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Green(e)Fest
April 2016

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Service Learning Intensive - a teaching and learning pedagogy that engages faculty, students, and community members in a partnership to:

- Achieve academic learning objectives
- Meet community needs
- Promote civic responsibility, the “citizen scientist”
- Reflect on the learning experience

- Good Laboratory Practices
- Standard Operating Procedures
- EPA methods
- Contributions by 60 students, so far . . .
Think of Glen Helen as a Living System

People and things go in

Glen Helen transforms them

People and things leave
Water Flow Through The Glen

**Water In**

- Yellow Springs Creek at Highway 68
- Overflow from Lift station
- Birch Creek from the north
- Stormwater drains from the Village of Yellow Springs
- Wastewater Treatment Plant (Permit OH0028212)
- Morris Bean wastewater pond effluent (Permit OH0040576)

**Water Out**

- Yellow Springs Creek at the Old Covered Bridge and into the Little Miami River
- Water seep in the well field and to the water treatment plant
Sample Sites

- **HWY68** Yellow Springs Creek north entry into Glen Helen
- **YSLS** Yellow Springs Creek at Yellow Springs Lift Station
- **YS** The Yellow Spring
- **YSTMB** Yellow Springs Creek at Glen Helen Trailside Museum
- **BCSC** Birch Creek Stone Crossing
- **YSCUP** Yellow Springs Creek after Birch Creek input before TS input
- **TS** Traveler’s Spring
- **WWTP** Yellow Springs Wastewater Treatment plant effluent
- **YSCVB** Yellow Springs Creek at Covered Bridge, includes inputs from BCSC, TS, and WWTP
- **LMRG** Little Miami River at Grinnell Road Bridge, prior to input from Yellow Springs Creek
- **MOR** Morris Bean effluent
- **JRS** Jacoby Rd Spring near Birch Manor House
- **LMR** Little Miami River at Jacoby Rd Canoe Access, includes inputs from YSCVB, LMRG, MOR, and JRS
Parameters Studied

- Anions
  - Nitrate, nitrite, phosphate (nutrients)
  - Fluoride, chloride, bromide, sulfate
  - EPA Method 300

- Turbidity

- E. coli
  - 3M Petri Plates

- Standard parameters
  - Dissolved oxygen
  - Temperature
  - Conductivity
  - Ammonia
  - YSI Multimeter

- Metals
  - As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, Sr, Zn
  - EPA Method 200
Nitrate-Nitrogen concentrations at all sampling sites (mg/L)

- JRS
- HWY68
- YS**
- LMR
- YSTMB
- YSLS
- YSCVB
- LMRG
- WWTP
- BCSC
- YSCUP
- TS
- MOR*

*No effluent to sample
**YS was below detection limit

EPA Drinking Water Limit (10 mg/L)

- Sept. 28
- Oct. 26
- Nov. 16

2015
Trends in Nitrate Concentration
Yellow Springs and Birch Creeks Entering Glen Helen

\[ y = 0.0072x - 286.22 \]
\[ R^2 = 0.5765 \]

\[ y = -0.0019x + 88.231 \]
\[ R^2 = 0.1116 \]
Trend in Nitrate Concentration Entering Glen Helen from Wastewater Treatment Plant

\[ y = -0.0092x + 407.12 \]
\[ R^2 = 0.1489 \]
Trend in Nitrate Concentration at the Covered Bridge Leaving Glen Helen

\[ y = -0.0049x + 217.38 \]

\[ R^2 = 0.1844 \]


2011-2015
Nitrate Concentration at Various Wells Surrounding Little Miami River (mg/L)

Nitrate-Nitrogen Concentrations at Various Wells Surrounding Little Miami River (mg/L)

**Site**
- JRS
- YSMW
- Well-A
- Well-B*
- Well-C
- Well-D
- Well-E
- Well-F
- Well-G

*Water treated by RO or filtration
Nitrate Analysis Summary

- Nitrates in drinking water usually originate from fertilizers or from animal and human wastes
- Nitrate-Nitrogen was found in some wells at levels that exceed the EPA Drinking Water Limit of 10 mg/L
- Citizens who have wells that are contaminated may not be aware
- Infants below the age of six months who drink water containing nitrate in excess of 10 mg/l could become seriously ill. Symptoms include shortness of breath and blue baby syndrome
- Treat water with Reverse Osmosis (up to 30 mg/L) or Ion Exchange (EPA and Health Dept)
- No nitrate was detected in the Yellow Spring or in the Village Municipal Well
E. coli

