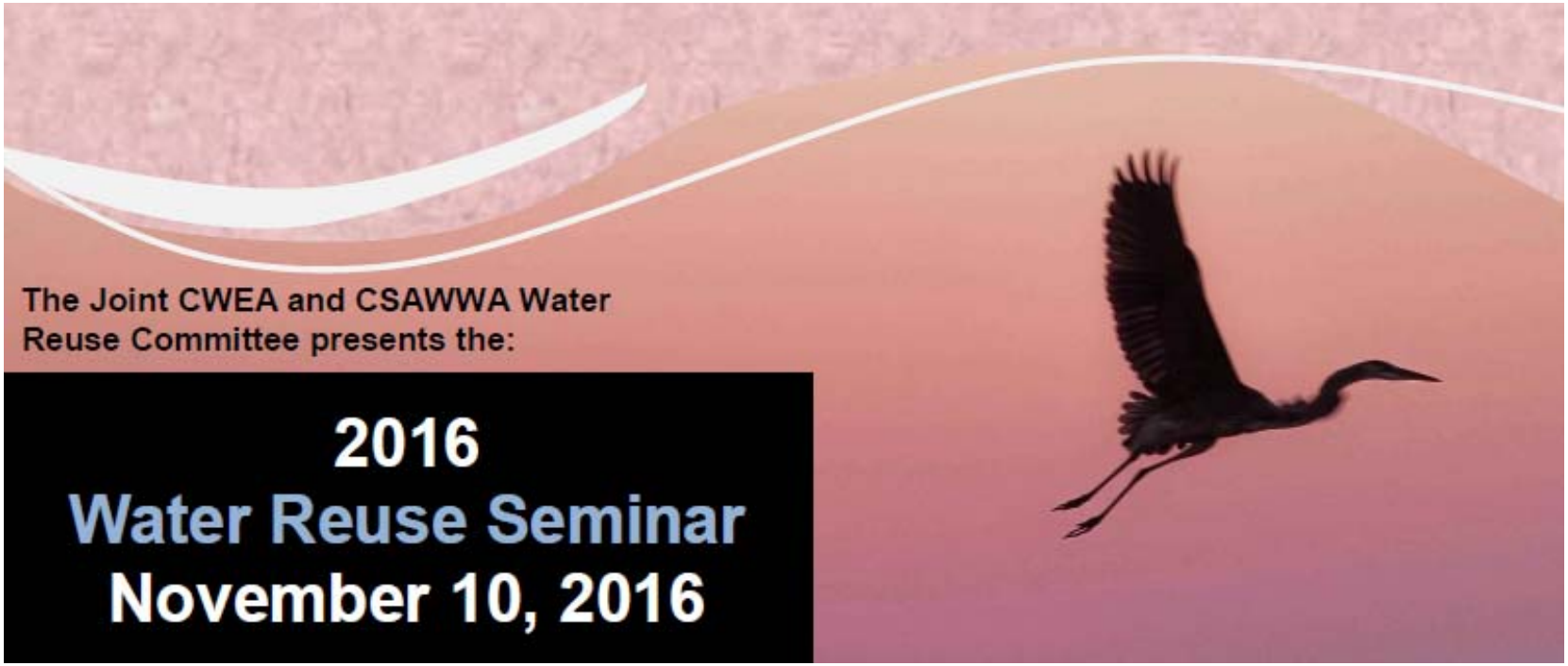
Hazen



Assessing the Impact of Anthropogenic Discharges on Endocrine Disruption in the Potomac River Watershed

Erik Rosenfeldt, Ph.D., P.E.

Project Driver: Intersex fish in Potomac Watersheds

Chesapeake Bay News Aug 09 2012
[Intersex fish widespread in Potomac River basin]

Intersex Fish Now in Three Pennsylvania River Basins
Released: 6/30/2014 7:00:00 AM
http://www.usgs.gov/newsroom

Potomac Observations of EDC Activity

Associations of Land-use with Intersex (Spawning Study 2007)

Site	Human Density[1]	WWTP[2]	WWTP Flow[3]	% Ag[4]	AFO[5]	Animal Numbers[6]	Intersex[7]
Gauley River	0.06	0	0	0.5	0	464	11.3% 0.02 (0.07)
South Branch Petersburg	0.07	3	0.95	16.4	296 (296)	1,450,120	74.3% 0.97 (0.95)
South Branch Moorefield	0.07	4	1.43	15.2	497 (496)	7,384,685	54.5% 0.50 (0.50)
South B Springfi		5	1.93	15.2	565 (562)	8,719,093	82.2% 1.02 (0.76)
Shenan North F							8)
Shenan Mainste							3)
Shenan South Fork					(1,176)		1.83 (0.65)
Conococheague Creek (lower)	0.69	13	8.31	50.3	10 (1)	1,819,225	87.5% 1.03 (0.78)

The Washington Post

Health & Science

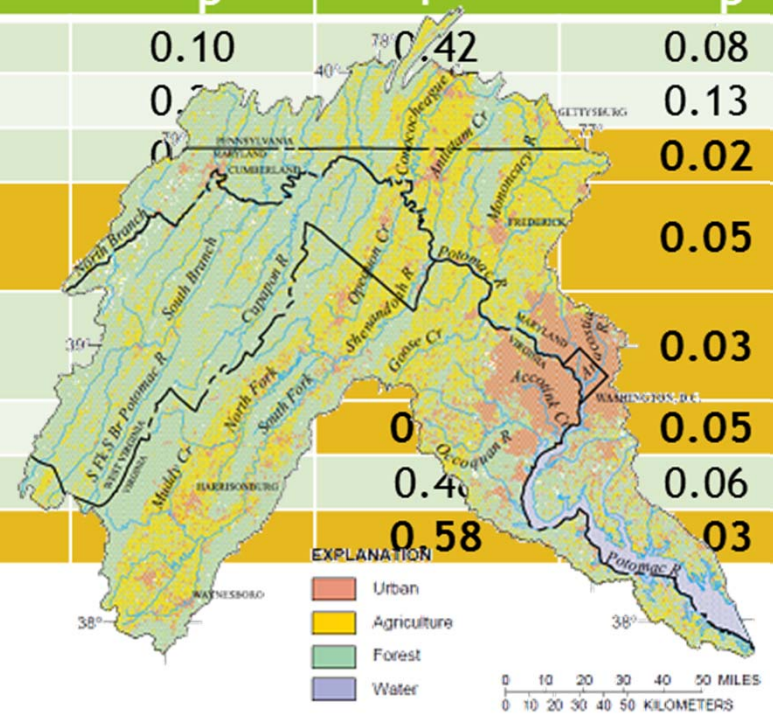
Bay's smallmouth bass under siege, report says

Impacts of Point and Non-point Sources

Comparing Land Use and Observed Intersex Activity

Land-use	Intersex prevalence r^2	Intersex prevalence p	Intersex severity r^2	Intersex severity p
Human population density	0.39	0.10	0.42	0.08
Number of WWTPs	0.22	0.[illegible]	[illegible]	0.13
WWTP flow	0.32	0[illegible]	[illegible]	**0.02**
Percent agricultural land use	**0.63**	[illegible]	[illegible]	**0.05**
Number of animal feeding operations	0.28	[illegible]	[illegible]	**0.03**
Number of poultry houses	0.27	[illegible]	**0**[illegible]	**0.05**
Total number of animals	0.27	[illegible]	0.4[illegible]	0.06
Animal density	**0.49**	[illegible]	**0.58**	**03**

Modified from Blazer et al., 2011

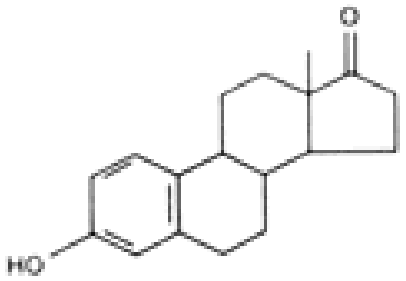


Land Use in the Potomac Watershed

Introduction – Endocrine-disrupting chemicals (EDCs):

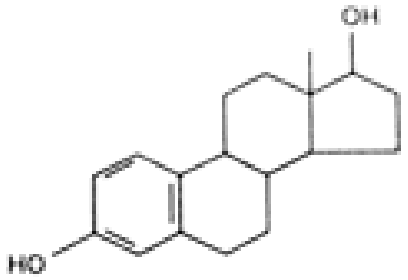
Substances in our environment, food, and consumer products that interfere with hormone biosynthesis, metabolism, or action resulting in a deviation from normal homeostatic control or reproduction.

Xenoestrogen: a type of xenohormone that imitates estrogen; steroidal estrogens



Estrone

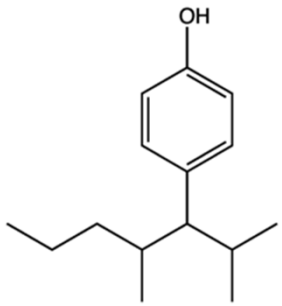
estrone (E1),



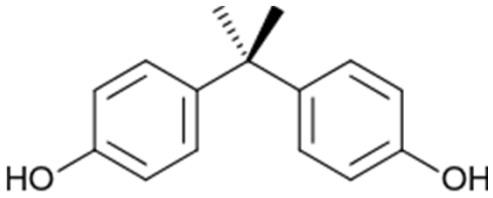
Estradiol

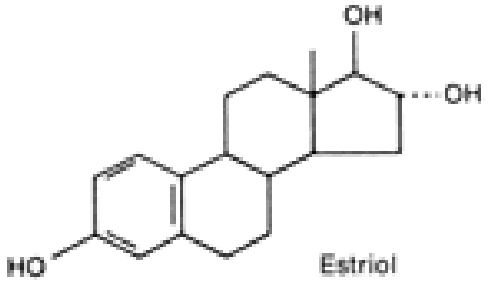
estradiol (E2),

Alkylphenol:



Bisphenol A





Estriol

estriol (E3)

