Yahara Pride Farms

2018 Phosphorus Reduction Report

Yahara Pride Board of Directors

July 8, 19

Executive Summary

What the data represents

This report provides the data and summary information for the 41 farms (up from 35 in 2017) cooperating in the 2018 Yahara Pride Farms (YPF) cost share program. In 2018 there were 8 new farms in the program. There were also farms that implemented practices but did not provide a SNAP+ file for evaluation or payment. 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. The 2018 data is based off the "SNAP+" plans provided to YPF by the farmers and/or their crop advisors.

All of the data presented in this report are derived from the individual farms nutrient management plan, which takes into account tillage, crop rotations, and 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 for each cost share program:

1. **Cover Crops**

Table 1 shows a comparison of the number of farms, acres and phosphorus reductions achieved through the **cover crop program** from 2013 to 2018.

Year	2013	2014	2015	2016	2017	**2018**
Farms	20	37	35	37	33	**37**
Fields	80	53	160	290	212	**274**
Acres	2,436	4,732	4,908	5,851	4,483	**7,294**
Average (lbs/acre)	0.7	0.8	1.8	1.5	1.8	**2.1**
Total P reduction (In pounds)	1,730	3,691	6,572	7,130	7,300	**11,497**

Table 1 Number of farms, acres and phosphorus reductions through the cover crop program

Despite challenging weather conditions, the number of farms, fields and acres cooperating in the cover crop program grew significantly in 2018. The information in the above table does not take into account the number of acres planted to a cover crop after low disturbance deep tillage. The next section of the report provides the data from the LDDT + cover crop.

2. **Low disturbance deep tillage with planting of a cover crop**

Table 2 shows a comparison of **the low disturbance deep tillage plus cover crop program** (LDDT), which was first offered to farmers in the watershed in 2016. Interest in this program continues to grow and the YPF board of directors feels it is important to encourage reduced tillage when conducting deep tillage.

Year	2016	2017	**2018**
Farms	8	11	**7**
Fields	?	52	**24**
Acres	730	956	**448**
Average (lbs/acre)	1.48	2.2	**2.6**
Total P reduction (In pounds)	1,080	1,981	**1,165**

Table 2 Number of farms, acres and phosphorus reductions through the LDDT + cover crop program

3. Low disturbance manure injection

Table 3 shows a comparison of the number of farms, acres and phosphorus reductions achieved through the **low disturbance manure injection program** from 2013 to 2018.

Low Disturbance Manure Injection Program	2013	2014	2015	2016	2017	**2018**
Number of farms	11	14	4	7	15	**15**
Number of fields	20	20	32	76	223	**196**
Tillable acres in program	361	841	566	1,203	3,885	**3,293**
Average phosphorus reduction (lbs./acre)	1.0	0.6	1.9	0.9	1.4	**1.1**
Total phosphorus reduction (in pounds)	357	530	1,081	1,106	6,039	**3,945**

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

The LDMI program was fairly stable in regards to acres and fields this year compared to previous years. This could be due to challenging weather conditions in the fall and spring, which decreases the amount of time available for manure application.

4. Strip Tillage

The table 4 shows a comparison of the number of farms, acres and phosphorus reductions achieved through **strip tillage program** from 2013 to 2018.

Strip Tillage Program	2013	2014	2015	2016	2017	**2018**
Number of farms	3	3	3	3	4	**3**
Number of fields	11	15	20	21	35	**39**
Tillable acres in program	156	253	1,489	917	1,829	**2,422**
Average phosphorus reduction (lbs./acre)	1.4	0.9	0.8	0.9	0.8	**1.3**
Total phosphorus reduction (in pounds)	225	220	1,221	703	1,458	**3,110**

Table 4 Number of farms, acres and phosphorus reductions through strip tillage program

Strip tillage grew to the largest number of acres since the beginning of the cost share program. The average phosphorus reduction grew this year compare to the previous 4 years and compares to the first year of the cost share program. This year strip tillage cost share program had the largest reduction in the risk of phosphorus loss in the history of the program.

