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Glen Helen Water Quality: A 5-Year Exploration, 2011-2015 (ACS)

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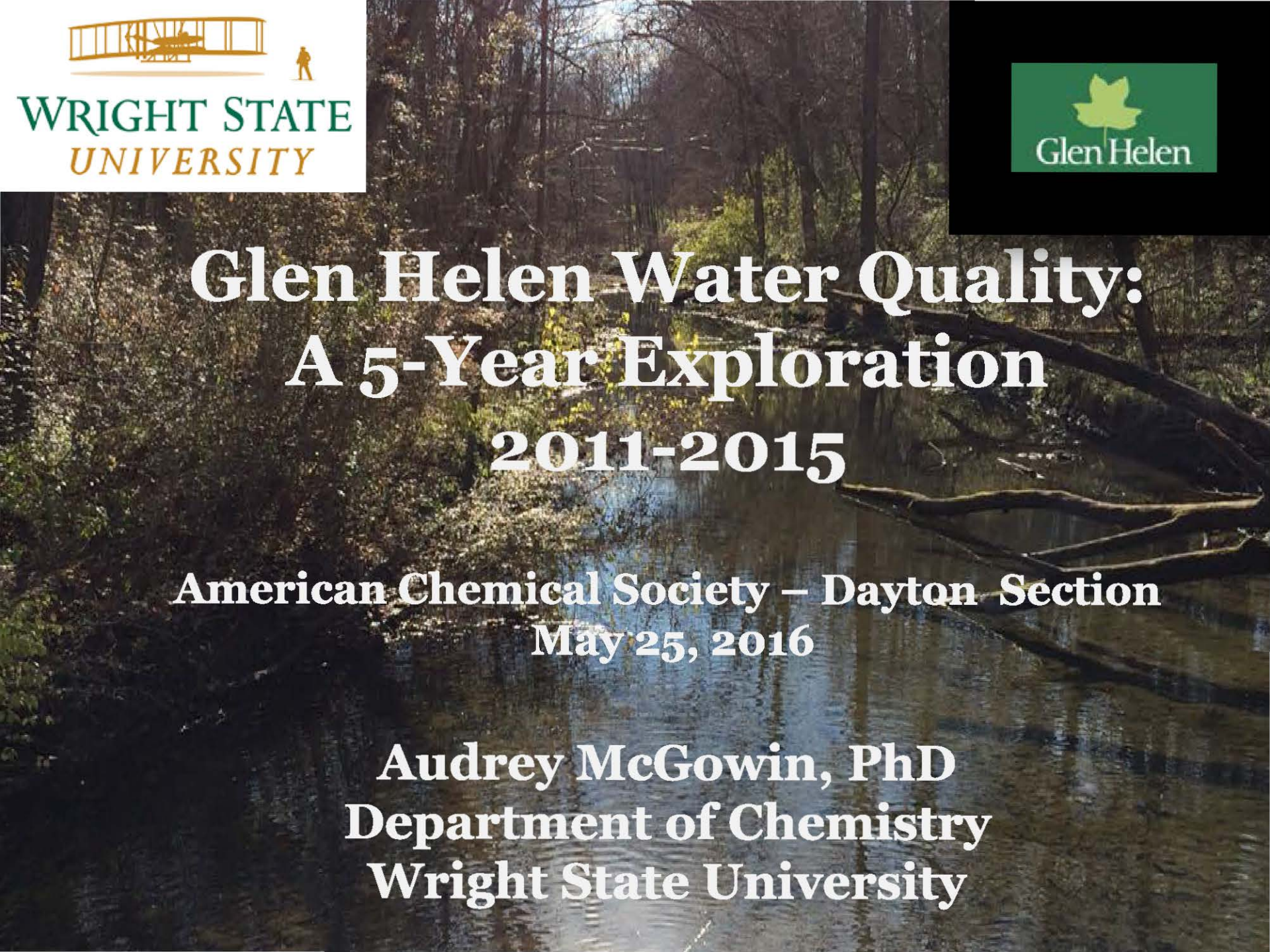


Glen Helen Water Quality: A 5-Year Exploration 2011-2015

American Chemical Society – Dayton Section
May 25, 2016

Audrey McGowin, PhD
Department of Chemistry
Wright State University

Historical Disconnect

Chemistry has been "Taught"

Mostly teacher talking

Students memorize

Students take exams

Labs provide some hands-on experience

75% lecture, 25% lab

Chemistry is Better "Learned"

Students engaged in learning experiences

Teacher facilitates experiences

Students solving problems

Students teaching each other what they have learned

Students reflect on learning

25% lecture, 75% lab

WSU CHM 4020/6020 Environmental Chemistry-SRVI

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

- Students achieve academic learning objectives by performing service
- Service meets community needs
- Promotes civic responsibility, the “citizen scientist”
- Students work in small groups
- Students reflect on the learning experience

Service experience is “real”

- Good Laboratory Practices (GLP)
- Standard Operating Procedures (SOP)
- EPA methods
- Contributions by 60 students, so far . . .

Citizen Science – A collaboration where members of the public participate in scientific research to meet real world goals; bird counts, hackathons, data analysis, solving cold cases, etc.

Versus

Citizen Scientist – A scientist who contributes to society by donating her/his scientific "powers" for the public good.

