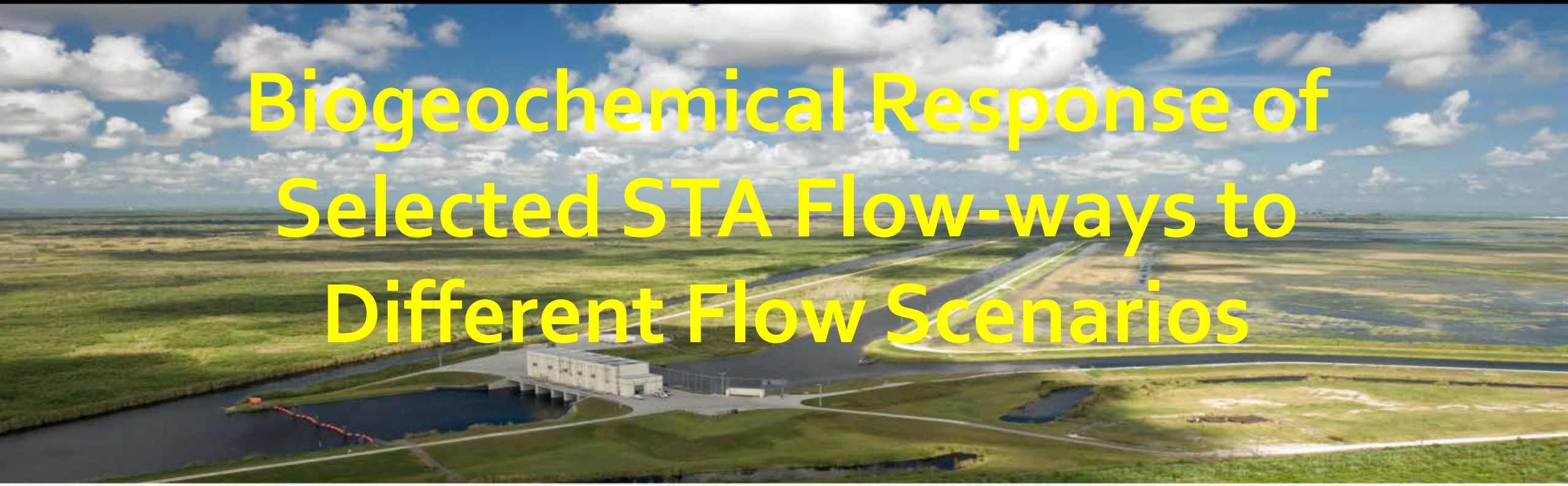
SOUTH FLORIDA WATER MANAGEMENT DISTRICT



Biogeochemical Response of Selected STA Flow-ways to Different Flow Scenarios

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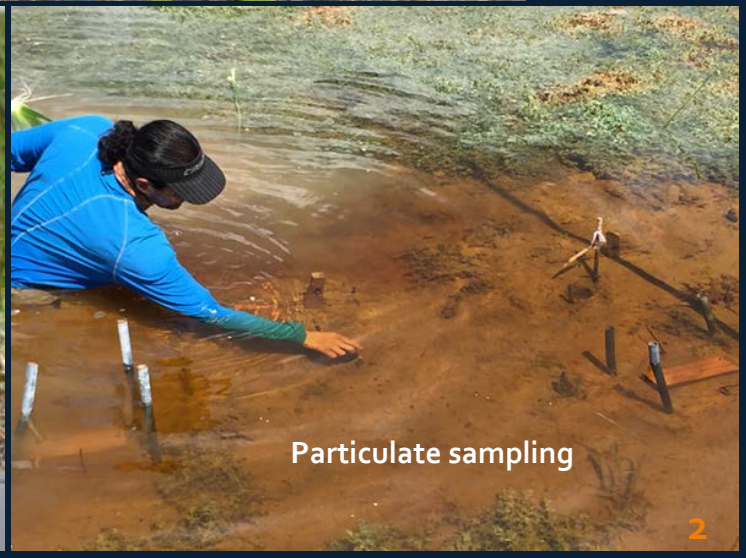
Restoration Strategies for Clean Water for the Everglades

Flow-Dependent Responses

- Particulate settling and entrainment
- Microbial enzyme activities
- Diffusive and net P fluxes
- Inflow to outflow WQ assessments

