Yahara Pride Farms

2016 Phosphorus Reduction Report

Yahara Pride Board of Directors

June 30, 17

Executive Summary

YPF 2016 P reduction report Final June 26, 2017

What the data represents

This report provides the data and summary information for the 37 farms cooperating with the 2016 Yahara Pride Farms (YPF) cost share program. The information provided is based on the difference in predicted phosphorus loss from the adoption of a practice such as strip tillage, low disturbance manure injection, cover crops, headland stacking of manure; or combination of two practices and the continued implementation of a practice for multiple consecutive years. The 2016 data is based off the "SNAP+" plans provided to YPF by the farmers and/or their crop advisors.

In most cases the plans were used as sent, however in a few cases where fields were planned from 2016 forward, the planning period was revised to include past years' data. Crop consultants plan forward to account for changes to the crop rotation and/or farming systems. A challenge facing farmers in the Yahara Watershed is that the factors used to calculate tolerable soil loss were updated in the 2014 – 2015 SNAP+ nutrient management-planning tool. The Natural Resources Conservation Service (NRCS) maintains the soil survey data used by the Revised Universal Soil Loss Equation 2 (RUSLE2) and SNAP+ to estimate sheet and rill soil erosion. In 2014 NRCS began a national update of soil survey data including Tolerable (T) soil loss values and soil erodibility factors (K). The University of Wisconsin Soils Department annually updates the SNAP+ database to reflect the most current NRCS soil survey data. The edits to the SNAP+ soils database will cause changes to occur to some of the year-to-year predicted phosphorus loss values even when no other change to the farming system occurred. Some fields within this database saw tolerable soil loss levels decrease, while others saw an increase in the predicted average rotational soil loss levels due to an increase of the K factor.

Some fields in this data set saw a major change in the 2015 revision in the both tolerable soil loss (T) levels, and in the calculated actual rotational soil loss because the factors used in the SNAP+ program. The change that occurred between 2014 and 2015 were fairly dramatic on certain fields and it is assumed that going forward we will see only minor changes within the SNAP+ program. This stabilization in the program will allow for better year-to-year comparisons of the predicted changes in the risk for phosphorus delivery to the nearest waterbody.

All the data presented in this report are derived from the individual farms nutrient management plan, which takes into account tillage, crop rotations, nutrient applications from both manure and fertilizer, and crop yields. This is the best representation of what is actually happening on the farms that participate in the Yahara Pride Cost Share program. Each farm and field has unique characteristics that influence yields, the tillage system and the risks for sediment and nutrient loss. That is why we see such large variation in losses within this data set.

Summary of phosphorus reductions

Table 1 shows a comparison of the number of farms, acres and phosphorus reductions achieved through **strip tillage program** from 2013 to 2016.

Strip Tillage Program	2013	2014	2015	**2016**
Number of farms	3	3	3	**3**
Number of fields	11	15	20	**21**
Tillable acres in program	156	253	1,489	**917**
Range in phosphorus reduction (lbs./acre)	(-0.2) – 2.7	(-0.1) – 2.9	0.1 – 5.6	**0.0 – 5.7**
Average phosphorus reduction (lbs./acre)	1.44	0.87	0.82	**0.89**
Total phosphorus reduction (in pounds)	225	220	1,221	**703**

Table 1 Number of farms, acres and phosphorus reductions through strip tillage program

Over the four years of the strip tillage cost share program there were two years with two fields that showed a negative response to the change in the tillage system. The past three years the reduction in phosphorus loss is extremely consistent averaging around 0.9 pounds per acre.

Table 2 shows a comparison of the number of farms, acres and phosphorus reductions achieved through the **low disturbance manure injection program** from 2013 to 2016.

Low Disturbance Manure Injection Program	2013	2014	2015	**2016**
Number of farms	11	14	4	**7**
Number of fields	20	20	32	**76**
Tillable acres in program	361	841	566	**1,203**
Range in phosphorus reduction (lbs./acre)	0.1 – 7.6	(-0.1) – 2.2	(-0.6) – 5.9	**(-1.0) – 4.8**
Average phosphorus reduction (lbs./acre)	0.99	0.63	1.91	**0.88**
Total phosphorus reduction (in pounds)	357	530	1,081	**1,106**

Table 2 Number of farms, acres and phosphorus reductions through the LDMI program

The average reduction in phosphorus loss varies from a low of two-thirds of a pound to almost two pounds. The total predicted reduction in phosphorus loss in 2016 was 1,106 pounds.

There were eight farms that cooperated in the **low disturbance deep tillage with the planting of a cover crop program** in 2016. These eight farms planted a total of 730 acres with about 378 acres cost shared. The way the tillage systems were reported on these eight farms made it impossible to assess how the changes in tillage affected potential phosphorus loss. Therefore, these farms were credited with reducing phosphorus loss strictly based on the cover crop. Based on the data generated in the combination of practices, we can say that these fields had an average phosphorus reduction of around 2.23 pounds per acre. **Subtracting the 1.48 pound average for cover crops from the combined data (2.23) we can assume that the low disturbance deep tillage with the planting of a cover crop generated a savings of 730 acres * 0.75 lbs. / acre = 548 lb. reduction in phosphorus loss.**

Table 3 shows a comparison of the number of farms, acres and phosphorus reductions achieved through the **cover crop program** from 2013 to 2016.

Year	2013	2014	2015	**2016**
Farms	20	37	35	**37**
Fields	80	53	160	**290**
Acres	2,436	4,732	4,908	**5,851**
Range in P reduction	(-1.1) to 6.2	(-1.1) to 6.2	-1.0 to 13.4	**(-1.9) to 10.7**
Average	0.71 lbs / acre	0.78 lbs / acre	1.76 lbs / acre	**1.48 lbs / acre**
Total P reduction	1,730 lbs	3,691 lbs	6,572 lbs	**7,130 lbs**

Table 3 Number of farms, acres and phosphorus reductions through the cover crop program

The average reduction in phosphorus loss varies from a low of 0.7 pounds to almost 1.8 pounds with a 2016 average of 1.48. The total predicted reduction in phosphorus loss was 7,130 pounds in 2016.

In 2016 YPF decided to provide two bonus payments for farms that either combined two practices on a field (one practice was always cover crops while the second practice was either strip tillage or LDMI); or implemented practices for more that three years on a field. In 2016 the average predicted phosphorus reduction for combining two practices was **2.23 pounds per acre**. This year's data set contained 35 fields totaling 1,432 acres. Since some of this reduction in phosphorus is included in the individual practice data sets, individual fields were evaluated looking at the difference from the individual practice to the combination of practices.

The data for continuing a practice for three years or longer includes 22 fields and 406.5 acres in 2016. These fields varied in the number of years of a practice continued **but the average reduction in just the last year for fields with 3 years continued implementation of one practice was 1.03 lbs./acre**. The average for multiple years of multiple practices was 0.18 lbs./acre. These data set supports the recommendation that farmers should consider planting cover crops on fields that are suitable for continuous corn silage. In those cases the cover crop provides both a water quality benefit and a soil quality benefit.

2016 Summary of Predicted Phosphorus Reduction

Practice	Average P Reduction	Total Predicted P Reduction
➢ Strip Tillage	0.89	703 lbs
➢ LDMI	0.88	1,106 lbs
➢ LDDT + cover crop	0.73	548 lbs
➢ Cover Crops	1.48	7,130 lbs
➢ Headland Stacking Manure	2.13	107 lbs
➢ Combined Practices	2.23	1,085 lbs
➢ Multiple Years of Adoption – 1	1.03	297 lbs
➢ Multiple Years of Adoption - 2	0.18	191 lbs
	Total	11,167 lbs

Introduction

In the past the Yahara Pride Farms (YPF) phosphorus reduction report began with an overview of the cost share programs offered and then went immediately into the data. As we complete the pilot project phase and enter the implementation stage of the Adaptive Management Program there are a few things that need to be stated in this introduction.

First and foremost – Thank you to all the farmers in the Yahara Pride Watershed program for working with Yahara Pride Farms and Yahara WINS to implement practices that reduce the potential for phosphorus loss to the streams and rivers that contribute water to the Yahara Lakes. The farmers in this area continue to be supportive of Yahara Pride Farms and continue to seek alternative farming systems and conservation practices that reduce phosphorus and sediment loss. This report shows how hard each and every one of you works to keep soil and nutrients on your fields and out of our water. ***Farmers are the heart and soul of the Yahara Pride Farms program and we thank you!***

Yahara Pride Farms and the farmers in the Yahara Watershed are also indebted to "The Yahara Watershed Improvement Network (Yahara WINs), led by MMSD", *which began in 2012 as a four-year pilot project to reduce phosphorus loads and meet more stringent water quality standards established by the Wisconsin Department of Natural Resources (WDNR). This groundbreaking program employs watershed adaptive management, a strategy in which all sources of phosphorus pollution in an area work together to meet water quality goals. This strategy is more effective and less expensive than the sources working separately on individual solutions.* ***Partners in Yahara WINs include cities, villages, towns, wastewater treatment plants, agricultural producers, environmental groups and others.***

Thanks also to the businesses and organizations who provide support (both financial and in-kind), to Yahara Pride Farms. It takes people and money to offer this cost share, certification and outreach and education events, and we wouldn't be able to do it without your support. This farmer-led watershed approach has become a model for others around the state because we have been able to offer programs and events based on your support. Thank you for being an important of the Yahara Pride Farms program.

Finally, thanks to the members of the Yahara Pride Farms board of directors and all the staff who have worked with us over the past 4 – 5 years. Your guidance and support have shaped this program and we cannot thank you enough for the time you committed to this organization.

Yahara Pride Farms Inc. Board of Directors

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Programs offered in 2016

During 2016 the Yahara Pride Farms (YPF) board of directors continued operating and implementing a number of agricultural conservation programs designed to reduce the loss of phosphorus within the Yahara Watershed. There were five major incentive programs offered within the watershed in 2016 including:

1. Strip tillage,
2. Low Disturbance Manure Injection,
3. Low Disturbance Deep Tillage and Cover Crop,
4. Cover Crop Assistance, and
5. Headland Stacking of Manure / Composting

In addition to these five programs, YPF offered bonus payments to farms that implemented a combination of practices on the same field (two or more practices). They also provided a bonus payment on fields where a practice had been implemented for greater than three years consecutive years. Each of these programs offers unique benefits both from a phosphorus reduction standpoint as well as educational and confidence/trust building within the watershed.

This report provides an update on the number of acres, fields and farms involved in each of these programs. The Wisconsin Phosphorus Index (P Index) is a model that estimates the pounds of phosphorus prevented from reaching the nearest waterbody. The nearest waterbody would in most cases be streams and rivers. These estimates of the pounds of phosphorus prevented from reaching a waterbody can then be used (with the appropriate delivery factors) to estimate the pounds of phosphorus prevented from entering the Madison chain of Lakes.

1. Strip Tillage:

Strip-tillage is a conservation system that offers an alternative to no-till, full-till and minimum tillage. It combines the soil drying and warming benefits of conventional tillage with the soil-protecting advantages of no-till by disturbing only the portion of the soil that is to contain the seed row (similar to zone tillage). Each row that has been strip-tilled is usually about eight to ten inches wide. The system still allows for some soil water contact that could cause erosion, however, the amount of potential erosion on a strip-tilled field would be lower than compared to the amount of erosion on an intensively tilled field. Compared to intensive tillage, strip tillage saves considerable time, fuel and money. Another benefit is that strip-tillage conserves more soil moisture compared to intensive tillage systems. However, compared to no-till, strip-tillage may in some cases reduce soil moisture and increase the potential for soil loss.

Strip-tillage is performed with a special piece of equipment and the YPF's strip till program originally assisted with the rental of a strip till machine to determine if this farming system fit into a farms overall farming system and management. In the first two years of the Yahara cost share program a unique partnership was formed between the Yahara Pride Farms Inc. and Kalscheur Implement. Since 2015, Kalscheur Implement was no longer able to provide a strip tillage machine, so the YPF's board dropped the rental of a machine and approved a payment of $15/acre for up to 50 acres for farmers wanting to experiment with strip tillage (maximum payment of $750 per farm).

The data contained in table 4 (page 8) shows the soil types, slope, soil test phosphorus and the changes in the estimated annual phosphorus index from all fields that were tilled using a strip till machine. There were four farms that cooperated in the strip tillage program and these operations were spread out around a wide area of the Yahara watershed. As can be seen in the table, strip tillage was conducted on 21 different fields with a large variation of soil types, soil test and slopes. This year the number of acres planted using a strip tillage system was about 917.

Running the SNAP calculations for each field is important because as demonstrated in the table, assuming that phosphorus reductions directly correspond to slope is not an accurate assumption. Based on the information gathered over the four years of this project, the factors that influence phosphorus loss (or reductions in phosphorus loss) include slope, tillage prior and after strip tillage, soil test levels, manure management program and the crop rotation. All of these factors play a large role in predicted phosphorus loss.

The 2016 strip tillage program was conducted on 916.7 acres in the Yahara Watershed. However, the vast majority of these acres were not cost shared by the Yahara Pride Farms program.

- **Total acres stripped tilled 916.7**
  - **YPF cost share acres 165.0**

Acres of strip tillage done without financial assistance = 751.7 acres

An evaluation of the estimated phosphorus savings by changing farming systems from what the farm was currently using to strip tillage shows a wide range of data. Switching from whatever the current tillage system was to strip tillage had a range in the reduction of phosphorus loss from 0.0 to 5.7 lbs phosphorus per acre. **For 2016 the data shows that in 19 of the 21 fields, switching from the old farming system to strip tillage reduced phosphorus loss.**

As demonstrated in table 4, there are times when switching to strip-tillage had a very minor affect on phosphorus loss. Most of the fields with minor reductions in phosphorus loss had slopes of 4% or less. On other fields and conditions the change to strip tillage had a dramatic affect, the three fields with the greatest reduction in predicted phosphorus loss had slopes of 9%, 9% and 16%. A closer evaluation indicates that many times changing tillage systems can reduce particulate phosphorus loss while increasing soluble P losses. The challenge is to determine when a change in the tillage system has the greatest positive impact on water quality.

Table 4 Changes in P loss from strip tillage

2016 Phosphorus Report Strip Tillage

Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Traditional Tillage: Rotat. PI	Traditional Tillage: Annual PI	Traditional Tillage: Part. PI	Traditional Tillage: Soluble PI	Strip Tillage: Rotat. PI	Strip Tillage: Annual PI	Strip Tillage: Part. PI	Strip Tillage: Soluble PI	Pounds: Annual P change per acre	Pounds: Annual P change for field	Tolerable Soil Loss for the field in tons	Without Strip Tillage: Actual Calculated Soil loss for the field tons/acre	With Strip Tillage: Actual Calculated Soil loss for the field tons/acre	Change in Soil Loss from Strip Tillage tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
	2016 YPF Strip Tillage																					
5.9	Batavia	BbB	4%	30	3	2	1.7	0.2	2	1	0.6	0.4	0.9	5.3	4	1.8	1.5	-0.3	Batavia	BbB	BbB	64
6.8	St Charles	ScB	4%	15	3	3	1.4	1.1	3	2	1.2	1.2	0.1	0.7	5	2.5	2.5	0	St Charles	ScB	ScB	64
8.4	Whalan	WxD2	16%	90	5	7	4.9	1.6	4	5	3.6	1.4	1.5	12.6	2	2.8	2	-0.8	Whalan	WxD2	WxD2	64
8.4	St Charles	ScB	4%	13	3	2	1.3	1.2	3	2	1.1	1.1	0.3	2.5	5	2.5	2.5	0	St Charles	ScB	ScB	64
9.1	Dresden	DsB	2%	83	1	1	0.7	0.5	1	1	0.3	0.9	0.0	0.0	3	2	1.8	-0.2	Dresden	DsB	DsB	64
23.5	Kidder	KeB	2%	167	2	2	1.1	0.8	2	2	0.5	1.1	0.3	7.1	3	1.6	1.2	-0.4	Kidder	KeB	KeB	64
26.7	Wacousta	Wa	1%	47	1	2	0.1	2.5	1	2	0	2	0.6	16.0	5	0.2	0.2	0	Wacousta	Wa	Wa	64
27.5	Dresden	DsC2	9%	113	2	2	1.6	0.6	2	2	0.8	1.1	0.3	8.3	3	5	2.9	-2.1	Dresden	DsC2	DsC2	64
28.4	Whalan	WxC2	9%	63	5	5	4.3	0.3	1	1	1	0.4	3.2	90.9	2	3.7	0.9	-2.8	Whalan	WxC2	WxC2	64
30.0	Whalan	WxC2	9%	40	3	7	6.6	0.4	1	1	0.9	0.4	5.7	171.0	2	4	2	-2.0	Whalan	WxC2	WxC2	64
33.7	Virgil	VrB	3%	65	2	2	1.3	0.4	2	2	1	0.7	0.0	0.0	5	1	0.9	-0.1	Virgil	VrB	VrB	64
34.0	St Charles	SaB	4%	49	2	3	2.5	0.2	1	2	1.6	0.3	0.8	27.2	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
38.4	Wacousta	Wa	1%	125	2	3	0.3	2.3	2	2	0.2	2	0.4	15.4	5	0.9	0.8	-0.1	Wacousta	Wa	Wa	64
39.1	Dresden	DsC2	9%	118	6	5	4	1	4	4	3.5	0.9	0.6	23.5	3	4.6	3.3	-1.3	Dresden	DsC2	DsC2	64
55.0	Plano	PnB	4%	17	1	1	0.7	0.1	1	0	0.2	0.1	0.5	27.5	5	1	0.8	-0.2	Plano	PnB	PnB	64
55.1	Kidder	KdD2	16%	17	5	2	2.8	0.2	2	2	2.1	0.2	0.7	38.6	5	5.2	2.3	-2.9	Kidder	DdD2	DdD2	64
57.0	Kidder	KeB2	4%	46	2	3	2.6	0.2	2	2	1.7	0.3	0.8	45.6	5	1.5	1.6	0.1	Kidder	KeB2	KeB2	69
95.7	Griswold	GwC	9%	20	1	2	1.8	0.2	1	1	0.8	0.3	0.9	86.1	5	1.7	0.8	-0.9	Griswold	GwC	Gwc	64
99.0	Dresden	DsB	4%	47	1	1	0.3	0.2	0	0	0.2	0.2	0.1	9.9	3	0.7	0.8	0.1	Dresden	DsB	DsB	69
114.0	St Charles	SaB	4%	27	2	2	2.2	0.2	1	2	1.4	0.2	0.8	91.2	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
121.0	Plano	PlA	4%	40	1	1	0.7	0.2	1	1	0.5	0.2	0.2	24.2	5	0.4	0.4	0	Plano	PlA	PlA	69
21	**Fields**																					
			Average Soil Test P	**58.7**									**Average Annual P Change/Acre**	**Total Phosphorus Reduction**			**Average change in Soil Loss**	**-0.65**	**Acres in Stream Reach**			
[illegible]16.7	**Total Acres**												**0.89**	**[illegible]03.4**					**62**	**0.0**		
			Maximum	**167.0**													**Maximum**	**0.1**	**63**	**0.0**		
			Minimum	**13.0**									**5.7**	**Maximum**			**Minimum**	**-2.9**	**64**	**491.7**	**53.64%**	
													0.0	**Minimum**					**65**	**0.0**		
																# Fields increasing Soil loss		**4**	**66**	**0.0**		
																# Fields with no change		**4**	**69**	**425.0**	**46.36%**	
																# Fields decreasing Soil loss		**13**	**Total**	**916.7**		

Table 5 shows the difference between the changes in particulate phosphorous loss (first column) and soluble phosphorous loss (third column). As you can see in each field particulate phosphorus loss decreased when adopting strip tillage, with changes ranging from 0.1 – 5.7 pounds per acre. Changes in soluble phosphorus loss ranged from (-0.5) to 0.5 with:

- 10 of 21 being negative (increasing losses),
- 6 of 21 being zero (no affect), and
- 5 of 21 being positive (decreasing losses).

