LOWER FOX RIVER

WATERSHED RECOVERY PLAN

IMPLEMENTATION
ACTION PLAN

TECHNICAL REPORT

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KEEPERS OF THE FOX — FROM THE VALLEY TO THE BAY

FOX-WOLF WATERSHED ALLIANCE

WISCONSIN DEPT. OF NATURAL RESOURCES

ALLIANCE for the GREAT LAKES

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INTRODUCTION

ACKNOWLEDGEMENT OF PAST & CURRENT EFFORTS

The Keepers of the Fox acknowledge that great conservation work is currently being done in the Lower Fox River Basin (Lower Fox River). This Implementation Action Plan is not intended to replace or duplicate any of the existing plans and/or implementation efforts discussed below. Each planning effort that has taken place in the past was done with purpose and met the needs for why it was developed at the time. This Plan also acknowledges that meaningful work to achieve reductions is being completed by wastewater and municipal stormwater entities. An improvement in water quality relies on a combination of point and non-point source reductions to meet phosphorus and sediment reduction targets.

IMPLEMENTATION IN THE LOWER FOX RIVER WATERSHED TO DATE

LOWER FOX RIVER BASIN AND LOWER GREEN BAY TMDL AGRICULTURAL IMPLEMENTATION STRATEGY

Implementation efforts have been underway in the Lower Fox River Watershed (Lower Fox River) since the approval of the TMDL[1] in 2012[2]. Recognizing that wastewater and municipal stormwater entities would work toward their reduction goals through permit compliance, WDNR, county land conservation departments, and partner non-profits began working toward the agricultural non-point reductions. Under the coordination of WDNR, an Agricultural TMDL Implementation team was formed to develop a Lower Fox River TMDL Agricultural Implementation Strategy[3] for conservation professionals to work together to meet TMDL goals. The Agricultural TMDL Implementation team included: Outagamie County, Calumet County, Brown County, Winnebago County, Oneida Nation, UW Extension, NRCS and the Fox-Wolf Watershed Alliance and has since expanded to include multiple other entities working towards conservation efforts.

They prioritized implementation of watersheds by highest phosphorus loading per agricultural acre first (see Figure 1). The strategy provided the team with direction for implementation of a large effort. The team would work together, beginning in the highest loading watersheds and moving watershed by watershed, write a Nine Key Element Plan, then secure funding to implement the plan.

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[1] TMDL and Watershed Management Plan for TP and TSS in the Lower Fox River Basin and Lower Green Bay, https://drive.google.com/file/d/13Y58GVLKKWrA_NmiV4faSz_JvXTqJoiM/view?usp=share_link
[2] For detailed information on the TMDL and its purpose, see the Lower Fox River Recovery Plan Introduction
[3] Lower Fox River TMDL Agricultural Implementation Strategy, https://dnr.wisconsin.gov/sites/default/files/topic/TMDLs/LFoxAgStrategy.pdf

Once implementation is firmly underway in one watershed, they would move on to the next. Recognizing that factors such as landowner willingness, financial resources, staff capacity, new technologies, etc. will impact implementation priorities, the TMDL Ag Implementation Strategy allows for flexibility in prioritizing subwatershed implementation schedule and strategy. Opportunity also exists for non-traditional agricultural implementation partners such as point sources choosing alternate compliance options to select watersheds to implement in based on their permit requirements.

TMDL Subwatershed	Agricultural Baseline Phosphorus Load	Ag load lbs per ag acre
	lb/year	*lbs/ag acre*
Plum Creek	27660	1.59
Kankapot Creek	17195	1.51
East River	38020	1.43
LFR Main Stem	12779	1.40
Bower Creek	22946	1.34
Apple Creek	27297	1.32
Garners Creek	2908	1.29
Mud Creek	1884	1.28
Neenah Slough	8015	1.27
Lower Green Bay	8670	1.22
Ashwaubenon Creek	12269	1.07
Baird Creek	9018	1.04
Dutchman Creek	10130	1.04
Duck Creek	49319	1.01
Trout Creek	3272	0.71

Figure 1. Watersheds Listed in Order of Implementation Based on Ag Implementation Strategy

NINE KEY ELEMENT PLANS

A significant push in recent years has been the development of Nine Key Element[4] plans for watersheds across the country. These watershed plans are detailed, technical implementation guides for conservation professionals to follow to work with producers in a watershed to meet water quality goals. They identify the source of non-point pollution as well as develop strategies to address water quality issues at a smaller watershed scale. For example, these plans hold detailed information including modeling efforts that were done to determine priority areas within individual watersheds for implementation as well as detailed streambank inventories. Written by County staff, reviewed by WDNR and approved by EPA, Nine Key Element Plans enable conservation partners to qualify for some federal grants and large scale state funding. The Nine Key Element plans will be referenced by implementation partners as implementation continues.

THE LOWER FOX RIVER WATERSHED RECOVERY PLAN

Leveraging the efforts of the TMDL and Nine Key Element plans but acknowledging that additional support was needed to accelerate progress and meet time-bound reduction goals, a partnership formed between the WDNR Office of Great Waters,

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[4] WDNR Nine Key Element Watershed Plans Webpage, https://dnr.wisconsin.gov/topic/Nonpoint/9keyElement/planMap.html

Fox-Wolf Watershed Alliance, and the Alliance for the Great Lakes. With the support of Brown County, Outagamie County, and the Oneida Nation through the Water Quality Pact, work began with partners to develop a water quality management plan that takes the information and water quality targets from the TMDL and generates a process and structure for meeting those goals across all pollution sources in a realistic timeframe. The watershed recovery program, coined Keepers of the Fox, engaged a broad coalition of watershed stakeholders to evaluate what was needed to accelerate the pace and scale of implementation.

The Agricultural TMDL Implementation team, WDNR water quality staff, and county conservation department staff were engaged in meaningful conversation on how the efforts in the Lower Fox River could be accelerated. Five key components were identified as key pieces of the Implementation Action Plan: Time Based Goals, Public Engagement, Per Acre Reduction Goals, Accounting for Streambank Erosion and Demonstrating Intensive Implementation Reduction Potential.

IMPLEMENTATION ACTION PLAN – GOING BEYOND TMDL AND NINE KEY ELEMENT PLANS

TIME BASED GOALS

This Implementation Action Plan supports the TMDL implementation strategy and follows the identified prioritization schedule. The action plan proposes the level of staffing required to meet and maintain needed reduction goals. Most importantly, this Implementation Action Plan sets a specified timeframe in which we are working to achieve these goals across the watershed, not just in one subwatershed at a time.

Lower Fox River conservation partners have been working on strategic implementation of TMDL goals since 2015. While progress is being made, it is not advancing at the pace needed to meet the Keepers of the Fox goal of meeting all required reductions to work toward water quality goals by 2040. This Implementation Action Plan lays out an aggressive timeline for advancing restoration efforts. Each Lower Fox River sub-watershed that had not begun implementation prior to 2020 will have a 10-year implementation plan. In order to meet the 2040 goal, all watersheds must begin implementation by the year 2030. To track progress towards goals, this effort has developed measurable milestone reduction targets.

These time based goals apply specifically to agricultural reductions. Permitted entities will reach their reduction targets through their permit cycle process.

Selecting Adaptive Management may also alter the reduction timeline goals. Ashwaubenon Creek and Dutchman Creek have been selected by NEW Water (Green Bay Metropolitan Sewerage District) for Adaptive Management as an alternate permit compliance option. These watersheds have an extended implementation period to match NEW Water's permit requirements.

PUBLIC ENGAGEMENT

Upon completion of this plan, the Fox-Wolf Watershed Alliance (Fox-Wolf) will host the Keepers of the Fox program. Through this effort, Fox-Wolf will continue to work with WDNR and local partners to track implementation progress, while engaging a larger audience in the water quality conversation to build broader support for watershed recovery. While this implementation action plan is built upon the TMDL's phosphorus reduction requirements to meet water quality goals, the targets and milestones identified in this implementation action plan are more tangible for the public, elected officials, and non-traditional funders.

During plan implementation, the Keepers of the Fox program will continue to build out specific engagement materials for localized audiences. Bringing the messages *to* the audience we need to engage is something that is not currently being done as a coordinated effort and is what makes this project different. Bringing implementation needs and progress to the public, elected officials and untraditional funders will include attending and presenting at public and community organization meetings, exhibiting at public events, hosting engaging events for target and general audiences and more.

Furthermore, this plan frames conservation goals and targets in different ways to connect with those who value the co-benefits that improvements in water quality provide. In addition to the phosphorus reduction goals and milestone targets, practices that lead to phosphorus reductions and improved water quality are identified in this plan for the co-benefits they provide:

- Soil Health
- Flood Mitigation
- Fish and Wildlife Habitat

Framing the conservation need through multiple lenses is anticipated to increase engagement and support for conservation ultimately leading to increased support and funding for implementation of this plan and the related Nine Key Element Plans. More information on the communication strategy for public communication of these metrics can be found in the Shared Measurement and Shared Decision Making technical documents.

PER ACRE REDUCTION GOALS

While a requirement of a Nine Key Element plan is to identify the number of each type of conservation practice needed to be implemented to meet conservation goals, the Implementation Plan sets clear targets for farmers and landowners to meet without being too prescriptive about which practices they use to get there. While understanding numbers of specific practices is a good guide for conservation practitioners, flexibility is needed when working with private property owners and farmers who are not required to implement these practices. This plan will not provide information on exactly what BMPs need to be installed where[5]. Nine Key Element Plans offer more details on what quantities of specific BMPs are anticipated to be installed in a particular watershed. For prioritizing where to start work within a particular watershed, implementers should reference the Nine Key Element Plans and utilize the prioritization work done for those efforts.