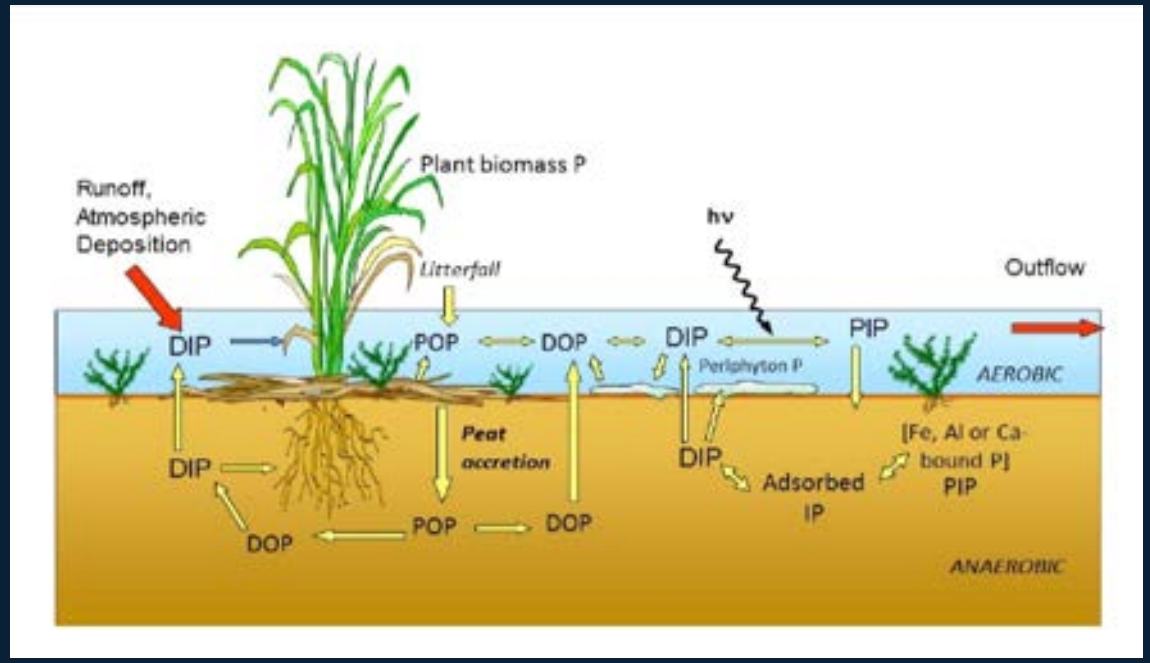

Diffusion chambers


Autosamplers

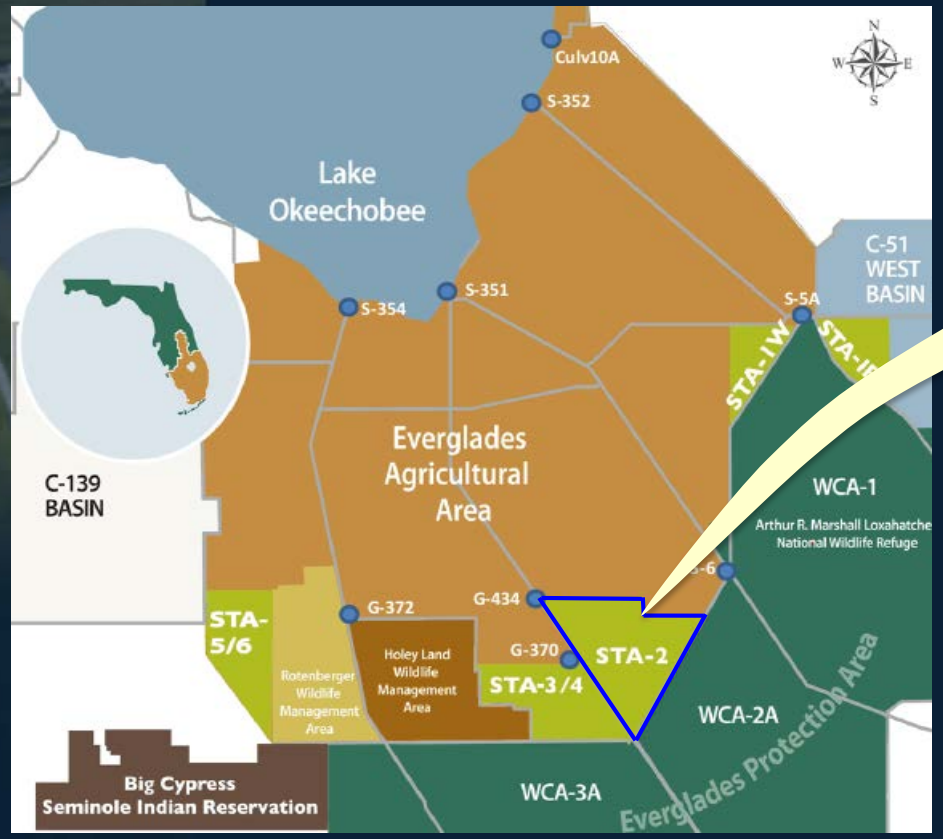

Particulate sampling

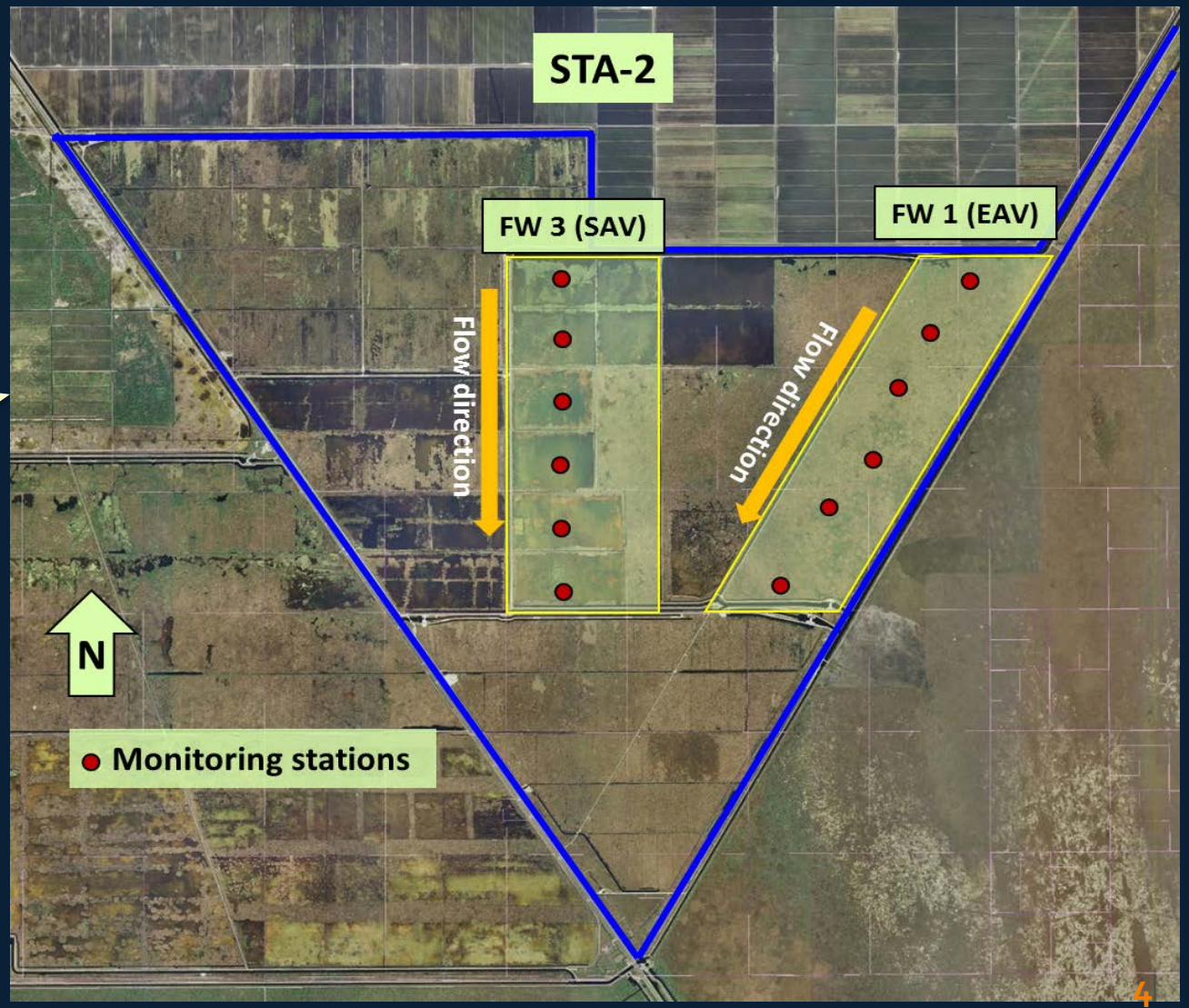
Study Objectives

- Evaluate changes in water column P concentrations and speciation along the flow direction under varying hydraulic conditions
- Determine biogeochemical factors and processes influencing responses, particularly those related to P retention and cycling along the flow-way



Study Locations





Data Collection

Method	Parameters	Frequency
Autosampler	Total phosphorus (TP)	Every 4 hours
	Total nitrogen (TN), Total organic carbon (TOC)	Daily composite
Grab	TP, Soluble reactive P, Total dissolved P, Dissolved organic C, TN, Calcium, Magnesium, Potassium, Sodium, Iron, Sulfate, Chloride, Alkalinity, Color, Total suspended solids, Hardness, Chlorophyll	Weekly
Field	pH, Dissolved oxygen, Specific conductance, Temperature	Every 30 minutes