Reflection Rubric

CRITERIA	4 EXCELLENT	3 VERY GOOD	2 SATISFACTORY	1 NEEDS WORK	0 UNSATISFACTORY
Writing Quality – Do you convey your ideas intelligently and correctly?	Writing style clearly expresses meaning and viewpoints. Excellent grammar and syntax. No spelling errors.	Writing style clearly expresses meaning and viewpoints. Proper use of grammar and syntax. No spelling errors.	Writing style is clear and conveys meaning. A few grammar and syntax errors. No or few spelling errors.	Writing style mostly clear. Grammar and syntax need attention. Spelling errors.	Writing style is poor. Ideas are not clearly articulated. Improper use of grammar and syntax. Spelling errors.
Description of Service-Learning Activity – What measurements were taken and how was this accomplished?	Complete description of activities. Demonstrated clear knowledge of techniques used. Able to critically evaluate data and results.	Complete description of the S-L activities. Demonstrates adequate knowledge of techniques used and some insight into the imitations of techniques and interpretation of data.	Adequate description of S-L activity and personal role in collecting and evaluating data and presenting results. Demonstrates adequate knowledge of techniques used.	S-L activity reported as a sequence of events. Description of personal role in collecting and evaluating data and presenting results. Limited knowledge or techniques used.	Inadequate description of activity and personal role in collecting and evaluating data and presenting results.
Insights and Understanding – What did you learn in the course that related to your S-L activity? What did you learn doing the activity that reinforced course content?	Explains how course content is integrated into the project. Demonstrates awareness of complexity of the issues.	Some insights into significance of project. Explains how course content is related. Some sense of complexity of the issues.	Explains significance of results and how they are related to course content. Some sense of complexity but most insights are simplistic.	Report of work done with limited insight about how fieldwork is related to learning of course content.	No evidence of understanding how course content relates to work. No evaluation or interpretation of results.
Commitment to Project and Group – Has your experience affected your thinking about the issues and possible solutions? Did you overcome any problems?	Demonstrated commitment to the activity and group. Finds solutions to problems. Generates ideas for future work.	Description of personal participation in the activities of the project. Demonstration of a commitment to the activity and finding solutions to problems.	Description of personal participation in the activities of the project. Reliance on others to resolve problems or interpret results.	Description of personal participation in the activities of the project. Reliance on others to resolve problems or interpret results.	No evidence of a commitment to the project. Lack of participation in group's work or class discussion.
Personal Achievement and Development – Did any of the activities give you a sense of personal accomplishment? Have your goals or views changed?	Evaluation of the implications of results for self, S-L partner, and public. Evidence of impact on career goals or feelings of personal accomplishment	Expresses satisfaction with activities and results. Aware of impact on career goals or feelings of personal accomplishment	Explanation of a personal increase in sensitivity of the issues, or a change of attitude, and awareness.	Participant reports efforts but is unaffected by the project and the outcomes.	Negative attitude reported about work on project. Excessive boredom and frustration with little effort to find resolution.

***Adapted from, "A Service Learning Rubric," by David Burton, VCU Teaching, March 1999.**
Developed with guidance from AAC&U Value Rubrics by Francisco Acoba, Assistant Professor, English, Service-Learning Faculty Coordinator, in collaboration with Kristine Korey-Smith, Assistant Professor, Developmental Education, and Coordinator, Faculty Senate's Learning Outcomes Assessment Committee, and other engaged faculty at Kapi'olani Community College, University of Hawai'i.

Think of Glen Helen as a Living System

People and things go in

Glen Helen transforms them

People and things leave

Glen Helen Association – Partner Concern:

What are the chemical threats to this system?

Water Flow Through The Glen

Water In

- Yellow Springs Creek at Highway 68
- Overflow from Lift station
- Birch Creek from the north
- The Yellow Spring
- 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
- Evaporation

