Eagle Creek Watershed MIB (Geosmin) Source Tracking

6/17/2009

2.94 (0) ng/L
69.04 (90.74) ng/L
4.11 (3.24) ng/L
2.96 (0) ng/L
2.88 (2.52) ng/L
0 ng/L
0 ng/L
2.66 (0) ng/L
6.99 (3.87) ng/L
2.9 (0) ng/L
69.04 (90.74) ng/L
4.11 (3.24) ng/L
0 ng/L
2.88 (2.52) ng/L
Fox Lake: Cyanobacteria and Taste and Odor Production

- **Cyanobacteria**
  - P. limnetica
  - L. redekei
  - P. agardhii
  - C. raciborski
  - R. curvata

- **Geosmin**
- **MIB**

**Graph Details**
- **X-axis**: Dates from Jun-09 to Apr-10
- **Y-axis**: Cyanobacteria (cells/mL)
- **Z-axis**: Geosmin/MB (ng/L)

The graph shows the trend of cyanobacteria and geosmin/MB levels from June 2009 to April 2010, with peaks in March and April.
# Fox Lake and Downstream Transport

<table>
<thead>
<tr>
<th>Date</th>
<th>Tcyno (cells/mL)</th>
<th>MIB (cells/mL)</th>
<th>Pseudanabaena (cells/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/29/2010</td>
<td>2,429</td>
<td>2.8</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>6,972</td>
<td>9.1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1,293,000</td>
<td>414.0</td>
<td>1,248,000</td>
</tr>
<tr>
<td>STORM EVENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/8/2010</td>
<td>5,800</td>
<td>2.3</td>
<td>2,857</td>
</tr>
<tr>
<td></td>
<td>65,600</td>
<td>29.0</td>
<td>46,400</td>
</tr>
<tr>
<td></td>
<td>1,795,700</td>
<td>800.0</td>
<td>1,760,000</td>
</tr>
</tbody>
</table>

Map showing Fox Lake and downstream transport between 86th St and 79th St. STORM EVENT highlighted with increased Tcyno and MIB values.
Downstream Transport of MIB (ng/L) (4-16-2010)

Prairie Creek Reservoir (4/11/10) Pseudanabaena 532,280 cells/mL
Downstream Transport of MIB (ng/L) (4-22-2010)

Prairie Creek Reservoir
Pseudanabaena - 1,228,300 cells/mL

- Drinking Water Intake
- Prairie Creek Reservoir

3.3 days travel time

<2.5
7,400
2,700
827
336
58
26
53
32
28
MIB Source and Downstream Transport

The chart shows the MIB concentration (ng/L) over different dates from April 9th to April 22nd, with data from various sources and downstream transport methods.

- Prairie Creek Reservoir
- Prairie Creek Outflow
- WR - Yorktown
- WR - 600W
- WR - Strawtown
- WR - 146TH
- WRN - Intake
- WR - Intake

The y-axis represents MIB concentration in ng/L, while the x-axis shows the dates from April 9th to April 22nd.
Distribution of Cyanobacteria and Diatoms vs MIB: White River (4/22/10)

Stephanodiscus spp.
Pseudanabaena limnetica vs MIB: White River

N=8
Indianapolis Drinking Water Supply

Legend
- Surface Intake
- Highly Urban
- Service Area

Map showing locations of Hendricks, Hamilton, Marion, and Johnson counties, with Fall Creek marked.
Downstream Trends: Cyanobacteria and Microcystin
Downstream Trends: MIB and Geosmin
Center for Earth and Environmental Science

Applied Interdisciplinary Solutions for Environmental Problems

www.cees.iupui.edu