Flow Events – STA-2 FW 1 (EAV)

Flow Phase	Phase Period	Mean Flow* (cfs)	Mean HLR (cm/d)	Mean PLR ($mg/m^2/d$)	Mean Water Depth (ft)
1st Flow Event (August 10 – September 14, 2015) - 35 days					
Low Flow	8/10 – 8/16	25 (33)	0.80 (1.08)	0.8 (1.1)	1.43 (0.20)
Stagnant	8/17 – 8/31	0	0	0	1.48 (0.04)
Low Flow	9/1 – 9/14	32 (11)	1.05 (0.36)	0.8 (0.3)	1.67 (0.08)
2nd Flow Event (May 29 – July 29, 2017) – 42 days					
Stagnant	5/29 – 6/4	0	0	0	1.22 (0.03)
High Flow	6/5 – 6/26	317 (147)	10.41 (4.82)	20.1 (10.2)	2.51 (0.34)
Low Flow	6/27 – 7/29	7 (0.01)	0.22 (0.91)	0.3 (1.3)	1.53 (0.11)
3rd Flow Event (November 12 – December 26, 2017) - 47 days					
Low Flow	11/12 – 11/27	102 (49)	3.35 (1.61)	0.9 (0.4)	2.14 (0.06)
No Flow	11/28 – 12/26	0	0	0	1.41 (0.20)

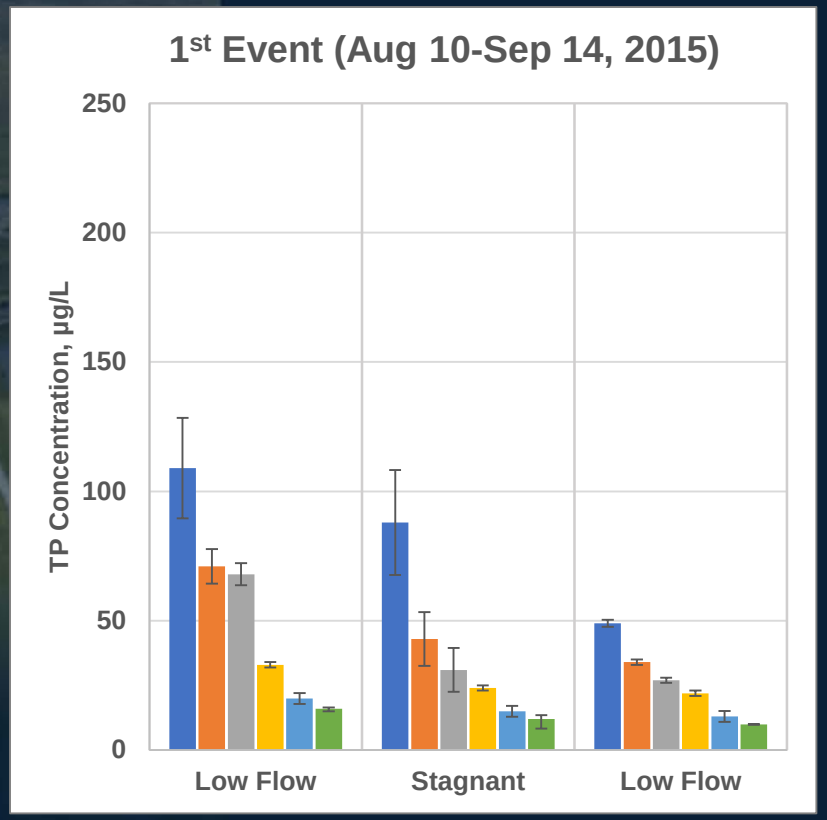
*Flow Categories: Low: 1-150 cfs; Moderate: 150-300 cfs; High: >300 cfs; No flow: stagnant
Numbers in parentheses are ± standard deviation

