2018-2019

FINAL REPORT

UniverCity Year

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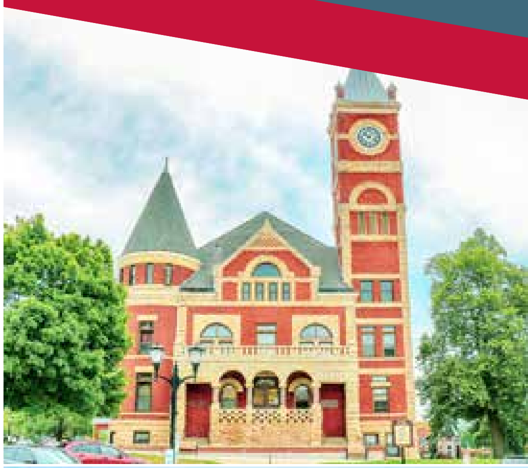
Lake Montesian conservation plan

ENVIRONMENTAL STUDIES 972: CONSERVATION PLANNING



UniverCity Alliance

UNIVERSITY OF WISCONSIN–MADISON

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1.Project summary

1.1 Project name

Lake Montesian Conservation Plan

1.2. Project Location

Lake Montesian is a 10 acre human-made lake in the Village of Monticello in Green County, Wisconsin, as seen below in Figure 1. Monticello has a population of just over 1,200 residents. The lake's maximum depth is about 15 feet. There is a 1.5 acre island in the middle of the lake, connected to the north shoreline with a concrete/wood bridge. It is surrounded by roads on all three sides, the town of Monticello to the north, east and south, and farmland to the west. The Little Sugar River runs parallel to the north shore of the lake.

Figure 1: Map of Wisconsin

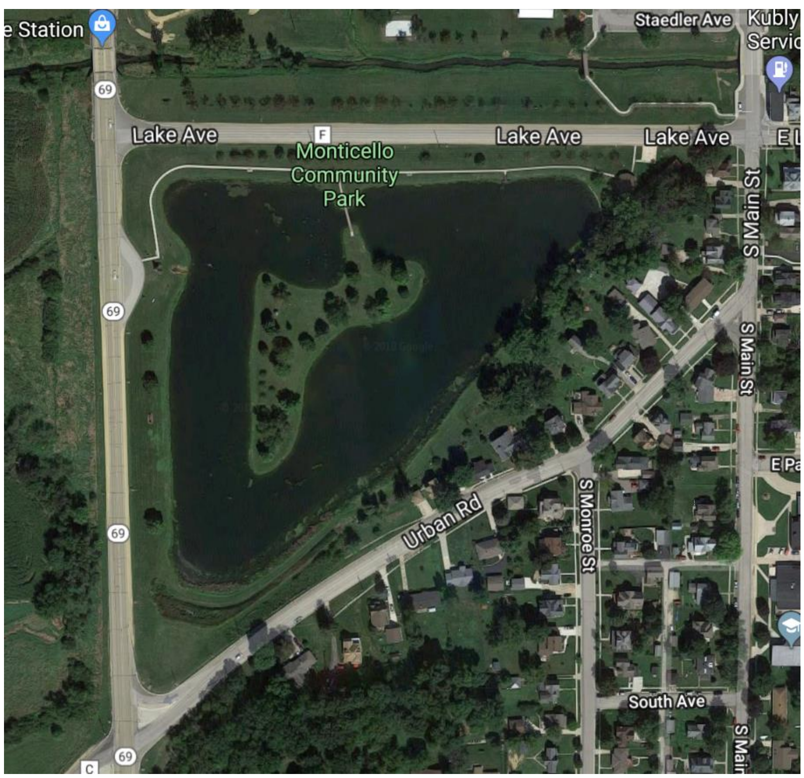


Figure 2: Map of Lake Montesian and surrounding area

1.3 Project Vision

Our group's vision is to improve water quality and increase the presence and health of native plant and animal communities within Lake Montesian, while promoting community engagement with the lake and the vitality of local businesses.

1.4. Contact Name and Address

Kevin Komprood, Project Representative
Public Works Director, Village of Monticello
140 North Main Street
Monticello, WI 53570
Phone: (608) 938-4383

1.5. Project Start and End Dates

The involvement of our class is August 2018 to November 2018, however, our project goals extend to 2028.

1.6 Brief Project Description

The Village of Monticello wants Lake Montesian to be a beautiful landmark of the town that can also provide a healthy population of fish to support fishing activities. In addition to the lake's aesthetic and practical functions, residents also enjoy using the island in the middle as a location for special events such as weddings and high school dances. Each January, the town holds a fishing tournament at Lake Montesian, and each July fireworks are set off on the island. The lake has been facing a number of environmental threats that have led to murky, eutrophic water and an uncertain and unhealthy population of fish. As a result, Kevin Komprood, the public works director of Monticello, reached out to The Nelson Institute at the University of Wisconsin, Madison to draft a conservation plan for Lake Montesian.