Instead of identifying prescriptive practice targets, this effort sets phosphorus runoff targets for non-permitted land and proposes conservation staff work with landowners to find the right suite of practices that work for the landowner to meet the targets.

The per acre runoff targets identified for agricultural cropland is based on work WDNR has done with Lower Fox River TMDL data for water quality trading. These edge-of-field runoff targets will help communicate conservation goals with farmers as they were developed utilizing SNAP+[6], a conservation planning tool Wisconsin farmers already use, instead of loading models used by conservation professionals. While the Implementation Action Plan recognizes that the widespread adoption of soil health practices is necessary to meet reduction targets, it also acknowledges that individual property owners and farmers may choose alternate practices or a combination of practices to meet that goal.

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[5] As this plan was developed a more detailed plan of how the AOC investment could be used in the watershed was developed to support the ask that was identified as the Focus Area 1 share of the effort. That specificity was needed for the funder. As we move forward, additional information will be gathered as needed to support specific requests to funders.

[6] SnapPlus, Wisconsin's Nutrient Management Software, https://snapplus.wisc.edu/

ACCOUNTING FOR STREAMBANK EROSION

The TMDL was developed with the best information available at the time of development. Since then, additional data has been gathered regarding streambank erosion in the watershed for both rural and urban areas. A 2019 study from the US Geological Survey[7] shows that streambank loading is a significant contribution of sediment and phosphorus and for the purposes of the TMDL its contribution was not separated out and was instead assigned to the agricultural load and reduction requirements.

This Implementation Action Plan takes a deeper dive into the load allocation assigned to agriculture in the Lower Fox River TMDL. This effort will clearly separate out reduction goals for agriculture fields from streambank reductions required. Identifying streambank reduction targets in both agricultural and urban landscapes provides benefits as it:

- Provides a more accurate depiction of what is needed on the landscape and allows for non-traditional agricultural partners to be engaged in meeting the agricultural reductions identified in the TMDL
- Separates the reductions required from agricultural fields versus streambank erosion and provides an attainable reduction target for farmers to meet on their active agricultural land
- Identifies water storage targets for the watershed, understanding that streambank erosion can only be restored if action is taken on the land to reduce flashiness to the streams

The phosphorus reduction goals identified by the TMDL provide the foundation this plan was built upon. Successful implementation of the plan through dedication, partnership building and resource acquisition will result in meeting load reductions identified by the Lower Fox River TMDL.

SETTING AND ACHIEVING NUTRIENT REDUCTION GOALS

Agriculture is an important part of the economy and identity of the region. While it is important the agricultural community contribute fairly to meeting water quality goals, it is also important that goals are fair to the community and attainable. The modeling done for urban stormwater loading did not account for streambank resulting in additional load being assigned to agriculture. To begin to divide the reductions assigned to agriculture by source (agricultural lands and streambank) we need to break down the data from the TMDL.

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[7] Fitzpatrick et al, “Stream Corridor Sources of Suspended Sediment and Phosphorus from an Agricultural Tributary to the Great Lakes,” http://www.sedhyd.org/2019/proceedings/SEDHYD_Proceedings_2019_Volume4.pdf

The TDML was developed using the Soil & Water Assessment Tool (SWAT)[8] model which reports phosphorus delivery to a waterbody, in this case the Fox River. The SWAT model is often used to model urban runoff so outputs from the model (loads and reductions targets) can be easily conveyed to the urban stormwater sector. The SWAT model is not a model typically used for agricultural conservation. The Soil Nutrient Application Planner (SNAP+) is a model utilized by farmers and agriculture conservation professionals for nutrient planning and able to estimate edge of field phosphorus loss. The first step in determining how agriculture reduction targets is to transfer results of SWAT model that reports in pounds of phosphorus loaded to the river to results from SNAP+ model.

DETERMINING TARGET PHOSPHORUS LOSS PER ACRE OF AGRICULTURAL LAND

The first step in setting fair and attainable reductions for active agricultural lands was to communicate Agricultural (load) reduction goals utilizing a measurement familiar to the agriculture sector (edge of field).

To do that, the following process was followed (Table 1):

- Agricultural Acres and Agricultural Baseline Load data was taken directly from the TMDL.
- The Baseline Load Pounds per Acre was calculated by dividing the Agricultural Baseline Load by Agricultural Acres.
- The SNAP+ Edge of Field Load was calculated by multiplying the SWAT derived Baseline Load Pounds per Acre by 2.42, a correlation factor derived from the relationship between TMDL Edge of Field and Edge of Field SNAP data developed by WDNR for Water Quality Trading Guidance.[9]
- The Total Watershed Edge of Field Baseline was calculated by multiplying the Edge of Field Baseline by Agricultural Acres
- The Percent Reduction needed is taken directly from the TMDL.
- The Watershed Agricultural Load Reduction Goal is taken directly from the LFR TMDL, but can also be derived by multiplying the Agricultural Baseline Load by the Percent Reduction
- The SNAP+ Total Watershed Agricultural Edge of Field Reduction Goal was calculated by multiplying the Edge of Field Baseline by the Percent Reduction
- The Target Load Pounds per Acre was calculated by dividing the SWAT Watershed Agricultural Load Reduction Goal by the Agricultural Acres
- The Target Edge of Field Pounds per Acre was calculated by dividing the Edge of Field Reduction Goal by Agricultural Acres

[8] The Soil and Water Assessment Tool (SWAT), https://swat.tamu.edu/

[9] WDNR WQ Trading https://dnr.wi.gov/water/wsSWIMSDocument.ashx?documentSeqNo=83858832

Phosphorus											
	TMDL	TMDL		SNAP+		TMDL		SNAP+	SWAT	SNAP+	
Watershed	Ag Acres	Ag Baseline Load	Baseline Load lbs/acre	Edge of Field runoff lbs/acre Baseline	Total Watershed Edge of Field Baseline	% Reduction	Watershed Ag Load Reduction Goal	Total Watershed Ag Edge of Field Reduction Goal	Target Load lbs/acre	Target Edge of Field lbs/acre	
Plum Creek	17,382	27,660	1.59	3.85	66,937.20	86.0%	23,799	57,565.99	0.22	0.54	
Kankapot Creek	11,367	17,195	1.51	3.66	41,611.90	81.8%	14,060	34,038.53	0.28	0.67	
East River	26,520	38,020	1.43	3.47	92,008.40	83.9%	31,897	77,195.05	0.23	0.56	
Duck Creek	48,858	49,319	1.01	2.44	119,351.98	76.9%	37,911	91,781.67	0.23	0.56	
Apple Creek	20,613	27,297	1.32	3.20	66,058.74	78.6%	21,469	51,922.17	0.28	0.69	
Lower Fox River Main Stem*	9,157	12,779	1.40	3.38	30,925.18	74.2%	9,488	22,946.48	0.36	0.87	
Garners Creek	2,256	2,908	1.29	3.12	7,037.36	63.1%	1,836	4,440.57	0.48	1.15	
Bower Creek	17,142	22,946	1.34	3.24	55,529.32	83.2%	19,086	46,200.39	0.22	0.54	
Ashwaubenon Creek	11,464	12,269	1.07	2.59	29,690.98	74.0%	9,078	21,971.33	0.28	0.67	
Dutchman Creek	9,697	10,130	1.04	2.53	24,514.60	76.4%	7,738	18,729.15	0.25	0.60	
Baird Creek	8,633	9,018	1.04	2.53	21,823.56	80.4%	7,246	17,546.14	0.20	0.50	
Lower Green Bay	7,135	8,670	1.22	2.94	20,981.40	60.7%	5,261	12,735.71	0.48	1.16	
Neenah Slough	6,302	8,015	1.27	3.08	19,396.30	66.7%	5,350	12,937.33	0.42	1.02	
Mud Creek	1,474	1,884	1.28	3.09	4,559.28	39.0%	734	1,778.12	0.78	1.89	
Trout Creek	4,580	3,272	0.71	1.73	7,918.24	54.9%	1,795	4,347.11	0.32	0.78	
	202,580	**251,382**			**608,344**		**196,748**	**476,136**			

Table 1. Translating Watershed Load Reductions to Edge of Field Reductions
Detailed Spreadsheet with Calculations Linked Here

The SNAP+ (edge of field) runoff baseline estimates still include the loading coming from streambank within both the urban and agricultural sectors. Now that more is known about the impact of streambank loading in the watershed, this project set out to divide the Agricultural load and set reduction targets for active agricultural cropland to an achievable target.

To assess what a challenging but achievable field goal would be, this effort utilized existing SNAP+ modeling efforts. An analysis conducted by Outagamie and Brown County land conservation staff explored the feasibility of water quality trading in the Lower Fox River[10] and ran SNAP+ models for a variety of representative farms throughout the watershed. The Fox-Wolf Watershed Alliance verified that under a maximum conservation scenario which included cover crop, no-till, and low disturbance manure management when applicable, it was achievable for farms to average one pound per acre phosphorus loss across all their fields in an individual year and meet a goal of 1lb/acre on each field across a typical dairy rotation. In addition to the models run locally, WDNR determined a goal of 1 lb of phosphorus loss per acre was feasible through continuous cover practices through models ran for setting water quality trading credit generating thresholds.

[10] "Exploring Water Quality Trading for Compliance," August 2018

Lower Fox River Phosphorus Edge of Field Runoff Target:

1 lb/acre

While it is possible for some acres to achieve less than 1 lb of phosphorus loss, especially if fields are taken out of production or utilized for grazing, the Implementation Action Plan sets a goal of 1lb phosphorus loss per acre. Additionally, this plan estimates that only 80% of ag acres will reach the goal of 1 lb loss. Setting the goal of 1 lb/acre loss across 80% of the agriculture acres will allow flexibility in implementation for farmers and landowners to develop plans to meet average annual goals across a whole farm and individual fields. Allowing for 20% of acres to above the loss goal allows for farmers to manage their land in a way that maintains flexibility to work their fields when necessary as well as takes into consideration the variability in agricultural practices used across years' long cropping cycles. It also acknowledges that adoption of annual cropping and structural practices is voluntary and not all farmers will choose to adopt these BMPs. An 80% continuous cover goal recognizes the need to cover the landscape yet remains realistic when considering voluntary adoption.