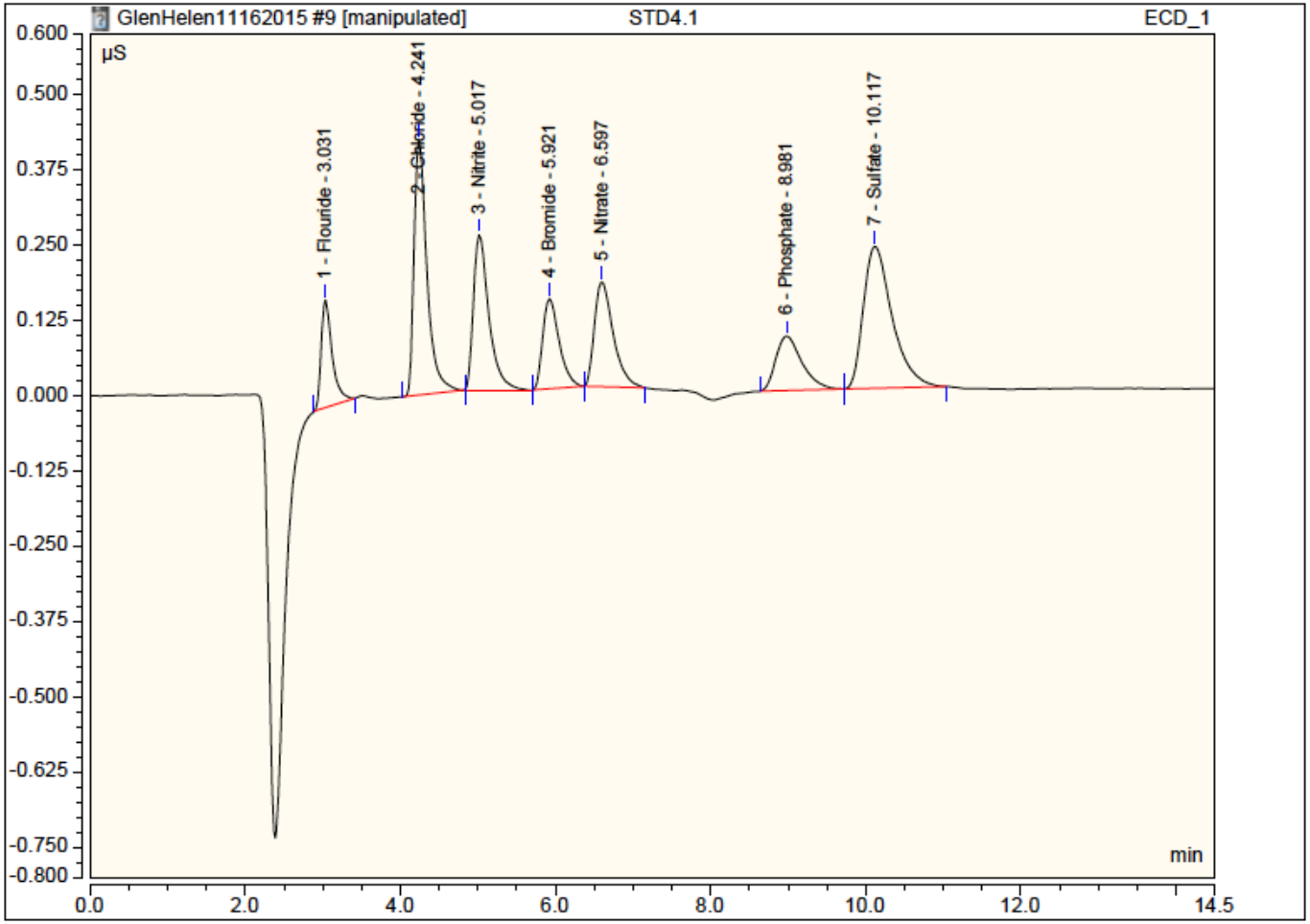
Sample Sites

- **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

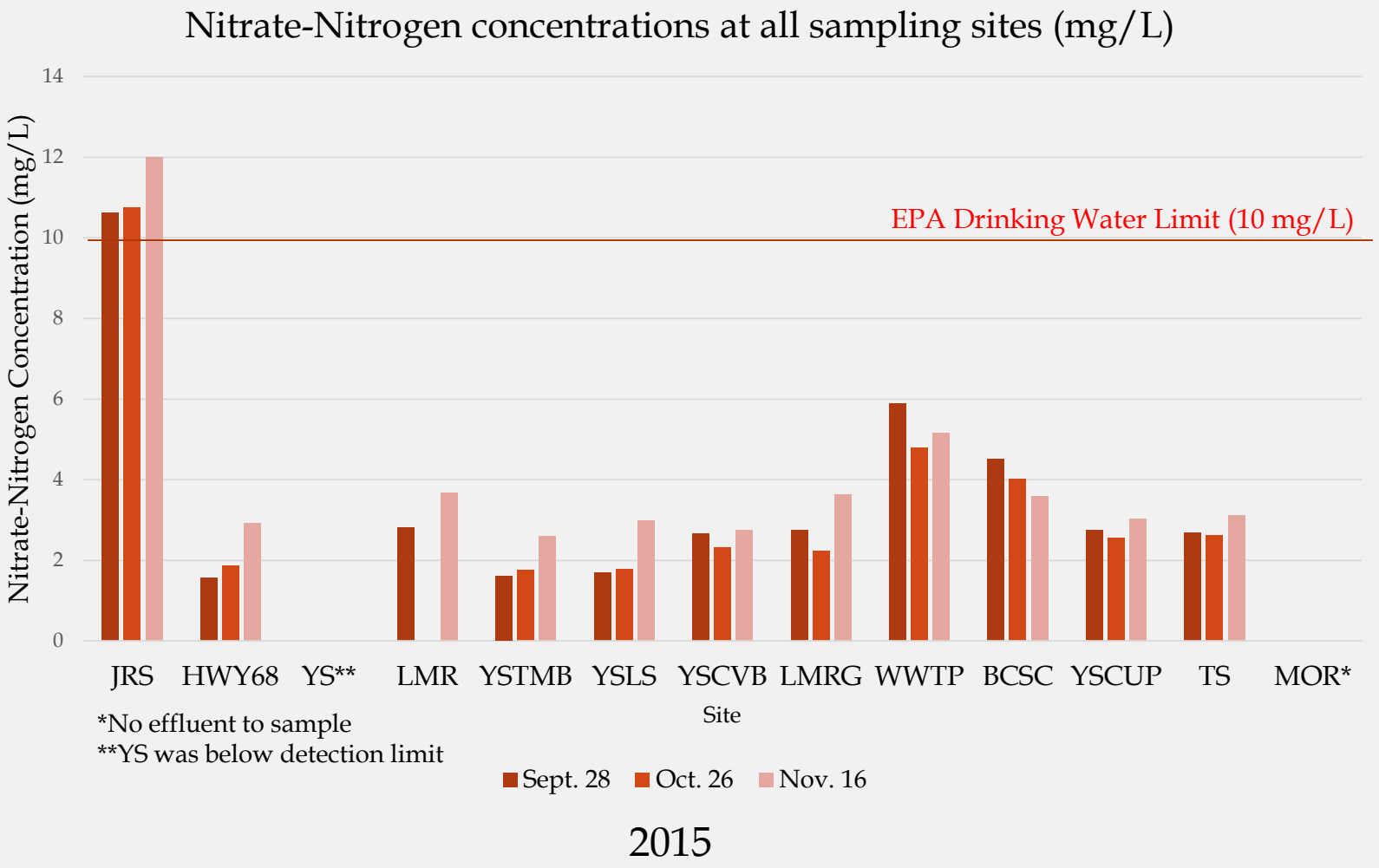
Parameters Studied

- Anions
  - **Nitrate**, nitrite, phosphate (nutrients)
  - Fluoride, chloride, bromide, sulfate
  - EPA Method 300.1
- 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

