Chris Jones, Research Engineer, IIHR Hydroscience and Engineering

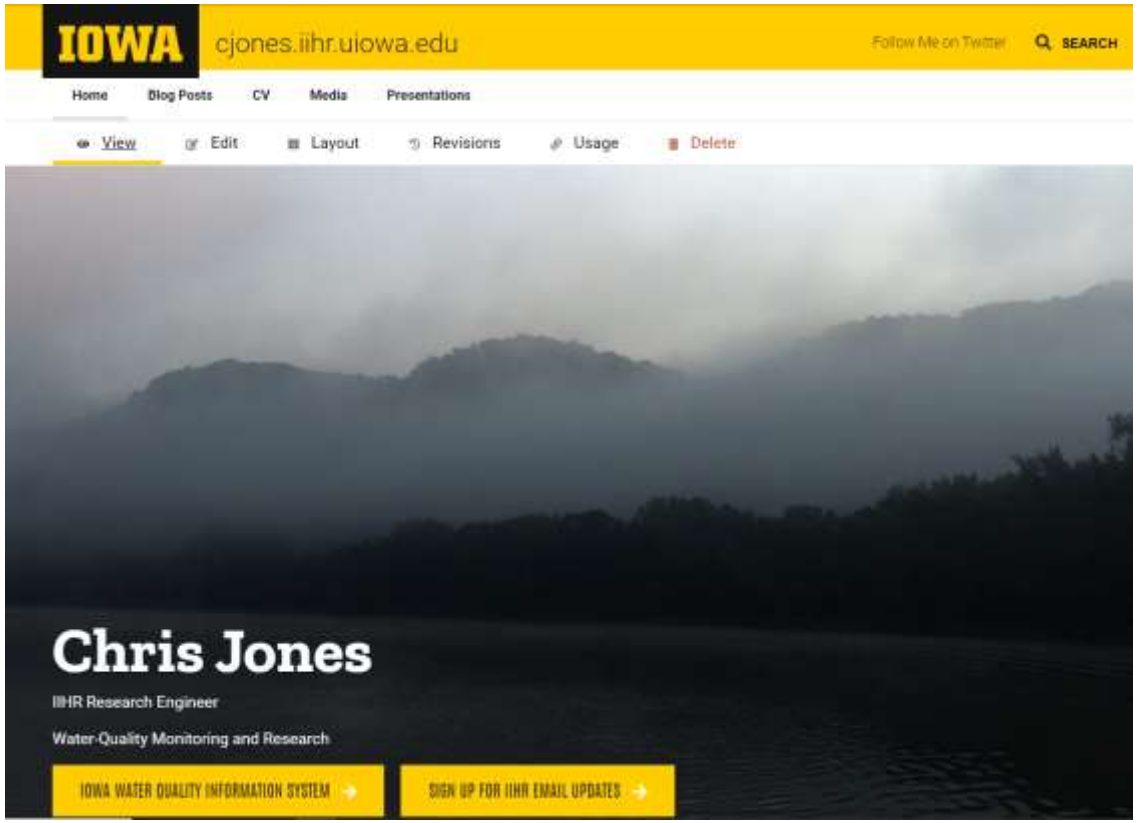
Iowa Nutrient Research Center

IIHR-UI Water Monitoring

October 12, 2022

Slides Available at:

https://cjones.iihr.uiowa.edu/



IIHR-Hydroscience and Engineering

102 years at UI

World-renowned center for education, research, and public service focusing on fluids.

Research Staff

51 Faculty Affiliates and PhD Research Staff

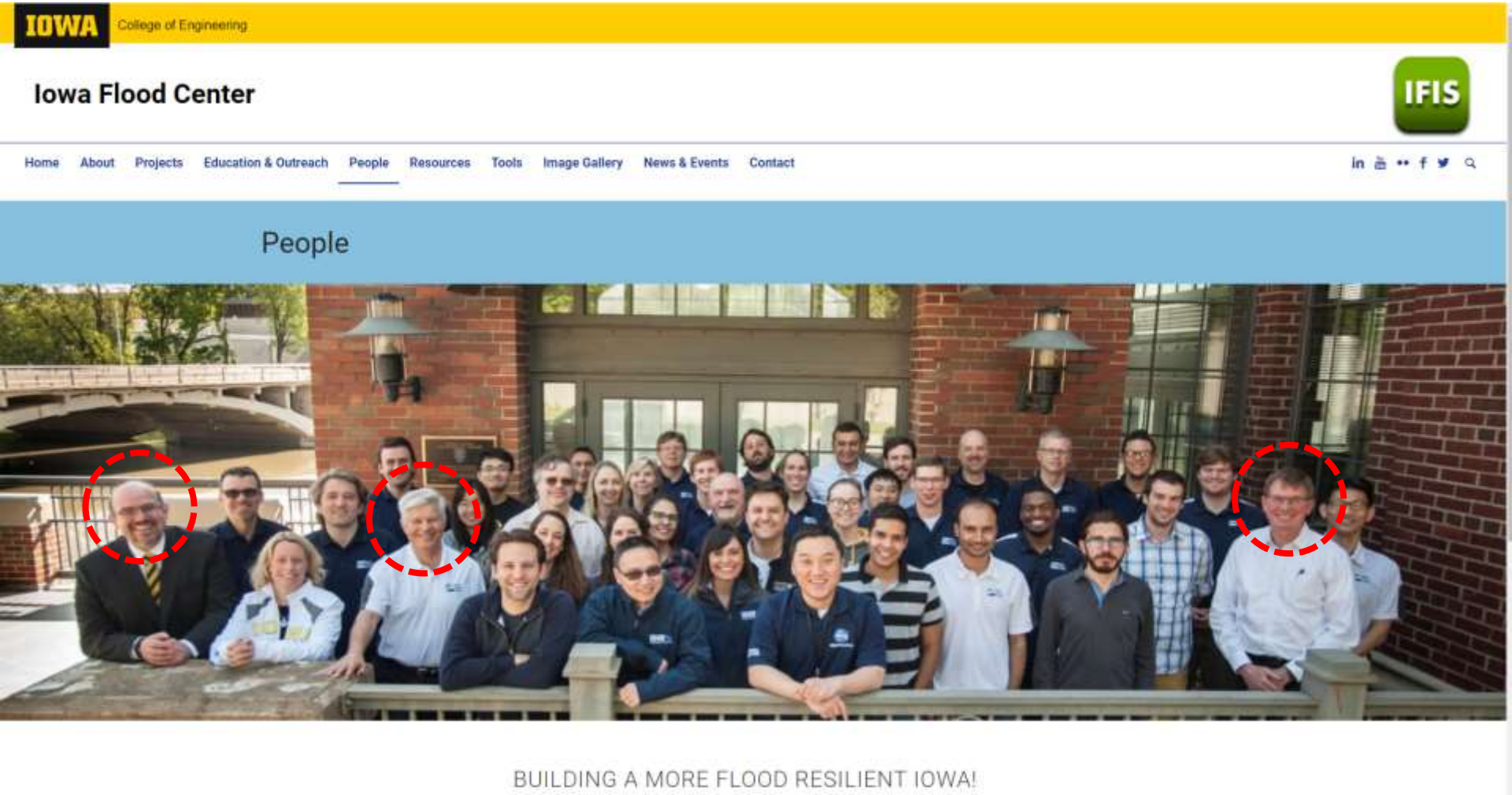
Professional Staff

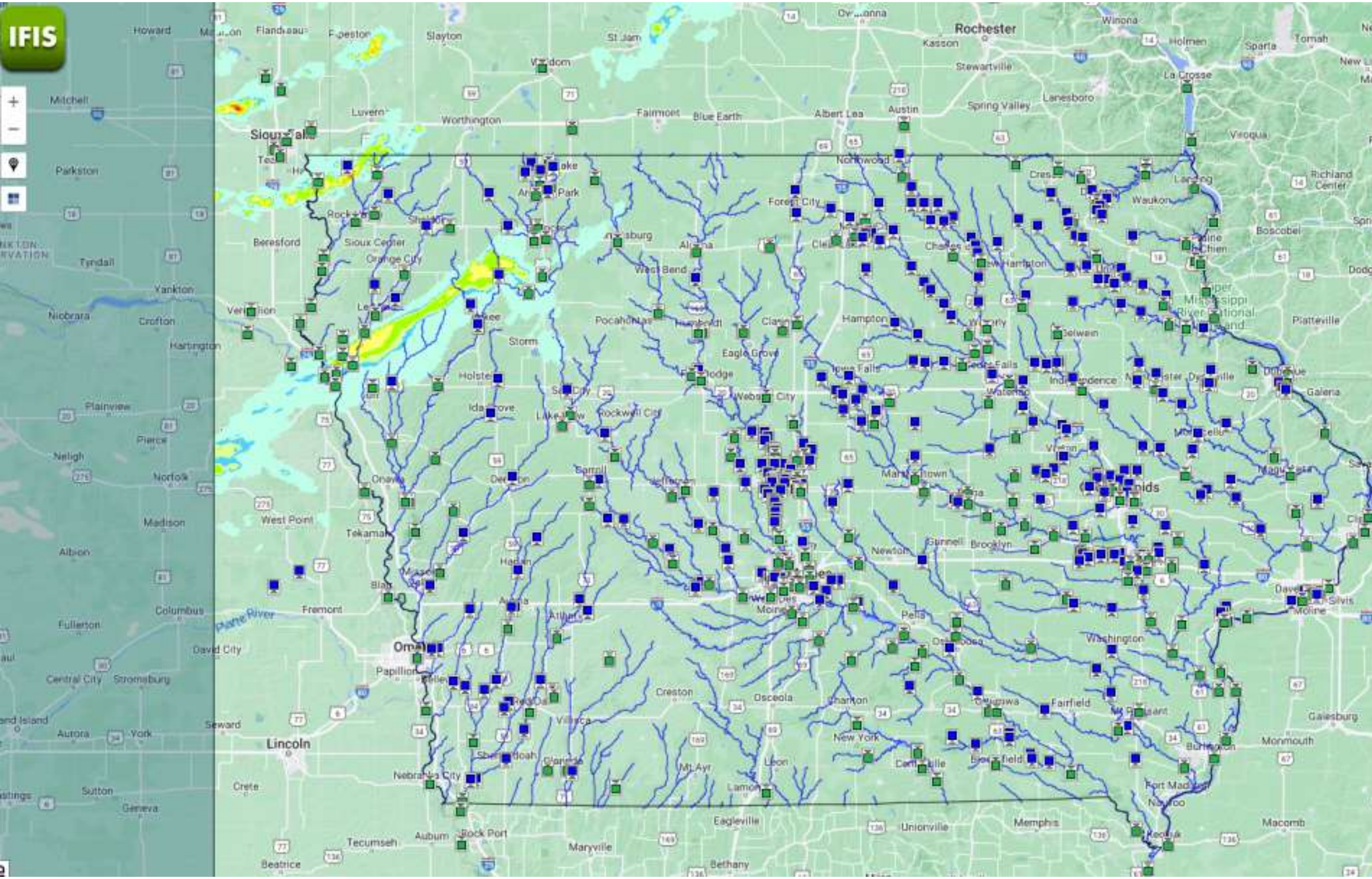
49 professional and support staff

Graduate Students and Post Docs

87 grad studens
12 post docs

Iowa Flood Center




IFIS
Rochester
Kasson
Stewartville
Winona
Holmen
La Crosse
Sparta
Tomah
Slayton
Worthington
Luverne
Fairmont
Blue Earth
Albert Lea
Austin
Spring Valley
Lanesboro
Viroqua
Howard
Mitchell
Parkston
Beresford
Sioux Center
Orange City
Tyndall
Yankton
Niobrara
Crofton
Hartington
Plainview
Pierce
Neligh
Norfolk
Madison
Albion
West Point
Tekamah
Columbus
Fullerton
Fremont
David City
Platte River
Papillion
Central City
Stromsburg
Seward
Aurora
York
Lincoln
Crete
Sutton
Geneva
Tecumseh
Auburn
Rock Port
Beatrice
Maryville
Bethany
Eagleville
Unionville
Memphis
Macomb
Monmouth
Galesburg
Platteville
Galena
Boscobel
Waukon
Lansing
Storm
Pocahontas
Humboldt
Eagle Grove
West Bend
Hampton
Newton
Brooklyn
Grinnell
Washington
Fairfield
Creston
Osceola
New York
Chariton
Leon
Lamoni
Mt Ayr
Villisca
Clarinda
Nebraska City
Webster City
Rockwell City
Independence
Monticello
Holstein
Denison
Harlan
Atlantic
Storm Lake
Charles City
Forest City
Northwood
Dubuque
Moline
Burlington
Fort Madison
Keokuk
Nauvoo
Marshalltown
Waterloo
Oelwein
Pella