DETERMINING TOTAL ANTICIPATED REDUCTIONS FROM AGRICULTURAL CROPPING PRACTICES AND REMAINING REDUCTIONS REQUIRED

The second step in determining how the agricultural reduction goals identified in the TMDL would be met was to determine how much of the Agriculture reduction would be met by individual farms and fields with a watershed-wide target phosphorus loss of one pound per acre. Utilizing information calculated in the previous table, the following calculations were made:

- The Edge of Field Runoff Target per acre to Support Local Water Quality identifies the challenging but achievable goal of one pound of phosphorus loss per acre set across all watersheds.
- The Edge of Field Reduction Anticipated from on Farm Practices based on target phosphorus loss per acre of 1 is calculated by subtracting the Edge of Field Runoff Target from the Edge of Field Runoff pounds per acre Baseline and multiplying the result by Agricultural Acres
- Anticipated Edge of Field Annual Reductions are based on meeting 1lb loss on 80% of acres and is calculated by multiplying the Edge of Field Reduction Anticipated from on Farm Practices based on target P loss per acre of 1 by 80%
- Total Load Reductions anticipated from Cropping Practices are calculated by multiplying Anticipated Edge of Field Annual Reductions based on plan of meeting 1lb loss on 80% of acres by 0.41 (a correlation factor derived from

the relationship between TMDL Edge of Field and Edge of Field SNAP data developed by WDNR for Water Quality Trading Guidance.)

- Remaining Edge of Field Reduction Needed are calculated by subtracting Anticipated Edge of Field Annual Reductions based on CC plan of meeting 1lb loss on 80% of acres by Total Watershed Ag Edge of Field Reduction Goal
- Remaining Load Reduction Needed is calculated by subtracting Total Load Reductions anticipated from Cropping Practices from Watershed Ag Load Reduction Goal

Phosphorus							
	TMDL	SNAP+	SNAP+	SNAP+	SWAT	SNAP+	SWAT
Watershed	Ag Acres	Edge of Field Runoff Target per acre to Support Local Water Quality	Edge of Field Reduction Anticipated from on Farm Practices based on target P loss per acre of 1	Anticipated Edge of Field Annual Reductions based on CC plan of 80% implementation	Total Load Reductions anticipated from Cropping Practices	Remaining Edge of Field Reduction Needed	Remaining Load Reduction Needed
Plum Creek	17,382	1	49,555	39,644	16,254.11	17,922	7,544.89
Kankapot Creek	11,367	1	30,245	24,196	9,920.33	9,843	4,139.67
East River	26,520	1	65,488	52,391	21,480.20	24,804	10,416.80
Duck Creek	48,858	1	70,494	56,395	23,122.03	35,386	14,788.97
Apple Creek	20,613	1	45,446	36,357	14,906.20	15,566	6,562.80
Lower Fox River Main Stem*	9,157	1	21,768	17,415	7,139.96	5,532	2,348.04
Garners Creek	2,256	1	4,781	3,825	1,568.29	615	267.71
Bower Creek	17,142	1	38,387	30,710	12,591.04	15,491	6,494.96
Ashwaubenon Creek	11,464	1	18,227	14,582	5,978.45	7,390	3,099.55
Dutchman Creek	9,697	1	14,818	11,854	4,860.17	6,875	2,877.83
Baird Creek	8,633	1	13,191	10,552	4,326.50	6,994	2,919.50
Lower Green Bay	7,135	1	13,846	11,077	4,541.62	1,659	719.38
Neenah Slough	6,302	1	13,094	10,475	4,294.93	2,462	1,055.07
Mud Creek	1,474	1	3,085	2,468	1,011.97	-	-
Trout Creek	4,580	1	3,338	2,671	1,094.94	1,677	700.06
	202,580	**1**	**405,764**	**324,612**	**133,091**	**152,214**	**63,935**

Table 2. Translating Edge of Field Targets to Anticipated Reductions
Detailed Spreadsheet with Calculations Linked Here

By achieving an edge of field loss of one pound of phosphorus per acre on 80% of the agricultural acres in the Lower Fox River, 133,091 lb or 68% of the necessary phosphorus reductions will be met. The remaining reductions are available to reach through a variety of practices as outlined in the recommended conservation practices below.

CONSERVATION PRACTICES RECOMMENDED TO MEET REDUCTION GOALS

While all conservation practices, those currently known and those that will be developed, designed, or created in the future, will be considered throughout the implementation period, this plan has modeled reductions and estimated funding needed based on those currently accepted as best management practices (BMPs). Falling into two categories, Annual Practices and Structural Practices, these practices provide producers and conservation staff opportunities to reach reduction goals through a variety of ways that are adaptable to individual needs and wants. While each BMP provides a conservation benefit individually, the total reduction needs cannot be met by annual practices alone and are best considered as a system of primary (annual practices), secondary (structural water storage practices), and tertiary (other structural BMPs) practices working together. A significant financial investment is required to meet reduction goals through implementation of BMPs. A strategy to address this need is further detailed in the Funding Strategy technical document.

ANNUAL PRACTICES – CONTINUOUS COVER

Annual practices, also referred to as soft practices or cropping practices, are a system of agricultural production practices that aim to minimize soil disturbance, build soil health and organic matter, sequester carbon, minimize soil compaction, suppress weeds, and create a soil that is primed to hold and assimilate nutrients and water. The aim of these practices is to keep root systems intact throughout the year, keeping the soil covered in organic matter and armoring against erosion. By reducing soil erosion and runoff from fields, this system of year-round cover has significant nutrient reduction potential. Annual practices are likely to be the primary mechanism to achieve agriculture reductions, as illustrated in the reduction calculated above as achievable based on adoption of continuous cover systems across 80% of the agricultural acres in the watershed.

While there are a variety of ways to achieve a Continuous Cover system, the most common methodology in the Lower Fox River is a combination of cover crops, no- or minimal-disturbance tillage, and low disturbance manure application. Estimations outlined in this plan are based on active agricultural land transitioning this system, but there are many types of Continuous Cover systems that can be combined in a variety of ways to meet the needs of an individual farmer. The following Continuous Cover systems identified by Green Lands Blue Waters[11] can provide the same or increased benefits and will be promoted as Continuous Cover solutions throughout the Lower Fox River:

[11] https://www.greenlandsbluewaters.org

- Summer annual crops rotated with winter annual crops grown as either a cover or cash crop harvested in spring.
- Perennial grasses and forbs grown as hay crops and in pastures that support the return of livestock to fields.
- Grazing of cover crops within row crop acres to re-integrate livestock.
- Tree and shrub crops to produce fruits, berries, nuts, wood, fuel, and fiber.
- Herbaceous and woody perennials to create biomass for fuel and industrial products.
- New varieties of perennial grain crops that lead to products similar to high-demand commodity crops, but with more positive impacts on soils, water, and wildlife are anticipated in the future.
- Perennial crops and annual crops can be grown in multi-year rotations and their locations in fields and on farms can shift to achieve increased continuous acres, adding up to landscape-scale change.

Beyond its ability to improve local waterways, a Continuous Cover system provides resiliency to increased storm frequency & intensity as well as to drought[12] by increasing the soils' own water holding capacity. Therefore, in addition to the direct phosphorus reductions being tracked for this effort, Continuous Cover is also included as a contribution to water storage targets for the Lower Fox River. The identified water storage capacity is based on a conservative estimate of the storage that can be built within the soil structure by increasing organic matter through Continuous Cover practices. Based on conservative estimates, after implementing Continuous Cover, soil organic matter increases by 0.05% per

Watershed	Ag Acres	Annual P lbs/yr Reduction after 10 years implementation	Increase Storage Capacity (gallons) after full Implementation
Plum Creek	17,382	39,644	139,056,000
Kankapot Creek	11,367	24,196	90,936,000
East River	26,520	52,391	212,160,000
Duck Creek	48,858	56,395	390,864,000
Apple Creek	20,613	36,357	164,904,000
Lower Fox River Main	9,157	17,415	73,256,000
Garners Creek	2,256	3,825	18,048,000
Bower Creek	17,142	30,710	137,136,000
Ashwaubenon Creek	11,464	14,582	91,712,000
Dutchman Creek	9,697	11,854	77,576,000
Baird Creek	8,633	10,552	69,064,000
Lower Green Bay	7,135	11,077	57,080,000
Neenah Slough	6,302	10,475	50,416,000
Mud Creek	1,474	2,468	11,792,000
Trout Creek	4,580	2,671	36,640,000
Lower Fox Total	**202,580**	**324,612**	**1,620,640,000**

Table 3. Phosphorus Reduction and Water Storage Benefits of 80% Continuous Cover Adoption

[12] Terri Queck-Matzie, "Cover Crops Offer Financial and Environmental Benefits," 12 Mar 2019, Successful Farming, https://www.agriculture.com/crops/cover-crops/cover-crops-offer-financial-and-environmental-benefits

year up to a 0.5% [13]in ten years, a capacity of 10,000 gallons per acre. Assuming 80% of acres are in continuous cover, this 0.5% increase in soil organic matter translates to 1.61 million gallons of water storage capacity across the watershed (see additional information on water storage capacity loss below).

Research[14] from across the country has proven economic benefit to farms that transition from a conventional till system to a continuous cover crop/no-till system. Because of the benefits to the field/farm and to the local waterways, continuous cover is a priority conservation practice for implementation promotion across the active agricultural acres in the Lower Fox River Basin.

