

# Conservation Management Plans: Door and Dorn Creek

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*Environmental Studies 972:  
Conservation Planning*



# Door Creek Watershed Conservation Management Plan

*Door Creek, Dane County, Wisconsin*

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# ***1. Project Summary***

## **1.1 Project Name**

The name of our project is the Door Creek Watershed Conservation Management Plan.

## **1.2 Project Location**

Door Creek is a tributary to the Yahara River that extends from the northeast edge of Madison, Wisconsin and flows 12.7 miles south to Lake Kegonsa. The Door Creek watershed runs through six towns and two villages in southern Wisconsin. Our main focus for this project is the main artery of the Door Creek valley.

## **1.3 Project Vision**

Our main project vision is to decrease the threat of phosphorus contamination in the Door Creek Watershed and create a thriving community of native flora and fauna, to improve the quality of life for residents.

## **1.4 Project Contacts**

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## **1.5 Project Start and End Dates**

This ten-year project began in December of 2016 and will end in December of 2026.

## 1.6 Brief Project Summary

In an effort to reduce the amount of phosphorus in the Rock River Basin throughout Dane County, the Wisconsin Department of Natural Resources (WDNR) and U.S. Environmental Protection Agency (EPA) concerted an effort to select several target areas most vulnerable to pollution from phosphorus and other contributing factors of ecosystem degradation. Due to the concentration of agricultural land around the Door Creek valley, accounting for approximately 48% of the total land use, it was identified as one of the sub-watersheds with the highest agricultural phosphorus contributions to the Yahara River Watershed (*Door Creek Watershed Management Action Plan*, 2016). However, agricultural contamination was only one factor threatening the health of this ecosystem, the growth of residential development areas around the area, amounting to 10%, has also presented several issues as well (*Door Creek Watershed Management Action Plan*, 2016).

Extensive research on the levels of phosphorus has already begun within this project, and our goal with this conservation plan is to build upon addressing the phosphorus issue and expand to working to protect Door Creek from that and other main contributing factors to the loss of biodiversity in this ecosystem.

For this project, we have identified three main targets to address the issue. The first target is the aquatic species that live within Door Creek, we will measure the health of this target by the biotic index of the macroinvertebrates that currently reside within the creek. The second target is the Door Creek ecosystem, meaning the chemical composition and purity of the water, which will be indicated by the level of algae within Lake Kegonsa, the outlet body of water for Door Creek. Finally, our last target is the riparian buffer that surrounds Door Creek, which will be identified by the total amount of ground cover and the proportion of native versus invasive species of plants located within the buffer. The main threats to these targets include climate change, phosphorus runoff, invasive species, and pollution.

This will be an important effort, not only to the native flora and fauna of Door Creek, but also the residents who live in the area and enjoy the recreational and health benefits that it provides to them.

Residential development and agriculture in and around the Door Creek watershed pose a direct threat to the biological diversity and water quality of the creek. Sustainable practices and proper management are vital to the health of the ecosystem, as the future of Door Creek relies on a concerted effort between Dane County and landowners of the Door Creek watershed.

## ***2. Introduction***

The Door Creek is a tributary of the Yahara River that begins in the northeast of the city of Madison and flows south 12.7 m to Lake Kegonsa, the southernmost lake of the Yahara River Chain of Lakes. Little Door Creek begins in the Town of Cottage Grove and joins the main Door Creek south of US Highway 12/18 (Door Creek Watershed Management Plan, 2016). This Watershed drains portion of six towns, two villages and a small segment of the city of Madison. The creek has a gradient of 2.4 feet per mile and a surface area of 12.3 acres (Door Creek Watershed Management Plan, 2016). The base discharge is 9.4 cubic feet per second (Door Creek Watershed Management Plan, 2016). The Door Creek was first recorded on a map in 1837, when Wisconsin was originally surveyed (Door Creek Watershed Assessment, 2009, p.3).

Based upon assessment of watersheds by the Dane County Land & Water Resources Department (LWRD) to reduce the amount of pollutants entering lakes and streams in Wisconsin, Door Creek was identified as one of the sub-watersheds that contribute the highest phosphorus to the Yahara Watershed as a result of runoff from agriculture and residential development that poses a threat to biological diversity in the watershed and affects the quality of the creek ecosystem (Door Creek Watershed Management Plan, 2016).

### **2.1. Conservation Planning for Project Area**

The Door Creek Watershed Conservation Plan is in support of the Dane County Land & Water Resources Department (LWRD) Door Creek Watershed Management Action Plan 2016, which outlines watershed planning and conservation practices for reducing the amount of pollutants entering the lakes and streams in the county. Based upon assessments carried out by the LWRD, Door Creek was identified as one of the sub-watersheds contributing the highest amount of phosphorus into the Yahara Watershed as a result of agricultural runoff (Door Creek Watershed Management Plan, 2016). The goals and objectives of the Door Creek Watershed Management Plan are consistent with the goal of our project, which is to reduce the threat of phosphorus and improve the creek's natural habitat.

The Door Creek Watershed Conservation Project area contains natural communities of aquatic and terrestrial species and other habitats, including wetlands. To achieve our project's vision, we identified the following conservation targets: riparian buffers, aquatic species and Door Creek Watershed. Within each of these targets, we also identified indicators that will inform us of the health of our conservation targets, and will provide us the means of determining the current and future health of our conservation targets.

This conservation plan specifies the goal and management strategies to achieve the vision of the project. The project will carry out periodic monitoring over the next ten years to assess progress in an adaptive framework. Due to the impending effects of climate change, we have also built into our project a

structure to look at the impact that climate change such increased period of drought, severe rain event affecting riparian buffers, loss of habitat for aquatic species etc. will have on our conservation targets.

## 2.2 Legislation, Orders or Documents Related to Establishment and Management of the Project Area and/or Theme

Year	Legal Documents	Regulatory directive
1972	Amended US EPA Clean Water Act	Establishes the structure for regulating pollutant discharge in waters in the US, gives EPA authority to implement pollution control programs such as setting water quality standards for all contaminants in surface water, made it unlawful to discharge pollutants from point source into navigable waters, unless by permit and recognizes the need to address critical problems posed by non-point source pollution.
1997	Wisconsin Admin. Code -NR 102	Established the water standard for phosphorus in surface water and sets the maximum threshold for phosphorus in Wisconsin surface water.
1997	Wisconsin Admin. Code -NR 217	Set procedures to implement phosphorus standard in Wisconsin Pollutant Discharge Elimination System (WPD) permits issued to point sources discharging to surface water of the state.
2002	Wisconsin Admin. Code -NR 151	Establishes run off pollution performance standard for agriculture, non-agriculture and transport facilities performance standard to help control point sources of excess phosphorus by tightening agricultural performance standards.
1980	Wisconsin Admin. Code -NR 115	Establishes the state required minimum standards for county shoreland ordinances to limit direct and cumulative impacts of shoreland development on water quality, near shore aquatic, wetland and upland habitat, aquatic life and natural scenic beauty

**Table 1: Legislation, Orders or Documents Related to Establishment and Management of the Project Area and/or Theme**

### 3. Methods

#### 3.1 Project Team

Student names redacted.

Accomplishing the conservation goal and vision of the Door Creek Watershed Conservation Project will also require the support and cooperation of many partners and stakeholders including farmers, Door Creek residents, funding organizations and community organizations.

#### 3.2 Conservation Planning Approach

The Door Creek Watershed Conservation Plan was developed using the Conservation Measures Partnership's Open Standards for the Practice of Conservation (Conservation Measures Partnership 2013, Foundations of Success 2009).



**Figure 1. Conservation Measures Partnership's Open Standards for the Practice of Conservation process (Conservation Measures Partnership 2013).**



The Door Creek Watershed Conservation Plan was developed using the Open Standards process and the following activities were carried out:

The Door Creek Watershed Conservation Management Planning Team was established and comprise of members of the Door Creek Watershed Conservation Management Project Team, members of the Dane County Land, Water & Natural Resources Department who serve as Advisors and contact person, and a member of the Water Quality Division of the Wisconsin Department of Natural Resources who also serves as an Advisor.

The Team held meetings to identify conservation targets that represent the biodiversity in the project area. As a result of our meeting, three conservation targets were identified. The team also evaluated the key ecological attributes (KEA), which are the aspects of the target that determines if the target is healthy or not. The KEAs were used to develop indicators, which were the measurable criteria for each target and evaluated them on the scale of very good, good, fair and poor.

Following this, the team identified direct threats to the conservation targets and ranked them based upon the scope, severity and irreversibility. After the threats were ranked, those of the highest priority were identified along with strategies to mitigate them in order to improve the health of the conservation targets. The team then decided upon the strategies with actions and objectives that would have the most impact on meeting the vision of the project. Next, a monitoring plan was developed to measure if the strategies were working and where adjustments would need to be made. A work plan was also developed for actions for one of the strategies, which indicated what needed to be done, who would be responsible for what, and what resources would be required for implementing the project.

Finally, the team met to evaluate actions to improve our knowledge of the conservation targets. The monitoring data was reviewed to find out if our actions were working, what needed to be changed or improved, and what lessons had been learned from our successes and failure that could be shared for the benefit of others.

## ***4. Scope Vision and Biodiversity Targets***

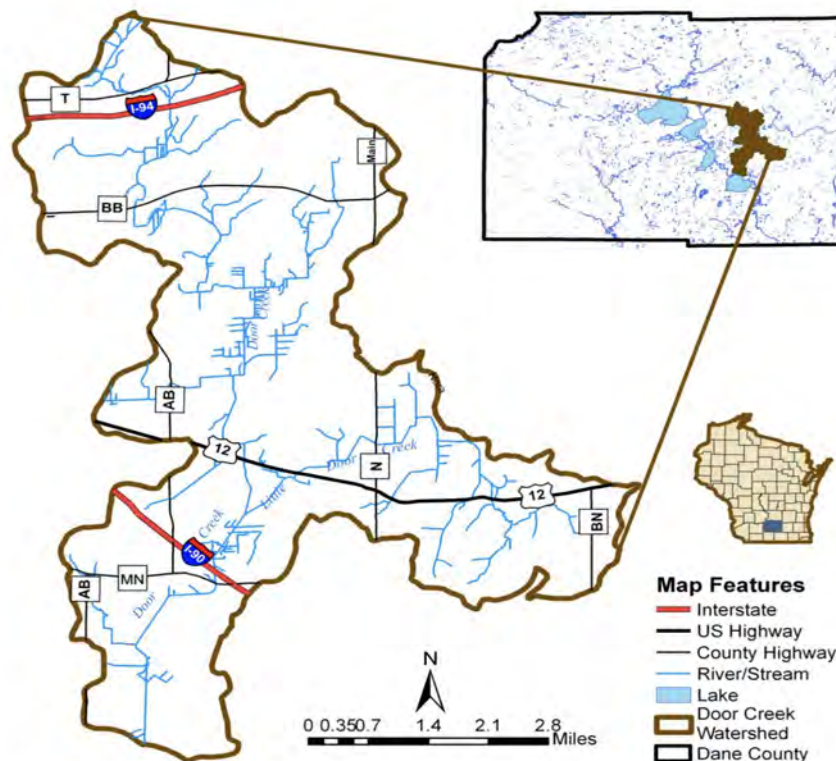
### **4.1 Scope and Maps**

According to the Open Standards a project's scope defines what the project intends to affect. The scope can either be a geographic scope, meaning that it is a "placed-based" location, or it

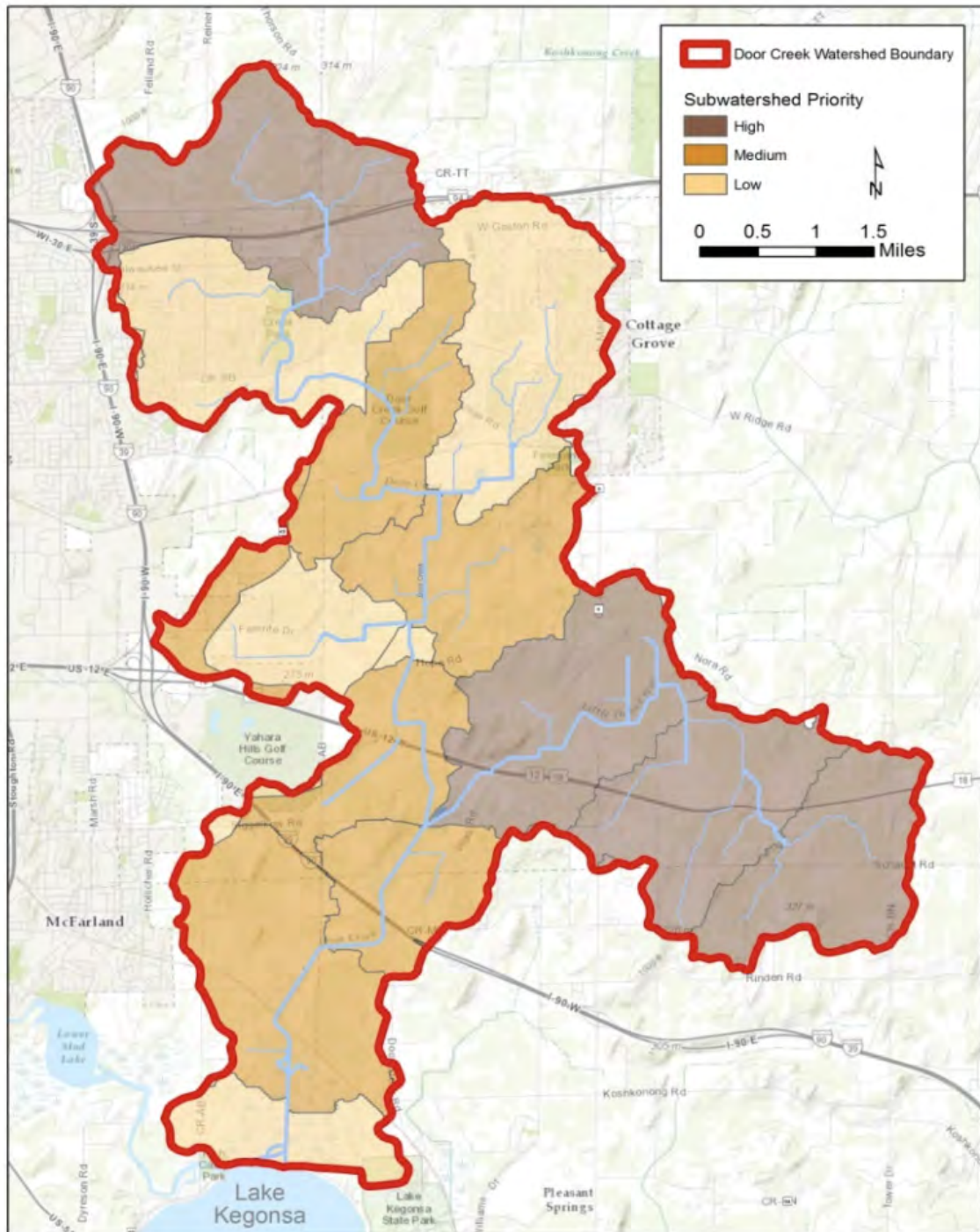
can be a thematic scope that is defined by a specific conservation target, threats, opportunities, or enabling condition. (CMP, 2013). Our project scope is a geographic scope.

Door Creek is located in the Yahara River watershed of the greater Lower Rock River watershed in South Central Wisconsin. The Yahara River connects a chain of four lakes that are called, from north to south: Lake Mendota, Lake Monona, Lake Waubesa, and Lake Kegonsa (*Door Creek Watershed Assessment*, 2009). Due to its proximity to the University of Wisconsin and several other large research institutions, the Yahara River watershed is one of the most studied lake systems in the world.

The Door Creek Watershed itself consists of approximately 20,503 acres of land and water, and according to the US Census, the population in the Door Creek Watershed was estimated to be 14,516 in 2010 and projected as 15,386 in 2013 (*Door Creek Watershed Management Action Plan*, 2016). Our scope consists of the the entire The Door Creek Watershed (Figure 1), but also includes sub-watershed properties that have been targeted due to phosphorus loading (Figure 2). Door Creek itself extends from the northeast edge of Madison, Wisconsin and flows 12.7 miles south to Lake Kegonsa.



**Figure 1: Location of the Door Creek Watershed**  
(*Door Creek Watershed Assessment*, 2009)



**Figure 2: Sub-watershed priorities for phosphorus loading  
(Door Creek Watershed Management Action Plan, 2016)**

## 4.2 Vision

According to the Open Standards, a project vision is a description of the desired state or ultimate condition that you are working to achieve. A project vision must meet the criteria of being relatively general, visionary, and brief. (CMP, 2013)

Our project vision is to decrease the threat of phosphorus contamination in the Door Creek Watershed and create a thriving community of native flora and fauna, to improve the quality of life for residents.

## 4.3 Biodiversity Targets

According to the Open Standards, biodiversity targets are “specific species or ecological systems/habitats that are chosen to represent and encompass the full suite of biodiversity in the project area for place-based conservation or the focus of a thematic program. They are the basis for setting goals, carrying out conservation actions, and measuring conservation effectiveness.” (CMP, 2013)

### 4.3.1. Aquatic Species

Aquatic biodiversity is the rich variety of plants and animals that live in watery habitats. The greater the diversity of habitat, whether in water or on land, the greater the biodiversity will be. Maintaining the health of aquatic species is particularly important because each day, aquatic organisms (bacteria and fungi) continually break down harmful toxins and nutrients that we let into water. Door Creek is no exception to this. In addition, having a healthy variety of fish species within the water, is a large indicator of progress in improving the health of Door Creek. Although we seldom recognize them, each aquatic species has an important role in making our lives easier, healthier, and more productive. Every living organism has an important role to play, and many are indispensable.

For the aquatic species we have identified two goals that also act as the indicators of progress. The first goal centers around the macroinvertebrates biotic index of Door Creek. A Biotic Index is a way of calculating the density of macroinvertebrate species that have low phosphorus tolerances in streams and waterways. The calculation gives a “score”, which then correlates to the degree of organic pollution in the stream, i.e. phosphorus and nitrogen (*Door Creek Watershed Management Action Plan*, 2016). Door creek currently carries a macroinvertebrate biotic index of 4.7, which according to our viability assessment, lies within our “good” condition.

By the end of the ten year conservation plan, our goal is to lower the biotic index to 3.7, which qualifies for the “very good” classification.

Additionally, the abundance and richness of fish within the creek is a key element that indicates the health of the aquatic species as a whole within Door Creek. An electroshocking survey is a useful tool in indicating the Fish Index of Biotic Integrity (IBI) of Door Creek. Door Creek currently has an IBI score of 22, which is considered to be a “fair” state. Our goal is to improve overall aquatic species health in Door Creek by raising the Fish Index of Biotic Integrity to 42 by 2026.

#### 4.3.2. Door Creek Ecosystem

Previous studies done on the nearby Rock River Basin identified major sources of total phosphorus and total suspended solids water pollution within the basin and assigned corresponding load allocations and reductions, these pollutants are also a threat to Door Creek. Major sources include both point sources (wastewater treatment facilities, industrial cooling water and process water discharge, and regulated urban areas) and non-point sources (agricultural land, non-regulated urban areas, and natural areas). The Wisconsin Department of Natural Resources added Door Creek to the 2012 Impaired Waters list for total phosphorus. “Impaired” means that levels of one or more pollutants are affecting the water body’s ability to meet its designated use. Door Creek is designated a Fish and Aquatic Life subcategory of Limited Forage Fishery under ch. NR 104.05, Wis. Adm. Code (*Door Creek Watershed Management Action Plan*, 2016).

Door Creek generally flows from the higher drumlin area in the north to the lower marshy area in the south before discharging into northern Lake Kegonsa. Since Lake Kegonsa is downstream and located in a lower elevation, we can test phosphorus levels in Lake Kegonsa for an accurate indicators of levels of phosphorus flowing throughout the entirety of Door Creek. Although we do not have working data for algal bloom counts in Lake Kegonsa or Door Creek directly, our general goal is to reduce algal bloom count by the end of the ten year management plan (both in Door Creek and Lake Kegonsa). Algal counts are currently underway for Lake Kegonsa and may be implemented in Door Creek directly.

Taking these factors into consideration, it is vital to target the Door Creek Ecosystem with our conservation efforts because it is the foundation of the health of the creek. Without a balanced chemical composition of the water and a reduction of the pollutants that are entering the watershed, the water is not safe for the species that live in the habitat or the residents that interact with creek.

### 4.3.3. Riparian Buffer

The USDA Forest Service defines a riparian buffer as follows: “the aquatic ecosystem and the portions of the adjacent terrestrial ecosystem that directly affect or are affected by the aquatic environment. This includes streams, rivers, lakes, and bays and their adjacent side channels, floodplain, and wetlands. In specific cases, the riparian buffer may also include a portion of the hillslope that directly serves as streamside habitats for wildlife.” (Johnson, 1995)

These areas are important to the overall health of the ecosystem for several reasons; they create habitat for species and contribute to the overall biodiversity of the ecosystem, they are more productive in terms of biomass than other areas of the watershed, they act as a final “safety net” to protect the water from pollutants and litter, and they add aesthetic value to the overall scenery of the stream. It is easy to see why this area is a critical target for protecting the overall health of Door Creek. Riparian buffers are particularly vulnerable to alteration by human activities and without a continuous strip lining the entire length of the creek edge-effects can occur resulting in a threat to the habitat and the flora and fauna that live there. In addition, these streamside vegetated buffer filters nonpoint source pollutants from incoming runoff and provides habitat for a balanced, integrated, and adaptive community of riparian and aquatic organisms.

Our goal is to increase the total feet of buffer coverage from 50,375 (2017) to 70,000 feet by 2026. We will be working to achieve this goal by implementing programs and educational materials to get more farms in the Door Creek watershed involved with Dane County’s harvestable buffer cost-sharing program. The number of farms that are participating in the program is an indicator of progress that is being made towards the riparian buffer scope. Currently there are 20 farms participating in the program, and we hope to increase that number to 30, in addition to monitoring the amount of feet of harvestable buffer being implemented through the program.

## **4.4 Human Wellbeing Targets**

A human wellbeing target is a target that shows how the conservation work ultimately affects humans.

“As defined by the Millennium Ecosystem Assessment, human well being includes: 1) necessary material for a good life, 2) health, 3) good social relations, 4) security, and 5) freedom and choice.”(CMP, 2013)

The three human wellbeing targets that we have selected center around three main themes: financial benefits, health benefits, and safety benefits.

#### *4.4.1. Human Recreation/Fishing*

The recreational services that Door Creek provides to its neighboring residents provides value to the property as well as the quality of life of those who enjoy playing and fishing in the water. Without protection for the fish that swim in the creek, that element of value would be lost. It is important to take into account the mental health benefits that spending time around a health body of water can provide to humans. Fishing alone can reduce stress, encourage independent thinking and problem solving, instill a sense of purpose and connectivity to nature, and also acts as a form of light physical exercise which has numerous other health benefits.

#### *4.4.2. Filtration for Human Safety*

The constant flow and natural filtration that the water and the species of plants and animals that reside in the water, act as cleansing devices that keep the water safe for residents who live within the area. With the warmer temperatures that we have been experiencing due to climate change algal blooms have been increasing which poses a severe health risk for humans and their animal companions who like to use bodies of water for recreational purposes. By working to protect the habitat, we also will directly affect the cleanliness of Door Creek as well as its ability to provide natural filtration services to those who enjoy spending time in and around the water. Without this function, the lake could be considered toxic which therefore could pose health risks, decrease property value in the area, and harm crops that are grown in the area.

#### *4.4.3. Flood Prevention for Homeowners*

Because of the large amounts of cleared land for agricultural purposes and residential developments, the Door Creek watershed acts as one of the few outlets for heavy amounts of rainfall that run off concrete structures or can not be absorbed into the cleared land. Without the creek serving this purpose the residents and farmers who live and work in the area would see much more flooding that poses a threat to damage their property, homes, and crops. In essence, Door Creek is providing a service that is potentially saving its residents thousands of dollars worth of damage control by diverting rainwater out of the area and into larger bodies of water.

### Ecosystem Services

Additionally, we had 3 ecosystem services that were provided by a healthy Door Creek watershed. These included Game and Wildlife Provisioning, Water Flow Regulation and Filtering, and Soil Stability and Erosion Prevention. Game and wildlife provisioning exist due to a healthy watershed which allows for numerous game and wildlife species to thrive. Positive improvements in the water quality of Door Creek will only improve the diversity and number of these species, resulting in an increased boon for human recreation and fishing/hunting. Secondly, water flow regulation and filtering are carried out by the creek naturally as well as with placed meanders to slow down water flow as it travels through the creek and ultimately into Lake Kegonsa (this promotes a healthy ecosystem overall and will also help improve water quality for human safety). Lastly, soil stability and erosion prevention are a large benefit of a riparian buffer in good condition. Native flora will hold the soil in place and prevent erosion of the banks and fertilizer in the surrounding agricultural soil to deposit into Door Creek. There is a dual benefit, as better soil stability will also help to defend against flooding for homeowners near the banks of Door Creek, with the soil less likely to erode during flash floods and heavy rainfall.