Project Team – A unique collaboration

Sudhir Murthy,
Ph.D., P.E., BCEE
DC Water

Erik Rosenfeldt,
Ph.D., P.E.
Hazen and Sawyer

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U. of Maryland

Luke Iwanowicz,
Ph.D.,
USGS

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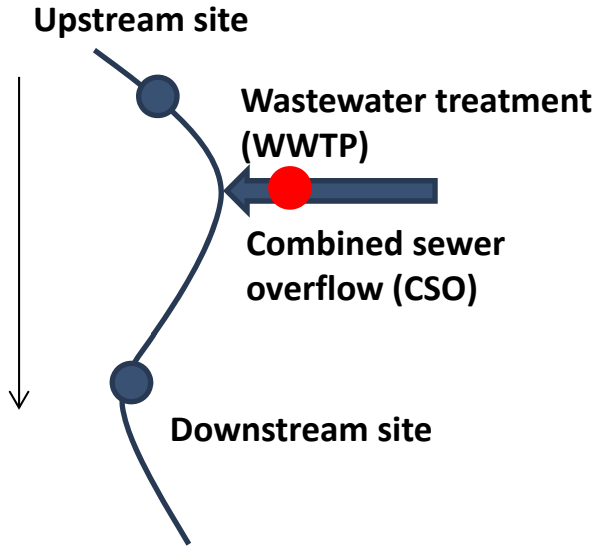
Ph.D.
U. of Buffalo

Shuiwang Duan,
Ph.D., U. of Maryland

Katia M. N. Oviedo,
PhD candidate, U. of Buffalo

Project Objective 1

Evaluate the upstream and downstream impacts from nutrient control, agriculture management, stormwater management and wastewater treatment strategies



↕ Agriculture management

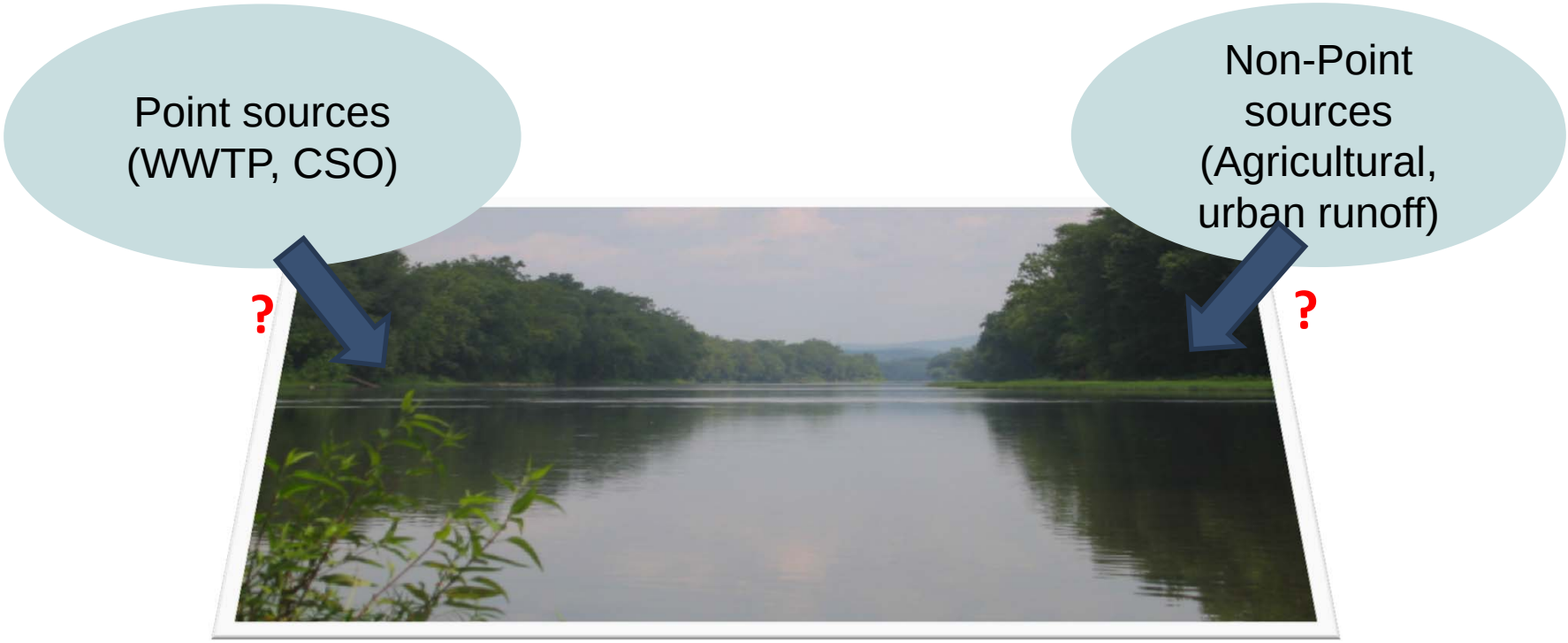
NO agriculture management

↕ Stormwater management (Urban)

NO stormwater management

Project Objective 2

Evaluate Impacts of EDC in receiving waters attributed to point versus non-point sources