In order to work toward a lake that has healthy water quality, our project team identified four main biodiversity targets for the lake: littoral zones, fish communities, submerged plant communities, and water column (see Section 4). Four direct threats to these targets have also been identified: mowing, overfishing, introduction of invasive species, and nutrient loading (Section 5).

2. Introduction

2.1 Project Theme: Past and Present

Our conservation team has identified water quality as the main concern of the community of Monticello regarding Lake Montesian. Our conservation plan revolves around trying to improve water quality so that the lake can continue to be aesthetically pleasing and serve as a focal point of activities in the town of Monticello. We believe several factors (direct threats) are negatively affecting the water quality of the lake, particularly mowing, overfishing, invasive species and nutrient loading (Section 5).

Our conservation plan seeks to provide an aesthetically pleasing body of water to serve as a centerpiece and highlight of the village for everyone to enjoy. We seek to improve the water quality of Lake Montesian so that the lake can serve as a viable and sustainable fishing area and be a beautiful backdrop for weddings and other special occasions. The Monticello Chamber of Commerce website summarizes the town's vision of the lake: "This idyllic setting is a place to relax, picnic or fish. The park offers a relaxing setting for family outings that includes a shelter house with all the facilities for a sizzling good time and a footbridge that leads to an island with benches and plenty of shade in the middle of the lake."

Lake Montesian was created in the late 1960s and replaced a pond called Lake Staedler. This pond had been formed in the mid 1800s by settlers who dammed two streams (Babler, 2010) and is now controlled by an underground dam system. In 1974, community members did some dredging and added rocks to the shoreline to help prevent erosion (Babler, 2010.) In 1998 the lake was dredged again and the fish were restocked by Gollon Bait and Fish Farm. The lake now also has four electric aerators.

More recently, the village of Monticello has tried several different tactics to improve the water quality of Lake Montesian. In addition to dredging native and invasive plants, the village has also tried working with a private company to treat the lake for invasive species. Unfortunately, that strategy proved too costly for them to continue. To control the geese population, the town planted a native grass perimeter. The residents of Monticello, however, did not enjoy the aestetics of the grass border. They wanted to be able to more easily access the shore to fish, and the perimeter is now extensively mowed, with only a few stands of shoreline vegetation remaining.

Currently, the village applies chemicals to the water to control invasive species and traps around 40-70 muskrats per year. It is believed that the muskrats are contributing to erosion of the shoreline. Additionally, holes in the shoreline are filled with rocks of different sizes in order to stabilize it.

2.2 Management Documents

We were unable to access any documentation regarding legislation, orders, establishment or management of Lake Montesian.

3. Methods

3.1 Project Team.

Stakeholders of Lake Montesian include the Monticello residents, adjacent landowners, and the trout fishers who make use of the adjacent Little Sugar River. The conservation planning team is listed below (*Redacted*). The plan will be submitted to our project leader, and he will share the plan with other stakeholders and residents in Monticello.

Figure 3. Members of the conservation planning project team for Lake Montesian.