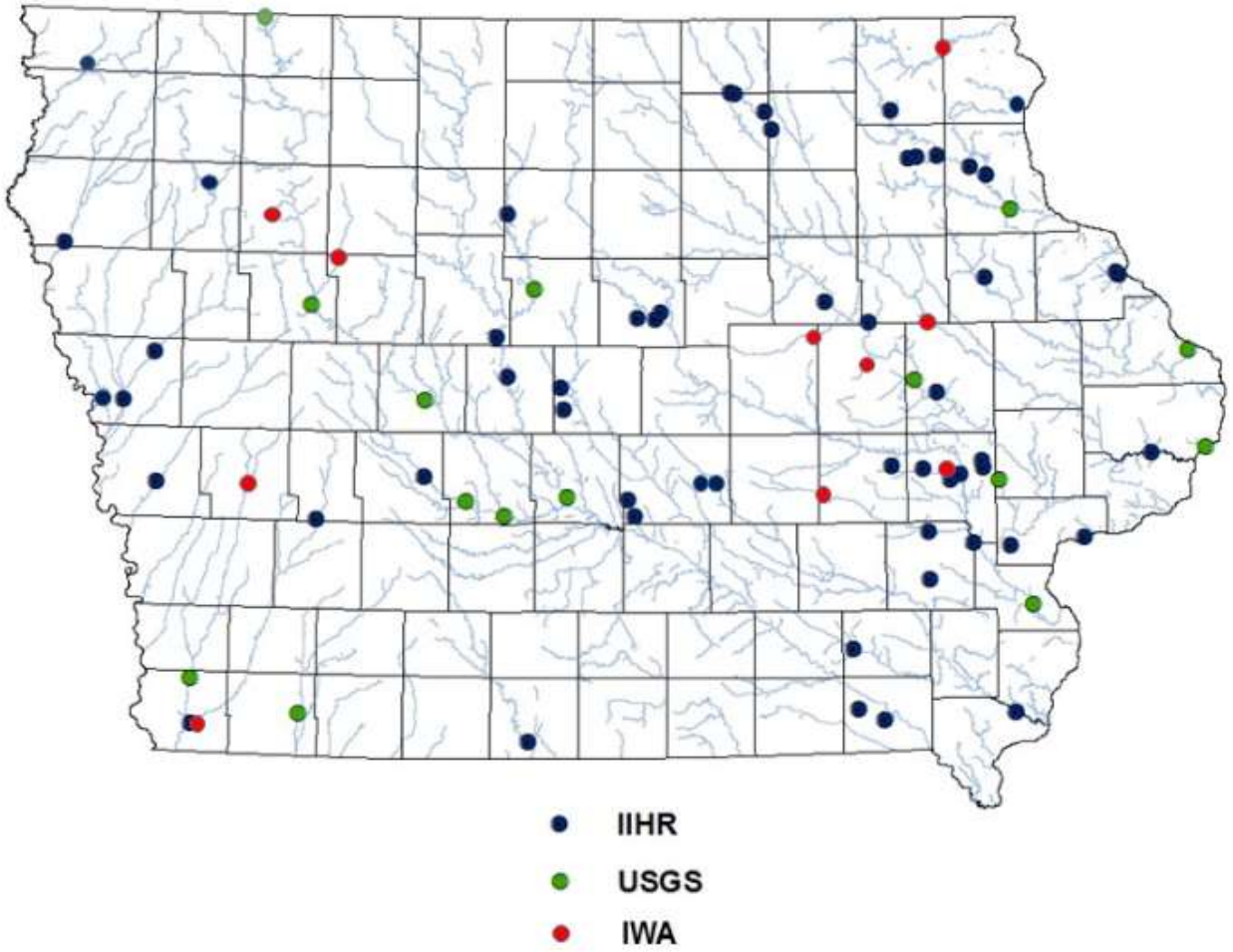
IIHR Water Quality Sensor Network

Sites

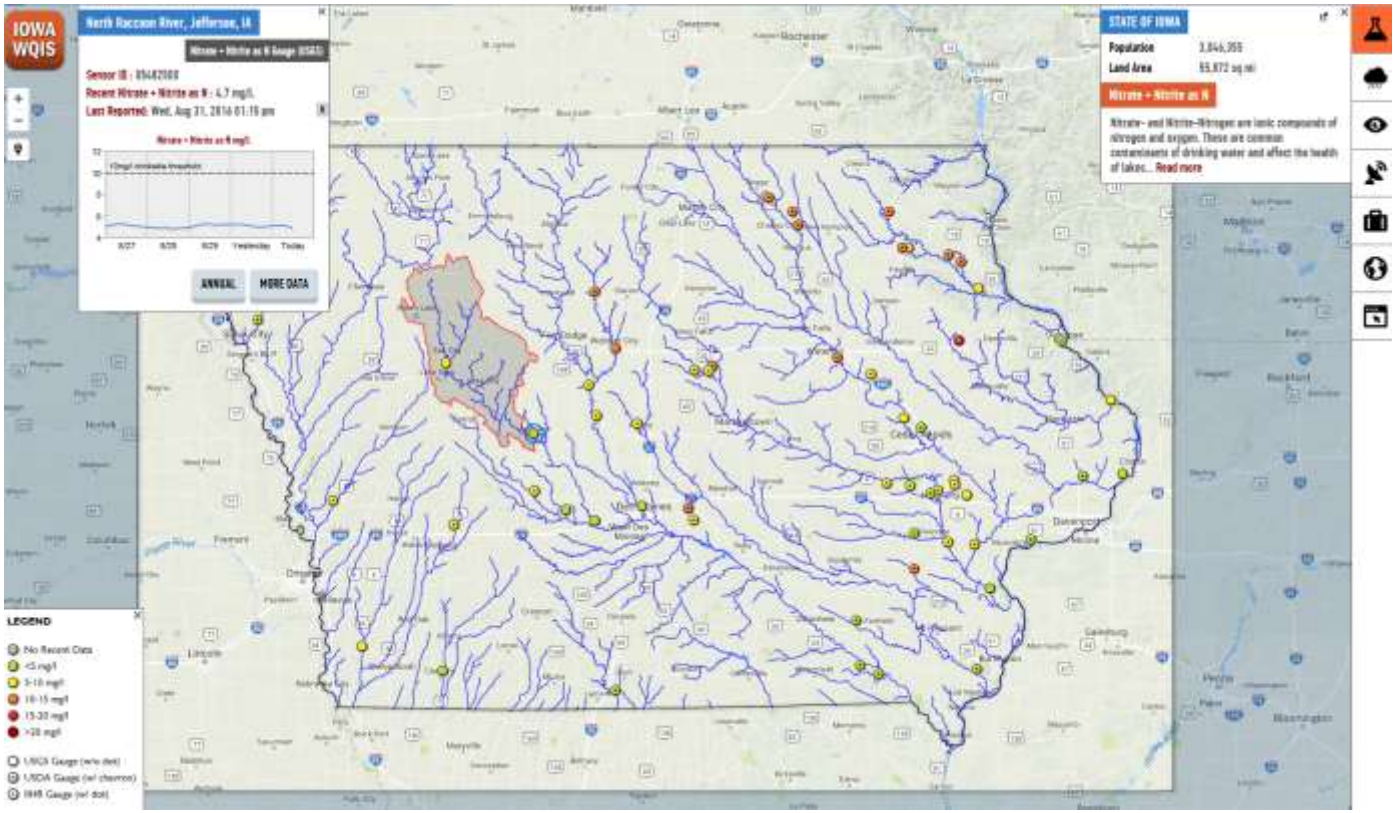
70+ sites
Nitrate-N

20-25 sites

- Temperature
- pH
- SC
- DO
- Turbidity



Iowa Water Quality Information System



iwqis.iowawis.org/

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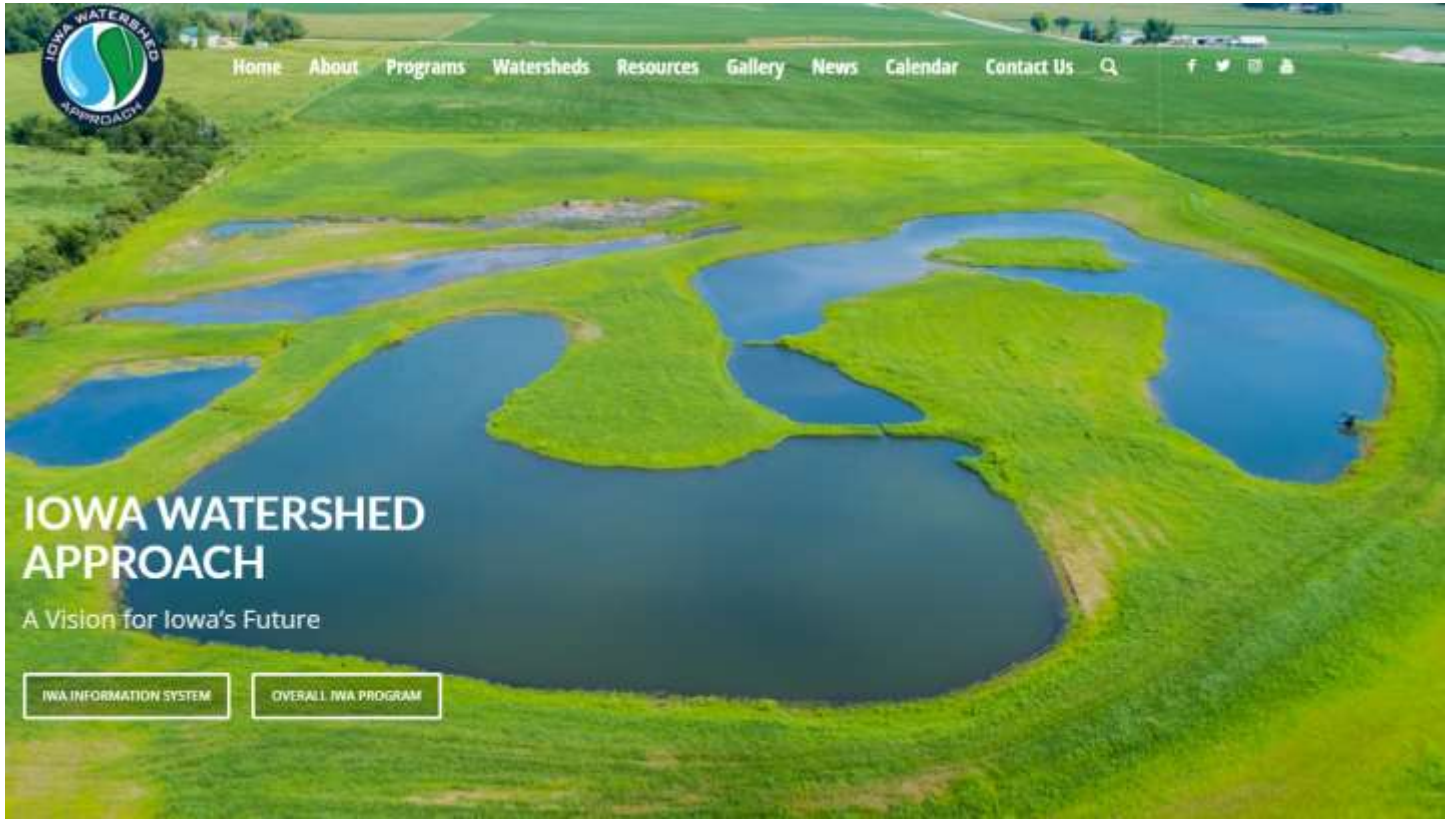
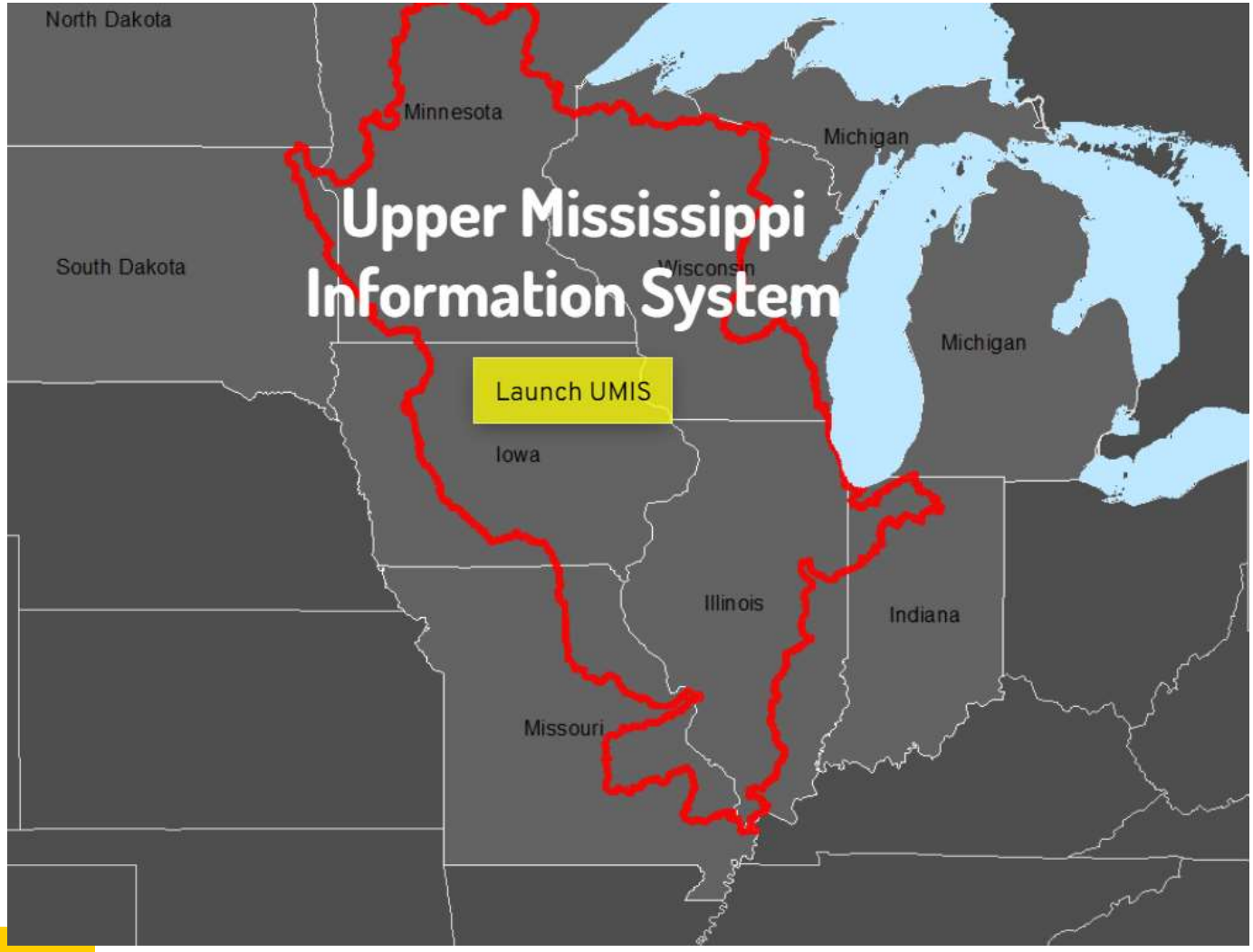
Iowa Watershed Approach



$94 million
HUD

- Reduction of flood risk;
- Improvement in water quality;
- Increased resilience;
- Engagement of stakeholders through collaboration, outreach, and education;
- Improved quality of life and health for Iowans; and
- Development of a replicable program.