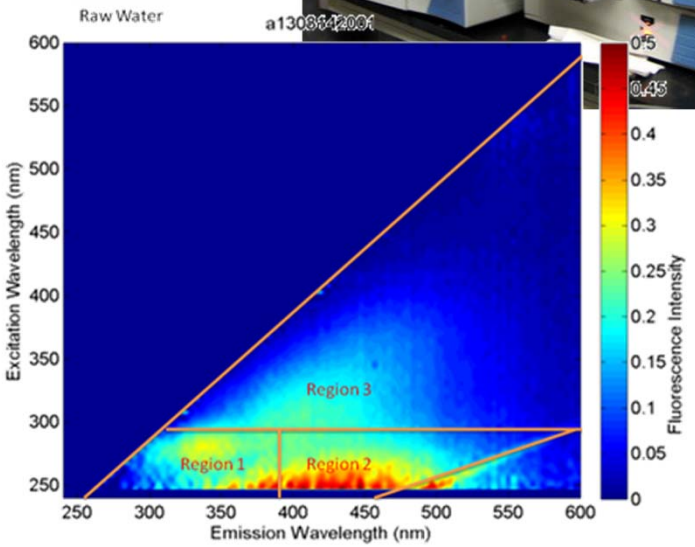


Potomac River EDCs and Activity

Methods – Chemical and WQ Endpoints

Analytical Detection

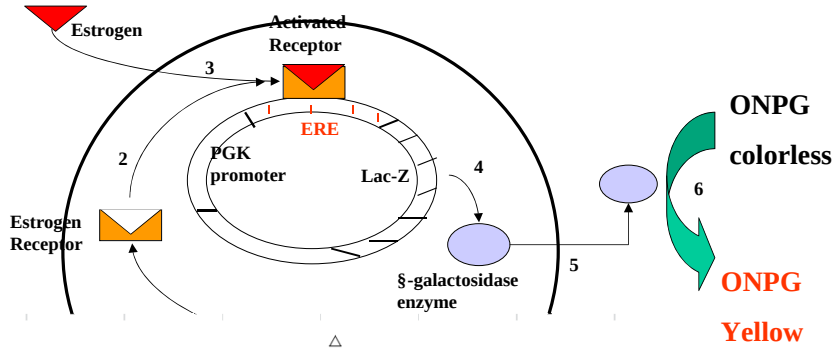
- Hormones *and* metabolites

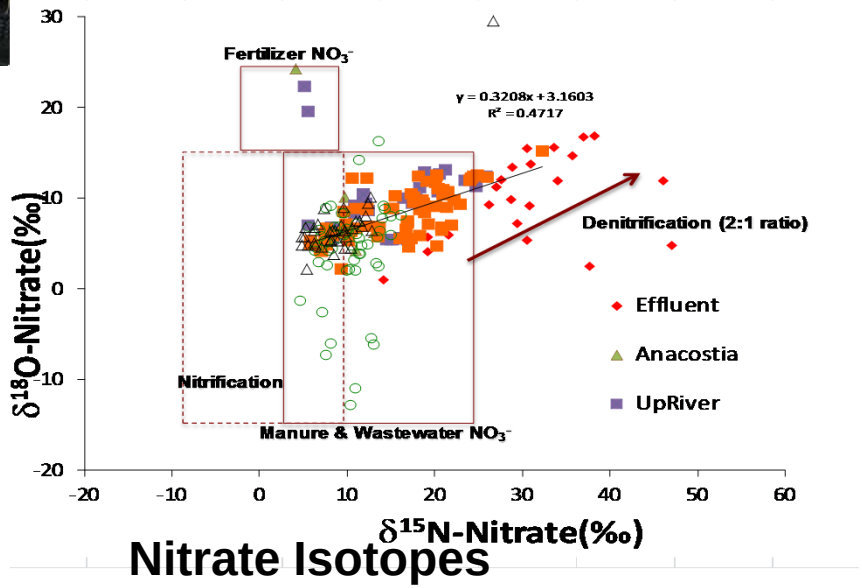


Advanced NOM Characterization

- Fluorometry

Bioactivity: Yeast Estrogen Assay



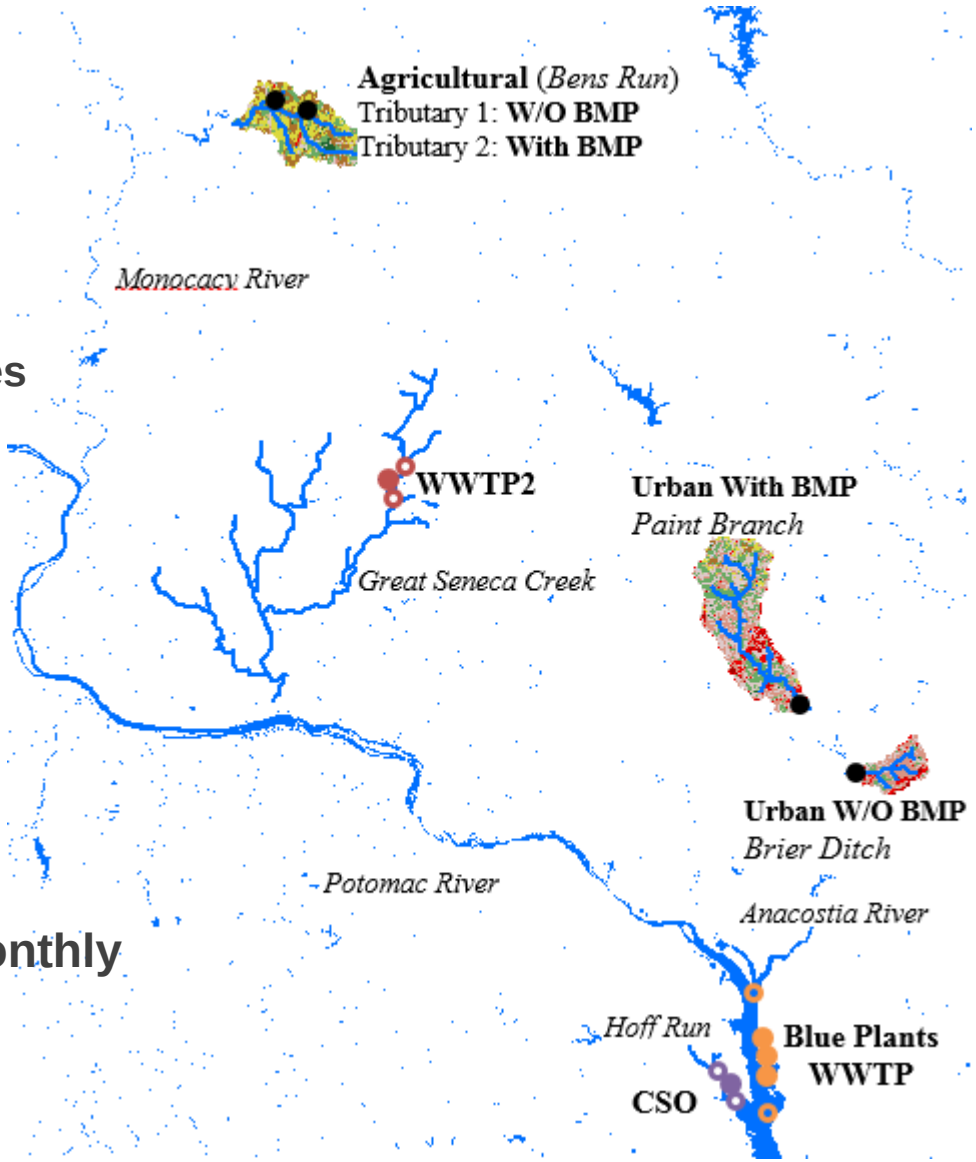


Nitrate Isotopes

- Source Tracking

Phase 1 Sampling

- Locations include:
  - "Paired" Watershed Samples
    - With and Without BMPs
  - Agriculture
  - Urban
  - CSO
  - Blue Plains WWTP
  - Additional WWTP
- Sampling Frequency is bimonthly for 1 year + 1 rain event



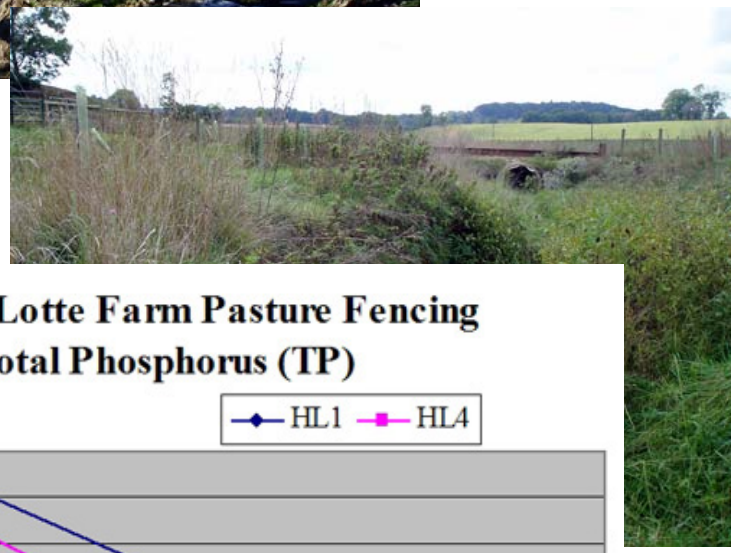
Agricultural BMPs

- Fencing
- Spring to replace in-stream cattle watering
- Stream crossings
- plantings of cool season grasses..

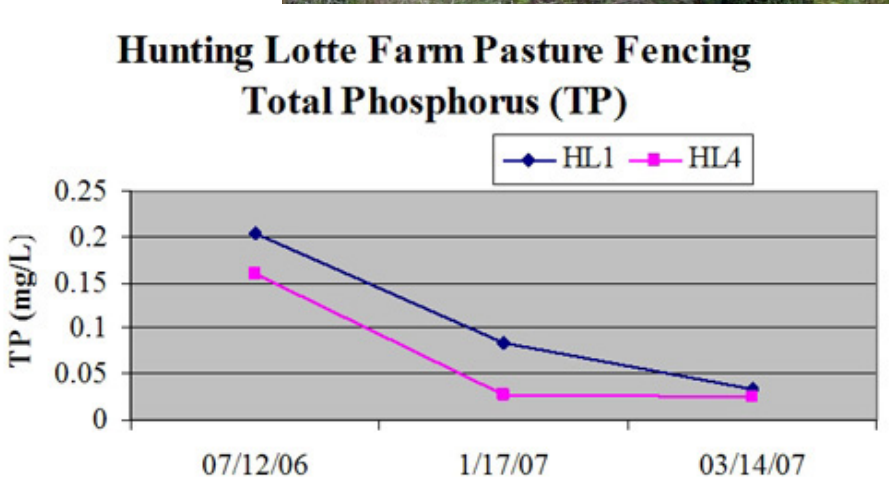
Result:

- streambank stability improved.
- Phosphorus concentrations declined

Fencing installation began in 2006 (visible erosion).



In autumn 2007 with fencing in plac area bac stat



Decreases in TP concentrations

Urban BMPs (Sligo Creek)

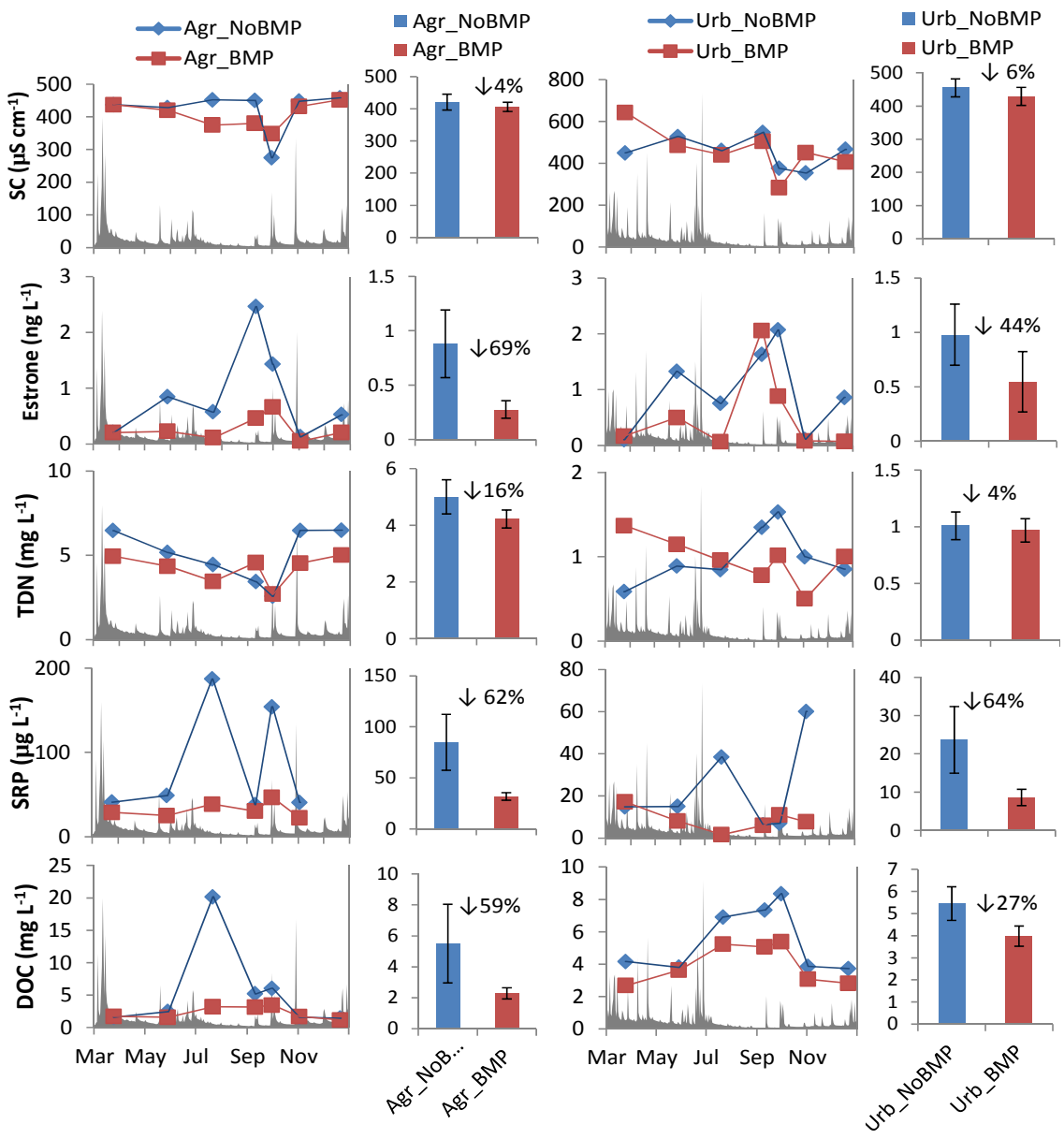
Devastation 1989 *Stream Restoration 1991* *Vegetation 1999*

