PURDUE UNIVERSITY | Agricultural and Biological Engineering

CAPSTONE/SENIOR DESIGN EXPERIENCE 2022

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Vollmer Family Farm: River Shore and Land-Use Management

Background

- 923 acres in Loogootee, IN along the East Fork White River
- 343 acres of tillable acres
- 4 miles of river bank on the property
- 2,125 ft of highly erodible river bank
- Tillable acres are rented by local farmer

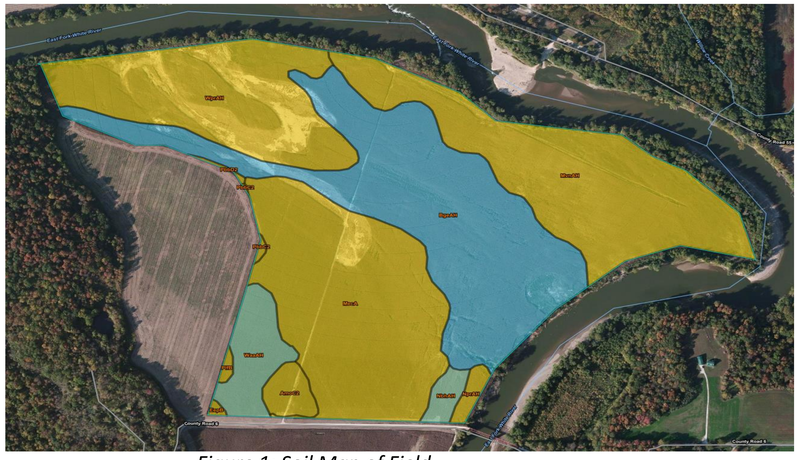

Figure 1: Soil Map of Field

Economic Analysis

- Buffer Zones
  - The total area that the buffer zones will cover is around 30 acres. The crop selected for buffer zones is Switchgrass. A perennial grass commonly used for erosion control. The estimated seed cost for 30 acres of Switchgrass is $2,840.
- Cover Crops
  - The primary field of concern is approximately 187 acres. One common cover crop is Rye Grass which costs approximately $13,050. For a crop such as Crimson Clover, the cost is approximately $15,750
- Soil Loss
  - The table below is the estimated financial costs of soil loss utilizing different practices. These numbers were calculated using the Universal Soil Loss Equation and data collected through RUSLE2.

$$A = R\,K\,LS\,CP$$

Table 1: Soil Loss Data

Soil Names	Soil Loss Total Till	Soil Loss Total No Till	Spring Till with Rye Cover Crop	No-Till with Rye Cover Crop
	tons/acre/year	tons/acre/year	tons/acre/year	tons/acre/year
	tons/acre/year	tons/acre/year	tons/acre/year	tons/acre/year
Apalona	56	14	8.3	7.6
Zanesville	56	14	8.4	6.7
Bloomfield	18.9	5.4	1.5	1.2
Birds	292.5	36.4	0.5	0.42
Martinsville	159.95	50.27	1	0.83
Moundhaven	48	14.8	0.33	0.27
Pike	380	100	4.3	3.4
Wakeland	35.36	11.288	0.75	0.62
Wirt	121.73	39.48	1	1.85
Tons Total	1168.44	285.638	26.08	21.89
Cost/ton	$7.03	$7.03	$7.03	$7.03
Total Cost	$8,214.13	$2,008.04	$366.68	$307.77

Value of Soil Erosion to the Land Owner | Ag Decision Maker (iastate.edu)

Soil Loss Data Source: RUSLE2 Soil Erosion Predictor

Impact and Sustainability

___The impact of this project extends to more than just the property of interest. With the river running on the outside of this property it is important that we address the erosion problem. Having buffer strips and cover crops implemented in the field and on the outside of the field, it will limit the amount of sediment ending up in the river. This will be very sustainable for the property as government subsidies will compensate for the lost production. This solution will also provide a environmental benefit. The buffer strips and waterways will help to slow the water running across the field, increasing the probability of the water soaking into the ground. This will reduce the amount of pollution from fertilizers and chemicals (herbicides, pesticides, and fungicides). This reduction of pollution will benefit the water quality improving the aquatic life in the river.

Alternative Solutions and Evaluations

- Rip-rap dumped along river bank at weak spots
  - Rip-rap is chunks of crushed concrete that can be used to buffer the water current and hold the soil in place along the bank.
- No-till or limited tillage practices
  - No-till is a farming practice where the ground is not tilled either after harvest or before planting. This leaves the root structures and residue on the surface and a few inches deep in the soil. This helps to hold onto the soil and prevent erosion during rain storms.
- Buffer Zones
  - Buffer Zones are a strip of land that is located along the problem areas on the property, these buffer zones will be approximately 50 ft wide and will be seeded with grasses and other vegetation to help establish a large root system to prevent water runoff erosion from the field, as well and to prevent any erosion in the case of a flood.
- Planting Trees
  - Planting trees is a very effective way to reduce riverbank erosion, it is a practice that is widely used all over the world. These trees will establish deep and expansive root systems that will help to hold the soil on the riverbank in place. The only downfall to this method is that trees are not an instantaneous fix, as they take time to grow and establish these root systems, this is more of a long-term solution. Another issue is that if there is a flood before the trees have established deep enough root structures, the trees could be wiped out.

Executive Summary

With this property being located along the East Fork White River, erosion along the riverbank as well as washouts in the field have become a large problem. Areas along the riverbank near the Brooks Bridge have little to no vegetation holding the soil in place. This has caused the loss of valuable farmland. This area also floods after large storms so water will rush out of the riverbank and across the field causing washouts and the loss of valuable topsoil. We were given a $20,000 budget to solve this problem. We explored many potential solutions like levees, buffer strips, alternative tillage methods, planting cover crops, riprap, retaining walls and many others. After many hours of using the RUSLE2 database and deliberation we chose the most effective method, while staying within our limited budget to reduced the effects of soil erosion on the Vollmer Family Farms property. Our final plan is to plant 50 foot buffer strips along the riverbank, use a no-till cropping system with a cover crop planted after harvest and terminated before spring planting. With the leftover budget from the cover crops and buffer strips, we plan to plant trees along the highly eroded area of the riverbank.

Table 2: Data for Soil Types

Soil Names	Kf Factor	Acres
Apalona, eroded	0.43	1.4
Zanesville, eroded	0.43	1.4
Bloomfield	0.1	3
Birds	0.43	65
Martinsville	0.32	45.7
Moundhaven	0.1	40
Pike	0.43	20
Wakeland	0.43	13.6
Wirt	0.32	32.9

Solution

___After we considered the cost and effectiveness of all of our options, we came to the solution of using cover crops and a no-till cropping system where possible in order to conserve soil. The most effective cover crop we found to reduce soil erosion while being cost effective is Ryegrass. We also incorporated a 50 foot buffer strip of Switchgrass along the riverbank into our plan in order to improve water quality as well as holding the soil. Using RUSLE2, we found that using this plan we can save around $6000 per year in the cost of soil loss just by eliminating tillage, and even more so using the combination of cover crops and no-till. This combination of no-till and cover crops will reduce erosion and help build the soil health.

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