NSF-Midwest Climate Hub




Big Data Innovation
Community Building
Cyber Tools and Services
Workforce Development
Education and Training
Midwest Big Data Hub
Upper Mississippi Information System
Data Acquisition
Continuous Modeling
Scientific Visualization
Data Integration
Food Water Energy
spoke
Digital Agriculture
spoke
Data, Tools and Service
group

Mud Creek/Middle Cedar Project

ENVIRONMENTAL PROTECTION AGENCY (EPA)
Gulf of Mexico Program Cooperative Agreements 2018
EPA-GM-Cooperative Agreements-2018-1

a. **Project Title**. A Flood-First Approach to Water-Quality Improvement in an Iowa Watershed

b. **Applicant Information**. University of Iowa, 2 Gilmore Hall, Iowa City, IA 52242-1320, 319-335-2123; dsp@uiowa.edu; (PI: Dr. Craig Just, 319-335-5051, craig-just@uiowa.edu) DUNS 06276167

c. **Total Project Cost**. $771,050; EPA Funds Requested: $771,050

d. **Priority Area**. Improve Water Quality

e. **Secondary Priority Areas(s)**. Environmental Education and Outreach; Community Resilience

Flood mitigation and nutrient reduction benefits of flood control wetlands

Knudson, Ashley J

https://iro.uiowa.edu/discovery/delivery/01IOWA_INST:ResearchRepository/12809743000002771?l#13836172310002771

City of Vinton

Mud Creek

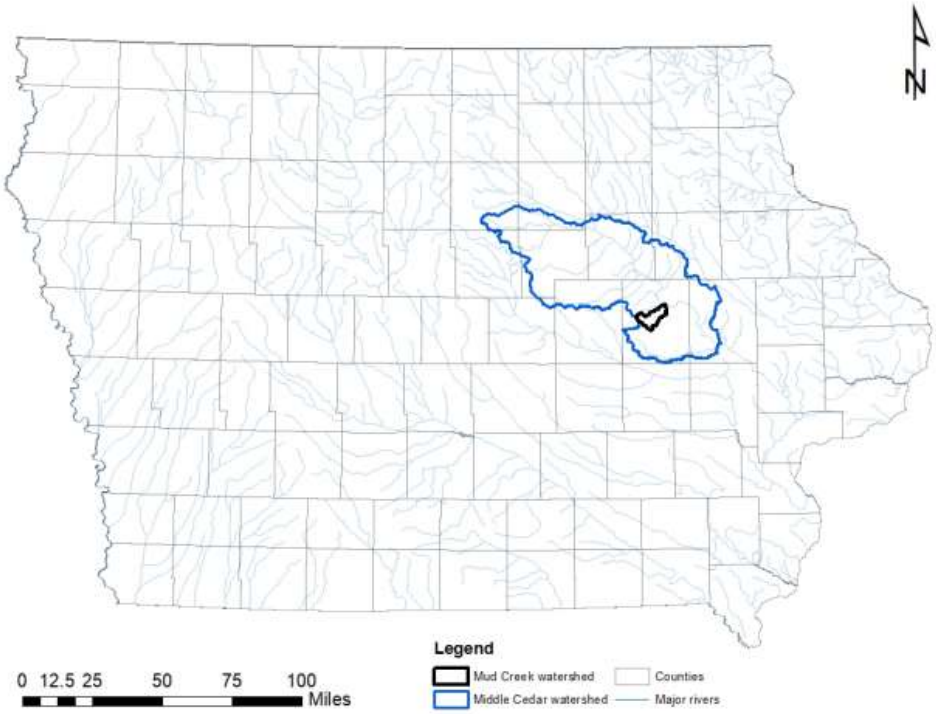


Figure 2.1: Mud Creek Watershed (Mud Creek watershed) is a HUC-12 watershed in eastern Iowa in Benton County. It is in the Middle Cedar Watershed and drains to the Cedar River.

Jellison Wetland

Jellison Wetland Outlet

Mud Creek

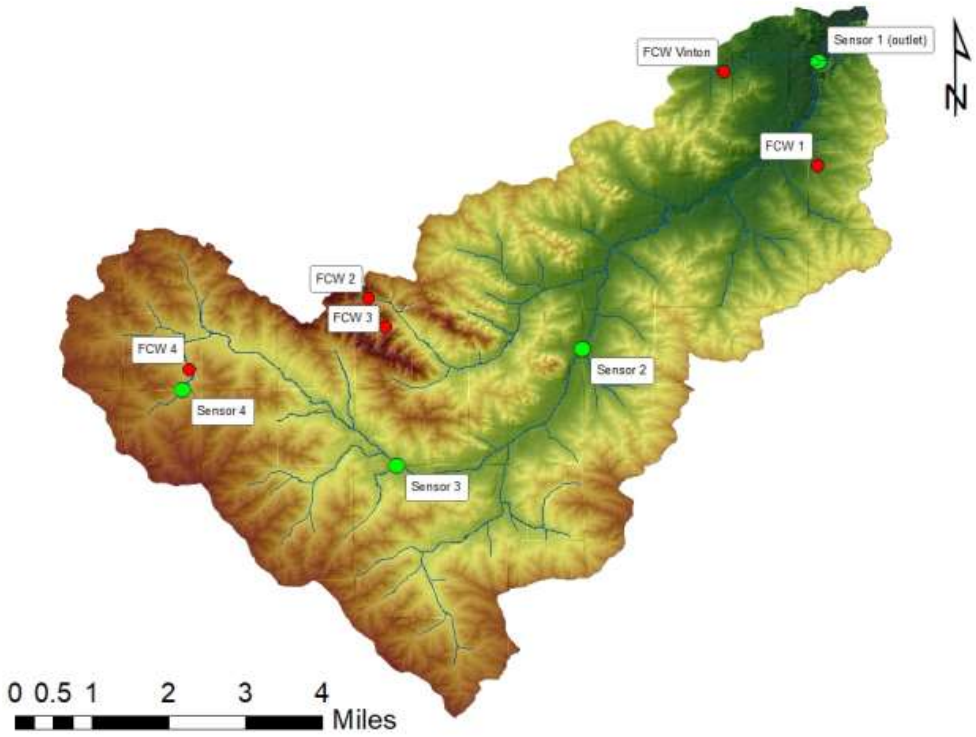
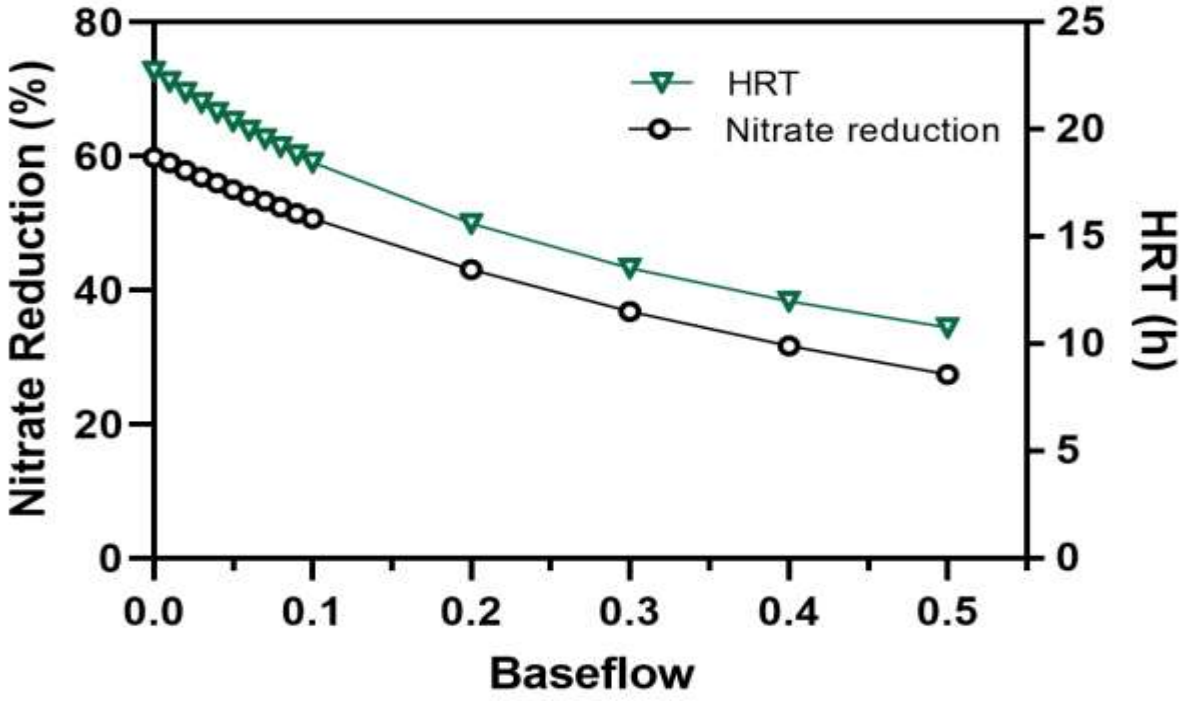


Figure 2.9: Stage and nitrate sensor and flood control wetland (FCW) locations in Mud Creek watershed. Stage and nitrate sensors are all collocated.

Conclusions: Nitrate Reduction

- Nitrate concentration reduction of 60% with an HRT of 23 hours; 27% with an HRT of 11 hours

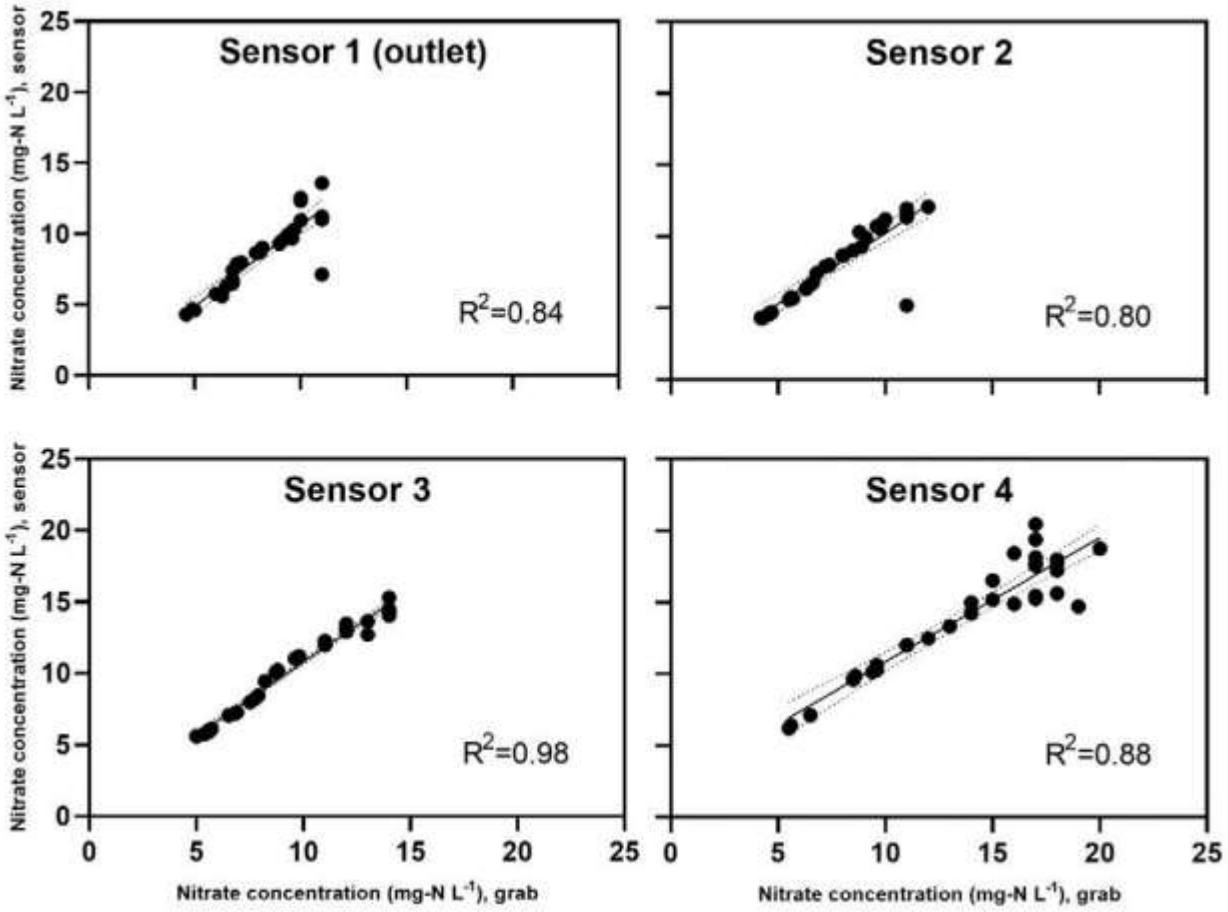


Conclusions: Peak Flow Reduction

- NRCS type A design storm: 15-26% (2-500 yr storms)