Tributary Stream Restoration

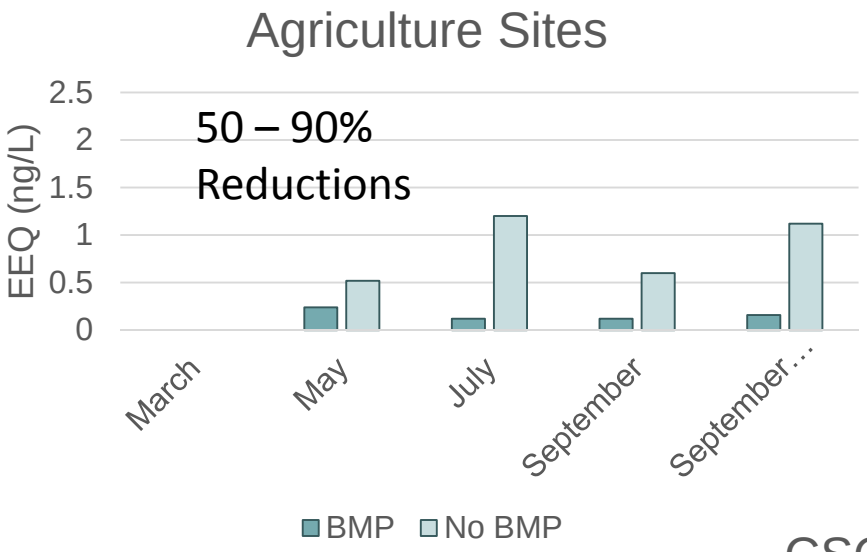
Constructed Wetlands

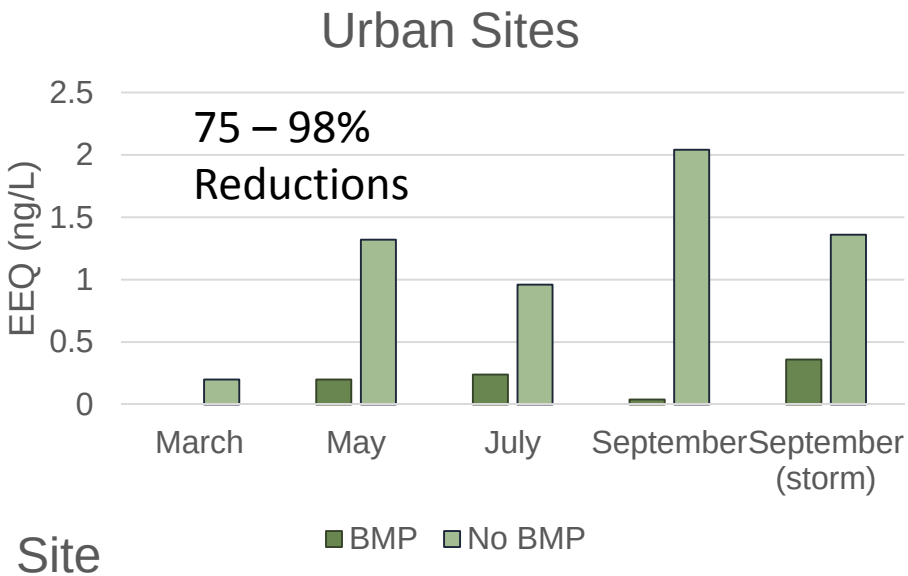
Stormwater Runoff Control Pond

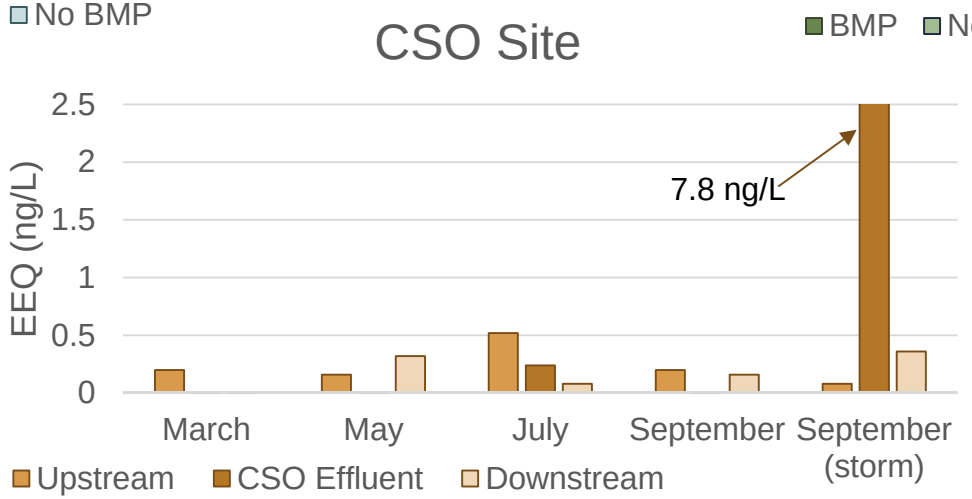
Results: Effect of Best Management Practices (BMPs) on Agricultural and Urban Runoff Inputs