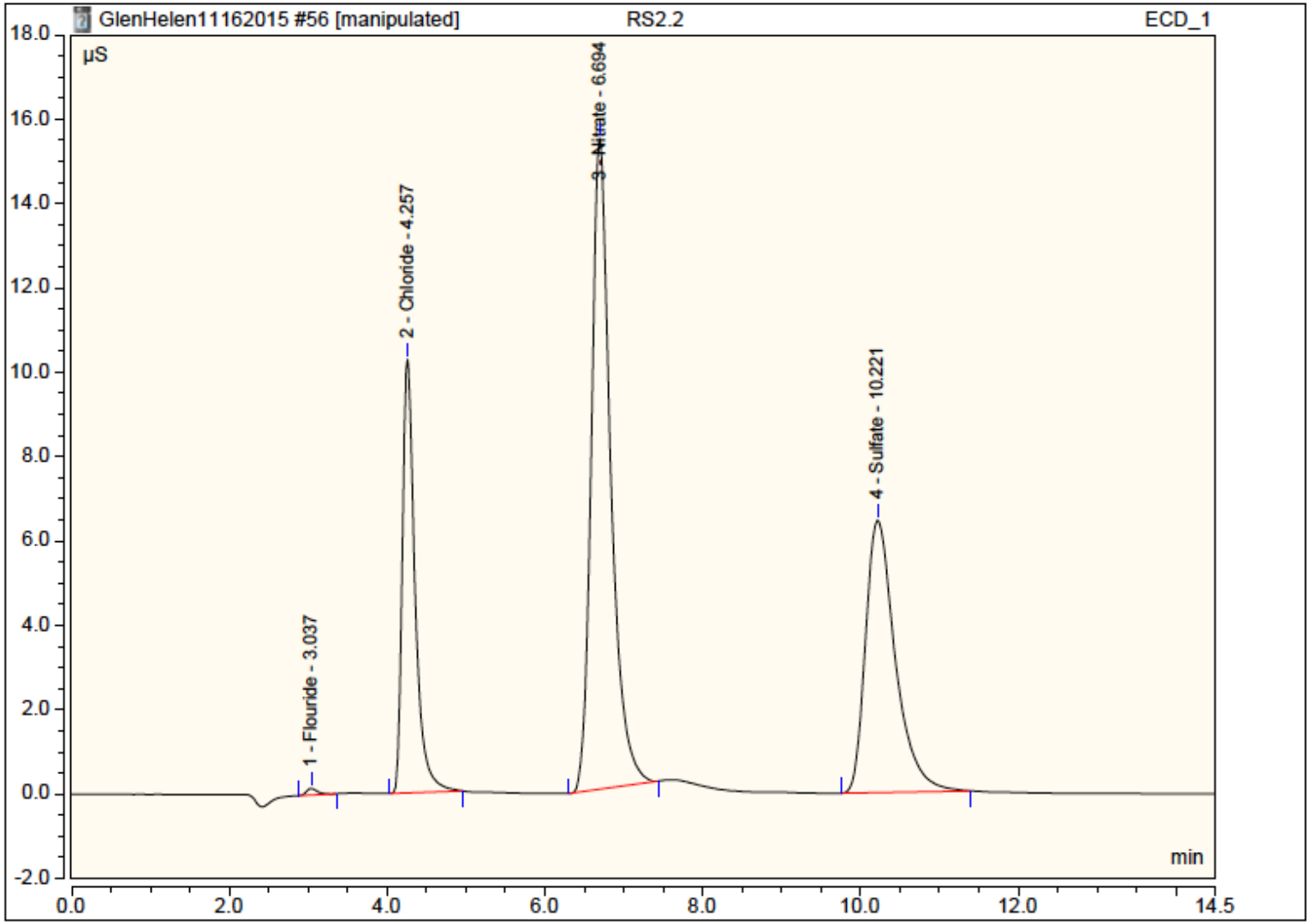
EPA Method 300.1
Determination of inorganic anions in drinking water by ion chromatography