- Bacteria found in feces
- Not all species are dangerous
- Some species can cause serious illness
- Water samples are cultured and incubated for 2 days
- Count colonies
E. coli Per 100 mL

EPA Recreational Limit 523

E. coli Colonies (per 100 ml)

*No data collected due to no effluent in drainage site

*Sept. 28  Oct. 26  Nov. 16

2015
Stormwater Samplers

HDPE Bottle
Stormwater Runoff – *E.coli*

**Before Rain Event**
07/22/2015 BCOSR

**After Rain Event**
07/27/2015 BCOSR
E. Coli Summary

- The water in Glen Helen is of high quality for the parameters tested, except for E. coli
- Although not required by OEPA, the Village of Yellow Springs should consider adding year-round treatment of WWTP effluent for bacteria because of the high potential of human and animal contact with Yellow Springs Creek, perhaps UV
- E. coli enters Glen Helen in extremely high amounts in runoff from precipitation
- E. coli was found in the Traveler’s Spring in 2014, 2015
  - People should not drink this water
  - Pets drinking from the Traveler’s spring or other places in Glen Helen could become sick
- It is important for people to pick up after their pets!
Morris Bean Outflow
NPDES Permit 1IN00095001

- Water from the wastewater pond should flow into Glen Helen from underneath the bike path
- For 5+ years the water has been flowing down sinkholes on the site
- Previous attempts to remedy the situation have failed
- Cannot monitor effluent
- Photo taken April 20, 2016
Since the Yellow Spring Municipal Wells are downstream, the village should consider setting timelines with OEPA and Morris Bean to permanently correct the situation by requiring a different method of wastewater management.
All parameters are within the EPA drinking-water limits, with an exception of iron.

Concentration of iron was detected to be 0.336 ppm, while the EPA drinking water limit for iron is 0.3 ppm.

Iron is described as a secondary contaminant. It is not hazardous in drinking water.

The iron deposits will normally affect the color and taste of the water, but it is not toxic to humans in small amounts.

Potential issues with manganese and strontium.
The **YELLOW SPRING (YS)**

No *E. coli*

All metals and anions below EPA National Primary Drinking Water Standards

Iron (Fe) is unusually high but not dangerous - 1.2 mg/L

\[ 4 \text{ Fe (dissolved)} + 3 \text{ O}_2 \text{ (air)} \rightarrow 2 \text{ Fe}_2\text{O}_3 \text{ (orange solid)} \]
Metal Concentrations in The Yellow Spring Sediment

<table>
<thead>
<tr>
<th>Metal (mg/kg dry weight)</th>
<th>TEC, Threshold Effect Concentration</th>
<th>The Yellow Spring Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic (As)</td>
<td>9.79</td>
<td>170</td>
</tr>
<tr>
<td>Cadmium (Cd)</td>
<td>0.99</td>
<td>4.04</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>No limit</td>
<td>24,892</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>35.8</td>
<td>11.1</td>
</tr>
</tbody>
</table>

**Remarkable Findings for Metals in The Yellow Springs Sediments**

- Sediments contained very high levels of arsenic
  - Arsenic in the water deposits in sediments over time as it emerges from the spring
  - The source of arsenic is likely natural minerals associated with iron deposits
  - This can occur in SE Ohio
- Sediments contained high levels of cadmium
- Sediments contained high levels of lead
- It is not advisable for people to handle sediments from the spring
- Iron concentrations in The Yellow spring sediments are 2 to 3 times greater than sediments at other sites at about 25,000 mg/kg dry weight, giving the sediment its characteristic orange color
In SUMMARY . . .

The GOOD NEWS!

- Water flowing from Glen Helen is cleaner than water flowing into it
- Glen Helen is a positive transforming force in the environment
- The protection of Glen Helen helps improve water quality in the region . . .

AND BEYOND!

The Challenges!

- *E. coli* in stormwater runoff
- *E. coli* from WWTP in winter
- Morris Bean wastewater pond discharge going down sinkholes
- Nitrate in agricultural runoff
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Thank You!

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