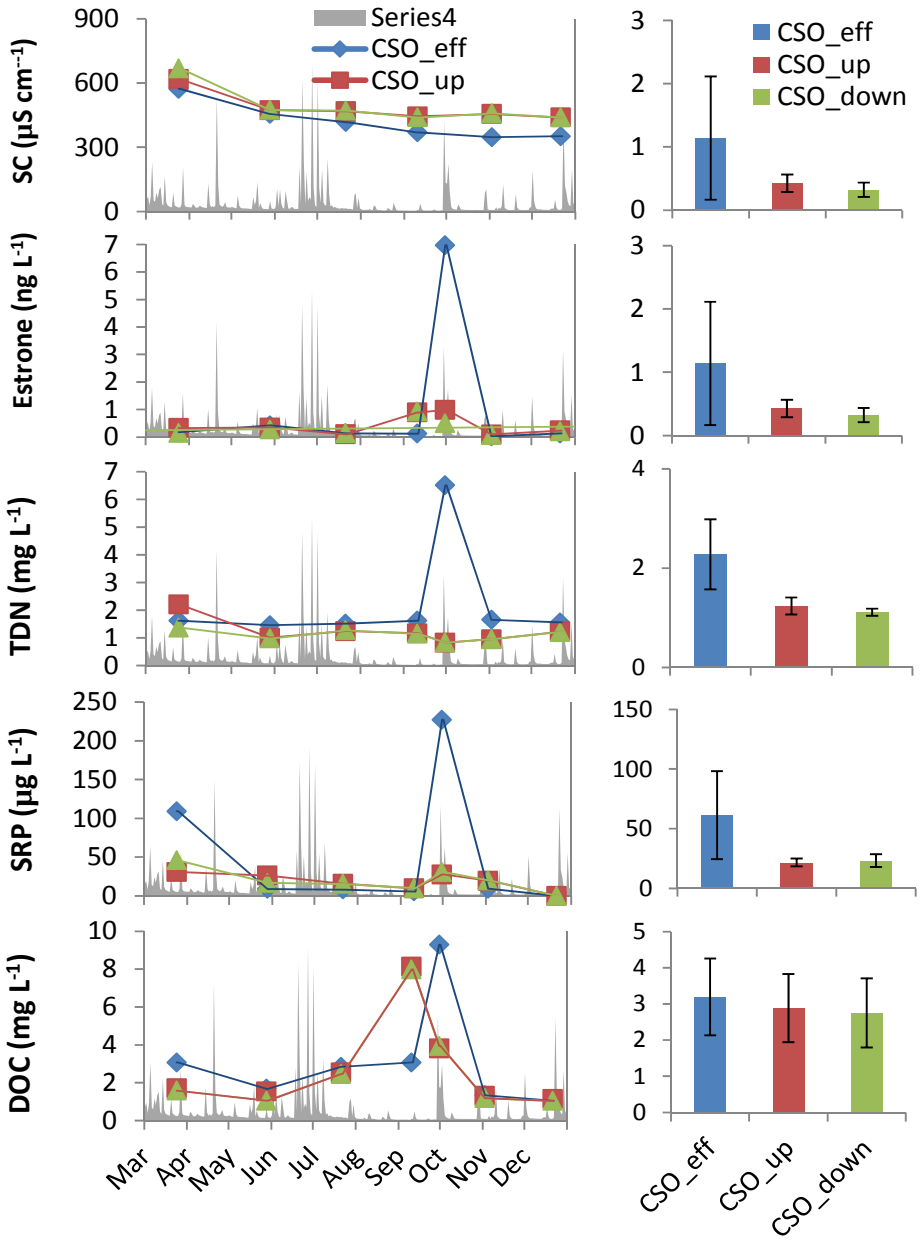
YES Comparison - BMPs



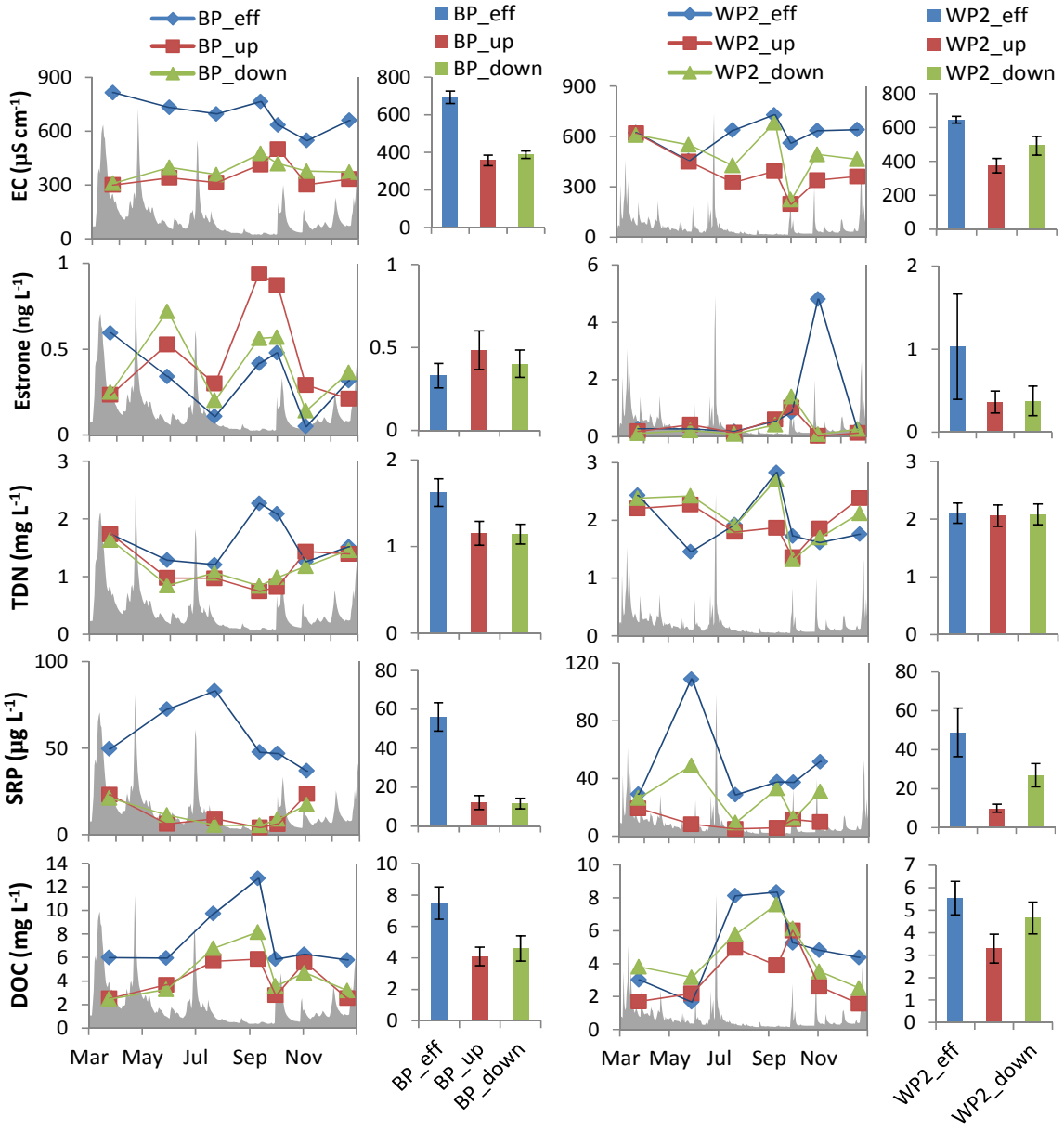




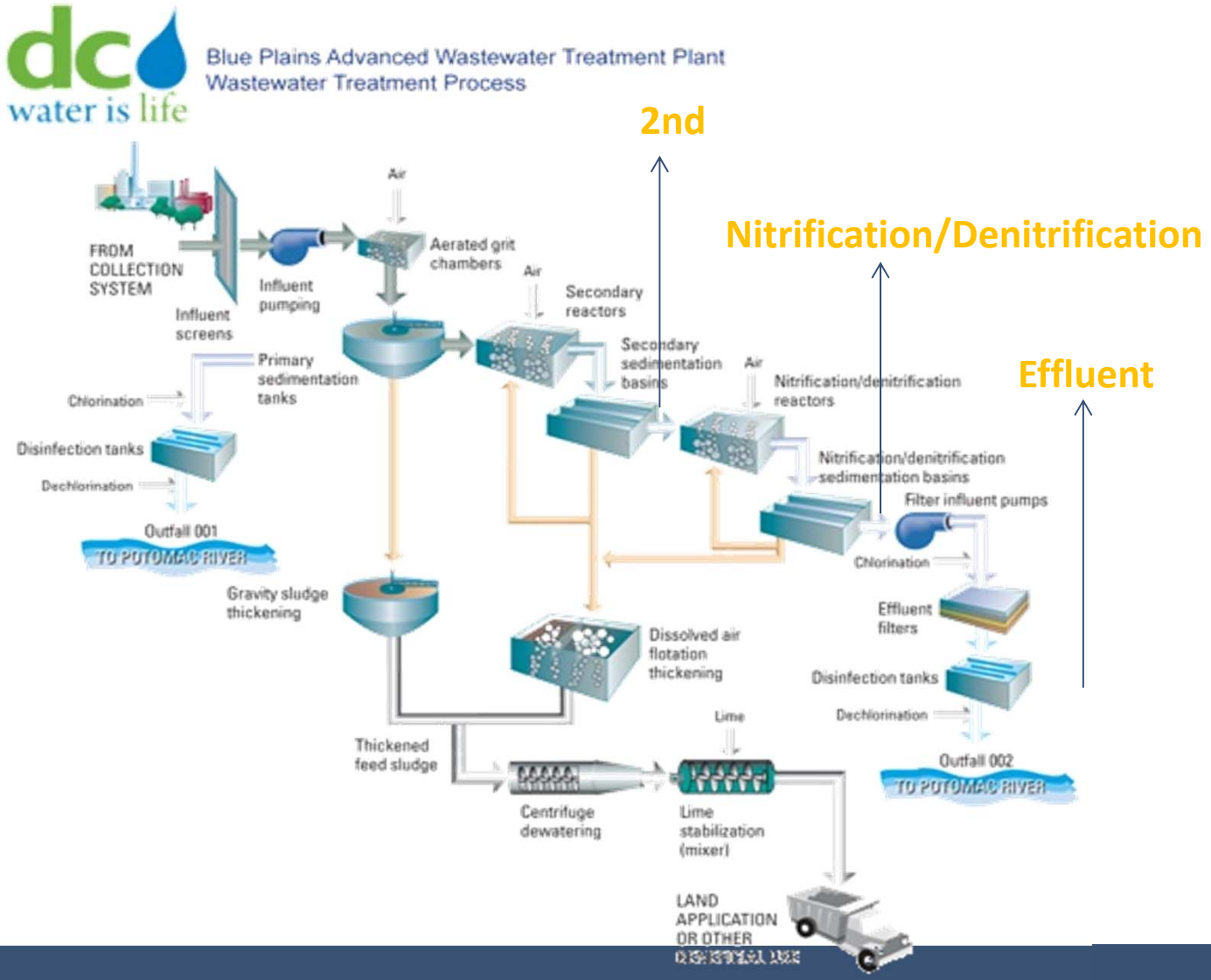
Results: CSO Impact on Water Quality



Results: Effect of Point Source Effluent

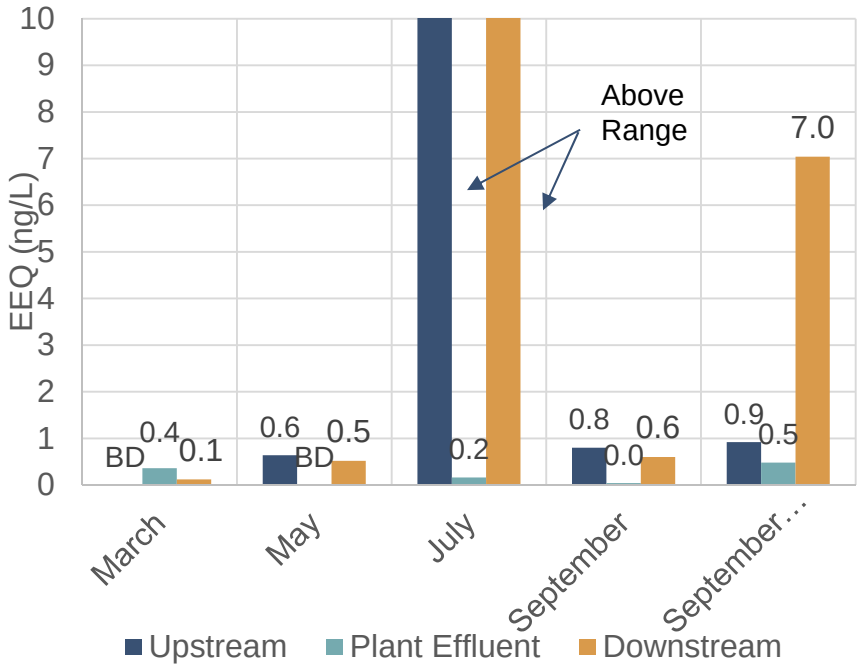


Wastewater treatment plants

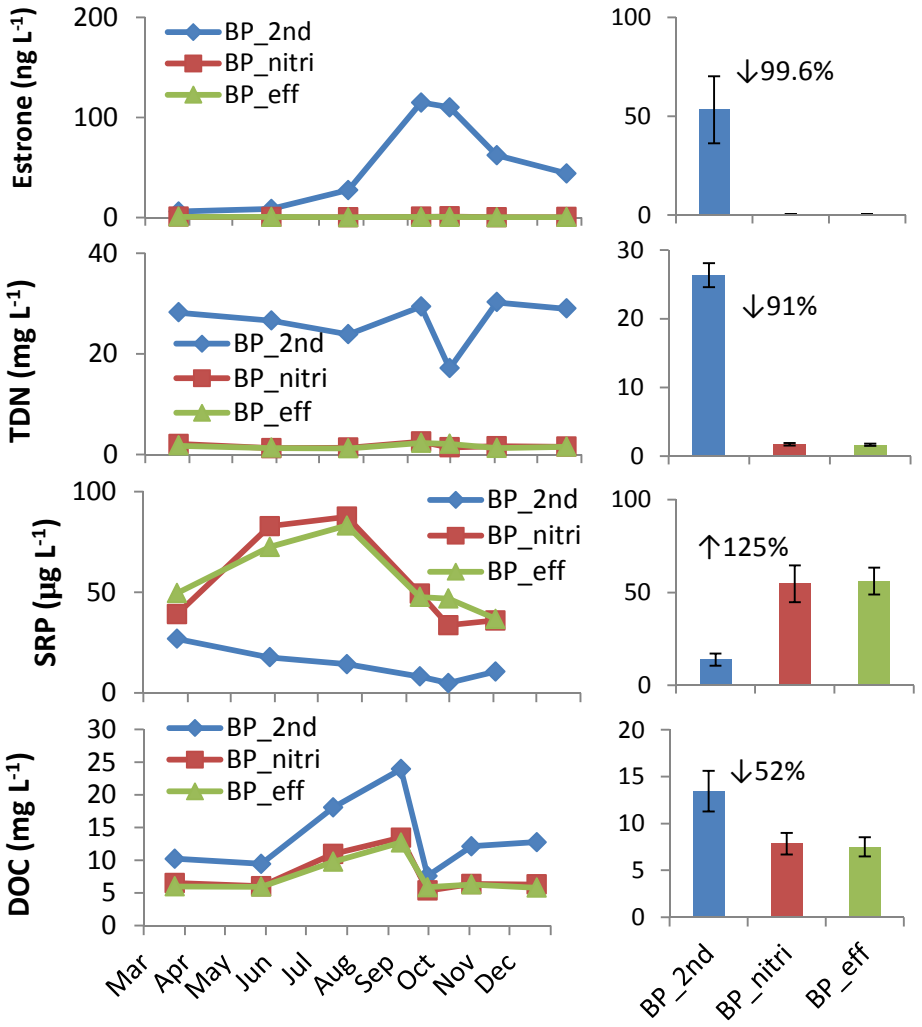


Blue Plains Impact

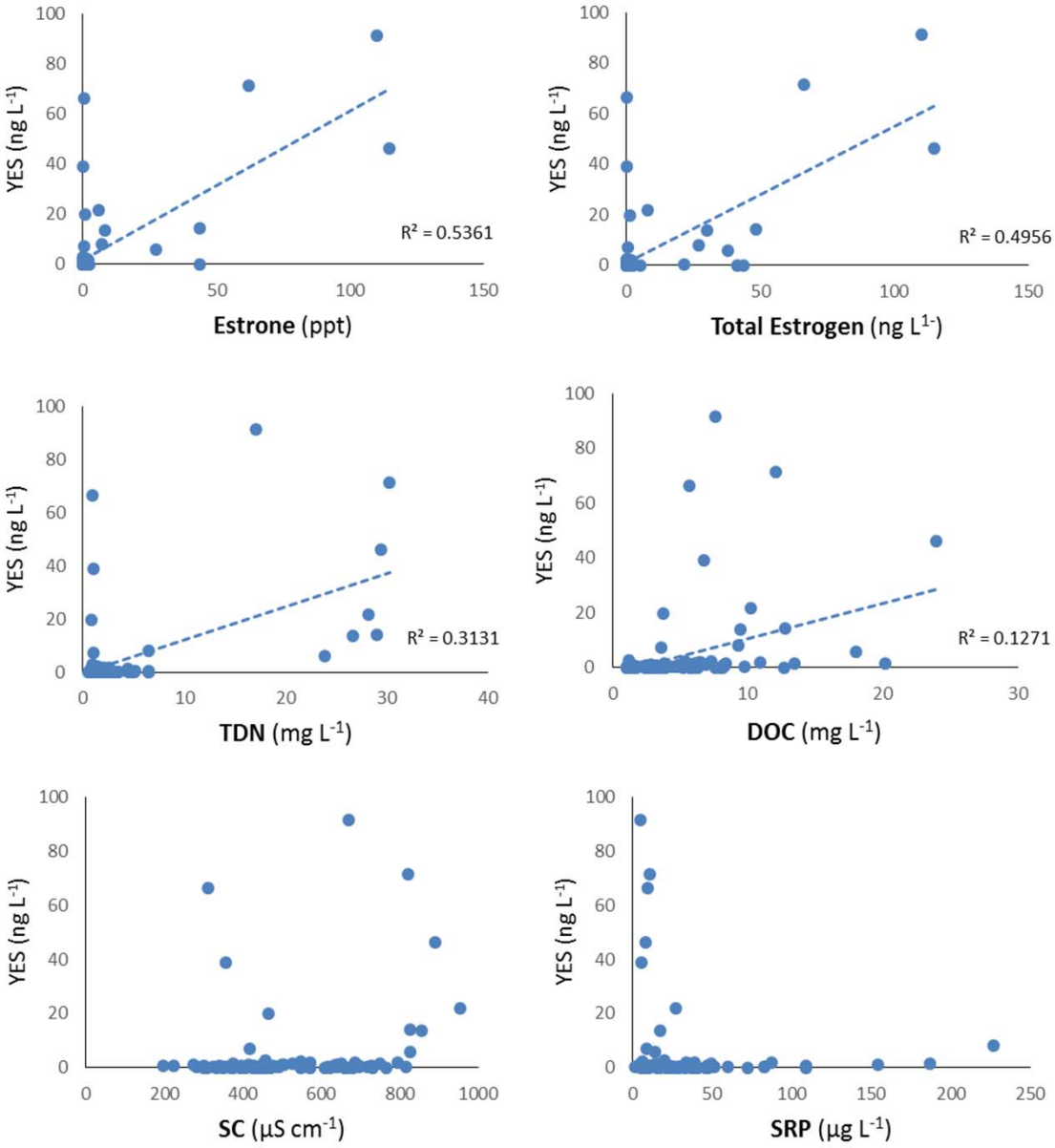
Estrogenic Activity



