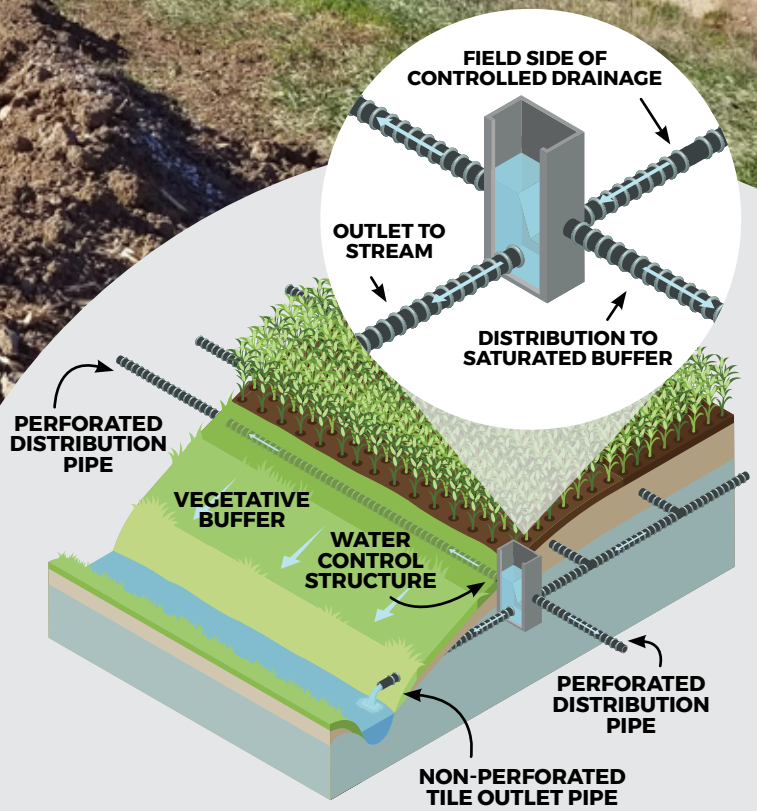
Blanchard River
DEMONSTRATION
FARMS NETWORK

Saturated Buffers in Northwest Ohio:

Reducing Drainage Water Volume for Improved Water Quality

WHAT IS A SATURATED BUFFER?

A saturated buffer is an edge-of-field conservation practice that is designed and intended to remove nitrate and potentially other nutrients from subsurface tile drainage water before it enters ditches, streams, and other surface waters. When properly sited and installed, a saturated buffer is capable of removing nitrate whenever the tile is flowing and requires little annual maintenance to ensure effective operation.



Within a typical saturated buffer layout, tile lines connect to a water control structure, which directs a portion of the water into the tile under the buffer rather than discharging directly into a stream or ditch. As water drains into the buffer, the living roots of vegetation absorb water and nutrients, potentially removing nitrate from the water that is diverted through the buffer.

Saturated Buffer Research in Northwest Ohio

A saturated buffer is an innovative conservation practice with positive impacts on downstream water quality. It is most effective as a nitrate removal practice, though there is some evidence that saturated buffers may also remove other nutrients from subsurface tile drainage water such as soluble phosphorus.

While this practice has been studied across the Midwest, there is limited research about how this practice performs in northwest Ohio. As a result, Ohio researchers are addressing the benefits, costs, and other related issues of this practice within the topography and soil characteristics of northwest Ohio.

The objective of this research is to expand the body of knowledge regarding the nutrient reduction potential of a saturated buffer and evaluate the effectiveness of redirecting subsurface tile drainage water through subsurface tile that runs under and parallel with the vegetated buffer zone adjacent to the stream.

Research Site Installation

The saturated buffer research site, known as the St. Charles saturated buffer, is located within the agricultural landscape of the Grand Lake St. Marys watershed in Mercer County, Ohio. The farm cropland in which it is located has been no-tilled for 12 years with a continuous corn rotation and cereal rye used as a typical cover crop. Manure is applied regularly per an active nutrient management plan developed by the local Soil and Water Conservation District office.

The saturated buffer was installed along an open ditch within a 30-acre subwatershed area. The vegetative buffer zone is approximately 30- to 40-feet wide and planted with cool-season grasses.