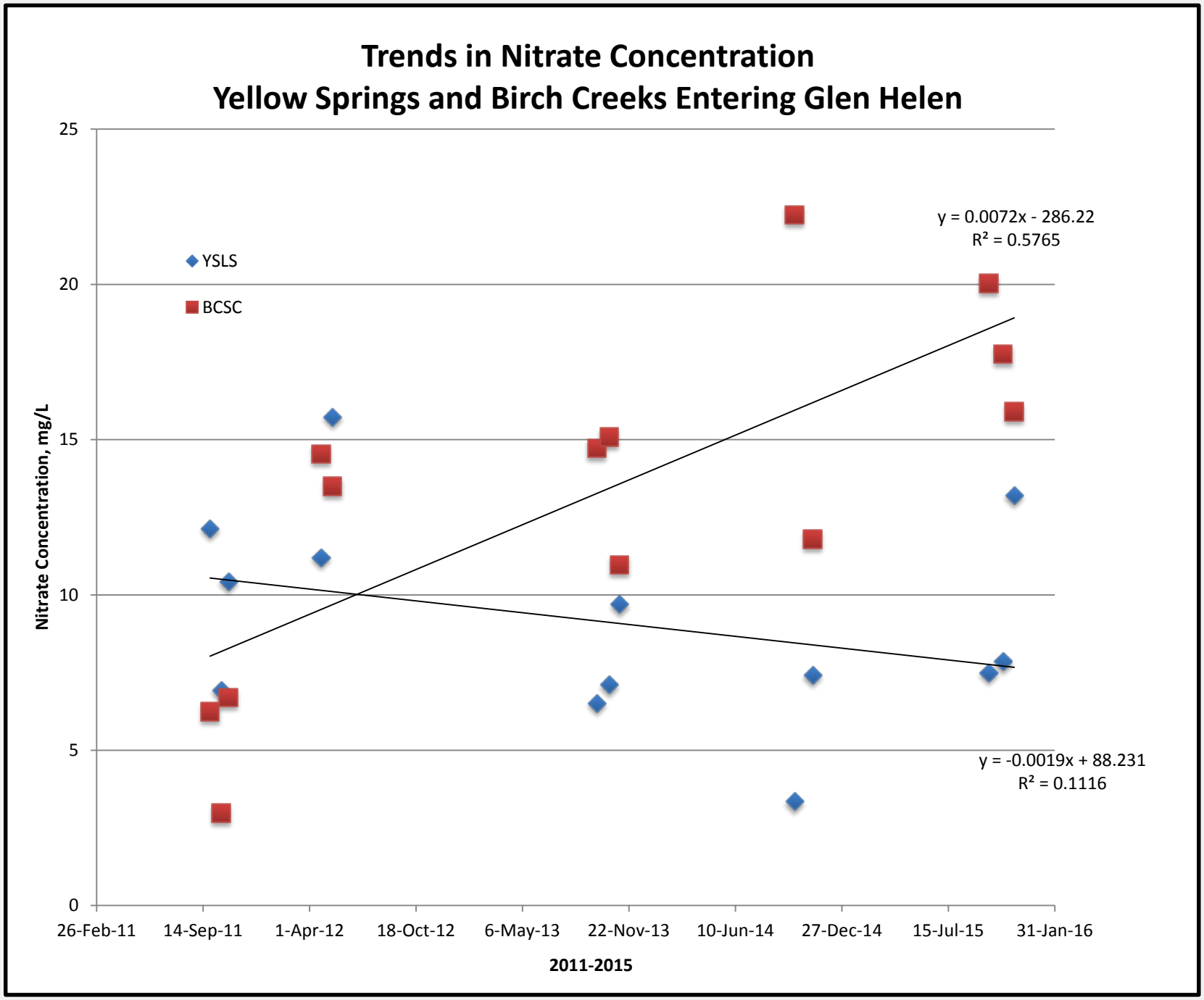


Nitrate-Nitrogen Concentrations

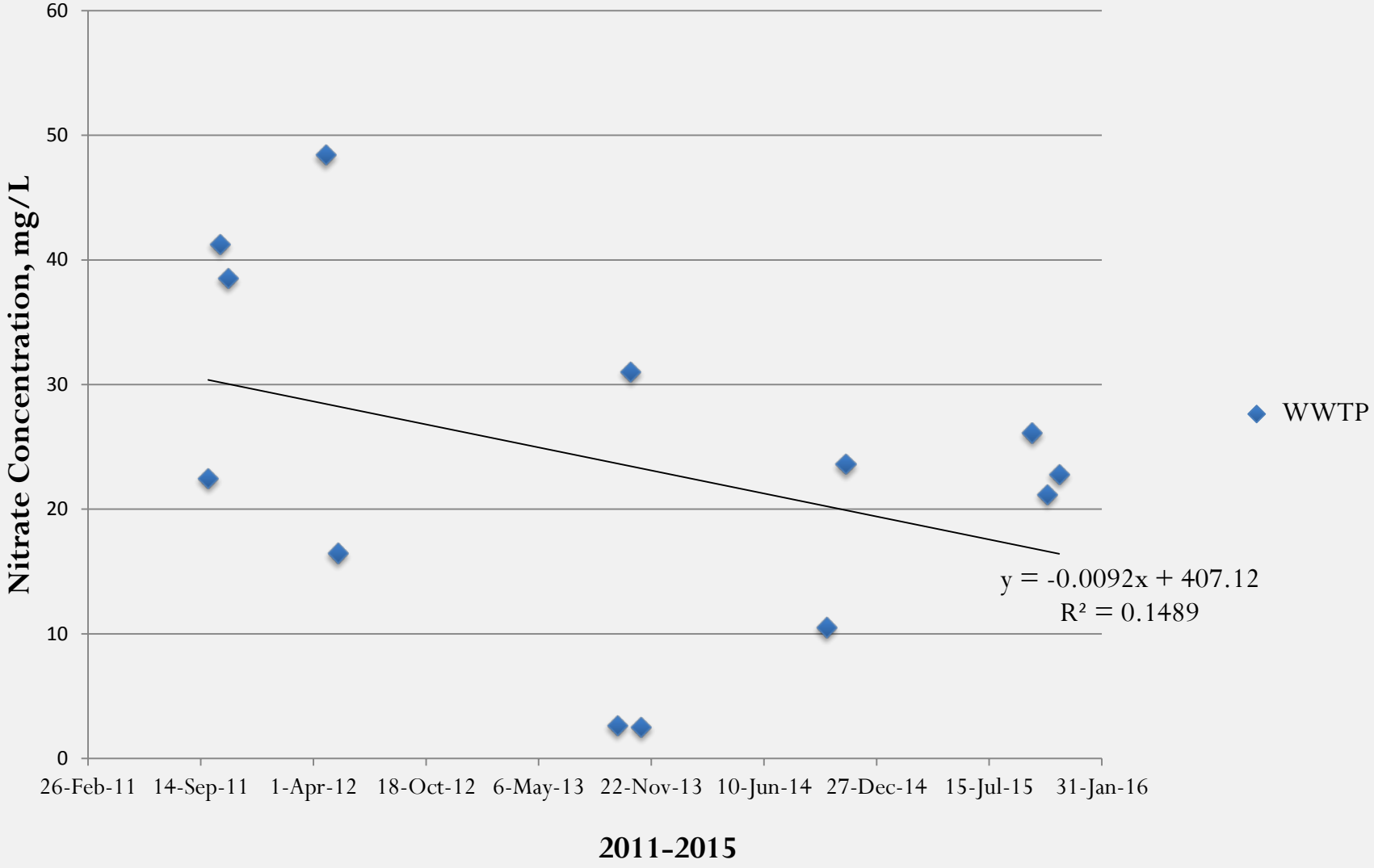


Contaminated Well Sample

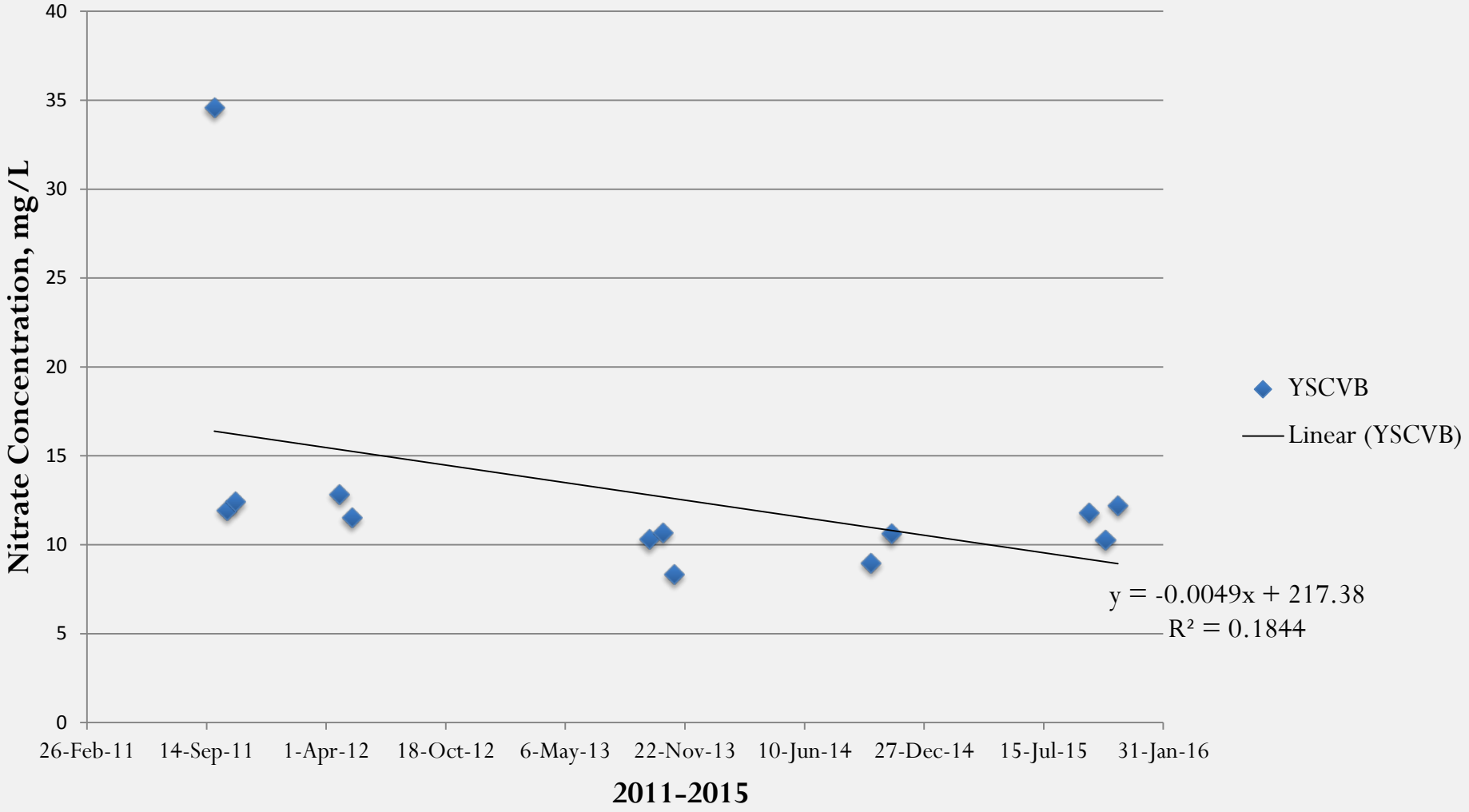



Trends in Nitrate Concentration
Yellow Springs and Birch Creeks Entering Glen Helen
Nitrate Concentration, mg/L
25
20
15
10
5