- NRCS type D design storm: 9.6-17%

Sensor Accuracy



Thesis

https://iro.uiowa.edu/view/pdfCoverPage?instCode=01IOWA_INST&filePid=13836172310002771&download=true

Johnson County Poor Farm

ENVIRONMENTAL PROTECTION AGENCY (EPA)
Gulf of Mexico Program Cooperative Agreements 2018
EPA-GM-Cooperative Agreements-2018-1

a. **Project Title**. Connecting Rural and Peri-urban Farmers to Demonstrate and Disseminate Innovative Nutrient and Sediment Reduction Practices

b. **Applicant Information**. University of Iowa, 2 Gilmore Hall, Iowa City, IA 52242-1320, 319-335-2123; dsp@uiowa.edu; (PI: Dr. Craig Just, 319-335-5051, craig-just@uiowa.edu) DUNS 06276167

c. **Total Project Cost**. $1,064,927; EPA Funds Requested: $1,064,927

Wetland, Terrace and Controlled Drainage Project with sensor monitoring

Figure 4: Sippy Wetland (summer of 2021). New drone images will be taken Q3 of 2022.

Iowa Valley Resource Conservation and Development manages JCHPF

Master plan focuses on five goals:

- local food production
- historic preservation
- Education
- Recreation
- conservation

The Johnson County Historic Poor Farm produces tons of produce that are donated to local food banks and other charities.

Boat Deployment of WQ Sensors

A novel approach to spatial assessments of surface water nitrate trends in selected Iowa rivers and lakes

Meulemans, Matthew James

https://iro.uiowa.edu/discovery/delivery/01IOWA_INST:ResearchRepository/12730602850002771?l#13730812880002771

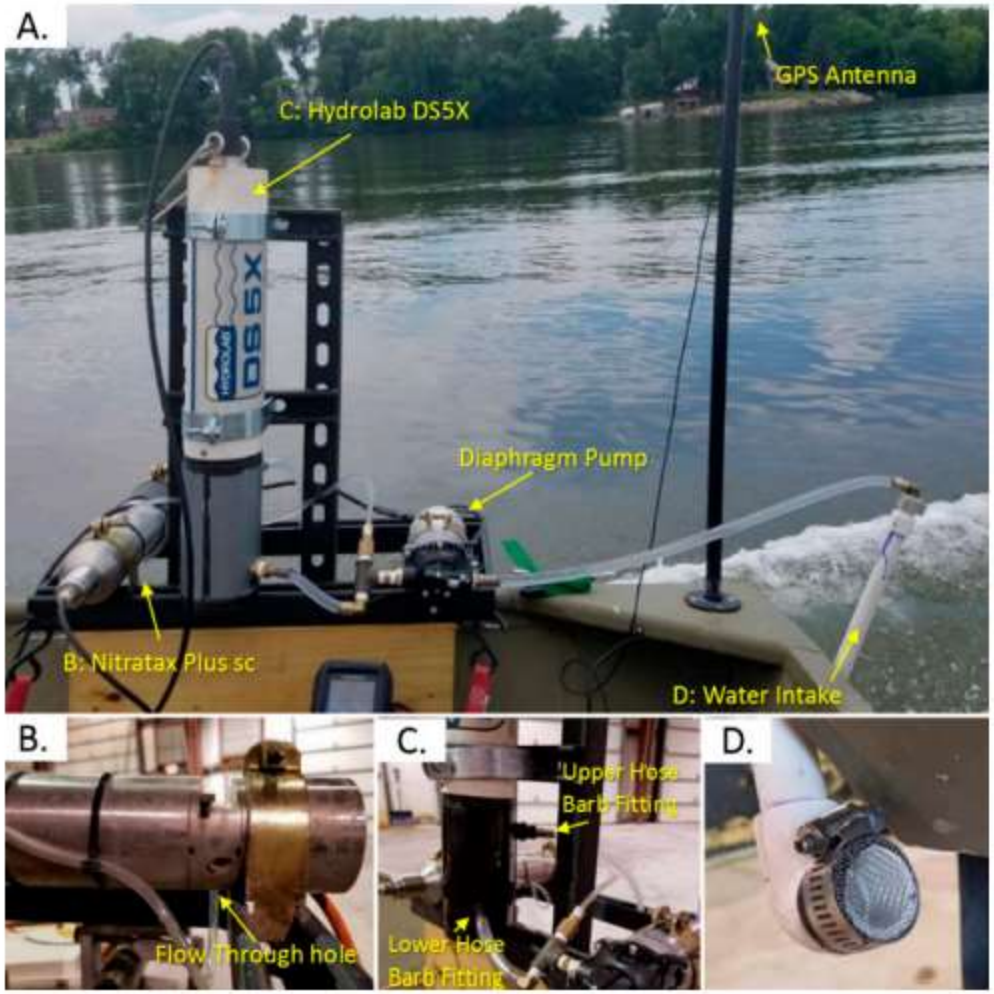


Figure 4. (**A**) Boat and sensor system. (**B**) Nitratax NO_3–N sensor with water delivery tube. (**C**) Hydrolab multi-probe with water delivery tube. (**D**) Water intake pipe with screen.