Annual P change per acre	Annual P change for field	Annual P change per acre	Annual P change for field
0.3	10.1	-0.3	-10.1
0.4	3.6	-0.4	-3.6
0.1	9.9	0.0	0.0
0.2	1.4	-0.1	-0.7
0.2	24.2	0.0	0.0
0.2	1.7	0.1	0.8
0.8	22.0	-0.5	-13.8
0.6	14.1	-0.3	-7.1
0.1	3.8	0.3	11.5
0.5	27.5	0.0	0.0
0.1	2.7	0.5	13.4
0.5	19.6	0.1	3.9
0.7	38.6	0.0	0.0
0.9	30.6	-0.1	-3.4
0.9	51.3	-0.1	-5.7
0.8	91.2	0.0	0.0
1.0	95.7	-0.1	-9.6
1.1	6.5	-0.2	-1.2
1.3	10.9	0.2	1.7
3.3	93.7	-0.1	-2.8
5.7	171.0	0.0	0.0
0.94	Average	-0.05	Average
Total P Reduction	**[illegible]30.1**	**Total P Reduction**	**-[illegible]6.6**

Table 5 Change in Particulate verses Soluble P

For the 2016 strip tillage program:

- ✓ **Overall the average reduction in phosphorus loss was 0.89 pounds.**
- ✓ **For the 916.7 acres in the program the risk of phosphorus loss was reduced 703.4 pounds by adopting strip tillage.**
- ✓ **The cost share program for strip tillage was $15 / acre for less than or equal to 50 acres.**
- ✓ **Three cooperators had more than 50 acres, so their payment was $750 while the fourth cooperator had 15 acres ($225).**
- ✓ **At $15/acre with phosphorus reduction of 0.89 pounds per acre the cost per pound of P loss reduction was $16.85.**

Switching from no-till to strip-till may increase the potential for particulate phosphorus loss while having minimal impact on soluble phosphorus losses (depending on manure applications). Considering that strip tillage normally replaces more aggressive tillage (chisel plowing, cultivation, etc.), it seems reasonable that most of the advantage to changing to this tillage system will be in the reduction of soil loss.

Looking at the data based on phosphorus reduction for each reach of stream is in table 6 (below).

Stream Reach	Acres	Percentage of Acres	Total Phosphorus Reduction
64	491.7	53.64%	505.3 pounds
69	425.0	46.36%	198.1 pounds

Table 6 Phosphorus reductions by stream reach

2. Low Disturbance Manure Injection:

The northern portion of the Yahara Watershed is an area with high concentrations of livestock and therefore a great deal of manure. Manure is either incorporated into the soil using a number of different tillage implements (chisel plow, disk, or field cultivator) or it is applied to the soil's surface and not incorporated. Surface applications of manure have been shown to increase nitrogen and phosphorus runoff to rivers and streams, while injection/incorporation places manure below the surface where it doesn't interact with runoff water during storms. However, on steep slopes injection/incorporation of manure can make the soil more susceptible to erosion.

For many livestock operations in the Yahara, manure incorporation is a standard practice. Traditional incorporation methods move a great deal of soil and increase the potential for soil erosion. Field evaluations conducted by the Yahara Pride Certification Program during the spring of 2013 and 2014 identified reducing soil erosion as a high priority. Since much of the tillage was conducted to incorporate manure, a system of incorporating manure with minimal soil disturbance needed to be implemented in the watershed. Minimum disturbance equipment also works well with no-till farming systems and allows farmers to experiment with new methods of preserving nitrogen, phosphorus and potassium to save on fertilizer costs. In addition to the economic benefits, improved manure utilization benefits the environment by ensuring efficient nutrient use and improving soil and water quality.

Yahara Pride Farms was one of the first groups in Wisconsin to experiment with vertical manure injection (VMI). VMI is a farming system that incorporates manure into the soil with minimal soil disturbance. Since YPF began using VMI there have been a number of companies that have made equipment to incorporate manure with low soil disturbance. These systems often use a single large fluted coulter to cut crop residue and open a channel in the soil surface for manure placement. Significantly less soil disturbance occurs with this process than with either chisel or chisel/disk manure incorporation systems. Since 2013, YPF has been encouraging farmers to try low disturbance manure injection (LDMI) systems. Dane County now offers cost share to farmers and custom manure applicators to upgrade their manure application equipment to LDMI.

In 2016 the manure application program includes any manure application equipment defined as low disturbance (Low Disturbance Manure Injection – LDMI). Participants in the cost share program were either farmers who had purchased LDMI equipment, or hired a custom operator who had LDMI equipment. In 2016, YPF had **seven farms (up from 4 in 2015)** participate in the LDMI program. The cost share program was modified to provide $20 per acre with a 100-acre maximum payment ($2,000 maximum). The seven farms used the equipment on **76 separate fields** (up from 32), which **totaled 1,203 acres** (up from 566 tillable acres). There was additional manure applied using this equipment, but some of that land was out of the Yahara Watershed. The data contained in table 7 are from the fields within the Yahara Watershed.

Table 7 Changes in phosphorus loss from the adoption of low disturbance manure injection

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1			2016 Phosphorus Report - LDMI																				
2						Without LDMI				With LDMI						Without LDMI		With LDMI					
3	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field	Calculated Soil loss for the field	Tolerable Soil Loss for the field	Calculated Soil loss for the field	Critical Soil	Soil Symbol	Soil used	Yahara Stream Reach field is located
4	8.1	Griswold	GwD2	16%	21	1	2	2.2	0.1	1	1	0.6	0	1.7	13.8	4	1.5	4	0.6	Griswold	GwD2	GwD2	64
5	7.9	Griswold	GwD2	16%	27	2	3	2.4	0.1	1	1	0.6	0	1.9	15.0	4	4	1.9	0.9	Griswold	GwD2	GwD2	64
6	15.2	Plano	PnB	4%	89	1	1	0.7	0.2	1	1	0.5	0.3	0.1	1.5	5	0.5	5	0.5	Plano	PnB	PnB	64
7	31.0	Plano	PnB	4%	74	1	1	0.7	0.2	1	1	0.5	0.3	0.1	3.1	5	0.5	5	0.5	Plano	PnB	PnB	64
8	12.2	St Charles	ScB	4%	75	1	1	0.8	0.2	1	1	0.5	0.3	0.2	2.4	5	0.6	5	0.6	St Charles	ScB	ScB	64
9	16.8	St Charles	ScB	4%	53	1	1	0.8	0.1	1	1	0.5	0.3	0.1	1.7	5	1	5	1	St Charles	ScB	ScB	64
10	14.8	Huntsville	HuB	4%	59	1	2	1.4	0.2	1	1	1	0.3	0.3	4.4	5	1.2	5	1.1	Huntsville	HuB	HuB	64
11	28.0	Plano	PnB	4%	90	4	2	1.8	0.3	4	2	1.4	0.4	0.3	8.4	5	3.2	5	3.1	Plano	PnB	PnB	64
12	28.0	Plano	PnB	4%	64	3	2	1.7	0.2	3	2	1.3	0.3	0.3	8.4	5	2.7	5	1.4	Plano	PnB	PnB	64
13	16.0	Virgil	VrB	3%	101	2	2	1.4	0.7	1	1	0.7	0.7	0.7	11.2	5	1	5	0.5	Virgil	VrB	VrB	66
14	10.0	Troxel	TrB	4%	128	2	3	2.6	0.6	1	1	1.1	0.6	1.5	15.0		1.6		0.6	Troxel	TrB	TrB	66
15	14.0	Kidder	KdC2	9%	91	1	1	0.3	0.3	0	0	0.1	0.3	0.2	2.8	5	0.5	5	0.2	Kidder	KdC2	KdC2	66
16	6.7	Plano	PnB	4%	86	4	8	7.8	0.6	4	8	6.8	0.9	0.7	4.7	5	3.2	5	3.1	Plano	PnB	PnB	64
17	19.2	Plano	PnB	4%	48	4	7	6.4	0.3	4	6	5.4	0.4	0.9	17.3	5	3.5	5	3.3	Plano	PnB	PnB	64
18	12.4	Plano	PnB	9%	36	3	3	2.8	0.2	3	3	2.3	0.3	0.4	5.0	5	3	5	2.9	Ringwood	RnC2	RnC2	64
19	13.0	Plano	PnB	9%	44	6	12	11.2	0.4	6	10	9.7	0.5	1.4	18.2	5	5.1	5	4.9	Plano	PnC2	PnC2	64
20	15.2	Plano	PnB	9%	51	2	3	2.5	0.5	2	3	1.9	0.7	0.4	6.1	5	4.8	5	4.5	Dodge	DnC2	DnC2	64
21	4.2	Dodge	DnC2	9%	36	1	2	1.4	0.4	1	2	1.6	0.6	-0.4	-1.7	5	3.2	5	3.5	Dodge	DnC2	DnC2	64
22	8.0	Warsaw	WrB	4%	177	8	10	9.5	1	8	10	8.4	1.5	0.6	4.8	3	2.7	3	2.6	Warsaw	WrB	WrB	64
23	9.8	Plano	PoB	4%	170	8	12	10.5	1.1	7	11	9.2	1.6	0.8	7.8	4	3.3	4	3.2	Plano	PoB	PoB	64
24	4.5	Plano	PoB	4%	96	6	6	5.8	0.6	5	6	5	0.9	0.5	2.3	5	3.2	5	3.2	Plano	PoB	PoB	64
25	14.5	Ringwood	RnC2	9%	132	8	15	14.4	0.6	8	14	13.2	0.9	0.9	13.1	5	6.1	5	6.3	Plano	PnC2	PnC2	64
26	7.3	Plano	PoB	9%	115	6	11	10.2	0.5	6	10	9.1	0.8	0.8	5.8	5	8.3	5	8.1	Plano	PnC2	PnC2	64
27	13.9	Troxel	TrB	4%	113	7	8	7.8	0.6	7	8	6.8	0.9	0.7	9.7	4	6.2	4	6.1	Plano	PoB	PoB	64
28	12.0	Plano	PoB	4%	210	8	11	9.7	1.1	8	10	8.7	1.6	0.5	6.0	4	5.2	4	5	Plano	PoB	PoB	64
29	21.3	Griswold	GwB	9%	48	6	8	7.5	0.2	6	7	6.1	0.4	1.2	25.6	3	6.8	3	6.5	Dresden	DsC2	DsC2	64
30	20.3	Plano	PoA	4%	60	5	5	5.1	0.3	5	5	4	0.5	0.9	18.3	4	5.2	4	5	Plano	PoB	PoB	64
31	28.1	Dodge	DnB	9%	27	7	6	5.4	0.2	6	5	4.7	0.4	0.5	14.1	5	6.2	5	6.1	Mchenry	MdC2	MdC2	64
32	25.5	Plano	PnB	9%	74	2	3	2.6	0.4	2	3	2.1	0.6	0.3	7.7	5	9.6	5	9.4	Plano	PnC2	PnC2	64
33	47.9	Plano	PoB	4%	84	5	7	6.2	0.4	4	6	5.4	0.6	0.6	28.7	4	4.4	4	4.3	Plano	PoB	PoB	64
34	16.5	Plano	PnB	8%	79	3	4	3.9	0.5	3	4	3.5	0.7	0.2	3.3	5	3.3	5	3.2	Griswold	GwC	GwC	64
35	19.5	Plano	PnB	8%	84	7	6	5.2	0.5	7	5	4.3	0.6	0.8	15.6	5	6.3	5	6.1	Griswold	GwC	GwC	64
36	14.9	Plano	PnC2	9%	116	4	3	2.6	0.4	3	1	0.9	0.4	1.7	25.3	5	2.7	5	2.3	Mchenry	MdC2	MdC2	64
37	17.1	Dodge	DnC2	28%	98	5	7	6.5	0.6	5	7	6.1	0.5	0.5	8.6	5	4.3	5	4.2	Dodge	DnC2	DnC2	64
38	22.7	St Charles	ScB	9%	43	5	5	4.7	0.3	5	4	4	0.2	0.8	18.2	5	3.7	5	3.7	Mchenry	MdC2	MdC2	64
39	22.7	Ringwood	RnB	9%	80	6	3	2.6	0.5	6	3	2.8	0.4	-0.1	-2.3	5	5.3	5	5.6	Dodge	DnC2	DnC2	64
40	9.8	Troxel	TrB	9%	108	3	4	3.4	0.5	3	2	1.8	0.4	2.4	23.5	5	2.5	5	2.1	Ringwood	RnC2	RnC2	64
41	12.2	Dodge	DnC2	9%	62	6	2	1.3	0.3	6	2	1.2	0.3	-0.3	-3.7	5	5.5	5	5.5	Dodge	DnC2	DnC2	64
42	10.3	Plano	PnB	16%	106	4	4	4	0.3	3	2	1.5	0.4	2.4	24.7	5	3.2	5	2.8	St Charles	ScD2	ScD2	64
43	6.4	Plano	PnB	28%	66	6	9	8.6	0.4	5	7	6.5	0.3	2.2	14.1	5	6	5	5.6	Kidder	KrE2	KrE2	64
44	18.0	Kidder	KdC2	9%	82	2	2	1.3	0.2	2	1	0.9	0.4	0.2	3.6	5	1.3	5	1.2	Kidder	KdC2	KdC2	64
45	23.5	Plano	PnB	9%	96	5	4	3.8	0.5	5	4	3.4	0.5	0.4	9.4	5	4.4	5	4.3	Ringwood	RnC2	RnC2	64
46	11.0	Ringwood	RnC2	9%	96	3	3	2.3	0.4	3	2	1.8	0.5	0.4	4.4	5	2.7	5	2.6	Ringwood	RnC2	RnC2	64
47	29.9	Plano	PnB	16%	76	8	11	10.8	0.4	7	9	8.1	0.5	2.6	77.7	5	7.2	5	6.6	Mchenry	MdC2	MdC2	64
48	11.5	Griswold	GwD2	15%	53	3	5	4.9	0.2	3	4	4.1	0.3	0.7	8.1	4	2.3	4	2.1	Griswold	GwD2	GwD2	64
49	38.8	Plano	PnB	4%	84	2	2	1.8	0.3	2	2	1.3	0.4	0.4	15.5	5	2.0	5	2.0	Plano	PnB	PnB	64
50	15.2	Ringwood	RnB	4%	45	2	2	1.7	0.3	2	2	1.4	0.3	0.3	4.6	5	1.5	5	1.5	Plano	PnB	PnB	64

Table 7 cont. Changes in phosphorus loss from the adoption of low disturbance manure injection

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1			2016 Phosphorus Report - LDMI																				
2						Without LDMI				With LDMI						Without LDMI		With LDMI					
3	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field	Calculated Soil loss for the field	Tolerable Soil Loss for the field	Calculated Soil loss for the field	Critical Soil	Soil Symbol	Soil used	Yahara Stream Reach field is located
51	11.8	Ringwood	RnC2	9%	20	4	3	2.6	0.1	3	2	1.8	0.1	0.8	9.4	5	2.9	5	2.5	Ringwood	RnC2	RnC2	64
52	17.5	Dodge	DnC2	9%	15	2	4	3.5	0.2	2	2	1.7	0.1	1.9	33.3	5	2.5	5	1.6	Dodge	DnC2	DnC2	64
53	20.0	Ringwood	RnC2	9%	56	3	1	0.5	0.4	3	1	0.5	0.3	0.1	2.0	5	3.1	5	3.1	Ringwood	RnC2	RnC2	64
54	26.0	Ringwood	RnC2	15%	14	2	2	2.1	0.2	1	2	1.6	0.1	0.6	15.6	4	2.0	4	1.9	Griswold	GwD2	GwD2	64
55	20.0	Ringwood	RnC2	9%	14	1	3	2.5	0.1	1	1	1	0	1.6	32.0	5	1.5	5	0.8	Ringwood	RnC2	RnC2	64
56	34.0	Ringwood	RnC2	9%	14	2	2	1.7	0.1	1	1	1.2	0.1	0.5	17.0	5	1.9	5	1.9	Ringwood	RnC2	RnC2	64
57	35.0	Plano	PnB	9%	88	5	3	2.9	0.4	5	3	2.5	0.4	0.4	14.0	5	5.0	5	5.0	Ringwood	RnC2	RnC2	64
58	19.7	Ringwood	RnB	8%	56	1	1	0.6	0.2	1	1	0.4	0.2	0.2	3.9	5	0.7	5	0.6	Griswold	GwC	GwC	64
59	18.2	Griswold	GwB	4%	42	1	1	0.7	0.8	1	1	0.4	0.2	0.9	16.4	5	0.5	5	0.5	Griswold	GwB	GwB	64
60	10.0	Rockton	RoD2	21%	55	2	2	1.3	0.7	2	1	1.0	0.2	0.8	8.0	2	1.4	2	1.5	Rockton	RoD2	RoD2	64
61	24.7	Troxel	TrB	2%	131	7	9	8.0	1.4	6	6	5.2	0.8	3.4	84.0	5	3.2	5	3.2	Troxel	TrB	TrB	64
62	2.9	Kidder	KrE2	12%	76	3	4	2.6	1.0	3	2	1.6	0.3	1.7	4.9	5	2.1	5	2.1	Kidder	KrE2	KrE2	64
63	22.5	Radford	RaA	2%	100	8	9	6.5	2.7	7	5	4.4	1.0	3.8	85.5	5	2.9	5	2.9	Radford	RaA	RaA	64
64	4.0	Kidder	KrE2	28%	57	4	5	4.7	0.8	3	3	2.6	0.2	2.7	10.8	5	4.0	5	4	Kidder	KrE2	KrE2	64
65	31.1	Ringwood	RnC2	9%	75	5	12	10.1	1.5	4	7	6.3	0.5	4.8	149.3	5	3.4	5	3.4	Ringwood	RnC2	RnC2	64
66	14.0	Plano	PnC2	9%	82	5	5	3.6	1.1	5	3	2.2	0.4	2.1	29.4	5	3.4	5	3.4	Plano	PnC2	PnC2	64
67	14.0	Elburn	EfB	3%	69	6	4	2.4	1.4	6	2	1.7	0.5	1.6	22.4	5	3.2	5	3.2	Elburn	EfB	EfB	64
68	10.0	Plano	PnB	2%	92	5	4	2.3	1.3	4	2	1.6	0.5	1.5	15.0	5	2.1	5	2.1	Plano	PnB	PnB	64
69	20.7	Mchenry	MdD2	10%	56	2	2	1.8	0.5	2	1	1.4	0.1	0.8	16.6	5	1.8	5	2	Mchenry	MdD2	MdD2	64
70	9.9	Plano	PnB	4%	56	6	4	2.8	1.1	6	2	1.8	0.2	1.9	18.8	5	4.2	5	4.3	Plano	PnB	PnB	64
71	4.5	Mchenry	MdD2	9%	55	4	3	2.5	0.5	4	3	2.3	0.3	0.4	1.8	5	2.2	5	2.3	Mchenry	MdD2	MdD2	64
72	4.7	Mchenry	MdD2	9%	29	2	2	1.2	0.3	2	1	1.1	0.2	0.2	0.9	5	1.2	5	1.2	Mchenry	MdD2	MdD2	64
73	4.1	Mchenry	MdD2	9%	23	2	1	1.2	0.3	2	1	1.0	0.1	0.4	1.6	5	1.2	5	1.2	Mchenry	MdD2	MdD2	64
74	5.3	Dodge	DnC2	9%	72	2	2	1.3	0.6	2	1	1.1	0.4	0.4	2.1	5	1.3	5	1.3	Mchenry	MdD2	MdD2	64
75	5.4	Kidder	KdD2	12%	25	2	1	1.1	0.2	2	1	0.8	0.2	0.3	1.6	5	1.9	5	2.1	Kidder	KdD2	KdD2	64
76	2.1	Seaton	SmC2	9%	32	2	1	1.2	0.2	2	1	0.8	0.2	0.4	0.8	5	2.0	5	2.1	Seaton	SmC2	SmC2	64
77	4.9	Mchenry	MdC2	12%	25	1	0	0.3	0.1	1	0	0.2	0.1	0.1	0.5	5	1.1	5	1.1	Kidder	KdD2	KdD2	64
78	18.4	Seaton	SmB	12%	37	3	2	1.8	0.4	3	2	1.7	0.2	0.3	5.5	5	2.5	5	2.6	Kidder	KdD2	KdD2	64
79	1.6	Whalan	WxD2	12%	27	2	1	0.3	0.2	2	1	0.7	0.1	-0.3	-0.5	5	2.0	5	2.3	Whalan	WxD2	WxD2	64
80																							
81	**74**	**Fields**																					
82				**Average Soil Test P**	**71.59**									**Average Annual P Change/Acre**	**Total Phosphorus Reduction**			**Average change in Soil Loss**	**3.04**	**Acres in Stream Reach**			
83	**1,202.8**	**Total Acres**												**0.88**	**1,105.7**					**62**	**0.0**		
84				**Maximum**	**210.0**												**Greatest increase in soil loss**		**9.4**	**63**	**0.0**		
85				**Minimum**	**14.0**									**4.8**	**Maximum**		**Greatest decrease in soil loss**		**0.2**	**64**	**1,162.8**	**96.67%**	
86														**-0.4**	**Minimum**					**65**	**0.0**		
87																	**# Fields increasing soil loss**		**11**	**66**	**40.0**	**3.44%**	
88																	**# Fields with no change**		**25**	**69**	**0**		
89																	**# Fields decreasing soil loss**		**38**	**Total**	**1,202.8**		
90																							

The estimates for the reductions in phosphorus loss were conducted using crop rotation, tillage practices and manure application data provided by farmers and their crop consultants in the watershed.