5. Manure stacking and/or composting

Table 5 shows a comparison of **the reduction in the risk of phosphorus loss from manure stacking and/or composting during the critical runoff period.** This program was first offered to farmers in the watershed in 2016. Interest in this program continues to grow and the YPF board of directors feels it is important to encourage farmers to not apply manure during high-risk periods. This practice is also one that has a significant reduction in soluble phosphorus loss.

Year	2016	2017	**2018**
Farms	1	9	**9**
Fields	1	9	**44**
Acres	50.4	301	**898**
Average (lbs/acre)	2.1	2.1	**2.0**
Total P reduction (In pounds)	106	665	**1,855**

Table 5 Number of farms, acres and phosphorus reductions through the LDDT + cover crop program

6. Combining practices

In 2018 YPF provided a bonus payment 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). On some fields there is not calculated benefit to combining practices when you take into account the individual benefits of each practice. However, there are fields where the benefit of adopting two practices was greater than the individual benefits of both practices.

In 2018, the average predicted phosphorus reduction for combining two practices was **0.8 pounds per acre**. This year's data set contained 98 fields totaling 2,010 acres. This reduction in phosphorus is over and above the phosphorus reductions for each of the two practices. The individual practice reductions are included in corresponding data sets.

2018 Summary of Predicted Phosphorus Reduction

Practice	Average P Reduction	Total Predicted P Reduction
➢ Cover Crops	2.1	11,497 lbs
➢ LDDT + cover crop	2.6	1,165 lbs
➢ LDMI	1.1	3,945 lbs
➢ Strip Tillage	1.3	3,110 lbs
➢ Headland Stacking Manure	2.0	1,855 lbs
➢ Combined Practices	0.8	525 lbs
	Total	22,097 lbs

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 many years. Your guidance and support have shaped this program and we cannot thank you enough for the time you committed to this organization.

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Programs offered in 2018

During 2018 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 2018 including:

1. Cover Crop Assistance,
2. Low Disturbance Deep Tillage and Cover Crop,
3. Low Disturbance Manure Injection,
4. Strip tillage, 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). 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. 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 is 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.

The Yahara Pride Farms began working with cover crops as a demonstration program in 2012. The program got a fair amount of publicity and recognition and other farmers within the watershed became interested in cooperating because of the ease of getting into the program. 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. A number of the farms participating in the YPF cover crop program also participated in the NRCS/Dane County aerial seeding program. **For the purpose of this years report on the impact of the Yahara Pride Farms cover crop program, none of the acres participating in the NRCS program were included in this report.** This means that the impact of planting cover crops were dramatically higher than accounted for in this report.

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 2018 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 2018 there were 274 fields (up from 212) with crop rotations and farming systems in the SNAP format. **This represented 90.5% of the total acres** planted with cover crops through the cost share program, though most of these acres were not cost shared.

There was one farm that YPF was unable to get the SNAP+ file for in time to be part of the analysis. For the purpose of this years report, the average phosphorus reduction for this farms cover crop fields was taken from the data collected on the farm last year's. Therefore, the number of fields reported and the potential reduction in phosphorus through the cover crop program is under reported. 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 field data collected during the 2018 seasons, the cover crop incentive program reduced the risk of phosphorus loss by 11,497 pounds (compared to 7,300 pounds in 2017). The average reduction in phosphorus loss was 2.1 pounds per acre in 2018 compared to 1.8 lbs/acre in 2017. Care should be used when comparing year-to-year changes in the predictions of phosphorus loss because of changes to the SNAP+ program.