Jet Drive Outboard

No propeller allows navigation in rocky conditions

Iowa-Cedar Basin

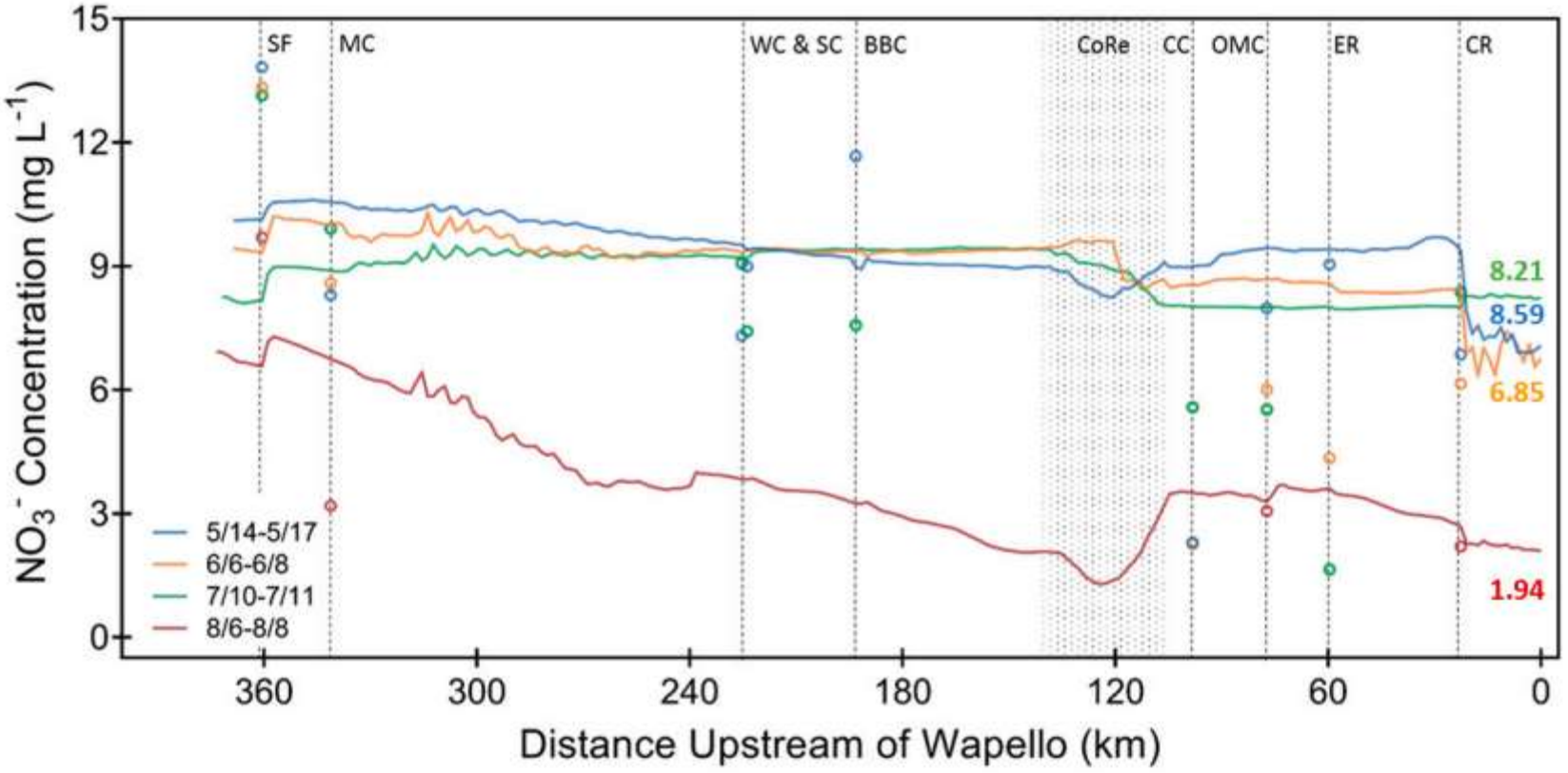
32,500 km2

20% of Iowa

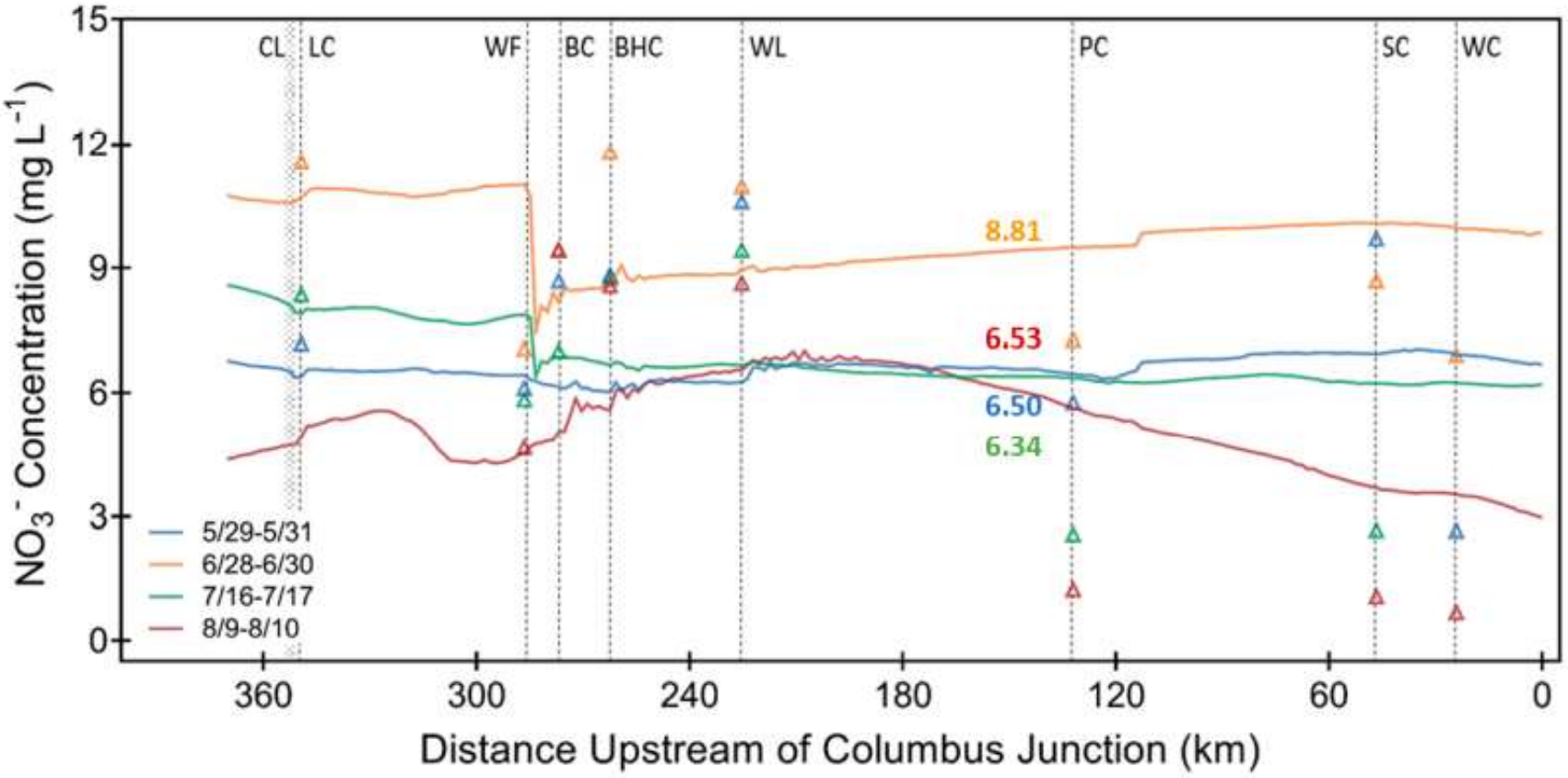
Intensely Cropped

2nd Largest internal basin

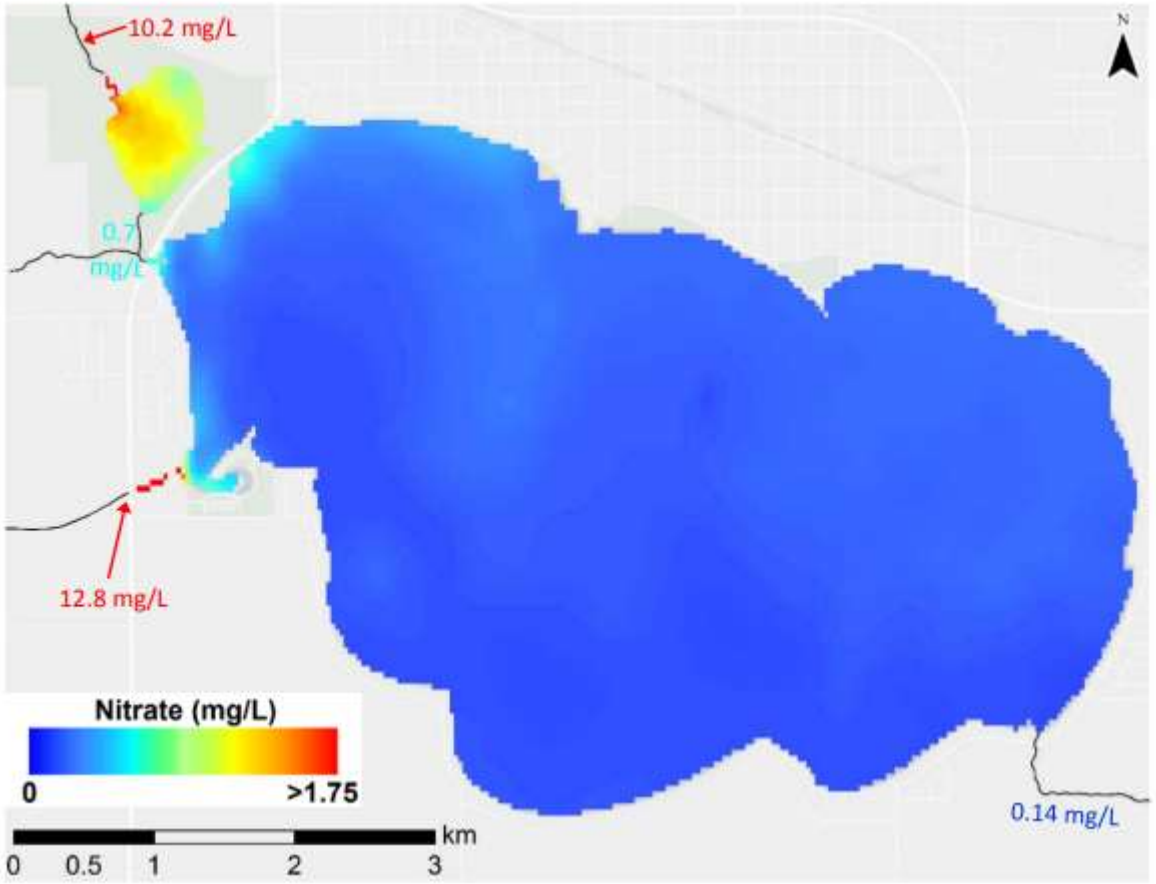
Iowa River


15
12
9
6
3
0
NO_3^- Concentration (mg L^{-1})
SF
MC
WC & SC
BBC
CoRe
CC
OMC
ER
CR
5/14-5/17
6/6-6/8
7/10-7/11
8/6-8/8
8.21
8.59
6.85
1.94
360
300
240
180
120
60
0
Distance Upstream of Wapello (km)

Cedar River


15
12
9
6
3
0
NO_3^- Concentration (mg L^{-1})
CL
LC
WF
BC
BHC
WL
PC
SC
WC
8.81
6.53
6.50
6.34
5/29-5/31
6/28-6/30
7/16-7/17
8/9-8/10
360
300
240
180
120
60
0
Distance Upstream of Columbus Junction (km)

Storm Lake



Storm Lake-pH

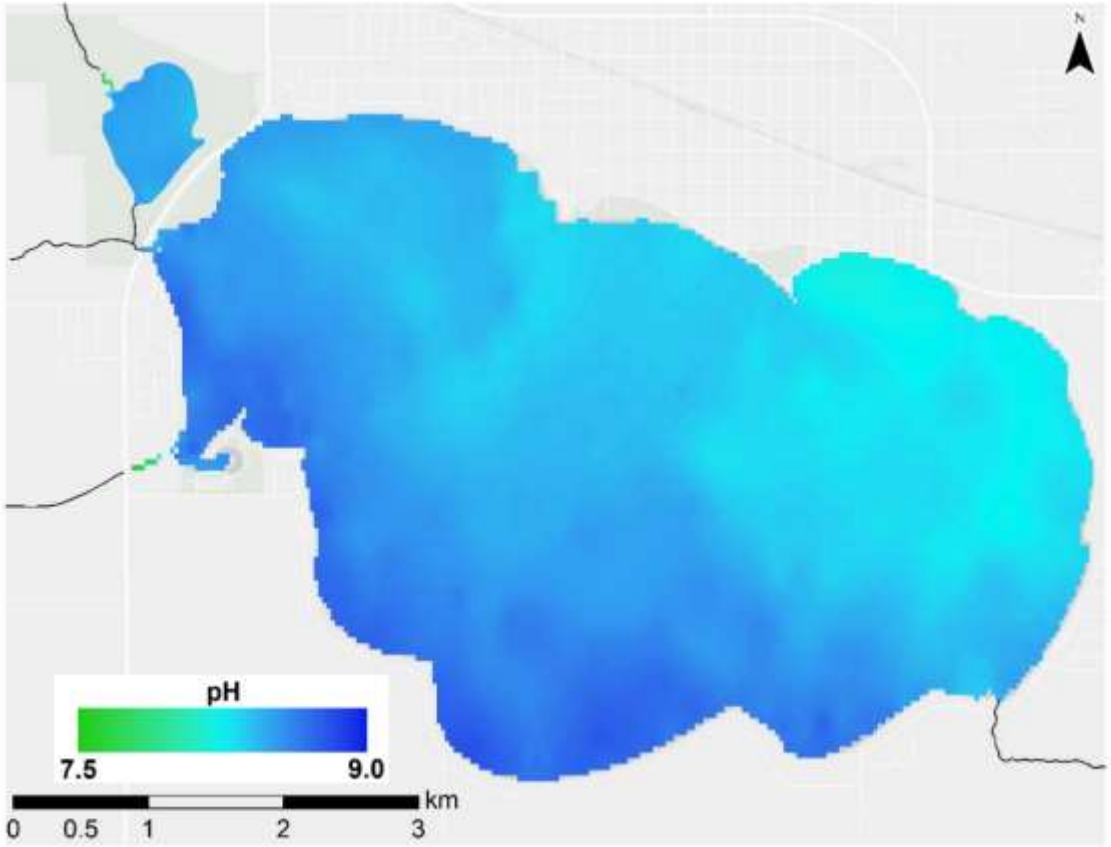
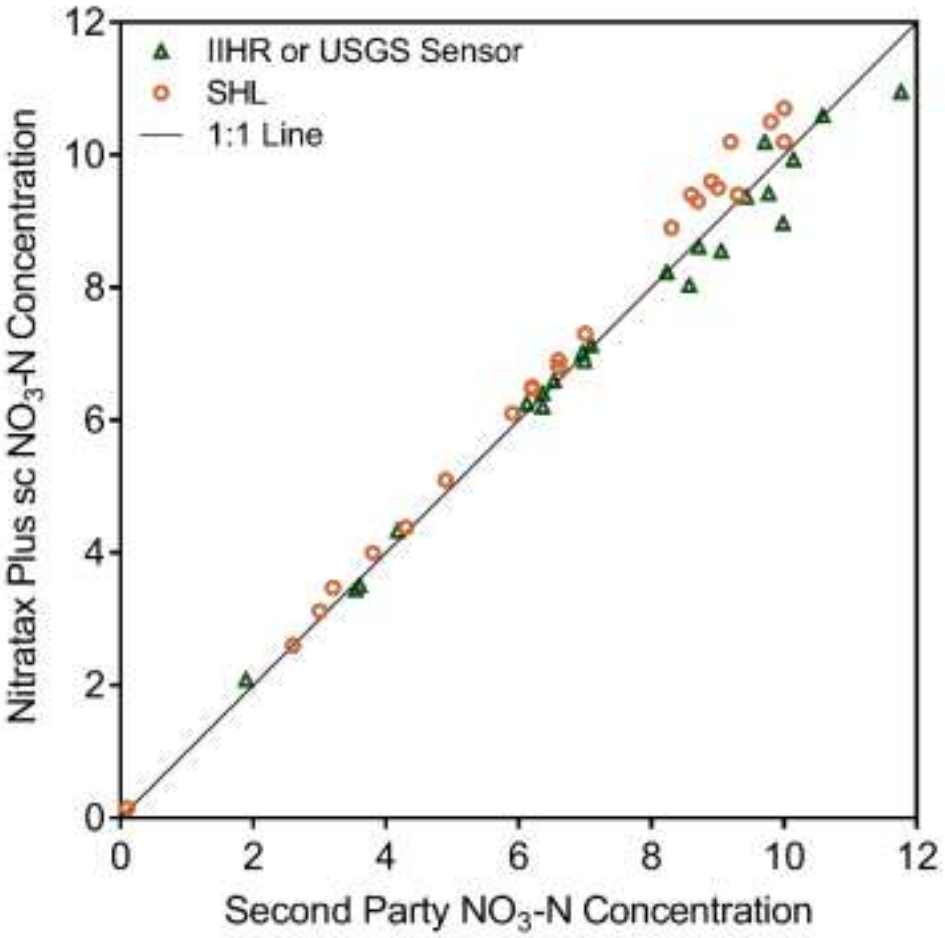


Figure 6.7: pH of Storm Lake and Little Storm Lake.