## **5. Viability Assessment**

The Viability Assessment is an Open Standards tool used to understand and define specific Key Ecological Aspects or components of an ecosystem that support biodiversity. These “KEA”s are assigned a corresponding Indicator that relates to the quality of those aspects in a measurable and goal oriented way. Goals are also assigned to give the assessment direction and inform potential strategies that will hopefully achieve said goals. These assessments can also be useful when monitoring to see if current implemented strategies are contributing to a desired result.

<b>Target 1.1</b>	Aquatic Species
<b>Category</b>	Condition
<b>KEA</b>	Diversity of Macroinvertebrate Communities
<b>Indicator</b>	Hilsenhoff Macroinvertebrate Biotic Index



Poor	Fair	Good	Very Good
10.00 - 6.51	6.50 - 5.01	5.00 - 4.26	4.25 - 0.00

<b>Current Status</b>	4.7
<b>Desired Status</b>	3.7
<b>Goal</b>	Improve Aquatic Species health in Door Creek by raising the macroinvertebrate biotic index to 3.7 by 2026.

**Table 3: Target 1.1 Viability Assessment of Aquatic Species (Macroinvertebrates)**

<b>Target 1.2</b>	Aquatic Species
<b>Category</b>	Condition
<b>KEA</b>	Diversity of Fish Species
<b>Indicator</b>	Fish Index of Biotic Integrity (IBI)

Poor	Fair	Good	Very Good
0 - 20	21 - 40	41 - 60	61 - 100

<b>Current Status</b>	22
<b>Desired Status</b>	42
<b>Goal</b>	Improve overall Aquatic Species health in Door Creek by raising the Fish Index of Biotic Integrity to 42 by 2026.

**Table 4: Target 1.2 Viability Assessment of Aquatic Species (Fish)**

<b>Target 2</b>	Door Creek Watershed
<b>Category</b>	Landscape Context: Ecological Process
<b>KEA</b>	Algae Blooms in Lake Kegonsa
<b>Indicator</b>	Annual # of Algae Blooms in Lake Kegonsa

<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Very Good</b>
Unknown	Unknown	Unknown	Unknown

<b>Current Status</b>	Unknown
<b>Desired Status</b>	Unknown
<b>Goal</b>	Improve the health of Door Creek by decreasing the annual total amount of algae blooms in Lake Kegonsa by 2026. NOTE: Currently do not have data to create specific metric for goal.

**Table 5: Target 2 Viability Assessment of Door Creek Watershed**

<b>Target 2</b>	Door Creek Watershed
<b>Category</b>	Condition
<b>KEA</b>	Algae in Lake Kegonsa
<b>Indicator</b>	Chlorophyll Trophic State Index

<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Very Good</b>
110 - 70	69 - 50	49 - 30	<30

<b>Current Status</b>	55
<b>Desired Status</b>	45
<b>Goal</b>	Improve the Door Creek Watershed by lowering the Chlorophyll Trophic State Index to 45 by 2026.

**Table 6: Alternative Viability Assessment for Algae monitoring in Lake Kegonsa**

<b>Target 3</b>	Riparian Buffer
<b>Category</b>	Landscape Context: Ecological Process
<b>KEA</b>	Riparian Buffer
<b>Indicator</b>	Number of feet of Harvestable Buffers on Door Creek

<b>Poor</b>	<b>Fair</b>	<b>Good</b>	<b>Very Good</b>
0 - 20,000	21,000 - 60,000	61,000 - 100,000	101,000+

<b>Current Status</b>	50,375 feet
<b>Desired Status</b>	70,000 feet
<b>Goal</b>	Improve the health of Door Creek by increasing the total amount Harvestable Buffers on Door Creek to 70,000 feet by 2026.

**Table 6: Target 3 Viability Assessment of Riparian Buffer**

## 5.1 Aquatic Species

A crucial indicator to measure the condition of a creek and how that condition is affecting wildlife is to use a Macroinvertebrate Biotic Index. Macroinvertebrates tend to be a good indicator species of the creek health because they are sensitive to important factors like levels of dissolved oxygen, temperature, water flow and concentrations of harmful chemicals or pesticides. The index measures the presence of particular macroinvertebrate species that are especially sensitive to those factors and creates a score based on that information. The current mean biotic index for Door Creek, according to a series of reports taken in 2016 by Dane County Land and Water Resources Department and sampled three sites along the creek, is 4.7 (Dane County Land and Water Resources Department, 2016). This score is on the low side of a “Good Water Quality” rating (Hilsenhoff, W., 1982). To reach a “Very Good Water Quality” score, the biotic index would have to be at least 4.25. We have set the following goal for this viability rating indicator: Improve Aquatic Species health in Door Creek by raising the macroinvertebrate biotic index to 3.7 by 2026. We hope in this amount of time Door Creek will be firmly in a “Very Good” Macroinvertebrate Biotic Index Rating.

The second viability assessment focusing on aquatic species is measuring the diversity of the fish in Door Creek. This is measured using a Fish Index of Biotic Integrity (IBI). The current mean index score for Door Creek, which uses six different sampling sites and was tested in March 2017, is 22 (Jopke, P., Marshall, D., 2017). This is on the very low side of a “Fair Quality” rating. The goal set for this assessment is to improve the quality to be in bounds of what this assessment would define as a “Good Quality” rating. Therefore the goal was set as following: Improve overall Aquatic Species health in Door Creek by raising the Fish Index of Biotic Integrity to 42 by 2026.

## 5.2 Door Creek Watershed

After 12.7 miles, Door Creek eventually flows into Lake Kegonsa. Lake Kegonsa gets roughly 24% of its annual phosphorus input from Door Creek and therefore is a significant ecological factor (Lathrop, R., Carpenter, S., 2014) . By measuring the frequency of algae blooms in the lake we can gather an idea of how much excess nutrients from Door Creek may be influencing the ecological aspects of Lake Kegonsa. This is important as the Dane County Department of Land and Water Resources does regularly sample the algae blooms of Lake Kegonsa. This plan currently does not have the data needed to estimate the current or desired frequencies of algal blooms in summer months, when blooms are most frequent. It is the recommendation of this plan to gather this information from official databases, or if insufficient amounts of data exist,

that this be collected and used as an indicator. Specific goals can then be set to measure the effectiveness of nutrient management strategies contained within this plan. An alternative indicator for monitoring the frequency of algal blooms in Lake Kegonsa could be by using the Chlorophyll Trophic State Index (TSI-CHL), which will be explored in further detail in our monitoring plan in Section 9. Note: Even with extensive restoration in Door Creek, changes in Kegonsa Lake could take a long time (>10 years) due to decades of nutrient loading and would most likely need restoration and nutrient management of the Yahara watershed as well to be effective.

### **5.3 Riparian Buffer**

Riparian habitats are an extremely important component to creek ecosystems. Not only do they provide crucial habitat and food for fish and macroinvertebrates, buffers also contribute to stable creek flows and help with absorption of urban and agricultural run-off. The amount of riparian buffer around a creek can be a clear indicator of its biological health. Since Door Creek currently contains extensive agricultural development, establishing native riparian habitat is not always practical. Native vegetation is not always well suited to absorb the high amounts of nutrients that come from farms and often farmers are not excited about losing potential agricultural land to native buffers. A compromise is what is called a Harvestable Buffer, plants that are planted to specifically absorb agricultural runoff and can be harvested by landowners for animal feed and other purposes. Simply keeping track of the amount of landowners who are currently enrolled in the Harvestable Buffer Program and the total amount of feet of buffer lining Door Creek can potentially be a good indicator of how much excess nutrients are being stopped from entering Door Creek. The current number of landowners implementing harvestable buffers on Door Creek is 20. Of those 20 landowners, according to the 2016 Door Creek Management Action Plan, is a total of 50,375 feet of harvestable buffers (Dane County Land and Water Resources Department, 2016). Given this information the goal for riparian buffers recommended by this assessment was set to the following: Improve the health of Door Creek by increasing the total amount Harvestable Buffers on Door Creek to 70,000 feet by 2021.

## 6. Direct Threat Assessment

Threats \ Targets	Door Creek ...	Aquatic Spec...	Riparian Buffer	Summary Threat Rating
Climate Change	High	Medium	Low	Medium
Invasive Species	Medium	Medium	Low	Medium
Phosphorus runoff	High	High		High
Pollution/Litter	Medium	Medium		Medium
Summary Target Ratings:	High	Medium	Low	Overall Project Rating: High

Figure 3: Direct Threat Assessment in Miradi

### 6.1. Threat Ranking

The core project team identified four direct threats affecting the Door Creek watershed (these are threats caused by human actions that may affect one or more conservation targets in our 10 year management planning period). Primarily, the team focused on stressors that affected these conservation targets, and broke them up into tiers based on how dramatically they may influence the ecosystem. For example, phosphorus runoff is a primary threat to algal levels in the Door Creek watershed in addition to Lake Kegonsa downstream (Miller et. al, 2013). A stressor or contributing factor to the amount of phosphorus runoff that ends up in Door Creek would be farms containing heavy concentrations of fertilizer. In addition, these heavy concentrations of fertilizer are attributed to the growing demand for more efficient food output (typically for cash grains).

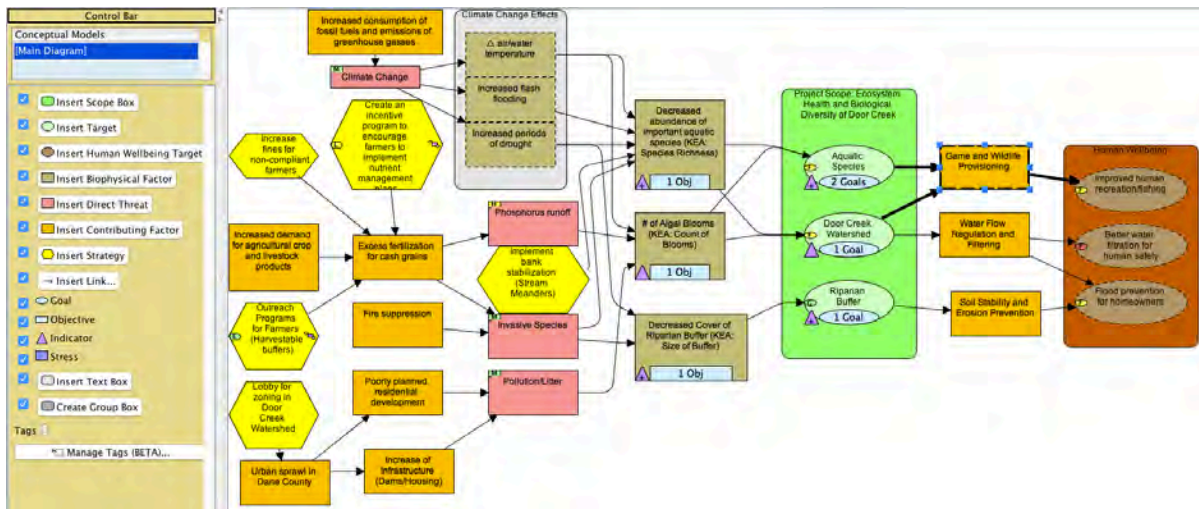
Our methods to prioritize and determine which threats should be our focus ultimately came down to a few qualifiers. The severity of the threat based on current and future damage it will cause to the conservation target, the irreversibility of the threat (both environmentally and cost-wise financially), and the scope of the threat (who and what it would affect in total), these can be seen in Figure 4.. The climate change portion of our threat rankings (and the inclusion of it as a direct threat) was based on the period of the next 25-50 years, and how these stressors can future exacerbate problems with the Door Creek watershed over time.

<b>Scope</b> – Most commonly defined spatially as the proportion of the target that can reasonably be expected to be affected by the threat within ten years given the continuation of current circumstances and trends. For ecosystems and ecological communities, measured as the proportion of the target's occurrence. For species, measured as the proportion of the target's population.	
<input type="radio"/> Not Specified	
<input type="radio"/> Low	<b>Low:</b> The threat is likely to be <b>very narrow</b> in its scope, affecting the target across a <b>small proportion</b> (1–10%) of its occurrence/population.
<input type="radio"/> Medium	<b>Medium:</b> The threat is likely to be <b>restricted</b> in its scope, affecting the target across <b>some</b> (11–30%) of its occurrence/population.
<input checked="" type="radio"/> High	<b>High:</b> The threat is likely to be <b>widespread</b> in its scope, affecting the target across <b>much</b> (31–70%) of its occurrence/population.
<input type="radio"/> Very High	<b>Very High:</b> The threat is likely to be <b>pervasive</b> in its scope, affecting the target across <b>all or most</b> (71–100%) of its occurrence/population.
<b>Severity</b> – Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends. For ecosystems and ecological communities, typically measured as the degree of destruction or degradation of the target within the scope. For species, usually measured as the degree of reduction of the target population within the scope.	
<input type="radio"/> Not Specified	
<input type="radio"/> Low	<b>Low:</b> Within the scope, the threat is likely to only <b>slightly degrade/reduce</b> the target or reduce its population by <b>1–10%</b> within ten years or three generations.
<input type="radio"/> Medium	<b>Medium:</b> Within the scope, the threat is likely to <b>moderately degrade/reduce</b> the target or reduce its population by <b>11–30%</b> within ten years or three generations.
<input checked="" type="radio"/> High	<b>High:</b> Within the scope, the threat is likely to <b>seriously degrade/reduce</b> the target or reduce its population by <b>31–70%</b> within ten years or three generations.
<input type="radio"/> Very High	<b>Very High:</b> Within the scope, the threat is likely to <b>destroy or eliminate</b> the target, or reduce its population by <b>71–100%</b> within ten years or three generations.
<b>Irreversibility (Permanence)</b> – The degree to which the effects of a threat can be reversed and the target affected by the threat restored.	
<input type="radio"/> Not Specified	
<input type="radio"/> Low	<b>Low:</b> The effects of the threat are <b>easily reversible</b> and the target can be <b>easily</b> restored at a relatively <b>low cost and/or within 0–5 years</b> (e.g., off-road vehicles trespassing in wetland).
<input checked="" type="radio"/> Medium	<b>Medium:</b> The effects of the threat <b>can be reversed</b> and the target restored with a <b>reasonable commitment</b> of resources and/or within <b>6–20 years</b> (e.g., ditching and draining of wetland).
<input type="radio"/> High	<b>High:</b> The effects of the threat <b>can technically be reversed</b> and the target restored, but it is <b>not practically affordable</b> and/or it would take <b>21–100 years</b> to achieve this (e.g., wetland converted to agriculture).
<input type="radio"/> Very High	<b>Very High:</b> The effects of the threat <b>cannot be reversed</b> and it is <b>very unlikely</b> the target can be restored, and/or it would take <b>more than 100 years</b> to achieve this (e.g., wetlands converted to a shopping center).

**Figure 4: Miradi Definitions of threat scope, severity, and irreversibility.**

The team identified 4 current and future threats to the Door Creek watershed, with climate change as one of the four affecting the future conservation of the area. To determine threat ratings and what was to be included we consulted the *Door Creek Watershed Management Action Plan* in addition to data provided by the Wisconsin DNR and USGS Wisconsin Chapter. Threat rankings were done by identifying the threat and then determining how dramatically that threat impacted the conservation target. For example, in the case phosphorus runoff, the threat on Aquatic Species and the Door Creek ecosystem was high, but there was no direct threat on the riparian buffer. Some data even suggests that phosphorus in the watershed can benefit the buffer area as long as invasive species are under control.

Phosphorus in the watershed (primarily from runoff) is shown to be the most critical threat to the Door Creek watershed (seen in Figure 3), with all other threats being summarized as a medium threat rating ([www.des.nh.gov](http://www.des.nh.gov), retrieved 8 October 2017). Phosphorus was the highest rated threat, determined by the measurement tools of Scope, Severity, and Irreversibility of the threat (Figure 4). Ultimately, the most threatened conservation target is the Door Creek ecosystem, which includes the flora and fauna making up the spatial system in question (apart from the riparian buffer and water flow into Lake Kegonsa). Details about each threat (the pink rectangles) and their related stressors can be seen below.





climate) of one of our targets such as the Door Creek Watershed, is directly related to water temperature and possibly flash floods reducing soil stability in the creek. This will increase the rate of algal blooms in the watershed, putting both floral and faunal diversity in jeopardy.

### **1.1: Air and Water Temperature**

There is a near unanimous consensus that the earth is increasing in temperature both atmospherically and aquatically. There is a new “hottest day of the year” annually in Wisconsin, and many projections show that water temperatures increasing can lead to higher oxygenation levels in water systems (*wicci.wisc.edu*, retrieved 2 October 2017). This increase in aquatic oxygen is partially due to more oxygen being released from the plants under the surface of Wisconsin’s river and lake systems, which threaten macroinvertebrates, and ultimately, the majority of aquatic species in both the Door Creek and Yahara watershed.

### **1.2: Drought**

Precipitation can vary drastically depending on the region, though in the southern portion of Wisconsin which is statistically more dry than Wisconsin as a whole, these areas will likely see increased periods of drought (*wicci.wisc.edu*, retrieved 2 October 2017). These episodes of drought will be a detriment to soil quality and structure, ultimately affecting the riparian habitat most severely. This variance in precipitation may also introduce new invasive species resulting from a shifting of local eco-zones.

### **1.3: Increased Flash Flooding**

Due directly to lower quality soil structure from elongated drought periods, absorption in southern Wisconsin soils may decrease along with the increasing severity of rainfall projected in coming decades (*wicci.wisc.edu*, retrieved 2 October 2017). This may be a detriment to both aquatic species and their food sources, but also the condition of riparian buffers along Door Creek.

### **1.4: Climate Change Summary**

In its entirety, climate change will shift ecozones northwards as time goes on, introducing more invasives and changes in precipitation and temperature to the Door Creek watershed. Accounting for these variations and anticipating problems that may arise as a result, is paramount to combat potential pitfalls and setbacks that the current Door Creek Watershed Management Plan did not notice.

## **Threat 2: Phosphorus Runoff**

### *Affected Conservation Targets*

The Door Creek ecosystem and aquatic species that occupy that spatial zone.

### *Threat Description*

Changing laws and regulations as well as population and soil management shifts are resulting in more phosphorus being dumped into the Yahara (and Door) watersheds annually (Dane County Land and Water, 2016). This change can affect various aspects of riverine habitats, including the macroinvertebrates and other fauna that inhabit the area. Phosphorus can increase algal bloom size and frequency, causing both an environmental and human health hazard for anybody in contact with these blooms or affected water sources during peak bloom periods. This poor water quality from algal blooms can also harm native species in the creek, such as fish and macroinvertebrates that subside throughout the watershed and Lake Kegonsa.

### *Threat Details*

Increased phosphorus can come from many sources, particularly in the agricultural sector, through cash grains and soil nutrient sources. These fertilizers and manure leak into the watershed passively or actively during rainstorms and other events. The increase in soil efficiency and other farming methods has resulted in a drastic uptick in possible sources of phosphorus runoff into the watershed. Coupled with generally more people settling along Door Creek, means that this is an issue that need management now to control pollution and environmental hardship in the future.

#### **2.1: Increased Demand for Agricultural and Livestock Products**

With population increases domestically and especially in the greater Madison metropolitan area, there is an added pressure for farmers to output more goods from the same amount of land. This pressure can lead to an excess of fertilizer going on to cropland or a general increase in some livestock on the same acreage of property as before (*Yaharaportal.org*, retrieved 2 October 2017).

#### **2.2: Excess Fertilization for Cash Grains**

The general increase in fertilization on that same static amount of land (to produce cash grains) has resulted in additional runoff into the Door Creek and Yahara watershed (*Yaharaportal.org*. Retrieved 2 October 2017).

### **Threat 3: Invasive Species Increase**

#### *Affected Conservation Targets:*

Door Creek ecosystem, riparian buffer, and aquatic species in the watershed.

#### *Threat Description:*

Invasive species prevalence has increased annually in the Door Creek watershed, with new invasive species arriving both by physical and natural transplanting (TMDL Overview, 2017). These plants and in some cases, animals, affect the quality of the riparian habitat that borders the Door Creek watershed and alter a previously well operating ecosystem. The most dominant type of invasive species in this project area of Door Creek are Narrow-leaved cattail (*Typha angustifolia*) and Reed canary grass (*Phalaris arundinacea*). These two species take over the riparian and harvestable buffers and outcompete both native grasses and other wetland loving flora, creating a monoculture.

#### *Threat Details:*

Riparian zones are being choked out by Reed Canary Grass and other wetland invasive species, jeopardizing human recreation, flood prevention and water retention zones, and natural water filtration areas for local residents. This direct threat can lower the quality and viability of the creek's natural ecosystem services, ultimately further affecting the human well-being targets as well as the biodiversity targets mentioned previously.

#### **3.1: Clearing of Land for Agricultural Use**

The clearing of land for agricultural use subjects previously farmed or anthropogenically focused areas to invasive species on a decades long level. Seed banks of some species can last decades, and the invasive species in human-centric or previously farmed zones are both a massive time and financial investment (Dane County Land and Water, 2016). Reverting land back to a natural riparian ecosystem requires purchasing seeds and workers to manage the area, invasives will be the first species to truly thrive when a new area is cleared, which creates an inherent problem for expanding farms.

#### **3.2: Fire Suppression**

Due to the jump in residential and commercial properties in the Door Creek watershed in the last few decades, there has been a draw to focus on controlling fires that naturally dominate some area of the landscape (Dane County Land and Water, 2016). Preventing proper fire management practices on surround prairie and even certain riparian habitats and allow many invasive floral and faunal species to outcompete natives, and dominate the landscape in a short period of time. Addressing careful fire practices and local

engagement is key to ensure ongoing support of fire as a form of conservation. Suppressing fires would ultimately put the ecosystem at additional risk for invasive species to take over and flourish.

## **Threat 4: Pollution and Litter**

### *Affected Conservation Targets*

Door Creek ecosystem, riparian buffer, and aquatic species in the watershed.

### *Threat Description:*

Pollution and litter are overarching problems that can affect all of the biodiversity targets quite equally. The increase in the population of Dane County, in particular around the Door Creek watershed, has introduced a new source of strain on the surrounding environment.

### *Threat Details:*

Poor planning and anticipatory actions has resulted in poor sewer lines, trash disposal areas, infrastructure, and an environmentally unsustainable population size surround the Door Creek watershed has allowed for domestic runoff and litter to ever increasingly become the focus of local conservation efforts (Dane County Land and Water, 2016). This direct threat affects the overall water quality of Door Creek and the tributaries that stem from main creek, as well as the overall water quality of Lake Kegonsa. Improved management and monitoring of careless pollution and litter near and funneling into the watershed is paramount.

### **3.1: Urban Sprawl in Dane County**

Urban sprawl is increasing in Dane County, and waterways are a prime destination, the cityscape will continually push out towards Door Creek, potentially causing more sources of pollution and litter to result.

### **3.2: Poorly Planned Residential Development**

Much improved when compared to several decades ago, but with the added stress of population expansion in the Madison area, many residential areas are put up quickly and with less restraint for environmental conservation than is advisable (Dane County Land and Water, 2016). This can lead to strained living situations and improper disposal methods which may result in more pollution and littering. Proper supervision and regulations must be put into place to combat this.

### **3.3: Increase of Infrastructure (Dams/Housing)**

With an increase in housing along the watershed, dams may be considered in the future as an alternative energy source. This would hurt the riparian zones as well as the flora and fauna that depend on the constant source of water from Door Creek. Roads and bridges may also jeopardize these sensitive areas (*Yahara Kegonsa Focus Watershed Report*, 2001).

### **3.4: Clearing of Land for Development Use**

Clearing land for residential developments is similar to agricultural development. Clearing of limited and valuable buffer and riparian zones can impact water quality and ecosystem health for local flora, fauna, and people that live near the watershed.

## **6.3. Threat Summary by Target**

### **6.3.1 Threats to Conservation Target 1: Aquatic Species**

Current and project threats of greatest concern to the aquatic species of the Door Creek Watershed are (1) climate change, (2) invasive species, (3) phosphorus runoff, and (4) pollution and littering. Climate change increasing water temperatures may push some native aquatic species out of this ecosystem (which cannot necessarily be helped), and introduce novel invasive species that may additionally push out native fauna/flora. Phosphorus runoff from local sources, coupled with pollution and littering from the general populace currently and will continue threatening the aquatic species of the Door Creek watershed. Proper enforcement and education must be implemented to protect these sensitive species, with continued monitoring of concerned or endangered local populations of aquatic species to be carried out either academically or by the Wisconsin DNR.