Flow Events – STA-2 FW 3 (SAV)

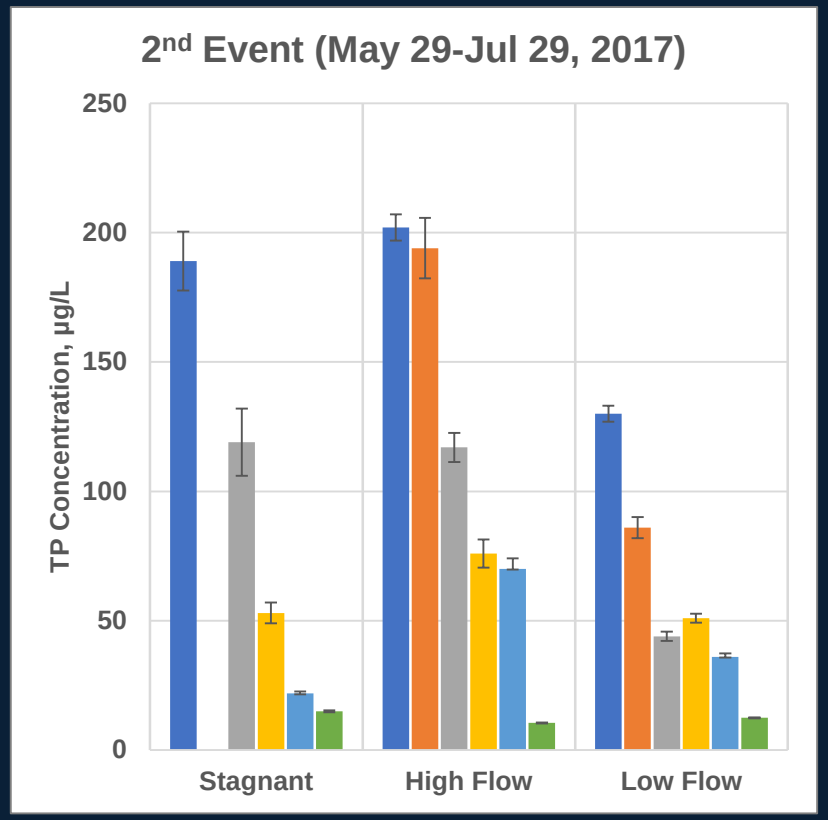
Flow Phase	Phase Period	Mean Flow* (cfs)	Mean HLR (cm/d)	Mean PLR ($mg/m^2/d$)	Water Depth (ft)
1st Flow Event (February 22 – April 11, 2016) - 50 days					
High Flow	2/22 – 3/7	325 (60)	8.55 (1.58)	3.7 (1.3)	1.96 (0.04)
Stagnant	3/8 – 3/29	0	0	0	1.91 (0.06)
Low Flow	3/30 – 4/11	55 (111)	1.45 (2.91)	1.0 (2.0)	1.60 (0.21)
2nd Flow Event (June 27– August 29, 2016) – 64 days					
Stagnant	6/27 – 7/2	0	0	0	1.46 (0.05)
Low Flow	7/3 – 7/24	132 (33)	3.48 (0.87)	1.6 (0.7)	2.03 (0.18)
Stagnant	7/25 – 8/8	0	0	0	1.93 (0.07)
Low Flow	8/9 – 8/29	120 (86)	3.15 (2.26)	2.3 (1.6)	2.00 (0.07)
3rd Flow Event (October 12 – November 22, 2016) - 49 days					
High Flow	10/12 – 11/3	301 (51)	7.90 (1.34)	5.9 (2.1)	2.46 (0.14)
Stagnant	11/4 – 11/22	0	0	0	2.32 (0.10)

Numbers in parentheses are ± standard deviation

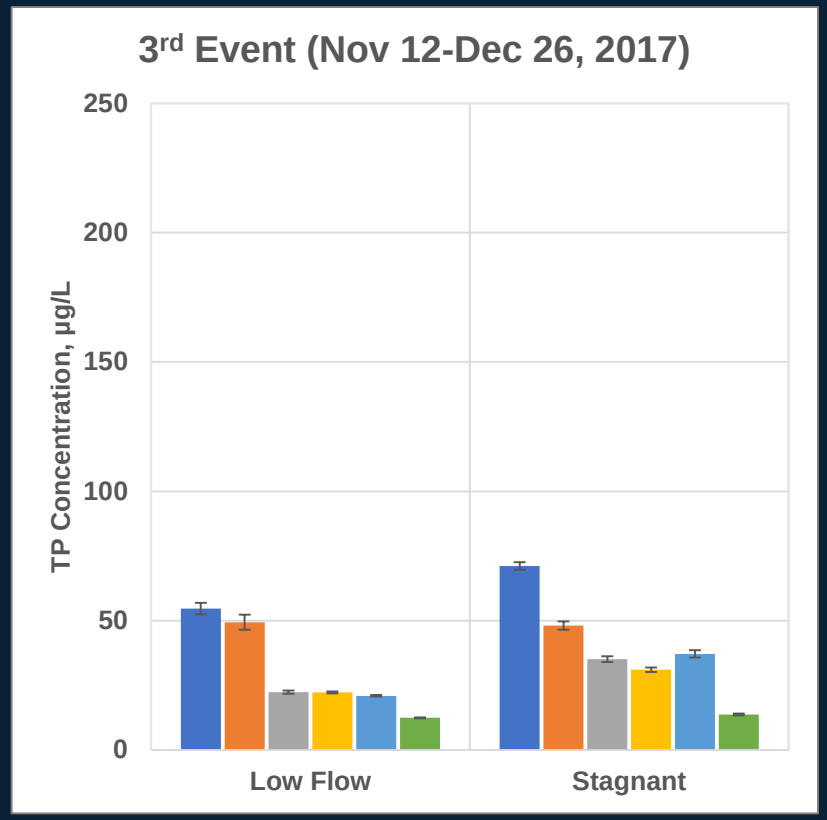
Mean TP Concentrations- STA-2 FW 1 (EAV)