Table 7 (pages 11 – 12) contains the SNAP data collected from these farms and shows the information for all of the cooperating farms. This is a significant increase in acres over what was done in 2015. There is still significant interest in using this equipment and over the past few years a few farmers and custom operators have purchased the equipment for use within the watershed.
The average reduction in the risk of phosphorus loss for the <u>**LDMI program was 0.88 pounds of P per acre**</u>, **with a range in reduction from (-1.0) to 4.8 pounds.**

As with strip tillage the question that arises is how do the reductions in particulate verses soluble P compare? Table 8 on page 14 shows the differences in particulate verses soluble P loss for the 76 fields in the program. The as demonstrated in the data, the vast majority of phosphorus reduction comes from particulate losses (93%).

Looking at the reductions of particulate phosphorus loss (table 8) contains the following information:

- 1 field with a (-0.4) change in particulate P loss,
- 2 fields with a (-0.2) change in particulate P loss, } (5.4% of total fields)
- 1 field with a 0.0 change in particulate P loss,
- 20 fields with a 0.1 -0.4 change in particulate P loss (27% of total fields),
- 22 fields with a 0.5 – 0.9 change in particulate P loss (29.7% of total fields), and
- 28 fields with ≥ 1.0 change in particulate P loss (37.9% of total fields).

Looking at the reductions of soluble phosphorus loss (table 8) contains the following information:

- 3 fields with a (-0.5) change in soluble P loss, (4.1%)
- 5 fields with a (-0.3) change in soluble P loss, (6.8%)
- 10 fields with a (-0.2) change in soluble P loss, (13.5%)
- 13 fields with a (-0.1) change in soluble P loss, (17.6%)
- 14 fields with a 0.0 change in soluble P loss, (18.9%)
- 18 fields with a 0.1 -0.4 change in soluble P loss, (24.3%)
- 9 fields with a 0.5 – 0.9 change in soluble P loss, (12.2%)
- 2 fields with ≥ 1.0 change in soluble P loss. (2.7%)

A review of the data in table 7 shows that the overall affect of implementing LDMI equipment produced an **average reduction in predicted soil loss of 0.16 tons/acre**. Of the 76 fields in the program 11 saw increases in predicted soil loss, 25 had no change and 40 were predicted to have less soil loss with soil loss decreases ranging from 0.1 to 3.1 tons per acre. These losses were highly dependent on the slope of the field and the application methods replaced by LDMI.

Table 8 Change in Particulate verses soluble phosphorus losses with LDMI for each field

2016*Phosphorus*Report*=*LDMI			
Particulate* Annual*P* change*per* acre	Annual*P* change*for field	Soluble* Annual*P* change*per* acre	Annual*P* change*for field
1.6	13.0	0.1	0.8
1.8	14.2	0.1	0.8
0.2	3.0	=0.1	=1.5
0.2	6.2	=0.1	=3.1
0.3	3.7	=0.1	=1.2
0.3	5.0	=0.2	=3.4
0.4	5.9	=0.1	=1.5
0.7	11.2	0.0	0.0
1.5	15.0	0.0	0.0
0.2	2.8	0.0	0.0
1.0	6.7	=0.3	=2.0
1.0	19.2	=0.1	=1.9
0.5	6.2	=0.1	=1.2
1.5	19.5	=0.1	=1.3
0.6	9.1	=0.2	=3.0
=0.2	=0.8	=0.2	=0.8
1.1	8.8	=0.5	=4.0
1.3	12.7	=0.5	=4.9
0.8	3.6	=0.3	=1.4
1.2	17.4	=0.3	=4.4
1.1	8.0	=0.3	=2.2
1.0	13.9	=0.3	=4.2
1.0	12.0	=0.5	=6.0
1.4	29.8	=0.2	=4.3
1.1	22.3	=0.2	=4.1
0.7	19.7	=0.2	=5.6
0.5	12.8	=0.2	=5.1
0.8	38.3	=0.2	=9.6
0.4	6.6	=0.2	=3.3
0.9	17.6	=0.1	=2.0
1.7	25.3	0.0	0.0
0.4	6.8	0.1	1.7
0.7	15.9	0.1	2.3
=0.2	=4.5	0.1	2.3
1.6	15.7	0.1	1.0
0.1	1.2	0.0	0.0
2.5	25.8	=0.1	=1.0
2.1	13.4	0.1	0.6
0.4	7.2	=0.2	=3.6
0.4	9.4	0.0	0.0

2016 Phosphorus Report - LDMI			
Particulate Annual P change per acre	Annual P change for field	Soluble Annual P change per acre	Annual P change for field
0.5	5.5	-0.1	-1.1
2.7	80.7	-0.1	-3.0
0.8	9.2	-0.1	-1.2
0.5	19.4	-0.1	-3.9
0.3	4.6	0.0	0.0
0.8	9.4	0.0	0.0
1.8	31.5	0.1	1.8
0.0	0.0	0.1	2.0
0.5	13.0	0.1	2.6
1.5	30.0	0.1	2.0
0.5	17.0	0.0	0.0
0.4	14.0	0.0	0.0
0.2	3.9	0.0	0.0
0.3	5.5	0.6	10.9
0.3	3.0	0.5	5.0
2.8	69.2	0.6	14.8
1.0	2.9	0.7	2.0
2.1	47.3	1.7	38.3
2.1	8.4	0.6	2.4
3.8	118.2	1.0	31.1
1.4	19.6	0.7	9.8
0.7	9.8	0.9	12.6
0.7	7.0	0.8	8.0
0.4	8.3	0.4	8.3
1.0	9.9	0.9	8.9
0.2	0.9	0.2	0.9
0.1	0.5	0.1	0.5
0.2	0.8	0.2	0.8
0.2	1.1	0.2	1.1
0.3	1.6	0.0	0.0
0.4	0.8	0.0	0.0
0.1	0.5	0.0	0.0
0.1	1.8	0.2	3.7
-0.4	-0.6	0.1	0.2
0.85	**Average**	**0.07**	**Average**
Total P Reduction	**1,034.2**	**Total P Reduction**	**81.4**

Key points in this data set include:

- ✓ **The estimated annual phosphorus loss was reduced by (-1.0) to 4.8 lbs/acre through this manure application system, with the 2016 average reduction of 0.88 lbs per acre.**

- ✓ **Based on the 2016 data, the LDMI cost share program reduced phosphorus loss by 1,106 lbs.**

- ✓ **The cost of reducing the risk of phosphorus loss through LDMI was $20 per acre divided by 0.88 pounds of P per acres = $22.73 / pound.**

- ✓ **Total acres with manure applied with the LDMI system = 1,203 acres**

- ✓ **Total acres cost shared = 593 acres**

- ✓ **Acres planted without cost share in watershed = 610 acres**

Looking at the data based on phosphorus reduction for each reach of stream is in table 9 (below).

Stream Reach	Acres	Percentage of Acres	Total Phosphorus Reduction
66	40.0	3.33%	29.0 pounds
64	1,163	96.67%	1,076.7 pounds

Table 9 Phosphorus reductions by stream reach

3. Low Disturbance Deep Tillage and Cover Crop:

The low disturbance deep tillage and cover crop program was offered in 2016 because of the wet fall and the very high potential for soil compaction done on fields harvested during high soil moisture conditions. The program offered cost share assistance to farmers willing to implement deep tillage practices that were also low disturbance. The goal was to reduce the potential for aggressive deep tillage conducted within the watershed, which would increase the potential for soil erosion. The cost share program offered a payment of $55 per acre with a 50 acre maximum for a total possible payment of $2,750 per operation.

Based on the information contained in the SNAP+ program it was impossible to determine the impact of low disturbance deep tillage verses other methods of deep tillage. This tillage system is not contained in the SNAP+ so farmers and crop consultants had to identify a tillage system that produces similar results. There are several ways of doing this so identification of the fields selected for this cost share practices was not possible.

However, the 2016 YPF cost share dataset does contain a large number of fields where two practices were done on the same field (combined practices). The combined practices data set consists of fields that had cover crops as one practice, and then either strip tillage or LDMI as the second practice. Both strip tillage and LDMI are very similar to low disturbance deep tillage so the average reduction in phosphorus loss from the combined data set was used as basis for the low disturbance deep tillage and cover crop program.

The average reduction in predicted phosphorus loss from the implementation of two practices was 2.23 pounds/acre compared to the average reduction from cover crops of 1.48. Therefore, the impact of either low disturbance manure injection or strip tillage in combination with planting a cover crop reduced phosphorus loss an additional 0.75 pounds per acre.

The low disturbance deep tillage and cover crop cost share program had **8 participants** who implemented the practices on a total of **730 acres within the watershed**. The YPF cost share program paid on 378 of these acres with a total expenditure of $ 20,790. The 730 acres with these practices implemented are included in the cover crop section of this report. Since evaluation of the low disturbance deep tillage verses conventional deep tillage is not possible within the current data set, we used the difference between the averages of combined practices and cover crops of develop a conservative estimate of phosphorus reduction.

Total acres planted with the LDDT plus cover crop system = 730 acres

Total acres cost shared = 378 acres

Acres planted without cost share in watershed = 392 acres

730 acres LDDT * 0.75 lbs. of phosphorus reduced over just cover crops = 547.5 pounds

A more accurate way to express the cost benefit of this program would be to take the total acres times the average of the combined practices and not include the acres in the cover crop portion of the report. **This program resulted in 730 acres * 2.23 pounds/acre = 1,628 lbs of phosphorus. At $55/acre divided by 2.23 pounds/acre the program resulted in a $24.66 /pound of phosphorus reduced.**

Of the eight farms participating in the LDDT + cover crop program seven were located in stream reach 64, while the other was in 63. The acres and phosphorus reductions are:

- ✓ Stream reach 64 650 acres 487.5 pounds of phosphorus
- ✓ Stream reach 63 80 acres 60 .0 pounds of phosphorus

Cover Crop Assistance Program:

Cover crops are grasses, legumes, small grains or other crops grown between regular grain crop production periods for the purpose of protecting and improving the soil. The most common cover crops are fall-seeded cereals, such as rye, barley or wheat, and fall-seeded annual ryegrass. Late summer-seeded spring oats or spring barley are sometimes used if winterkill is preferred to avoid spring termination by tillage or herbicide. One of the two major reasons for growing winter cover crops is to reduce soil erosion. In the Yahara Watershed a significant amount of the tillable acres has sufficient slope to be at risk for erosion if not adequately protected. Eroding soil particles not only fill in wetlands and streams, but they also carry particulate bound phosphorus to surface water.

Based on the data collected by the Yahara Pride Farms over the years of this cost share program, the use of cover crops is most effective when targeted to specific fields and farming systems. Cover crops have a high potential to reduce phosphorus loss on fields being harvested as corn silage with manure incorporated in the late summer or fall. Research has shown that fields with winter cover incorporated in the spring have 55 percent less water runoff and 50 percent less soil loss annually than do fields with no winter cover. More recent studies show soil losses from corn or soybeans no-tilled into a vigorous growth of rye or wheat to be 90-95 percent less than soil losses from corn and soybeans conventionally tilled.

Yahara Pride Farms began working with cover crops as a demonstration program in 2012. As the program gained publicity and recognition, farmers in the watershed became interested. Joining the program was also very easy, which was also very attractive to farmers. While not all the fields in the watershed planted into cover crops can be attributed to the Yahara Pride Farms program, it is clear that cover crops are becoming a recognized and accepted practice in the watershed. There are still a number of important considerations that need to be evaluated and addressed in regards to cover crops in this region of the state. Some of these include the cover crop species planted, the timing of planting, targeting fields that have the greatest potential for nutrient and sediment loss and targeting farming systems that have the greatest potential for nutrient and sediment loss.

In 2016 YPF worked with local crop consultants to get the information required to calculate the potential environmental benefits of all three cost shared practices. The information on the following pages for the cover crop program shows that in 2016 there were 290 fields with crop rotations and farming systems in the SNAP format. **This represented 100% of the total acres** planted with cover crops through the cost share program, though most of these acres were not cost shared. The wide range of farms and farming systems reflected in the data improves our understanding of the potential for cover crops to reduce phosphorus loss.

Based on the 290 fields, the **estimated annual phosphorus loss was reduced in the range of (-1.9 lbs increased P loss) to 10.7 lbs/acre (decreased P loss) by the adoption of planting cover crops, with an average reduction of 1.48 lbs per acre.**

Based on the field data collected during the 2016 seasons, the cover crop incentive demonstration program reduced phosphorus loss by 7,130 pounds (compared to 6,572 pounds in 2015). This reduction in the potential phosphorus delivery to surface water was an 8.5% increase over the 2015 cover crop program. The average reduction in phosphorus loss was almost 1.5 pounds per acre in 2016 compared to 1.8 lbs/acre in 2015. Care should be used when comparing year-to-year changes in the predictions of phosphorus loss because of changes to the SNAP+ program[1].

This year's phosphorus reduction = 7,130 lbs

Cost per pound of P reduced this year = $40 / acre divided by 1.5 lbs / acre average phosphorus reduction = $ 26.67/ lb.

Cost share program sponsored at $40 / acre for a maximum of 50 acres

Total acres planted using a cover crop system (includes both the cover crop program and the low disturbance deep tillage with a cover crop) = 5,851 acres

Total estimated acres cost shared = 1,903 acres

Acres planted without cost share in watershed = 3,948 acres

32.5% of the acres planted to cover crops on YPF's land were cost shared

Year	2013	2014	2015	2016
Farms	20	37	35	37
Fields	80	53	160	290
Acres	2,382	4,732	4,908	5,851
Range in P reduction	-3.1 to 6.2	-0.6 to 6.2	-1.0 to 13.4	-1.9 to 10.7
Average	1.0 lbs / acre	0.8 lbs / acre	1.8 lbs / acre	1.5 lbs / acre
Total P reduction	1,957 lbs	3,786 lbs	6,572 lbs	7,130 lbs

[1] The Natural Resources Conservation Service (NRCS) maintains the soil survey data used by the Revised Universal Soil Loss Equation 2 (RUSLE2) to estimate sheet and rill soil erosion. In 2014 NRCS began a national update of soil survey data including Tolerable (T) soil loss values and soil erodibility factors (K). The University of Wisconsin Soils Department annually updates the SNAP+ database to reflect the most current NRCS soil survey data. The edits to the SNAP+ soils database can cause changes to occur in the year-to-year predicted P loss values even when no other change to the farming system occurred. As a result, any comparison of year-to-year P loss values after 2014 must include an evaluation of SNAP+ soils data to determine if any edits occurred.