Sensor Accuracy



Thesis

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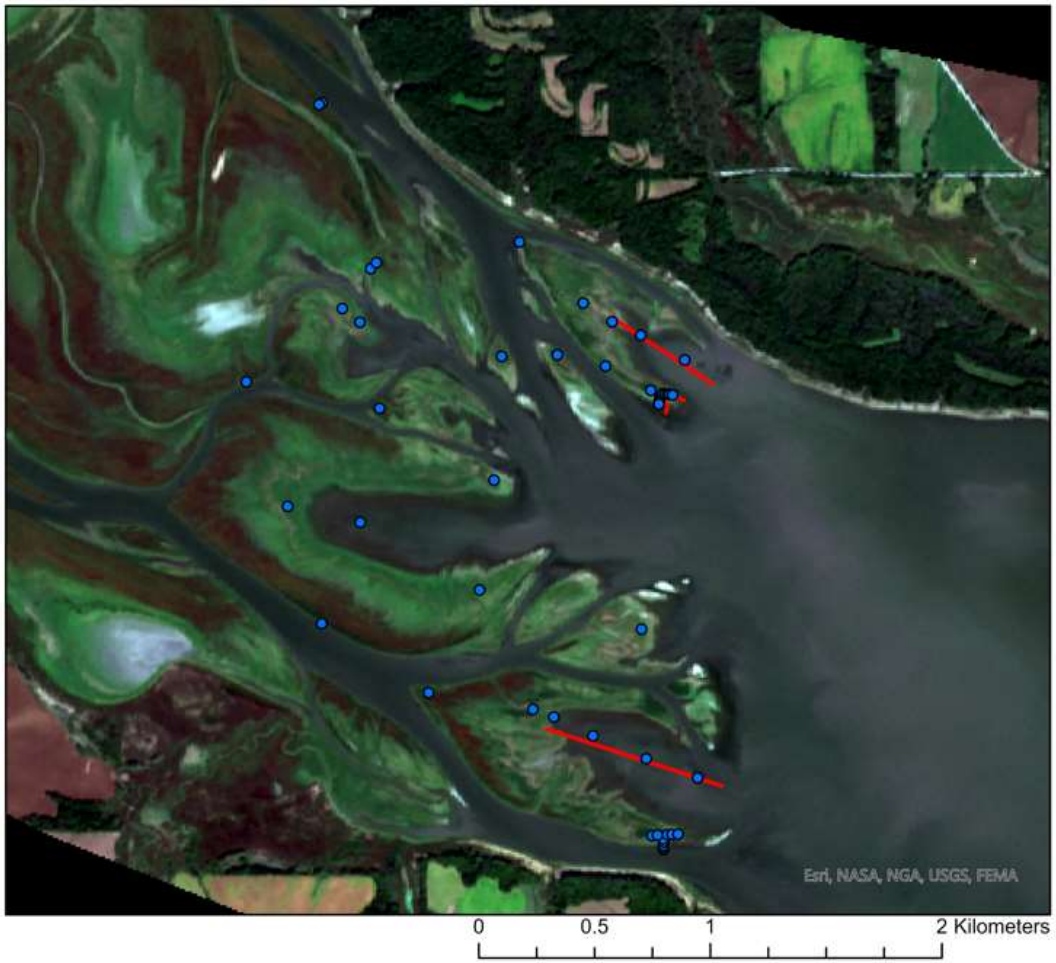
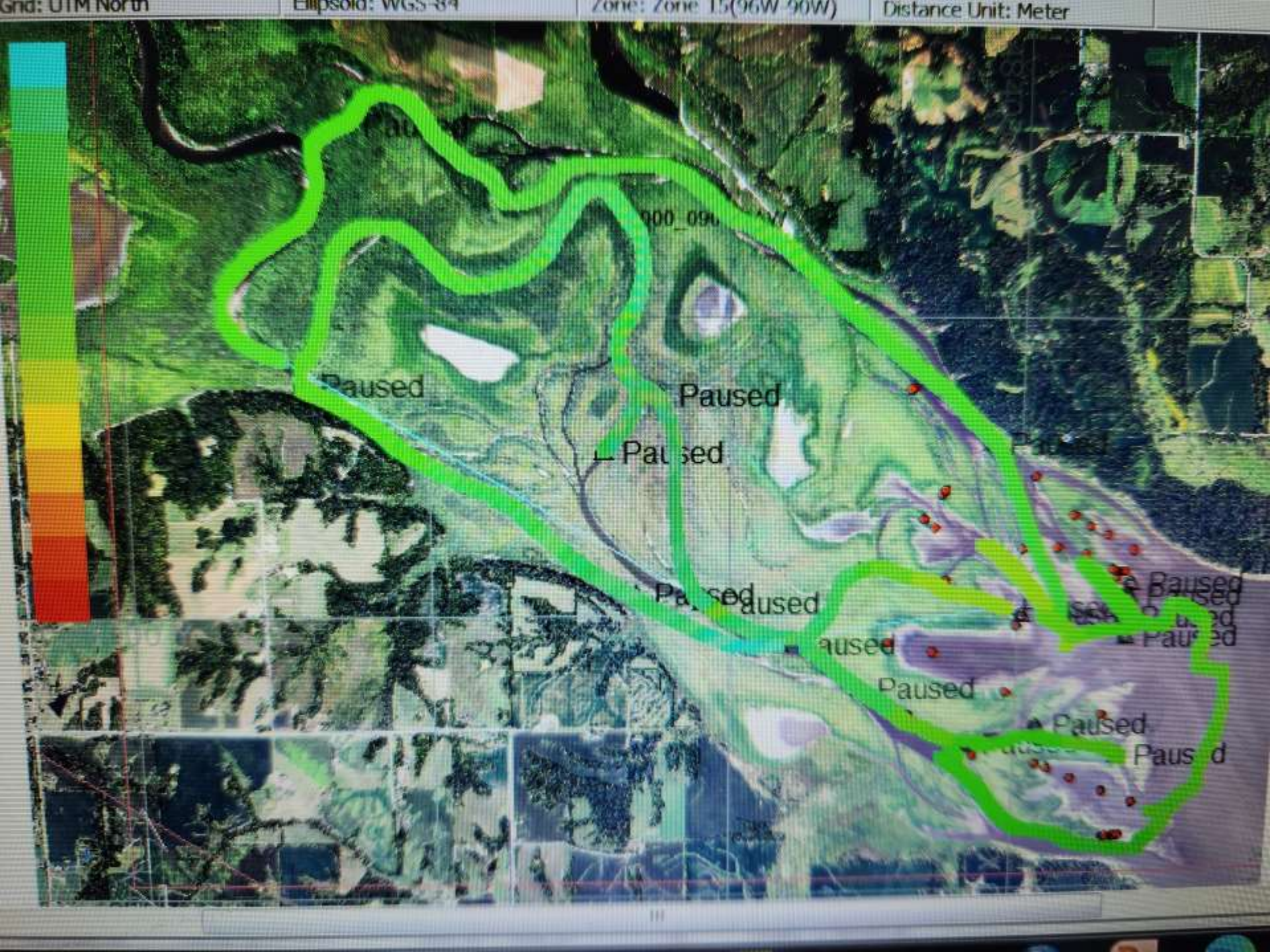
Red Rock Delta-Nitrate Attenuation




Grid: UTM North
Ellipsoid: WGS-84
Zone: Zone 15(96W-90W)
Distance Unit: Meter
Paused
Paused
Paused
Paused
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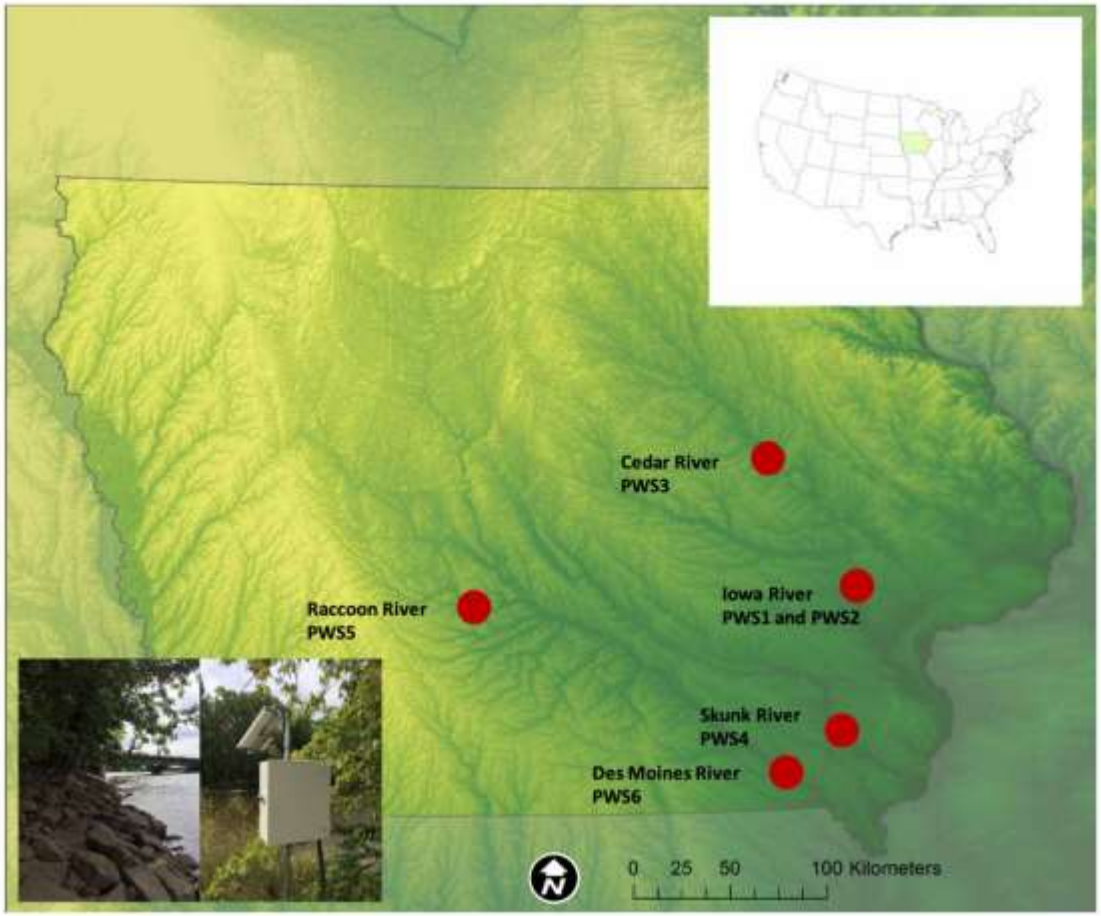
Paused
Paused
Paused
Paused

Sensor Monitoring: Implications for Municipal Drinking Water

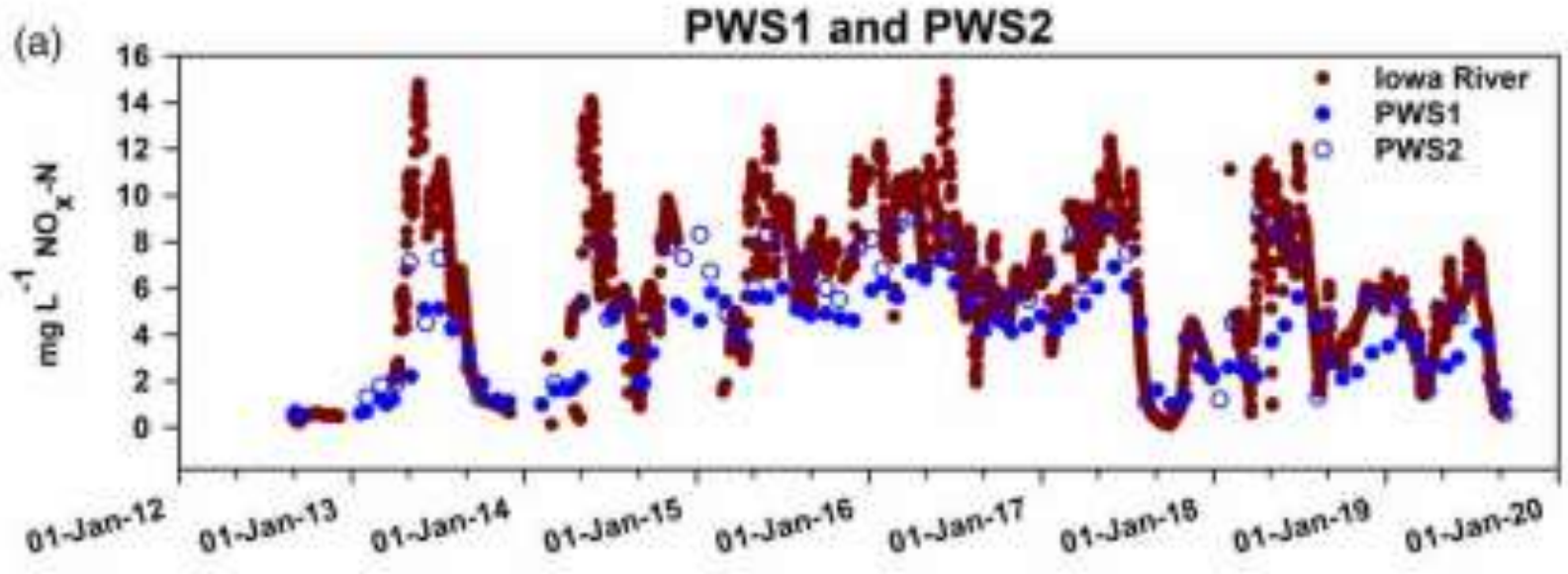
Use of real-time sensors for compliance monitoring of nitrate in finished drinking water

Christopher S. Jones, Tianyi Li, Alex Sukalski, Darrin A. Thompson and David M. Cwiertny

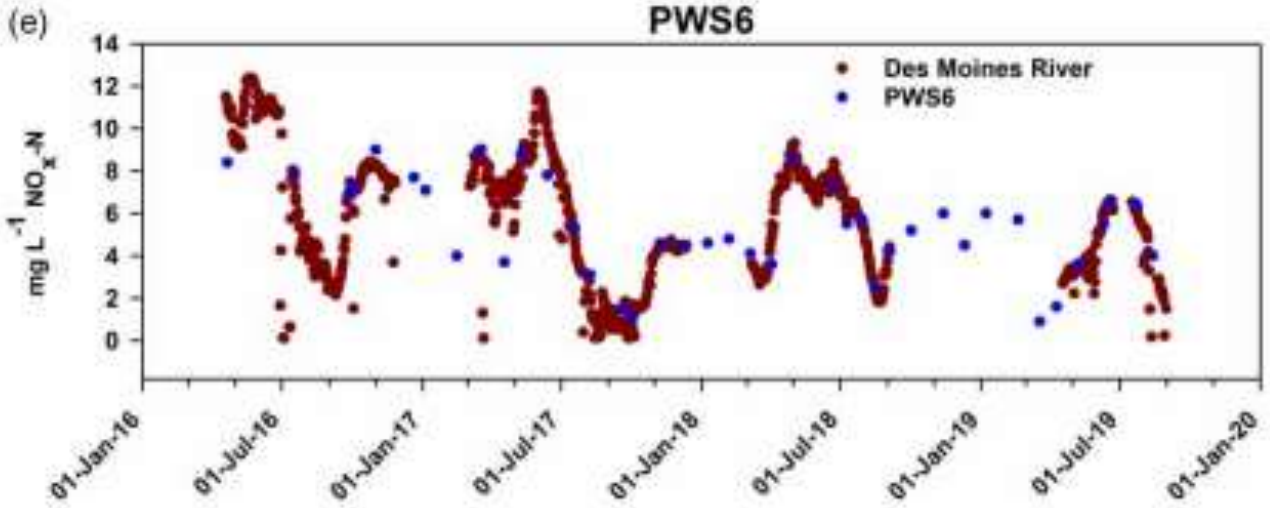
Sites


Cedar River
PWS3
Iowa River
PWS1 and PWS2
Raccoon River
PWS5
Skunk River
PWS4
Des Moines River
PWS6
0 25 50 100 Kilometers