Flow direction

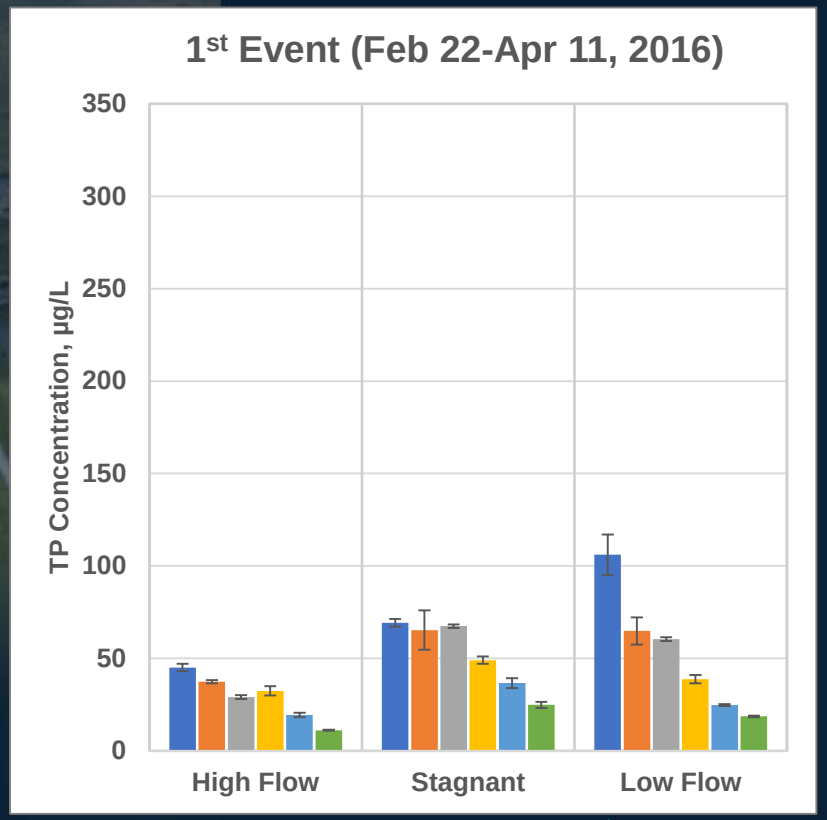


Flow direction

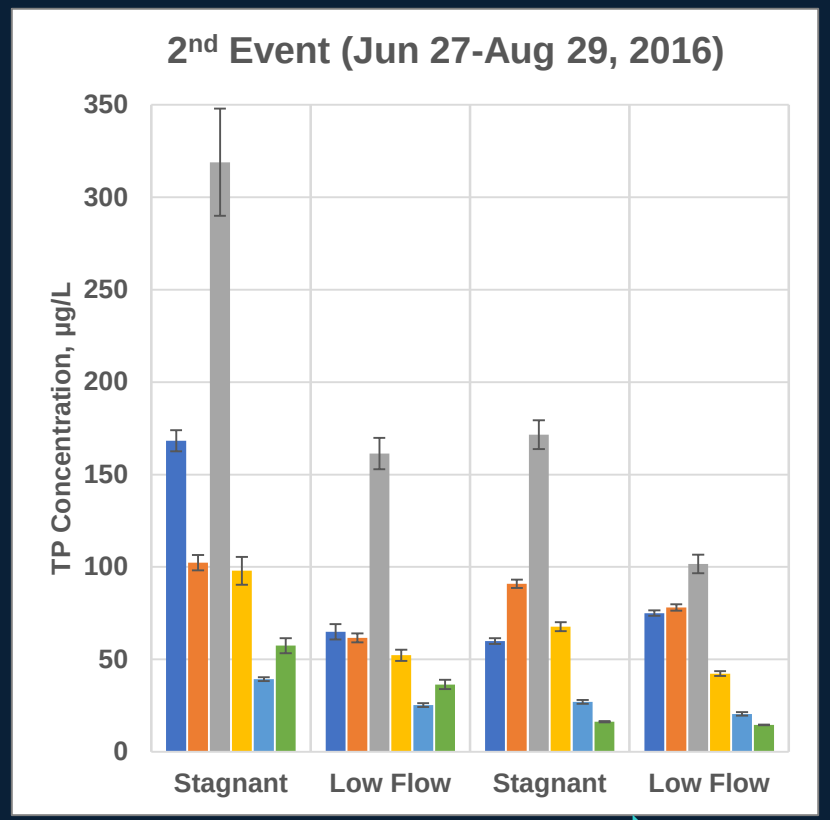


Flow direction

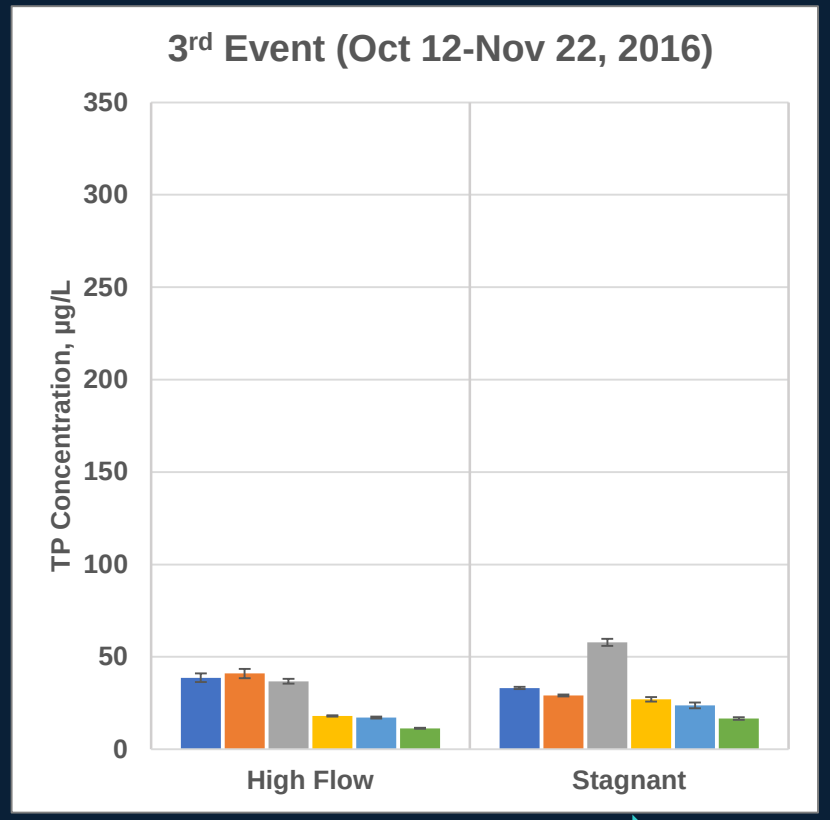
Mean TP Concentrations- STA-2 FW 3 (SAV)