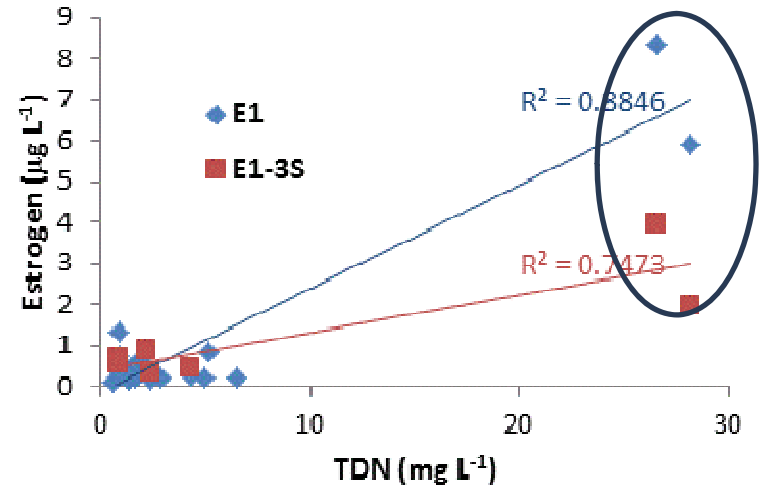
Water Quality

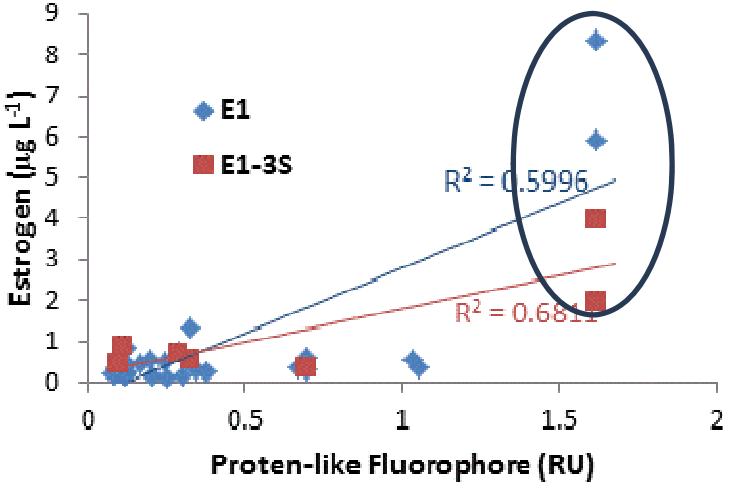


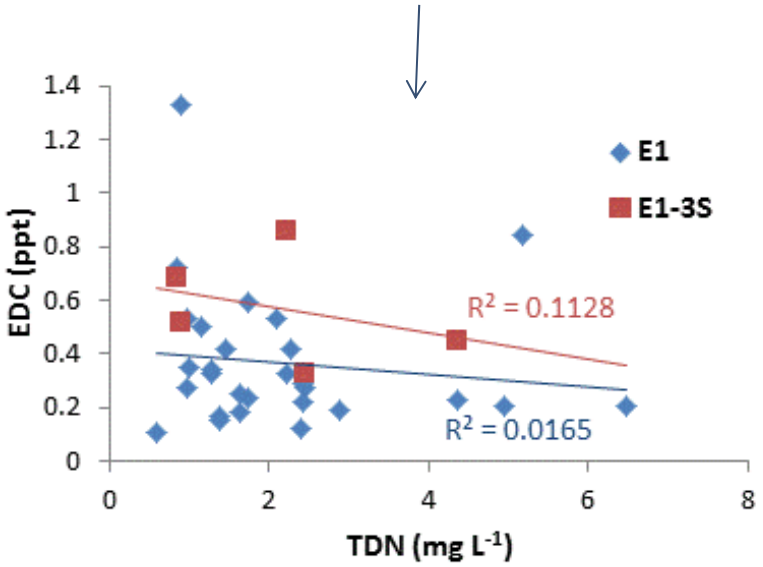
Correlations between EDCs and WQ

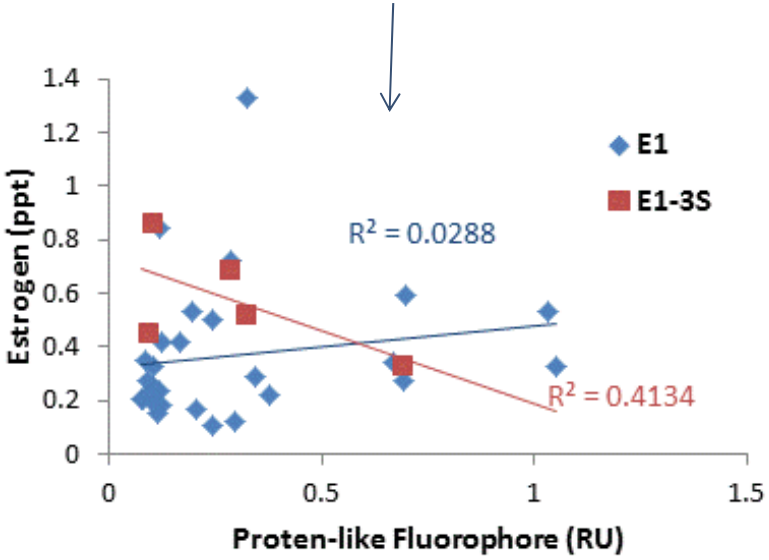


Correlations between EDCs and WQ

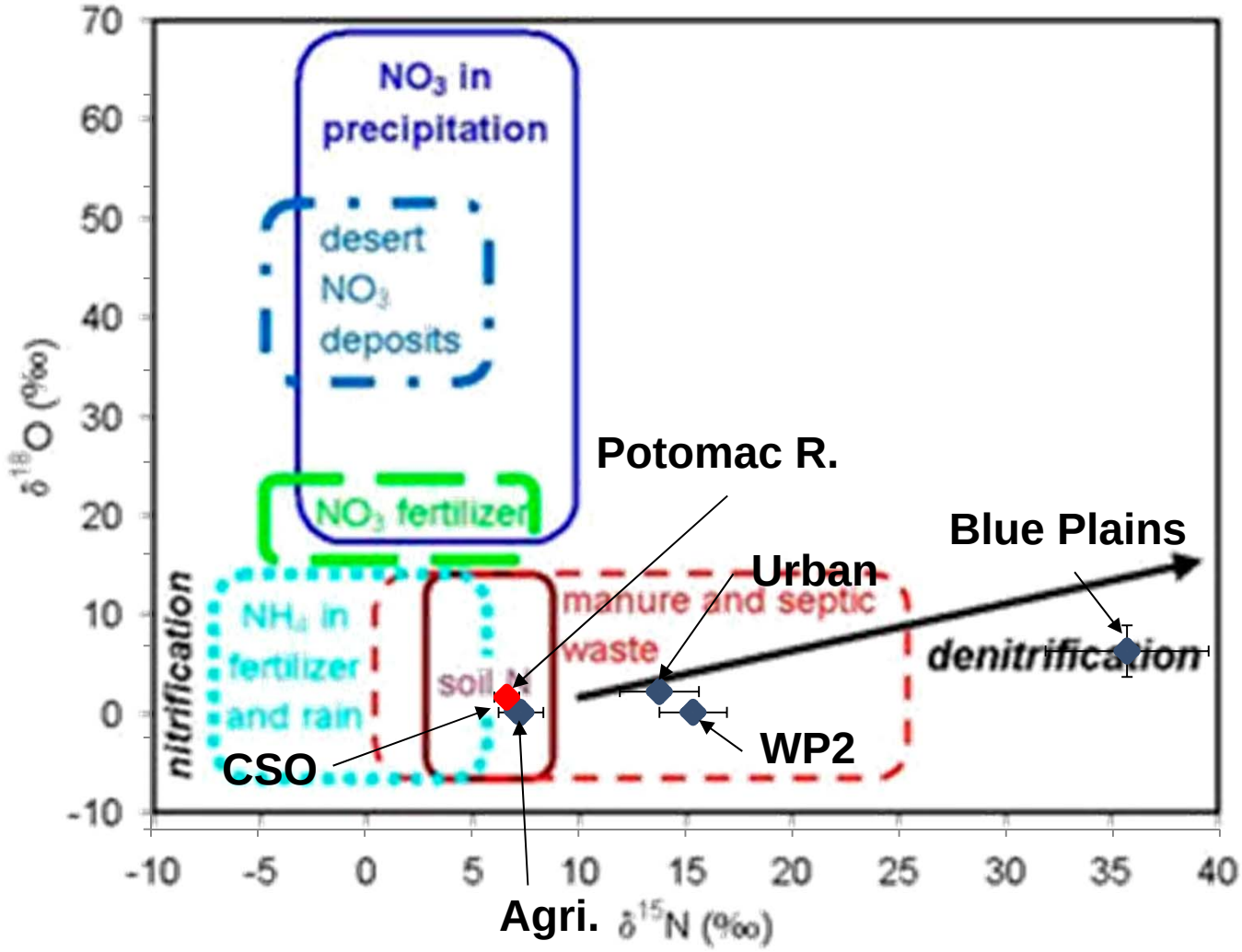




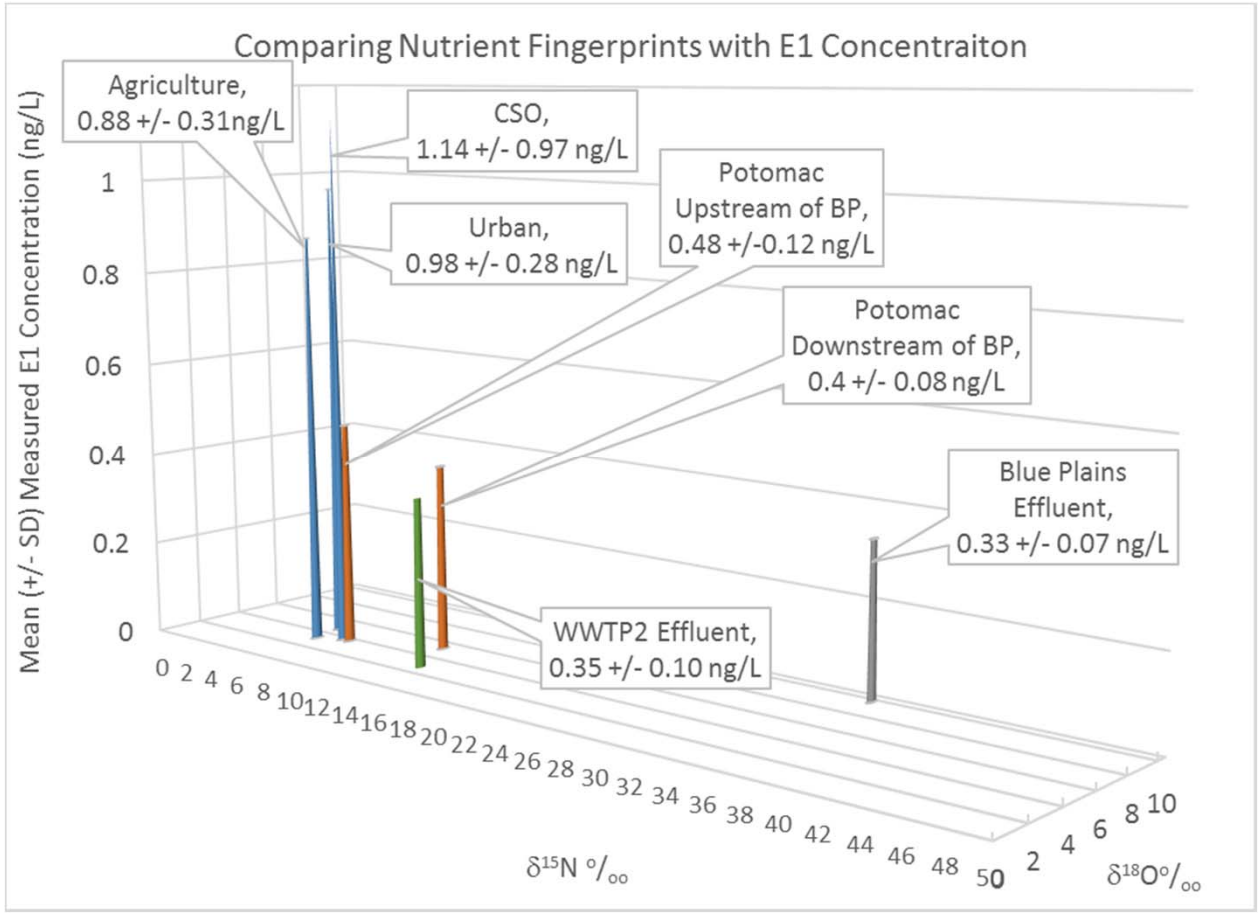




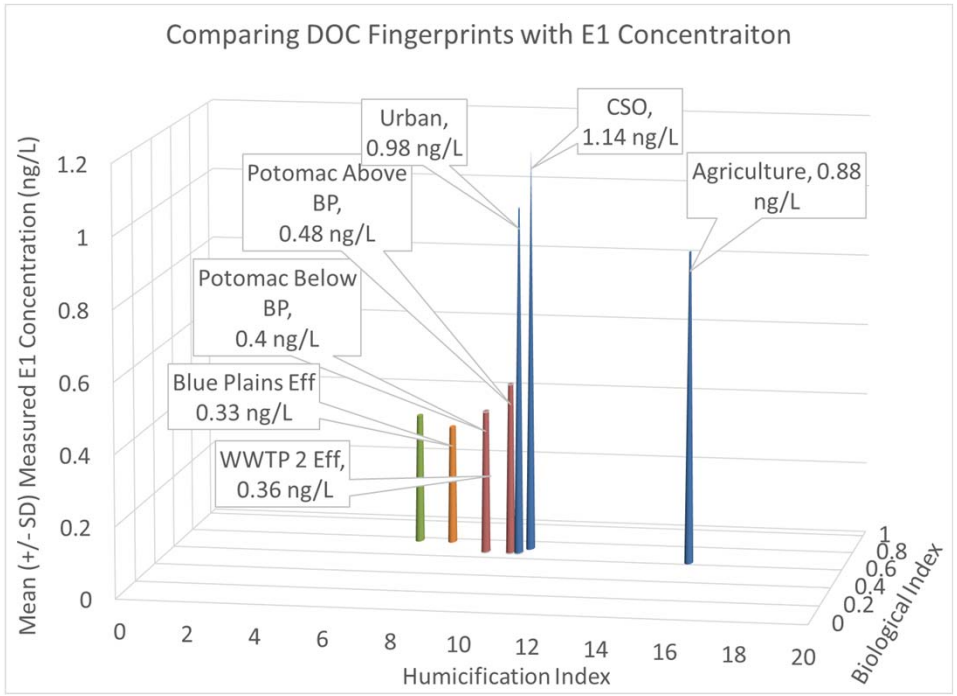
Source Tracking via Nutrient Isotopes

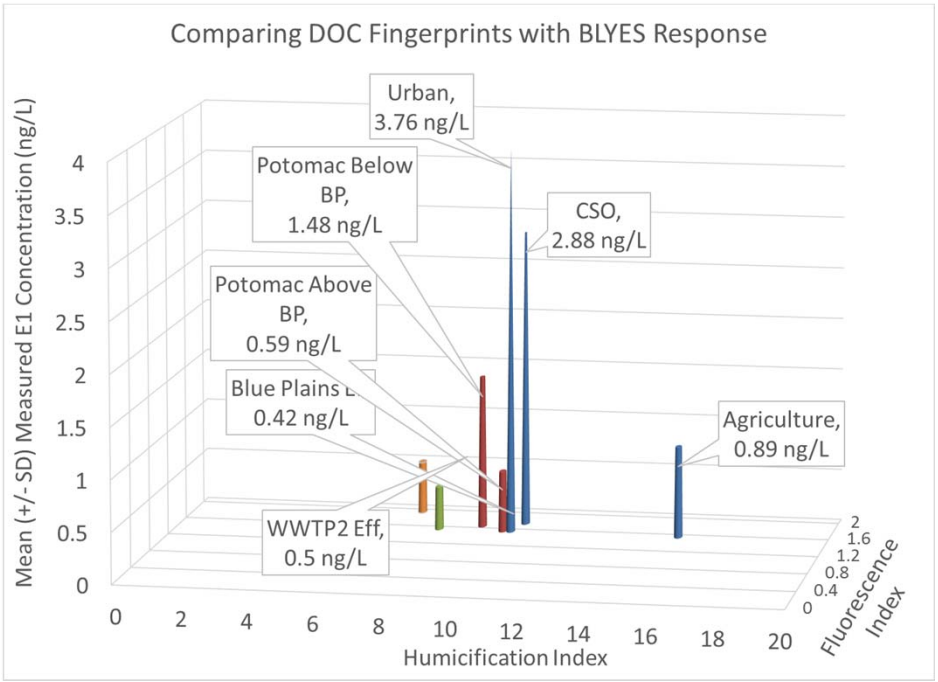