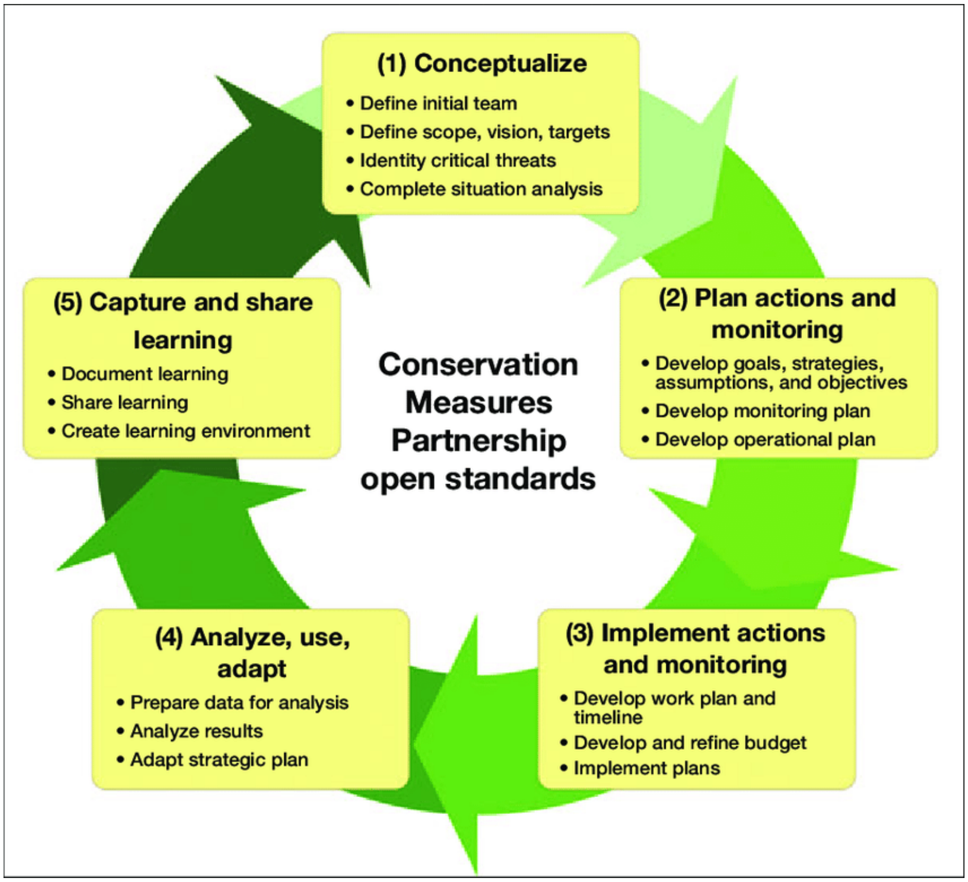
3.2 Conservation Planning Approach

Our team used the Open Standards planning method while constructing Lake Montesian's conservation planning approach. The Open Standards are a series of guidelines that conservation practitioners are encouraging other practitioners to use and adopt. It practices adaptive management, providing a framework to systematically test assumptions, promote learning, and supply timely information for management decisions (FOS, 2018). This method provides a widely applied practice for practitioners to monitor, evaluate, and share their successes and failures throughout the careers as conservationists.

The Open Standards are organized into a five-step project management cycle: (CMP, 2013).

- Step One: Conceptualize the Project Vision and Context
- Step Two: Plan Actions and Monitoring
- Step Three: Implement Actions and Monitoring

- Step Four: Analyze Data, Use the Results, and Adapt
- Step Five: Capture and Share Learning



Researchgate.net

Figure 4. This diagram shows the steps used when following the Open Standards method.

The team began by working with and asking questions to our Team Manager, Kevin Komprood. Based on information provided to our team members, we were able to identify the biggest threats to the lake itself and refined the vision for the residents of Monticello County regarding their lake. We discussed concerns that the village has regarding Lake Montesian and we identified water quality as being one of the main conservation targets. Afterwards, we began constructing a plan for the lake and listed water quality as one of the main focuses, among other biodiversity factors. This process was developed to help the team develop the necessary skills to be able to involve stakeholders, develop and cultivate partnerships, embrace learning, document our decisions, and to share our results with our peers (CMP, 2013).

4. Scope, Vision and Biodiversity Targets

4.1 Scope and Maps

Lake Montesian is a man-made lake which receives storm water runoff from a section of the town of Monticello before discharging into the Little Sugar River. The lake has historically had issues with sedimentation, invasive vegetation and algae growth, and heavy fishing pressure.