### **6.3.2 Threats to Conservation Target 2: Door Creek Ecosystem**

Current and project threats of greatest concern to the aquatic species of the Door Creek ecosystem are (1) climate change, (2) invasive species, (3) phosphorus runoff, and (4) pollution and littering. Overall the Door Creek ecosystem has a high threatened rating, with climate change affecting water and air temperatures, local ecozones, and making the soil structure and composition of the area more fragile. Invasive species may outcompete local flora and fauna, phosphorus can spawn algal blooms in Lake Kegonsa and in Door Creek itself, and pollution/littering from local sources only exacerbates these problems. Phosphorus runoff must be addressed as the primary threat, implementing best management practices for farmers and residential neighborhoods that border or have their soils runoff into the Door Creek watershed. Only through both

community engagement and awareness is a holistic ecosystem improvement possible for Door Creek and additionally Lake Kegonsa.

### 6.3.3 Threats to Conservation Target 3: Riparian Buffer

Current and project threats of greatest concern to the riparian buffer zone of the Door Creek Watershed are (1) climate change, (2) invasive species, and (3) pollution and littering. Overall, the riparian zone has a medium threatened rating, with invasive species potentially outcompeting natives in the future, climate change shifting local species out of the spatial zone of Door Creek and introducing new invasives, and pollution and littering destroying the quality of the riparian zone. This quality is very hard to recreate, so preventing additional development or poor land management methods is paramount to the continued survival of this fragile ecosystem.

## 7. Overall Situation Analysis

### 7.1 Diagram

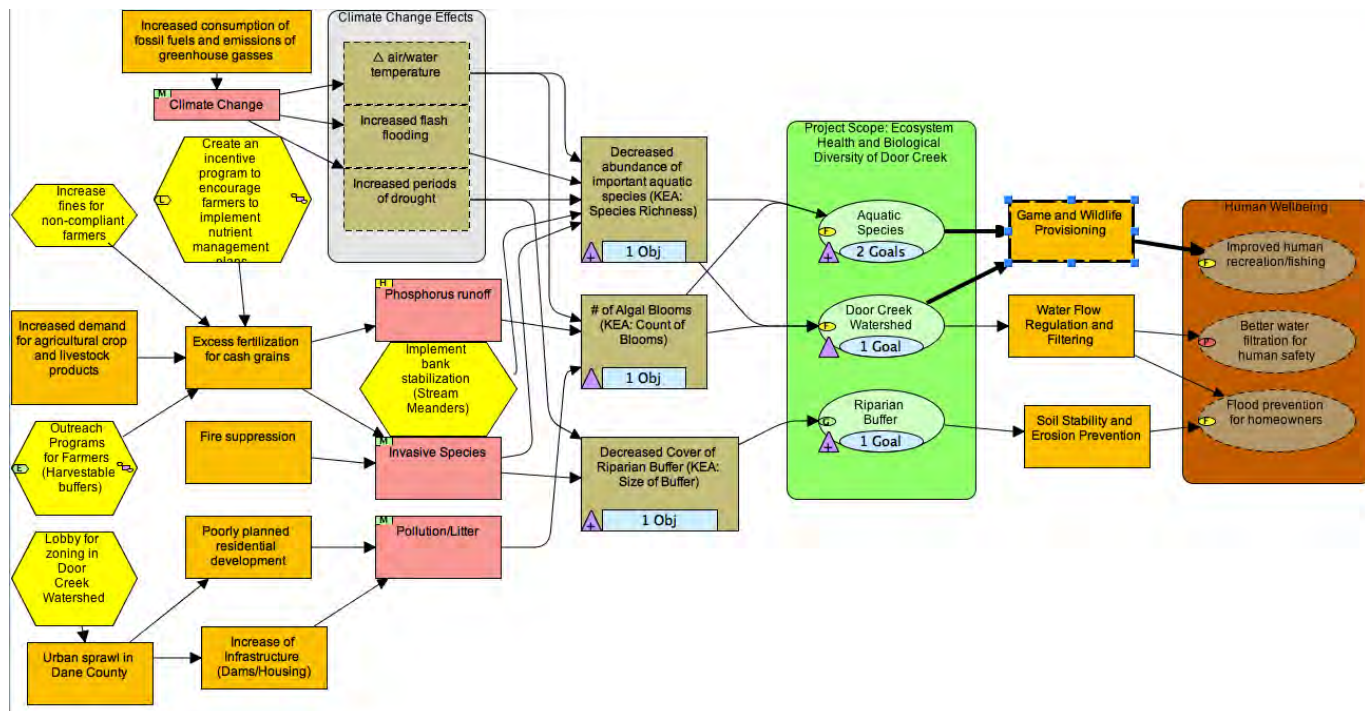


Figure 7: Conceptual Model in Miradi

**Color/Shape Key:**

*Yellow Hexagon: Management strategies*

*Orange Rectangle: Contributing factors*

*Lavender Rectangle: Climate change effects*

*Tan/Grey Dotted Line Rectangle: Climate Change effects/stresses*

*Pink Rectangle: Direct Threats*

*Tan/Grey Rectangle: Key Ecological Attributes & Stresses*

*Small Light Blue Rectangle w/ Purple Triangle: Objectives*

*Green Rectangle: Project Scope*

*Light Green Ovals: Biodiversity Targets*

*Light Blue Oval w/ Purple Triangle: Biodiversity Goals*

*Orange Rectangle Leading into Brown: Ecosystem Services*

*Brown: Human Wellbeing Targets*

( Note: The small boxes with letters within threats, targets, strategy etc. represents threat ratings, priority strategies and targets, and feasible strategies)

**7.2 Narrative**

There are several indirect threats that put stress on our targets within the Door Creek Ecosystem. One notable indirect threat is one of policy, economics, and state funding. According to the Healthy Farms and Healthy Lakes Task Force, increased pressures on farmers to grow their crops for sale and use, coupled with lack of enforcement and lack of effectiveness of regulations on phosphorus-based fertilizers, and manure storage units in Wisconsin causes farmers to continue practices that are prohibited by law, instead accepting fines, or flying under the radar. While a farmer can be fined between \$50-\$200 for a violation of state conservation standards (NRCS 590, NRCS 313, and NR 243), often, farmers decide it is less expensive to pay the fine than it is to take steps to bring their facilities up to code. If a facility is not up to code, the facility contributes to increasing phosphorus loads surrounding watershed areas by either improper nutrient management, overfertilization, or improper manure storage (or a combination of the three) (Gilbertson, M. & Matson, J., 2017).

With low funding and staff in the DNR, it is impossible to inspect every farm constantly. As a result, outside of regularly scheduled inspections, Dane County relies on citizens who notice violations to report them to the appropriate enforcement agencies. As a result, only an estimated 37% of farmers in Dane County are currently in complete compliance with all state conservation standards. This is, in part, because farms built before the Farm Bill passed in

October 2002 are considered “existing” facilities, and are not required to comply with the bill’s standards unless the government pays them to comply with the 2002 laws. The DNR budget only allots between \$45,000-\$100,000 depending on the desired allocation purpose to help farms deal with issues with compliance with 2002 laws. Unfortunately, this is not enough for Dane County to help all of its non-compliant “existing” facilities. So, it must rely on other modes of assistance and enforcement, or choose to ignore facilities that are non-compliant but are not deemed “egregious”(Gilbertson, M. & Matson, J. 2017).

It is also worth noting, that when inspected, quite a few farmers refused to turn over concrete and detailed results to the DNR regarding their practices, leaving the DNR only with the information whether the farm is compliant or not. A member of the Healthy Farms Healthy Lakes Task Force explained in their October meeting that this occurs because the farmers are afraid to give away trade secrets regarding fertilizers, growing methods, etc. Their top priority is protecting the profitability of their facilities, and any detailed information released could be an edge to the competition (Gilbertson, M. & Matson, J. 2017).

Meanwhile, pressure on the city to grow economically and develop for prospective and existing residents leads to building, clearing out land and filling in wetland areas for new subdivisions and roads, as well as building on waterfront areas (a very desirable property type). This contributes to runoff, as well as destruction of riparian habitat which if preserved would prevent erosion and otherwise assist in phosphorus removal processes in the Kegonsa area. Poorly-planned growth also means an increase in litter and pollution for the Door Creek Ecosystem. Additionally, when development occurs, it is easier for weedy invasive species to take hold in newly developed areas.

Another indirect threat that affects the Door Creek Ecosystem is that there is not enough regulation on fossil fuel use in the US, in fact, the current administration is in the process of gutting clean energy proposals from previous administrations, and recently chose to pull the US out of the Paris Climate Accord. Additionally, there is little facilitation of alternative energy options right now, on account of our strong cultural and economic value of coal and oil products. This exacerbates greenhouse gas emissions. Since the US government is not working quickly to lower greenhouse gas emissions, it allows rampant use of inefficient energy which in turn contributes to climate change and effects such as increased flooding and drought, changes in air and water temperature.

Greenhouse gas emissions, excess phosphorus and runoff, pollution and habitat destruction, and changes in water and air temperature all contribute to problems within the Door Creek Ecosystem in different ways, all of which affect human well-being to some capacity.



Greenhouse gasses trap heat in the atmosphere, causing weather patterns to change and become more volatile. One common example of this is increase in both flooding and drought, due to extreme weather events, and in contrast, long periods without rain at all. When a flood occurs, without proper preventative measures, runoff can enter watershed areas more quickly. When a drought occurs, shallow areas of important watershed ecosystems can dry out and stress or destroy aquatic species. It is worth noting that while climate change is a direct threat to the Door Creek ecosystem by way of exacerbating phosphorus runoff and algae growth, because it is a massive and complicated global problem, it is outside the scope of this particular project, and should instead be more of a lense through which to view our more feasible focuses and actions, like slowing down phosphorus loading and removing phosphorus from the watershed.

For example, phosphorus from agricultural practices (excess fertilization), and increased flooding from climate change can cause algal blooms to spike. When this happens, water can become hypoxic, killing wildlife like fish and macroinvertebrates. The excess phosphorus can also cause invasive aquatic species to grow out of control, and outcompete native aquatic vegetation. When these factors are out of balance, the wetland ecosystem does not function properly. Under these conditions, humans suffer. If the wetlands do not function properly, drinking water can be contaminated and unsafe. If the macroinvertebrates die, there is no food for larger organisms. Additionally, if water is hypoxic and fish die, people who fish cannot enjoy their sport, and dead fish also wash up on banks, which is not ideal to landowners and land users, and also requires money and manpower for the resulting cleanup required. Since fish provide a provisioning ecosystem service, as well as affect human wellbeing by providing enjoyment through sport, it is then essential to remove and slow what phosphorus we can, so that when these climate change storm events occur, as little phosphorus as possible gets transferred into the watershed and damage its beloved species (Wisconsin's Changing Climate: Impacts and Adaptation, 2011).

Development that destroys riparian land is also a problem again because riparian land is one good way to slow and prevent runoff from entering waterways and wetlands. Without strong riparian cover, runoff from flooding, from paved roads, and from farms can get into the Door Creek watershed more easily. Optimal riparian cover vegetation provides an ecosystem service of helping to naturally clean the water and reduce phosphorus levels by 7-14%, so they are vital to the Door Creek Ecosystem (USGS, 2008). This again, is important to keeping water clean for human consumption, recreation, and general use. Riparian cover can also prevent flooding and erosion, by holding soil, and therefore water. This is beneficial to homeowners who do not want to see their property damaged either by flood damage or loss of property due to erosion.

Finally, increased air and water temperatures are a problem, because they can speed up algal growth and the process of hypoxia. They can also stress aquatic flora and fauna, leading to population decline of important wetland species (Door Creek Watershed Management Action Plan, 2016).

## ***8. Action Plan***

The action plan for restoring health to the Door Creek ecosystem relies on a multi-faceted approach to address multiple issues caused by phosphorus runoff within biological communities. Since phosphorus directly affects algal blooms, we recommend monitoring algal blooms in Lake Kegonsa, as well as looking into monitoring blooms within Door Creek itself, with the goal of reducing algal blooms during peak growth season in mind. Fewer blooms indicate a reduction in phosphorus within the ecosystem. The team will also monitor the health of aquatic species, primarily fish and macroinvertebrates sensitive to the effects of phosphorus on their habitat, food, and oxygen supplies. Currently, there are primarily adaptable species in the Door Creek ecosystem, and not very many sensitive species. With the reduction of phosphorus, ideally the sensitive species will increase in population and health. To more quickly facilitate phosphorus removal and biological inventory improvement, we intend to increase riparian cover and harvestable buffers along the creek (Krueger, E., Minks, K., & Reimer, J., 2017).

In order to improve the health and quality of these biodiversity targets and achieve our improvement goals, the team will implement and monitor several threat-reduction objectives, primarily working with farmers along the watershed to reduce phosphorus loading and runoff via education and incentive programs encouraging them to implement best practices for mitigation and nutrient management.

### **8.1. Conservation Goals**

#### **Reducing Algal Blooms by Reducing Phosphorus Contamination**

**GOAL:** For Door Creek, the water quality criterion is 0.075 mg/L. Reduce nonpoint agricultural sources to 6,190 lbs of phosphorus annually; additionally, reduce the annual total phosphorus from permitted urban MS4s to 3,085 lbs.

**-SUBGOAL:** Reduce summer algal bloom counts by 2026.

### **Introducing Meanders to State-Owned Land**

**GOAL:** By 2026, 100% of state owned land will contain meanders to aid with bank stabilization and slow/trap sediment.

### **Improving Macroinvertebrate Population Health and Species Abundance**

**GOAL:** Improve the macroinvertebrate biotic index to 3.75 or lower in Door Creek by 2026.

### **Improving Fish Population Health and Species Abundance**

**GOAL:** Increase fish species cool transitional index of biotic integrity score from an average of fair-poor (10-30), to good (60 or higher), by 2026.

## **8.2. Threat Reduction Objectives**

### **Nutrient Management Plan Implementation**

**OBJECTIVE:** By 2021, increase the number of farmers with registered nutrient management plans from 37% to 50%, with a 1.3% increase per year of the 10 year plan.

### **Harvestable Buffer Implementation**

**OBJECTIVE:** By 2021, increase the number of farmers who are utilizing harvestable buffers by 50%. There are currently 20 farmers who are partaking in the program. By 2021, the number of farmers will be increased to 30 (thus, a 50% increase)

## **Reducing Phosphorus Runoff into the Door Creek Ecosystem (Human Behavior)**

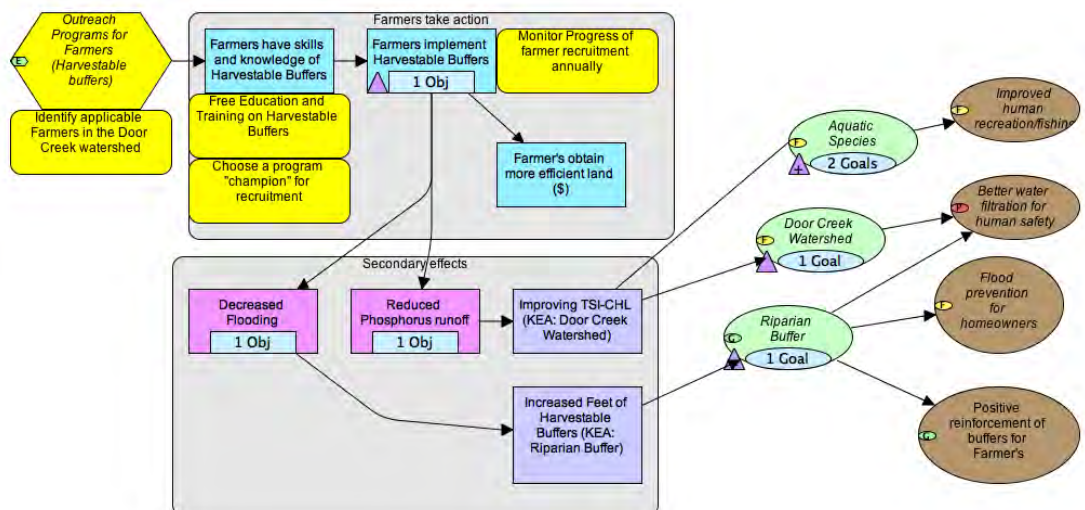
**OBJECTIVE:** For phosphorus runoff through Door Creek and into Lake Kegonsa, the water quality criterion is 0.075 mg/L. Reduce non-point agricultural sources to 6,190 lbs of phosphorus annually (currently at 10,150lbs) by 2026.

### **8.3. Management Strategies to Achieve Goals and Threat Reduction Objectives**

#### **8.3.1 Strategy Summary**

The team considered several strategies, and came to the consensus that rather than bulking up legislative processes like increasing fines and drafting more regulations, the focus should instead be on changing the behaviors of farmers operating within the Door Creek watershed. This will both alleviate financial and human resources costs for both the county and the surrounding farmers. Relevant strategies include utilizing a variety of potential new incentive programs, mixed with currently existing incentive programs, educating farmers and landowners about these programs, and finding champions, farmers already taking advantage of incentive programs, to advocate for expansion of these programs along the Door Creek watershed. In order to accomplish these programs, the team will rely largely on forming relationships and partnerships with farmers in the area to ensure the most comprehensive and holistic use of best practices possible (Krueger, E., Minks, K., & Reimer, J., 2017).

### 8.3.2.1 Outreach to Farmers about Harvestable Buffer Program



**Figure 8: Results Chain (A conceptual model for a specific strategy) for the Outreach for Farmers (Harvestable Buffers) Strategy in Miradi**

This strategy involves attempting to connect and inform farmers and landowners in the Door Creek watershed about the benefits of harvestable buffers. Through this education and outreach, hopefully more farmers and landowners will implement this nutrient management strategy that will result in healthier Aquatic Species in Door Creek, improve the excess nutrient problem in the Door Creek Watershed, which will also benefit Lake Kegonsa and increase the amount of riparian buffers on Door Creek . This strategy, if implemented and if it achieves the desired results, will reduce the following direct threats: (1) Excess Phosphorus Runoff and (2) flooding caused by Climate Change.

#### 8.3.2.1.1 Assumptions and Biodiversity Targets

The assumptions concerning how this particular strategy will ideally function:

If farmers and landowners obtain the skills and knowledge of how to implement harvestable buffers and how those buffers will benefit them financially and Door Creek environmentally, then we expect an increased number of farmers will implement harvestable buffers. If more farmers and landowners implement this practice, then decreases in both phosphorus runoff and environmentally harmful invasive plants will occur. Buffers will provide a decrease in excessive nutrients entering Door Creek will lead to increases to the respective indexes of macroinvertebrates and fish, as well as decreasing phosphorus input into Lake Kegonsa, which will affect the lake's chlorophyll trophic state index. Therefore, by implementing this outreach strategy, it should help achieve desired goals pertaining to all three biodiversity targets: (1) Aquatic species, (2) Door Creek watershed, and (3) riparian buffers.

#### 8.3.2.1.2 Intermediate Objectives

The strategy we are recommending has one intermediate objective: Improve the health of the Door Creek by increasing the amount of farmers/landowners with a harvestable buffer contract from 20 to 30 by 2021. This objective has been set in place to measure the success of the strategy, as well as contributing the strategy to our ultimate goal.

#### 8.3.2.1.3 Activities

The activities, planned actions done by an organization to help achieve a specific goal, recommended for this strategy are the following: Identify applicable farmers in the Door Creek Watershed, give free education and training on harvestable buffers, choose a program “Champion” for recruitment, and monitor progress of farmer recruitment annually. These activities are designed to help give information and connect farmers to the project. Choosing a program “champion” could potentially be an extremely useful way to do that. This would involve choosing someone that is fairly well known on the Door Creek watershed, who is a farmer and is currently enrolled in the harvestable buffer program. Small events could be set up to have other farmers and landowners in the area talk to this farmer in the program or there could be some sort of newsletter that would contain an interview with the “champion”.

#### 8.3.2.2 Incentive to Encourage Implementation of Nutrient Management Plans

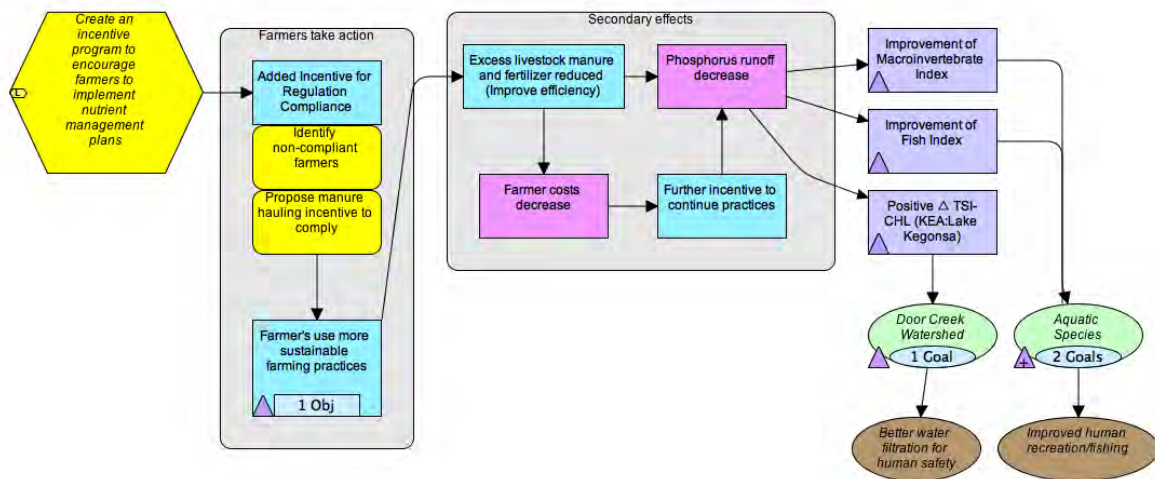


Figure 9: Results chain for Nutrient Management Strategy in Miradi

This strategy involves attempting to create incentives for Door Creek farmers to ultimately encourage implementation of nutrient management plans along the creek. These incentives will hopefully increase the amount of formal nutrient management plans for the Door Creek watershed that will lead to an increased likelihood of implementing those management plans that will in turn have positive effects on this project's biodiversity targets. This strategy, if implemented and if it achieves the desired results, will reduce the following direct threats: (1) Excess Phosphorus Runoff.

#### 8.3.2.2.1 Assumptions and Biodiversity Targets

These are the assumptions concerning how this particular strategy will ideally function: If we find a suitable incentive for Door Creek farmers to get and implement nutrient management (NM) plans, then we expect that farmers will get and implement NM plans, which will cause more sustainable farming practices to be more common. Through the incentive, which will take excess manure from farms with any livestock, this will decrease costs for manure relocation and save farms money, further incentivizing continued implementation of plans.

Continued implementation will decrease the amount of phosphorus entering Door Creek which we expect will improve indexes pertaining to macroinvertebrates and fish in Door Creek and the chlorophyll trophic state index in Lake Kegonsa. Therefore, by implementing this incentive strategy, it should help achieve desired goals pertaining to two biodiversity targets: (1) Aquatic species, and (2) Door Creek watershed.

#### 8.3.2.2.2 Intermediate Objectives

The strategy we are recommending has one intermediate objective: By 2021, 50% of farmers in the Door Creek watershed will have registered Nutrient Management plan and are implementing it. Currently 37% of farmers in the watershed have registered Nutrient Management plans, and we would like to increase that by an average of 1.3% per year of the 10 year plan.

#### 8.3.2.2.3 Activities

The activities recommended for this strategy are the following: Identify non-compliant farmers, propose manure hauling incentive to comply, propose manure digester incentive to comply. These activities are meant to create incentives to NM registration and implementation. The two suggestions that this Conservation Plan proposes is helping farmers taking away excess manure or providing a manure digester in exchange for NM registration and implementation, that will obviously have to be monitored in some fashion. The writers realize these incentives may be extremely expensive and therefore impractical. An alternative could be to simply pay farmers for NM registration and implementation in a "payment for environmental services" fashion.

### 8.3.3. Strategy Timeline and Budget

Item	2018	2019	2020	Total	Budget Totals
Door Creek Project -v0.25-	34	30	30	94	19,928
Outreach Programs for Farmers (Harvestable buffers)	34	30	30	94	19,928
Outreach Programs for Farmers (Harvestable buffers)	34	30	30	94	19,928
Free Education and Training on Harvestable Buffers	24	24	24	72	15,264
P1: Person 1	24	24	24	72	15,264
Identify applicable Farmers in the Door Creek watershed	4			4	848
P2: Person 2	4			4	848
Monitor Progress of farmer recruitment annually					
Choose a program "champion" for recruitment	2	2	2	6	1,272
P3: Person 3	2	2	2	6	1,272
Keep count of how many farmers have harvestable buffer contracts with Dane County	4	4	4	12	2,544
Eric Krueger	4	4	4	12	2,544

Extra Expenses	2018	2019	2020	Annual Total
Gasoline	\$120	\$120	\$120	\$360
Educational Handouts	\$150	\$150	\$150	\$450
Meet ups	\$300	\$300	\$300	\$900

Total: \$1,732

**Figure 10: Budget for the Outreach to Farmers for Harvestable Buffer strategy**

This is a rough strategy timeline and budget for a three year portion of the overall proposed 10 year plan. The units in the orange section of the upper chart are the number of days likely needed to complete each task on a yearly basis. The financial totals of these work days, in the green section, are assuming that people working on the project are getting paid \$212 dollars a day (Salary of \$50,000 a year). If these estimates are relatively correct, then over the course of three years the Harvestable Buffers Outreach strategy will cost approximately **\$19,928** for man hours alone. We can assume that there will also be additional costs associated with the "Free Education and Training" and the "Program 'Champion'" actions which would likely include gasoline, educational handouts, and money for meeting ups with farmers to talk about harvestable buffers. Gasoline assumes a 22 mpg car will be driving up to a total 40 miles per day throughout each of the 24 days of the year needed for the education actions. "Educational handouts" assumes the education action will be printing up to a total of 100 pages at 5 cents a page per day out of the 24 days needed for the action annually, with \$30 added in case extra printing is necessary. "Meet ups" assumes \$50 worth of food and beverages will be sufficient for an event every other month of the year. That puts these extra expenses totaling **\$1732**. Combined with labor costs, that makes a total of **\$21,660** for the proposed harvestable buffer strategy over the course of three years. If we take this assumed spending budget and expand it on the entire 10 years of the proposed strategy the total cost of the strategy would equal **\$72,200**.