0
YSLS
BCSC
y = 0.0072x - 286.22
R² = 0.5765
y = -0.0019x + 88.231
R² = 0.1116
26-Feb-11
14-Sep-11
1-Apr-12
18-Oct-12
6-May-13
22-Nov-13
10-Jun-14
27-Dec-14
15-Jul-15
31-Jan-16
2011-2015

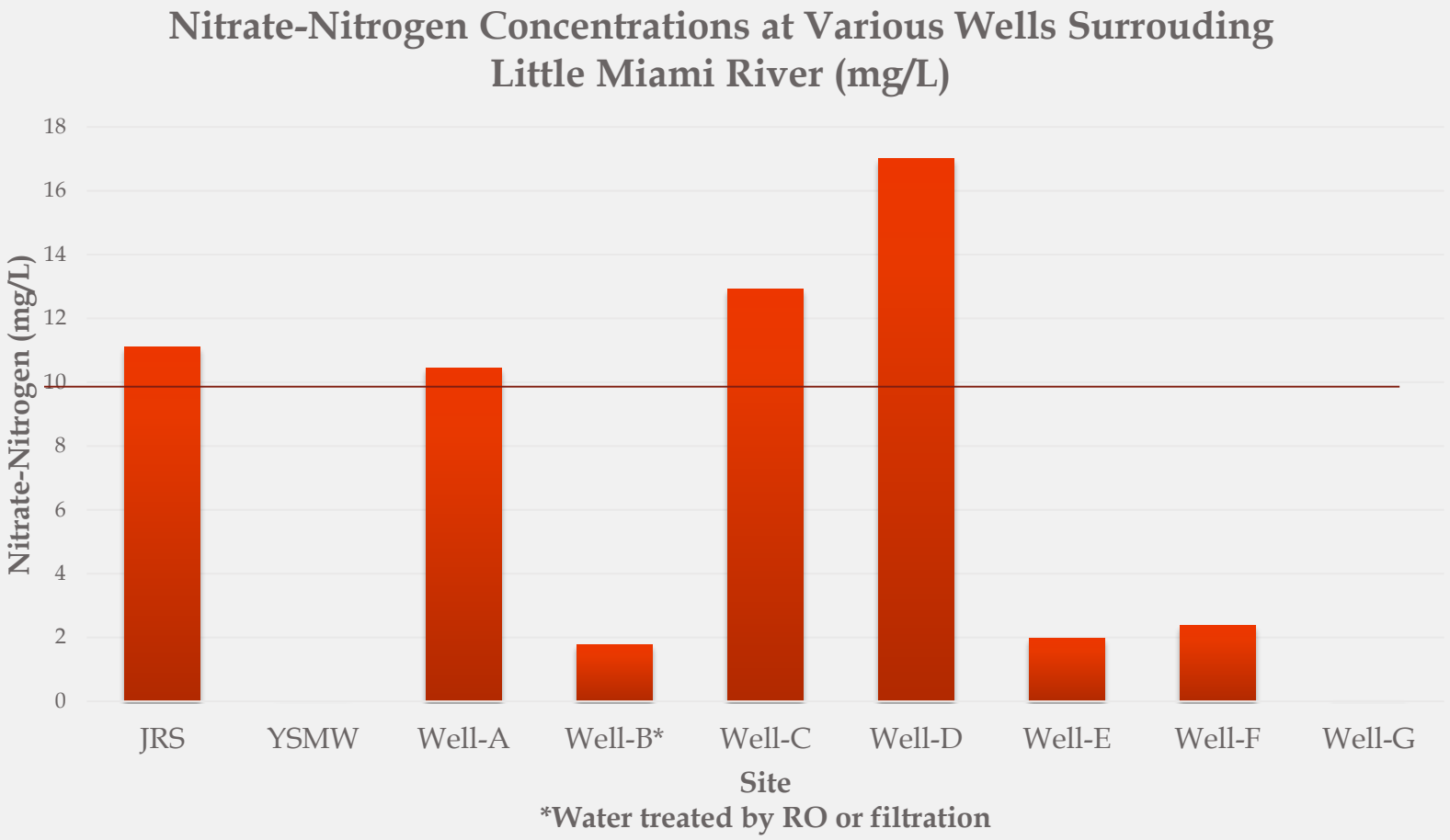
Trend in Nitrate Concentration Entering Glen Helen from Wastewater Treatment Plant