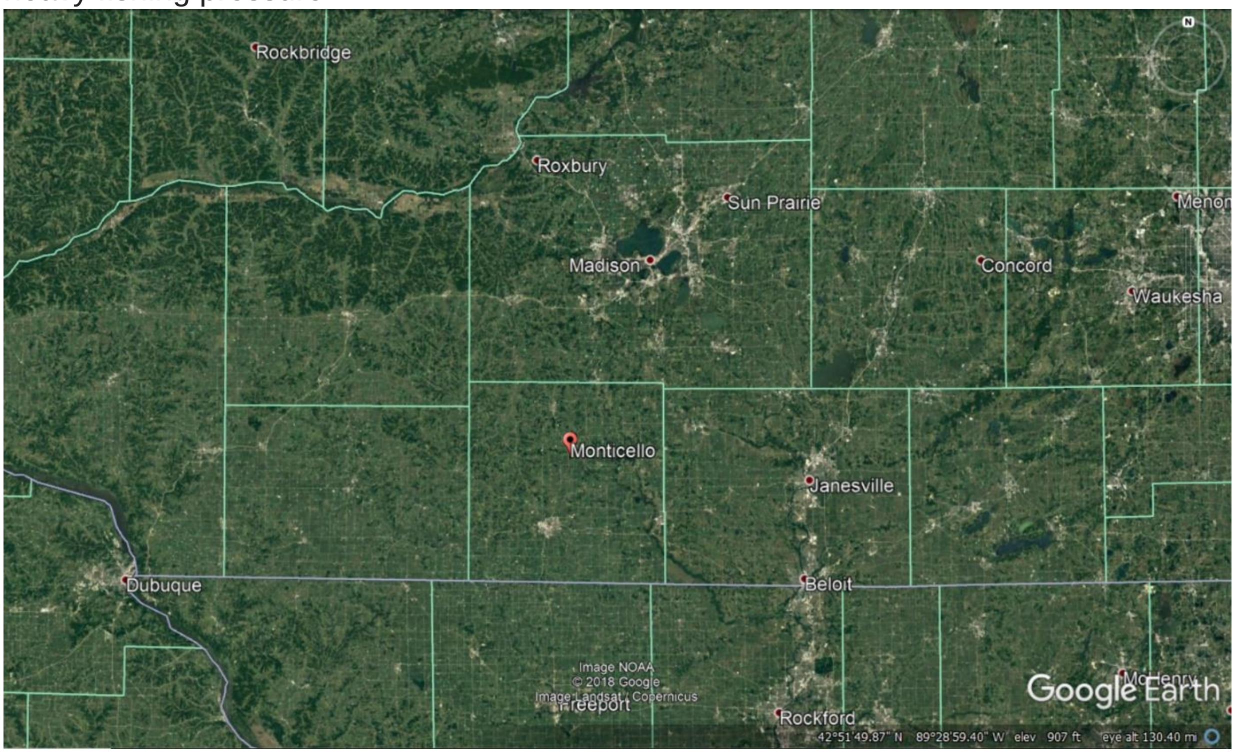


Figure 5a: Satellite view of Southern Wisconsin, showing the location of Monticello within Green Co.

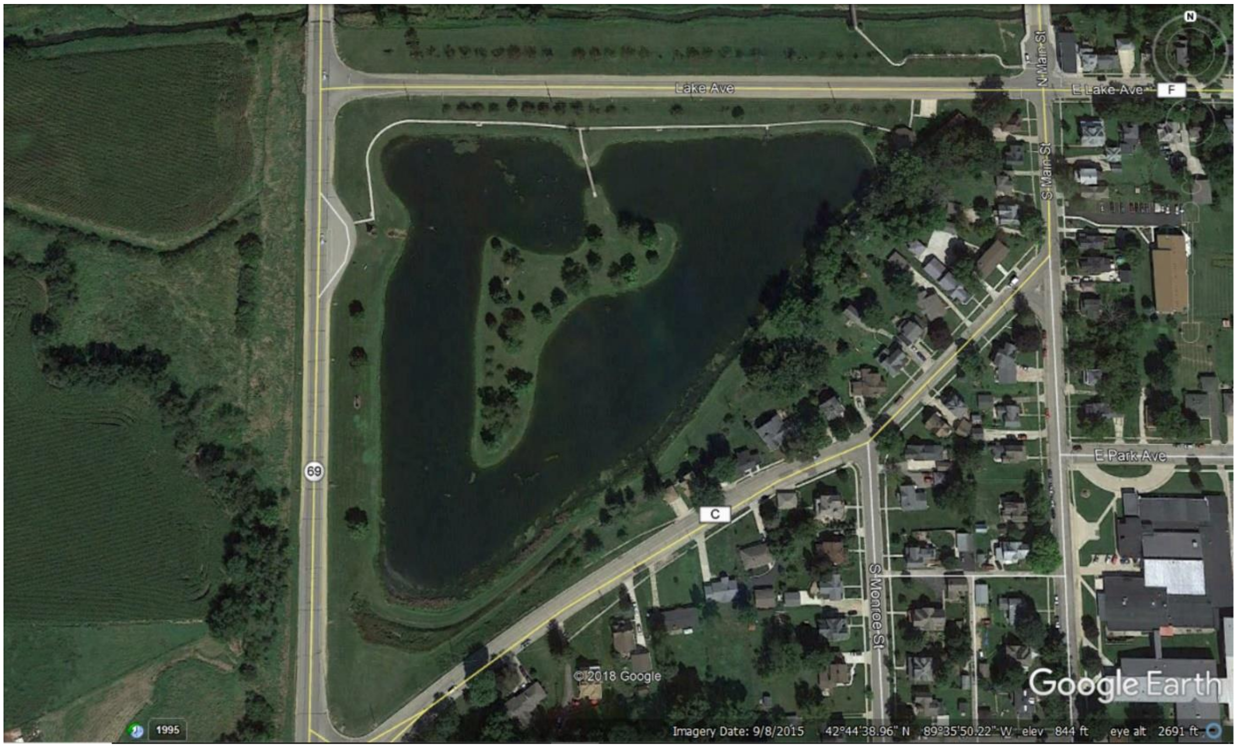


Figure 5b: Satellite view of Lake Montesian and surrounding Community Park, as well as a portion of the village.

4.2 Vision.

Our group's vision is to improve water quality and increase the presence and health of native plant and animal communities within Lake Montesian, while promoting community engagement with the lake and the vitality of local businesses.

4.3 Biodiversity Targets

Biodiversity Target 1

<u>Littoral Zones:</u>

The littoral zones are the areas along the shore which contain emergent plants. These plants are rooted in water, with leaves in the air. By far the most common plants currently in this area are cattails *(Typha spp.).* Other plants include arrowhead *(Sagittaria latifolia*), pickerelweed *(Pontedaria cordata*), bur-reeds *(Sparganium spp.),* bulrushes (*Scirpus spp.),* common rushes *(Juncus spp*.), and sedges *(Carex spp*.).