Table 10 Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1	2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops					
2	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
3	1.0	Plano	PnC2	9%	31	1	0	0.1	0.2	1	0	0.1	0.2	0.0	0.0	5	0.8	0.8	0.0	Plano	PnC2	PnC2	64
4	1.0	Plano	PnC2	9%	81	7.0	14.0	13.1	0.7	5.0	5.0	4.8	0.5	8.5	8.5	5	6.5	5.0	-1.5	Dodge	DnC2	DnC2	64
5	1.8	Troxel	TrB	15%	37	3	3	2.3	0.6	3	3	2.1	0.6	0.2	0.4	4	2.5	2.3	-0.2	Griswold	GwD2	GwD2	63
6	2.0	Ringwood	RnB	4%	103	2	4	3.1	0.6	2	4	3.0	0.6	0.1	0.2	5	0.6	0.6	0.0	Ringwood	RnB	RnB	64
7	2.2	Mchenry	MdC2	9%	74	4	8	7.8	0.5	4	8	7.2	0.5	0.6	1.3	5	2.4	2.3	-0.1	Mchenry	MdC2	MdC2	64
8	2.9	Mchenry	MdD2	10%	25	2	4	3.7	0.2	2	2	1.8	0.1	2.0	5.7	5	2.0	1.6	-0.4	Mchenry	MdD2	MdD2	64
9	3.0	Plano	PoB	4%	82	3	6	5.9	0.5	2	6	5.3	0.6	0.5	1.5	4	1.7	1.6	-0.1	Plano	PoB	PoB	62
10	3.1	Rodman	RpE	24%	125	4	7	6.0	0.5	4	6	5.8	0.5	0.2	0.6	2	4.6	4.1	-0.5	Rodman	RpE	RpE	64
11	3.3	Mchenry	MdC2	9%	68	3	8	7.9	0.4	3	8	7.7	0.4	0.2	0.7	5	1.3	1.3	0.0	Mchenry	MdC2	MdC2	64
12	3.4	Orion Var	Os	1%	101	2	2	0.5	1.4	2	2	0.4	1.3	0.2	0.7	5	0.4	0.4	0.0	Orion Var	Os	Os	64
13	3.5	Mchenry	MdC2	9%	64	3	6	5.5	0.4	3	5	5.1	0.4	0.4	1.4	5	1.7	1.6	-0.1	Mchenry	MdC2	MdC2	64
14	3.5	Plano	PnB	8%	130	6.0	3.0	2.2	0.7	6.0	3.0	2.0	1.2	-0.3	-2.0	5	3.8	3.8	0.0	Griswold	GwC	GwC	64
15	3.5	Dodge	DnB	9%	42	4	4	4.1	0.3	3	3	3.2	0.2	1.0	3.5	5	4.9	4.5	-0.4	Mchenry	MdD2	MdD2	64
16	3.7	Kidder	KdD2	16%	73	3	4	3.2	1.1	3	4	2.4	1.1	0.8	3.0	5	1.4	1.5	0.1	Kidder	KdD2	KdD2	64
17	3.7	Mchenry	MdC2	9%	64	4	6	6.0	0.4	4	6	5.5	0.4	0.5	1.9	5	2.2	2.1	-0.1	Mchenry	MdC2	MdC2	64
18	4.0	Kidder	KdC2	9%	37	2	0	0.2	0.2	2	0	0.2	0.2	0.0	0.0	5	1.3	1.3	0.0	Kidder	KdC2	KdC2	64
19	4.0	Kidder	KrE2	28%	57	4	6	6.2	0.3	4	3	3.0	0.2	3.3	13.2	5	4.8	4.0	-0.8	Kidder	KrE2	KrE2	64
20	4.0	Mchenry	MdC2	9%	41	5	5	4.3	0.5	4	3	2.5	0.4	1.9	7.6	5	3.7	3.4	-0.3	Mchenry	MdC2	MdC2	62
21	4.2	Griswold	GwD2	16%	21	1	1	0.6	0.1	1	1	0.6	0.1	0.0	0.0	4	0.5	0.6	0.1	Griswold	GwD2	GwD2	64
22	4.2	Ringwood	RnB	4%	133	9.0	9.0	8.3	1.1	8.0	9.0	7.6	1.5	0.3	1.3	5	4.8	4.6	-0.2	Ringwood	RnB	RnB	64
23	4.2	Rockton	RoD2	11%	109	3	5	4.1	1.0	3	3	2.3	0.9	1.9	8.0	2	1.4	1.2	-0.2	Rockton	RoD2	RoD2	64
24	4.2	St Charles	ScB	4%	78	3	3	2.4	0.6	3	3	2.1	0.6	0.3	1.3	5	2.4	2.3	-0.1	St Charles	ScB	ScB	64
25	4.4	Mchenry	MdC2	9%	59	4	9	8.5	0.5	4	9	8.4	0.5	0.1	0.4	5	2.3	2.2	-0.1	Mchenry	MdC2	MdC2	64
26	4.4	Elburn	EfB	2%	153	4	5	4.3	0.9	4	5	3.7	0.8	0.7	3.1	5	2.3	2.3	0.0	Ringwood	RnB	RnB	64
27	4.4	Ringwood	RnB	4%	115	9.0	11.0	8.9	1.8	8.0	9.0	7.6	1.4	1.7	7.5	5	4.6	4.4	-0.2	Ringwood	RnB	RnB	64
28	4.4	Griswold	GwC	8%	85	0.0	0.0	0.2	0.2	0.0	0.0	0.1	0.3	0.0	0.0	5	0.2	0.1	-0.1	Griswold	GwC	GwC	64
29	4.8	St Charles	ScB	4%	79	3	5	4.2	0.6	2	2	1.9	0.5	2.4	11.5	5	2.1	1.3	-0.8	St Charles	ScB	ScB	64
30	4.9	Batavia	BbB	4%	116	3.0	6.0	5.4	0.6	3.0	3.0	2.7	0.4	2.9	14.2	4	2.9	2.3	-0.6	Batavia	BbB	BbB	64
31	5.1	Kegonsa	KeB	4%	106	5	7	5.9	1.3	5	6	5.0	1.2	1.0	5.1	3	2.9	2.6	-0.3	Kegonsa	KeB	KeB	64
32	5.3	St Charles	ScC2	10%	36	0	0	0.2	0.2	1	1	0.5	0.2	-0.3	-1.6	5	0.2	0.7	0.5	St Charles	ScC2	ScC2	64
33	5.4	Kidder	KdD2	12%	46	3	5	4.6	0.4	2	5	4.3	0.3	0.4	2.2	5	2.3	2.1	-0.2	Kidder	KdD2	KdD2	64
34	5.5	McHenry	MdD2	16%	69	1	1	0.4	0.3	1	1	0.8	0.4	-0.5	-2.8	5	0.4	1.3	0.9	McHenry	MdD2	MdD2	64
35	5.5	St Charles	SaA	9%	13	4	7	6.7	0.1	3	3	3.2	0.1	3.5	19.3	5	6.0	4.7	-1.3	Kidder	KeC2	KeC2	69
36	5.5	Dresden	DsB	1%	121	2	2	0.6	1.8	1	2	0.4	1.4	0.6	3.3	3	1.2	1.1	-0.1	Dresden	DsB	DsB	64
37	5.7	Dodge	DnC2	9%	80	5	11	10.0	0.8	4	4	3.3	0.6	6.9	39.3	5	3.6	2.7	-0.9	Dodge	DnC2	DnC2	64
38	5.9	Ringwood	RnB	4%	53	1	1	0.7	0.2	1	1	0.6	0.2	0.1	0.6	5	0.5	0.5	0.0	Ringwood	RnB	RnB	64
39	5.9	Batavia	BbB	2%	161	7	8	6.7	1.7	6	4	2.7	1.1	4.6	27.1	4	2.6	2.3	-0.3	Batavia	BbB	BbB	63
40	5.9	St Charles	ScB	4%	69	2	2	2.0	0.4	2	1	0.9	0.4	1.1	6.5	5	1.0	0.7	-0.3	St Charles	ScB	ScB	64
41	6.0	Boyer	BoB	4%	48	1	1	1.2	0.2	1	1	0.5	0.5	0.4	2.4	3	1.0	0.7	-0.3	Boyer	BoB	BoB	64
42	6.0	Griswold	GwC	9%	45	3	5	2.6	2.1	3	5	2.5	2.1	0.1	0.6	5	1.3	1.3	0.0	Griswold	GwC	GwC	62
43	6.0	St Charles	ScB	9%	48	4	4	2.4	1.6	3	3	1.9	1.4	0.7	4.2	5	2.4	2.3	-0.1	Griswold	GwC	GwC	62
44	6.0	Dodge	DnB	9%	34	4	5	4.4	0.2	3	4	3.5	0.2	0.9	5.4	5	4.9	4.5	-0.4	Mchenry	MdC2	MdC2	64
45	6.2	Edmund	EdB2	4%	163	4	5	3.5	1.3	3	3	1.3	1.6	1.9	11.8	1	1.6	0.7	-0.9	Edmund	EdB2	EdB2	64
46	6.4	Plano	PnB	28%	66	7.0	18.0	17.5	0.5	5.0	8.0	7.5	0.4	10.1	64.6	5	7.8	5.6	-2.2	Kidder	KrE2	KrE2	64
47	6.4	Whalan	WxD2	16%	82	4	8	7.4	0.7	4	7	6.5	0.7	0.9	5.8	2	4.5	4.0	-0.5	Whalan	WxD2	WxD2	64
48	6.5	Wacousta	Wa	4%	86	6	5	4.5	0.4	6	4	4.0	0.3	0.6	3.9	5	4.7	4.6	-0.1	Ringwood	RnB	RnB	64
49	6.6	Virgil	VrB	3%	49	2	2	0.9	1.5	1	1	0.1	1.3	1.0	6.6	5	0.6	0.1	-0.5	Virgil	VrB	VrB	62
50	6.8	St Charles	ScB	4%	15	3	3	2.4	0.1	3	1	1.3	0.1	1.1	7.5	5	2.7	2.5	-0.2	St Charles	ScB	ScB	64
51	6.9	Kidder	KdC2	9%	90	3	4	3.1	0.7	2	3	2.7	0.6	0.5	3.5	5	2.6	2.4	-0.2	Kidder	KdC2	KdC2	64
52	7.0	McHenry	MdC2	16%	23	3	4	4.5	0.3	2	3	2.9	0.1	1.8	12.6	5	1.8	2.0	0.2	McHenry	MdC2	MdC2	64
53	7.0	McHenry	MdC2	9%	51	5	7	5.1	2.0	5	7	5.2	2.0	-0.1	-0.7	5	2.5	2.6	0.1	McHenry	MdC2	MdC2	62
54	7.0	Mchenry	MdC2	9%	67	3	3	2.6	0.3	3	3	2.1	0.3	0.5	3.5	5	3.2	2.9	-0.3	Mchenry	MdC2	MdC2	64
55	7.0	Dresden	DsB	16%	67	3	10	9.3	0.6	1	3	2.8	0.5	6.6	46.2	3	3.4	1.4	-2.0	Dresden	DrD2	DrD2	64
56	7.0	Mchenry	MdD2	16%	33	3	5	4.8	0.1	2	3	3.4	0.1	1.4	9.8	5	2.9	2.2	-0.7	Mchenry	MdD2	MdD2	64
57	7.3	Dodge	DnC2	16%	11	3	6	5.6	0.1	2	2	2.2	0.1	3.4	24.8	5	3.7	2.4	-1.3	Kidder	KdD2	KdD2	64
58	7.4	Ringwood	RnC2	9%	96	10	15	14.0	1.0	8	10	8.6	1.0	5.4	40.0	5	5.8	4.9	-0.9	Ringwood	RnC2	RnC2	63
59	7.5	Plano	PnC2	16%	78	5.0	5.0	4.8	0.7	4.0	2.0	1.5	0.5	3.5	26.3	5	4.8	4.0	-0.8	Kidder	KdD2	KdD2	64
60	7.5	Houghton	Ho	1%	61	1	2	0.3	1.7	1	2	0.2	1.4	0.4	3.0	2	0.1	0.1	0.0	Houghton	Ho	Ho	64

Table 10 cont. Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1	2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops					
2	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
61	7.5	Batavia	BbB	4%	105	3	5	4.4	0.6	3	4	3.4	0.8	0.8	6.0	4	2.6	2.4	-0.2	Batavia	BbB	BbB	63
62	7.6	Kidder	KdC2	9%	39	2	3	2.2	0.7	2	3	2.1	0.7	0.1	0.8	5	1.1	0.9	-0.2	Kidder	KdC2	KdC2	64
63	7.7	Kidder	KdC2	9%	47	1	1	0.2	0.3	1	1	0.2	0.3	0.0	0.0	5	0.4	0.4	0.0	Kidder	KdC2	KdC2	64
64	7.7	Dresden	DsC2	9%	81	5.0	6.0	5.6	0.7	4.0	4.0	3.2	0.5	2.6	20.0	3	4.0	3.2	-0.8	Dresden	DsC2	DsC2	64
65	7.9	Griswold	GwD2	16%	27	1	1	0.6	0.0	1	1	0.6	0.0	0.0	0.0	4	0.9	0.9	0.0	Griswold	GwD2	GwD2	64
66	7.9	Kidder	KdD2	16%	60	6	8	6.9	1.4	5	6	4.3	1.2	2.8	22.1	5	3.8	3.5	-0.3	Kidder	KdD2	KdD2	64
67	8.0	Whalan	WxC2	9%	41	4	4	4.0	0.5	4	4	3.6	0.5	0.4	3.2	2	3.5	3.3	-0.2	Whalan	WxC2	WxC2	64
68	8.0	Ringwood	RnC2	9%	75	5	13	10.1	2.5	4	7	5.0	2.2	5.4	43.2	5	2.4	2.0	-0.4	Ringwood	RnC2	RnC2	64
69	8.0	Sable	SaA	1%	197	6	7	2.9	3.9	5	4	1.3	3.0	2.5	20.0	5	1.0	0.9	-0.1	Sable	SaA	SaA	63
70	8.0	Kidder	KrE2	16%	51	6	5	4.7	0.2	6	5	4.7	0.2	0.0	0.0	5	6.0	6.0	0.0	Kidder	KrE2	KrE2	62
71	8.0	Plano	PoA	9%	63	2	5	3.9	1	2	5	3.8	0.8	0.3	2.4	5	2.7	2.6	-0.1	Dodge	DnC2	DnC2	63
72	8.0	Ringwood	RnB	4%	107	2	3	2.8	0.5	2	3	2.1	0.8	0.4	3.2	5	0.8	0.7	-0.1	Ringwood	RnB	RnB	64
73	8.1	Griswold	GwD2	16%	21	1	1	0.6	0.0	1	1	0.6	0.0	0.0	0.0	4	0.6	0.6	0.0	Griswold	GwD2	GwD2	64
74	8.2	Dodge	DnC2	8%	136	4	2	1.0	0.8	4	2	0.9	1.0	-0.1	-0.8	5	2.3	2.3	0.0	Dodge	DnC2	DnC2	64
75	8.2	Dodge	DnB	4%	40	2	2	1.6	0.2	2	1	1.1	0.2	0.5	4.1	5	1.7	1.6	-0.1	Dodge	DnB	DnB	64
76	8.3	Dodge	DnB	9%	25	1	1	0.6	0.1	1	1	0.5	0.1	0.1	0.8	5	0.6	0.6	0.0	Dodge	DnC2	DnC2	64
77	8.4	Whalan	WxD2	16%	90	4	9	6.9	1.6	4	5	3.6	1.4	3.5	29.4	2	2.1	2.0	-0.1	Whalan	WxD2	WxD2	64
78	8.4	St Charles	ScB	4%	13	3	2	2.2	0.1	3	1	1.0	0.1	1.2	10.1	5	2.7	2.3	-0.4	St Charles	ScB	ScB	64
79	8.5	Troxel	TrB	2%	90	4	3	2.4	0.6	3	2	1.1	0.4	1.5	12.8	5	2.6	2.2	-0.4	Troxel	TrB	TrB	62
80	8.6	Dodge	DnB	4%	21	0	1	1.6	0.1	1	1	1.3	0.1	0.3	2.6	5	0.6	0.3	-0.3	Dodge	DnB	DnB	64
81	8.7	Plano	PnB	15%	59	4	4	3.4	0.3	4	4	3.5	0.3	-0.1	-0.9	5	3.9	3.9	0.0	Kidder	KrD2	KrD2	64
82	8.7	Ringwood	RnC2	9%	19	2	2	2.1	0.1	2	2	1.7	0.2	0.3	2.6	5	1.2	1.1	-0.1	Ringwood	RnC2	RnC2	64
83	8.7	Whalan	WxB	4%	33	1	2	1.5	0.3	1	2	1.4	0.2	0.2	1.7	2	2.0	2.0	0.0	Whalan	WxB	WxB	64
84	8.9	Kidder	KrD2	15%	66	12	9	7.5	1.2	8	6	4.3	1.3	3.1	27.6	5	7.0	5.0	-2.0	Kidder	KrD2	KrD2	62
85	9.0	St Charles	ScB	4%	128	1	1	0.3	0.6	1	1	0.1	0.5	0.3	2.7	5	0.4	0.3	-0.1	St Charles	ScB	ScB	66
86	9.0	Mchenry	MdD2	16%	48	4	8	8.2	0.3	3	8	8.0	0.3	0.2	1.8	5	3.0	2.8	-0.2	Mchenry	MdD2	MdD2	62
87	9.1	Griswold	GwC	9%	67	5	12	11.5	0.4	5	12	11.5	0.4	0.0	0.0	5	5.1	5.1	0.0	Plano	PnC2	PnC2	64
88	9.1	Dresden	DsB	2%	83	1	1	0.4	1.0	1	1	0.3	0.8	0.3	2.7	3	2.0	1.9	-0.1	Dresden	DsB	DsB	64
89	9.2	Ringwood	RnC2	9%	61	4	11	10.4	0.4	3	4	4.0	0.3	6.5	59.8	5	3.0	2.1	-0.9	Ringwood	RnC2	9%	64
90	9.5	Ringwood	RnB	4%	104	3	2	1.4	0.7	3	2	1.1	0.7	0.3	2.9	5	6.0	5.8	-0.2	Plano	PnB	PnB	64
91	9.5	Mchenry	MdD2	16%	36	3	7	6.4	0.3	2	2	2.1	0.3	4.3	40.9	5	2.1	1.5	-0.6	Mchenry	MdD2	MdD2	62
92	9.6	Whalan	WxD2	16%	25	2	5	3.6	1.0	1	1	0.3	0.7	3.6	34.6	2	1.6	0.7	-0.9	Whalan	WxD2	WxD2	64
93	9.7	Dodge	DnB	9%	21	1	1	0.6	0.1	1	1	0.5	0.1	0.1	1.0	5	1.0	0.9	-0.1	Kidder	KdD2	KdD2	64
94	9.8	Plano	PoB	4%	170	7	11	9.2	1.6	7	10	8.5	1.8	0.5	4.9	4	3.3	3.0	-0.3	Plano	PoB	PoB	64
95	9.8	Troxel	TrB	9%	108	4.0	9.0	8.7	0.3	3.0	3.0	2.9	0.2	5.9	57.8	5	3.2	2.1	-1.1	Ringwood	RnC2	RnC2	64
96	9.8	Plano	PnC2	12%	68	2	2	1.4	0.4	2	2	1.3	0.3	0.2	2.0	5	2.1	2.1	0.0	Kidder	KrD2	KrD2	64
97	9.9	Plano	PnB	4%	56	6	5	4.7	0.5	5	2	2.0	0.3	2.9	28.7	5	4.3	3.8	-0.5	Plano	PnB	PnB	64
98	9.9	Dodge	DnB	9%	33	4	9	7.6	1.0	3	5	4.0	1.0	3.6	35.6	5	3.3	2.7	-0.6	Mchenry	MdC2	MdC2	64
99	10.0	Dodge	DnC2	9%	48	5	7	5.4	1.4	5	5	4.1	0.4	2.3	23.0	5	1.8	2.3	0.5	Dodge	DnC2	DnC2	62
100	10.0	Kidder	KdC2	9%	120	1	1	0.1	0.4	1	0	0.1	0.4	0.0	0.0	5	0.1	0.1	0.0	Kidder	KdC2	KdC2	66
101	10.0	Plano	PlA	4%	17	2	3	2.4	0.2	2	3	2.5	0.2	-0.1	-1.0	5	1.9	1.9	0.0	Kidder	KdB	KdB	69
102	10.0	Plano	PnB	2%	92	4	4	3.5	0.9	4	2	1.6	0.7	2.1	21.0	5	2.1	1.8	-0.3	Plano	PnB	PnB	64
103	10.0	Whalan	WxD2	8%	46	3	6	5.6	0.3	2	2	2.0	0.2	3.7	37.0	2	2.0	1.5	-0.5	Whalan	WxD2	WxD2	64
104	10.0	Dodge	DnC2	8%	123	9	20	17.7	1.9	7	9	7.5	1.5	10.6	106.0	5	4.6	3.5	-1.1	Dodge	DnC2	DnC2	64
105	10.1	Ringwood	RnC2	9%	74	3	6	5.4	0.3	3	3	1.9	0.2	3.6	36.4	5	2.0	1.4	-0.6	Ringwood	RnC2	9%	64
106	10.2	Batavia	BbB	4%	97	6	5	4.6	0.7	5	3	2.5	0.4	2.4	24.5	4	5.4	4.5	-0.9	Batavia	BbB	BbB	62
107	10.3	Kidder	KrD2	15%	58	10	9	8.5	0.9	8	9	7.7	0.9	0.8	8.2	5	6.3	5.1	-1.2	Kidder	KrD2	KrD2	62
108	10.3	Dodge	DnC2	9%	20	3	2	1.9	0.3	3	2	1.4	0.3	0.5	5.2	5	1.8	1.6	-0.2	Dodge	DnC2	DnC2	64
109	10.3	Plano	PnB	16%	106	3.0	6.0	5.5	0.3	3.0	5.0	5.2	0.3	0.3	3.1	5	3.0	2.8	-0.2	St Charles	ScD2	ScD2	64
110	10.4	Plano	PoA	1%	133	4	6	4.1	2.2	4	5	3.0	2.2	1.1	11.4	4	1.6	1.5	-0.1	Plano	PoA	PoA	63
111	10.5	Dodge	DnB	4%	33	6	7	6.0	1.5	5	4	2.9	1.3	3.3	34.7	5	5.9	5.3	-0.6	Dodge	DnB	DnB	64
112	10.6	Dodge	DnC2	9%	78	3	5	4.3	1.0	3	4	2.5	1.2	1.6	17.0	5	2.0	1.7	-0.3	Dodge	DnC2	DnC2	64
113	10.6	Mchenry	MdC2	9%	12	1	1	1	0.2	1	1	0.9	0.2	0.1	1.1	5	0.9	0.8	-0.1	Mchenry	MdC2	MdC2	64
114	10.7	Dresden	DsC2	8%	46	4	3	2.4	0.7	4	3	2.2	0.7	0.2	2.1	3	3.0	2.9	-0.1	Dresden	DsC2	DsC2	64
115	10.9	Plano	PnB	8%	52	2	3	2.8	0.3	2	3	2.8	0.3	0.0	0.0	5	2.2	2.2	0.0	Griswold	GwC	GwC	64
116	10.9	Wacousta	Wa	4%	255	11	12	9.3	2.4	11	9	7.2	2.2	2.3	25.1	3	3.4	4.2	0.8	Dresden	DsB	DsB	62
117	11.0	Ringwood	RnC2	9%	96	4.0	10.0	9.4	0.4	3.0	5.0	4.5	0.3	5.0	55.0	5	3.9	3.0	-0.9	Ringwood	RnC2	RnC2	64
118	11.0	Kidder	KdD2	16%	52	3.0	3.0	2.9	0.5	3.0	3.0	2.9	0.5	0.0	0.0	2	2.5	2.5	0.0	Whalan	WxD2	WxD2	64