Trend in Nitrate Concentration at the Covered Bridge Leaving Glen Helen



Nitrate Concentration at Various Wells



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

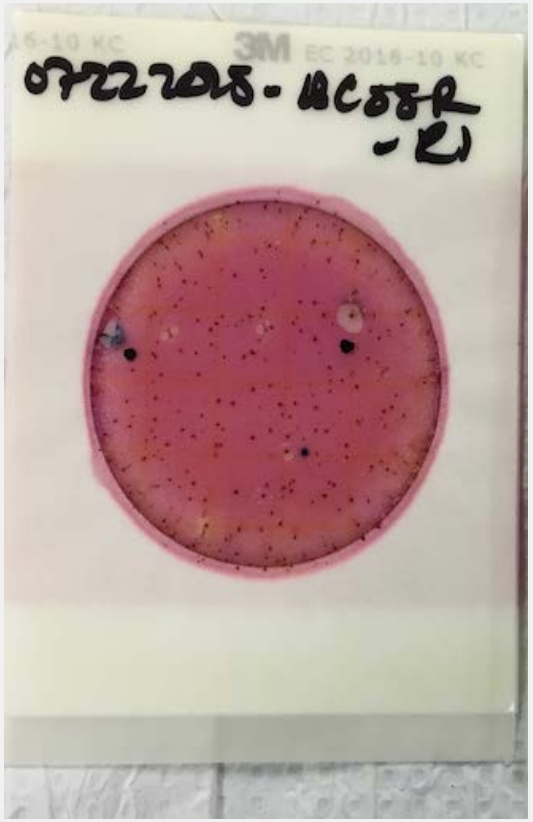
2015

Stormwater Samplers

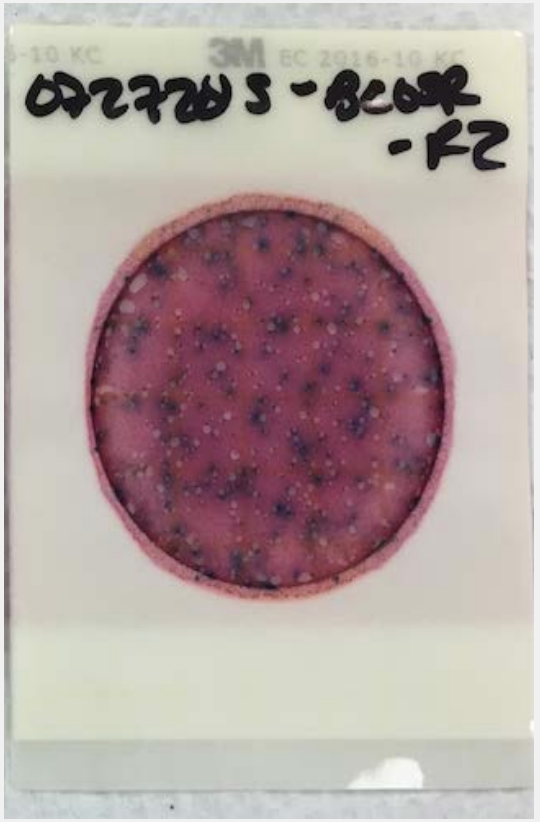
HDPE Bottle

Stormwater Runoff – *E.coli*

Before Rain Event
07/22/2015 BCOSR



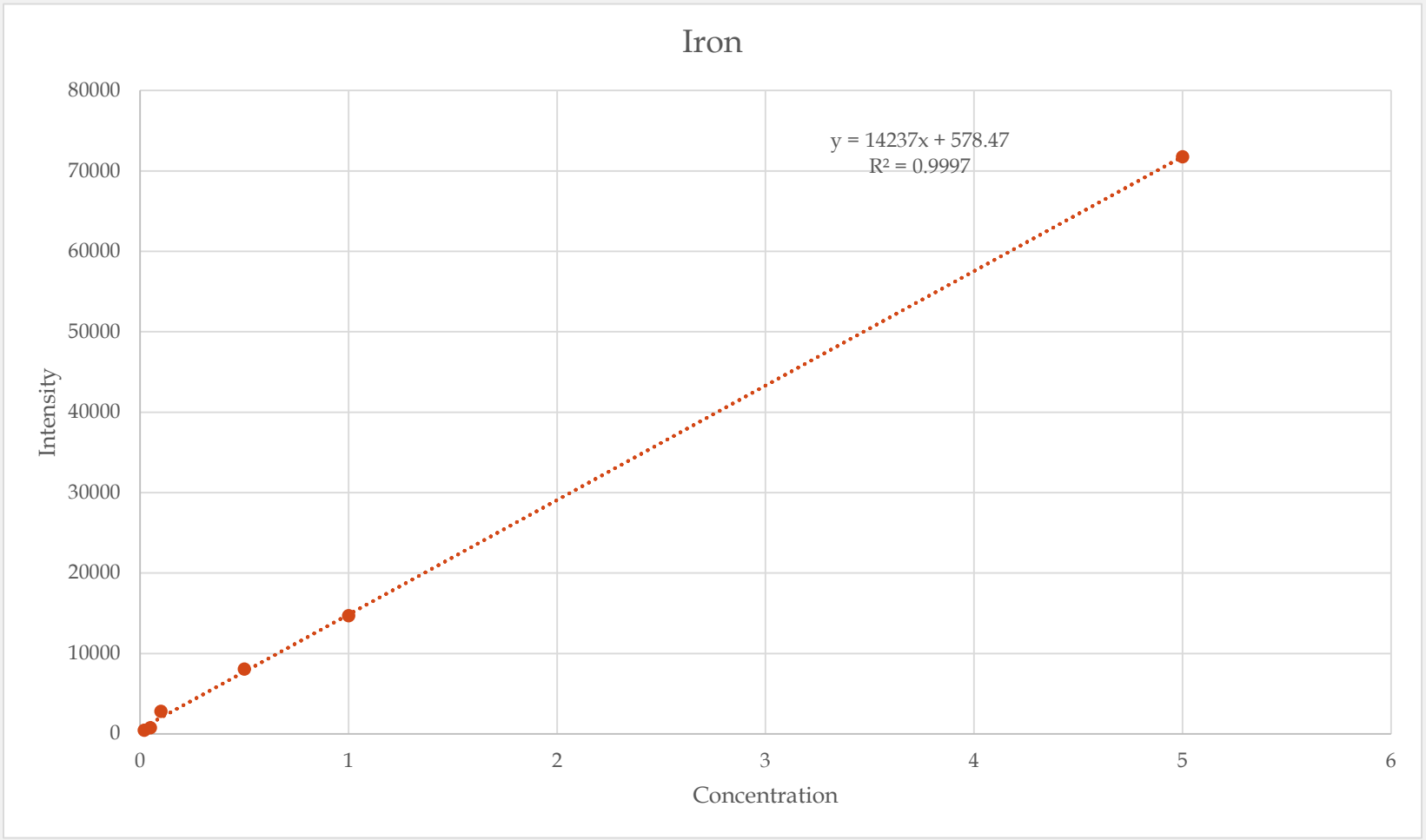
After Rain Event
07/27/2015 BCOSR



E. Coli Summary

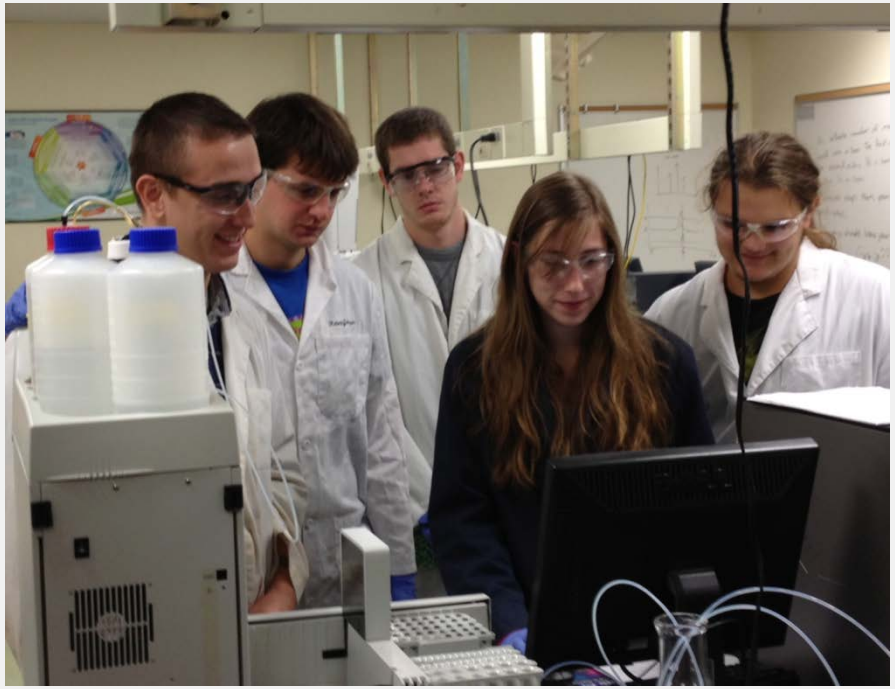
- The water in Glen Helen is of high quality for the parameters tested, except for *E. coli*
- *Although not required by OEPA, the Village of Yellow Springs should consider adding year-round treatment of WWTP effluent for bacteria because of the high potential of human and animal contact with Yellow 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!**

EPA Method 200.7: Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry



Yellow Springs Municipal Well (YSMW)

- 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 Fe (dissolved) + 3 O_2 (air) ➔ **2 Fe_2O_3 (orange solid)**

Metal Concentrations in The Yellow Spring Sediment

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

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

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

Class Recommendation:

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

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 and toward municipal well
- Nitrate in agricultural runoff

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Thank You!

Steve Trohalaki and the Dayton-ACS

Mr. Nick Boutis, Executive Director, Glen Helen Ecology Institute

Glen Helen Staff: Mr. Shahkar Strolger, Mr. George Bieri,

Mr. Ben Silliman, Ann Simonson, Tina Spencer

Dr. David Kammler, Antioch College

Mr. Joe Bates and Mr. Brad Ault and staff at WWTP

Ms. Jessica Clemmons and YSI/Xylem

Dino's Cappuccinos

(helped keep students warm and gave us ice to keep samples cold)

Mr. Garrett VanNess, laboratory assistance

Wright State University Department of Chemistry funding

Sture Fredrik Anliot Fund for stormwater analysis funding

Class posters available in WSU Libraries CORE Scholar

http://works.bepress.com/audrey_mcgowin/