## 9. Monitoring Plan

The team considered multiple monitoring plans to measure factors which indicate a decrease in overall phosphorus in the Door Creek Ecosystem. One of the quickest and most cost-effective monitoring plans involves surveying macroinvertebrates and fish every five years and checking them within the guidelines of a Hilsenhoff Biotic Index and a fish Index of Biotic Integrity. If scores improve, then the phosphorus is likely decreasing in ideal amounts. If the score stays the same, or worsens, a new approach for phosphorus removal must be considered. The same can be said for testing the trophic state indicator for summer algal blooms. In order to help remove the phosphorus, and slow its movement into the creek and eventually Lake Kegonsa, we aim to stabilize the banks of state-owned land by adding meanders throughout the course of the 10 year plan. We will leave private including the two drainage-district-owned properties straight in order to maintain crucial relationships with the landowners (Krueger, E., Minks, K. & Reimer, J. 2017).

### 9.1. Goals

What (Indicator)	How (Methods)	When	Who	Where	Comments
Goal: By 2026, 100% of banks on state-owned land will contain meanders to aid with bank stabilization and slow/trap runoff sediment.					
Monitoring Approach: Time series					
Meanders present on all state-owned land	Site visits and evaluation based on DNR standards & environmental best practices	Every 5 years	Land & Water Resources Management/Door Creek Project Team	State-owned/natural and wildlife areas along Door Creek Watershed Area	Leave drainage district & private land to ensure good relationship with adjacent property owners and businesses

Figure 11: Monitoring Plan for a potential bank stabilization strategy

What (Indicator)	How (Methods)	When	Who	Where	Comments
Goal:	Improve Hilsenhoff macroinvertebrate biotic index count in testing areas from an average of 4.7 (good-fair) to an average of 3.7 (very good-excellent), by 2026				
Monitoring Approach:	Time series				
Macroinvertebrates	Water testing and species inventory in the four designated observation areas	Every 5 years	Land & Water Resources Management/Door Creek Project Team	Four designated observation areas along door creek (detailed in project documents)	

Figure 12: Monitoring plan for Macroinvertebrate Index goal.

What (Indicator)	How (Methods)	When	Who	Where	Comments
Goal:	Increase fish species cool transitional IBI score from fair-poor (10-30) range, to 60 (good), by 2026				
Monitoring Approach:	Time Series				
Fish species	Water testing and species inventory in the four designated observation areas.	Every 5 years	Land & Water Resources Management/Door Creek Project Team	Four designated observation areas along Door Creek (detailed in project documents)	

Figure 13: Monitoring Plan for Fish Index goal.

What (Indicator)	How (Methods)	When	Who	Where	Comments
Goal:	Decrease summer algal bloom count by in Lake Kegonsa by 2026.				
Monitoring Approach:	Time Series				
Chlorophyll trophic index	Use chlorophyll trophic index to acquire accurate counts of algal blooms.	Annually	Land & Water Resources Management/Door Creek Project Team	Lake Kegonsa	*Current numerical bloom count data unknown. *Currently looking into additionally measuring bloom counts within the creek itself

Figure 14: Monitoring Plan for Algae bloom goal.

**Note:** While we do not currently have complete sufficient data regarding the current number of summer algal blooms in Lake Kegonsa or Door Creek, we intend to monitor summer algal blooms at the height of biomass using the chlorophyll trophic state index, which will indicate the health and abundance of certain species of algae expected to be present in the creek given the levels of phosphorus. We expect that once obtained, the data will be consistent with the current “fair quality” TSI-CHL rating.

The current TSI-CHL rating (based on the mean of four water samples taken by citizen surveys at four different site at Lake Kegonsa in June and August, 2016 - 2017) is 55, which puts Lake Kegonsa in a “Fair Quality” rating (dnr.wi.gov , accessed on 4, November, 2017). Given that Door Creek provides only a portion of the total input of phosphorus into Lake Kegonsa, a reasonable goal for a desired status could be a TSI-CHL of 45. It should be noted that more extensive TSI-CHL tests should be taken to calculate a sufficiently accurate score as the sources and scope of this assessment were limited to only four samples over the course of two years.

## 9.2. Threat Reduction Objectives

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Objective:</b>	By 2026, increase the number of farmers who are utilizing harvestable buffers on Door Creek by 50%. There are currently 20 farmers who are partaking in the program. By 2021, the number of farmers will be increased to 30 (thus, a 50% increase).				
<b>Monitoring Approach:</b>	Time Series				
Number of farmers in Door Creek Area Using Harvestable Buffers increased from 20 to 30 (50% increase)	Review DNR records of applicants and participants	Annually	Land & Water Resources Management/Door Creek Project Team	Facilities along the Door Creek Watershed Area	

Figure 15: Monitoring for flooding threat reduction objective

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Objective:</b>	For phosphorus runoff through Door Creek and into Lake Kegonsa, the water quality criterion is 0.075 mg/L. Reduce non-point agricultural sources to 6,190 lbs of phosphorus annually (currently at 10,150 lbs) by 2026.				
<b>Monitoring Approach:</b>	Time Series				
Amount of algal blooms is directly related to phosphorus levels. Reducing phosphorus in the watershed will reduce the number of algal blooms.	Use remote sensing setups, citizen scientist data, and DNR data to analyze phosphorus levels within Door Creek and Lake Kegonsa	Annually or bi-annually	Land & Water Resources Management/Door Creek Project Team, citizen scientists/Friends of Lake Kegonsa	Designated test areas along Door Creek	Will also observe algal summer blooms in conjunction to testing P levels, to help solidify consistent data, using chlorophyll trophic index.

Figure 16: Monitoring for phosphorus runoff threat reduction objective

### 9.3. Intermediate Objectives

What (Indicator)	How (Methods)	When	Who	Where	Comments
Objective:	By 2026, increase the number of farmers with registered nutrient management plans from 37% to 50%, with a 1.3% increase per year of the 10 year plan.				
Monitoring Approach:	Time Series				
50% of farmers in the Door Creek Watershed Area have a registered NM plan and are implementing it.	Review and survey applicant and participant DNR documents	Annually	Land & Water Resources Management/Door Creek Project Team	Facilities along the Door Creek Watershed	Create program to transport manure to approved processing facility for free, for participants in Harvestable Buffer Program

Figure 17: Monitoring for Nutrient Management intermediate objective

### 9.4. Management Effectiveness Questions

Moving forward, as the plan is implemented, it will be essential to connect within the team to ask several questions regarding effectiveness of the plan. First, the team must assess whether or not outreach and education efforts toward farmers in the watershed area to learn about incentives and benefits of harvestable buffers actually leads to increased implementation of harvestable buffers. Second, it will be important to gauge whether or not sensitive species of fish and macroinvertebrates actually return to the Door Creek Ecosystem as phosphorus is removed. If the status of richness in these species does not increase and improve, the team should consider other factors and strategies.

## 10. Recommendations for Adaptive Management: Analyze, Use, and Adapt

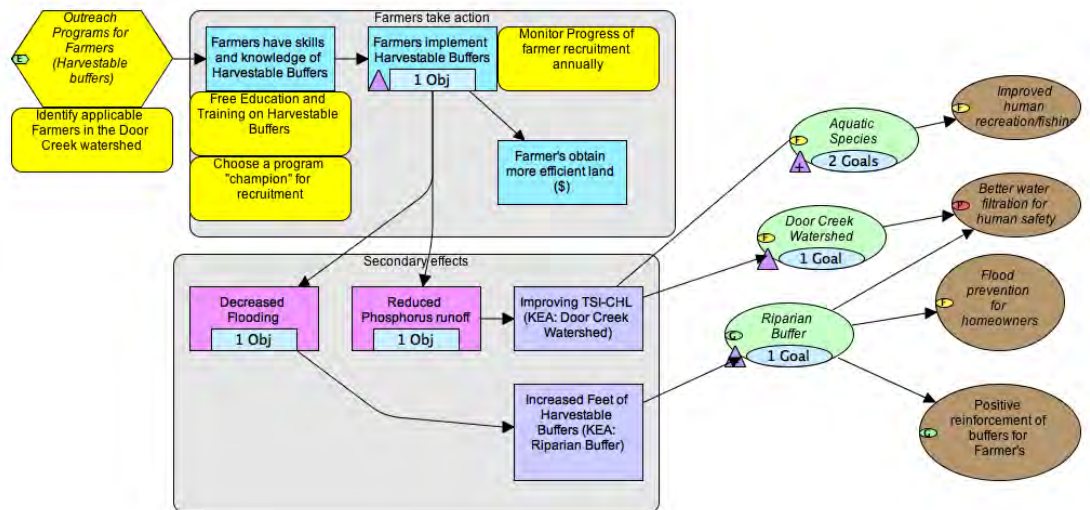


Figure 18: Results chain for Outreach Programs for Farmers

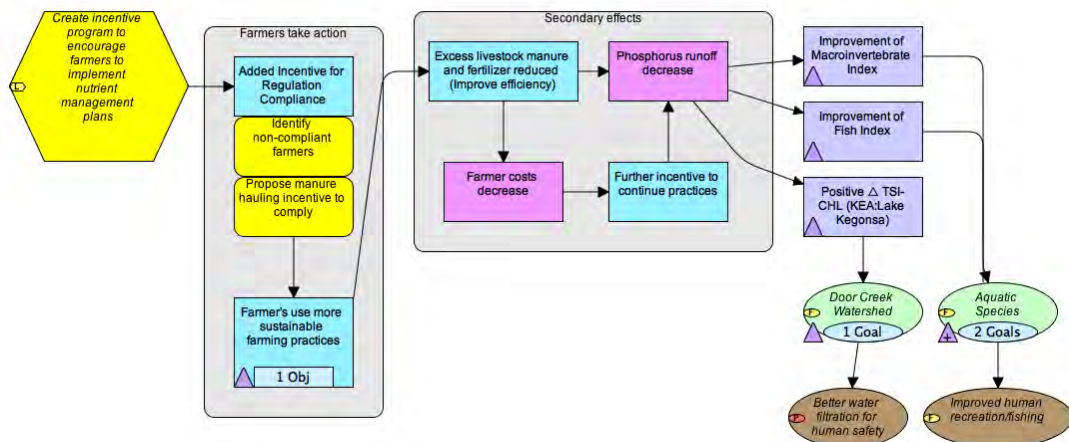


Figure 19: Results chain for Nutrient Management Plan Incentive Program

It is paramount as a monitoring strategy to continue monitoring the frequency of algal blooms that occur in Lake Kegonsa, especially during the peak bloom months between May and September. Additionally, eventual implementation of a strategy to monitor both the number and size of algal blooms during the summer month is recommended. Currently there is no plan in place to analyze and monitor these blooms in Door Creek directly, with Dane County solely using algal bloom counts in Lake Kegonsa to determine environmental effects of phosphorus input into the watershed (Miller et al., 2013). Monitoring Door Creek directly during the height of bloom propagation will yield the most accurate and applicable data.

As viewable in Figure 18 and 19, further education and relationship-building among both local farmers and landowners will be critical to continue to improve the quality and reach of the Harvestable Buffer and Nutrient Management Plan initiatives. Currently the goal by the end of 2026 is to increase participation from 37% of farmers in the watershed with a Nutrient Management Plan to 50%. During this same time period, it is desired add 10 more farmers to the Harvestable Buffer program, ultimately increasing total participation by 50%, to 30 farmers in the Door Creek watershed. This can be done through annual or bi-annual meetings to address issues that arise from either plan. Additionally, a program could be created to transport manure to approved processing facilities for free (to participants of the Harvestable Buffer Program, or at discounted rates to those who have a working Nutrient Management Plan). Free education programs for these farmers or local landowners (providing free coffee and snacks) may open up a floor to address any concerns the community has with these programs. A positive and open communication pathway is essential when implementing these new programs, so that landowners know that they can trust their local government to have their best interests in mind.

Citizen science could be further implemented with physical water sampling in Door Creek more than annually (increase two or three fold in frequency). This participation by the local community will allow them to feel involved in the conservation and improvement of Door Creek. These opportunities for citizen water sampling also open the door to educational moments and further outreach in the Door Creek watershed. For the rest of the sampling (aquatic macroinvertebrates every 5 years, remote sensors daily or hourly, etc.), these methods can continue as is for the foreseeable future or until the completion of the 10 year management plan (Door Creek Watershed Management Plan, 2016).

For our three main biodiversity targets, we are hoping to implement several strategies. We would like to implement meanders in Door Creek to slow down water and reduce soil erosion and phosphorus input into the watershed. To do this we will couple site visits and proper evaluation in line with environmental best practices as well as avoiding private land and drainage districts to ensure a good working relationship with landowners and businesses. Additionally, we are hoping to couple both macroinvertebrate and fish sampling in four designated areas along Door Creek before it reaches Lake Kegonsa. This will reduce variables in further years (location changes, etc.) and provide clear data on the environmental effects of phosphorus changes during the Management Plan's implementation period.

Ultimately, if the above guidelines are carried out, adaptation to any issues that arise that have not been directly addressed should be minimally difficult at most.

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## ***Appendix:***

Not applicable. All necessary figures referenced in-text and can be referred to through provided references in the “Literature Cited” section.

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# **Dorn Creek Conservation Management Plan**

**Addressing Phosphorus Impairments and Habitat Improvement**







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## ►1. Project Summary

### 1.1 Project Name

Dorn Creek Conservation Plan

### 1.2 Project Location

The Dorn Creek Watershed is a subwatershed within the Six Mile and Pheasant Branch Watershed located in Dane County, Wisconsin just outside of the City of Madison.

### 1.3 Project Vision

The Dorn Creek Conservation Management Plan strives to establish a comprehensive strategy that results in a healthy Dorn Creek waterway with reduced phosphorus levels in the creek and adjoining wetlands, a restored and widened riparian buffer zone, and improved water quality and wildlife habitat throughout the creek and Lake Mendota.

### 1.4 Contact Name and Address

Lauren Kuhl  
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Dane County Board of Supervisors  
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(608) 266-5758

### 1.5 Project Duration

**Planning Period:** September 2017-November 2017

**Implementation:** November 2017-December 2030

### 1.6 Project Description

Graduate students from the Nelson Institute for Environmental Studies, through the University of Wisconsin, collaborated with the Dane County Board of Supervisors and the Dane County Land and Water Resources Department (LWRD) staff to devise a conservation plan for Dorn Creek.

Dorn Creek is a tributary to Six Mile Creek and Lake Mendota. The creek was identified as an impaired waterway, and thus, it is as a significant contributor to heightened phosphorus levels in Lake Mendota. The creek transports high levels of bioavailable phosphorus to Lake Mendota, which contributes to increased algal growth and degraded water quality in the lake.

Not only does degraded water quality and increased algal growth have a detrimental impact on urban aesthetics and recreational opportunities available to area residents, it also affects the long-term sustainability of the area's agricultural economy, which must adapt to expanded development within Dane County and to higher standards regarding agricultural runoff.



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The agricultural economy is a key factor that shapes management decisions within the watershed. Therefore, the planning team sought to create a plan to reduce legacy phosphorus levels and decrease future phosphorus runoff into the creek. This goal is achieved through a combination of contaminated sediment removal and the implementation of various conservation practices intended to reduce the amount of phosphorus and other agricultural contaminants entering Dorn Creek.

## ► 2. Introduction

### 2.1 Project Area

The geographic scope of the Dorn Creek Restoration Project includes 12.7 square miles of Dorn Creek, the Dorn Creek County Wildlife Area, and the riparian lands alongside the creek. The 287 acre Dorn Creek County Wildlife Area is a combination of state-owned Department of Natural Resources (DNR) property and Dane County-owned land. The majority of the remaining area of the Dorn Creek Watershed is privately owned land, most of which is presently used for agricultural production, the primary source of the phosphorus pollution targeted by this project.

#### 2.2.1 Legislation, Orders, or Documents related to the establishment and management of Dorn Creek

Under state law, the DNR prescribes agriculture performance standards and the Department of Agriculture, Trade, and Consumer Protection (DATCP) prescribes technical standards to achieve compliance with performance standards.

##### 2.2.1.1 NR 243, Wis. Adm. Code

NR 243 “establishes the criteria under which the department may issue a notice of discharge or a permit to other animal feeding operations that discharge pollutants to waters of the state or fail to comply with applicable performance standards and prohibitions in ch. NR 151.”

##### 2.2.1.2 NR 151, Wis. Adm. Code

NR 151 “establishes runoff pollution performance standards for non-agricultural facilities and transportation facilities and performance standards and prohibitions for agricultural facilities and practices designed to achieve water quality standards as required by s. 281.16 (2) and (3), Stats.” NR 151 contains livestock and cropland performance standards that are mandatory for all farms. Implementation of these standards is conducted through a cooperative process involving DATCP, DNR, Dane County, and manure handling entities.

##### 2.2.1.3 Clean Water Act - Impaired Waters

Section 303(d) of the CWA requires the listing of waters that do not meet water quality standards using Total Maximum Daily Load (TMDL) measures. Impaired waters that are restored to meet water quality standards are removed from the Impaired Waters list based on a biennial review process.

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Legal Document	Year Implemented	Level of Implementation
NR 243, Wis. Adm. Code	2007	State
NR 151, Wis. Adm. Code	2002	State
Clean Water Act	1972	Federal

**Table 1: Summary of Legal Documents relevant to project**

### 2.2.2 Conservation Planning for Project Area, Past and Present

Research on phosphorus runoff in the Dorn Creek Watershed occurred through a University of Wisconsin project conducted from 2003 until 2006. This project focused on phosphorus sediment transport and the relationships between agricultural runoff events and phosphorus deposits contained within the streambed (Lathrop et al., 2007). Additionally, research conducted by Justin Rogers of Stanford University, published in 2006, expanded upon knowledge of the role that major weather events play in re-suspending sedimentary phosphorus and the impact that different mixes of phosphorus forms have on water quality downstream (Rogers et al., 2006)

Furthermore, in 2013, the Madison Metropolitan Sewer District (MMSD) and the Yahara Watershed Improvement Network (Yahara WINs) collaborated with graduate students from the University of Wisconsin-Madison's Water Resources Management (WRM) Program to investigate the potential for phosphorus reduction management strategies in the Upper Dorn Creek Watershed. This project contributed to a greater understanding of the extent of phosphorus sedimentation and ongoing phosphorus runoff into Dorn Creek and set forth a series of suggestions for management actions that could be taken in the future (2013 WRM Practicum, 2015). One of those recommendations, removal of legacy sediment deposits, was selected for testing through a pilot program.

In 2016, Dane County Executive Joe Parisi launched a \$12 million project targeting 33 miles of Yahara watershed waterways for legacy sediment removal, with an overall goal of removing 870,000 pounds of phosphorus over several years (Verberg, 2016). To test out the viability of removing legacy phosphorus sediment, the county vacuumed 200 cubic yards of sediment from a 300 foot long stretch of Dorn Creek contained within the county wildlife area. Sediment was piped out of the creek to an excavated ditch about 20 yards from the edge of the creek, where it was pumped into a large semi-permeable storage bag. A polymer that binds with phosphorus was injected into the sediment, causing phosphorus to coagulate and allowing water to drain from the storage bag back into the ground. Once contained in the storage bag, the removed phosphorus sediment can be covered with soil and replanted, although this had not yet occurred at the pilot site as of the project team's most recent visit to the Dorn Creek County Wildlife Area in October 2017 (J. Reimer, personal communication, October 18, 2017).

Pre-test and post-test comparisons of dredged areas to control areas of the creek revealed that the hydraulic dredging process was successful in removing significant quantities of phosphorus.

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Removals were also calculated to be far more cost effective per-pound of phosphorus removed relative to conservation measures aimed at reducing phosphorus runoff. Given the success of the pilot program, Dane County Land and Water began accepting bids for the remaining 2.3 mile stretch of Dorn Creek bounded by County Highway M and County Highway Q, the same stretch that contains the pilot dredging area and the Dane County Wildlife Area (K. Minks, personal communication, October 18, 2017).

Dane County LWRD Interim Deputy Director John Reimer informed the conservation team that the department's future plans for conservation actions in the Dorn Creek Watershed include the continuation legacy sediment phosphorus removal projects, an expansion of harvestable buffer acreage, and other Yahara WINs program farmer-focused conservation actions such as nutrient management planning and runoff mitigation infrastructure improvement (J. Reimer, personal communication, October 18, 2017).

## ► 3. Methods

### 3.1 Project Team

Student names redacted.

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### 3.1.2. Process Facilitators

ES 972 Professor Arlene Johnson and Teaching Assistant Alicia Cruz are facilitators for this project and provided support and guidance throughout the conservation plan drafting process.

### 3.1.3. Project Advisors

Lauren Kuhl serves as Legislative Management System Specialist for the Dane County Board and is the primary contact representing the board for the purposes of this project. Project team members also received information, advising, and a tour of the restoration area from John Reimer and Kyle Minks, staff members of the Dane County Land and Water Resources Department.

## 3.2 Conservation Planning Approach

The Dorn Creek Conservation Plan was created using the Conservation Measures Partnership's (CMP) Open Standards for the Practice of Conservation, hereafter referred to as "Open Standards" (CMP, 2013). The CMP states that the Open Standards "bring together common concepts, approaches, and terminology in conservation project design, management, and monitoring in order to help practitioners improve the practice of conservation (CMP, 2013).

1.1 The plan was conceptualized and recorded in Miradi conservation planning software, a program designed to assist conservation practitioners in adaptive management strategy design, implementation, and evaluation.

The five steps in the Open Standards process, as outlined in the 2013 CMP guide, are:

**Step 1: Conceptualize the Project Vision and Context**

**Step 2: Plan Actions and Monitoring**

**Step 3: Implement Actions and Monitoring**

**Step 4: Analyze Data, Use the Results, and Adapt**

**Step 5: Capture and Share Learning**

Each of these steps is outlined in greater detail in the diagram below (see Figure 1).



**Figure 1. CMP Open Standards Project Management Cycle Version 3.0**

### 3.2.1. Methodological Definitions

The following are terms defined in the Open Standards that are used throughout the Dorn Creek Conservation Plan:

**Activity** - a specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives. Also referred to as an action, intervention, response, or strategic action.

**Adaptive Management** - refers to the incorporation of a formal learning process into conservation action. Specifically, it is the integration of project design, management, and monitoring, to provide a framework to systematically test assumptions, promote learning, and supply timely information for management decisions.

**Assumption** - a project's core assumptions are the logical sequences linking project strategies to one or more targets as reflected in a results chain diagram. Other assumptions are related to factors that can positively or negatively affect project performance.

**Conceptual Model** - a diagram that represents relationships between key factors identified through situation analysis that are believed to impact or lead to one or more conservation targets. A good model should link conservation targets to threats, opportunities, stakeholders, and key intervention points. It should also indicate which factors are most important to monitor.

**Conservation Targets/Biodiversity Targets** - interchangeable terms referring to the specific species, ecological systems, or habitats selected to represent the full extent of biodiversity present in the project area. These targets are utilized for setting conservation goals, implementing conservation strategies, and measuring the overall effectiveness of a conservation plan.

**Direct Threats** - primarily human activities that have an immediate detrimental impact on a conservation target that are identified and ranked based on the relative severity and observed or

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potential impact on specified targets. Natural phenomena that are altered as a result of human activities, such as flooding events exacerbated by climate change, are also considered direct threats.

**Factor** - a generic term for an element of a conceptual model including direct and indirect threats, opportunities, and associated stakeholders.

**Goals** - formal statements of the ultimate impacts that a conservation team hopes to achieve that are linked to a project's conservation targets and represent the desired status of conservation targets over the long-term. Quality goals meet the following criteria: linked to targets, impact oriented, measurable, time limited, and specific.

**Human Well-being Target** - focus on those components of human well-being affected by the status of conservation targets. All human well-being targets at a site should collectively represent the array of human well-being needs dependent on the conservation targets.

**Indicator** - a measurable entity related to a specific information need such as the status of a target/factor, change in a threat, or progress toward an objective. Good indicators are: measurable, precise, consistent, and sensitive.