Table 10 cont. Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1	2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops					
2	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
119	11.0	Mchenry	MdD2	9%	32	2	2	1.8	0.1	2	3	2.8	0.2	-1.1	-12.1	5	3.2	3.2	0.0	Mchenry	MdD2	MdD2	62
120	11.0	Mchenry	MdD2	16%	35	5	10	9.1	0.6	3	2	1.2	0.6	7.9	86.9	5	3.3	2.3	-1.0	Mchenry	MdD2	MdD2	64
121	11.2	Plano	PnC2	15%	37	1.0	3.0	2.1	0.4	1.0	3.0	2.2	0.4	-0.1	-1.1	4	1.0	1.0	0.0	Griswold	GwD2	GwD2	64
122	11.5	Griswold	GwD2	15%	53	2.0	3.0	2.2	0.5	3.0	3.0	2.3	0.4	0.0	0.0	4	1.9	0.9	-1.0	Griswold	GwD2	GwD2	64
123	11.7	Mchenry	MdD2	16%	113	2	6	5.9	0.5	2	3	2.9	0.5	3.0	35.1	5	1.9	1.3	-0.6	Mchenry	MdD2	MdD2	64
124	11.8	Ringwood	RnB	4%	51	2	1	0.8	0.4	2	1	0.7	0.4	0.1	1.2	5	1.2	1.2	0.0	Ringwood	RnB	RnB	64
125	11.8	St Charles	ScB	4%	78	3	4	3.9	0.6	2	2	1.7	0.6	2.2	26.0	5	1.9	1.2	-0.7	St Charles	ScB	ScB	64
126	12.0	Plano	PnC2	25%	79	2	2	1.2	0.9	2	3	1.8	1.1	-0.8	-9.6	2	2.6	2.7	0.1	Whalan	WxE2	WxE2	63
127	12.0	Griswold	GwC	16%	26	3	6	5.9	0.2	3	6	5.8	0.1	0.2	2.4	5	2.5	2.4	-0.1	Mchenry	MdD2	MdD2	64
128	12.1	Plano	PnB	4%	77	2	3	2.4	0.3	3	3	2.9	0.5	-0.7	-8.5	5	1.2	1.4	0.2	Ringwood	RnC2	RnC2	64
129	12.3	Dodge	DnC2	9%	47	3	4	3.5	0.2	2	1	1.2	0.3	2.2	27.1	5	2.2	1.8	-0.4	Dodge	DnC2	DnC2	64
130	12.5	Plano	PnB	15%	39	3	4	2.6	1.3	3	2	1.8	0.6	1.5	18.8	4	1.7	1.7	0.0	Griswold	GwD2	GwD2	64
131	12.7	Troxel	TrB	2%	96	5	7	4.7	1.9	5	6	3.9	1.9	0.8	10.2	5	1.4	1.2	-0.2	Troxel	TrB	TrB	62
132	12.7	Mchenry	MdD2	16%	87	5	10	9.4	0.4	5	7	6.5	0.5	2.8	35.6	5	5.9	5.3	-0.6	Mchenry	MdD2	MdD2	63
133	12.7	Kidder	KrE2	16%	76	5	10	9.1	0.6	5	10	9.1	0.6	0.0	0.0	5	5.0	5.0	0.0	Kidder	KrE2	KrE2	62
134	12.7	Dodge	DnC2	4%	71	4	12	11.4	1	4	12	11.1	1	0.3	3.8	5	2.2	2.1	-0.1	Dodge	DnB	DnB	63
135	12.8	Ringwood	RnB	4%	97	2	1	0.8	0.4	2	1	0.4	0.6	0.2	2.6	5	0.8	0.9	0.1	Ringwood	RnB	RnB	64
136	12.9	Dresden	DsC2	9%	82	5	11	10.8	0.5	3	5	4.0	0.9	6.4	82.6	3	4.4	2.5	-1.9	Dresden	DsC2	DsC2	64
137	13.0	Dodge	DnC2	16%	27	9	24	23.3	0.8	6	13	12.8	0.6	10.7	139.1	5	7.6	5.7	-1.9	Mchenry	MdD2	MdD2	62
138	13.1	Kidder	KdD2	7%	41	1	1	0.6	0.1	1	1	0.6	0.1	0.0	0.0	5	0.9	0.9	0.0	Kidder	KdD2	KdD2	62
139	13.2	Whalan	WxC2	9%	16	2	2	1.8	0.4	2	0	0.1	0.1	2.0	26.4	2	2.2	1.7	-0.5	Whalan	WxC2	WxC2	64
140	13.5	Ringwood	RnC2	9%	71	4.0	5.0	4.1	0.5	4.0	5.0	4.1	0.5	0.0	0.0	5	3.4	3.5	0.1	Ringwood	RnC2	RnC2	64
141	13.6	Dodge	DnC2	9%	47	8	13	12.5	0.5	6	5	4.5	0.6	7.9	107.4	5	4.3	3.2	-1.1	Dodge	DnC2	DnC2	64
142	13.6	Mchenry	MdD2	9%	59	3	3	3.2	0.2	3	3	3.2	0.2	0.0	0.0	5	4.7	4.7	0.0	Mchenry	MdD2	MdD2	62
143	13.7	Griswold	GwB	4%	41	1	2	1.7	0.2	1	1	1.3	0.2	0.4	5.5	5	1.5	1.3	-0.2	Plano	PnB	PnB	64
144	13.8	Mchenry	MdC2	8%	36	4	3	3.1	0.3	4	3	3.0	0.3	0.1	1.4	5	8.0	8.0	0.0	Mchenry	MdC2	MdC2	62
145	14.0	Kidder	KdC2	9%	25	4	3	1.8	0.8	4	2	1.6	0.8	0.2	2.8	5	3.3	3.3	0.0	Kidder	KdC2	KdC2	64
146	14.0	Virgil	VrB	4%	30	2	2	1.2	0.3	1	1	0.3	0.3	0.9	12.6	5	1.6	1.2	-0.4	Virgil	VrB	VrB	66
147	14.0	Kidder	KdC2	9%	91	1	1	0.3	0.3	0	0	0.1	0.3	0.2	2.8	5	0.5	0.2	-0.3	Kidder	KdC2	KdC2	66
148	14.0	Plano	PnC2	9%	82	5	8	7.6	0.9	4	3	2.6	0.6	5.3	74.2	5	3.4	2.8	-0.6	Plano	PnC2	PnC2	64
149	14.0	Elburn	EfB	3%	69	6	4	3.6	0.7	6	2	1.6	0.6	2.1	29.4	5	3.2	2.9	-0.3	Elburn	EfB	EfB	64
150	14.0	Griswold	GwB	15%	64	2	3	2.7	0.6	2	3	2.7	0.6	0.0	0.0	4	1.4	1.4	0.0	Griswold	GwD2	GwD2	64
151	14.1	Plano	PnB	9%	52	1	2	1.3	0.3	1	2	1.2	0.3	0.1	1.4	5	0.8	0.9	0.1	Ringwood	RnC2	RnC2	64
152	14.3	Grays	GsB	4%	93	6	7	6.1	0.8	6	5	4.2	0.7	2.0	28.6	5	2.4	2.2	-0.2	Grays	GsB	GsB	64
153	14.4	Mchenry	MdC2	9%	27	4	4	3.6	0.1	4	2	2.3	0.1	1.3	18.7	5	4.0	3.7	-0.3	Mchenry	MdC2	MdC2	64
154	14.5	Ringwood	RnC2	9%	132	8	15	14.4	0.6	8	14	13.0	0.9	1.1	16.0	5	7.0	6.3	-0.7	Plano	PnC2	PnC2	64
155	14.6	Dresden	DsC2	9%	74	4	9	8.2	0.6	2	2	1.7	0.7	6.4	93.4	3	2.4	1.7	-0.7	Dresden	DsC2	DsC2	64
156	14.8	St Charles	ScB	4%	11	2	3	3.0	0.1	2	3	2.6	0.1	0.4	5.9	5	1.9	1.8	-0.1	St Charles	ScB	ScB	64
157	14.9	Ringwood	RnC2	9%	58	4.0	10.0	10.0	0.2	4.0	10.0	9.5	0.2	0.5	7.5	5	4.0	3.9	-0.1	Ringwood	RnC2	RnC2	64
158	15.0	Plano	PnC2	14%	53	3	2	2.1	0.4	3	2	1.8	0.4	0.3	4.5	3	2.9	2.5	-0.4	Military	MhD2	MhD2	62
159	15.0	Sebewa	Se	1%	47	3	2	0.9	0.8	3	1	0.8	0.7	0.2	3.0	3	1.9	1.9	0.0	Sebewa	Se	Se	69
160	15.0	Mchenry	MdD2	14%	50	2	2	2.0	0.4	2	2	1.9	0.4	0.1	1.5	5	1.8	1.8	0.0	Mchenry	MdD2	MdD2	64
161	15.2	Kidder	KdC2	9%	52	1	1	0.4	0.2	1	1	0.3	0.2	0.1	1.5	5	1.2	1.2	0.0	Kidder	KdC2	KdC2	62
162	15.5	Kidder	KdC2	8%	109	5	6	5.0	0.8	3	3	2.4	0.5	2.9	45.0	5	5.6	4.7	-0.9	Kidder	KdC2	KdC2	62
163	15.8	Ringwood	RnC2	9%	116	5	5	4.5	0.9	4	4	3.3	0.9	1.2	19.0	5	3.0	2.8	-0.2	Ringwood	RnC2	RnC2	64
164	15.9	McHenry	MdC2	16%	20	2	3	3.2	0.1	2	3	2.7	0	0.6	9.5	5	1.2	1.4	0.2	McHenry	MdC2	MdC2	64
165	16.0	Griswold	GwC	8%	58	2	3	2.7	0.4	2	3	2.2	0.5	0.4	6.4	5	2.2	2.0	-0.2	Griswold	GwC	GwC	64
166	16.0	Elburn	EoA	2%	64	1	1	0.5	0.8	2	1	0.5	0.8	0.0	0.0	5	0.6	0.6	0.0	Elburn	EoA	EoA	69
167	16.0	Dresden	DrD2	9%	70	4	7	6.4	0.6	4	3	2.8	0.4	3.8	60.8	3	3.6	3.1	-0.5	Dresden	DrD2	DrD2	62
168	16.1	Radford	RaA	2%	69	3	4	2.4	1.7	3	3	1.3	1.3	1.5	24.2	5	1.8	1.6	-0.2	Radford	RaA	RaA	64
169	16.2	Wacousta	Wa	4%	148	6.0	7.0	3.9	2.7	6.0	6.0	3.6	2.7	0.3	4.9	3	2.8	2.4	-0.4	Dresden	DsB	DsB	62
170	16.3	Kidder	KdD2	16%	133	2	2	1.0	1.4	2	2	0.8	1.1	0.5	8.2	5	2.6	2.7	0.1	Kidder	KdD2	KdD2	64
171	16.3	Ringwood	RnC2	9%	142	9	18	16.5	1.4	8	12	10.2	1.4	6.3	102.7	5	5.3	4.5	-0.8	Ringwood	RnC2	RnC2	64
172	16.4	Troxel	TrB	16%	151	11.0	16.0	14.7	1.2	7.0	8.0	6.9	1.0	8.0	131.2	3	2.9	2.0	-0.9	Dresden	DrD2	DrD2	64
173	16.4	Dodge	DnB	9%	17	1	1	0.6	0.1	1	1	0.5	0.1	0.1	1.6	5	0.9	0.9	0.0	Mchenry	MdC2	MdC2	64
174	16.7	Plano	PnB	9%	165	3	4	2	1.9	3	4	1.6	2	0.3	5.0	5	1.1	1.0	-0.1	Griswold	GwC	GwC	63
175	16.7	Whalan	WxC2	9%	40	1	3	2.2	0.4	1	2	1.3	0.4	0.9	15.0	2	1.9	1.3	-0.6	Whalan	WxC2	WxC2	64
176	17.1	Dodge	DnC2	28%	98	6.0	17.0	16.0	0.9	5.0	7.0	6.5	0.6	9.8	167.6	5	5.7	4.3	-1.4	Kidder	KrE2	KrE2	64