St. Charles saturated buffer watershed area

When there is subsurface tile drainage flow, a three-chambered water control structure regulates water flow to the buffer. The water control structure utilizes two sets of stop logs, wherein the initial stop log acts as a controlled drainage mechanism for the field. Once the water table is high enough to leave the field, the water flows into a central portion of the control structure where it is distributed along the length of the 1,200-foot distribution tile. Any water that does not percolate through the soil is able to leave the central chamber of the control structure to continue flowing out the third chamber and into the stream.

A paired monitoring site without a vegetative buffer zone or water control structure was also installed adjacent to the St. Charles saturated buffer site in another subwatershed of comparable size in the same field. Comparing the drainage water outflow of both sites allows researchers to monitor the volume of water reduced over the course of the year by adding the saturated buffer, rather than allowing drainage water to flow directly into the stream.

Cost Of Installation

The cost of installing a saturated buffer varies depending on the size of the control structure and the diameter and length of the distribution pipe. The cost of design, excavation, and labor also varies depending on location. **The total cost to install the St. Charles saturated buffer system was $9,111.00.**

COST TO INSTALL AND MAINTAIN THE ST. CHARLES SATURATED BUFFER SITE

SYSTEM COMPONENT	COST
Water Control Structure	**$2,235**
Distribution Pipe & Labor	**$4,672**
Miscellaneous Materials (Gravel, Tile Fittings & Connections	**$1,609**
Anti-Seep Collar	**$95**
Vegetative Buffer Seeding	**$500**

Maintenance Requirements

- An annual inspection of the water control structure is needed to check for accumulated debris or sediment.
- The distribution pipe and tile outlet are also annually checked for debris and any failures such as blow holes.
- The buffer vegetation should be regularly mowed or hayed when possible to reduce nutrient accumulation on the ground surface as a result of vegetative breakdown from late fall through winter. *However, if the buffer is enrolled in a cost-share program like the Conservation Reserve Program (CRP), contract restrictions may impact how regularly the buffer can be mowed.*

A look inside the three-chambered water control structure.

Findings

During the initial monitoring period (December 13, 2020 to December 12, 2021) of the St. Charles saturated buffer site, conditions were extremely dry over the first half of the year. However, the total annual precipitation during the study period was 33.1 inches. Approximately 11 distinct rain events occurred during the study period to raise the water table in the field enough to initiate active tile runoff from the field into the buffer.

Controlled drainage estimates suggest that the field exhibited a **70%** **reduction in outflow volume** as a result of the first stop log.

Flow volume was further reduced by processing approximately **35%** **of flow leaving the field** with the vegetative saturated buffer.

Once infiltrated, abiotic and biotic processes facilitated significant nutrient reductions of dissolved nitrogen and phosphorus.

This project is scheduled to complete water quality monitoring in 2022 to generate a full two years of data from which to draw conclusions from.

Discussion

Saturated buffers are still a relatively new conservation practice. Identifying additional sites within the Grand Lake St. Marys watershed will be needed to test site-specific analyses. Continued data monitoring will be valuable to address questions regarding this practice. Saturated buffers are still a relatively new conservation practice. When extending this research into the future, there is a need to quantify expected benefits from the controlled drainage aspect of the project as well as identify how the nutrients are being sequestered (e.g. is phosphorus being taken up by the sediment or the vegetation, or both?). Impacts of site-specific qualities on the effectiveness of the saturated buffers can also inform decisions on placement in the future. **Saturated buffers exhibit strong potential to find their way into our tool bag as we work together to reduce nutrient runoff across the region. More research will be needed to answer these questions moving forward.**

PARTNERS

Ohio Farm Bureau Est. 1919

USDA Natural Resources Conservation Service Ohio
United States Department of Agriculture

Wright State University Lake Campus

Mercer County Community & Economic Development

ACKNOWLEDGEMENTS

The background, monitoring and findings of this research are based upon the work of Dr. Stephen Jacquemin, Professor of Biology at Wright State University Lake Campus and Theresa Dirksen, Agriculture and Natural Resources Director, Mercer County.

REFERENCES

Jaynes, D., Reinhart, B., Hay, C., Isenhart, T., Jacquemin, S., Kjaersgaard, J., Nelson, K., Utt, N. 2018. Transforming Drainage: Questions and Answers about Saturated Buffers for the Midwest. https://www.extension.purdue.edu/extmedia/ABE/ABE-160.pdf

Contact

For more information, resources and upcoming events, please visit **blancharddemofarms.org**

Find Us on Social Media

Blanchard River DEMONSTRATION FARMS NETWORK