WHO IS RESPONSIBLE FOR IMPLEMENTATION OF CONTINUOUS COVER?

County agronomy staff will work with farmers to confront hurdles to adoption of continuous cover practices. As implementation advances, farmers will be shown how they can access their SNAP+ data to determine how they are doing toward the target of one pound of phosphorus loss per acre. Farms participating in the cost share programs and interested in being able to communicate how their farm is progressing towards conservation targets will be provided a farm progress report developed by Fox-Wolf Watershed Alliance with support from County staff. As the supply chain increases requirements to be more environmentally or climate friendly, additional support for implementation is anticipated to come from the private sector.

This Implementation Plan includes flexibility in implementation. While farmers will be encouraged to meet the reduction and storage goals correlated to the number of acres operated through continuous cover practices, an alternate combination of practices could be implemented to meet the targets.

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[13] Lara Bryant, "Organic Matter Can Improve Your Soil's Water Holding Capacity, Natural Resources Defense County, May 2015, https://www.nrdc.org/experts/lara-bryant/organic-matter-can-improve-your-soils-water-holding-capacity

[14] Jacqui Fatka, "Economics Prove Cover Crops Pay," Farm Progress 24 Oct 2018, https://www.farmprogress.com/cover-crops/economics-prove-cover-crops-pay;

Elizabeth Creech, NRCS, "Saving Money, Time and Soil: The Economics of No-Till Farming," USDA 03 Aug 2021, USDA, https://www.usda.gov/media/blog/2017/11/30/saving-money-time-and-soil-economics-no-till-farming;

"Economics of Soil Health Systems," Soil Health Institute, https://soilhealthinstitute.org/our-work/initiatives/economics-of-soil-health-systems/

"Quantifying Economic and Environmental Benefits of Soil Health," American Farmland Trust with case-studies co-authored by NRCS, https://farmland.org/project/quantifying-economic-and-environmental-benefits-of-soil-health/

STRUCTURAL PRACTICES

Adaption of soil health practices continue to be the gold standard to achieve water quality goals. However, not all producers will choose to adopt these practices and instead may look to BMPs that require less annual management. Structural practices, also referred to as engineered practices, differ from Annual Practices in that they are installed as long-term solutions, meant to stay on the landscape for 20 years or more. When paired with annual practices, they provide a system of nutrient and sediment reduction. Structural practices must consider specific siting to maximize their effectiveness. The siting criteria included in this plan are general rules of thumb and specific site analysis will need to be conducted for each potential site. Structural practices also require operation and maintenance plans to ensure the functionality of the practice over its lifespan, and some uncertainty remains on the willingness of landowners to assume this responsibility. Structural storage BMPs currently used in the Lower Fox River include but are not limited to Agricultural Runoff Treatment Systems (ARTS), Two Stage Ditches, Wetland Creation, Water and Sediment Control Basins (WASCOBs), Buffers, and Streambank Restoration.

STRUCTURAL WATER STORAGE & MANAGEMENT

Natural hydrologic storage consists of lakes and streams, wetlands, ponds and other depressions that hold water for a period of time. Natural storage has been significantly altered in the Lower Fox River Basin due to urbanization and agriculture land use. [15] Reduced water storage capacity on the landscape leads to higher peak flows and flashy stream flows which causes intense streambank erosion in many areas of the basin as well as increased annual runoff and risk of flood damage.

According to the Minnesota Board of Water and Soil Resources; "Different storage practices affect the runoff from the watershed in different ways. Constructed storage practices such as ponds or wetlands will slow down runoff and reduce the peak flow from a watershed, but these types of projects typically do not change the overall volume of runoff. Other practices such as land use changes or improvements in soil health will promote additional infiltration and reduce the overall runoff volume from a watershed, but typically do not reduce the peak runoff

[15] Carolyn Kousky, Sheila Olmstead, Margaret Walls, Adam Stern & Molly Macauley, "The Role of Land Use in Adaption to Increased Precipitation and Flooding: A Case Study in Wisconsin's Lower Fox River Basin," Nov 2011 Resources for the Future https://media.rff.org/documents/RFF-Rpt-Kousky.etal.GreatLakes.pdf

rate the way that structural practices do."[16] To combat the loss of water storage, in addition to building storage within the soil profile through implementing continuous cover on agricultural fields, this effort proposes that storage also be added throughout the Lower Fox River in the form of structural water storage.

In 2019, Wisconsin Department of Natural Resources partnered with Outagamie County to analyze water storage capacity in the Lower Fox River Basin and quantify the amount of storage needed to return hydrology in the basin to pre-settlement runoff conditions. The study, concluded in 2020, found that based on the MSE4 two year rainfall event, an estimated 1.6 billion gallons of water storage capacity has been lost across the Lower Fox. The final report recommended that structural storage be installed within 17 of the 20 HUC12 Watersheds in the Lower Fox River to store the 2-year storm event and reduce streambank erosion caused by loss of storage in those watersheds.[17]

Watershed	Implementation (10 year) Start	End	Acres of storage needed for 2-year rainfall event. (2 yr)	Total Phosphorus Reduction (lbs)	Gallons of Storage (2 yr event)
Plum Creek	2015	2030	249	12,969	162,400,000
Kankapot Creek	2015	2030	155	6,335	100,900,000
East River	2017	2030	268	13,825	174,900,000
Duck Creek	2017	2030	642	17,768	418,100,000
Apple Creek	2018	2030	355	13,083	175,900,000
Lower Fox River Main Stem	2024	2034	not analyzed		
Garners Creek	2025	2035	not analyzed		
Bower Creek	2026	2036	190	8,562	123,900,000
Ashwaubenon Creek	2021	2040	157	5,758	102,200,000
Dutchman Creek	2021	2040	140	4,276	91,300,000
Baird Creek	2027	2037	89	3,288	58,100,000
Lower Green Bay	2028	2038	79	2,177	51,400,000
Neenah Slough	2029	2039	153	4,261	99,700,000
Mud Creek	2030	2040	40	1,020	26,200,000
Trout Creek	2030	2040	77	1,338	49,900,000
Total			2594	94,660	1,634,900,000

Table 4. Annual Phosphorus Reduction and Water Storage Gained Through Installation of ARTS as Proposed in "Non-Point Source Runoff Storage Capacity Opportunities for Sediment & Nutrient Reduction in the Lower Fox River Basin"

In addition to providing water quality improvement through reducing downstream streambank erosion, these storage practices can be designed to treat agriculture runoff offering a place for sediments and nutrients to settle before making their way to local waterbodies.[18] Utilizing storage structures to treat agricultural runoff is

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[16] Water Storage and Climate Resilience, https://bwsr.state.mn.us/node/6301

[17] "Non-Point Source Runoff Storage Capacity Opportunities for Sediment & Nutrient Reduction in the Lower Fox River Basin," Mar 2020 Outagamie County Land Conservation Department https://drive.google.com/file/d/1zixbvVLA77srhcd-kqd7df1xmrrvr5f2/view?usp=sharing

[18] Rosemary Myers & Allen Davis, "Treatment of Agricultural Runoff by a Cascading System of Floodway Stormwater Containment Basins," 01, Jul 2015 High Impact Environmental, Inc & University of Maryland https://highimpactenvironmental.org/wp-content/uploads/MIPS-Research-Project-Final-Summary-Thesis.pdf

a newer idea, and innovative technologies continue to be advanced to increase their effectiveness. While modeled reductions associated with storage practices accounted for only the storage practice itself, this effort proposes utilizing dissolved phosphorus filters[19] to trap phosphorus from hot spots in the basin as more is learned about the impact of the filters and maintenance requirements.

AGRICULTURAL RUNOFF TREATMENTS SYSTEMS (ARTS)

This innovative BMP was developed by designing a constructed wetland as a combination of existing BMPs (sediment basin, constructed wetland, pond, structure for water control, and grade stabilization structure) in such a way as to enhance the constructed wetlands to treat nonpoint runoff at the edge of field while also mitigating downstream streambank erosion and flooding potential. This combination of BMPs and methodology has been termed Agricultural Runoff Treatment Systems (ARTS). Since 2017, four ARTS have been installed in Outagamie and Brown Counties in Plum Creek watershed. Intensive and dedicated monitoring by USGS and University of Wisconsin-Green Bay at two of these sites has demonstrated the water quality benefits including greater than 60% particulate phosphorus and 80% suspended solids load reductions annually. The implementation milestones and associated phosphorus reductions calculated for this plan use ARTS as the structural water storage BMP applied across the watershed.

Siting Criteria

General siting criteria to consider when evaluating a site for potential installation of an ARTS system:

- A minimum of 4 feet elevation change for gravity flow
- Captures direct runoff from agricultural land
- Greater than 40 soil test phosphorus
- Nutrient management plan in place for the majority of fields
- Additional consideration for potential for installation of detention pond as an in-line diversion of an existing drainage
- Plan for long term operations and maintenance

TWO STAGE DITCHES

Two stage ditches are drainage ditches that have been modified by adding benches that serve as floodplains within the overall channel. The benches can also function

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[19] Dr. Chad Penn, “A Tool for Trapping Dissolved Phosphorus,” Arizona State University Sustainable Phosphorus Alliance https://phosphorusalliance.org/2019/09/chad-penn/

as wetlands during certain times of the year, reducing ditch nutrient loads. The modified ditches maintain drainage while allowing sediment and nutrients to settle out, and provide flood storage during rain events. Two stage ditches take the place of existing ditches and are often sited in drainage districts where agricultural land is prevalent and drainage is a challenge.