**Indirect Threat** - a factor identified in an analysis of the project situation that is a driver of direct threats that is often an entry point for conservation actions.

**Intermediate Result** - a specific result that a project is working to achieve en route to accomplishing a final goal or objective.

**Key Ecological Attribute (KEA)** - aspects of a target's biology or ecology that if present, define a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time.

**Monitoring** - the periodic collection and evaluation of data relative to stated project goals and objectives.

**Monitoring Plan** - the plan for monitoring a project. It includes information needs, indicators, and methods, spatial scale and locations, timeframe, and roles and responsibilities for collecting data.

**Method** - a specific technique used to collect data to measure an indicator. A good method should meet the criteria of accurate, reliable, cost-effective, feasible, and appropriate.

**Objective** - a formal statement detailing a desired outcome of a project such as reducing a critical threat. A good objective meets the criteria of being: results oriented, measurable, time limited, specific, and practical. If the project is well conceptualized and designed, realization of a project's objectives should lead to the fulfillment of the project's goals and ultimately its vision.

**Outcome** - the desired future state of a threat or opportunity factor. An objective is a formal statement of the desired outcome.

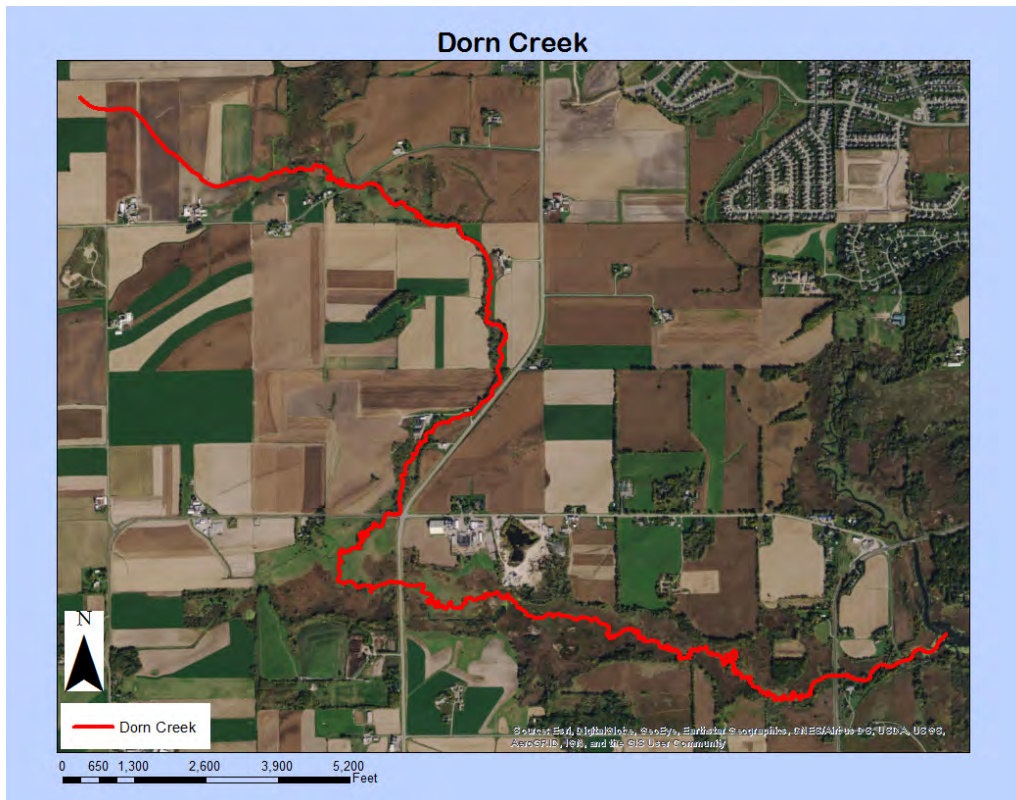
**Results Chain** - a graphical depiction of a project's core assumption, the logical sequence linking project strategies to one or more targets. In scientific terms, it lays out hypothesized relationships.

**Strategy** - a set of actions with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, integrating opportunities, and limiting constraints. A good strategy meets the criteria of being: linked, focused, feasible, and appropriate.

**Stress** - impaired aspect of a conservation target that results directly or indirectly from human activities. (e.g., reduced creek flow, increased sedimentation). Generally equivalent to a degraded key ecological attribute (e.g., habitat loss).







**Figure 3. Dorn Creek**

The figure above depicts the geographic area of Dorn Creek. The geographic area is heavily composed of agricultural land as depicted in the map above.

## 4.2 Vision

The Open Standards require that a project vision be broad, concise, and inspirational and reflect the overall outcome of the management plan (CMP, 2013).

The Dorn Creek Conservation Management Plan strives to establish a comprehensive adaptive management model that will result in a healthy Dorn Creek waterway with reduced phosphorus levels in the creek and adjoining wetlands, a restored and widened riparian buffer zone, and improved water quality and wildlife habitat throughout the creek and Lake Mendota.

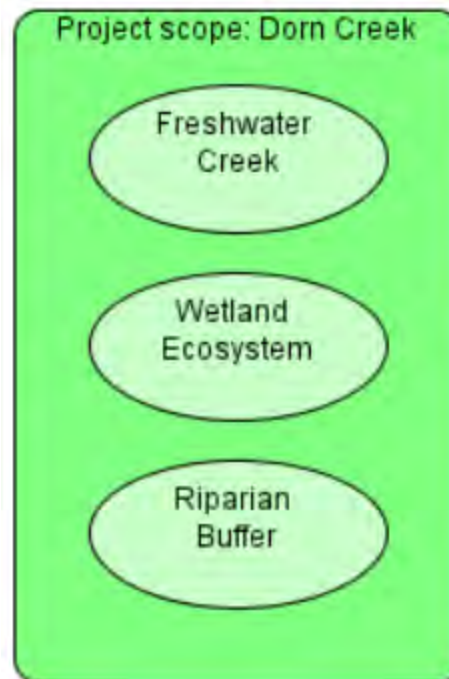
## 4.3 Description and Justification for Selection of Biodiversity Targets

According to the open standards, targets can be ecosystems or species. Our team originally chose both, but we quickly felt overwhelmed that we'd be unable to adequately address all of them. "Although most conservation teams want to conserve this entire complex system, they typically lack the staff, financial, and time resources to explicitly focus on all elements of biodiversity within the system. For this reason, when planning and monitoring conservation projects, it is useful to select a handful of "conservation targets" that can represent the overall biodiversity at your site." (CMP, 2013)



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Our initial target analysis identified six potential biodiversity targets including freshwater creek and riparian ecosystem; freshwater lake and shoreland ecosystem; wetland ecosystem; freshwater aquatic species; amphibians; and waterfowl. After some group deliberation, we decided to Group targets by ecosystem and clarify the project's vision. This led to a narrower focus on three biodiversity targets: freshwater creek, wetland ecosystem and riparian buffer (see figure 4).



**Figure 4: Biodiversity Targets**

#### 4.3.1. The Freshwater Creek

Dorn Creek bears the name of this project, and is central to our focus. The creek is heavily polluted with phosphorus, nitrates, and other pollutants via agricultural runoff originating from nearby and sometimes adjacent agricultural and livestock activities. Agricultural runoff has adverse effects on hydrologic systems. Aquatic species are directly affected by altered water chemistry, and indirectly affected by algal blooms intensified from the excess nutrients within the runoff (Moeder et al., 2017). Dorn Creek is a tributary to Lake Mendota and the greater Yahara Watershed. Thus, Dorn Creek and its inherited pollutants contribute to the increasing frequency and intensity of algal blooms observed in both Dorn Creek and Lake Mendota.

#### 4.3.2. Wetlands

Most of the adjoining lands near Dorn Creek have hydric soils which are indicator characteristic of wetlands. Wetlands are saturated for either a portion of or the entirety of any given year, and in the Dorn Creek area, soils are continuously saturated for at least a portion of the year due to their close proximity to the creek and Lake Mendota.

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Wetlands play an important role in biodiversity by offering unique habitat for waterfowl and other native species and Ecosystem services such as water filtration (Wu et al., 2017). However, pollutants which have runoff into the creek in excess and are subsequently leaching into and degrading the adjoining wetlands by overloading filtration capacity and degrading native habitat.

#### 4.3.3. Riparian Buffer Zone

A riparian buffer zone is a vegetated area adjoining a water body and it plays a key role in preserving/restoring water chemistry.. “Nitrogen (N) and phosphorus (P) flows [originating from nearby agricultural land use] may be intercepted and assimilated by riparian vegetation” (Neilen et al., 2017). Riparian zones also significantly reduce erosion by locking soil in place with root systems. This vegetative buffer area also has the capability to serve as habitat for native wildlife and plant species, thus increasing biodiversity. (Neilen et al., 2017).

### ► 5. Viability Assessment

A viability assessment creates a foundation for defining healthy targets and the measureable goals in which to achieve those. A viability assessment identifies key ecological attributes (KEA) and indicators for each biodiversity target in order to assess the current state of the target and establish a future desired status for each biodiversity target. Foundations of Success defines key ecological attributes as “aspects of a target’s biology or ecology that if present, define a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time” (2009). Indicators are determined to further assess the attribute over the management period, and establish acceptable ranges for those indicators. *Poor, fair, good* and *very good* indicator ratings were determined for each indicator, and each indicator was evaluated to determine its current rating. The desired indicator rating was also established for each indicator. Below are the following definitions for each indicator rating (Foundations of Success, 2009):

**Very Good** – Ecologically desirable status; requires little intervention for maintenance.

**Good** – Indicator within acceptable range of variation; some intervention required for maintenance.

**Fair** – Outside acceptable range of variation; requires human intervention.

**Poor** – Restoration increasingly difficult; may result in extirpation of target.

Section 5.1 to 5.3 discuss each KEA and the corresponding indicators and indicator ratings for each of the biodiversity targets. The following desired future statuses for Freshwater Creek Water Chemistry and the Riparian Buffer Invasive Plant Cover and Extent are to be achieved by 2025. The remaining desired future statuses are to be achieved by 2030. It is recommended that further data and information be gathered for each of these KEAs and current indicator ratings due to a lack of information at time of management plan development. The following tables displaying KEAs, indicators and indicator ratings are easily changeable and should be updated as further knowledge is gained.

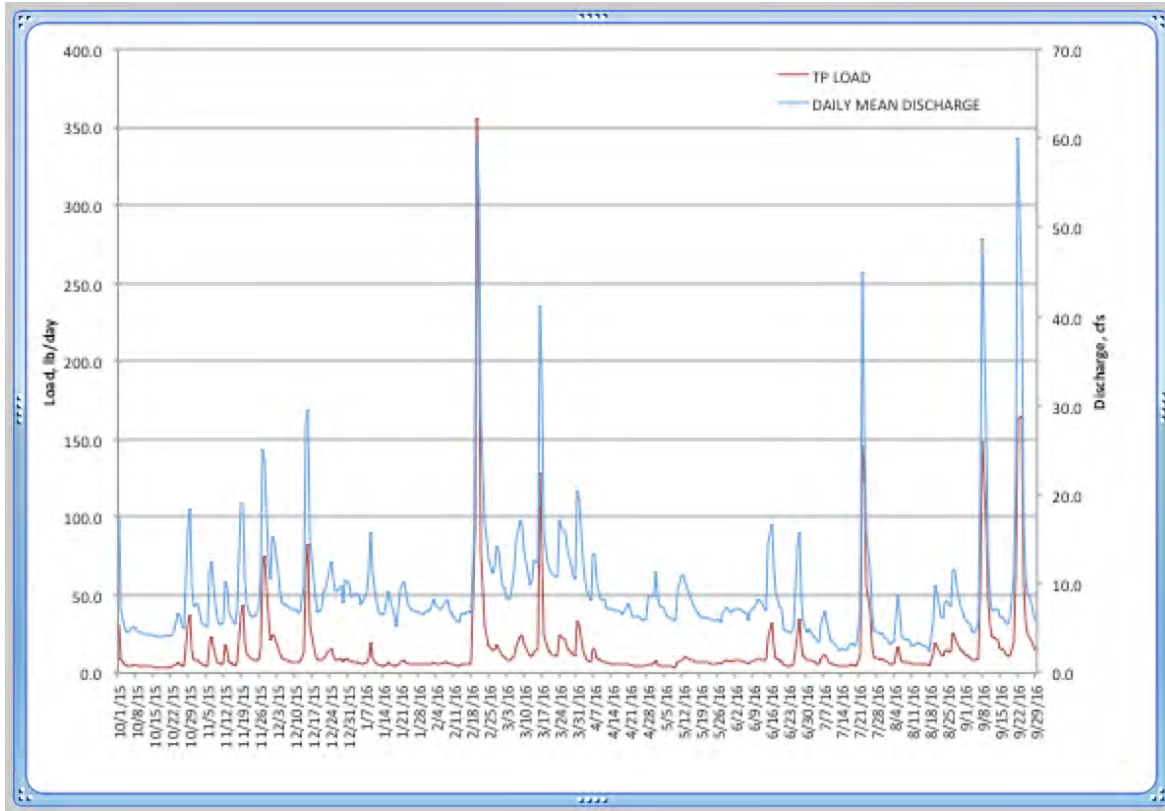
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## ► 5.1 Freshwater Creek

### 5.1.1. KEA- Water Chemistry

Water chemistry is important for the overall health of streams as a slight change in chemistry can affect the entire ecosystem. Phosphorus is a necessary nutrient for both plants and animals, but is often the limiting factor for the organisms meaning that all other necessities for survival are in full abundance (LaLiberte, 2012). However, excess phosphorus has devastating consequences for the system and contributes significantly to freshwater eutrophication. Increased eutrophication leads to lower oxygen levels which can lead to fish kills and the decline of aquatic invertebrates (WRM, 2013). Most commonly, phosphorus binds to soil particles, allowing it to be easily transported whenever wind, water or another affect transports sediment (Reddy, Kadlec, Flaig & Gale, 2010).

Total Phosphorus Daily Load and Total Phosphorus will both be used to measure phosphorus levels in Dorn Creek. Total Phosphorus Daily Load (TPDL) will be measured daily using the water column (lb P/day). Since, TPDL varies largely on a daily basis, especially after large storm events resulting in greater discharge flow, Annual Cumulative Total Phosphorus Daily Load (lbs) will be our unit of measurement. Figure 6 displays the relationship between TPDL and discharge flow. This is an important indicator in that it represents the difference in phosphorus leaving the system and entering the system. Total phosphorus (TP) will be measured daily using the water column (mg P/L water). Total phosphorus will be averaged at the end of year. WI has a State water quality standard (criterion) of 0.1 mg/L for streams (WRM, 2013). Dorn Creek greatly exceeds this standard. As of 2016, Annual Cumulative TPDL was 5897 lbs and Annual Average TP was 0.227 mg/L. These measurements will represent the baseline. The current status of each correspond to a *poor* indicator rating. The goal for Dorn Creek water chemistry is to have a *good* indicator rating; which would be a moderate reduction of Annual Cumulative TPDL and Annual Average TP.



**Figure 5: Total Phosphorus Daily Load Plotted Against Daily Mean Discharge for the entirety of 2016.**  
(Dane County Land and Water Resource Department, Dorn Creek Daily Runoff Loads and Concentrations).

Target	Category	KEA	Indicator	Indicator ratings			
				Poor	Fair	Good	Very Good
Freshwater creek	Condition	Water Chemistry	Annual Cumulative Phosphorus Total Daily Load (lbs)	significant increase	moderate increase	moderate reduction	significant reduction
			Current Status	X			
			Desired Future Status			X	

**Table 3: Target: Freshwater Creek, KEA: Water chemistry, Indicator: Annual Cumulative Phosphorus Total Daily Load.**

				Indicator ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Freshwater creek	Condition	Water Chemistry	Annual Average Total Phosphorus (mg/L)	significant increase	moderate increase	moderate reduction	significant reduction
			Current Status	X			
			Desired Future Status			X	

**Table 4: Target: Freshwater Creek, KEA: Water chemistry, Indicator: Annual Average Total phosphorus**

### 5.1.2. KEA- Algae Abundance

Filamentous algae (algae for the remainder of this document) are important members of freshwater systems. They photosynthesize to provide oxygen and carbohydrates to the surrounding environment (LaLiberte, 2012). Additionally, they are important prey for various aquatic species, such as, zooplankton and snails. Like most species, algae require phosphorus for growth and reproduction. However, slight excess amounts of phosphorus cause algal blooms, which are detrimental to the freshwater system. Algal blooms shade out aquatic plants below them decreasing their potential for growth and survival. Further, algal blooms greatly reduce the surrounding oxygen, due to algae decay, raising the risk of death for many species, especially fish (Sanseverino, 2016). Lastly, if the algal bloom is extreme enough, small invertebrates and small fish may get trapped in the algal mat. Not only do algae blooms affect the freshwater system, but they also impact human and pet health. Respiratory illnesses, liver diseases and death are common among algae infections in humans and pets (LaLiberte, 2012).

Algae blooms indicate an imbalance of excess nutrients, primarily phosphorus. Therefore, algae cover in Dorn Creek can be measured to indicate the health of the system. Currently the percent cover of filamentous algae abundance is 30-50%, a *fair* indicator rating. The goal is to reduce the percent cover to 10-30%, giving the creek a new indicator rating of *good*.

				Indicator ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Freshwater creek	Condition	Algae Abundance	Percent (%) cover	50% - 100%	30% - 50%	10% - 30%	< 10%
			Current Status		X		
			Desired Future Status			X	

**Table 5: Target: Freshwater Creek, KEA: Algae abundance Indicator: Percent cover**

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### 5.1.3. KEA- Water Clarity

Turbidity is a measurement of water clarity, influenced by the amount of suspended particles in the water column (MVLMP, 2017). Excess nutrients indirectly and directly influence turbidity by remaining in the water column attached to particles and by promoting algae growth. Although turbidity cannot be specifically linked to phosphorus levels in the water column, it is still a representative measure of the creek health (Meozzi, 2011). As previously mentioned, phosphorus is the limiting nutrient in aquatic systems promoting further algal growth and increasing turbidity (LaLiberte, 2012). When turbidity is low, it is likely that phosphorus levels are low as there is less material for phosphorus to attach itself to (MVLMP, 2017). Therefore, fluctuations in turbidity (suspended particles and algae) can be attributed to increasing or decreasing phosphorus levels in the stream.

The current state of Dorn Creek's turbidity is *fair*, a moderate increase in turbidity from historic levels. The desired future status is *good*, a moderate reduction in turbidity from historic levels.

				Indicator ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Freshwater creek	Condition	Water Clarity	Turbidity (m)	significant increase	moderate increase	moderate reduction	significant reduction
			Current Status		X		
			Desired Future Status			X	

**Table 6: Target: Freshwater Creek, KEA: Water clarity, Indicator: Turbidity (m)**

### 5.1.4. KEA- Macroinvertebrates

Macroinvertebrates are a good way to measure stream health because of their sensitivity to changes in the environment. The use of macroinvertebrates as indicators for water quality assessment in Wisconsin began with the development of the Hilsenhoff Biotic Index (HBI) at the University of Wisconsin Madison in cooperation with the DNR in 1977. (Lillie et al. 2003) What originally started as a seven group system, the index has been modified over the years to make it more user friendly for volunteers. Macroinvertebrates are grouped into 4 different categories. These categories are: Group 1 invertebrates are sensitive to pollution, Group 2 are semi-sensitive to pollution, Group 3 are semi tolerant to pollution and Group 4 are tolerant to pollution. Macroinvertebrates aren't measured in density but species richness using the HBI. The number of species found in each category are added and put into an equation that then determines the stream's biotic index score. (UW- Extension) Ideally a healthy stream would have many species in each group, especially Groups 1 and 2, giving it a higher biotic index score.

The current state of Dorn Creek's macroinvertebrate biotic index score is 1.935 (Zoology 360), a *poor* indicator rating. This desired future status is a biotic index score between 2.6 and 3.5, a *good* indicator rating.

Target	Category	KEA	Indicator	Indicator ratings			
				Poor	Fair	Good	Very Good
Freshwater creek	Condition	Macroinvertebrates	Biotic index score (Richness)	1.0 - 2.0	2.1 - 2.5	2.6 - 3.5	>3.6
			Current Status	X			
			Desired Future Status			X	

**Table 7: Target: Freshwater Creek, KEA: Macroinvertebrates, Indicator: Biotic index score**

## ► 5.2 Wetland Ecosystem

### 5.2.1. KEA- Invasive Plant Cover

Invasive plant cover in wetlands is another effective indicator of wetland health. Invasive species, such as Reed Canary Grass, Phragmites, and narrow-leaved or hybrid cattails, take advantage of excess nutrients in the system, where native species cannot thrive as well (Thompson & Luthin, 2004). These species have indirect and direct effects on the wetland ecosystem. They outcompete native plant species, alter water chemistry, assist in population declines of native exotic or rare animal species, alter natural fire regimes, change soil composition and impede water flows (EPA, 2017). Invasive species are far less efficient in nutrient uptake than the native wetland plants, leading to decreased assimilation of phosphorus in the system (Zedler & Kercher, 2004). Ultimately, they disrupt the natural functioning of a wetland, which is to filter nutrients from the system and provide habitat for important species. Invasive plants suggest excess nutrient availability (EPA, 2017).

Current wetlands in Dorn Creek are composed of approximately 100% Reed Canary Grass, representing a *poor* indicator rating. This management plan aims for *good* indicator rating, meaning invasive plant cover will comprise 10-30% of the wetland plant composition.

				Indicator ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Wetlands	Condition	Invasive Plant Cover	Percent (%) cover	50% - 100%	30% - 50%	10% - 30%	< 10%
			Current Status	X			
			Desired Future Status			X	

**Table 8: Target: Wetland, KEA: Invasive plant cover, Indicator: Percent cover**

### 5.2.2. KEA- Water Chemistry

Wetlands are important players in regulating water chemistry. Phosphorus retention, specifically, is a key function of wetlands. Retention decreases the load of phosphorus and other nutrients to downstream systems (Reddy, Kadlec, Flaig & Gale, 2010). As previously mentioned, excess phosphorus has devastating effects on the entire ecosystem and downstream. Best management practices include wetland ability to retain phosphorus without releasing it under normal conditions, contributing to the balanced water chemistry and a healthy system (Reddy, Kadlec, Flaig & Gale, 2010).

Wetland sediments typically range from 50 to 300 mg/kg phosphorus (WRM, 2013). Current levels of phosphorus throughout Dorn Creek wetlands are between 385 and 820 mg/kg (WRM, 2013). The current status of wetland total phosphorus levels is *poor*. The desired status is *good*, between 50 to 300 mg/kg phosphorus.

				Indicator ratings			
Target	Category	KEA	Indicator	Poor	Fair	Good	Very Good
Wetland	Condition	Water Chemistry	Total Phosphorus	>550 mg P/kg	300 to 550 mg P/kg	50 to 300 mg P/kg	<50 mg P/kg
			Current Status	X			
			Desired Future Status			X	

**Table 9: Target: Wetland KEA: Water chemistry, Indicator: Total phosphorus**

## ► 5.3 Riparian Buffer

### 5.3.1. KEA- Riparian Buffer Extent

A riparian buffer is an important tool in preventing runoff into the stream. Sediment carries attached phosphorus during runoff, and riparian buffers effectively trap this sediment, reducing the potential for eutrophication in streams (Wegner, 1999). Additionally, riparian buffers stabilize soils, reducing the potential for erosion, and provide shade for the stream system (The Science



Behind the Need for Riparian Buffer Protection, n.d.). Studies suggest that a 100 ft buffer extending along an entire stream is recommended to sufficiently trap sediments. In some cases, a wider buffer is recommended (Wegner, 1999).

Wisconsin law only requires a 5 ft buffer for developed areas surrounding rivers and streams with the caveat of no buffer being required on agricultural land (M. Miller of WI DNR, personal communication, September 28, 2017). According to the Wisconsin DNR forestry management document, an ideal buffer size would be 50 ft or greater surrounding a stream the size of Dorn Creek (WI DNR 2011). Currently, Dorn Creek's riparian buffer extent is 15-30 ft, representing a *fair* indicator rating. The desired future status is a *good*, 30 - 50 ft of riparian buffer surrounding Dorn Creek.