Table 10 cont. Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1	2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops					
2	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
177	17.3	Griswold	GwC	8%	29	1	1	0.5	0.7	1	1	0.5	0.7	0.0	0.0	5	0.6	0.7	0.1	Griswold	GwC	GwC	64
178	18.0	Griswold	GwB	16%	19	5	4	4.1	0.1	5	4	3.6	0.1	0.5	9.0	1	4.8	4.7	-0.1	Edmund	EdD2	EdD2	64
179	18.0	Ringwood	RnB2	4%	33	5	15	14.2	0.6	4	5	4.4	0.3	10.1	181.8	5	5.2	5.0	-0.2	Ringwood	RnB2	RnB2	69
180	18.0	Dodge	DnB	9%	71	9	7	4.5	2.7	9	7	4.1	2.6	0.5	9.0	5	5.7	5.5	-0.2	Mchenry	MdC2	MdC2	62
181	18.3	Dodge	DnB	4%	44	3	2	1.8	0.7	3	2	1.7	0.6	0.2	3.7	5	1.6	1.6	0.0	Dodge	DnB	DnB	64
182	18.4	Kegonsa	KeB	16%	60	5	11	10.2	0.5	4	5	4.5	0.3	5.9	108.6	3	5.4	4.1	-1.3	Dresden	DrD2	DrD2	64
183	18.4	Seaton	SmB	12%	42	3	5	4.4	0.4	3	5	4.3	0.4	0.1	1.8	5	2.6	2.6	0.0	Kidder	KdD2	KdD2	64
184	19.0	Ringwood	RnB	4%	44	1	2	1.6	0.6	1	1	1	0.2	1.0	19.0	5	0.7	0.6	-0.1	Ringwood	RnB	RnB	64
185	19.2	Batavia	BbB	9%	89	4	3	2.9	0.4	2	1	0.6	0.7	2.0	38.4	3	2.4	1.3	-1.1	Dresden	DsC2	DsC2	63
186	19.2	St Charles	ScB	4%	15	3	2	1.4	0.1	3	1	1.3	0.1	0.1	1.9	4	3.2	2.9	-0.3	Plano	PoB	PoB	64
187	19.2	Plano	PoB	4%	54	2	2	1.5	0.2	1	1	1.1	0.3	0.3	5.8	5	1.4	1.2	-0.2	Dodge	DnB	DnB	64
188	19.5	Ringwood	RnC2	15%	50	7	7	6.9	0.4	4	2	1.9	0.4	5.0	97.5	5	5.5	3.1	-2.4	Kidder	KrD2	KrD2	63
189	19.6	Kegonsa	KeB	9%	98	5	6	6.1	0.4	4	6	5.8	0.4	0.3	5.9	3	2.8	2.1	-0.7	Dresden	DsC2	DsC2	63
190	19.9	Batavia	BbB	2%	173	7	6	4.3	1.3	6	5	3.0	1.6	1.0	19.9	4	2.5	2.2	-0.3	Batavia	BbB	BbB	63
191	20.0	Plano	PnB	4%	96	2	1	1.0	0.4	2	1	0.9	0.4	0.1	2.0	5	0.7	0.6	-0.1	Plano	PnB	PnB	64
192	20.0	Plano	PnA	9%	46	1	2	1.5	0.2	1	2	1.3	0.2	0.2	4.0	5	1.3	1.2	-0.1	Ringwood	RnC2	RnC2	64
193	20.0	Plano	PoB	4%	57	4	4	3.2	0.5	4	4	3.2	0.5	0.0	0.0	4	3.5	3.3	-0.2	Plano	PoB	PoB	64
194	20.0	Ringwood	RnB	4%	50	4	6	5.0	0.5	3	5	4.8	0.5	0.2	4.0	5	3.3	2.6	-0.7	Plano	PnB	PnB	64
195	20.0	Elburn	EgA	9%	58	7	9	6.2	2.8	6	6	3.6	2.7	2.7	54.0	3	3.7	3.4	-0.3	Warsaw	WrC2	WrC2	64
196	20.0	Batavia	BbB	9%	130	6	9	7.8	0.8	5	5	3.9	0.6	4.1	82.0	3	3.2	2.6	-0.6	Dresden	DsC2	DsC2	64
197	20.0	Mchenry	MdC2	9%	91	1	0	0.1	0.3	1	0	0.1	0.3	0.0	0.0	5	0.1	0.1	0.0	Mchenry	MdC2	MdC2	65
198	20.0	St Charles	ScB	3%	49	3	2	1.3	0.2	3	2	1.3	0.2	0.0	0.0	5	3.1	3.1	0.0	St Charles	ScB	ScB	62
199	20.0	Mchenry	MdC2	9%	27	3	4	3.9	0.4	3	4	3.6	0.5	0.2	4.0	5	3.0	2.5	-0.5	Mchenry	MdC2	MdC2	62
200	20.0	Mchenry	MdC2	9%	20	4	5	4.4	0.2	3	4	3.7	0.2	0.7	14.0	5	4.8	4.5	-0.3	Mchenry	MdC2	MdC2	64
201	20.3	Plano	PoA	4%	60	5	5	4.0	0.5	5	4	3.2	0.5	0.8	16.2	4	5.2	4.8	-0.4	Plano	PoB	PoB	64
202	20.6	Wacousta	Wa	1%	94	3	3	0.9	2.2	2	2	0.4	1.8	0.9	18.5	5	1.0	0.9	-0.1	Wacousta	Wa	Wa	64
203	20.9	Warsaw	WrC2	4%	45	1.0	2.0	1.3	0.3	1.0	1.0	1.8	0.3	-0.5	-10.5	1	1.1	1.3	0.2	Edmund	EdB2	EdB2	64
204	21.0	St Charles	SbC2	9%	14	4	8	7.6	0.1	2	1	1.0	0.1	6.6	138.6	4	3.8	2.5	-1.3	St Charles	SbB	SbB	69
205	21.0	Plano	PnB	8%	85	2	3	2.3	0.6	2	2	1.6	0.8	0.5	10.5	5	0.8	0.7	-0.1	Griswold	GwC	GwC	64
206	21.1	Dresden	DsC2	8%	106	3	8	7.3	1.1	2	6	5.4	1.0	2.0	42.2	3	1.3	1.1	-0.2	Dresden	DsC2	DsC2	64
207	21.2	St Charles	ScB	9%	39	2	4	4	0.2	2	4	4.1	0.2	-0.1	-2.1	2	2.8	2.9	0.1	Whalan	WxC2	WxC2	64
208	21.3	Griswold	GwB	9%	48	7	7	6.2	0.4	5	6	6.0	0.4	0.2	4.3	3	7.1	5.9	-1.2	Dresden	DsC2	DsC2	64
209	21.3	Dresden	DsC2	9%	20	4	8	7.4	0.5	4	7	6.1	0.7	1.1	23.4	3	2.6	2.4	-0.2	Dresden	DsC2	DsC2	62
210	21.4	Rockton	RoD2	21%	51	3	2	1.8	0.4	3	1	0.9	0.5	0.8	17.1	2	2.7	2.3	-0.4	Rockton	RoD2	RoD2	64
211	22.0	Plano	PoA	4%	76	2	4	4.2	0.3	2	5	4.4	0.3	-0.2	-4.4	4	1.3	1.4	0.1	Batavia	BbB	BbB	64
212	22.0	St Charles	ScB	16%	47	3	8	7.3	0.5	3	7	6.5	0.6	0.7	15.4	5	2.9	2.8	-0.1	Kidder	KdD2	KdD2	62
213	22.1	Ringwood	RnB	4%	61	4.0	5.0	4.0	0.5	4.0	4.0	3.2	0.4	0.9	19.9	5	3.1	3.0	-0.1	Plano	PnB	PnB	64
214	22.2	Plano	PnC2	9%	22	2	1	1.0	0.2	1	1	0.6	0.2	0.4	8.9	5	1.2	1.1	-0.1	Plano	PnC2	PnC2	64
215	22.6	Elburn	EfB	3%	83	2	5	4.1	0.9	2	3	1.8	0.7	2.5	56.5	5	1.3	1.0	-0.3	Elburn	EfB	EfB	64
216	23.0	Rockton	RoC2	9%	37	1	2	1.3	0.2	1	2	1.3	0.2	0.0	0.0	2	1.5	1.6	0.1	Rockton	RoC2	RoC2	64
217	23.5	Kegonsa	KeB	2%	167	2	2	0.8	1.4	2	2	0.5	1.1	0.6	14.1	3	1.6	1.2	-0.4	Kegonsa	KeB	KeB	64
218	23.9	Plano	PnB	9%	45	5	4	4.3	0.2	5	4	4.1	0.2	0.2	4.8	5	4.1	4.0	-0.1	Ringwood	RnC2	RnC2	63
219	24.0	Griswold	GwD2	15%	33	4	7	6.8	0.5	3	3	2.8	0.3	4.2	100.8	4	2.7	2.3	-0.4	Griswold	GwD2	GwD2	62
220	24.0	Ringwood	RnB	9%	42	5	7	6.3	0.4	4	3	2.7	0.3	3.7	88.8	5	4.4	3.5	-0.9	Ringwood	RnC2	RnC2	64
221	24.0	Ringwood	RnB	4%	74	2	3	3	0.4	2	3	2.5	0.6	0.3	7.2	5	0.8	0.7	-0.1	Ringwood	RnB	RnB	64
222	24.4	Plano	PoB	9%	80	3	3	2.4	0.4	2	2	2.0	0.4	0.4	9.8	5	1.8	1.6	-0.2	Plano	PnC2	PnC2	64
223	24.4	Mchenry	MdC2	9%	33	3	4	3.4	0.1	3	2	2.2	0.2	1.1	26.8	5	3.0	2.8	-0.2	Mchenry	MdC2	MdC2	64
224	24.5	Virgil	VrB	4%	163	4.0	5.0	4.7	0.7	4.0	5.0	4.0	1.1	0.3	7.4	4	1.7	1.6	-0.1	Batavia	BbB	BbB	62
225	24.9	Whalan	WxB	9%	23	4	5	4.9	0.2	3	4	3.9	0.2	1.0	24.9	5	4.9	4.5	-0.4	Mchenry	MdC2	MdC2	64
226	26.0	Plano	PnB	4%	77	1	1	0.3	0.5	1	1	0.3	0.5	0.0	0.0	5	0.3	0.3	0.0	Plano	PnB	PnB	64
227	26.5	Plano	PoB	4%	129	8.0	10.0	8.8	0.8	6.0	9.0	8.6	0.8	0.2	5.3	3	4.8	4.1	-0.7	Dresden	DsB	DsB	64
228	27.0	Dodge	DoC2	16%	38	0	0	0.2	0.1	0	0	0.2	0.1	0.0	0.0	5	0.1	0.2	0.1	Kidder	KdD2	KdD2	64
229	27.0	Elburn	EgA	4%	81	3	4	3.3	0.5	2	3	2.5	0.4	0.9	24.3	5	2.3	1.6	-0.7	Plano	PnB	PnB	64
230	27.0	Griswold	GwD2	15%	62	2	4	3.8	0.4	2	3	2.4	0.4	1.4	37.8	4	1.0	0.9	-0.1	Griswold	GwD2	GwD2	64
231	27.2	Mchenry	MdD2	16%	29	5	10	9.8	0.4	4	8	7.2	0.6	2.4	65.3	5	3.8	3.0	-0.8	Mchenry	MdD2	MdD2	62
232	27.2	Troxel	TrB	2%	120	3	2	1.1	1.2	3	2	1.0	1.1	0.2	5.4	5	1.5	1.5	0.0	Troxel	TrB	TrB	64
233	27.3	Plano	PoA	9%	61	5	5	4.5	0.2	4	5	4.4	0.2	0.1	2.7	5	3.7	3.5	-0.2	Mchenry	MdC2	MdC2	63
234	27.3	Roc	RoC2	9%	37	2	2	2.1	0.3	2	2	2.0	0.3	0.1	2.7	1	2.6	2.6	0.0	Dunbarton	1180D2	RoC2	64

Table 10 continued Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	G	H	I	J	L	M	N	O	Q	R	T	U	V	W	Y	Z	AA	AC
1	2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops					
2	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used	Yahara Stream Reach field is located
235	27.5	Dresden	DsC2	9%	113	2	3	1.7	1.0	2	2	0.8	1.1	0.8	22.0	3	4.8	2.9	-1.9	Dresden	DsC2	DsC2	64
236	28.0	Plano	PnB	4%	91	3	5	4.2	0.6	2	1	1.0	0.4	3.4	95.2	5	2.4	1.9	-0.5	Plano	PnB	PnB	64
237	28.0	Plano	PnB	4%	90	3	2	1.8	0.3	2	2	1.3	0.7	0.1	2.8	5	2.6	2.4	-0.2	Plano	PnB	PnB	64
238	28.0	Plano	PnB	4%	64	3	2	1.7	0.2	2	2	1.1	0.4	0.4	11.2	5	2.7	1.4	-1.3	Plano	PnB	PnB	64
239	28.0	Ringwood	RnB2	9%	19	4	6	5.7	0.2	3	3	2.7	0.1	3.1	86.8	5	4.5	3.6	-0.9	Ringwood	RnC2	RnC2	69
240	28.1	Elburn	EgA	9%	78	2	3	1.3	1.9	2	2	0.7	1.2	1.3	36.5	3	4.7	3.9	-0.8	Boyer	BoC2	BoC2	64
241	28.1	Griswold	GwD2	16%	23	2.0	4.0	4.0	0.1	2.0	1.0	0.9	0.1	3.1	87.1	2	1.7	1.8	0.1	Whalan	WxD2	WxD2	64
242	28.8	Kegonsa	KeB	4%	133	10	12	10.4	1.3	6	5	3.9	0.8	7.0	201.6	3	6.3	5.1	-1.2	Kegonsa	KeB	KeB	62
243	29.3	Mchenry	MdD2	6%	29	2	4	3.5	0.3	2	2	1.4	0.3	2.1	61.5	5	1.6	1.3	-0.3	Mchenry	MdD2	MdD2	64
244	29.6	Huntsville	HuB	4%	87	2	5	3.7	1.1	2	2	1.3	0.7	2.8	82.9	5	1.4	1.1	-0.3	Huntsville	HuB	HuB	64
245	29.9	Plano	PnB	16%	76	8.0	11.0	10.2	0.4	7.0	6.0	5.8	0.4	4.4	131.6	5	7.4	6.6	-0.8	Mchenry	MdD2	MdD2	64
246	30.0	Whalan	WxC2	9%	40	2	4	3.2	0.4	2	2	1.8	0.4	1.4	42.0	2	2.5	1.0	-1.5	Whalan	WxC2	WxC2	64
247	30.0	Plano	PnB	8%	64	2	2	1.7	0.7	2	2	1.4	0.6	0.4	12.0	5	1.0	1.0	0.0	Griswold	GwC	GwC	64
248	30.0	Plano	PnB	9%	23	4	12	11.8	0.3	4	11	10.5	0.4	1.2	36.0	5	3.3	3.2	-0.1	Plano	PnC2	PnC2	64
249	30.8	Plano	PoB	4%	140	7	11	9.8	1.4	6	9	8.0	1.2	2.0	61.6	4	3.6	3.3	-0.3	plano	PoB	PoB	63
250	30.9	Ringwood	RnB	15%	62	2	3	1.6	1.0	2	2	1.7	0.3	0.6	18.5	5	1.3	1.3	0.0	Griswold	GwC	GwC	64
251	31.1	Orion Var	Os	1%	77	3	3	2.1	1.4	3	2	1.0	1.1	1.4	43.5	5	1.1	0.9	-0.2	Orion Var	Os	Os	64
252	31.1	Ringwood	RnC2	9%	75	4	5	4.5	0.6	4	2	2.0	0.4	2.7	84.0	5	3.4	3.0	-0.4	Ringwood	RnC2	RnC2	64
253	31.8	Troxel	TrB	2%	145	7	8	5.7	1.9	6	6	4.0	1.6	2.0	63.6	5	3.0	2.8	-0.2	Troxel	TrB	TrB	63
254	32.1	Hayfield	HaA	9%	72	3	2	1.7	0.5	4	4	3.6	0.5	-1.9	-61.0	5	3.2	3.7	0.5	Mchenry	MdC2	MdC2	64
255	33.8	Griswold	GwD2	16%	19	0	0	0.2	0.1	0	0	0.2	0.1	0.0	0.0	4	0.2	0.1	-0.1	Griswold	GwD2	GwD2	64
256	34.0	St Charles	SaB	4%	49	1	2	1.6	0.3	1	2	1.6	0.3	0.0	0.0	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
257	35.1	Griswold	GrC2	8%	15	1	1	0.9	0.5	2	1	0.7	0.5	0.2	7.0	4	0.7	0.8	0.1	Griswold	GrC2	GrC2	64
258	35.6	Plano	PnB	9%	90	4.0	4.0	3.2	0.4	3.0	3.0	2.4	0.7	0.5	17.8	5	2.2	2.1	-0.1	Ringwood	RnC2	RnC2	64
259	36.9	Dresden	DsC2	12%	54	8	12	12.1	0.4	7	6	5.6	0.3	6.6	243.5	3	6.7	5.8	-0.9	Dresden	DsC2	DsC2	62
260	37.0	Plano	PnB	4%	82	3	3	2.8	0.5	3	3	2.2	0.6	0.5	18.5	5	1.8	1.7	-0.1	Plano	PnB	PnB	64
261	38.0	Plano	PnA	9%	68	5	4	3.3	0.8	5	4	3.1	0.9	0.1	3.8	2	3.0	2.8	-0.2	Ripon	ReC2	ReC2	64
262	38.4	Wacousta	Wa	1%	125	2	3	0.3	2.5	2	2	0.2	2.0	0.6	23.0	5	0.9	0.8	-0.1	Wacousta	Wa	Wa	64
263	38.9	St Charles	ScC2	8%	35	2	3	3.1	0.2	2	3	2.9	0.2	0.2	7.8	5	1.5	1.5	0.0	St Charles	ScC2	ScC2	64
264	39.0	Ringwood	RnB	9%	126	4	6	5.4	0.7	4	5	3.8	0.8	1.5	58.5	5	2.8	2.6	-0.2	Ringwood	RnC2	RnC2	63
265	39.1	Dresden	DsC2	9%	118	6	9	8.0	1.2	4	4	3.5	0.9	4.8	187.7	3	4.3	3.3	-1.0	Dresden	DsC2	DsC2	64
266	40.0	Plano	PnB	4%	50	2	1	0.7	0.3	2	1	0.7	0.4	-0.1	-4.0	5	1.2	1.4	0.2	Plano	PnB	PnB	64
267	41.0	Plano	PnB	9%	46	3	4	3.6	0.3	2	3	2.7	0.3	0.9	36.9	5	2.1	1.8	-0.3	Ringwood	RnC2	RnC2	64
268	41.8	Plano	PnB	4%	111	7.0	8.0	6.2	2.2	6.0	4.0	3.0	1.2	4.2	175.6	5	4.4	3.9	-0.5	Plano	PnB	PnB	64
269	44.1	St Charles	ScB	5%	135	5	6	5.2	1.0	3	3	2.5	0.6	3.1	136.7	5	5.8	5.0	-0.8	St Charles	ScB	ScB	62
270	45.3	Dresden	DrD2	16%	25	1	1	0.8	0.3	1	1	0.3	0.3	0.5	22.7	3	0.9	0.5	-0.4	Dresden	DrD2	DrD2	64
271	46.0	Ringwood	RnC2	9%	20	2	1	1.1	0.1	1	1	0.8	0.1	0.3	13.8	5	1.8	1.4	-0.4	Ringwood	RnC2	RnC2	69
272	46.0	St Charles	ScB	9%	50	5	10	8.9	0.8	5	9	7.6	1.0	1.1	50.6	5	3.8	3.6	-0.2	Dodge	DnC2	DnC2	62
273	46.1	Plano	PoA	4%	160	12	18	16.6	1.5	11	15	13.6	1.4	3.1	142.9	4	4.7	4.4	-0.3	Batavia	BbB	BbB	64
274	49.0	Plano	PnB	4%	26	2	3	2.5	0.3	2	2	1.9	0.4	0.5	24.5	5	1.3	1.2	-0.1	Plano	PnB	PnB	64
275	55.0	Plano	PlB	4%	119	2	2	0.9	0.7	2	2	0.8	0.7	0.1	5.5	5	1.4	1.4	0.0	Plano	PlB	PlB	69
276	55.1	Kidder	KdD2	16%	17	2	3	3.1	0.2	2	2	2.1	0.2	1.0	55.1	5	2.6	2.3	-0.3	Kidder	KdD2	KdD2	64
277	57.0	Kidder	KeB2	4%	46	1	2	1.6	0.3	1	2	1.6	0.3	0.0	0.0	5	1.5	1.6	0.1	Kidder	KeB2	KeB2	69
278	60.0	Rockton	RoC2	9%	58	2	1	0.7	0.3	2	1	1	0.4	-0.4	-24.0	2	1.1	1.2	0.1	Rockton	RoC2	RoC2	63
279	63.0	Plano	PnB	9%	62	2	2	1.3	0.4	2	1	0.8	0.4	0.5	31.5	5	1.6	1.2	-0.4	Ringwood	RnC2	RnC2	64
280	65.0	Ringwood	RnC2	9%	39	1	1	1.0	0.1	1	1	0.9	0.1	0.1	6.5	5	1.3	1.1	-0.2	Ringwood	RnC2	RnC2	64
281	67.0	Plano	PnB	4%	26	2	2	1.4	0.2	2	2	1.2	0.2	0.2	13.4	5	1.4	1.3	-0.1	Griswold	GrB2	GrB2	64
282	68.2	Kidder	KeB2	9%	15	2	3	2.6	0.2	1	1	1.2	0.1	1.5	102.3	5	2.6	2.1	-0.5	Kidder	KdC2	KdC2	69
283	72.0	Ringwood	RnB2	8%	44	4	6	5.8	0.4	4	3	2.6	0.3	3.3	237.6	4	3.5	3.4	-0.1	Griswold	GrC2	GrC2	69
284	75.0	St Charles	SaB	9%	32	3	2	2.1	0.2	2	2	1.7	0.2	0.4	30.0	5	3.9	3.3	-0.6	Kidder	KdC2	KdC2	69
285	90.0	Plano	PlA	1%	48	1	0	0.2	0.2	1	0	0.2	0.2	0.0	0.0	5	0.3	0.3	0.0	Plano	PoA	PoA	69
286	99.0	Dresden	DsB	4%	47	1	1	0.3	0.3	1	1	0.2	0.3	0.1	9.9	3	0.7	0.8	0.1	Dresden	DsB	DsB	69
287	109.1	Griswold	GrC2	9%	22	3	3	2.5	0.3	3	2	2.0	0.2	0.6	65.5	4	4.0	3.4	-0.6	Griswold	GrC2	GrC2	69
288	110.0	Batavia	BbA	9%	16	1	1	1.1	0.1	1	1	1.2	0.1	-0.1	-11.0	4	1.4	1.5	0.1	Batavia	BbA	BbC2	69
289	114.0	St Charles	SaB	4%	27	1	2	1.3	0.2	1	1	1.3	0.2	0.0	0.0	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
290	117.0	Plano	PmA	1%	40	1	0	0.3	0.2	1	0	0.3	0.2	0.0	0.0	4	0.4	0.5	0.1	Plano	PmA	PmA	69
291	121.0	Plano	PlA	4%	40	1	1	0.5	0.2	1	1	0.5	0.2	0.0	0.0	5	0.4	0.4	0.0	Plano	PlA	PlA	69
292	153.0	Dresden	DsB	4%	33	1	1	0.8	0.2	1	1	0.7	0.2	0.1	15.3	3	1.2	1.2	0.0	Dresden	DsB	DsB	69

Table 10, on pages 19 – 23 provides the information from each field in the cover crop program. The summary of this data is contained in Table 11 (on the right). As shown in the summary information there were 290 fields in the cover crop program totaling 5,851.4 acres of cropland. The average reduction in the risk of phosphorus delivery was **1.48 pounds per acre**, which is a combination of both the particulate and soluble phosphorus fractions.

As shown in the summary data the minimum change in predicted phosphorus loss was (-1.9 lbs)/acre while the maximum change in predicted phosphorus loss was 10.7 lbs/acre. The next question is how much is particulate verses soluble?

Particulate Average Annual P Change/Acre	Total Phosphorus Reduction	Average Annual P Change/Acre	Total Phosphorus Reduction
1.43	6,865.2	0.05	266.0
Max	10.5	Max	1.0
Min	-1.9	Min	-0.5

Table 12 Changes in Particulate verses soluble phosphorus

As shown in the table 12, the vast majority of reduction came from the reduction in the risk of particulate phosphorus. The summary information (table 11) under column W shows the average change in predicted soil loss (-0.30 tons/acre) and the range of (-1.9) to 0.5. **The average change in soil loss, which is a negative number means that planting cover crops decreased soil loss by 0.30 tons per acre.** The summary data as shows that 30 fields had an increase in soil loss, 53 fields had no change and 207 fields had a predicted reduction in soil loss from the planting of a cover crop. As stated in most of the sections of this report, the greatest potential for reducing phosphorus loss comes on fields that undergo significant soil disturbance, have significant slopes or a combination of both of these factors.