Siting Criteria

General siting criteria to consider when evaluating a site for potential installation of a two stage ditch:

- Waterway without stream history
- Large catchment of greater than 100 acres
- Minimal grade of less than 4%
- Plan for long term operations and maintenance

WATER AND SEDIMENT CONTROL BASINS (WASCOBS)

WASCOBs are constructed across small drainageways to intercept runoff to reduce gully erosion and trap sediment. The basin captures field runoff and slowly releases it, allow sediment to settle out.

Siting Criteria

General siting criteria to consider when evaluating a site for potential installation of a WASCOB:

- Small catchment of less than 10 acres of drainage
- Sited to allow for cropping through
- A minimum of 4 feet elevation change for gravity flow
- Captures direct runoff from agricultural land
- Plan for long term operations and maintenance

WETLAND CREATION

Wetlands provide several important ecosystem services, including water storage, trapping sediments and nutrients, and providing critical fish and wildlife habitat. As described previously, over 1.6 billion gallons of water storage has been lost in the Lower Fox as a result of wetland conversion to other land uses through drainage or filling (i.e., agricultural fields, urban areas, residential areas, etc.). As a result, restoring wetlands can provide some of the lost water storage and nutrient reduction services needed in the Lower Fox River Basin.

Wetland restoration activities generally fall into four categories:

- Wetland rehabilitation: restoration in existing wetlands that have become degraded in condition due to alterations in hydrology, vegetation, soil or fauna. This includes addressing the source of degradation and/or improving the condition of the wetland itself.
- Wetland enhancement: restoration in existing wetlands that improve wetland function(s). An example of this would be creating more deep water habitat in an existing wetland for waterfowl habitat.
- Wetland re-establishment: restoring historically present wetlands that are considered upland areas today as a result of filling or draining. While this is similar to implementing an ARTS, the main difference here is that wetland re-establishment assumes the primary function of the wetland is for fish and wildlife habitat, with water storage and nutrient and sediment reduction services being a secondary goal.
- Wetland creation: creating new wetlands were there were not wetlands documented historically.

In 2018, The Nature Conservancy published a report in partnership with WDNR OGW and UWGB Cofrin Center for Biodiversity that provided the results of an ArcGIS evaluation of potentially restorable wetlands (PRWs) where re-establishment opportunities exist in the LFR basin. Of those opportunities, TNC ranked PRWs as "Very High", "High", and "Moderate" based on the likelihood that the site would retain sediment and phosphorus, if tile drain was present, and soil test phosphorus levels from NMP data.

Using this information, a group of stakeholders estimated the total acres of opportunity for re-establishing wetlands or installing ARTS by considering only the sites in the "Very High" or "High" PRW rankings, removing those that are known to have buildings or other features that would preclude restoration, and estimated that only 15-25% of the remaining acres would actually be restorable.

The group found that between 5,745 – 9,575 acres of PRWs likely exist within the LFR. However, phosphorus retention in natural wetlands can range between 0 – 100% and is dependent on several factors, including upland management[20]. This suggests that while natural wetlands do provide several ecosystem services, it

[20] Maximizing the Water Quality Benefits of Wetlands in Croplands. https://www.nrcs.usda.gov/sites/default/files/2023-01/CEAP-Wetlands-2023-ConservationInsight-WetlandsWaterQuality.pdf.

should be used as a tertiary nutrient and sediment reduction treatment downstream of a system of other conservation practices.

Siting Criteria
General siting criteria to consider when evaluating a site for potential installation of a wetland:

- Tertiary practice to be used in conjunction with other structural practices
- Identified as potentially restorable wetland
- Plan for long term operations and maintenance
- Not appropriate as a primary treatment for nutrients

WHO IS RESPONSIBLE FOR IMPLEMENTATION OF STRUCTURAL WATER STORAGE?

The structural water storage goal has been divided up into a per acre goal. The Implementation Action Plan recommends that each land use sector and individual stakeholders within that sector will be assigned the storage targets related to the number of acres they are responsible for within the watershed. The number of acres managed by an entity will be used to calculate the storage target they would be responsible for and the storage goal for a subwatershed will be divided out proportionally to the entities who manage land in that area.

Increasing Structural Storage to increase watershed resiliency will be a primary goal of the Keepers of the Fox program. Connecting those that may benefit from storage with those that choose to implement structural storage will be crucial to success and long-term management of these structures. End users who may benefit from structural storage include but are not limited to:

1. Downstream communities could rely on structural storage for flood mitigation
2. Farmers could rely on structural storage for irrigation if needed in future

County technician staff (see staffing need below) will work with private property owners to identify sites, design practices and oversee installation and ensure the practices are functioning as intended. While the Keeper of the Fox program will work with County staff and private property owners to build support to cover operation and maintenance costs of ARTS systems that are installed to reduce impacts of downstream flooding, long term operation and maintenance will be the responsibility of the land owner. While ARTS implementation was the practice modeled for this exercise, if property owners prefer to meet structural storage targets through other avenues, all practices that increase storage capacity and have water quality benefits will be promoted and considered. If farmers increase soil organic matter beyond 0.5% the additional storage gained through soil structure could be applied toward meeting their structural storage targets.

STREAMBANK RESTORATION

Lost storage on the landscape has caused increased peak stream flows resulting in the frequency of out-of-bank flooding increasing. In many cases, streams have responded by enlarging their channels and floodplains. Long standing riparian property owners in the Basin have told stories about once being able to step across a stream or have cows cross a stream that now have banks higher than 5 feet tall.

Watershed	Implementation (10 year) Start	Implementation (10 year) End	Inventory & Estimated Eroding Streambank (ft)	50% Implementability Filter (ft)	Estimated Phosphorus Reductions after restoration
Plum Creek	2015	2030	132,400	**66,200**	**1,862**
Kankapot Creek	2015	2030	83,347	**41,673**	**1,014**
East River	2017	2030	91,927	**45,963**	**1,104**
Duck Creek	2017	2030	21,936	**10,968**	**123**
Apple Creek	2018	2030	52,654	**26,327**	**836**
Lower Fox River Main Stem	2024	2034	Not inventoried	N/A	N/A
Garners Creek	2025	2035	16,903	**8,452**	**238**
Bower Creek	2026	2036	48,216	**24,108**	**706**
Ashwaubenon Creek	2021	2040	46,094	**23,047**	**971**
Dutchman Creek	2021	2040	27,285	**13,642**	**198**
Baird Creek	2027	2037	25,177	**12,589**	**319**
Lower Green Bay	2028	2038	6,512	**3,256**	**36**
Neenah Slough	2029	2039	Not inventoried	N/A	N/A
Mud Creek	2030	2040	Not inventoried	N/A	N/A
Trout Creek	2030	2040	15,929	**7,964**	**89**
Lower Fox River Watershed Total			**568,379**	**284,189**	**7,497**

Table 5. Phosphorus Reduction of Streambank Restoration Implemented on 50% of Eroding Streambanks

Results from the Plum Creek Sediment Fingerprinting study conducted by USGS have shown that streambank erosion is a significant source of total phosphorus and total suspended solids in Plum Creek[21] (Fitzpatrick et al. 2019), indicating that a combination of practices that increase water holding capacity and streambank stabilization are necessary in the Lower Fox River to realize meaningful improvements in water quality. While increasing storage in the watershed is the main solution in restoring stability to local streambanks, active streambank restoration will likely still be needed for very highly eroded streambanks. As with other structural practices, the effectiveness and maintenance of streambank stabilization projects is affected by the presence of upland conservation practices. As a result, streambank

[21] Fitzpatrick et al, "Stream corridor sources of suspended sediment and phosphorus from an agricultural tributary to the Great Lakes," 2019 *Proceedings of SEDHYD 2019* Page 189 http://www.sedhyd.org/2019/proceedings/SEDHYD_Proceedings_2019_Volume4.pdf

stabilization should be implemented only when water quantity control has been assured upstream.

Streambank inventories of individual HUC 12 watersheds have been conducted by Outagamie County staff through the 9 Key Element Planning process for the Lower Fox River Basin. These inventories provided the data necessary for a technical work group brought together by WDNR in 2019 to determine the quantity of severely eroded stream bank that would be accessible for active stabilization and restoration and the associated phosphorus reductions that would result from restoration efforts.

Phosphorus reductions calculated through this effort was conservative. Actual reductions are anticipated to be higher than estimated. Additionally, only streambank restored through active restoration is currently being counted in anticipated reductions. As implementation advances and more is learned about streambank restoration attributed to storage capacity, additional reductions for restored streambank may be counted, potentially reducing the need for other practices.

Siting Criteria
General siting criteria to consider when evaluating a site for potential installation of streambank restoration:

- Tertiary practice to be used in conjunction with other structural practices
- Only appropriate when water quantity has been addressed upstream
- Plan for long term operations and maintenance
- Not appropriate as a primary treatment for nutrients

WHO IS RESPONSIBLE FOR IMPLEMENTATION?

The land owner of the streambank that needs restoration is ultimately responsible for restoration of the bank. County technician staff will work with private property owners to identify sites needing restoration, design practices and oversee installation. Ensuring that proper storage has been built either through increased capacity in the soil or structural practices prior to streambank restoration work being complete will be important to long term success of restoration efforts. Long term operation and maintenance will be the responsibility of the land owner. Restoration solutions will be unique to each landowner and needs of the stream segment.

IMPLEMENTATION MILESTONES & ASSOCIATED PHOSPHORUS REDUCTIONS

The Implementation Action Plan is designed to provide flexibility. After years of experience implementing conservation plans, implementers know that that even the most thought-out plans have to be adaptable. Landowner willingness, existing features on the landscape, new technologies, changing agribusiness, available equipment and weather are all factors that can impact implementation of a plan.