Flow direction

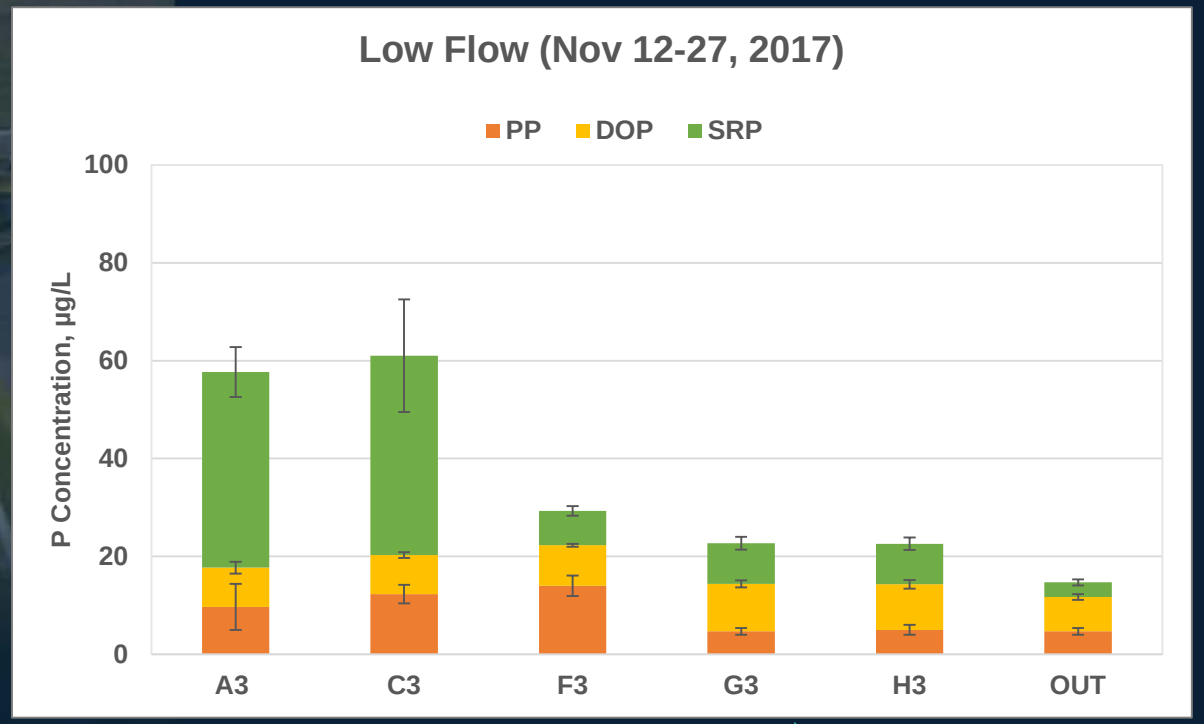


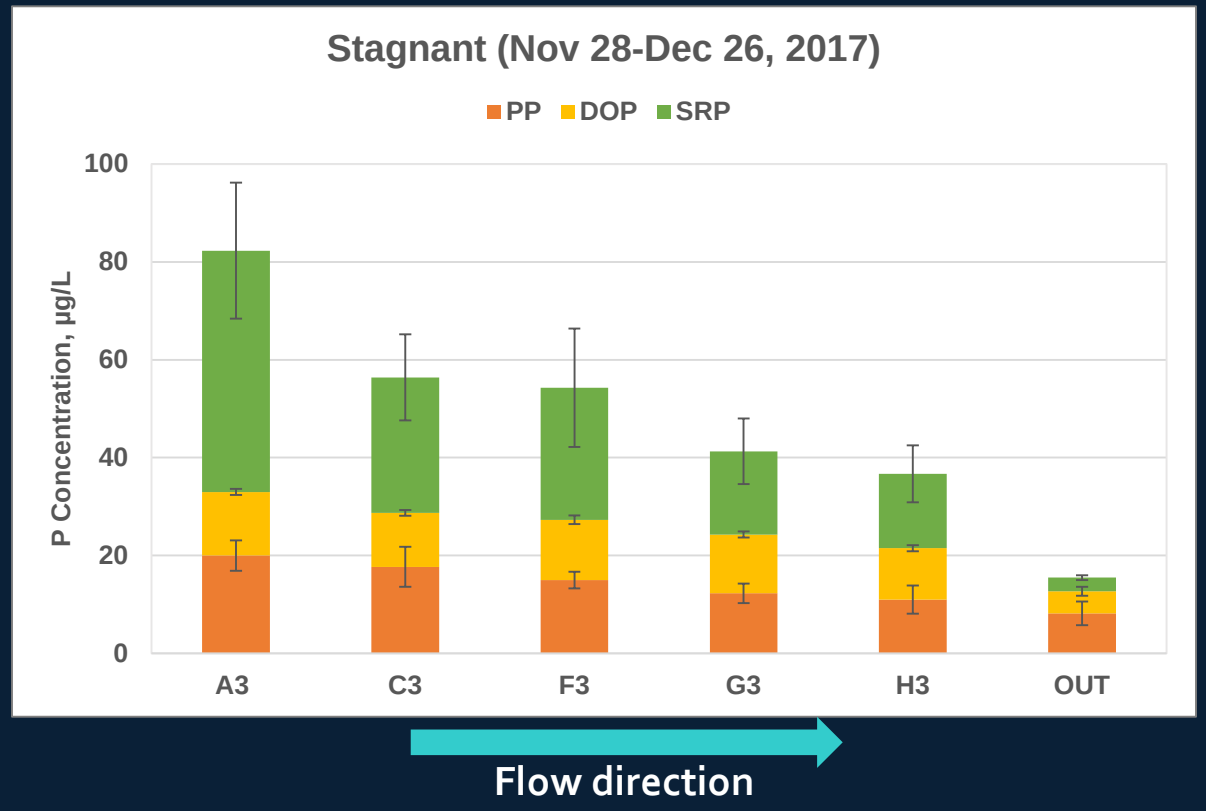
Flow direction



Flow direction

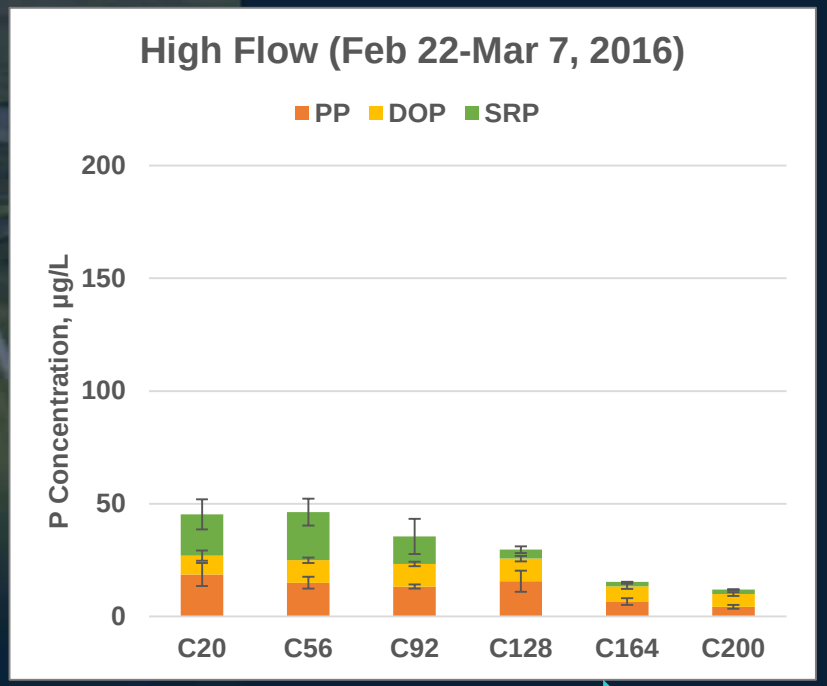
P Speciation– STA-2 FW 1 (EAV)