These areas are key to water filtration as well as providing habitat for fish, amphibians, macroinvertebrates and other animals. These emergent plants are a direct buffer between the lake and runoff that comes into the lake.

Biodiversity Target 2

<u>Fish Communities:</u>

Maintaining a healthy fish community seems to be of great concern to the residents of the area. Sport fishing is a popular past time and could be a major draw for both locals and tourists. Currently, there are state restrictions as well as city-level recommendations for bag limits and size. Our team recorded the presence of bass, panfish, pike, and catfish.

Along with providing good fishing, having a healthy variety of fish species also helps to keep the lake free from algae and other material consumed by these fish.

Biodiversity Target 3

Submerged Plant Communities:

These plants live with all parts underwater. Similar to the plants in the littoral zone, submerged plants can filter water and provide habitat to fish and other lacustrine organisms. These plants also provide food to waterfowl and some fish. Currently there is a mix of native and invasive plants. Invasives include Eurasian water millfoil and curly-leaf pondweed. Some native plants include coontail, native pondweeds, and native milfoils.

Biodiversity Target 4

Lake:

This target encompasses any algae, phytoplankton, zooplankton and bacteria within the water. While often invisible to the naked eye, these tiny organisms are essential to the balance of the ecosystem of the lake.

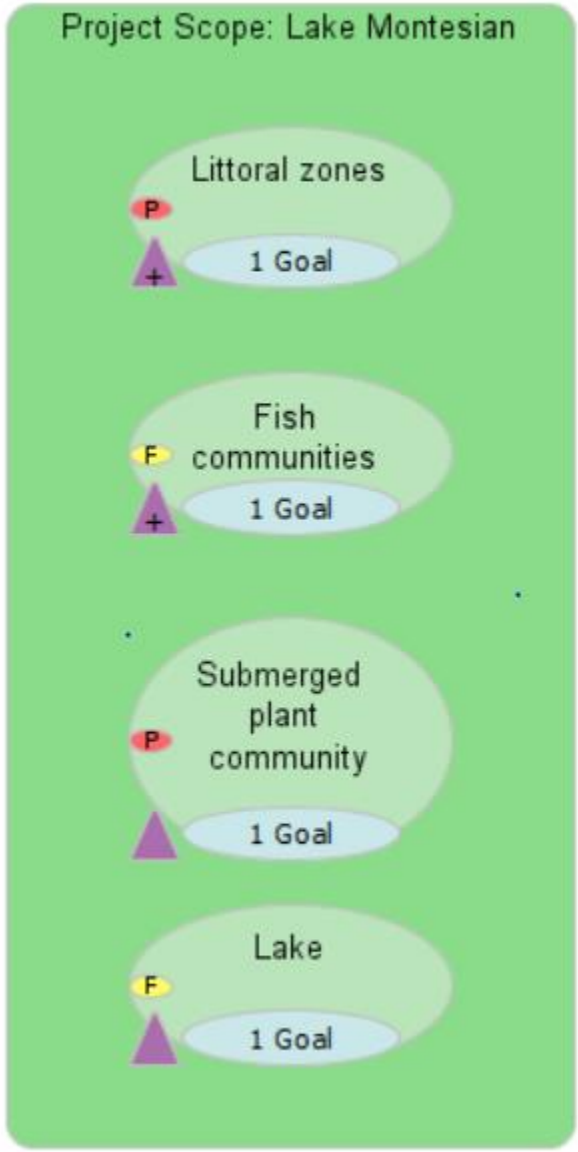


Figure 6. Project scope and biodiversity targets for Lake Montesian.

5. Viability Assessment

KEAs: Key Ecological Attributes. These are measurable features of the target areas.

Indicators: These are the ways of measuring our KEAs.

Rankings: Poor, Fair, Good, and Very Good. Rankings below Good often require significant intervention to maintain or improve.

5.1 Littoral Zones

The KEA our group identified for the target of littoral zones is native vegetation cover. One indicator for this would be the percentage of the cover that is native. Currently, we estimate the native vegetation coverage at less than 25 percent. This qualifies as a rating of *Poor*. We feel that 50 percent native vegetation is an achievable goal within the next 10 years, and this would constitute a ranking of *Fair.*

Another indicator for littoral zone native coverage is the overall area of unmaintained (not mown) vegetation. Currently there is less than 500 yards of unmaintained vegetation along the shore, which we ranked as *Poor*. Our goal for the lake is between 500 and 750 yards of vegetation. This would qualify as fair, while still allowing for fishing and other activities.

5.2 Fish Communities

The KEA identified for fish communities was species diversity. Our first indicator for the kea of species diversity is the number of species in the lake. Currently we believe there four species in the lake: Panfish, Largemouth Bass, Northern Pike, and an unidentified species of catfish. This qualifies as *Good*. We would like to maintain this number or even see it grow.

