



Grantee Information

Project Title: Reducing Nutrient Loads in WASCObS in Southern Illinois

Institution: University of Illinois at Urbana-Champaign

Primary Investigator: Lowell Gentry

NREC Project # NREC Project 2019-3-360350-103

Is your project on target from an IMPLEMENTATION standpoint? Yes No
 If you answered "no" please explain:

Is your project on target from a BUDGET standpoint? Yes No
 If you answered "no" please explain:

Based on what you know today, will you meet the objectives of your project on-time and on-budget? Yes No
 If you answered "no" please explain:

Have you encountered any issues related to this project? Yes No
 If you answered "yes" please explain:
 Wet conditions have delayed the installation of 2 Agri Drain structure until this Spring.

Have you reached any conclusions related to this project that you would like to highlight? Yes No
 If you answered "yes" please explain:

Have you completed any outreach activities related this project? Or do you have any activities planned? Yes No
 If you answered "yes" please explain and provide details for any upcoming outreach:

John Pike has introduced our study at numerous meetings and conferences. See Annual Report

Please write a detailed summary report that includes: Details of each objective and the progress made towards its completion, planned research activities for 2020, major accomplishments, any preliminary findings or data relevant to the project, relevant budgeting, and any publications or outreach accomplished from the research. Also this year please include a one page summary with relevant data tables or graphs and pictures related to the project that you would like included in the NREC end of the year report.

The overall goal of this project is to evaluate nutrient and sediment loads transported by WASCOBs and evaluate practices that further reduce nutrient and sediment loss. This study design is based on the paired watershed approach where pairs of WASCOBs that are located in fields under identical production practices are evaluated. Three pairs of WASCOBs were identified as suitable candidates. Flow monitoring equipment has been installed on two pairs and nutrient and sediment loads have been evaluated throughout the fall and winter months. We have had numerous flow events as southern Illinois has received above average precipitation this winter. Monitoring equipment will be installed on the third pair when soils are fit this spring.

Due to the flashy nature of flow through the WASCOBs, automated water samplers are being used to collect samples. Nutrient and sediment data clearly show that total P concentrations are strongly related to particulate P and sediment concentrations. Dissolved P is more variable with flow and can be greatly influenced by a recent broadcast application of ammoniated P fertilizer. Year 1 is considered the baseline evaluation period to compare and contrast water quality from WASCOBs and we are pleased with the similarity in nutrient concentrations, total suspended solids, and turbidity between each of the pairs. Therefore, the paired watershed approach can be used with confidence and treatments may be imparted this fall.

This summer we will meet with each producer to discuss possible treatments based on their experiences and interests. For treatments, we will discuss fertilizer changes such as broadcast P versus P incorporation; or adding a cover crop such as cereal rye after corn versus no cover crop. The paired watershed approach works best when only one production variable is changed for one WASCOB while the other WASCOB remains business as usual. With the amount of baseline data already collected (and more to come this wet spring), adding one treatment variable this fall should produce clear and measurable water quality differences between the pairs of WASCOBs next winter and spring. This study will allow us to quantify typical nutrient and sediments loads under current production systems and more importantly, determine techniques that further reduce nutrient and sediment loss from WASCOBs.

Reducing Nutrient Loads in WASCObS in Southern Illinois

Lowell Gentry, John Pike, and Greg McIsaac
University of Illinois at Urbana-Champaign

Synopsis:

The Illinois Science Assessment has identified phosphorus (P) loss from agricultural systems to be the predominant non-point source of nutrient loss in southern Illinois. Water and sediment control basins (WASCObS) have been installed throughout southern Illinois to reduce the potential for gully erosion on sloping agricultural soils. Surface runoff is allowed to temporarily pool on terraces and drain through surface inlets delaying water release and allowing sedimentation of soil particles on the terraces. This technique is a USDA NRCS conservation practice standard and design criteria can be found in the technical guide No. 638. Although not well documented, WASCObS are effective at reducing sediment transport from fields, but little real-world on-farm information exists as to their delivery of nutrients to streams. This study represents a novel investigation as to nutrient and sediment delivery via WASCObS and will evaluate management practices in the field that can further reduce nutrient loss (especially dissolved P and particulate P). The primary beneficiaries of the project will be the agricultural producers of southern Illinois, who are tasked with reducing non-point source P pollution from their fields.

Objectives:

The overall goal of this project is to quantify flow, nutrient, and sediment flux transported by Water and Sediment Control Basins (WASCObS) in southern Illinois and evaluate practices that further reduce sediment and nutrient loss (especially phosphorus).

Specific objectives are:

1. To investigate baseline nutrient and sediment loads transported by WASCObS on individual working farms in southern Illinois.
2. To use pairs of fields with WASCObS for on-farm evaluations of practices that can further reduce nutrient and sediment loss.

Possible practices to evaluate are:

- a. tillage vs. no tillage
- b. broadcast fertilizer P vs. incorporated fertilizer P
- c. manure vs. no manure
- d. cover crop vs. no cover crop

Length of Project

This project has completed the 1st year of funding.