This year we added the change in predicted soil loss to the report. Many of the conservation practices encouraged through this cost share program reduce the risk of phosphorus loss by reducing soil loss. The YPF board of directors thought it was important to add the data calculated through the RUSLE 2 calculation to the report,

This year's phosphorus reduction = 11,497 lbs

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

Total acres planted using a cover crop system = 7,294 acres

Total estimated acres cost shared = 1,562 acres

Acres planted without cost share in watershed = 5,732 acres

21.4% of the acres planted to cover crops on YPF's land were cost shared

Average reduction in soil loss 0.5 pounds/acre

Total reduction in soil loss 8,114 lbs

The table in appendix 1 provides the information from each field in the cover crop program.

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

Stream Reach	Phosphorus Reduction Lbs	Acres	Number of Fields	Percentage of total cover crop acres
62	860.2	293.2	18	4%
63	376.0	177.2	20	2%
64	8,134.9	4,127.1	201	57%
66	25.1	65.0	7	1%
69	9782,100.7	2,631.4	28	36%

Table 6 2018 Phosphorus reductions through the cover crop program by stream reach

2. 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.

In 2018 crop consultants identified the fields where LDDT with a cover crop was conducted. The low disturbance deep tillage and cover crop cost share program had **24 fields identified** with a total of **448 acres within the watershed**. This is a reduction in the number of fields and acres compared to previous years. This may be due to better harvest conditions or due to a lack of time to conduct deep tillage in the fall of the year.

Total acres planted with the LDDT plus cover crop system = 448 acres

Total acres cost shared = 325 acres

Acres planted without cost share in watershed = 123 acres

The fields identified using LDDT plus a cover crop reduced the risk of phosphorus loss by 1,165 lbs.

Average reduction in P loss = 2.6 pounds per acre

Appendix 2 contains the individual field data for the LDDT plus cover crop program.

Stream Reach	Phosphorus Reduction Lbs	Acres	Number of Fields	Percentage of total cover crop acres
62	343.5	137.3	8	31%
63	97.6	52.3	4	12%
64	724.0	258.4	12	58%

Table 7 2018 Phosphorus reductions through the low disturbance deep tillage plus cover crop program by stream reach

3. 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 2018 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, rented the LDMI equipment from YPF, or hired a custom operator who had LDMI equipment. In 2018, YPF had **fifteen farms (up from 14 in 2017)** participate in the LDMI program. The cost share program provided $20 per acre with a 100-acre maximum payment ($2,000 maximum). The fifteen farms used the equipment on **196 separate fields,** which **totaled 3,293 acres** compared to 3,885 acres in 2017. There was additional manure applied using this equipment, but some of that land was out of the Yahara Watershed. **The data contained in appendix 3 are from the fields within the Yahara Watershed.**

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. The average reduction in the risk of phosphorus loss for the **LDMI program was 1.1 pounds of P per acre.**

Based on the 2018 data, the LDMI cost share program reduced phosphorus loss by 3,945 lbs.

Total acres with manure applied with the LDMI system = 3,393 acres

Total acres cost shared = 1,206 acres

Acres planted without cost share in watershed = 2,187 acres

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

Stream Reach	Phosphorus Reduction Lbs	Acres	Number of Fields	Percentage of Acres
62	206.8	217.5	19	7%
63	313.8	281.9	22	9%
64	3,390.7	2,751.3	151	83%
66	34.0	42.0	4	1%

Table 8 Acres implementing LDMI by stream reach

The individual field data for low disturbance manure injection in contained in appendix 3.

4. 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 100 acres for farmers wanting to experiment with strip tillage (maximum payment of $1,500 per farm).

The data contained in appendix 4 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 three farms that cooperated in the strip tillage program and these operations were spread out around a wide area of the Yahara watershed. Strip tillage was conducted on 39 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 2,422 compared to last years total of 1,829 acres.

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 2018 strip tillage program was conducted on 2,422 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 2,422**
  - **YPF cost share acres 300**

Acres of strip tillage done without financial assistance = 2,122 acres

Overall the average reduction in phosphorus loss was <u>1.3 pounds</u>.

For the 2,422 acres in the program the risk of phosphorus loss was <u>reduced 3,110 pounds</u> by adopting strip tillage.