Another important indicator is the number of individuals of each species, or the population size. However, there is currently no data or good estimate on fish numbers within the lake.

5.3 Submerged Plant Communities

The KEA for submerged plant communities is native plant cover. This is best indicated as an objective observation on the percentage of native plant cover. Our rough guess is that it is currently less than 25 percent, which ranks as *Poor*. We feel that a goal of 25 to 50 percent native vegetation is reasonable, and this would qualify as fair.

5.4 Lake

Our KEA for the lake is water quality. One way that this is indicated is by milligrams per liter or Mg/L of dissolved oxygen. Currently dissolved oxygen levels measure at 4.2 Mg/L. This qualifies as *Fair*. A goal for a lake which would best support a healthy fish population would be between 6 and 10 Mg/L, and would qualify as good.

Another indicator is phosphorous levels in parts per million, or ppm. Water tests conducted by Kevin Komprood show 2018 phosphorous levels at 5 parts per million (Figure 3). This qualifies as a ranking of *Fair*. Our team would like to see this improve to 1-3 ppm by 2028.

Item	Viability Mode	Status	Future Status	Type	Poor	Fair	Good	Very Good	Source
Montesian Lakes Project (v0.80)		Fair	Good						
Biodiversity Target	Simple	Not	Not						
Fish communities. Fish communities	Key Attribute	Fair	Good						
Species Diversity		Fair	Good	Size					
Number of Species		Good	Good		<2	2-3	4-5	>5	Rough Guess
Population size		Poor	Good		1-9	10-19	20-29	>29	Rough Guess
Lake	Key Attribute	Fair	Good						
Water Quality		Fair	Good	Condition					
mg/L dissolved oxygen		Fair	Good		<2 mg/L	2.1-5.9 mg/L	6-10 mg/L	>10 mg/L	External
ppm phosphorous		Fair	Good		>10	10-3.1	3-1	<1	Expert
Littoral zones	Key Attribute	Poor	Fair						
Native Vegetation Cover		Poor	Fair	Condition					
Percent Native Vegetation		Poor	Fair		<25%	25-50%	51-75%	>75%	Expert
Vegetation Cover		Poor	Fair		<500 yards	500-749 yards	750-1000 yards	>1000 yards	Rough Guess
Submerged plant community	Key Attribute	Poor	Fair						
Native plant cover		Poor	Fair	Condition					
Percent native plant community		Poor	Fair		<25%	25-50%	51-75%	>75%	Expert

Figure 7. Viability assessment and KEA table in Miradi.

Sample Type	Collection date	Test	Results	LOD/LOQ
Lake	3/21/2018	BOD	<2	
Lake	3/21/2018	TSS	6	
Lake	3/21/2018	Dist Amm	0.06	0.04/0.14
Lake	3/21/2018	Phos	0.05	0.03/0.11
Lake	3/21/2018	Nitrates	0.86	
Well	3/21/2018	BOD	<2	
Well	3/21/2018	TSS	<2	
Well	3/21/2018	Dist Amm	0.07	0.04/0.14
Well	3/21/2018	Phos	0.05	0.04/0.11
Well	3/21/2018	Nitrates	0.55	

Figure 8: Water test results, gathered by public works director Kevin Komprood.

6. Threat Assessment

Threats \ Targets	Lake	Fish communities	Littoral zones	Submerged plant...	Summary Threat Rating
Greenhouse Gas Emissions	Very High	Very High	High	High	Very High
Nutrient loading	High	Medium			Medium
Overfishing		Low			Low
Introduction of invasive species		Medium		Very High	High
Mowing			Medium		Low
Summary Target Ratings:	High	High	Medium	High	Overall Project Rating: Very High

Figure 9. Direct threats and threat ratings to Lake Montesian biodiversity targets. Ratings are calculated on the basis of threat scope, severity, and irreversibility, and were determined based on literature review, expert opinion, and data gathered by our project partner and the Wisconsin Department of Natural Resources.

6.1 Threat Ranking

The purpose of this assessment is to apply a systematic methodology by which direct threats to our biodiversity targets are ranked and prioritized. In the conservation planning context, direct threats are defined as specifically human-driven actions that negatively impact aspects of the target ecosystem. Each threat is evaluated on the basis of 1) **scope,** or the proportion of the target expected to be affected by the threat within 10 years, 2) **severity,** or the level of damage to the target expected if current trends continue, and 3) **irreversibility,** or the degree to which target can be restored if threat removed. Each of these components are evaluated on a four-tier rating system of Low, Medium, High, and Very High (see Appendix X for definitions of each rating), and, taken together, they form the basis for the threat rating system by which the dangers to each of our biodiversity targets are ranked.