Project Update:

- March 1, 2019 – Scouting began for potential WASCOB sites in Perry, Randolph, St. Clair, and Bond counties
- March 24, 2019 – WASCOB water samples collected at potential sites (before DAP application)
- March 25, 2019 – WASCOB water samples collected at potential sites (after DAP application)
- April 14, 2019 – WASCOB water samples collected at other potential sites
- April 24, 2019 – Lowell Gentry visits all potential sites
- April 24, 2019 – Agridrain structures purchased for a pair of WASCOBs
- April 28-29, 2019 – WASCOB water samples collected
- April 29, 2019 – Agridrain structures purchased for 2 pairs of WASCOBs
- May 2, 2019 – WASCOB water samples collected
- May 5, 2019 – John Pike visited U of I to discuss sites and monitoring equipment setup
- May 8, 2019 – Purchased 8 ISCO automated water samplers
- May 8, 2-19 – Install Agridrain structure at Tilden, IL
- May 8, 2019 – Installed an Agridrain structure at the field south of Tildon, IL
- May 15, 2019 – Agridrain structures purchased for a pair of WASCOBs near Pocahontas
- July 18, 2019 – ISCO equipment picked up at U of I campus
- Aug. 2, 2019 – Remainder of sampling equipment picked up at U of I
- Aug. 26, 2019 – Hand sample of rain event Coulterville, Tilden, Fayetteville
- Sept. 6, 2019 – Agridrain structures installed at Coulterville
- Sept. 20, 2019 – Agridrain structures installed at Fayetteville
- Sept. 27, 2019 – Seeding around test structures
- Oct. 26, 2019 – WASCOB water samples collected
- Oct. 29, 2019 – Installed 4 ISCO sampling stations on Agridrains
- Nov. 5, 2019 – WASCOB water samples collected
- Nov. 26, 2019 – WASCOB water samples collected
- Dec. 18, 2019 – WASCOB water samples collected
- Dec. 27, 2019 – WASCOB water samples collected
- Jan. 7, 2019 – WASCOB water samples collected
- Jan. 14, 2019 – WASCOB water samples collected
- Jan. 27, 2019 – WASCOB water samples collected
- Feb. 23, 2019 – WASCOB water samples collected
- Feb. 25, 2019 – Delivered 2 Agridrain structures to Justin Jefferson, Bond Co.
- Feb. 28, 2019 – WASCOB water samples collected

This study design is based on the paired watershed approach where pairs of WASCOBs that are located in fields under identical production practices are evaluated. Three pairs of WASCOBs were identified as suitable candidates. Flow monitoring equipment has been installed on two pairs and nutrient and sediment loads have been evaluated throughout the fall and winter months. We have had numerous flow events as southern Illinois has received above average precipitation this winter. Monitoring equipment will be installed on the third pair when soils are fit this spring. Due to the flashy nature of flow through the WASCOBs, automated water samplers are being used to collect samples. Water samples were analyzed for NO₃-N, NH₄-N, total N, dissolved reactive P (DRP), total P, SO₄-S, Cl, and total suspended solids (TSS). Particulate P was calculated as total P minus DRP. The first year of monitoring will establish a baseline of flow and nutrient loads between pairs of WASCOBs.

Preliminary Results from Site Evaluations:

We collected preliminary data on 10 fields with WASCOBs in southern IL. We collected a total of 52 grab samples of runoff in WASCOBs during rain events in March, April, and May from the 10 fields.

On unfertilized fields, we found total P concentrations during runoff events to range from 0.12 – 2.84 mg/L across all fields. We found the majority of the total P consisted of DRP except during peak flows when sediment loads are greatest then particulate P is the majority of total P. NO₃-N concentrations during these events are often below 1 mg/L indicative of surface runoff as rainwater contains little NO₃-N (sometimes below our detection limit of 0.1 mg/L).

On two occasions we sampled water draining into the inlet of the WASCOB following the broadcast application of di-ammonium phosphate (DAP) on bean stubble. Although the flow into the WASCOB was very low at the time of sampling, we found elevated concentrations of total P from 18.6 – 70.8 mg/L. The NH₄-N concentrations were also elevated at this time and ranged from 9.9 – 50.1 mg/L. **This preliminary data clearly indicates that broadcast fertilizer P can be transported into the surface inlets of WASCOBs during heavy rain events.**

Results for Baseline Comparison:

