



# Saturated Buffers

**Saturated buffers** are a conservation drainage practice designed to remove nitrate from agricultural tile water by modifying the outlet to allow flow to be diverted through the soil profile of a vegetated buffer. The outlet is modified by using a control structure which directs a portion of the flow to a distribution line that runs parallel to the stream.

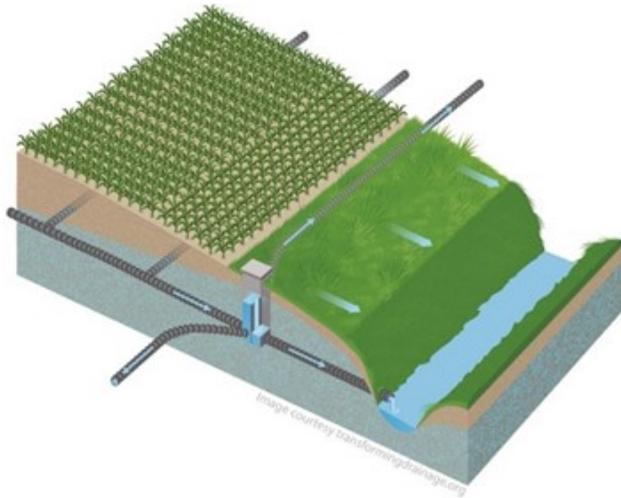


Figure 1 Saturated buffer schematic by transformingdrainage.org.

## Project

ADMC worked with FSA to monitor 7 Midwest sites from October 2017- August 2018.

- Site average nitrate concentration reductions ranged from **41% - 98%**
- Nitrate load reductions ranged from **10 – 194 pounds**

Table 1 ADMC monitored saturated buffer performance, Oct. 17—Aug. 18.

Site	Nitrate-N	
	Concentration Reduction	Load Removed, pounds
IA-1	97%	87
IA-2	74%	194
IA-3	98%	10
IL-2	79%	NA
IL-5	69%	177
MN-2	41%	16
MN-4	73%	41

## Sites

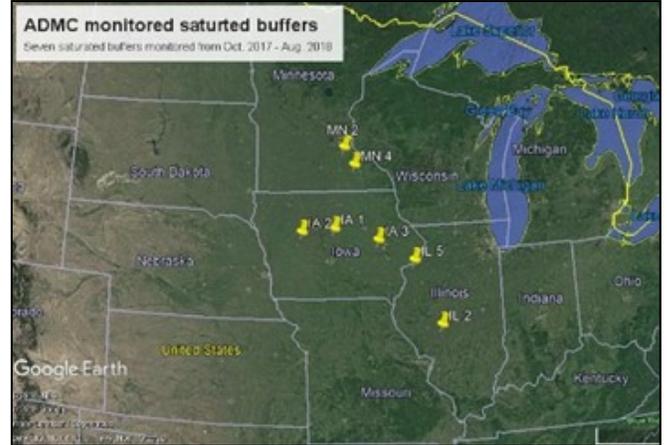


Figure 2 ADMC monitoring locations.

The 7 sites were distributed among IA, IL, and MN. Each of the sites had three transects of wells. The transects consisted of a stream side well and then 2 additional wells distributed evenly between the stream side well and the distribution line. Figure 3 displays the monitoring layout of IL 5.



Figure 3 IL 5 site overview.

## Costs

**\$3,584** was the average installation cost of the 7 monitored saturated buffers, and they have operated at an efficiency of **\$1.22/pound of N removed** over the 20 collective site years of monitoring.

## Site Suitability

- 30 feet of perennial vegetation
- > 1.2% soil organic matter
- No sand lenses or gravel layers
- Stable stream banks



## Scalability

Researchers from the Department of Crop Sciences at the University of Illinois, Urbana-Champaign developed a decision support tool to determine the extent of feasible sites in the Midwest. To do so, they implemented a stepwise GIS model to eliminate stream miles with surrounding conditions not conducive to saturated buffer installation.

### Stream length elimination steps

If a stream length met the following criteria, it was eliminated as a possible site.

- 1) Lengths identified as a major river or intermittent stream in the National Hydrography Dataset
- 2) 330 ft around streams with soil organic matter <2.5%
- 3) 980 ft zone around streams without poorly drained soils
- 4) <50% of area within the 980 ft in corn or soybean production

### Model results

**23,460 miles of stream or 46,920 miles of stream bank** were shown to be suitable sites for installation.

IA (6,660 miles), IL (6,580 miles), and OH (4,050 miles) have the greatest potential for suitable sites.



Figure 4 Miles of potential saturated buffers in the Midwest, acres in ().

## Impact

### How many Midwest acres can be treated with a saturated buffer?

**9.5 million acres**, or 22% of the estimated drained area in the Midwest can possibly be treated with a saturated buffer. Acres were determined based upon previous ADMC work that established that a typical saturated buffer is 690 to 1,000 ft long, and that it takes 26 linear feet to treat 1 acre of drainage.

### How much nitrogen can be removed with full-scale implementation in the Midwest?

**22,000— 43,000 tons of N** can be removed assuming a N load removal rate of 23-44% load from the field tile, and that an average acre of drained land generates 20.5 lbs of N.

### Enhancing existing CP21 and CP22 buffers

According to USDA fact sheets, CP21 and CP22 buffers hold back 6.4 pounds of N per acre. Over 20 site years of monitoring by ADMC, the 7 saturated buffers averaged 117 pounds of N removal per year and have a typical footprint of 1.4 acres. Enhancing a current CP21 filter strip or CP22 riparian buffer with a saturated buffer will remove 13 times the amount of N and by 6 to 10 times more cost effective.

Table 2 Efficiency gained by enhancing a standard buffer with a saturated buffer.

Practice	\$/lb. of N removed*	\$/lb. of N removed with a SB <sup>†</sup>
CP21**	\$16.6	\$2.61
CP22***	\$44.3	\$4.58

\* Assuming a 1.4-acre area of a typical saturated buffer and an average of 6.4 pounds of N retained by buffer.

\*\* Assumes average payment rate of \$148.3.

\*\*\* Assumes average payment rate of \$396.6.

† Assumes an average saturated buffer removal rate of 117.02 lbs of N per year and an equivalent annual cost of \$181.06 with a 40-year lifespan and a 4% real discount rate.

For a detailed version of how calculations were made, please refer to full report found at:

[www.admcoalition.com](http://www.admcoalition.com)