The ultimate goal of this effort is not to get a certain number of identified practices on the land but to get a combination of practices on the land that meet the phosphorus reduction targets anticipated to lead to meeting water quality goals. Conservation professionals will work with farmers and landowners to determine what type of conservation practices work best on their land and for their individual business to meet the needed load reduction from their land. As the majority of the conservation work needed to meet the agricultural reduction target will need to be installed voluntarily, finding the right practices for each farmer/landowner will be critical to ensuring long term adoption of practices.

ESTIMATED REDUCTIONS BY PRACTICE TYPE

The Lower Fox River Total Maximum Daily Loads assigns 196,748 lbs of phosphorus to be reduced by the agricultural land base. This plan developed targets to reach a reduction up to 236,316 lbs of phosphorus. Increasing the planned reductions will allow for some flexibility in implementation as well as provide additional reductions to offset some of the impact of a changing climate.

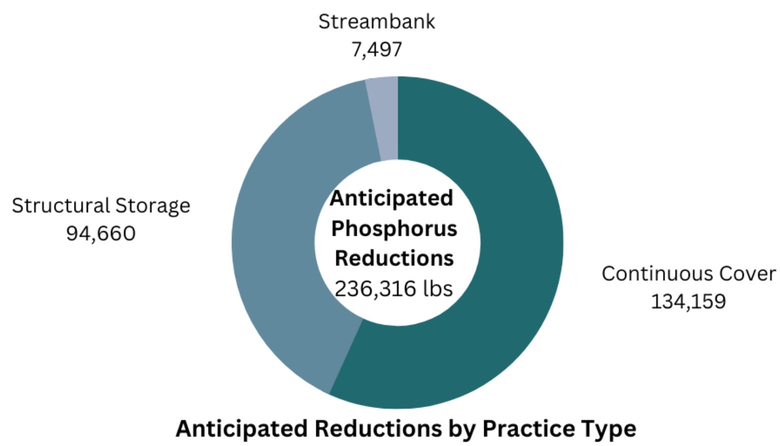

Figure 2. Total Phosphorus Reductions Anticipated Across the Lower Fox River By Practice Type

Implementation of this plan is dependent upon funding being available to advance the plan as presented. The KOF program and its partners will work to build support for funding implementation of the plan (see Funding Strategy technical document). The Implementation Action Plan was intentionally developed on an aggressive timeline to show urgency in the need for watershed recovery.

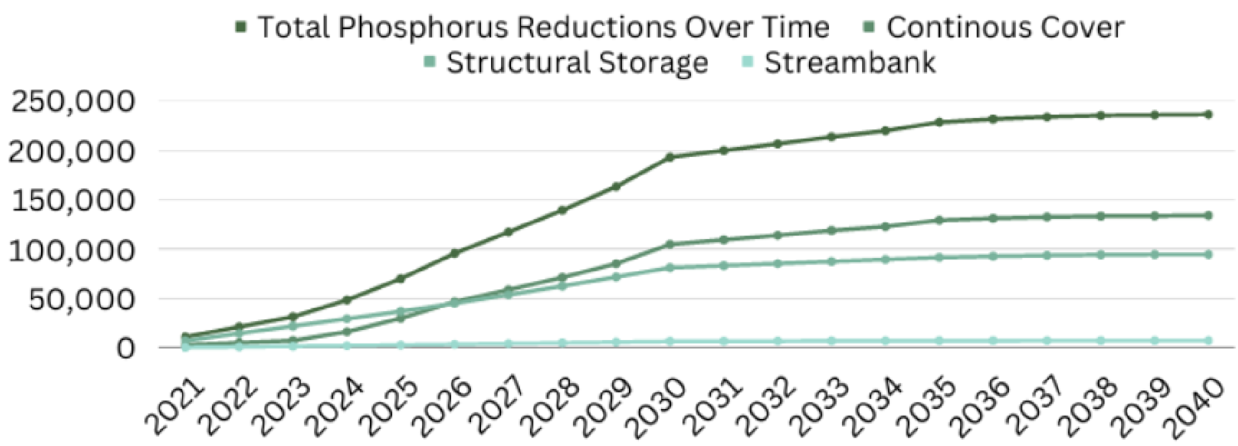

Figure 4. Total Phosphorus Reductions Anticipated Across the Lower Fox By Practice Type and Timeline

Ashwaubenon and Dutchman Creek Watersheds have been selected by NEW Water (Green Bay Metropolitan Sewerage District) to be implemented through the Adaptive Management alternate compliance option for waste water treatment permit compliance. While reduction targets and water quality targets will be met, the timeline for Ashwaubenon and Dutchman Creek watersheds is shown at NEW Water's Adaptive Management permit compliance timeline (25% reductions after the first 5-year permit, 70% after the second 5 year permit, 95% after the third 5-year permit and 100% after the fourth 5 year permit.) NEW Water is committed to reporting reductions annually as obtained within the watersheds so actual implementation reporting will show gains within the 5-year timeframes.

CONTINUOUS COVER

As continuous cover practices are implemented and adopted by farmers in the watershed, it is anticipated that the rate of implementation increases over time. For planning purposes, the rate of implementation is consistent across each subwatershed.

Assuming implementation and adoption occurs within the subwatershed's 10 year strategic implementation period, the following rates of implementation are planned:

Year 1 – 3% of Agricultural Acres
Year 2 – 5% of Agricultural Acres
Year 3 – 7% of Agricultural Acres
Year 4 – 15% of Agricultural Acres
Year 5 – 25% of Agricultural Acres

Year 6 – 40% of Agricultural Acres
Year 7 – 50% of Agricultural Acres
Year 8 – 60% of Agricultural Acres
Year 9 – 70% of Agricultural Acres
Year 10 – 80% of Agricultural Acres

Phosphorus reductions were calculated using the difference between each subwatershed's edge of field baseline load and the edge of field target of 1. The difference is the anticipated reduction of lbs/acre. That difference was multiplied by the number of acres implemented to estimate total annual P reduction. As implementation progresses, actual implemented acres and associated reductions will be tracked and reported. See the Shared Measurement technical document for more information.

			Implementation Year			Year 1			Year 10			Year 20		
Watershed	Ag Acres	Annual Edge of Field P lbs/yr Reduction after 10 years implementation	Annual Load P lbs/yr Reduction after 10 years implementation (SWAT)	Implementation (10 year) *Start*	*End*	% of Total Acres	Edge of Field P Reduction (SNAP+)	Load P Reduction (SWAT)	% of Total Acres	Edge of Field P Reductio n (SNAP+)	Load P Reduction (SWAT)	% of Total Acres	Edge of Field P Reduction (SNAP+)	Load P Reductio n (SWAT)
Plum Creek	17,382	39,644	16,385	2015	2030	3%	1,487	614	80%	39,644	16,385	80%	39,644	16,385
Kankapot Creek	11,367	24,196	10,000	2015	2030	3%	907	375	80%	24,196	10,000	80%	24,196	10,000
East River	26,520	52,391	21,653	2017	2030	3%	1,965	812	80%	52,391	21,653	80%	52,391	21,653
Duck Creek	48,858	56,395	23,308	2017	2030	3%	2,115	874	80%	56,395	23,308	80%	56,395	23,308
Apple Creek	20,613	36,357	15,026	2018	2030	3%	1,363	563	80%	36,357	15,026	80%	36,357	15,026
Lower Fox River Ma	9,157	17,415	7,197	2024	2034		-	-	50%	10,884	4,498	80%	17,415	7,197
Garners Creek	2,256	3,825	1,581	2025	2035		-	-	40%	1,913	790	80%	3,825	1,581
Bower Creek	17,142	30,710	12,692	2026	2036		-	-	25%	9,597	3,966	80%	30,710	12,692
Ashwaubenon Creel	11,464	14,582	6,026	2021	2040		-	-		10,207	4,219	80%	14,582	6,026
Dutchman Creek	9,697	11,854	4,899	2021	2040		-	-		8,298	3,429	80%	11,854	4,899
Baird Creek	8,633	10,552	4,361	2027	2037		-	-	15%	1,979	818	80%	10,552	4,361
Lower Green Bay	7,135	11,077	4,578	2028	2038		-	-	7%	969	401	80%	11,077	4,578
Neenah Slough	6,302	10,475	4,329	2029	2039		-	-	5%	655	271	80%	10,475	4,329
Mud Creek	1,474	2,468	1,020	2030	2040		-	-	3%	93	38	80%	2,468	1,020
Trout Creek	4,580	2,671	1,104	2030	2040		-	-	3%	100	41	80%	2,671	1,104
Lower Fox Total	**202,580**	**324,612**	**134,159**	**Lower Fox Total**		2%	7,837	3,239	55%	253,676	104,842	80%	324,612	134,159

Table 6. Summary of Anticipated Reductions From Continuous Cover Through 2040
Detailed Spreadsheet with Each Year of Implementation and Calculations Linked Here

STRUCTURAL WATER STORAGE

The Implementation Action Plan will work to install permanent structural storage to hold the 2-year rain event within sub-watersheds. Structural storage is not only beneficial for improving water quality but also has flood mitigation benefits. This is especially important as frequency and intensity of rain events increase. Modeled reductions for this plan are based on ARTS but the water storage goals can also be achieved through installation of the additional practices included in this document.

For detailed information about how structural storage targets were developed, read "Non-Point source Runoff Storage Capacity Opportunities in the Lower Fox River Basin.[22]"

Structural storage is planned to be implemented evenly over the 10 year implementation period for each subwatershed.