Relate river N to finished DW N



Ottumwa

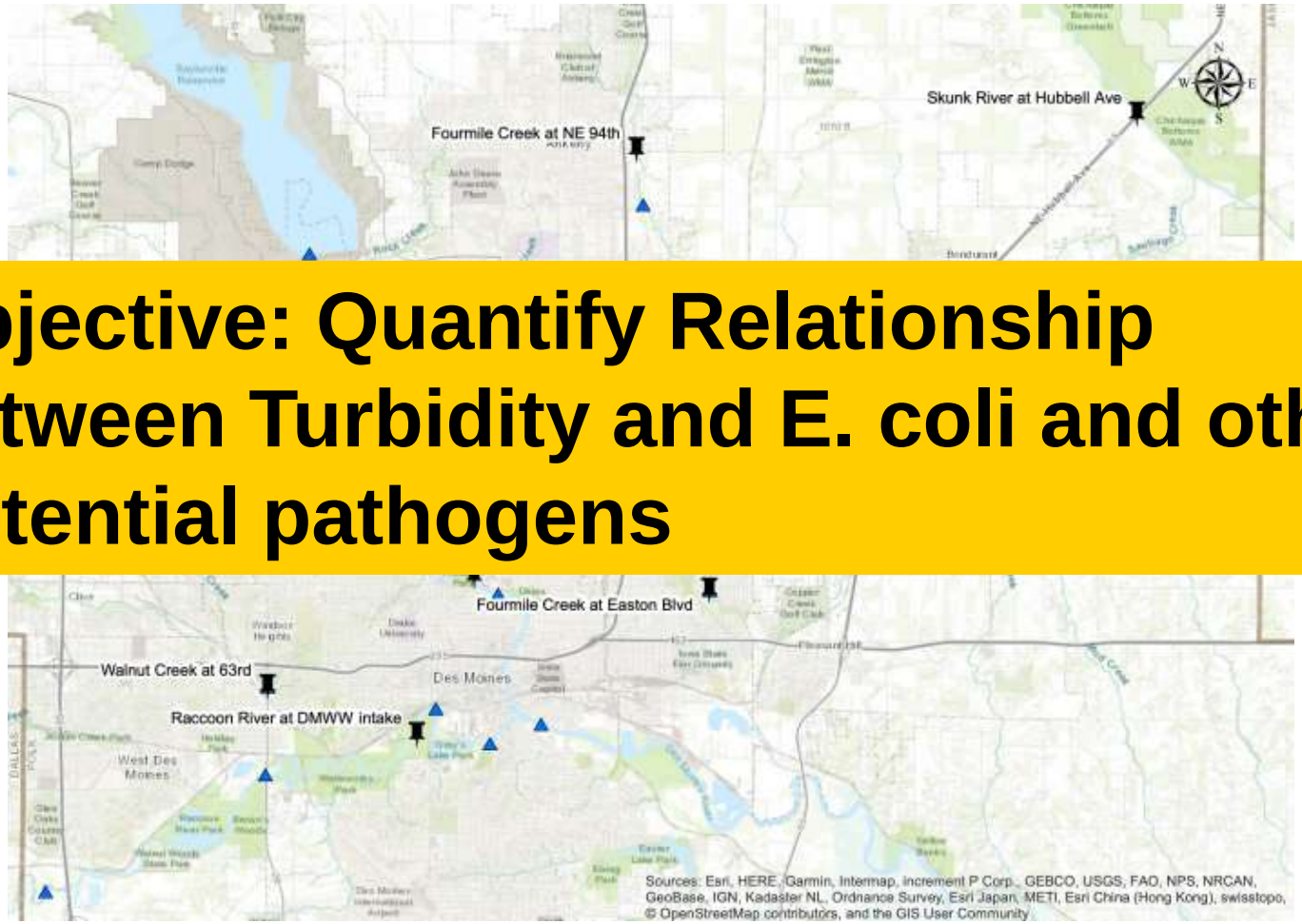


Utility	PWS1	PWS2	PWS3 Plant 1	PWS3 Plant 2	PWS4	PWS5 McMullen	PWS6
Ratio of finished/sensor NO_x-N	0.66	0.97	0.51	0.62	0.26	0.68	0.93
Sensor NO_x-N that would generate 10 mg L^{-1} in finished water	15.1	10.3	19.7	16.1	38.5	14.8	10.8