Table 11 Summary of Table 10 Changes in phosphorus loss from planting cover crops

	A	B	C	D	E	F	H	I	J	K	M	N	O	P	R	S	U	V	W	X	Z	AA	AB
1		2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops				
2	Yahara Stream Reach fields is located	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used
295		2016 Phosphorus Report - Cover Crops					Without Cover Crop				With Cover Crop				Pounds			Without Cover Crops	With Cover Crops				
296	Yahara Stream Reach fields is located	Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Change in Soil Loss from Cover Crop tons/acre	Critical Soil used	Soil Symbol	Soil used
297	290	Fields																					
298					Average Soil Test P	66.99									Average Annual P Change/Acre	Total Phosphorus Reduction			Average change in Soil Loss	-0.36	Acres in Stream Reach		
299		5,851.4	Total Acres												1.48	7,130.3					62	618.5	10.57%
300					Maximum	255.0												Greatest increase in soil loss		0.8	63	394.1	6.74%
301					Minimum	11.0									10.7	Maximum		Greatest decrease in soil loss		-2.4	64	3,338.0	57.05%
302															-1.9	Minimum					65	20.0	0.34%
303																		# Fields increasing soil loss		30	66	47.0	0.80%
304																		# Fields with no change		53	69	1,433.8	24.50%
305																		# Fields decreasing soil loss		207	Total	5,851.4	

Table 13 Soil Test Phosphorus Levels at different changes in P Loss

Change in P	Ave Soil Test P	Max Soil Test P	Min Soil Test P	Percentage of total acres
< 0	59.9	136	16	6.8%
0	51.1	120	19	15.4%
0.1 – 1.0	65.0	173	11	46.1%
1.1 – 2.0	70.7	163	13	10.9%
2.1 – 3.0	88.4	255	29	5.5%
3.1 – 4.0	58.4	160	11	6.5%
4.1 – 5.0	90.1	161	33	2.9%
5.1 – 6.0	84.2	108	60	1.5%
6.1 – 7.0	78.6	142	14	2.1%
7.1 – 8.0	77.7	151	35	0.9%
8.1 – 9.0	81.0	81	81	0.3%
9.1 – 10.0	98.0	98	98	0.3%
> 10	62.3	123	27	0.8%
				100.0%

How much influence do soil test phosphorus levels have on predicted phosphorus losses? The first column in table 13 shows the predicted change in phosphorus loss when comparing a field with and without a cover crop. The second column is the average soil test P_2O_5, followed by the maximum and minimum soil test levels from fields with similar phosphorus reductions. The final column in the table shows the percentage of the total acres in cover crops in each of the categories.

The data in table 13 shows that 22.2% of all the cropland planted to cover crops had either a negative or no reduction (first two lines) in phosphorus loss. This means that 77.8% of the fields planted to cover crops had reductions in phosphorus loss, with reductions predicted to be between 0.1 – > 10.0 lbs/acre. Fields with reductions between 0.1 – 1.0 had slightly higher average soil test P levels than those with negative or no reduction, and were the majority of the fields.

There were not a significant number of fields with greater that 4-pound reductions in phosphorus loss (about 8.8% of the total acres in the program) so care should be taken in evaluating the influence of soil test P because of the limited number of fields. Two of the categories (8.1 – 9 and 9.1 10) had only one field each. Comparing this data to the reductions in particulate verses soluble phosphorous, it appears that tillage and slope play larger roles in predicting phosphorus delivery.

Looking at the data based on phosphorus reduction for each reach of stream is in table 14 (below).

Stream Reach	Acres	Percentage of Acres	Total Phosphorus Reduction
62	618.5	10.57	1,296.5 pounds
63	394.1	6.74	471.0 pounds
64	3,338.0	57.05	4,447.4 pounds
65	20.0	0.34	0 pounds
66	47.0	0.80	18.1 pounds
69	1,433.8	24.5	897.3 pounds

Table 14 Phosphorus reductions by stream reach

4. Headland Stacking Manure

Based on data collected at the Discovery Farms and Pioneer Farms, winter runoff events that occur as a combination of increased temperatures and rainfall, along with frozen soils and deep snow cover, produces a high potential for surface runoff from fields. Livestock producers who make manure applications to cropland during this high-risk period need to understand that spreading manure during snowmelt does have an extremely high risk of runoff. Studies from farms cooperating in the Discovery Farm Program indicate that manure applied to snow covered and/or frozen soils during conditions of snowmelt or rain on frozen soils **can contribute the majority of the annual nutrient losses. One inappropriately timed manure application can generate large losses of phosphorus to surface waters.**

Yahara Pride Farms decided to provide an incentive to farmers who sometimes have to clean out lots with solid manure during this critical runoff period. The goals of this program were to reduce the risk of manure run off by:

- Offering an incentive to farmers for stacking, reloading and spreading manure during a low risk runoff period.
- The incentive payment is offered to help offset the cost of double handling manure.

Calculating the predicted reductions in phosphorus loss from headland stacking during critical runoff periods can be accomplished using the SNAP+ program by comparing the risk of a manure application in the winter (surface applied) and in the spring (incorporated). The predicted reductions in phosphorus loss are shown in table 15.

There was one farm that cooperated in the headland-stacking program in 2016. This farm stacked about 500 tons of solid dairy manure on a site approved for stacking. If the manure had been applied to cropland during the critical runoff period, the application would have covered about 50 acres.

Table 15 Change in phosphorus loss from headland stacking solid dairy manure

					Winter Spreading				Headland Stacking				Pounds	
Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble P	Rotat. PI	Annual PI	Part. PI	Soluble P	Annual P change per acre	Annual P change for field
13.6	Dodge	DnC2	9%	47	6	3	0.6	2.8	6	1	0.5	0.8	2.1	28.6
22.2	Plano	PnC2	9%	22	2	3	0.2	2.3	1	0	0.1	0.3	2.1	46.6
14.6	Dresden	DsC2	9%	74	3	4	1.6	2.5	2	2	1.4	0.5	2.2	32.1
3	**Fields**													
													Average Annual P Change/Acre	**Total Phosphorus Reduction**
50.4	**Total Acres**												**2.13**	**107.3**

As shown in table 15, stacking manure during the critical runoff period reduced the loss of phosphorus by 2.13 pounds per acre. Headland stacking showed a greater reduction in the risk of phosphorus loss than any other single practice. It is also important to note that headland stacking of manure during the critical runoff period is the only practices where soluble phosphorus losses are the dominant form of phosphorus reduction. The predicted reductions in soluble phosphorus from each of the three fields in this study were two pounds per acre.

Manure application rates were the same on each field, the only variable was whether manure was spread during the winter on frozen and/or snow covered ground or during the spring and incorporated within 72 hours. This one operation stacking just 500 tons of manure reduced the predicted risk of phosphorus loss to nearby surface water by 107.3 pounds.

Practices that reduce losses of soluble phosphorus are of particular importance because once phosphorus is in runoff water there is little that can be done to remove it prior to reaching nearby surface water. Most conservation practices are designed to capture and slow water running off of fields so that particulate soil particles fall out of the runoff and remain in the buffers settling basins and wetlands. However, soluble phosphorus is not tied to particles and therefore flows with the water. Keeping soluble phosphorus out of runoff is a critical factor in reducing the overall phosphorus loads to the Madison chain of lakes.

All of the fields impacted by this year's stacking program are in stream reach 64.

6. Combined Practices

The incredible cooperation of the local crop advisors and farmers provided YPF with an adequate data allowed us to evaluate "How does stacking different best management practices impact the potential for phosphorus loss"? **This question was evaluated on 35 fields in 2016 and the data is contained in table 16 on page 28.**

To determine the impact of applying more than one best management practice, we first ran the SNAP calculation with all the practices in place. Then one practice was removed from the field and the numbers were entered into the table for that practice. Then the practice that was removed was added back to the field and the second practice was removed. Those numbers were then entered into the spreadsheet for that practice. Finally both best management practices were removed from the field and the impact on the potential phosphorus loss was recorded. The data contained in table 16 are from a single year and compare fields with and without both practices. The phosphorus reductions for these fields appear in the individual practice sections of the report (LDMI, strip tillage and cover crops) so the reductions in predicted phosphorus loss for each single practice are not provided using the data in table 16.

Table 16 Changes in Phosphorus loss from combining practices

2016 Phosphorus Report – combination of practices																						
					Without tillage/cover crops				With Tillage/Cover Crops				Pounds			Without practices	With practices					
Acres	Soil Type	Soil Symbol	Slope	Soil Test P PPM	Rotat. PI	Annual PI	Part. PI	Soluble PI	Rotat. PI	Annual PI	Part. PI	Soluble PI	Annual P change per acre	Annual P change for field	Tolerable Soil Loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Calculated Soil loss for the field tons/acre	Changes in Soil Loss from both Tillage and Cover Crop tons/acre	Critical Soil	Soil Symbol	Soil used	Yahara Stream Reach field is located
4.0	Kidder	KrE2	28%	57	4	6	4.8	0.8	3	3	2.6	0.2	2.8	11.2	5	4.7	4.0	-0.7	Kidder	KrE2	KrE2	64
6.8	St Charles	ScB	4%	15	3	3	2.8	0.1	3	1	1.1	0.1	1.7	11.6	5	2.8	2.3	-0.5	St Charles	ScB	ScB	64
7.9	Griswold	GwD2	16%	27	4	9	8.2	0.3	1	1	0.6	0	7.9	62.4	4	4.5	0.9	-3.6	Griswold	GwD2	GwD2	64
8.1	Griswold	GwD2	16%	21	3	8	7.5	0.3	1	1	0.6	0	7.2	58.3	4	4.0	0.6	-3.4	Griswold	GwD2	GwD2	64
8.4	Whalan	WxD2	16%	90	6	15	12.6	1.9	4	5	3.6	1.4	9.5	79.8	2	3.5	2	-1.5	Whalan	WxD2	WxD2	64
8.4	St Charles	ScB	4%	13	3	3	2.6	0.1	3	1	1	0.1	1.6	13.4	5	2.8	2.3	-0.5	St Charles	ScB	ScB	64
9.1	Dresden	DsB	2%	83	1	2	0.6	1.1	1	1	0.3	0.9	0.5	4.6	3	2.2	1.8	-0.4	Dresden	DsB	DsB	64
9.8	Plano	PoB	4%	170	8	12	10.5	1.1	7	11	9	1.6	1.0	9.8	4	3.3	3.0	-0.3	Plano	PoB	PoB	64
9.9	Plano	PnB	4%	56	6	4	2.8	1.1	5	2	1.8	0.2	1.9	18.8	5	4.2	3.8	-0.4	Plano	PnB	PnB	64
10.0	Plano	PnB	2%	92	5	4	2.3	1.3	4	2	1.6	0.5	1.5	15.0	5	2.1	1.8	-0.3	Plano	PnB	PnB	64
14.0	Plano	PnC2	9%	82	5	5	3.6	1.1	4	2	2.1	0.4	2.2	30.8	5	3.4	2.8	-0.6	Plano	PnC2	PnC2	64
14.0	Elburn	EfB	3%	69	6	4	2.4	1.4	6	2	1.6	0.5	1.7	23.8	5	3.2	2.9	-0.3	Elburn	EfB	EfA	64
14.5	Ringwood	RnC2	9%	132	8	15	14.4	0.6	8	14	12.9	0.9	1.2	17.4	5	6.3	5.7	-0.6	Plano	PnC2	PnC2	64
16.0	Elburn	EoA	2%	64	2	1	0.7	0.7	1	1	0.5	0.8	0.1	1.6	5	0.6	0.6	0.0	Elburn	EoA	EoA	69
20.1	Mchenry	MdD2	10%	25	2	2	1.8	0.5	2	1	1.3	0.1	0.9	18.1	5	1.8	1.6	-0.2	Mchenry	MdD2	MdD2	64
20.3	Plano	PoA	4%	60	5	5	5.1	0.3	5	4	3.9	0.5	1.0	20.3	4	5.2	4.8	-0.4	Plano	PoB	PoB	64
23.5	Kegonsa	KeB	2%	167	2	2	1.5	0.9	2	2	0.5	1.1	0.8	18.8	3	2.1	1.2	-0.9	Kegonsa	KeB	KeB	64
27.5	Dresden	DsC2	9%	113	3	3	1.9	0.7	2	2	0.8	1.1	0.7	19.3	3	8.1	2.9	-5.2	Dresden	DsC2	DsC2	64
28.0	Plano	PnB	4%	90	3	2	1.8	0.3	3	2	1.2	0.3	0.6	16.8	5	2.6	2.4	-0.2	Plano	PnB	PnB	64
28.0	Plano	PnB	4%	64	3	2	1.7	0.2	2	1	1.1	0.3	0.5	14.0	5	2.7	1.4	-1.3	Plano	PnB	PnB	64
30.0	Whalan	WxC2	9%	40	3	7	6.8	0.4	1	1	0.9	0.4	5.9	177.0	2	5	2	-3.0	Whalan	WxC2	WxC2	64
31.1	Ringwood	RnC2	9%	75	5	12	10.1	1.5	4	6	5.9	0.5	5.2	161.7	5	3.4	3.0	-0.4	Ringwood	RnC2	RnC2	64
34.0	St Charles	SaB	4%	49	2	5	4.3	0.2	1	2	1.6	0.3	2.6	88.4	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
38.4	Dresden	DsB	1%	115	2	3	0.4	2.8	2	2	0.2	2.2	0.8	30.7	5	1	0.8	-0.2	Dresden	DsB	DsB	64
39.1	Dresden	DsC2	9%	118	8	13	11.1	1.4	4	4	3.5	0.9	8.1	316.7	3	6.2	3.3	-2.9	Dresden	DsC2	DsC2	64
55.0	Plano	PlB	4%	119	2	2	1.2	0.6	2	2	0.8	0.7	0.3	16.5	5	1.4	1.4	0.0	Plano	PlB	PlB	69
55.1	Kidder	KdD2	16%	17	6	5	5.2	0.3	2	2	2.1	0.2	3.2	176.3	5	6	2.3	-3.7	Kidder	KdD2	KdD2	64
57.0	Kidder	KeB2	4%	46	3	5	4.4	0.2	2	2	1.7	0.3	2.6	148.2	5	1.5	1.6	0.1	Kidder	KeB2	KeB2	69
90.0	Plano	PlA	1%	48	1	1	0.4	0.2	1	0	0.2	0.2	0.2	18.0	5	0.3	0.3	0.0	Plano	PoA	PoA	69
99.0	Dresden	DsB	4%	47	1	1	0.8	0.1	0	0	0.2	0.2	0.5	49.5	3	0.7	0.8	0.1	Dresden	DsB	DsB	69
110.0	Batavia	BbA	9%	16	2	1	0.7	0.1	0	1	0.5	0.1	0.2	22.0	4	1.4	1.5	0.1	Batavia	BbA	BbC2	69
114.0	St Charles	SaB	4%	27	3	4	3.7	0.1	1	2	1.4	0.2	2.2	250.8	5	1.3	1.4	0.1	St Charles	SaB	SaB	69
117.0	Plano	PmA	1%	40	1	1	0.4	0.2	1	0	0.3	0.2	0.1	11.7	4	0.4	0.5	0.1	Plano	PmA	PmA	69
121.0	Plano	PlA	4%	40	1	1	1.1	0.2	1	1	0.5	0.2	0.6	72.6	5	0.4	0.4	0.0	Plano	PlA	PlA	69
153.0	Dresden	DsB	4%	33	2	1	1.1	0.2	1	1	0.7	0.2	0.4	61.2	3	1.2	1.2	0.0	Dresden	DsB	DsB	69
35	Fields																					
			Average Soil Test P	66.29									Average Annual P Change/Acre	Total Phosphorus Reduction			Average change in Soil Loss	-0.88	Acres in Stream Reach			
1,432.0	Total Acres												2.23	2,067.1					62	0.0		
			Maximum	170.0												Greatest increase in soil loss		0.1	63	0.0		
			Minimum	13.0									9.5	Maximum		Greatest decrease in soil loss		-5.2	64	466.0	32.54%	
													0.1	Minimum					65	0.0		
																# Fields increasing soil loss		6	66	0.0		
																# Fields with no change		5	69	966.0	67.46%	
																# Fields decreasing soil loss		24	Total	1432.0		

However, for the purposes of the discussion the three cost shared practices (cover crops, low disturbance manure injection and strip tillage) were evaluated on fields that had multiple practices applied. The 2016 data set did not contain any fields that had all three practices and in all cases one of the practices was cover crops in combination of either LDMI or strip tillage.

The 35 fields totaled 1,432 tillable acres and contained a range in estimated phosphorus reduction for these fields of 0.1 to 9.5 lbs per acres (all positive). Of the 35 fields none showed a negative potential phosphorus reduction. **The average phosphorus reduction for these fields was 2.23 lbs per acre**. If we take the averages for the three practices included in the combined data it appears that conducting two practices on a field produces less phosphorus reduction than the combination of each practice:

- Strip Tillage Average P reduction = 0.89 pounds per acre
- LDMI Average P reduction = 0.88 pounds per acre
- Cover Crops Average P reduction = 1.48 pounds per acre

Farm	Average impact of cover crop (lbs/acre)	Average impact of tillage (lbs/acre)	Predicted impact of both practices (lbs/acre)	Difference between CC+tillage and implementing both practices (lbs/acre)	Acres with both practices	P change from adopting 2 practices (pounds for the farm)	Stream Reach	Additional Phosphorus Reduction in Stream Reach
1	0.02	0.54	1.70	1.14	966.0	1101.2	69	1101.2
2	0.00	1.80	7.55	5.75	16.0	92.0	64	-16.7
3	0.25	0.30	0.55	0.00	56.0	0.0	64	
4	0.80	0.87	1.07	-0.60	44.6	-26.8	64	
5	2.91	2.20	2.31	-2.80	103.1	-288.7	64	
6	1.15	0.20	1.65	0.30	15.2	4.6	64	
7	1.63	1.19	3.69	0.88	231.1	202.2	64	
					1432.0	**1084.6**		

Table 17 Phosphorus reductions for the 7 farms with two practices on a field

However, using the averages for all the farms participating in the cover crop, strip tillage and the low disturbance manure injection programs would lead to an incorrect conclusion. The data in table 17 was derived from each of the 35 fields participating in the combination of practice program. The data shows the averages by farms instead of each field. Six of the seven farms had a reduction in phosphorus loss through the adoption of cover crops, one farm saw no benefits to cover crops on these fields. All of the farms had a reduction in phosphorus loss through the adoption of reduced tillage with the range being from 0.2 to 2.20 pounds per acre. All of the farms also had a reduction in phosphorus loss through the adoption of two practices with the range being from 0.55 to 7.55 pounds per acre. The center column shows the difference between adopting two practices and the sum of the cover crop and reduced tillage programs. **For the 7 farms in this program:**

- ✓ **Two had a lower predicted phosphorus loss than the sum of cover crops and tillage,**
- ✓ **One had no difference between the combination of practices and the sum of the 2 practices,**
- ✓ **Four had higher predicted phosphorus loss than the sum of cover crops and tillage.**

It is important to note here that combining practices had a higher average (2.23 lbs per acre) than any one of the individual practices (strip tillage = 0.89; LDMI = 0.91; and cover crops = 1.48 lbs per acre). This information is exactly what the YPF's board had expected but had never previously calculated. However, after running many of these calculations it cannot be said that combining practices will in every case increase the potential for phosphorus reduction. Reductions are strongly influenced by tillage, slope and the practices being replaced.

There are some general conclusions that can be derived from this data set:

- **YPF needs to continue promoting the use of more than one conservation practice on a field in order to have adequate sample numbers to clearly identify the impact of two or more practices,**

- **The range in the difference between the combination of practices and the sum of two practices is wide (-2.8) to 5.75 and more work needs to be done to determine on what types of farms and fields the implementation of two practices is most beneficial,**

- **The combination of practices provided the greatest reduction in phosphorus loss at 2.23 pounds per acre,**

- **The combination of practices reduced phosphorus losses in 2016 by 1,085 pounds over the sum of the individual practices.**

The seven farms participating in the combination of practices received a bonus payment. This year's bonus was $15 per acre for up to 103 acres of cropland with a total bonus payment of $5,100.