Structural Storage						Year 1				Year 10			Year 20		
	Implementation (10 year)						Cumulative Total Imple	Cumulative Annual Benefits		Cumulative Total Imple	Cumulative Annual Benefits		Cumulative Total Imple	Cumulative Annual Benefits	
Watershed	*Start*	*End*	Ag Acres	Total P Reduction (lbs)	Gallons of Storage (2 yr event)	Funding Need	%	P Reduction (lbs)	Water Storage (gallons)	%	P Reduction (lbs)	Water Storage (gallons)	%	P Reduction (lbs)	Water Storage (gallons)
Plum Creek	2015	2030	17,382	12,969	162,400,000	$ **1,813,700**	10%	**1,297**	**16,240,000**	100%	**12,969**	**162,400,000**	100%	**12,969**	**162,400,000**
Kankapot Creek	2015	2030	11,367	6,335	100,900,000	$ **1,195,400**	10%	**634**	**10,090,000**	100%	**6,335**	**100,900,000**	100%	**6,335**	**100,900,000**
East River	2017	2030	26,520	13,825	174,900,000	$ **2,239,100**	10%	**1,383**	**17,490,000**	100%	**13,825**	**174,900,000**	100%	**13,825**	**174,900,000**
Duck Creek	2017	2030	48,858	17,768	418,100,000	$ **4,331,800**	10%	**1,777**	**41,810,000**	100%	**17,768**	**418,100,000**	100%	**17,768**	**418,100,000**
Apple Creek	2018	2030	20,613	13,083	175,900,000	$ **2,229,500**	10%	**1,308**	**17,590,000**	100%	**13,083**	**175,900,000**	100%	**13,083**	**175,900,000**
Lower Fox River Main Ste	2024	2034	9,157	not analyzed			not analyzed			not analyzed			not analyzed		
Garners Creek	2025	2035	2,256	not analyzed			not analyzed			not analyzed			not analyzed		
Bower Creek	2026	2036	17,142	8,562	123,900,000	$ -	0%	-	-	50%	**4,281**	**61,950,000**	100%	**8,562**	**123,900,000**
Ashwaubenon Creek	2021	2040	11,464	5,758	102,200,000	$ -	0%	-	-	70%	**4,031**	**71,540,000**	100%	**5,758**	**102,200,000**
Dutchman Creek	2021	2040	9,697	4,276	91,300,000	$ -	0%	-	-	70%	**2,993**	**63,910,000**	100%	**4,276**	**91,300,000**
Baird Creek	2027	2037	8,633	3,288	58,100,000	$ -	0%	-	-	40%	**1,315**	**23,240,000**	100%	**3,288**	**58,100,000**
Lower Green Bay	2028	2038	7,135	2,177	51,400,000	$ -	0%	-	-	30%	**653**	**15,420,000**	100%	**2,177**	**51,400,000**
Neenah Slough	2029	2039	6,302	4,261	99,700,000	$ -	0%	-	-	20%	**852**	**19,940,000**	100%	**4,261**	**99,700,000**
Mud Creek	2030	2040	1,474	1,020	26,200,000	$ -	0%	-	-	10%	**102**	**2,620,000**	100%	**1,020**	**26,200,000**
Trout Creek	2030	2040	4,580	1,338	49,900,000	$ -	0%	-	-	10%	**134**	**4,990,000**	100%	**1,338**	**49,900,000**
		Total	**202,580**	**94,660**	**1,634,900,000**	**$ 11,809,500**	6%	**6,398**	**103,220,000**	80%	**78,341**	**1,295,810,000**	100%	**94,660**	**1,634,900,000**

Table 7. Summary of Anticipated Reductions From Structural Storage Through 2040
Detailed Spreadsheet with Each Year of Implementation and Calculations Linked Here

STREAMBANK RESTORATION

Streambank erosion has been exacerbated by increased peak flows due to land use changes. As water storage is restored on the landscape, through improved soil health and structural storage, streambanks in need of active restoration will be addressed. The Implementation Action Plan will work to restore streambanks for benefits to both water quality and habitat.

In 2019, the Wisconsin Department of Natural Resources Office of Great Waters convened a stakeholder group to estimate the amount of streambank erosion and the amount of restorable streambanks throughout the Lower Fox River Watershed. With support of this group, Outagamie County Land Conservation Department utilized streambank inventories conducted for 9 Key Element Planning and

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22 "Non-Point Source Runoff Storage Capacity Opportunities for Sediment & Nutrient Reduction in the Lower Fox River Basin," Mar 2020 *Outagamie County Land Conservation Department* https://drive.google.com/file/d/1zixbvVLA77srhcd-kqd7df1xmrrvr5f2/view?usp=sharing

developed estimates for the linear feet of eroding streambank, phosphorus loss and the impact of restoration throughout the Lower Fox River Watershed. Documentation on the process of estimating streambank restoration needs can be found in the Method for Estimating TP & TSS Reductions From Implementing Streambank Stabilization[23] and the Streambank Calculations prepared by Outagamie County[24].

Streambank Restoration is planned to be implemented evenly over the 10-year implementation period for each subwatershed.

Streambank Restoration				Year 1			Year 10			Year 20		
Watershed	Implementation (10 year) Start	End	Phosphorus Reductions after restoration (lb)	Cumulative % of Total Implemented	Cumulative Streambank Restored (ft)	Cumulative Annual P Reduction (lbs)	Cumulative % of Total Implemented	Cumulative Streambank Restored (ft)	Cumulative Annual P Reduction (lbs)	Cumulative % of Total Implemented	Cumulative Streambank Restored (ft)	Cumulative Annual P Reduction (lbs)
Plum Creek	2015	2030	**1,862**	10%	6,620	**186**	100%	66,200	**1,862**	100%	66,200	**1,862**
Kankapot Creek	2015	2030	**1,014**	10%	4,167	**101**	100%	41,673	**1,014**	100%	41,673	**1,014**
East River	2017	2030	**1,104**	10%	4,596	**110**	100%	45,963	**1,104**	100%	45,963	**1,104**
Duck Creek	2017	2030	**123**	10%	1,097	**12**	100%	10,968	**123**	100%	10,968	**123**
Apple Creek	2018	2030	**836**	10%	2,633	**84**	100%	26,327	**836**	100%	26,327	**836**
Lower Fox River Main Stem	2024	2034	N/A	Not Inventoried/Analyzed			Not Inventoried/Analyzed			Not Inventoried/Analyzed		
Garners Creek	2025	2035	**238**	0%			60%	5,071	**143**	100%	8,452	**238**
Bower Creek	2026	2036	**706**	0%			50%	12,054	**353**	100%	24,108	**706**
Ashwaubenon Creek	2021	2040	**971**	0%	-	-	70%	16,133	**680**	100%	23,047	**971**
Dutchman Creek	2021	2040	**198**	0%	-	-	70%	9,550	**139**	100%	13,642	**198**
Baird Creek	2027	2037	**319**	0%			40%	5,035	**128**	100%	12,589	**319**
Lower Green Bay	2028	2038	**36**	0%	-	-	30%	977	**11**	100%	3,256	**36**
Neenah Slough	2029	2039	N/A	Not Inventoried/Analyzed			Not Inventoried/Analyzed			Not Inventoried/Analyzed		
Mud Creek	2030	2040	N/A	Not Inventoried/Analyzed			Not Inventoried/Analyzed			Not Inventoried/Analyzed		
Trout Creek	2030	2040	**89**	0%	-	-	10%	796	**9**	100%	7,964	**89**
Lower Fox River Watershed Total			**7,497**	7%	19,113	**494**	85%	240,748	**6,401**	100%	284,189	**7,497**

Table 8. Summary of Anticipated Reductions from Streambank Restoration Through 2040. Detailed Spreadsheet with Each Year of Implementation and Calculations Linked Here

AGRONOMY & TECHNICAL SUPPORT NEEDED TO MEET TARGETS

"Boots on the ground" are a critical component to successful implementation and permanency of recovery efforts. To meet the intense pace during the implementation period, the following is being recommended for staff during the 10 year strategic implementation period for each sub-watershed. Trained Implementation Staff will move from watershed to watershed as implementation advances.

[23] Method for Estimating TP & TSS Reductions From Implementing Streambank Stabilization, https://docs.google.com/document/d/11oh57fcT-9u1QgPofj0MLkR3-Bhft_hH/edit
[24] Streambank Background worksheet, https://docs.google.com/spreadsheets/d/1Y0WBWYmxrNJDnolcgVGTpzgL_fhrh52F/edit#gid=1922765808

- 1 Agronomist for every 15,000 agricultural acres
- 1 Technician for every 15,000 agricultural acres
- 1 Contract/Grant Manager for every 60,000 agricultural acres

To ensure practices remain in place, permanent conservation staff is important to provide farmers and landowners continued support for installed practices. To conduct continued verification that structural practices are installed and operating as intended and to be able to provide support to farmers with annual cropping practices, the following staff level is recommended to remain in place after implementation is complete.

- 1 Agronomist for every 30,000 agricultural acres
- 1 Technician for every 60,000 agricultural acres

More detail on the need for staffing to support implementation at the pace called for the Implementation Action Plan can be found in the Funding Strategy technical document, including specifics on staff needed per watershed and the anticipated financial investment from County Land Conservation departments.

PERMITTED URBAN STORMWATER & WASTEWATER

The Implementation Action Plan acknowledges the work and investment that is being made by municipalities for urban stormwater management and municipal and industrial wastewater entities to reduce pollutants to meet required reduction targets and improve water quality.

Public facing reports will show required reductions for permittees in the watershed, however, besides being supportive of the permittees working towards target, this Implementation Action Plan will not be providing funding to permitted stakeholders to install conservation practices to meet targets.

DEMONSTRATING THE BENEFITS OF INTENSIVE IMPLEMENTATION

This Implementation Action Plan sets bold goals of continuous cover on 80% of all agricultural acres in the watershed along with additional structural practices to meet reduction goals. We are optimistic that with the support of county conservation staff, cost share dollars, and market pressure, producers in the Lower Fox River will adopt this Implementation Action Plan in the 20 year timeline. However, we acknowledge that questions still remain around the time it will take to see improvements in water quality, land owner willingness, ongoing maintenance and operation agreements, and water storage permitting. For that reason, a subset of the Implementation Workgroup convened to develop a demonstration project to test the effectiveness of implementation of a full suite of practices in selected small scale catchments. By implementing the annual and structural practices as recommended in the Implementation Action Plan on a smaller and focused catchment-level scale, we are optimistic we will see improved water quality, habitat, and fish and macroinvertebrate condition at a faster pace and also show success in implementing the parameters of the plan. These successes will provide an opportunity to celebrate wins and bring more support for conservation efforts.