Stream Reach	Phosphorus reduction (Lbs)	Acres	Number of fields	Percentage of Acres
64	292.1	301.8	10	12.5%
69	2,817.4	2,120.3	29	87.5%

Table 9 Acres in the Yahara Watershed adopting strip tillage by stream reach

5. **Headland Stacking and/or Composting 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 appendix 5.

There were 9 farms that cooperated in the headland-stacking program in 2018. These farms stacked about 3,880 tons of solid dairy manure on sites approved for stacking. If the manure had been applied to cropland during the critical runoff period, the application would have covered about 898 acres of cropland.

As shown in the table in appendix 5, staking manure during the critical runoff period reduced the loss of phosphorus by 2.0 pounds per acre. 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.

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. These operations stacking just 3,880 tons of manure reduced the predicted risk of phosphorus loss to nearby surface water by 1,855 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.

The 2018 headland stacking and/or composting program reduced manure applications on 898 acres in the Yahara Watershed.

Overall the average reduction in phosphorus loss was 2.0 pounds

For the 898 acres in the program the risk of phosphorus loss was reduced 1,855 pounds

Stream Reach	Phosphorus reduction (Lbs)	Acres	Number of fields	Percentage of Acres
62	283	160.0	1	18%
64	1,531	717.4	31	80
66	42	20.0	11	2%

Table 10 Acres in the Yahara Watershed adopting strip tillage by stream reach

6. Combined Practices

The incredible cooperation of the local crop advisors and farmers provided YPF with an adequate data set so that we could evaluate "How does stacking different best management practices impact the potential for phosphorus loss"? **This question was evaluated on 98 fields in 2018 and the data is contained in appendix 6**. It is important to note that not all fields had a benefit in excess of the two individual practices. Therefore, the estimated reduction in the risk of phosphorus loss comes from those fields that had a reduction above the total of the two practices used on the field.

To determine the impact of applying more than one best management practices, 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 the tables in appendix 6 compare fields with and without both practices. The numbers in the data (columns 17) show the annual change in the risk of phosphorus loss with and without both practices in place. The next two columns (18 & 19) show the reductions from the cover crop and the reductions in tillage. Column 20 shows whether there was a reduction in phosphorus loss that exceeded the combined individual benefits. Forty fields showed a greater benefit.

The phosphorus reductions for these fields appear in the individual practice sections of the report (LDMI, strip tillage and cover crops) but the reductions in predicted phosphorus loss for each single practice are included in the data so that the calculations could be made. The phosphorus reductions taken at the bottom of the table is only the impact of adopting two practices above and beyond the individual practices. 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 2018 data set did contain a few 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 98 fields totaled 2,010 tillable acres. The average phosphorus reduction for these fields was 3.6 lbs per acre, however that includes the reductions already in the individual practice data. When you take off the reductions from the other practice, combining practices results in an additional reduction of 0.8 pounds per acre.

2,010 acres were managed with a combination of practices adopted

The average reduction in the risk of phosphorus loss was 0.8 lbs greater than both practices

Combining practices resulted in an additional 525 pounds of phosphorus reduced

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

Looking at the data based on phosphorus reduction for each reach of stream is in table 11 (below).

Stream Reach	Phosphorus Reduction Lbs	Acres	Number of Fields	Percentage of Acres
62	103.3	58.9	4	3%
63	7.1	61.0	6	3%
64	415.0	1,452.8	81	72%
66	0.0	14.0	2	0%
69	0.0	422.8	5	22%

Table 11 Acres with a combination of two or more practices by stream reach

The individual field data for the combination of practices is contained in appendix 6.

Conclusion:

The 2018 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.

This report did not evaluate multiple year data but a closer look at the impact of farms continuing a conservation practice is desirable. Future analysis should attempt to do a better job of looking at multiple years of adoption to understand the impacts of multiple years on a field.

The headland-stacking program is the only program that has a dramatic potential reduction in soluble phosphorus loss.

Additional work should be done to accurately 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.