Target	Category	KEA	Indicator	Indicator ratings			
				Poor	Fair	Good	Very Good
Riparian buffer	Size	Riparian Buffer Extent	Width (ft)	0 - 15 ft	15 - 30 ft	30 - 50 ft	> 50 ft
			Current Status		X		
			Desired Future Status			X	

Table 10: Target: Riparian buffer, KEA: Riparian buffer extent, Indicator: Width (ft)

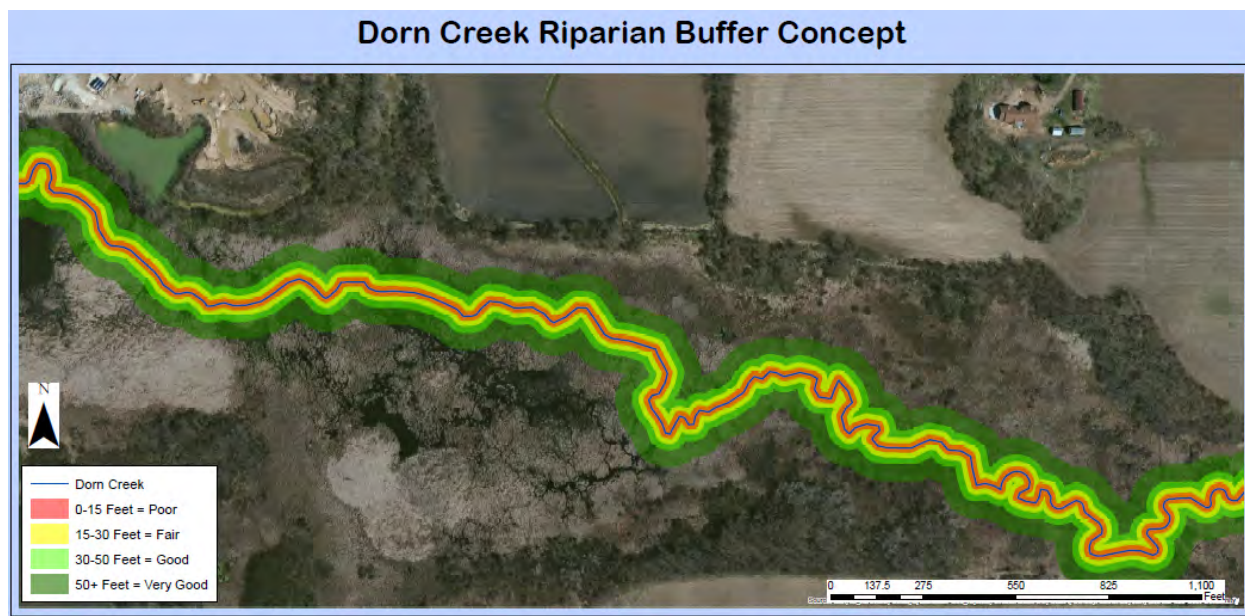


Figure 6: Map displaying the various riparian buffer extents relating to indicator ratings

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### 5.3.2. KEA- Invasive Plant Cover

Invasive plants are important to the function of a riparian buffer. They have a negative impact on the stream, especially when in high abundance (Wegner, 1999). Invasive plants can spread easily in riparian areas because they are adjacent to waterways, which carry invasive seeds easily; invasive plants grow best in disturbed areas (Zedler & Kercher, 2004). The riparian area of Dorn Creek is often disturbed due to agricultural practices therefore creating a good habitat for invasive species to thrive. Invasive plants prevent habitat diversity surrounding the stream because they outcompete native species (Wegner, 1999). Habitat diversity is important in providing suitable habitat and food sources for native wildlife (Wegner, 1999).

Harvestable buffers, those which can be harvested while also providing the environmental benefit of native riparian buffers, are alternatives to native riparian buffers (K. Minks, personal communication, October 18, 2017). The continued cutting of harvestable buffers prevents the growth and establishment of invasive species (K. Minks, personal communication, October 18, 2017).

Invasive plant cover will be measured as a percentage. The current indicator rating *poor*, with 50-100% invasive plant cover. The desired future status is a *very good*, <10% invasive plant cover.

Target	Category	KEA	Indicator	Indicator ratings			
				Poor	Fair	Good	Very Good
Riparian buffer	Condition	Invasive plant cover	Percent (%) cover	50% - 100%	30% - 50%	10% - 30%	< 10%
			Current Status	X			
			Desired Future Status				X

Table 11: Target: Riparian Buffer, KEA: Invasive plant cover, Indicator: Percent cover

## ► 6. Threat assessment

### 6.1 Threat ranking

Once direct threats, indicators, stresses, and targets were finalized the team was able to rank the potential impact of each direct threat on each biodiversity target. Threat rankings allow the team to determine which targets are most affected by each threat, to what degree, and thus ultimately assign order of importance for the direct threats. There is no guarantee that all threats are associated with all targets which is evident by the lack of threat ranking between agricultural runoff and the freshwater creek.

**Threat ranking method:** The threat assessment is broken down into classifying scope, severity, and irreversibility (permanence) for each of the biodiversity targets. Definitions below were taken from FOS-CMP training manual 2009.

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**Scope** - Most commonly defined spatially as the proportion of the target that can reasonably be expected to be affected by the threat within ten years given the continuation of current circumstances and trends.

**Severity** - Within the scope, the level of damage to the target from the threat that can reasonably be expected given the continuation of current circumstances and trends. For ecosystems and ecological communities, typically measured as the degree of destruction or degradation of the target within the scope.

**Irreversibility (Permanence)** - The degree to which the effects of a threat can be reversed and the target affected by the threat restored.

For each of these parameters there is an additional classification to the degree of impact it is expected to have on the target. These degrees of impact are *Very High*, *High*, *Medium*, and *Low*. Again, the definitions below were taken from FOS-CMP training manual 2009.

**Scope:**

**Very High:** The threat is likely to be **pervasive** in its scope, affecting the target across **all or most (71-100%)** of its occurrence/population.

**High:** The threat is likely to be **widespread** in its scope, affecting the target across **much (31-70%)** of its occurrence/population.

**Medium:** The threat is likely to be **restricted** in its scope, affecting the target across **some (11-30%)** of its occurrence/population.

**Low:** The threat is likely to be **very narrow** in its scope, affecting the target across a **small proportion (1-10%)** of its occurrence/population.

**Severity:**

**Very High:** Within the scope, the threat is likely to **destroy or eliminate** the target, or reduce its population **by 71-100%** within ten years or three generations.

**High:** Within the scope, the threat is likely to **seriously degrade/reduce** the target or reduce its population by **31-70%** within ten years or three generations.

**Medium:** Within the scope, the threat is likely to **moderately degrade/reduce** the target or reduce its population by **11-30%** within ten years or three generations.

**Low:** Within the scope, the threat is likely to only **slightly degrade/reduce** the target or reduce its population by **1-10%** within ten years or three generations.

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### **Irreversibility:**

**Very High:** The effects of the threat cannot be reversed and it is **very unlikely** the target can be restored, and/or it would take **more than 100 years** to achieve this (e.g., wetlands converted to a shopping center).

**High:** The effects of the threat can technically be reversed and the target restored, but it is **not practically affordable** and/or it would take **21-100 years** to achieve this (e.g., wetland converted to agriculture).

**Medium:** The effects of the threat can be reversed and the target restored with **a reasonable commitment of resources** and/or within **6-20 years** (e.g., ditching and draining of wetland).

**Low:** The effects of the threat are **easily reversible** and the target can be easily restored at a relatively low cost and/or within **0-5 years** (e.g., off-road vehicles trespassing in wetland).


For the sake of creating a management plan with a reasonable time table, the impacts of these threats are within the context of the next 10 years. Therefore, a threat like climate change garnered a low threat ranking despite its potential to have a greater impact in the more distant future.

A “summary target-threat ranking” is formulated after having assigned degrees of scope, severity, and irreversibility for each individual target-threat association. Below is an example regarding the threat of GHG emissions in regards to the riparian zone. A *very high* scope, *low* severity, and *low* irreversibility combined to form a *low* summary target-threat rating for the GHG emissions-riparian zone association.

Figure 7 shows a user interface for assigning target-threat ratings. It includes fields for 'Direct Threat' (GHG emissions) and 'Target' (Riparian Buffer). Below these, three criteria are evaluated: 'Scope' (Very High, red), 'Severity' (Low, green), and 'Irreversibility' (Low, green). Each criterion has a small icon to its right. On the right side, a 'Summary Target-Threat Rating' is shown as a green box with the word 'Low'.

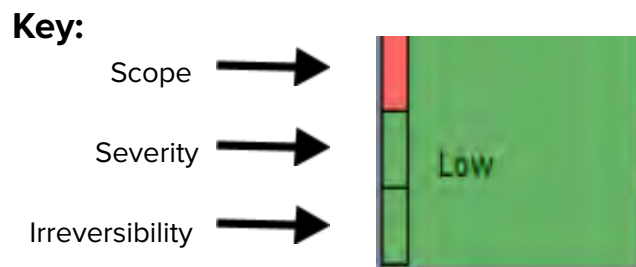
**Figure 7: Example summary target-threat ranking for GHG emissions on riparian buffer**

After assigning a summary target-threat rating, a summary threat rating is then formulated for the individual threat as a whole. A complete list of summary threat ratings allows the team to order the direct threats according to level of importance. Below is an example of a summary threat rating for GHG emissions (*Low*)

Threats \ Targets	Riparian Buffer	Wetland Ecosyst...	Freshwater Creek	Summary Threat Rating
 GHG emissions	Low	Low	Medium	Low

**Figure 8: Example threat rating for GHG emissions on each biodiversity target**

A complete list of summary threat ratings then allows the team to order the direct threats according to level of importance. The figure below depicts each summary target threat ranking. Agricultural runoff is the number one direct threat affecting our targets. Agricultural runoff has a *High* summary threat rating, whereas agricultural expansion and GHG emissions both have a summary threat rating of *Low*.



	Threats \ Targets	Riparian Buffer	Wetland Eco...	Freshwater C...	Summary Threat Rating
	Legacy Phosphorus	Not Speci...	Low	High	Medium
	GHG emissions	Low	Low	Medium	Low
	Current Agricultural Runoff	Low	Medium	High	Medium
	Agricultural Expansion	Medium	Low	Low	Low

**Figure 9: Threat assessment and ranking affecting Dorn Creek.**

After completing a threat assessment on all the direct threats affecting Dorn Creek, using the guidelines stated above, our team was able to see the summary threat ratings for each threat (Figure 9). These threat summaries show that GHG emissions and agricultural expansion have low summary threat ratings. It also shows that agricultural runoff is the highest threat to continued degradation and the declining health of Dorn Creek.

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## 6.2 Threat Description and Details

### 6.2.1 Direct Threat: Legacy Phosphorus

**Affected Targets:**

Wetland Ecosystem (Target Specific Threat Level: *Low*)

Freshwater Creek (Target Specific Threat Level: *High*)

**Summary Threat Ranking:** *Medium*

**Threat Description:** Legacy phosphorus developed in the Dorn Creek watershed due to historical agricultural runoff. The legacy phosphorus directly negatively affects the Wetland Ecosystems and Freshwater Creek.

**Threat Details:** Legacy phosphorus deposits are contained in the creek bed sediment and wetlands as a result of historical runoff events building up over time. This phosphorus impairs the water quality in Dorn Creek and contributes to undesirable phosphorus levels in Lake Mendota. Target-specific threat levels vary: Wetland Ecosystem (*Low*), Freshwater Creek (*High*). The threat rating of *High* for the Freshwater Creek reflects the severity of current water quality impairment and the strong need for action to address the legacy phosphorus in the creek.

### 6.2.2 Direct Threat: Current Agricultural Runoff

**Affected Targets:**

Riparian Buffer (Target Specific Threat Level: *Low*)

Wetland Ecosystem (Target Specific Threat Level: *High*)

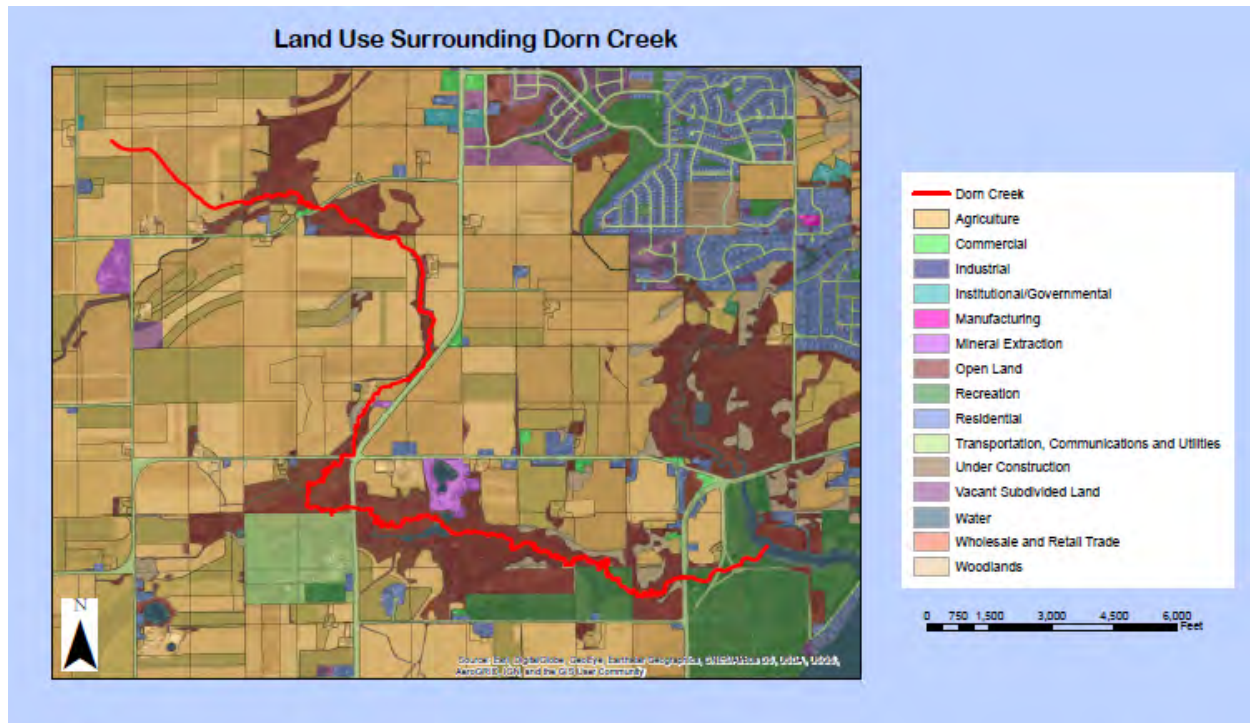
Freshwater Creek (Target Specific Threat Level: *Very High*)

**Summary Threat Ranking:** *Medium*

**Threat Description:** Agricultural runoff from farms within the Dorn Creek watershed and the broader Six Mile and Pheasant Creek basin has led to degraded water quality in the creek, which is listed as an impaired waterway. Phosphorus is the primary target for reduction but E. coli levels have been identified as problematic and also demand attention.

**Threat Details:** Significant continuing agricultural activity and associated runoff events in the watershed will affect three targets: Riparian Buffer, Wetland Ecosystem, and Freshwater Creek. Target-specific threat levels vary: Riparian Buffer (*Low*), Wetland Ecosystem (*High*), Freshwater Creek (*Very High*). The threat rating of *Very High* for the Freshwater Creek reflects the severity of current water quality impairment and the strong need for action to address it. However, the Riparian Buffer target's importance to overall ecosystem health may be undervalued by this specific assessment measure due to the importance of healthy wetlands for runoff reduction.





**Figure 10: Land use surrounding Dorn Creek (highlighted in red)**

### 6.2.3 Threat: Greenhouse Gas Emissions

#### **Affected Targets:**

Riparian Buffer (Target Specific Threat Level: *Low*)

Wetland Ecosystem (Target Specific Threat Level: *Low*)

Freshwater Creek (Target Specific Threat Level: *Medium*)

#### **Summary Threat Ranking: *Low***

**Threat Description:** GHG emissions and associated Climate Change affect nearly every imaginable biodiversity target. Climate Change causes alterations in trends of abiotic factors and phenology and will have devastating effects on ecosystems and wildlife populations worldwide.

**Threat Details:** Changes in mean annual Air temperature, water temperature, and precipitation will have far reaching effects on both non-native and native flora and fauna across the board of aquatic, terrestrial, and avian species in all three of our biodiversity targets. It's almost certain that in the future, certain species which rely on current, specific abiotic conditions will no longer find Wisconsin to be suitable habitat, and will thus migrate north out of the state. GHG emissions pose a serious long-term threat. However, when assigning threat rankings it's important to remember that they are to be focused on the potential effects posed on biodiversity targets within a 10 year timeframe. This is important, so that practitioners can address threats with an order of importance. Funds and resources are always limited, and we must be efficient in identifying which threats are of most importance now. Since the drastic effects of climate change won't set in for some time still, GHG emissions have garnered a low Summary threat ranking.

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#### 6.2.4 Threat: Agricultural Expansion

##### **Affected Targets:**

Riparian Buffer (Target Specific Threat Level: *Medium*)

Freshwater Creek (Target Specific Threat Level: *Low*)

Wetland Ecosystem (Target Specific Threat Level: *Low*)

##### **Summary Threat Ranking:** *Low*

**Threat Description:** Agricultural expansion is a direct threat to the wetland ecosystems and riparian buffer surrounding Dorn Creek.

**Threat Details:** Agricultural expansion is predominantly a historic threat because Dorn Creek is surrounded almost entirely by agricultural lands with not much room for continued expansion. When it occurred, agricultural expansion around Dorn Creek affected the overall health of the creek and reduced the wetlands and riparian buffer. It's estimated that 54% of wetlands have been lost in the Dorn Creek sub-watershed primarily due to agricultural expansion (Craig 2007). Wetlands play an important role in waterways as nutrient sinks. They can sequester carbon and nitrogen that are released from point and nonpoint sources. Therefore, preventing these nutrients from entering the stream. Historic agricultural expansion around Dorn Creek not only eliminated wetlands but also disrupted the soil. This soil disruption made it easier for invasive species to take root and grow in the wetlands. An increase in invasive species can result in decreased wetland productivity.

Also, as stated earlier in this report, there are no WI regulations that require agricultural lands to provide riparian buffers along streams. This is evident in some areas of Dorn Creek where there are depleted riparian buffers due to historical agricultural expansion.

### 6.3 Threat Summary by Target

#### 6.3.1. Freshwater Creek

The team determined that agricultural runoff, legacy phosphorus and GHG emissions are direct threats to the freshwater creek. Agricultural runoff and legacy phosphorus are the highest threats to the health of Dorn Creek. Agricultural runoff causes increased phosphorus levels. Increased phosphorus levels lead to increased legacy phosphorus. This can lead to toxic algal blooms, decrease in species richness within the creek, and ultimately increases phosphorus levels in Lake Mendota. GHG emissions have the potential to create additional long term disruptions in water chemistry and phenology in Dorn Creek. However, because our plan is mainly focusing on the next 10 years, GHG emissions are seen as a low threat to the freshwater creek.

#### 6.3.2. Wetland Ecosystem

The team determined that agricultural runoff, legacy phosphorus, GHG emissions and agricultural expansion are direct threats to the wetland ecosystem. Agricultural runoff is a high threat to the wetland ecosystem surrounding Dorn Creek. The soils surrounding Dorn Creek are primarily composed of poorly drained, hydric soils. Hydric soils are a characteristic of wetlands. Wetlands are difficult to repair when damaged thus, they have a high irreversibility threat when degraded



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by agricultural runoff. They are also threatened by GHG emissions but not as much as other targets. Wetlands are good at reversing the effects of climate change and are productive at storing carbon and other GHG emissions. Legacy Phosphorus is another threat to the wetland ecosystem because when too much phosphorus develops in a wetland it is hard to reverse it back to the way that it used to be. Also, dredging is not as easy to accomplish in the wetland ecosystem like it is in the freshwater creek. Wetlands are a lot more delicate of ecosystems than the creek bed. Agricultural expansion is seen as a historical threat to the wetland ecosystem. It caused many wetlands to be filled or disturbed, creating a good environment for invasive species. Similar to agricultural run off, the irreversibility of this threat on the wetland ecosystem was high.

### 6.3.3. Riparian Buffer

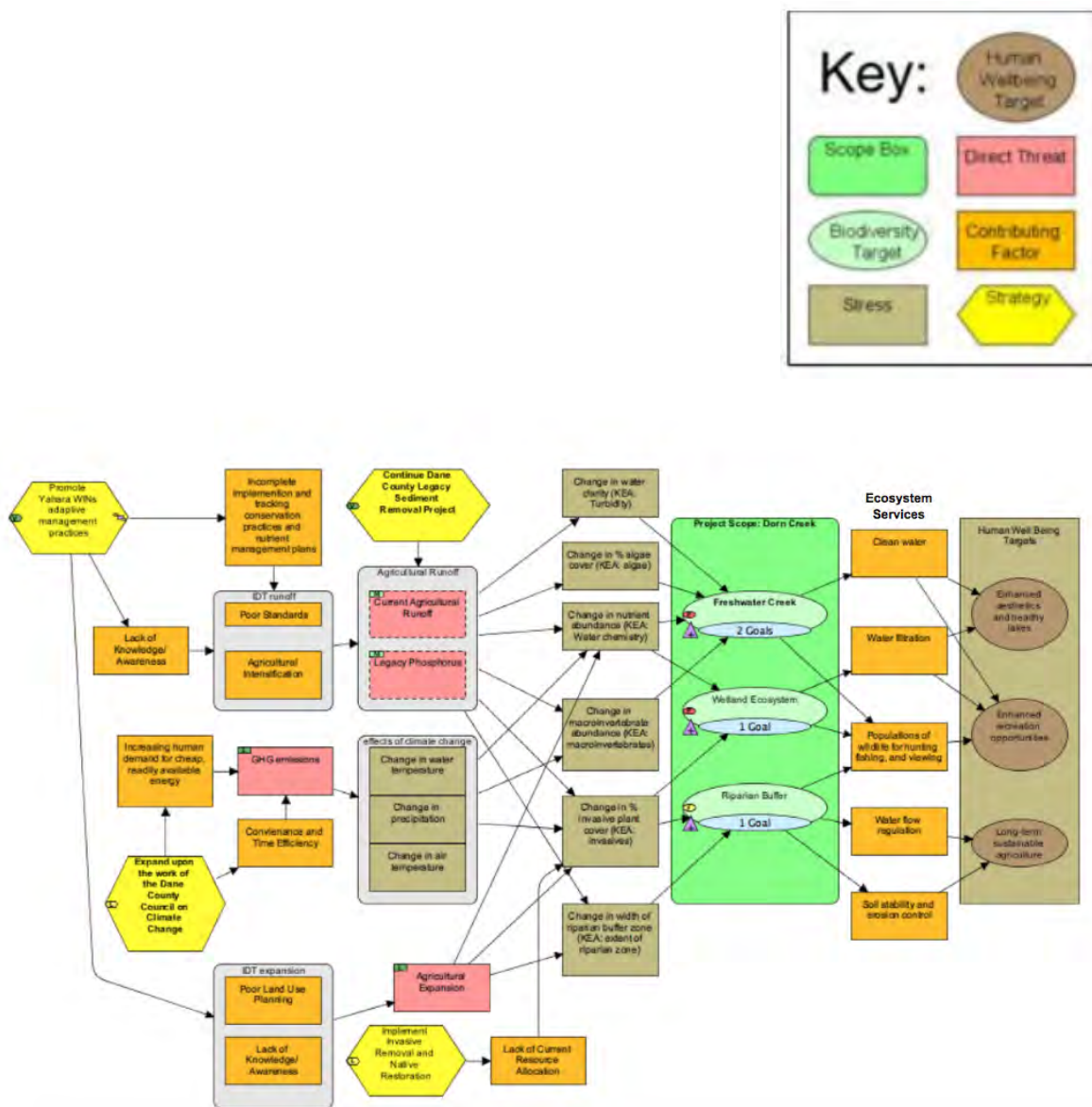
Dorn Creek's riparian buffer is threatened by agricultural runoff, GHG emissions and agricultural expansion. Agricultural expansion has a high threat rating for the riparian buffer; because as agriculture practices expanded around Dorn Creek much of the riparian buffer was eliminated. That in turn created the problem of runoff into the creek. With no riparian buffer to trap polluted sediments, more phosphorus can reach the stream. Agricultural runoff is a low threat to the riparian buffer because the runoff itself doesn't affect the buffer much. Runoff along with GHG emissions mainly affect the plant diversity of the buffer, allowing for more invasive species to grow in the nutrient rich soils and warming temperatures.



**Figure 11: Common Hydric Soils Along Dorn Creek's 100 Foot Riparian Buffer**

Marsh and Houghton Muck are common poorly drained soils that are considered wetland soils. These soils, along with other hydric soils, can be found along the creek's 100 foot buffer.

## ► 7. Situation Analysis



**Figure 12: Conceptual Model for Dorn Creek**

Figure 12, the conceptual model of the overall conservation plan for Dorn Creek, displays a range of indirect threats, or contributing factors, to the four direct threats confronted by this management plan: current agricultural runoff, legacy phosphorus, greenhouse gas emissions, and agricultural expansion (See Appendix A for a full-page sized version of the model in Figure 12).

Incomplete implementation and tracking of conservation practices and nutrient management plans and a lack of knowledge and awareness of runoff mitigation practices are two indirect threats contributing to the current agricultural runoff and legacy phosphorus direct threats. A history of poor standards, both in terms of state agricultural regulations and the stringency of

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requirements surrounding fertilizer and manure use, paired with a gradual, ongoing intensification of agriculture are two additional indirect threats contributing to the two direct threats grouped in the “Agricultural Runoff” box.