Costs

- Daily grab sample monitoring: $14,600/yr
- Sensor: $25,000 good for many years

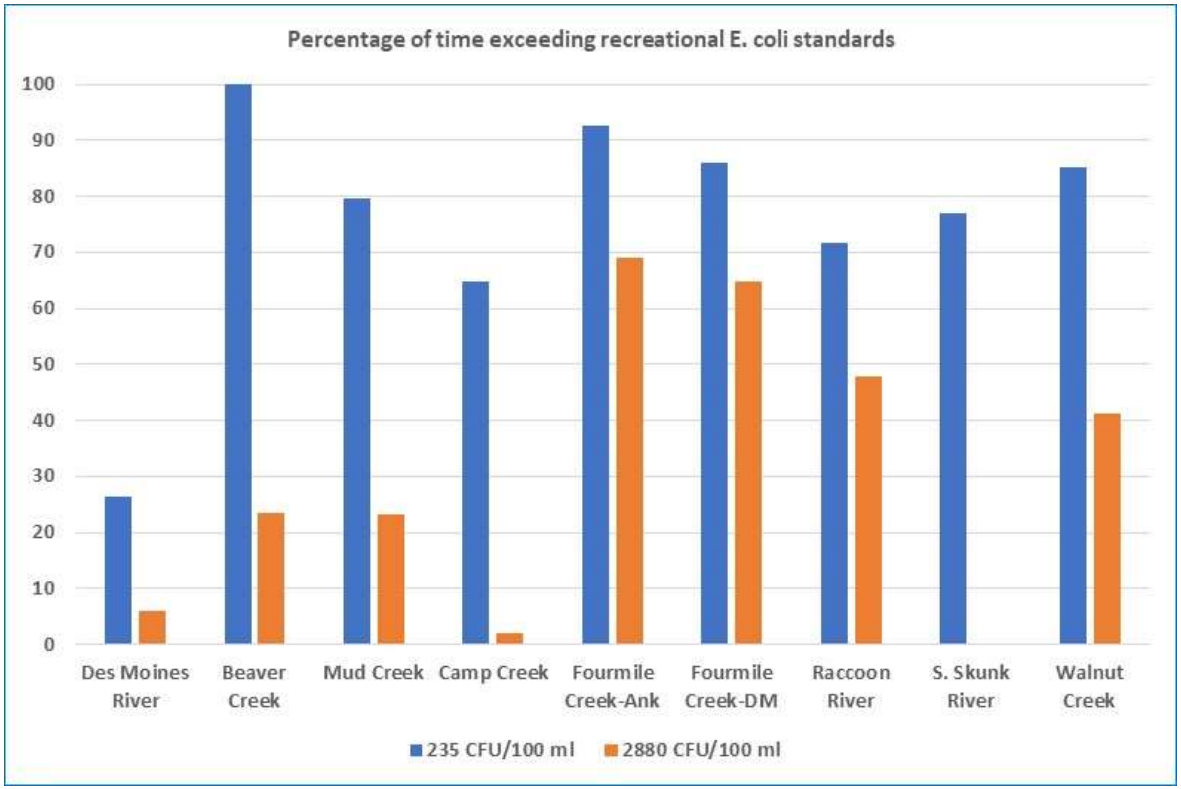
Polk County Water Trails

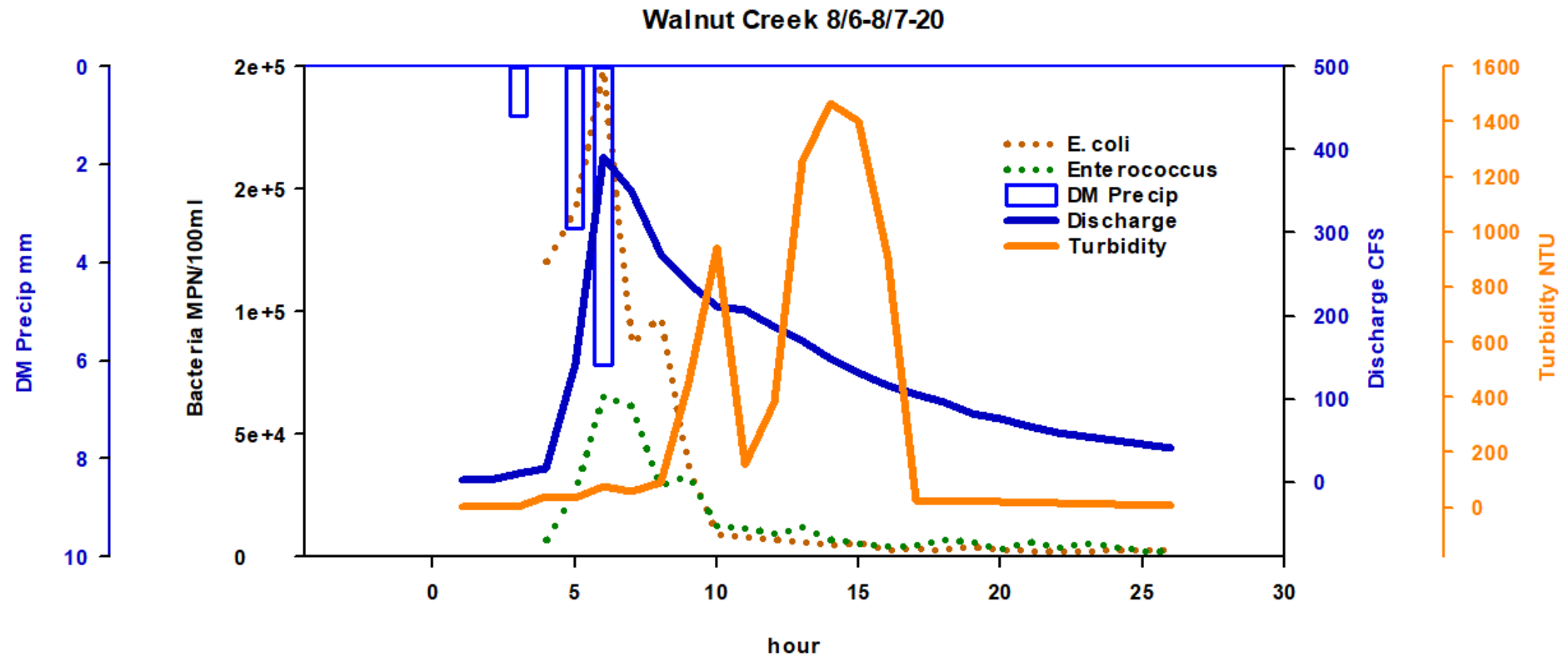


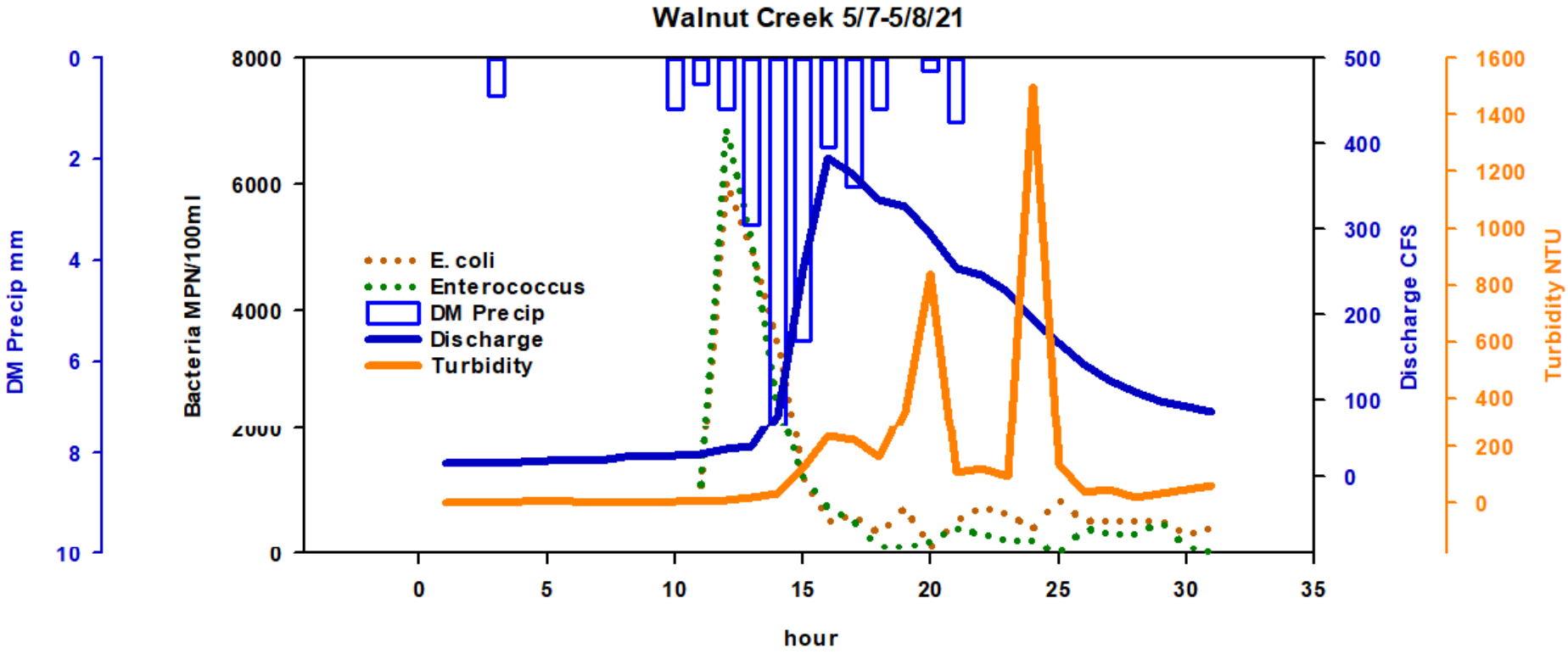
Objective: Quantify Relationship between Turbidity and E. coli and other potential pathogens

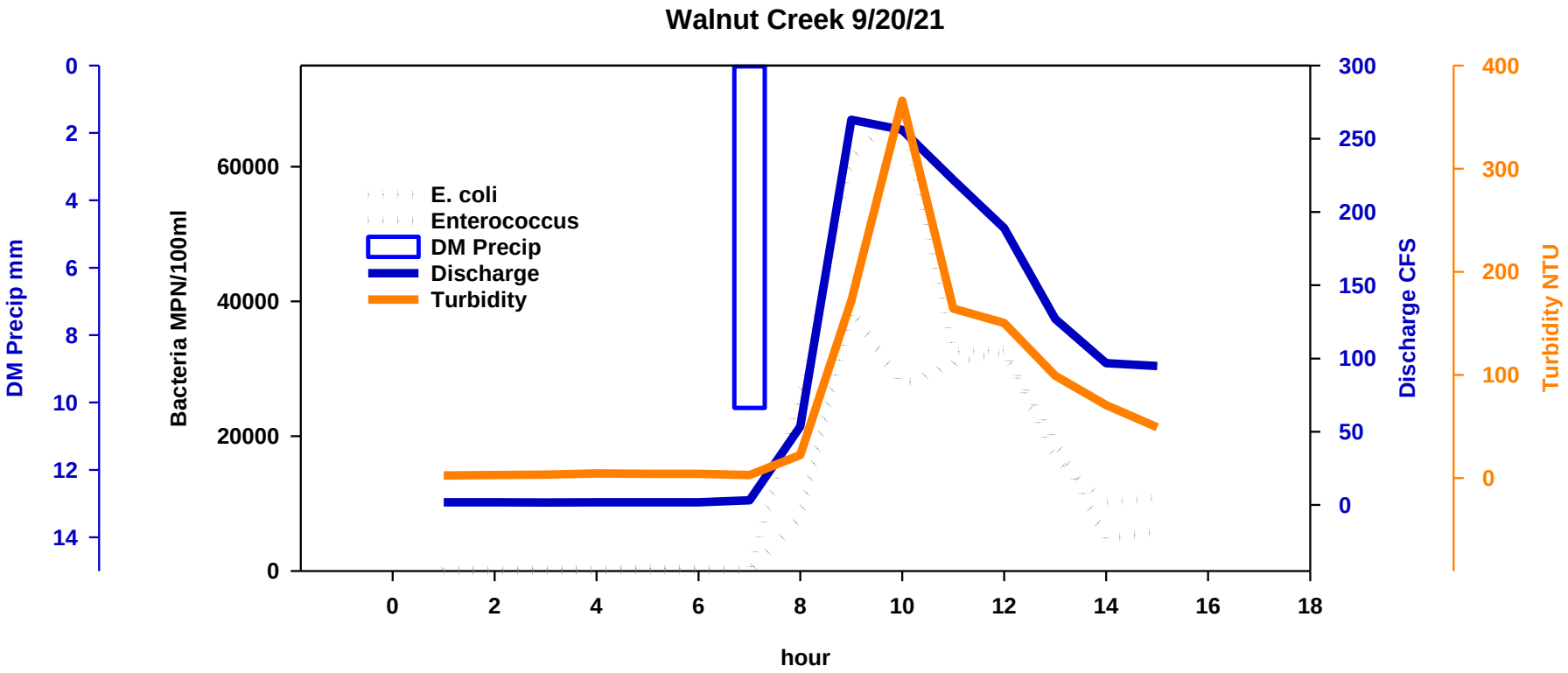
Des Moines River WQS 0092

E. Coli exceeding thresholds



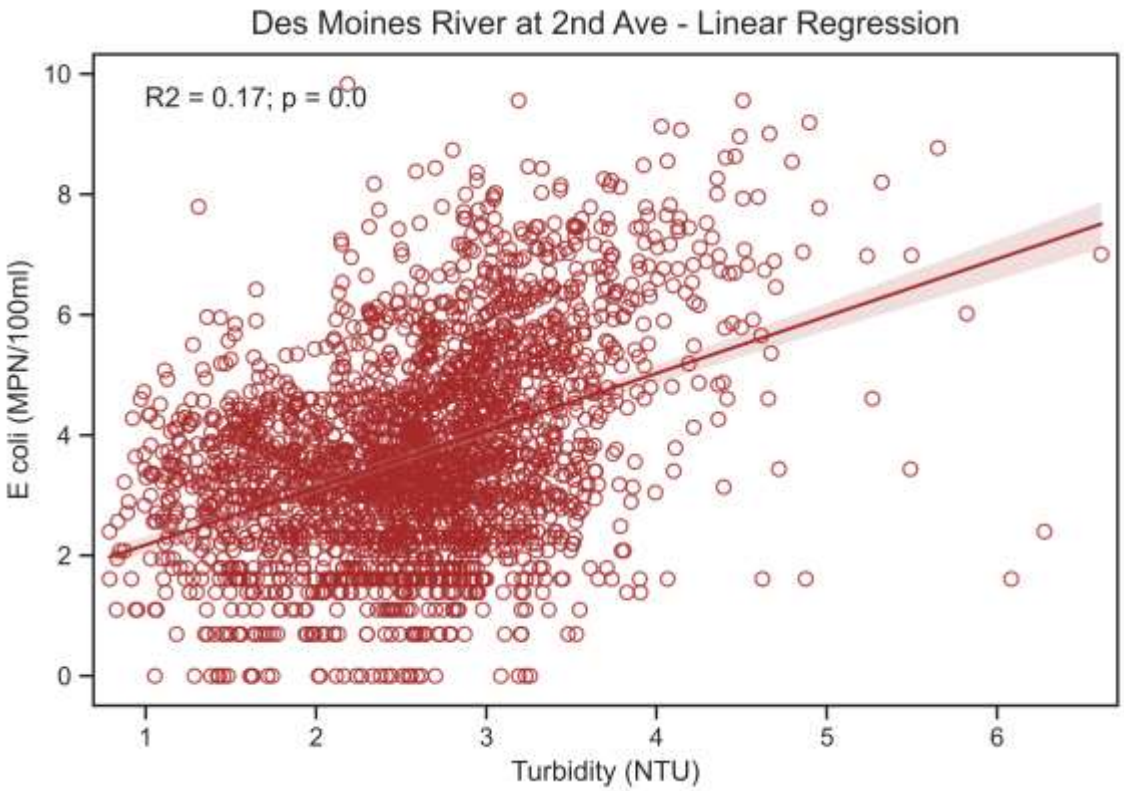

Walnut Creek 8/6-8/7-20
DM Precip mm
Bacteria MPN/100ml
Discharge CFS
Turbidity NTU
hour
E. coli
Enterococcus
DM Precip
Discharge
Turbidity
0
2
4
6
8
10
2e+5
2e+5
1e+5
5e+4
0
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30


Walnut Creek 5/7-5/8/21
DM Precip mm
Bacteria MPN/100ml
Discharge CFS
Turbidity NTU
hour
E. coli
Enterococcus
DM Precip
Discharge
Turbidity
0
2
4
6
8
10
8000
6000
4000
2000
0
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
0
5
10
15
20
25
30
35

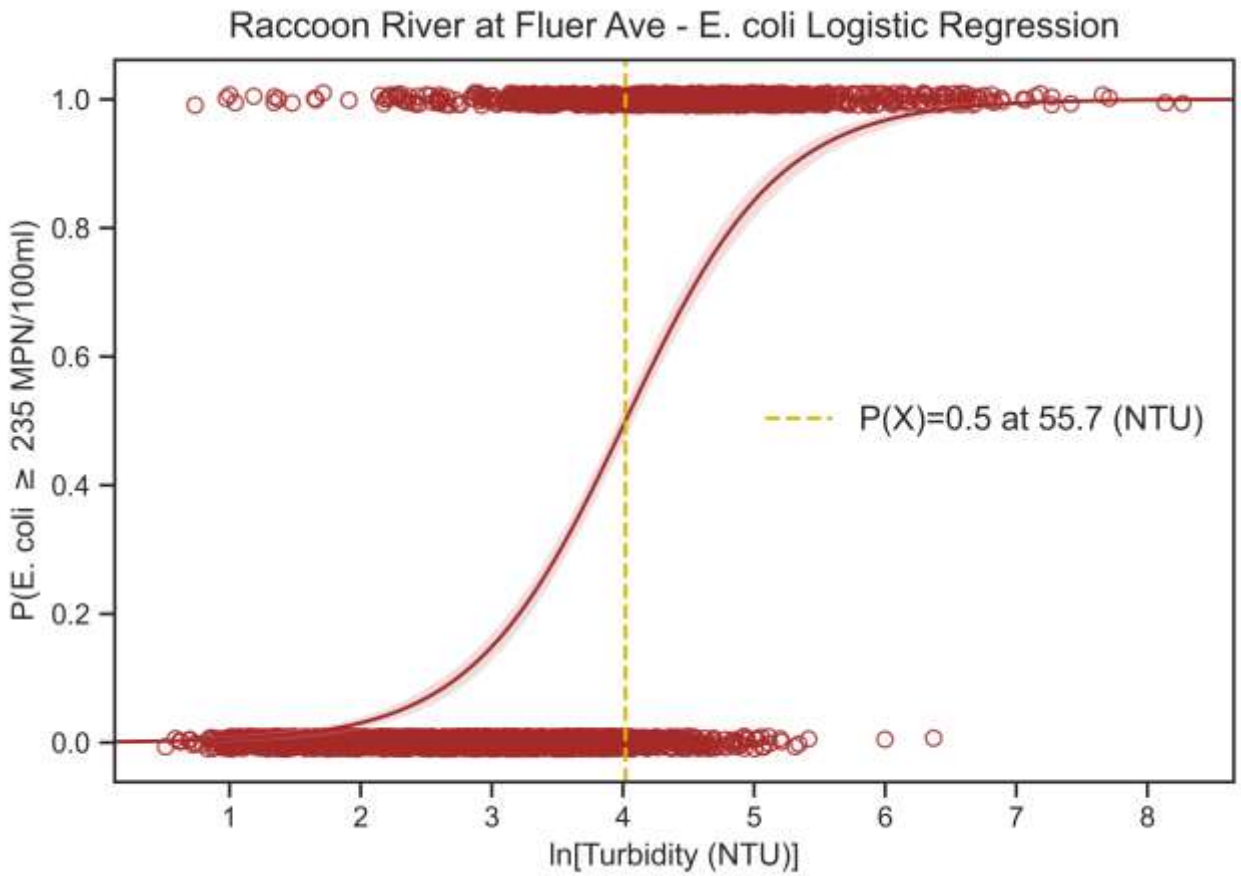

Walnut Creek 9/20/21
DM Precip mm
0
2
4
6
8
10
12
14
Bacteria MPN/100ml
60000
40000
20000
0
E. coli
Enterococcus
DM Precip
Discharge
Turbidity
0
2
4
6
8
10
12
14
16
18
hour
Discharge CFS
300
250
200
150
100
50
0
Turbidity NTU
400
300
200
100
0

Traditional regression models struggle due to the variability in E. coli

- This is a relationship here, but quantifying the amount of E. coli is impractical



Logistic Models



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