CRITERIA

Brown County and Outagamie County, along with WDNR, Fox-Wolf, and NEW Water gathered to determine site selection for these intensive demonstration sites and selected the Plum Creek and Upper East River as watersheds to implement in. Not only are these two of the three highest loading watersheds, both demonstrate clear storage needs as downstream flooding occurs in the East River and significant portions of Plum Creek suffer from degraded streambank. We considered five main factors for determining which catchments to focus on:

- Where do we see existing adoption of conservation practices and are confident we could get 80% of the catchment in continuous cover?
- Where do local staff know there are willing landowners to the continuous cover goal and install structural practices on their land?
- Where are there opportunities for a full suite of structural practices and a high acreage efficiency factor (highest phosphorus reduction for the financial investment)?
- What catchments have a localized tributary outlet that will be near enough to implementation to show improvement?
- What catchments have existing water quality monitoring?

SITE SELECTION

Originally, the group heavily weighted sites with previous data collection. However, after evaluating many catchment opportunities in the East River and Plum watersheds, it was clear that landowner willingness is the limiting factor in selecting sites for intensive implementation. Two catchments in each watershed were determined to be appropriate sites and comparable sizes between the two, allowing for paired observations. In Plum, catchment 737 (678 acres) and 739 (212 acres) and in East River catchment 734 (681 acres) and 729 (180 acres). Maps of existing conditions for each catchment including soil test phosphorus concentrations and existing conservation practices are included as Appendix 1[25].

Brown and Outagamie County reviewed the total conservation opportunity in each of the catchments and designed a stacked implementation approach to achieve the total reduction needed or beyond for that catchment. 80% was assumed and structural practices were implemented as appropriate, including ARTS, streambank stabilization, two stage ditches, and buffer. SWAT modeling was completed to determine the associated reductions if these opportunities were implemented, with a total of 2,268 lbs/year of TP and 595 tons/year TSS removed (Tables 9 and 10). Maps of the catchments with conservation practices indicated for each catchment are included as Appendix 2[26].

Subwatershed ID	Plum 737	Plum 739	Upper East 734	Upper East 729	Total
Total Acreage	678	212	681	180	1751
Acreage Efficiency Factor (AEF)	23	24	30	38	
Total TP Loading (lbs/yr)	875	273	708	187	2043
Total TSS Loading (tons/yr)	176	55	140	40	411
Agricultural Acres in Continuous Cover	542	170	144	545	1401
ARTS Treated Acres	595	163	0	254	1012
Streambank Stabilization (ln ft)	760	0	0	0	760
Buffer Treated Acres	0	0	2	8.5	10.5
TSD Length (ln ft)	5380	0	0	0	5380
Number of WASCOBs	3	8	0	0	11

Table 9. Summary Acreage and TP/TSS Loading for Selected Catchments Along with Total Conservation Opportunities

[25] ArcGIS maps of current condition of each catchment including soil test phosphorus, residue and cover crops, and existing conservation implementation, March 30, 2023
https://drive.google.com/file/d/1zRaCIDKRIKRbDCKEicqfmr8ungSVKLtx/view?usp=sharing
[26] ArcGIS maps of mapped conservation practices for each catchment,
https://drive.google.com/file/d/1aD8P2560J6RNmxRZ4PXs18P8A9_yNnMl/view?usp=share_link

Subwatershed ID	Plum 737	Plum 739	Upper East 734	Upper East 729	Total
80% CC TP Reduction (lbs/yr)	598	187	143	540	1468
80% CC TSS Reduction (tons/yr)	133	42	32	121	328
ARTS TP Reduction (lbs/yr)	393	108	0	151	652
ARTS TSS Reduction (tons/yr)	117	32	0	45	194
SBS TP Reduction (lbs/yr)	26	0	0	0	26
SBS TSS Reduction (tons/yr)	16	0	0	0	16
Buffer TP Reduction (lbs/yr)	0	0	19	28	47
Buffer TSS Reduction (tons/yr)	0	0	5	8	13
TSD TP Reduction (lb/yr)	44	0	0	0	44
TSD TSS Reduction (tons/yr)	27	0	0	0	27
WASCOBTP Reduction (lbs/yr)	14	13	0	0	27
WASCOB TSS Reduction (tons/yr)	8	9	0	0	17
Total TP Reductions for Catchment (lbs/yr)	1075	308	162	719	2264
Total TSS Reductions for Catchment (tons/yr)	301	83	37	174	595

Table 10. Total TP/TSS Reduction Potential Through Implementation of a Full Suite of Conservation Practices

FUNDING

While the structural storage and streambank stabilization reductions appear to cost significantly more per pound of total phosphorus removed on an annual basis compared to that of annual continuous cover implementation, it should be noted that the structural storage and streambank stabilization practices provide these annual reductions across a 10 to 30 year time period. As long as adequate maintenance is completed, structural storage and streambank projects should maintain a high removal efficiency and therefore become much more comparable in cost per pounds of phosphorus removed over the lifespan of the project (Table 11). The total estimated cost to implement all conservation practices over a 6 year period is $3,298,002.

Subwatershed ID	Plum 737	Plum 739	Upper East 734	Upper East 729	Average Cost/lb Over Lifespan of the Project	Total Project Cost
CC Total Cost Over 6 Years	$344,966	$108,120	$91,584	$346,620		$891,290
CC Annual Cost/lb TP Reduced	$96	$96	$107	$107	$102	
ARTS Total Project Cost	$682,260	$189,872		$1,060,091		$1,932,223
ARTS Annual Cost/lb TP Reduced	$1,734	$1,762		$7,019		
ARTS 20 Year Cost/lb TP Reduced	$87	$88		$351	$175.00	
Streambank Total Cost	$38,000					$38,000
Streambank Annual Cost/lb TP Reduced	$1,462					
Streambank 20 Year Cost/lb TP Reduced	$73				$73	
Buffer Total Cost			$1,152	$4,897		$6,049
Buffer Annual Cost/lb TP Reduced			$61	$175		
Buffer 10 Year Cost/lb TP Reduced			$6	$17	$12	
Two Stage Ditch Total Cost	$349,700					$349,700
WASCOB Total Cost	$22,020	$58,720				$80,740

Table 11. Total project costs for annual and structural practices and estimated cost per lb total phosphorus reduced over the lifespan of the practice. Annual and longer term costs per pound of total phosphorus reduced was not calculated for two stage ditches or WASCOBs

This intensive implementation of Continuous Cover practices will be funded using the strategy recommending in the Funding Strategy technical document. Adoption of new annual practices will be cost shared through farmer initiated funding sources such as EQIP or through an innovative funding source available through GLRI Focus Area 3. The structural storage and streambank stabilization practices will be included on the Lower Green Bay & Fox River AOC Eutrophication or Undesirable Algae Management Action List, and therefore funding will be pursued by WDNR OGW from Focus Area 1 (Toxic Substances and Areas of Concern) of GLRI.

Practice	Funding Source	Estimated Total Request	Funding Request Timeline	Implementation Timeline
Continuous Cover	Focus Area 3 GLRI or Farmer-Initiated Funding	$891,290	Federal Fiscal Year 2024	2024 – 2030
Structural Storage (ARTS, Buffers, TDS, WASCOBs)	Focus Area 1 GLRI	$2,368,712	Federal Fiscal Year 2024, Quarter 2	2024 - 2025
Streambank Stabilization	Focus Area 1 GLRI	$38,000	Federal Fiscal Year 2025, Quarter 2	2025

Table 12. Funding Need for Intensive Implementation Demonstration

MONITORING FOR CHANGE

The WDNR Water Quality program will assist in a monitoring protocol before, during, and after implementation of this intensive monitoring. This will include the following activities:

- Completing Wisconsin Perennial Stream Determination Field Methodology for waterways in the selected catchments. Determining whether a waterway is intermittent or perennial using geomorphic, hydrologic and biological stream features will aid in WDNR Wetlands and Waterways staff and resource managers in decision making for required Chapter 30 permits for recommended structural conservation practices.
- Collect Total Suspended Solids, Total Phosphorus, and Orthophosphate samples monthly (May – October) at the pour point of each of the selected catchments.
- Collect 2-3 significant rain event samples at the pour point of each catchment and evaluate Total Suspended Solids, Total Phosphorus and Orthophosphate
- Conduct flow measurements following standard protocol each time water samples are collected, including event samples.
- Complete a quantitative habitat survey using standard protocol "Guidelines for Evaluating Habitat of Wadeable Streams" near the pour point of each catchment.
- Complete macroinvertebrate and fish surveys following standard protocol near the pour point of each catchment.

Additionally, the KOF Council will discuss the potential to implement a USGS gaging station at one or more of the demonstration catchments to continuously evaluate nutrient and sediment loading and flow. This will help determine the impact of structural storage practices on reduce water flow/flashiness in these tributaries and overall impact of nutrient and sediment reduction when pairing this system of practices together.

OPPORTUNITY TO SHARE LESSONS LEARNED

As anticipated, the site selection for the intensive implementation demonstration sites was complex. However, we are optimistic that this approach will demonstrate success and will continue to develop catchment-sized plans for focused implementation. While each catchment must be evaluated individually and has different criteria to consider, we are hopeful that this approach can be used both across and between watersheds as a successful implementation approach to achieving agricultural nutrient reductions.