In 2002, Wisconsin adopted minimum conservation standards, including nutrient management standards, for farms. However, As of 2016 just 32% of Wisconsin cropland was covered by a verifiable nutrient management plan (37% in Dane County). A verifiable nutrient management plan is only required if the landowner wishes to participate in cost-share funding to help compensate for costs associated with newly implemented management practices as part of the verifiable nutrient management plan. However, enforcement is rare and counties rely on voluntary participation of landowners in upholding and implementing nutrient management plans (Matson, 2017).

The legacy of poor agricultural standards and regulations make it difficult to achieve our goal of reducing the direct threat of agricultural runoff, which impacts all of KEA’s except for “extent of riparian zone.” Agricultural runoff also affects all of our biodiversity targets. Improving upon agricultural standards by enforcing the implementation of nutrient management plans, paired with expanding use of other runoff-mitigation oriented conservation practices, will be crucial to our goal of reducing agricultural runoff. This is especially important because “agricultural intensification” is also likely to continue as farmers try to continually increase annual crop yields in response to increasing demand for food stemming from an ever increasing human population.

Heavy use of fertilizers is likely to continue and perhaps increase in severity as farmers try to meet these higher demands. Mitigating runoff is also crucial to ensure that legacy phosphorus removed through dredging is not merely replaced by new phosphorus runoff in the future. The indirect threats and direct threats related to agricultural runoff are inextricably linked to the three human well-being targets included in the conceptual model: enhanced aesthetics and healthy lakes, enhanced recreation opportunities, and the long-term sustainability of agriculture in the region.

Greenhouse Gas (GHG) emissions is another direct threat affecting Dorn Creek. With changes occurring in air temperature, water temperature and change in precipitation, the environment around Dorn Creek will be changing and affecting all of the identified biodiversity targets, ecosystem services, and human well-being targets. The indirect threats influencing GHG emissions are increasing human demand for cheap readily available energy and the preference for convenience and time efficiency, which drive transportation decisions toward carbon-intensive, individual options instead of more efficient mass-transit.

Agricultural expansion is another direct threat to Dorn Creek, however, this is more of a historic threat as minimal land is presently available for further expansion. Additionally, development trends within the watershed suggest that future developments will likely trend toward suburban residential projects or commercial enterprises rather than an increase in land utilized for agriculture. Poor land use planning and a lack of knowledge and awareness surrounding the

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long-term ecological repercussions of agriculture on the scale present within the watershed, and in such close proximity to Dorn Creek, accelerated the negative impact of this direct threat. Agricultural expansion affects two biodiversity targets; the wetland ecosystem and riparian buffer. The main stressors affecting the riparian buffer that are caused by agricultural expansion are change in width of the riparian buffer and change in percent of invasive plant cover. The stressors affecting the wetland ecosystem is change in percent of invasive plant cover and change in nutrient abundance, of phosphorus, specifically.

## 7.1 Human Well-Being Targets

As defined by the Open Standards, human well-being targets “focus on those components of human well being affected by the status of conservation targets” (CMP, 2013). A restored Dorn Creek will provide four ecosystem services (Clean water, water filtration, populations of wildlife for hunting, fishing, and viewing, water-flow regulation, and soil stability and erosion control) contributing to the three human well-being targets (enhanced aesthetics and healthy lakes, enhanced recreation opportunities, and long-term sustainable agriculture).

### 7.1.1. Enhanced aesthetics and healthy lakes

Clean water and water filtration contribute to the “Enhanced aesthetics and healthy lakes” human well-being target.

Most segments of Dorn Creek are currently degraded and are filled with waist to chest high muck. Additionally, the water is covered in algae and few species of fish or macroinvertebrates utilize the water within the creek. Additionally, the phosphorus-laden water passing through Dorn Creek flows into Lake Mendota. By reducing amounts of legacy phosphorus and current phosphorus runoff, the appearance and health of both Dorn Creek and Lake Mendota can be restored. The creek is currently an eyesore, and cleaning it up could improve the aesthetics of the creek, the lake, and the broader Yahara Watershed by decreasing cumulative phosphorus loads and reducing the frequency and severity of toxic, unsightly algae blooms. Beyond benefiting the appearance and health of these waterways, this improvement could improve the quality of life enjoyed by Madison residents and the attractiveness of the city, benefiting future economic development in Madison and Dane County.

### 7.1.2. Enhanced recreation opportunities

Water filtration, clean water and wildlife for hunting, fishing, and viewing contribute to “enhanced recreation opportunities

Hunting, fishing, and wildlife viewing are permitted on public lands adjoining Dorn Creek. A restored Dorn Creek will offer more abundant populations of fish, waterfowl, deer, pheasant, and turkey for local hunters, fishermen, and wildlife enthusiasts. Water filtration leading to clean water in Dorn Creek will also foster a reduction in the amounts of phosphorus and nitrogen entering Lake Mendota, allowing for a decrease in algal blooms and muck and an increase in turbidity. These improved conditions will provide better opportunities for recreational activities such as

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boating, kayaking, swimming, etc.

When restored, Dorn Creek will be a healthy natural area in a largely agricultural community. Nearby residents likely lack daily interaction with the natural world as a result of agriculture having largely replaced the natural, once dominant prairie/woodland ecosystems of Wisconsin. We believe that if restored, Dorn Creek can benefit the mental health of nearby residents by providing an aesthetically pleasing natural environment to connect with.

### 7.1.3. Long-term sustainable agriculture

Water flow regulation and soil stability and erosion control contribute to “long-term sustainable agriculture”.

The riparian zone provides soil stability by locking soil into place with the help of vegetative root systems that prevent loose sediment that can be displaced from the bank or nearby soils from ending up downstream (erosion). Since Dorn Creek is in close-proximity to private land, it's important we mitigate erosion and the loss of property. If erosion persists into the future, it will have detrimental effects on local landowner's livelihoods and agricultural productivity.

Stable soils resulting from buffers along the creek also lead to enhanced water flow regulation. The soils within and along the buffers are capable of holding higher amounts of water, which helps prevent storm surges during heavy rainfall events that could be harmful to nearby crops.

## ► 8. Action Plan

### 8.1 Conservation Goals

Conservation goals are a “formal statement detailing a desired impact of a project such as the desired future status of a conservation target” (FOS, 2009). Open Standards identifies a conservation goal as being impact oriented, measurable, time limited and specific (FOS, 2009).

#### 8.1.1. Conservation Goal: Freshwater Creek

##### 8.1.1.1. Conservation Goal 1

By 2025, annual cumulative total phosphorus daily load and annual average total phosphorus in the creek's water and bed sediment will be reduced with the long-term goal of eventually delisting Dorn Creek from Wisconsin's impaired water list.

##### 8.1.1.2. Conservation Goal 2

By 2030, algae cover will be reduced to 10-30%, water clarity will be increased and macroinvertebrate biotic index score will be improved to 2.6-3.

#### 8.1.2. Conservation Goal: Wetland Ecosystem

Improve the condition of wetlands surrounding Dorn Creek by reducing Total Phosphorus to 50-300 mg/kg and by reducing invasive plant cover to 10% - 30% in wetland areas by 2030.

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### 8.1.3. Conservation Goal: Riparian Buffer

Expand and strengthen riparian buffer areas along Dorn Creek by widening buffers to at least 30 feet and reducing invasive plant coverage to 10% along the entire length of the creek by 2025.

## 8.2. Threat Reduction Objectives

A direct threat reduction objectives explains the desired status of a corresponding direct threat. Below are two strategies, the direct threat each impacts and the desired status of that direct threat (direct threat reduction objective). Current agricultural runoff and legacy phosphorus in the sediment are the two highest rated direct threats impacting Dorn Creek. For this reason, strategies were developed for these two threats.

### **Strategy 1:** Promote Yahara WINs Adaptive Management Practices

**Direct Threat:** Current Agricultural Runoff

**Direct Threat Reduction Objective:** Agriculture phosphorus runoff reduced relative to previous year.

Agricultural phosphorus runoff is an expected value rather than an observed one. Agricultural phosphorus runoff uses a mathematical calculation taking into account the various conservation practices implemented in order to quantify the lbs of phosphorus in runoff (K. Minks, personal communication, October 18, 2017). With increasing implementation of conservation practices (see Strategy 2, section 8.3.2.2), expected agricultural phosphorus runoff will reduce every year compared to the previous. For 2016, cumulative phosphorus mitigated through conservation practices was 966.7 lbs (K. Minks, personal communication, October 18, 2017). (See Appendix B for a complete list of Yahara WINs conservation practices enacted within the Yahara Watershed as of a 2016 audit).

### **Strategy 2:** Continue Dane County Legacy Sediment Removal Project

**Direct Threat:** Legacy Phosphorus

**Direct Threat Reduction Objective:** By 2020, all targeted segments of Dorn Creek have undergone legacy sediment removal process.

Legacy phosphorus is stored in the sediment of the creek altering the benthic environment. Legacy phosphorus translocates downstream after large flow events and may be released increasing the phosphorus in the water column (Dane County Land and Water Resources Department, 2016). As of November 2017, a 300 foot stretch in Dorn Creek County Wildlife Area has been dredged (J. Reimer, personal communication, October 18, 2017). Segments of Dorn Creek have been targeted for dredging.



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## 8.3. Management Strategies to Achieve Goals and Threat Reduction Objectives

### 8.3.1. Strategy Summary

The Open Standards define strategies as “a set of actions with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, integrating opportunities, and limiting constraints. A good strategy meets the criteria of being: linked, focused, feasible, and appropriate” (CMP, 2013).

Strategies were identified during a group brainstorming session on the basis of their link to key intervention points identified in the overall conceptual model, their implementability, their feasibility given the financial and personnel constraints of this project, and their appropriateness given the broader context of the project and the restoration area (CMP 2013). For example, strategies that could potentially reduce a stressor or direct threat but that would also jeopardize the long-term sustainability of agriculture in the project area (one of the project’s human well-being targets) would not be appropriate.

After brainstorming a range of potential strategies, strategies that appeared to meet the criteria described above were prioritized using the Strategy Rating tool in Miradi. Strategies are rated based on two criteria: potential impact and feasibility.

**Potential impact** describes the degree to which a strategy will lead to desired results if implemented. Strategies with a **Very High** potential impact are very likely to completely mitigate a threat or restore a target. A **High** impact strategy is likely to help mitigate a threat or restore a target, whereas a **Medium** impact strategy could possibly help mitigate a threat or restore a target. Finally, a **Low** impact strategy will probably not contribute to a meaningful threat reduction or restoration of a target (Foundations of Success, 2009).

**Feasibility** describes the degree to which the project team could implement a strategy within likely time, financial, staffing, ethical, and other constraints. **Very High** feasibility strategies are ethically, technically, and financially possible, whereas a **High** feasibility strategy may require additional financial resources for implementation. A **Medium** feasibility strategy is ethically feasible, but may be either technically or financially different without a substantial increase in resources. Finally, a **Low** feasibility strategy meets none of the above criteria (Foundations of Success, 2009).

Table 12, on the following page summarizes the strategies that were selected for assessment with the Miradi strategy rating tool, displaying the potential impact and feasibility for each strategy as well as the combined roll-up score generated by Miradi. The two highest rated strategies identified through this process were Strategy 1, Continue Dane County Legacy Sediment Removal Project and Strategy 2, Promote Yahara WINs Adaptive Management Practices. These strategies were selected for prioritization within our plan and we created comprehensive results chains to lay the foundations for adaptive implementation and monitoring by Dane County.

Strategy	Potential Impact	Feasibility	Summary Rating
S1: Continue Dane County Legacy Sediment Removal Project	Very High	Very High	Very Effective
S2: Promote Yahara WINS Adaptive Management Practices	Very High	Very High	Very Effective
S3: Expand upon the work of the Dane County Council on Climate Change	Medium	Very High	Less Effective
S4: Implement invasive removal and native restoration	Very High	Medium	Less Effective
S5: Improve farmer education for runoff mitigation	Medium	High	Less Effective
S6: Limit agricultural activity in Yahara Watershed	Medium	Low	Not Effective
S7: Improve minimum legal requirements for setbacks near streams.	High	Low	Not Effective
S8: Enact statewide legislation to expand agricultural buffer areas, decreasing proximity of cattle to riparian zones and wetland areas	Very High	Low	Not Effective
S9: Require stricter management within agricultural Nutrient Management Plans	High	Low	Not Effective
S10: Enact land use policies on the county level that prevent expansion or intensification of agricultural land uses beyond present levels	High	Low	Not Effective
S11: Implement regular enforcement of NPs for all farms regardless of cost sharing participation	High	Low	Not Effective

**Table 12: Miradi Strategy Rating Summary for Selected Strategies**



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## 8.3.2.Strategies and Intermediate Objectives

### 8.3.2.1. Strategy 1

**Description:** Our first strategy was created to address the issue of legacy sediment within Dorn creek created by historical deposits of phosphorus runoff. The team believes that by continuing with the Dane County legacy sediment removal project created by Yahara WIN, all phosphorus laden sediment within the creek can be removed and the total amount of phosphorus within Dorn Creek reduced.

**Conservation targets impacted by this strategy:** This strategy will affect all of our biodiversity targets: The Freshwater Creek, the Wetland Ecosystem, and the Riparian Buffer.

**Direct threats addressed by this strategy:** Legacy Phosphorus

**Assumption illustrated in results chain:** Discussions with Dane County Land and Water Resources staff helped the team compile a results chain for the strategy “Continue Dane County Legacy Sediment Removal Project,” shown in Figure 13. To move forward with this strategy, it is assumed that Dane county is committed to this project and will not decrease its funding for the project until Dorn Creek has been dredged in its entirety. It is also assumed that once the project has been completed, reduced sediment within Dorn creek will lead to a direct decrease in phosphorus levels within the Creek.

In regards to our results chain, we believe that if the Dane County board continues to appropriate financial resources for the ongoing legacy sediment removal project, then legacy phosphorus will no longer be a threat to our biodiversity targets in the near future.

The end result is the completion of our objective of having all targeted segments of dorn creek having undergone legacy sediment removal by 2020. This, in combination with our second strategy of reducing current runoff, will ultimately lead to a decrease in the total amount of phosphorus in all biodiversity targets.

**Intermediate objectives:**

1. Dane County continues to appropriate financial resources for the Legacy Sediment Removal Project.
2. Legacy phosphorus sediment decreased in Dorn Creek

**Activities:**

1. Lobby Dane County Board and publicize the effectiveness of the program to build public support.
2. Continue dredging and muck removal projects on a segment by segment basis until all target areas are completed.

The first action will be to lobby the Dane County board and publicize the effectiveness of the program in hopes of building public support. This action will aid the Dane County board in being able to continue appropriating financial resources for the legacy sediment removal project.

The second action is continuing with ongoing dredging and muck removal on a segment by segment basis until all of Dorn Creek has been dredged. This will result in legacy phosphorus being eradicated in Dorn Creek, which will lead to a decrease in overall phosphorus concentrations in all of our biodiversity targets.

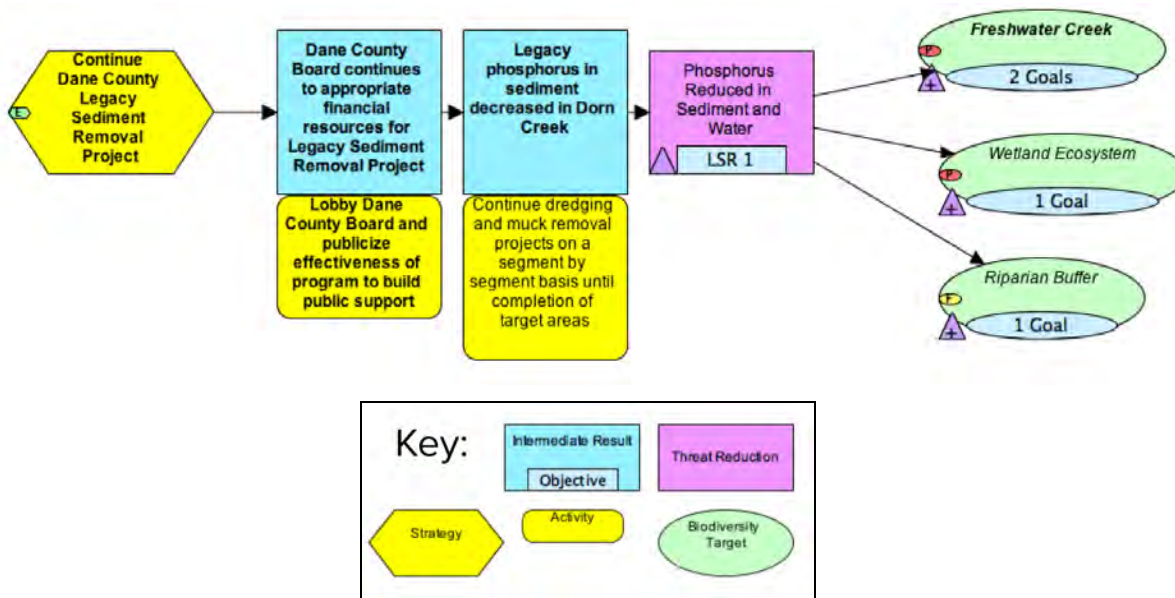


Figure 13: “Continue Dane County Legacy Sediment Removal Project” results chain

#### 8.3.2.2. Strategy 2

**Description:** This strategy was created to address the issue of increased phosphorus in Dorn Creek due to agricultural runoff. The team believes that by implementing Yahara WINs adaptive management practices, phosphorus loading into Dorn Creek will decrease. This will affect all biodiversity targets, making it an effective strategy.

**Conservation targets impacted by this strategy:** Freshwater Creek, Wetland Ecosystem, and Riparian Buffer

**Direct threats addressed by this strategy:** Agricultural Runoff box with two direct threats: Current Agricultural Runoff and Legacy Phosphorus. Agricultural Expansion.

**Assumptions illustrated in results chain:** Discussions with Dane County Land and Water Resources staff helped the team compile a results chain for the strategy “Promote Yahara WINS Adaptive Management,” shown in Figure 14 . To move forward with this strategy, it is assumed that after lobbying the Dane County Board, funding for Yahara WINs is continued. If that happens,

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Dane County can continue promoting and directing Dane County farmers to use conservation practices that reduce runoff. The results chain then splits in two paths. These two paths are both intermediate results of implementation of conservation practices. The first intermediate result is nutrient management plans adopted by farmers. The second is acreage of harvestable buffers in Dane County increases as participation continues to expand among farmers. Landowners along Dorn Creek are encouraged to implement both nutrient management plans and harvestable buffers; both lead to the threat reduction of current agricultural phosphorus runoff reduced.

**Intermediate Objectives:**

1. Annual implementation count for conservation practices remains stable or increases compared to previous year.
2. Annual increase in acreage of farmland within Dorn Creek Watershed under Nutrient Management Plan relative to previous year until all agricultural land in the watershed is mapped.
3. Increase in harvestable buffer acreage along Dorn Creek compared to previous year.

**Activities:**

1. Lobby Dane County Board in support of WIN funding.
2. Communicate the wide range of conservation measures available to landowners.
3. Improve and expand upon communication efforts aimed at publicizing the advantages of NMP programs and the benefits of agricultural conservation measures.
4. Explore strategies to ease implementation of harvestable buffers and adaptively manage future buffer creation projects to maximize positive outcomes for water quality.

The first activity of this results chain, similar to our phosphorus removal results chain, is to lobby the Dane County board for continued funding. This funding would be used for continued implementation of Yahara WINs adaptive management cost sharing. The second activity is for staff to communicate with landowners about the conservation management measures available to them. This would hopefully get landowners interested in participating. There are currently 35.2 conservation practices total in the Dorn Creek Watershed. The next activity is improve and expand upon communication efforts aimed at publicizing the advantages of NMP programs and the benefits of agricultural conservation measures. This would educate landowners and promote Nutrient Management Plans. Most farmers have some sort of nutrient management plan but Dane County would like to have those plans on file and map them as a way of monitoring whether or not they get implemented.

The last activity of this results chain is explore strategies to ease implementation of harvestable buffers and adaptively manage future buffer creation projects to maximize positive outcomes for water quality. Currently landowners can receive \$400 per acre for a five year contract, \$425 per acre for a ten year contract, and \$450 an acre for a fifteen year contract. These contracts require a minimum of a 30 ft buffer from the creek with maximum size decided on a case by case basis. (Information gathered from a Dane County Land and Water Resource Harvestable Buffer Flyer.) The exact amount of harvestable buffer acreage surrounding Dorn Creek, that is enrolled in this

program, is unknown. However, we know it isn't surrounding the creek completely and there are many farms that can still enroll. Hopefully with continued education and awareness, Dane County can increase the amount of program participants.

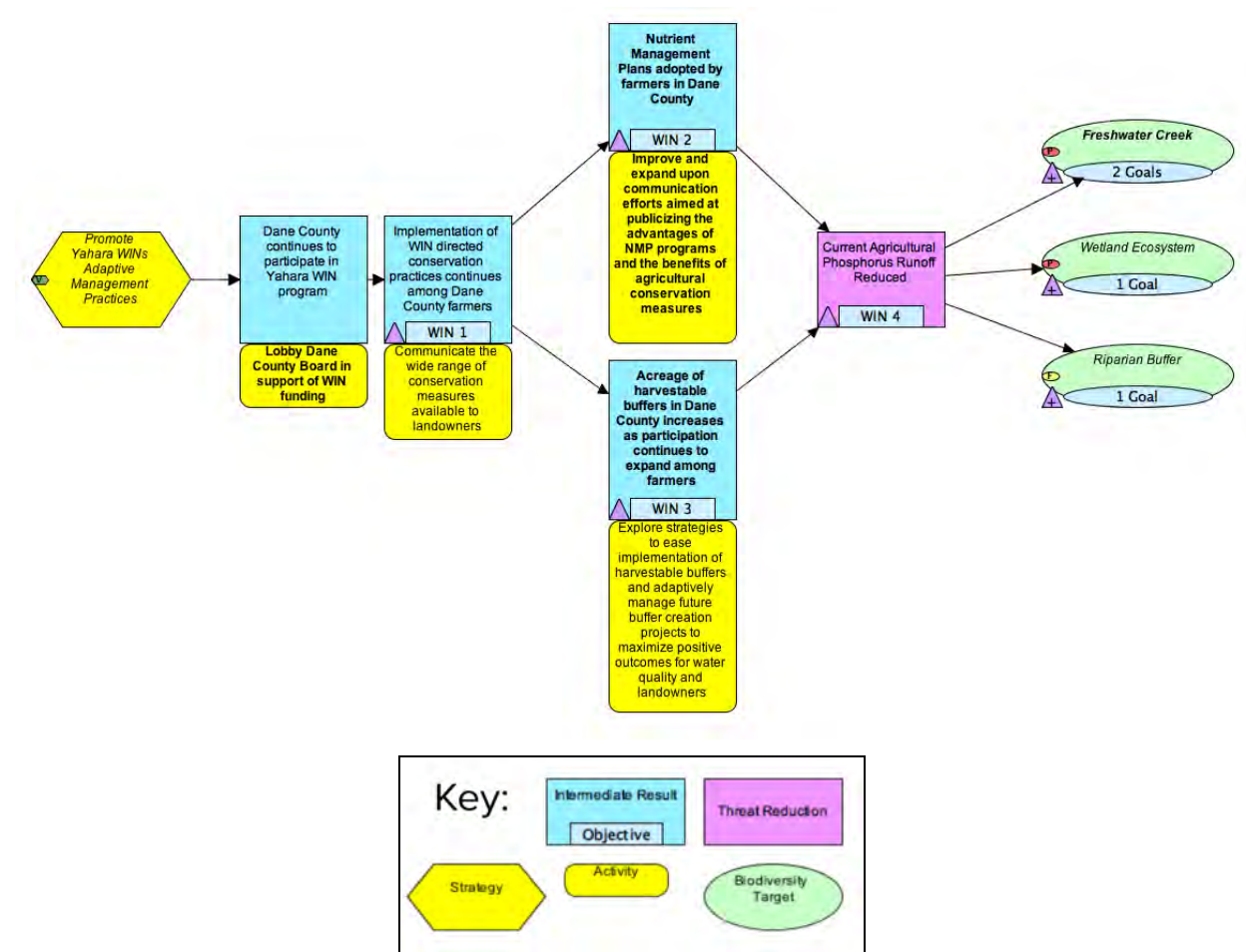


Figure 14: “Promote Yahara WINS Adaptive Management Practices” results chain.

### 8.3.3. Strategy Timeline and Budget

Table 13 below shows the timeline for implementing and monitoring the “Promote Yahara WINs Adaptive Management Practices” strategy over the span of the project duration.