The cropland enrolled in this program reduced phosphorus loss by 1,085 pounds over what was provided by the individual practices. Therefore the cost per pound of phosphorus was:

$5,100 in bonus payments / 1,085 pounds of phosphorus reduced =

$ 4.70 per pound of phosphorus

7. Multiple Years of Best Management Practices

A. Multiple Years of one practice:

The final question that YPF decided to evaluate was "How important are continuous multiple years of practice implementation"? In other words, instead of thinking about cost sharing a practice for one or two years, what happens if the practice becomes an integral part of the farming system? That's what happened on many farms that experimented with no-till. The first few years were often challenging, but the farmers determined that the benefits to this farming system out-weighed the negatives and they worked to perfect the system on their farms.

Table 19 (pages 32 – 35) contains the data from the 22 fields that have cooperated in the YPF cost share program and have implemented the same practice on a field for at least 3 years in a row. The fields in this analysis were planted to a variety of crops but many of the fields in this data set were planted to continuous corn silage. The use of a cover crop lowered the soil losses and the Phosphorus Index to an acceptable level for many of these fields and to continue to harvest corn silage some conservation practices need to be adopted.

There are probably several ways to calculate the impact of multiple year implementation of a practice but for this project the reductions in the potential loss of phosphorus were only taken on the 2016 crop year. When looking at the data in table 19, the initial year is the field without the practice being implemented. The second line (2016) shows the implementation of the practice and the changes to annual soil loss, rotational Phosphorus Index, annual Phosphorus Index, annual particulate phosphorus loss and annual soluble phosphorus loss. The lines following the 2016-year show the impact of adopting the practices in prior year on the field in 2016. There were reductions in phosphorus loss in each of the preceding years (2012 – 2014), but for the purpose of this analysis these reductions are not credited.

Table 18 contains a summary of the average phosphorus reduction on these 22 fields, the total reduction per field and the total reduction for the multiple year single practice program.

P reduction per acre	P reduction for field	P reduction per acre	P reduction for field	P reduction per acre	P reduction for field	Average P reduction / acre
0.2	1.5	0.9	26.4	0.2	2.0	1.03
0.0	0.0	2.7	37.8	3.6	20.5	
0.9	4.4	1.2	16.8	0.5	10.0	Total P reduction in pounds
4.0	30.8	0.5	4.9	0.2	2.1	
0.4	12.4	1.1	6.5	1.0	7.4	296.9
0.2	6.7	0.2	1.6	2.5	40.8	
-0.1	-5.5	0.5	15.9		90.5 lbs in S.R. - 63	
1.8	47.7	0.2	6.2		206.4 lbs in S.R. - 64	

Table 18 Average phosphorus reductions per acre and total phosphorus reduction in field for multiple years of one practice

Table 19 Phosphorus reductions for multiple years of implementing one practice

Multiple Years of Implementing a Practice

Field Size	Slope	Tolerable Soil Loss	Year of Cover Crop	Actual Soil Loss	Rotational PI	Annual PI	Particulate Phosphorus	Soluble Phosphorus	Impact of CC over preceeding Year	Phosphorus reduction in 2016 practice section	Change Due to Multiple Years
7.5	1%	2	None	0.1	1	2	0.3	1.7			0.2
			2016	0.1	1	1	0.3	1.2	0.5		per acre
			2015	0.1	1	1	0.3	1.2	0.0		
			2014	0.1	1	1	0.2	1.2	0.1		1.5
									0.6	0.4	field
26.7	1%	5	None	0.2	1	1	0.1	1.3			0.0
			2016	0.3	1	1	0.1	1.3	0.0		per acre
			2015	0.3	1	1	0.1	1.3	0.0		
			2014	0.3	1	1	0.1	1.3	0.0		0.0
									0.0	0.0	field
4.9	4%	4	None	6.1	7	7	6.4	0.6			0.9
			2016	5.5	6	3	3.0	0.5	3.5		per acre
			2015	4.9	6	3	2.8	0.4	0.3		
			2014	4.8	5	3	2.8	0.4	0.0		4.4
			2013	4.2	5	3	2.8	0.4	0.0		field
			2012	3.5	4	3	2.8	0.4	0.0		
									3.8	2.9	
7.7	9%	3	None	6.5	9	10	9.6	0.7			4.0
			2016	5.5	8	4	3.6	0.5	6.2		per acre
			2015	4.2	6	4	3.2	0.5	0.4		
			2014	3.2	4	4	3.2	0.5	0.0		30.8
									6.6	2.6	field
31.1	1%	5	None	1.5	4	4	2.3	1.6			0.4
			2016	1.3	3	2	1.0	1.3	1.6		per acre
			2015	1.2	3	2	0.9	1.2	0.2		
			2014	1.0	3	2	0.9	1.2	0.0		12.4
			2013	0.9	3	2	0.9	1.2	0.0		field
									1.8	1.4	

Table 19 continued Phosphorus reductions for multiple years of implementing one practice

14.0	2.5%	5	None	4.1	7	5	4.5	0.8			1.2
			2016	3.6	7	2	1.7	0.6	3.0		per acre
			2015	3.3	6	2	1.5	0.5	0.3		
			2014	3.0	6	2	1.5	0.5	0.0		16.8
			2013	2.5	5	2	1.5	0.5	0.0		field
									3.3	2.1	
9.9	4%	5	None	5.5	7	7	6.1	0.5			0.5
			2016	4.9	6	3	2.5	0.4	3.7		per acre
			2015	4.3	6	3	2.2	0.3	0.4		
			2014	3.7	5	2	2.1	0.3	0.1		4.9
			2013	3.2	4	2	2.1	0.3	0.0		field
									4.2	3.7	
5.9	2%	4	None	3.6	9	9	7.5	1.9			1.1
			2016	3.2	8	4	3.0	1.2	5.2		per acre
			2015	2.9	7	4	2.7	1.1	0.4		
			2014	2.6	7	4	2.7	1.1	0.0		6.5
			2013	2.2	6	4	2.6	1.1	0.1		field
									5.7	4.6	
8	1%	5	None	1.2	6	8	3.5	4			0.2
			2016	1.1	6	5	2.2	3.1	2.2		per acre
			2015	1	6	5	1.8	3	0.5		
			2014	0.8	5	5	1.8	3	0.0		1.6
									2.7	2.5	per field
31.8	2%	5	None	3.5	8	9	6.8	1.8			0.5
			2016	3.4	8	7	5.6	1.6	1.4		per acre
			2015	3.3	7	7	5.5	1.6	0.1		
			2014	3.1	7	7	5.5	1.6	0.0		15.9
									1.5	1	per field
30.8	4%	4	None	4	8	12	10.6	1.6			0.2
			2016	3.8	7	10	8.8	1.4	2.0		per acre
			2015	3.7	7	10	8.6	1.3	0.3		
			2014	3.7	7	10	8.7	1.3	-0.1		6.2
									2.2	2.0	per field

Table 19 continued Phosphorus reductions for multiple years of implementing one practice

Field Size	Slope	Tolerable Soil Loss	Year of Cover Crop	Actual Soil Loss	Rotational PI	Annual PI	Particulate Phosphorus	Soluble Phosphorus	Impact of CC over preceeding Year	Phosphorus reduction in 2016 practice section	Change Due to Multiple Years
33.7	2.50%	5	None	1.2	2	3	0.9	2.1			0.2
			2016	1.1	2	2	0.7	1.7	0.6		per acre
			2015	1.0	2	2	0.7	1.6	0.1		
			2014	0.9	2	2	0.6	1.6	0.1		6.7
									0.8	0.6	field
55.0	4%	5	None	1.3	1	1	0.8	0.1			-0.1
			2016	1.2	1	1	0.7	0.1	0.1		per acre
			2015	1.1	1	1	0.7	0.1	0.0		
			2014	1.0	1	1	0.7	0.1	0.0		-5.5
									0.1	0.2	field
26.5	4%	3	None	6.2	11	11	9.7	1.0			1.8
			2016	5.7	9	10	8.2	1.3	1.2		per acre
			2015	5.5	9	9	7.8	0.9	0.8		
			2014	5.2	8	9	7.8	0.9	0.0		47.7
			2013	4.9	8	9	7.8	0.9	0.0		field
									2.0	0.2	
29.3	6%	5	None	3.2	5	5	4.4	0.3			0.9
			2016	2.5	4	2	1.5	0.3	2.9		per acre
			2015	2.0	3	2	1.4	0.3	0.1		
			2014	1.6	3	2	1.4	0.3	0.0		26.37
			2013	1.6	2	2	1.4	0.3	0.0		field
									3.0	2.1	
14.0	9%	5	None	6.5	8	12	10.6	0.9			2.7
			2016	5.4	7	4	3.2	0.6	7.7		per acre
			2015	4.5	6	3	2.9	0.6	0.3		
			2014	3.7	5	3	2.9	0.6	0.0		37.8
			2013	3.5	5	3	2.9	0.6	0.0		field
									8.0	5.3	

Table 19 continued Phosphorus reductions for multiple years of implementing one practice

10	2%	5	None	3.1	7	5	4.3	1.0			0.2
			2016	2.8	6	2	1.8	0.7	2.8		per acre
			2015	2.5	6	2	1.7	0.7	0.1		
			2014	2.2	5	2	1.6	0.6	0.2		2
			2013	1.9	5	2	1.6	0.6	0.0		field
									3.1	2.9	
5.7	9%	5	None	7.0	10	16	14.9	0.9			3.6
			2016	5.5	8	6	5.2	0.6	10.0		per acre
			2015	4.4	6	5	4.8	0.6	0.4		
			2014	3.4	5	5	4.7	0.6	0.1		20.5
									10.5	6.9	per field
19.9	2%	4	None	3.3	9	10	7.9	2.3			0.5
			2016	2.9	8	5	3.1	1.6	5.5		per acre
			2015	2.5	7	4	2.8	1.5	0.4		
			2014	2.2	6	4	2.8	1.5	0.0		10.0
									5.9	5.4	per field
10.4	1%	4	None	1.7	4	6	4.2	2.3			0.2
			2016	1.6	4	6	3.5	2.0	1.0		per acre
			2015	1.5	4	5	3.4	2.0	0.1		
			2014	1.5	4	5	3.4	2.0	0.0		2.1
									1.1	0.9	per field
7.4	9%	5	None	6.7	11	17	15.5	1.1			1.0
			2016	6.4	11	14	13.1	1	2.5		per acre
			2015	6.2	11	14	12.8	1	0.3		
			2014	6.1	10	14	12.7	0.9	0.2		7.4
									3.0	2.0	per field
16.3	9%	5	None	6.7	11	20	18.6	1.6			2.5
			2016	6.3	11	17	15.4	1.4	3.4		per acre
			2015	6.2	10	17	15.2	1.4	0.2		
			2014	6.2	10	17	15.2	1.4	0.0		40.8
									3.6	1.1	per field

One point that should be made from the data in table 19 is that while the reductions in phosphorus loss on a field for the most recent year of the practice (2016) generally peak out after three years (meaning that the influence of a practice appears to carry forward about 3 years), the impact on the annual losses each year shows up in the change in actual soil loss and the rotational Phosphorus Index numbers. As this data clear shows the more years of practice adoption the lower the actual soil loss and rotational Phosphorus Index numbers.

The average predicted reduction in phosphorus loss based on this data is continuing to increase, however this is influenced by the slope and tillage system used on the farm. Farmers who have a field or two that they want to harvest as continuous corn silage may find that inserting a cover crop in between the corn crops and using a no-till corn planting system may help the field achieve acceptable levels or soil and phosphorus loss.

One challenge in this watershed is that many of the fields have hay in the rotation, which reduces the number of years for crediting the cover crop. A suggestion for YPF board to consider is to look at providing an incentive to farmers to maintain a living crop on the field throughout the rotation. Fields planted to corn, soybeans and small grain crops would require a cover crop after harvest to be consider in compliance with the program, while fields during the hay rotation are considered in compliance.

B. Multiple years of two practices

The data in tables 20 and 21 comes from those farms and fields that implemented two or more practices continuously on the same fields for 3 or more years. This data comes from a limited number of farms and represents only 12 fields so crop rotation and slope have a major impact on several of these fields. However, this data has a similar finding to the combined practices data.

One caution is that the 2016 cost share program data has been evaluated over a long period of time and in a number of different ways. This probably had an impact on the annual phosphorus reduction numbers from cover crops and strip tillage that were subtracted from the multiple years and multiple practices reduction figure. The author accepts all criticisms and can only say that the analysis and the ways to analyze the data underwent a significant number of revisions in an attempt to accurately represent the data. With multiple years and practices the impact of a practice on the year following implementation is large, however YPF is evaluating only the cost share year. Yahara Pride Farms needs a few more years of data in the multiple years and practices to be able to clearly draw conclusions.

Table 20 Phosphorus reductions from multiple years and practices

		Multiple Years of implementing two practices									
Field Size	Slope	Tolerable Soil Loss	Year of Cover Crop	Actual Soil Loss	Rotational PI	Annual PI	Particulate Phosphorus	Soluble Phosphorus	Impact of CC over preceeding Year	Phosphorus reduction in 2016 practice section	Change Due to Multiple Years
23.5	2%	3	None	3.8	3	3	1.6	1.0			-0.1
			2016	3.6	3	2	1.2	0.9	0.5		per acre
			2015	3.2	2	2	1.0	0.8	0.3		
			2014	2.6	2	2	1.0	0.8	0.0		-2.4
			2013	2.2	2	2	1.0	0.8	0.0		field
									0.8	0.9	
16.0	2%	5	None	1.2	2	3	2.0	0.6			0.3
			2016	1.1	2	2	1.9	0.5	0.2		per acre
			2015	0.9	2	2	1.8	0.5	0.1		
			2014	0.8	2	2	1.8	0.5	0.0		4.8
									0.3	0.0	per field
34.0	4%	5	None	3.4	2	3	2.5	0.2			0.6
			2016	2.6	2	1	1.2	0.2	1.3		per acre
			2015	2.5	2	1	1.1	0.2	0.1		
			2014	1.6	2	1	1.1	0.2	0.0		20.4
									1.4	0.8	per field
55.0	4%	5	None	2.9	3	4	3.9	0.5			0.4
			2016	2.8	3	4	3.6	0.5	0.3		per acre
			2015	2.1	3	4	3.5	0.4	0.2		
			2014	2.0	2	4	3.5	0.4	0.0		22.0
									0.5	0.1	per field
57.0	4%	5	None	3.8	3	2	1.4	0.2			-0.6
			2016	3.0	3	1	1.2	0.2	0.2		per acre
			2015	2.9	2	1	1.2	0.2	0.0		
			2014	1.9	2	1	1.2	0.2	0.0		-34.2
									0.2	0.8	field
90.0	1%	5	None	0.5	1	1	1.0	0.2			0.3
			2016	0.5	1	1	0.9	0.2	0.1		per acre
			2015	0.4	1	1	0.8	0.2	0.1		
			2014	0.3	1	1	0.8	0.1	0.1		27.0
									0.3	0.0	per field

Table 20 continued Phosphorus reductions from multiple years and practices

Field Size	Slope	Tolerable Soil Loss	Year of Cover Crop	Actual Soil Loss	Rotational PI	Annual PI	Particulate Phosphorus	Soluble Phosphorus	Impact of CC over preceeding Year	Phosphorus reduction in 2016 practice section	Change Due to Multiple Years
99	4%	3	None	1.3	1	1	0.5	0.2			0.1
			2016	1.0	1	1	0.4	0.2	0.1		per acre
			2015	1.0	1	1	0.3	0.2	0.1		
			2014	0.9	1	1	0.3	0.1	0.1		9.9
									0.3	0.2	per field
110	9%	4	None	2.7	2	3	2.0	0.0			1.0
			2016	1.7	1	1	1.4	0.1	0.5		per acre
			2015	1.7	1	1	1.2	0.1	0.2		
			2014	1.1	1	1	1.0	0.1	0.2		110.0
									0.9	-0.1	per field
114	4%	5	None	3.4	3	1	1.1	0.1			-0.7
			2016	2.7	2	1	1	0.1	0.1		per acre
			2015	2.5	2	1	1	0.1	0.0		
			2014	1.7	1	1	1	0.1	0.0		-79.8
									0.1	0.8	per field
117	1%	4	None	0.8	1	1	1	0.2			0.6
			2016	0.6	1	1	0.4	0.2	0.6		per acre
			2015	0.5	1	1	0.4	0.2	0.0		
			2014	0.4	1	1	0.4	0.2	0.0		70.2
									0.6	0	per field
121	1%	5	None	0.8	1	1	0.4	0.2			0.1
			2016	0.7	1	1	0.4	0.1	0.1		per acre
			2015	0.6	1	1	0.4	0.1	0.0		
			2014	0.5	1	1	0.4	0.1	0.0		12.1
									0.1	0	per field
153	4%	3	None	2.4	2	3	3.1	0.1			0.2
			2016	2.3	2	3	2.9	0.1	0.2		per acre
			2015	1.7	2	3	2.8	0.1	0.1		
			2014	1.7	2	3	2.8	0.1	0.0		30.6
									0.3	0.1	per field

Table 21 is a summary of the impacts of multiple years and practices on the field in 2016. This table contains that difference in reduction estimates from the annual cover crops and tillage changes and the additive impacts of multiple years.

P reduction in (lbs./ acre)	P reduction for field (pounds)	P reduction in (lbs./ acre)	P reduction for field (pounds)		Average P reduction / acre
(-0.1)	(-2.4)	0.1	9.9		0.18
0.3	4.8	1.0	110		
0.6	20.4	(-0.7)	(-79.8)		Total P reduction in pounds
0.4	22.0	0.6	70.2		
(-0.6)	(-34.2)	0.1	12.1		190.6
0.3	27.0	0.2	30.6		
					-2.4 lbs in S.R. - 64
					193.0 lbs in S.R. - 69

Table 21 Average phosphorus reductions per acre and total phosphorus reduction in field for multiple years and practices

Conclusion:

The 2016 Yahara Pride Cost Share Program has engaged a large number of farmers in one or more of the five cost share programs. This report provides information on the predicted reductions in phosphorus loss by farmers adopting one or more of these practices. The report provides both a total for the entire watershed and the reductions for each of the six stream reaches that Yahara Pride Farms is working with farmers on adoption of conservation systems.

The analysis of phosphorus reduction for the multiple year data probably under estimates the impact of the conservation systems. It focuses only on the last year of the rotation and doesn't take into account other changes in the field. Future analysis will attempt to do a better job of working to understand the impacts of multiple year and multiple practices on a field.

The headland-stacking program is the only program that has a dramatic potential reduction in soluble phosphorus loss. Consider that on a total of 50.4 acres of cropland, there was a 100.8 pound reduction in soluble phosphorus loss, while on 5,851 acres planted to cover crops we saw a 266 pound reduction in soluble phosphorus loss.

Finally, the estimated cost per pound of phosphorus reduced provided in this report reflect only the cost associated with the cost share. These numbers do not reflect the cost that farmers bare in adopting these conservation systems. The cost of seed, planting, killing and impact of the cover crop on yield have not been examined. The cost of handling manure twice and hauling to an approved stacking site and then to the field, also need to be considered. A report evaluating the cost to farmers for adoption should be done to accurately reflect the total cost of these programs. Protecting water quality is important to everyone, and everyone needs to be part of the solution.