When it comes to assessing the climate change vulnerability of our targets, the additional factors of **exposure (**the degree to which the target will encounter the effects of rising greenhouse gas emissions), **sensitivity** (the degree to which the target's wellbeing will be compromised by the effects of climate change), and **adaptive capacity** (the target's resilience in the face of climate change-induced alterations to its environment) are taken into consideration.

Our project group encountered a fairly common obstacle in our process of threat evaluation: a lack of available data. The village of Monticello has not kept detailed records of the general state of Lake Montesian since the lake's creation half a century ago, and so the only external data we had to rely on in ranking threats to this unique ecosystem were records from the Department of Natural Resources, peer-reviewed studies, and the limited testing data that our partner in Monticello had obtained on our behalf. Therefore, our judgments are subject to change upon gathering new information.

Our first experience with the lake was an on-site visit. During our survey of the area, we noted invasive species mingling with natives, and a rigorous mowing regime that extended from the lawns of adjacent homeowners into the water where the abbreviated stems of native arrowhead (*Sagittaria latifolia*) rose a few centimeters above the water line. We also observed that the lake receives a significant amount of debris from a number of cast-iron pipes, including a large amount of gravel. Subsequent communications with Susan Graham, a senior water resources management specialist with the DNR, indicated that stormwater outflow was a significant source of nutrients to the lake, which would account for its generally eutrophic condition at the time of our visit. We also took a measurement of dissolved oxygen using borrowed equipment and found a generally hypoxic environment even within three feet of the water's surface. Being able to visit the site in person allowed us to gain a more concrete idea of its situation and our threat assessment would not be possible without it.

Another valuable source for our threat rankings were the communications with Susan Graham. At our request, she provided us with an email chain from spring and summer of 2017 between herself, her colleague Jeanne Scherer, and Mike Davis of the Monticello's Lions' Club, in which the three of them discussed the challenges facing the lake and potential solutions to address them. For a number of reasons that we will touch on later in this document, Mr. Davis's lake improvement initiative never came to fruition, but his input, and the input of the two specialists, proved vital to our conception of the greatest threats to Lake Montesian.

Our third source of information came from various studies published on relevant topics, as well as data gleaned from the official websites of the Wisconsin DNR and the United States Environmental Protection Agency. In assessing the potential impacts of our threats, we made use of a number of peer-reviewed articles on the subject of driftless region ecology, the impact of common invasive aquatic plants on lake health, and the ways that climate change is projected to augment already-existing environmental threats. None of these papers dealt with Lake Montesian specifically, but some principles did apply to our situation, and the evidence of past studies proved

essential to the creation of our final product.

We identified 5 total direct threats to Lake Montesian: a heavily managed mowing regime, the introduction of numerous invasive species, nutrient loading, overfishing, and the continuous and growing stress generated by climate change. The heavily managed mowing regime had a summary threat of *Low*. The introduction of invasive species had a summary threat rating of *High,* while nutrient loading had a summary threat rating of *Medium.* Overfishing, the threat with the least available information, had a tentative overall rating of *Low.* Greenhouse gas emissions, which are expected to impact the lake ecosystem in a variety of significant ways well after the stated project timeframe of 2018-2028, had a rating of *Very High*.

6.2 Threat Description

Greenhouse gas emissions. Greenhouse gas emissions have long been recognized by the scientific community as a threat to a wide array of human and natural systems. In its 2014 Synthesis Report Summary for Policymakers, the Intergovernmental Panel on Climate Change (IPCC) wrote that "each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850," adding that "it is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together (IPCC 2014)." Climate change has further been linked with a decrease in water quality and an increase in harmful algal blooms and water-borne illnesses, both of which flourish in warmer conditions (Shanley, 2017).

<u>Threat to the lake:</u>

For the open-water portion of Lake Montesian's ecosystem, climate change will act to augment existing stresses. Current climate change projections for southern Wisconsin indicate that flood risk will increase over the course of the next century (Schuster et. al., 2012). Studies of total annual precipitation indicate that the frequency of intense rainfall events have increased significantly over the past century (Groisman et. al., 2004; Kunkel et. al., 1999; Karl and Knight, 1998). If this trend holds true over the next fifty years, Lake Montesian will receive more stormwater inputs at a higher volume and frequency than at any point in its history, and its status as a relatively small, shallow lake means that it is inherently vulnerable to eutrophication. Increased stormwater inputs will expose an already sensitive ecosystem to further nutrient loading. In this scenario, as in so many others, climate change acts as a magnification of existing issues at the site.

Taking these facts into account, the threat rating for climate change is *High* for scope and severity, and *Very High* in terms of irreversibility, as it is estimated that, even if we stopped emitting greenhouse gases tomorrow, it could take millennia for the global climate to return to normal (Archer, 2009). The overall threat rating to this biodiversity target is therefore *Very High*.