Activity or Indicator	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27	FY 28	FY 29	FY 30
Lobby Dane County Board in support of WIN funding														
Communicate the wide range of conservation measures available to landowners														
Improve and expand upon communication efforts aimed at publicizing the advantages of NMP programs.														
Explore strategies to ease implementation of harvestable buffers and adaptively manage future buffer creation projects.														
Annual implementation count for conservation practices.														
Annual mapping of farmland acreage within Dorn Creek Watershed under Nutrient Management Plan.														
Annual mapping of harvestable buffer acreage along Dorn Creek.														
Annual assessment of phosphorus runoff reduction due to conservation practices.														
In- Stream Monitoring														
Annual Riparian Buffer Extent Land Survey														
Annual Kicknet collection of macroinvertebrates and classification														
Annual Secchi Tube Monitoring of Turbidity														
Annual EPA Rapid Algae Bioassessment Protocol														
Annual Soil Coring														
Annual Invasive Species Transect Survey														

**Table 13: Timeline for the “Promote Yahara WINs adaptive management” strategy timeline runs from from fiscal year 2017 (FY 17) to fiscal year 2030 (FY 30).**

Table 13 shows the actions work plan and budget needed to complete activities in the “Promote Yahara WINs Adaptive Management Practices” strategy results chain. It includes estimated salary allocation for time spent completing the activities along with projected expenses that are associated with each activity. The team assigned two Dane County Land and Water Resources staff to this strategy: John Reimer, Interim Deputy Director and Kyle Minks, Land and Water Resources Scientist. However, Dane County Land and Water Resources may allocate these activities to other staff members as they see fit. The team estimates that the total budget needed to complete all activities for this result chain, in the given timeframe, is \$500,006

			Work Units	Work Units	Work Units	Work Units	Work Units	Work Units	Work Units	Work Units	Work Units	Work Units	Projected Expenses Total	Budget Totals Total
	Timeframe	Who	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total		
<b>Promote Yahara WINS Adaptive Management Practices</b>	<b>FY17-FY25</b>	<b>JR, KM</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>97</b>	<b>873</b>	<b>\$314,320</b>	<b>\$500,006</b>
Lobby Dane County Board in support of WIN funding	FY17-FY25	JR	1	1	1	1	1	1	1	1	1	9		\$1,914
Communicate the wide range of conservation measures available to landowners	FY17-FY25	JR, KM	48	48	48	48	48	48	48	48	48	432		\$96,206
Transportation													\$4,320	
Improve and expand upon communication efforts aimed at publicizing the advantages of NMP programs and the benefits of agricultural conservation measures	FY17-FY25	JR, KM	24	24	24	24	24	24	24	24	24	216		\$55,943
Web and Direct Mail Educational Outreach													\$10,000	
Explore strategies to ease implementation of harvestable buffers and adaptively manage future buffer creation projects to maximize positive outcomes for water quality	FY17-FY25	JR, KM	24	24	24	24	24	24	24	24	24	216		\$345,943
Harvestable Buffer Implementation													\$300,000	

**Table 14: Actions Work Plan and Budget for “Promote Yahara WINS adaptive management” strategy**

Table 14 shows the total work units and budget needed for each monitoring activity associated with the “Promote Yahara WINS Adaptive Management Practices” strategy results chain. Each monitoring activity is associated with either an intermediate result, threat reduction or biodiversity target. The team assigned Kyle Minks to all monitoring activities but Dane County Land and Water Resources Staff may allocate the monitoring activities to other employees where they see fit. The total budget estimated for all monitoring activities, in the given timeframe, is \$25,312.

Monitoring Activity	Who	Timeframe	Work Units Total	Projected Expenses Total	Budget Total
Annual implementation count for conservation practices.	KM	FY 17 - FY 25	9	0	\$1,914
Annual mapping of farmland acreage within Dorn Creek Watershed under Nutrient Management	KM	FY 17 - FY 25	9	0	\$1,914
Annual mapping of harvestable buffer acreage along Dorn Creek.	KM	FY 17 - FY 25	9	0	\$1,914
Annual assessment of phosphorus runoff reduction due to conservation practices.	KM	FY 17 - FY 25	9	0	\$1,914
In-Stream Monitoring	KM	FY 17 - FY 30	14	0	\$2,978
Annual Riparian Buffer Extent Land Survey	KM	FY 17 - FY 30	14	0	\$2,978
Annual Kicknet collection of macroinvertebrates and classification	KM	FY 20 - FY 30	11	0	\$2,340
Annual Secchi Tube Monitoring of Turbidity	KM	FY 20 - FY 30	11	0	\$2,340
Annual EPA Rapid Algae Bioassessment Protocol	KM	FY 20 - FY 30	11	0	\$2,340
Annual Soil Coring	KM	FY 20 - FY 30	11	0	\$2,340
Annual Invasive Species Transect Survey	KM	FY 20 - FY 30	11	0	\$2,340
<b>Total of all Monitoring Activities</b>	<b>KM</b>	<b>FY 17 - FY 30</b>	<b>119</b>	<b>0</b>	<b>\$25,312</b>

**Table 15: Monitoring Work Plan and Budget for “Promote Yahara WINS adaptive management” strategy**



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## ► 9. Monitoring Plan

The monitoring plan describes how the biodiversity target goals, threat reduction objectives and intermediate results objectives will be monitored throughout the project duration. Through monitoring, strategies and activities are assessed to determine their effectiveness in achieving the objectives, and the goals associated with the biodiversity targets. This allows for assessment and possible revision of the plan.

Table 16 and Table 17 are monitoring activities for the biodiversity targets' goals (encompassing KEAs: freshwater creek water chemistry, riparian buffer extent and riparian buffer invasive species cover) to be implemented at the start of the project. The remaining monitoring activities will begin in 2020 after all targeted segments of Dorn Creek have been dredged (see Strategy 1, Section 8.3.2.1). Freshwater creek phosphorus and the Riparian Buffer, contributing to phosphorus mitigation, are presently the main concerns for Dorn Creek, and assessing the effectiveness of Strategy 2 on these is of high priority. Once targeted segments have been dredged and successful efforts aimed at phosphorus reduction and riparian buffer health have continued for 3 years, effort can be allocated to monitoring the desired future statuses of the remaining KEAs, and ensuring that they succeed. Moreover, dredging is a non-selective, invasive process that comes at the expense of removing other biodiversity within the creek and the immediate vicinity. Heavy machinery access to the bank of the stream is necessary during this process, further altering the landscape. For these reasons, the remaining KEAs will begin monitoring in 2020 after dredging has concluded. Further, phosphorus levels influence the remaining KEAs, and thus, we expect to see a positive change in these after phosphorus sediment has been dredged and efforts aimed at preventing phosphorus runoff have increased.

The team advises obtaining current measurements prior to the start of the project for the KEAs lacking initial measurements. Our objectives state an annual increase from the previous year for conservation practices implemented, nutrient management plans mapped and harvestable buffer acreage. The team suggests that this annual increase for each be quantified to clarify a sufficient increase that would lead to achieving the desired threat reduction objective and biodiversity target goals.

The threat reduction monitoring activity and intermediate results monitoring activities will be monitored from the beginning of the project. The project team anticipates that monitoring will continue upon completion of this management plan, but specific, future monitoring protocol should be determined by Dane County at that time to best reflect changes in site circumstances and information needs.

**Further details regarding EPA Rapid Bioassessment Protocol:** The EPA Rapid Bioassessment Protocol for algae cover involves a clear bucket marked with a 50-point grid on the bottom to quantify algal cover. The bucket is submerged top down so the bottom sits on the surface. Algae is quantified by counting the number of dots occurring over areas of algae. This method is quick

and reliable for a moderately sized area through the collection of multiple samples. See EPA Rapid Bioassessment Protocol: An Introduction for more information. (EPA, n.d.).

## 9.1. Goals

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Goal:</b> By 2025, annual cumulative total phosphorus daily load and annual average total phosphorus in the creek's water and bed sediment will be reduced to an extent that achieves delisting from Wisconsin's impaired waters list.					
<b>Monitoring Approach:</b> Time series					
Annual Cumulative Total Phosphorus Daily Load (lbs)	In-stream monitoring	Measured daily and assessed annually	Dane County Land and Water Department	At existing USGS monitoring sites within Dorn Creek Watershed	<i>2016 annual cumulative total phosphorus daily load was 5897 lbs. Monitoring will continue to 2030 to better assess the long term impacts of the project.</i>
Annual Average Total Phosphorus (mg/L)	In-stream monitoring	Measured daily and assessed annually	Dane County Land and Water Department	At existing USGS monitoring sites within Dorn Creek Watershed	<i>2016 annual average total phosphorus was 0.256 mg/L. Monitoring will continue to 2030 to better assess the long term impacts of the project.</i>

**Table 16: Monitoring Plan for Conservation Goal 1 - Freshwater Creek**



What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Goal:</b> By 2030, algae cover will be reduced to 10-30%, water clarity will be increased and macroinvertebrate biotic index score will be improved to 2.6-3.5.					
<b>Monitoring Approach:</b> Time Series					
Macroinvertebrate Biotic Index Score (Richness)	Kicknet to collect macroinvertebrates and classify biotic index score	Annually: beginning 2020 and ending 2030	Dane County Land and Water Department	Two dredged segments of the Dorn Creek Watershed	<i>Current macroinvertebrate biotic index score is 1.935</i>
Turbidity (m)	Secchi Tube	Annually: beginning 2020 and ending 2030	Dane County Land and Water Department	Two dredged segments of the Dorn Creek Watershed	<i>No current measurements exist for turbidity. We recommend obtaining initial measurements when possible.</i>
Algae Cover (%)	EPA Rapid Bioassessment Protocol (RBP)	Annually: beginning 2020 and ending 2030	Dane County Land and Water Department	Two dredged segments of the Dorn Creek Watershed	<i>No current measurements exist for algae cover. We recommend obtaining initial % algae cover when possible.</i>

**Table 17: Monitoring plan for Conservation Goal 2 - Freshwater Creek**

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Goal:</b> Improve the condition of wetlands surrounding Dorn Creek by reducing annual average total phosphorus to 50-300 mg/kg and by reducing invasive plant cover to 10% - 30% in wetland areas by 2030					
<b>Monitoring Approach:</b> Time Series					
Annual Average Total Phosphorus (mg/kg)	Soil Coring	Annually: beginning 2020 and ending 2030	Dane County Land and Water Department	Selected sites within the Dorn Creek Wetlands	<i>2013 Annual average total phosphorus for selected wetland sites ranged between 385-820 mg/kg</i>
Invasive Species Cover (%)	Transect Survey	Annually: beginning 2020 and ending 2030	Dane County Land and Water Department	Selected sites within the Dorn Creek Wetlands	<i>Wetlands within Dorn Creek are completely dominated by Reed Canary Grass</i>

**Table 18: Monitoring plan for Conservation Goal - Wetland Ecosystem**

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Goal:</b> Expand and strengthen riparian buffer areas along Dorn Creek by widening buffers to at least 30 feet and reducing invasive plant coverage to 10% along the entire length of the creek by 2025.					
<b>Monitoring Approach:</b> Time Series					
Invasive Species Cover (%)	Transect Survey	Annually	Dane County Land and Water Department	County and State Lands	<i>Invasive removal is targeted in the county and state lands due to the prioritization of harvestable buffers on private lands. Monitoring will continue to 2030 to better assess the long term impacts of the project.</i>
Width (ft)	Land Survey	Annually	Dane County Land and Water Department	Along the entire Dorn Creek Watershed	<i>Width can be dependent on characteristics of individual farms and the equipment available to landowners. Monitoring will continue to 2030 to better assess the long term impacts of the project.</i>

**Table 19: Monitoring plan for Conservation Goal - Riparian Buffer**

## 9.2 Threat Reduction Objective

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Threat Reduction Objective:</b> Agricultural phosphorus runoff reduced relative to previous year					
<b>Monitoring Approach:</b> Time Series					
Projected pounds of phosphorus runoff reduced through implementation of conservation practices	Calculation of cumulative phosphorus runoff mitigated through conservation practices	Annually	Dane County Land and Water Department	Dorn Creek Watershed	<i>Current (2016) cumulative mitigated phosphorus runoff is 966.7 pounds of phosphorus.</i>

**Table 20: Threat reduction monitoring plan for the “Promote Yahara WINS adaptive management practices” results chain**

### 9.3 Intermediate Objectives

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Objective:</b> Annual implementation count for conservation practices remains stable or increases compared to previous year					
<b>Monitoring Approach:</b> Time Series					
Number of conservation practices implemented	Annual conservation practice audit	Annually	Dane County Land and Water Department	Dorn Creek Watershed	<i>Current (2016) conservation practice count is 35.2.</i>

**Table 21: Monitoring plan for WIN 1 objective of the “Promote Yahara WINs adaptive management practices” results chain**

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Objective:</b> Annual increase in acreage of farmland within Dorn Creek Watershed under Nutrient Management Plan relative to previous year until all agricultural land in the watershed is mapped.					
<b>Monitoring Approach:</b> Time Series					
Acreage within watershed under NMP	NMP acreage mapping and inventory	Annually	Dane County Land and Water Department	Dorn Creek Watershed	<i>NMP acreage mapped for Dorn Creek 2014: 505, 2015: 2,077, 2016: 2794</i>

**Table 22: Monitoring plan for WIN 2 objective of the “Promote Yahara WINs adaptive management practices” results chain**

What (Indicator)	How (Methods)	When	Who	Where	Comments
<b>Objective:</b> Increase in harvestable buffer acreage along Dorn Creek compared to previous year					
<b>Monitoring Approach:</b> Time Series					
Harvestable buffer acreage	Harvestable buffer acreage mapping and inventory	Annually	Dane County Land and Water Department	Dorn Creek Watershed	<i>No current measurements exist for harvestable buffer acreage. We recommend obtaining initial mapped harvestable buffer acreage when possible.</i>

**Table 23: Monitoring plan for WIN 3 objective of the “Promote Yahara WINs adaptive management practices” results chain**

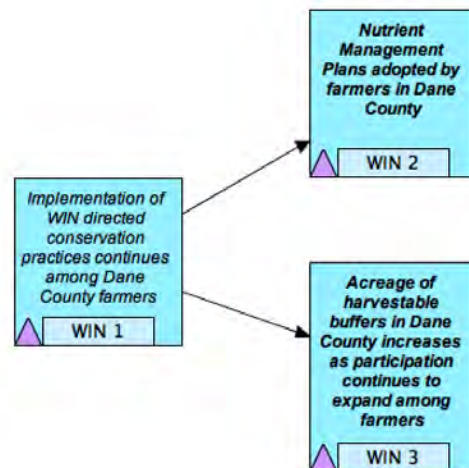
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## 9.4. Management Effectiveness Questions

Management effectiveness questions address the assumptions within the results chain. These questions recognize that there is doubt in the link between two intermediate results, and looks to answer that doubt. Below are two management effectiveness questions that the team deemed important for the success of the project.

### 9.4.1 Management Effectiveness Question 1

The figure below represents the portion of the results chain relating to the first management effectiveness question: Does implementation of WIN directed conservation practices lead to increase mapped nutrient management plans and harvestable buffer acreage adopted by farmers? The team assumed that a large portion of the WIN directed conservation practices implemented among Dane County farmers would be nutrient management plans and harvestable buffers. It is possible that farmers would choose conservation efforts requiring less effort and money than the two presented below. The team recommends that as staff talks with farmers that an emphasis be placed on the adoption of nutrient management plans and harvestable buffers.



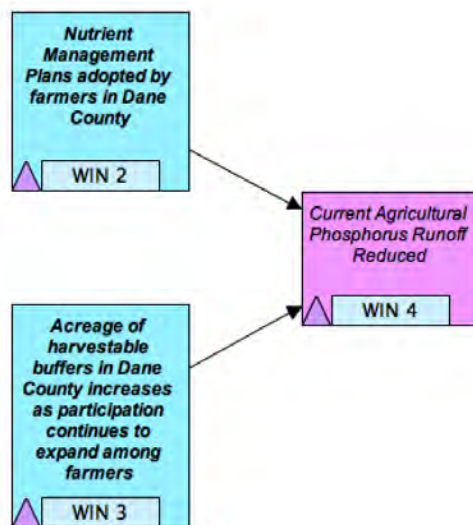
**Figure 15: Intermediate results portion discussed in management effectiveness question 1**

### 9.4.2 Management Effectiveness Question 2

The figure below represents the portion of the results chain relating to the second management effectiveness question: Do mapped nutrient management plans and harvestable buffer acreage adopted by farmers lead to actual decreases in current agricultural phosphorus runoff? Current reductions in agricultural phosphorus runoff due to conservation practices is determined by a calculation (K. Minks, personal communication, October 18, 2017). This means that the phosphorus runoff is an expected number rather than an actual number. The team assumed that the expected current agricultural phosphorus runoff is representative of actual current agricultural phosphorus runoff. The team also assumed that increases in nutrient management plans mapped and harvestable buffer acreage will lead to substantial reductions for current agricultural phosphorus runoff to be reduced every year relative to the previous year (See Threat Reduction Objective, Section 9.2). The team believes that the expected numbers are representative of the

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actual numbers, and this can be observed on an annual basis when annual cumulative TPDL and annual average TP are obtained.



**Figure 16: Intermediate results portion discussed in management effectiveness question 2**

## ► 10. Recommendations for Adaptive Management:

1) The removal of legacy sediment and limitation of future runoff are the current management priorities in the Dorn Creek area. Our conceptual model has identified additional, potential key ecological attributes such as invasives species in the wetlands and riparian buffer zone. However, these additional KEAs cannot be addressed until the prioritized direct threat of agricultural phosphorus runoff has met its goal and resources are freed up for allocation elsewhere.

Thus, the planning team recommends a strong, continued effort in promoting the implementation of harvestable buffers and verified nutrient management plans in the Dorn Creek area even after acceptable water chemistry and nutrient composition have been achieved.

The current legacy sediment removal project is costly, time consuming, and detrimental to biodiversity within Dorn Creek. It requires the majority of available manpower, funds, and other resources. It also is a nonselective process and a disturbance to the creekbed and organisms living within. Future repetition of hydraulic dredging needs to be avoided by continuing to limit the addition of future runoff after the original goal has been achieved. This can be accomplished by continuing to utilize the aforementioned strategies of promoting the implementation of harvestable buffer zones, verified nutrient management plans, and conservation practices in accordance with Yahara WINs.

Maintaining acceptable phosphorus levels after the original goal has been achieved will allow resources, funds, and manpower to be reallocated to secondary management strategies such as invasive species management in the wetlands and riparian zone where harvestable buffers are

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not in place. These secondary practices will continue to further improve the health of the Dorn Creek area.

If invasive vegetative species abundance and distribution decrease the native vegetative species abundance and distribution will increase. This should in turn foster the growth of native wildlife populations which are crucial to our human well-being targets.

2) Before any strategies can be implemented, baseline data must be acquired for each of the conservation targets. As strategies are implemented, it is essential to monitor the intermediate objectives.

3) monitoring should continue past the target deadline for all goals. Our project has deadlines of 2025 and 2030 depending on the KEA, but this by no means should be viewed as an end date for the project.

4) We suggest annual meetings with all project partners to assess the open standards and discuss where the team is in the progression of meeting goals and what challenges, setbacks, opportunities and success they've encountered. It's during these meetings that participants have the best opportunity to discuss what is working and what's not and how they can to adapt to overcome obstacles and exploit potential opportunities. This is also the time to make changes in the budget in order to include any newly agreed upon changes in the management plan.

#### Major Assumptions:

- We assumed that conservation practices and compliance to nutrient management plans leads to actual reductions in phosphorus runoff.
- We assumed our goals, objectives and strategies will all result in healthy biodiversity targets that will continue into the future without continued interference.
- We assumed a decrease in non-native vegetation and invasives would correlate to an increase in native vegetation (habitat) for wildlife populations. But the implementation of harvestable buffers does not lead to an increase in native vegetation.

## ► Acknowledgements

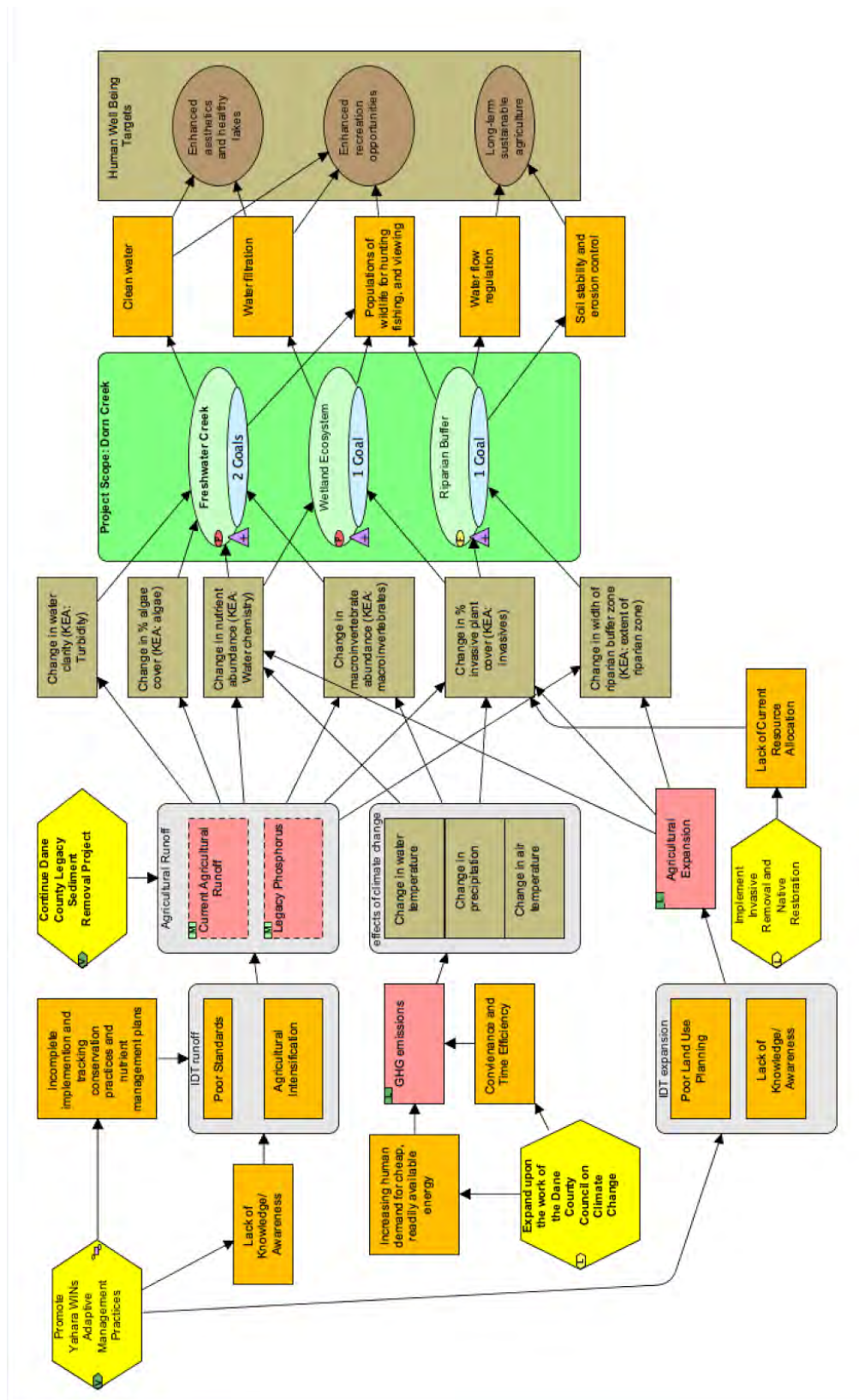
The team would like to thank the Dane County Board, specifically Lauren Kuhl and Karin Peterson for allowing our team to develop a management plan for Dorn Creek. We would also like to thank the Dane County Land and Water Resources Department, specifically John Reimer and Kyle Minks, for their continued patience and availability in providing background, answering our questions and leading a site visit to Dorn Creek.

Thank you to Arlyne Johnson and Alicia Barceinas Cruz for teaching the Open Standards and Miradi Adaptive Management Software. We look forward to using these skills in the future.

Lastly, thank you to the rest of our classmates in Conservation Planning.



## ► Appendix A: Conceptual Model



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## ► Appendix B: Yahara WINs Conservation Actions List

The following list contains the range of conservation actions implemented across the Yahara Watershed through cooperation between landowners and the Yahara WINs program, sourced from the 2016 Annual Dane County Yahara WINs Adaptive Management Report (Dane County Land and Water Resources Department, 2016):

*Cover Crop*

*Grade Stabilization Structure*

*Grassed Waterway*

*Pasture and Hay Planting*

*Roof Runoff Structure*

*Waste Storage Facility*

*Closure of Waste Impound*

*Filter Strip*

*Heavy Use Area Protection*

*Water and Sediment Control Structure*

*Dane County Perpetual Easement*

*Conservation Cover*

*Critical Area Planting*

*Diversion*

*Lined Waterway or Outlet*

*Access Control*

*Prescribed Grazing*

*Animal Trails and Walkways*

*Stream Crossing*

*Streambank and Shoreline*

*Manure Transfer*

*Wastewater Treatment Strip*

*Wetland Restoration*

*Forage Harvest Management*

*Tree/Shrub Establishment*

*Shallow Water Development*

*Wetland Wildlife Habitat*



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