Overlaying EDCs on Nutrient Fingerprints



Overlaying EDCs on Organic Matter Fingerprints





Conclusions

Low level estrogenic activity found throughout the Potomac

Estrone was the most common EDC detected

- Effectively removed by wastewater treatment

CSOs showed limited observed impact, except after the heavy rain event

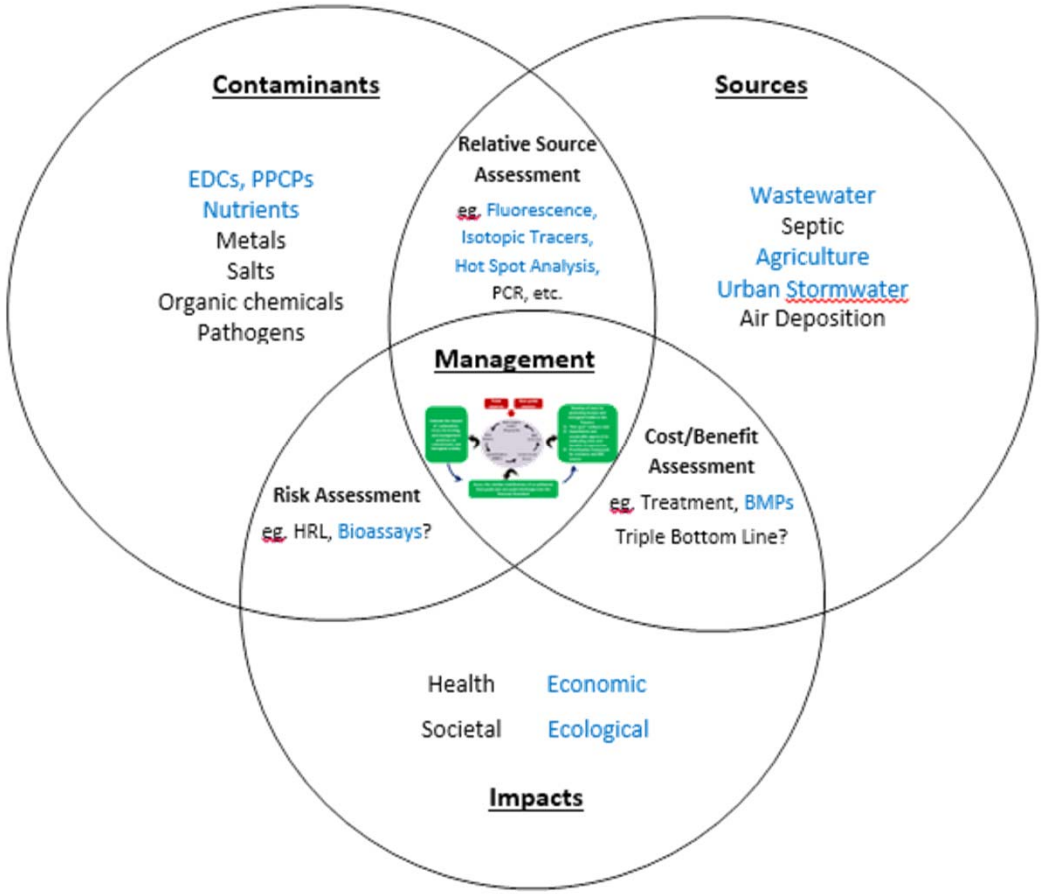
Nonpoint urban and agricultural sources served as continual sources