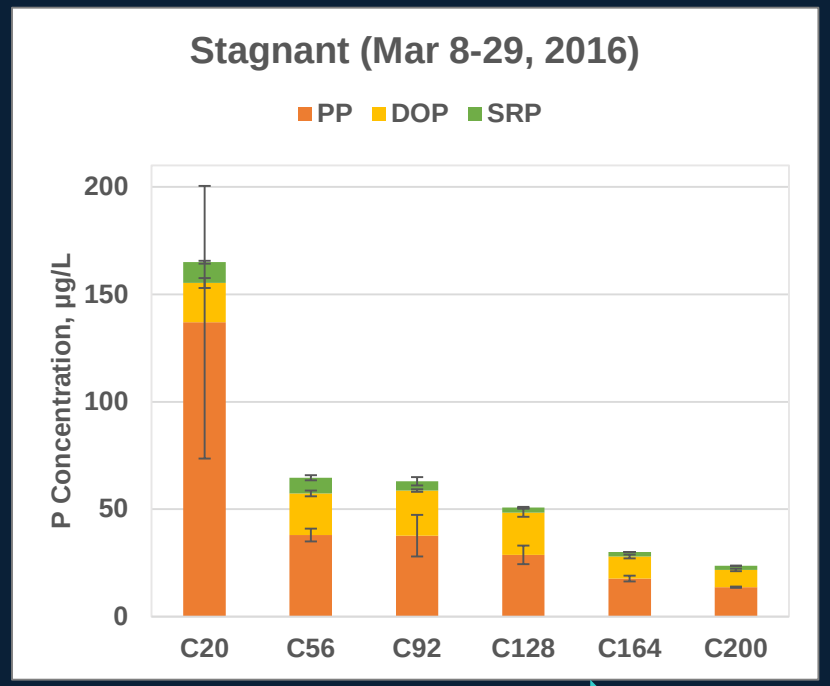


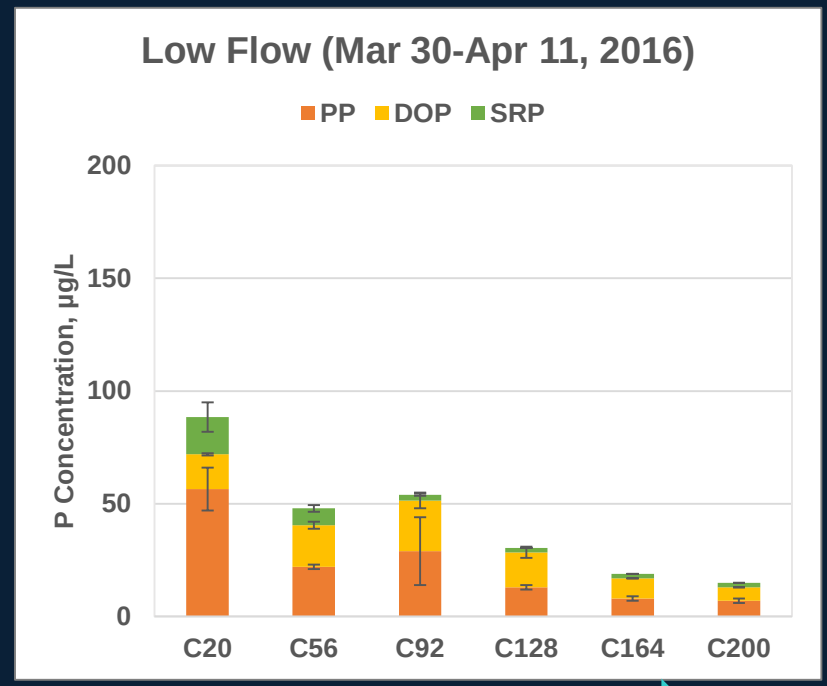


PP – particulate P; DOP- dissolved organic P; SRP- soluble reactive P

P Speciation – STA-2 FW 3 (SAV)







PP – particulate P; DOP- dissolved organic P; SRP- soluble reactive P

Correlation of TP with Key Water Quality Parameters

Correlating Parameter	STA-2 FW 1 (EAV) (n=64)[a]	STA-2 FW 3 (SAV) (n=72)
pH	-0.277*[b]	0.148[ns]
Dissolved oxygen	-0.401**	0.163[ns]
Temperature	0.138[ns]	0.258*
Alkalinity	0.218*	0.232*
Aluminum	0.083[ns]	0.442*
Calcium	0.242*	0.184*
Chlorophyll a	0.399**	0.759**
Iron	0.652**	0.438**
Total nitrogen	0.461**	0.502**
Total suspended solids	0.269*	0.757**

a. n= sample size

b. Spearman's rank correlation ;*- significant at $p<0.05$; **-significant at $p<0.001$; ns – not significant

Summary of Findings

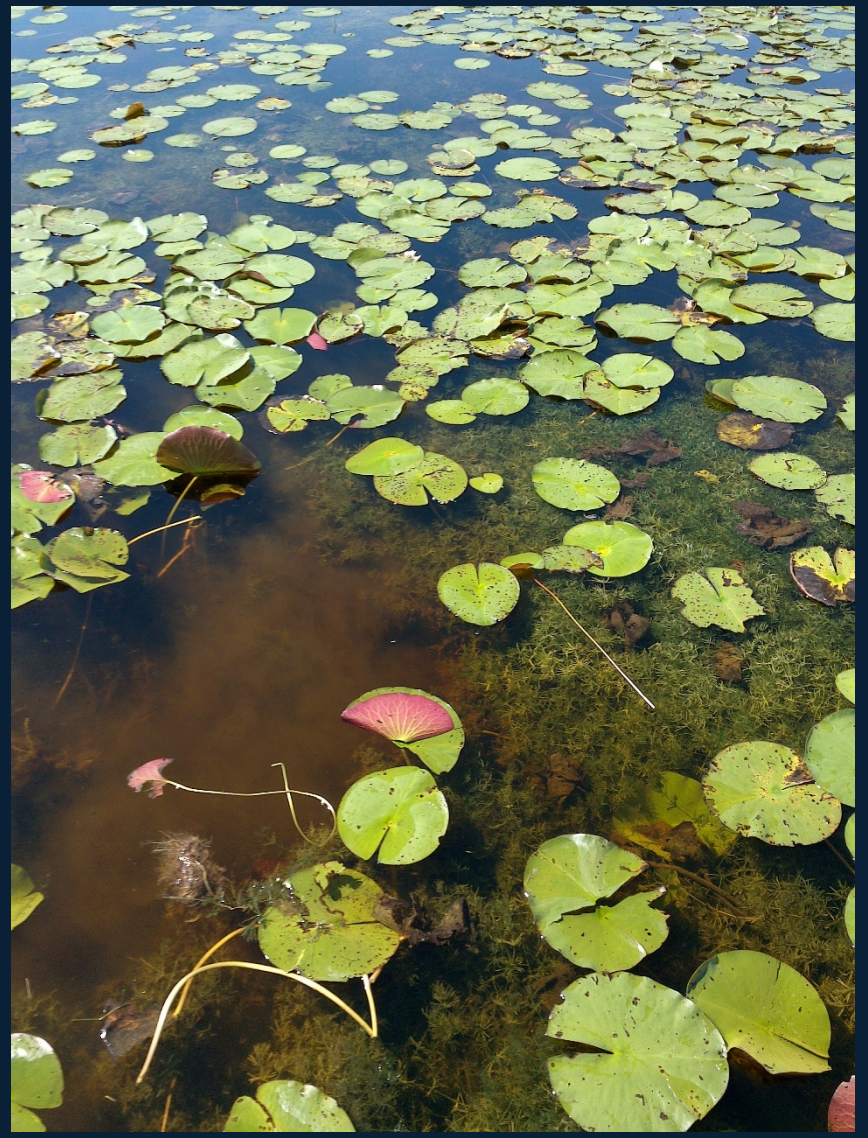
- Average TP concentration reduction higher for FW1 than for FW3
- More PP was produced under stagnant condition following a period of high flow but not after low flow (FW3)
- SRP accounted for majority of the reduction in FW1 while PP accounted for most of the reduction in FW3
- Residual P comprised mainly of PP and DOP (both FWs)
- PP and DOP concentrations much higher in FW3 than in FW1
- TP showed significant correlations with key water quality parameters (both FWs)

What remains unknown

- Sources of PP under stagnant condition
- Actual composition of PP and DOP at the outflow water
- Origin (sources of P) detected at the outflow structures
- Management of DOP and PP at the lower reaches of the treatment trains

Supplementary Research Efforts

- Identification and quantification of organic P forms in the water column and soils of the STAs
- Use of biomarkers to determine sources and fate of particulate organic matter in the STAs
- Photolytic degradation of DOM



Thank you!