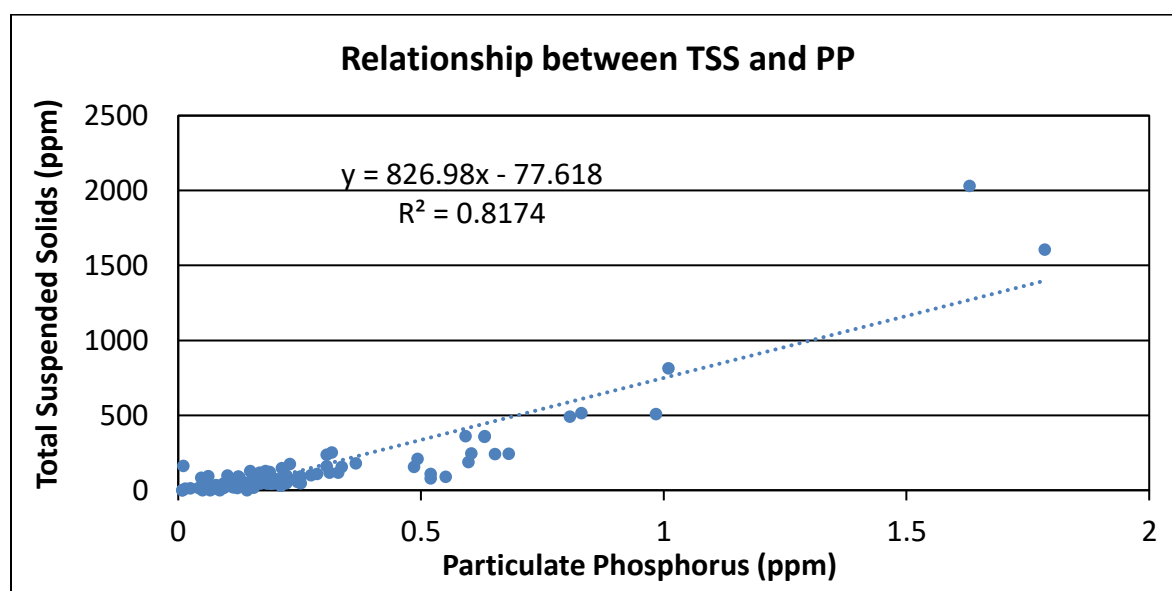
We have had numerous flow events through the two pairs of WASCOBs for baseline comparisons during the past fall and winter. Year 1 is considered the baseline evaluation period to compare and contrast water quality from WASCOBs. Below are examples of average nutrient concentrations (10 samples each at Campbell site and 5 samples each at Brandt site) during two flow events this past fall on unfertilized fields:

Site	Date	Nitrate	DRP	PP	TP
Campbell 1	10/31-11/1	2.7	0.33	0.22	0.55
Campbell 2	10/31-11/1	1.9	0.26	0.2	0.46
Brandt 1	11/29-11/30	0.4	0.13	0.12	0.25
Brandt 2	11/29-11/30	0.7	0.11	0.10	0.21

We are very pleased with the similarity in nutrient concentrations between each of the pairs. Thus, we can conclude that the paired watershed approach can be used with confidence and treatments may be imparted this fall.

Next winter and spring will be the period for baseline evaluation of nutrients and sediment through the third pair of Agridrain structures that will be installed this spring. We are hopeful that nutrient concentrations will be as similar between these two WASCOBs as with the first two pairs.

To date, our WASCOB water quality data are documenting a strong relationship between Total Suspended Solids (TSS) and Particulate Phosphorus (PP) (see below).



Total Suspended Solids (TSS) is a direct measure of the amount of sediment carried with overland runoff draining through the WASCOBs. Particulate phosphorus (PP) in water is associated with sediment movement, therefore, a strong relationship between TSS and PP is expected ($R^2 = 0.8174$).

This summer we will meet with both producers to discuss possible treatments based on their experiences and interests. For treatments, we will discuss fertilizer changes such as broadcast P versus P incorporation; or adding a cover crop such as cereal rye after corn versus no cover crop. The paired watershed approach works best when only one production variable is changed for one series of WASCOBs while the adjacent, companion series of WASCOBs remains business as usual. With the amount of baseline data already collected (and more to come this wet spring), adding one treatment variable this fall should produce clear and measurable water quality differences between the pairs of WASCOBs next winter and spring. **This study will allow us to quantify typical nutrient and sediments loads under current production systems and more importantly, determine techniques that further reduce nutrient and sediment loss from WASCOBs.**

Outreach:

Mr. Pike presented plans and preliminary data for this project at numerous meetings and workshops this past year including at the Crop Management Conference in Mt. Vernon, IL on January 22, H&R Agri-Power Sales Meeting in McLeansboro on January 23, IFCA Convention in Peoria on Jan. 27, Jefferson County SWCD N-P-K Conference in Mt. Vernon on January 29, Cover Crop Field Day in Marion on March 7, Advanced Soil Health Training in Mt. Vernon on March 12, Wabash Valley Nutrient Management Field Day in Springerton on March 13, Advanced Soil Health Training in Marion on June 24 and 25, National Strip-Tillage Conference in Peoria on August 2, Indiana NRCS in Vincennes, IN on August 8, IL Association of SWCD in Mt. Vernon on August 20, Tri-State Advanced Soil Health Training in Princeton, KY, and Bayer SIU Academic Roundtable.

Project Budget

C1459: 1-550150-875000-191100 (NREC agreement 2019-3-360350-103):

Personnel:	Salary	Fringe benefits
Administrative/professional		
Total personnel	0.00	
Total fringe benefits	0.00	
Travel (domestic)	246.88	
Supplies	5,146.86	
Contractual services	14,196.46	
Equipment	29,609.14	
Facilities and administration	5,461.14	
Tuition		
Total expenditures	54,660.48	

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We thank NREC for the support of this research.

Summary of 2019 Highlights:

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