- BMPs were capable of significantly reducing estrogenic activity

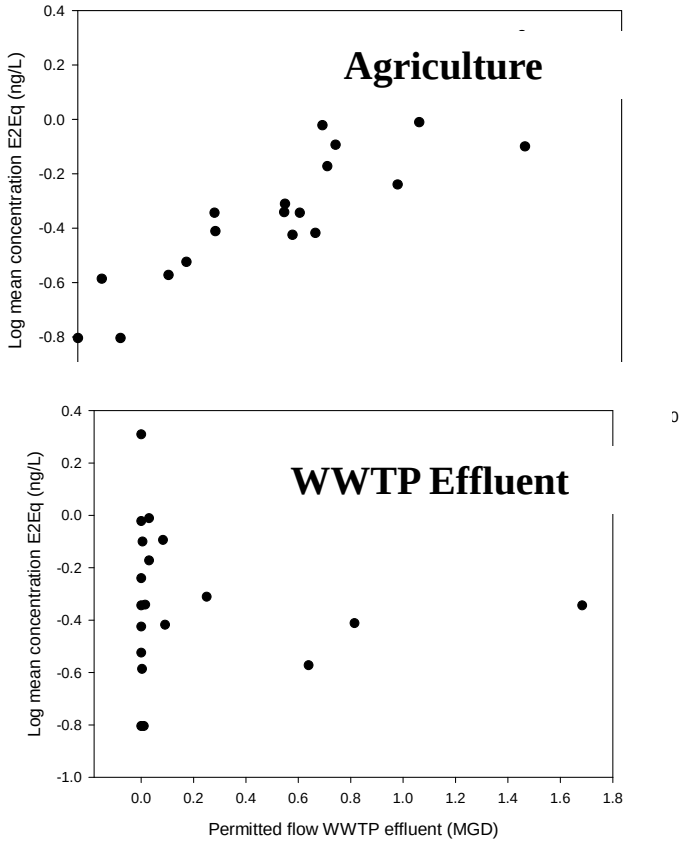
Limited correlations between typical water quality parameters and EDCs/EDC activity

- Advanced metrics showing promise

Baby Steps Towards Co-management of Pollutants?



Shenandoah Drainage, 2009



Ciparis et al. (2012) Effects of watershed densities of animal feeding operations on nutrient concentrations and estrogenic activity in agricultural streams. Science of the Total Environment, 414: 268-276

Next Steps: Justin will discuss in greater detail

EPA United States Environmental Protection Agency

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Improving Water Reuse for a Much Healthier Potomac Watershed

Grantee Research Project Results

Grantee Research Project Results

EPA Grant Number: R835825

Title: Improving Water Reuse for a Much Healthier Potomac Watershed

Investigators: Pramanik, Amit , Aga, Diana S. , Duan, Shuiwang , Grizzard, Tom , Iwanowicz, Luke , Kaushal, Sujay , Murthy, Sudhir , Rosenfeldt, Erik

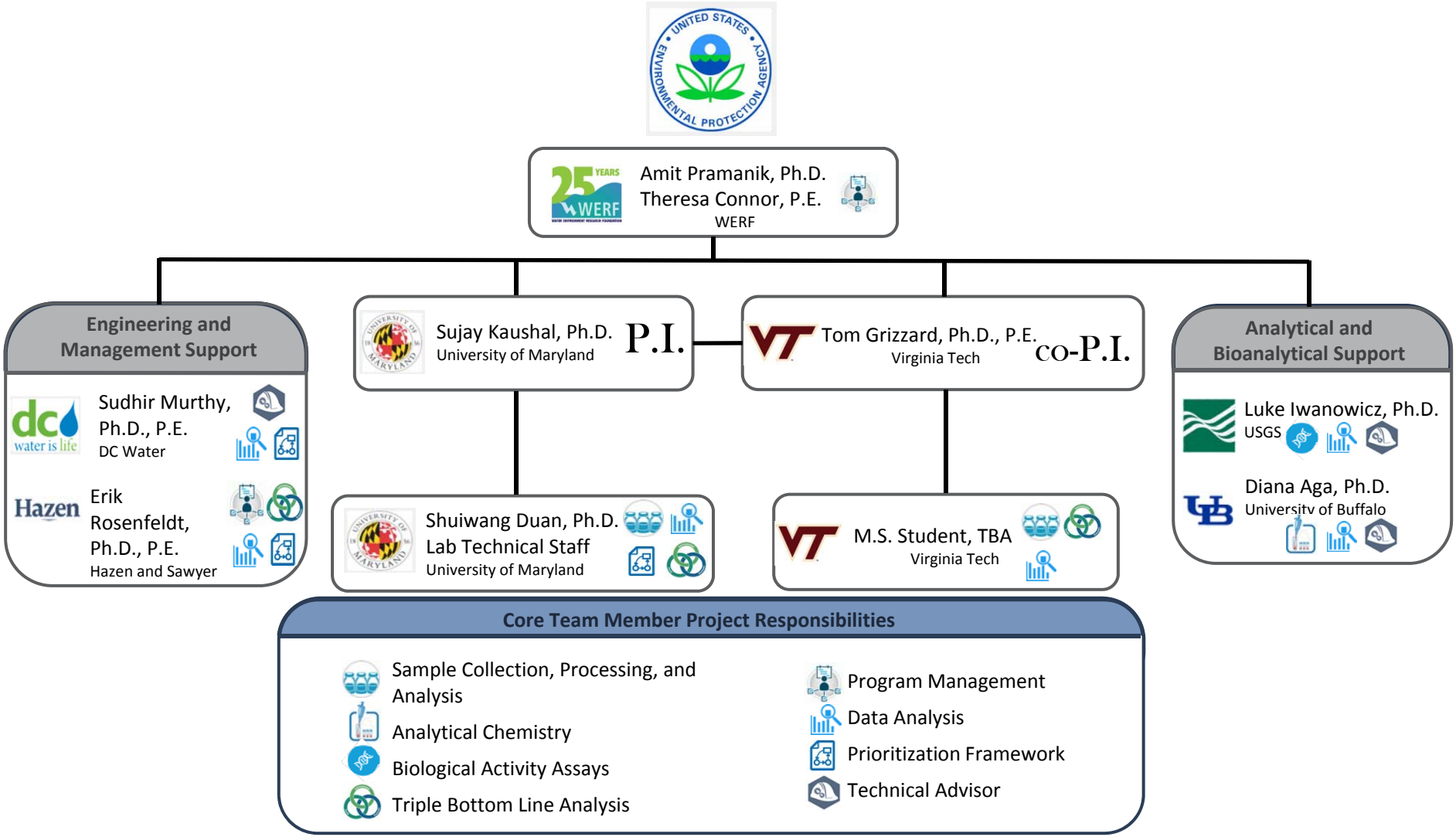
Institution: **Water Environment Research Foundation** , DC Water , Hazen and Sawyer , United States Geological Survey [USGS] , University of Buffalo , University of Maryland , Virginia Polytechnic Institute and State University

EPA Project Officer: Packard, Benjamin H

Project Period: August 1, 2015 through July 31, 2018

Project Amount: $750,000

Another exciting collaboration



EPA STAR Timeline

Year 1 (July 2016 – June 2017)

- Identify and track spatial and temporal variations in “hot spots”

Year 2 (July 2017 – June 2018)

- Focused study on impact and outcomes of reclamation, reuse, harvesting, and management strategies on sources of pollutants

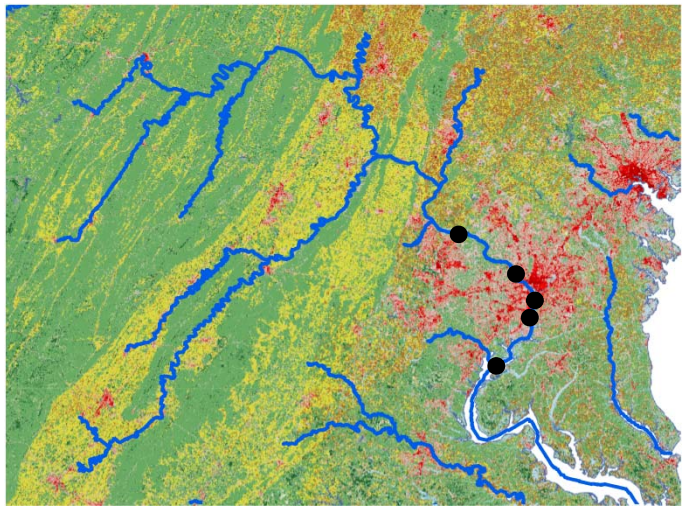
Year 3 (July 2018 – June 2019)

- Quantitative assessment of costs, benefits, and impact of advanced reclamation, reuse, harvesting, and management practices on human and ecological health in the Potomac

Distilling it down a bit further

	Non-Point Source Agriculture Urban		Point Source	Background
EDCs				
Nutrients				
Pathogens				

OWML – Site of May 23rd "unofficial" Project Kickoff Meeting



Land Use in the Potomac Watershed

Questions?

erosenfeldt@hazenandsawyer.com