<u>Threat to fish communities:</u>

The effects of climate change on fish communities at the lake are somewhat less well understood. A 2015 study of northern pike (*Esox lucius*), largemouth bass (*Micropterus salmoides*), and bluegill (*Lepomis macrochirus)* populations in a shallow lake in the Nebraska sandhill region under predicted 2040 and 2060 temperatures suggests that increased temperatures will coincide with increased predation of bluegill by pike and bass, which, in turn could result in extra pressure on bluegill populations (Breeggemann et al., 2015). Although the Nebraska sandhill region is further south than Green County, it provides a potential model for fish community dynamics in shallow lakes as the climate warms. While largemouth bass are projected to benefit from warmer surface water temperatures over the coming century, there are also indications that exposure to elevated levels of carbon dioxide induces a stress response in the fish that heightens their sensitivity to low-oxygen conditions and increase their mortality rates (Hasler et al., 2016; O'Connor et al., 2010; Kates et al., 2012).

All of these projected climate-related consequences have the potential to reduce the fitness of Montesian's community and its long-term viability as a population. The scope and severity ratings for this target are *High*, and the irreversibility here is *Very High*. The overall rating, then, is also *Very High*.

Threat to the littoral zone:

Climate change is projected to increase the range of many invasive species in the littoral zone, both as a result of the warmer temperatures allowing for an expansion of species that were previously limited by cold winters and to the fact that many invasive species are capable of thriving under a wider range of environmental conditions than natives (Hellman et. al., 2008)**.** The irreversibility of climate change is a central reason that it poses such a threat, and that threat is only expected to increase over the next fifty years. However, with the implementation of careful management and monitoring practices, it is possible to maintain a healthy littoral plant community even in the face of altered temperature and precipitation regimes (Harris et al., 2010; Borre et al., 2016). Thus, while the scope of the threat to this target is *High* and its irreversibility is *Very High*, we judged its severity to be *Medium*, giving it a summary threat rating of High.

Threat to submerged plant communities:

Like the plants of the littoral zone, Montesian's submerged plant communities are expected to be exposed to a number of new stresses over the course of the next fifty years. As noted above, climate change is expected to widen the ranges of many aquatic pests, including many of concern to water management specialists in Wisconsin. Hellman et. al. note that many invasive species have strong potential to thrive under an altered climatic regime. For example, hydrilla *(Hydrilla verticillata)* and water hyacinth *(Eicchornia crassipes*) have recently become the subject of concern for natural resource managers in the American northeast due to the rising temperatures potentially allowing them to overwinter and thus increase their survival rate (Hellman. et. al., 2008). Furthermore, climate change is expected to result in a greater frequency of severe precipitation events in Wisconsin over the course of the next century (Groisman et. al., 2004; Kunkel et. al., 1999; Karl and Knight, 1998) and this, in the absence of adequate riparian buffer zones, can cause nutrient loading that further encourages the establishment of invasive plants.

Our ratings for this target were the same as for the littoral zone community, with the caveat that we have less data on Montesian's submerged plants and thus cannot make a calculation of threat magnitude with full confidence at this time. The summary rating of *High* reflects the wide scope of climate change and its essential irreversibility, while also taking into account the fact that conservation best management practices can mitigate the effects of invasive plant expansion and increased runoff.

Nutrient loading. Nutrient loading is a major issue at Lake Montesian, which directly receives stormwater outflow from the adjacent village with each storm (Jeanne Scherer, personal communication, April 2017). Stormwater runoff from paved urban areas is linked to excessive phosphorus and nitrogen inputs into nearby bodies of water (US Environmental Protection Agency, 1972; Carpenter et al., 1998; Schindler, 2006).

<u>Threat to the lake:</u>

The impacts of this phenomenon on the lake are varied and almost uniformly negative – manifesting as toxic algal blooms that sicken children and pets, oxygen depletion that kills fish, and unsightly, bad-smelling water that deters recreation (Carpenter et al., 1998). The lake was visibly overgrown with algae at the time of our site visit, and our perception of a eutrophic lake were borne out by the low amount of dissolved oxygen we found in our measurements and the information we were given by both our project partner and Susan Graham at the DNR. The threat of nutrient loading we rated as *High*, with a scope and severity of *High* and an irreversibility rating of *Medium*.

<u>Threat to fish communities:</u>

We tentatively rated nutrient loading as *Medium* in its overall threat to fish in the lake. Nutrient loading of lakes can cause harmful algal blooms that deplete oxygen levels and clog the gills of fish (Selbig, 2016), and the fact that Montesian was in a eutrophic state at the time of our site visit suggests that it fish populations may be affected. However, although its scope is *High*, we have no hard evidence of how it is affecting the fish, and removal of excessive nutrients has the potential to be accomplished within a human lifetime, giving both severity and irreversibility ratings of *Medium*. Further research will need to be conducted at Lake Montesian to further refine the accuracy of this rating.

Introduction of invasive species. Invasive species are defined by the Wisconsin Department of Natural Resources as non-native plants and animals that "aggressively invade and dominate natural areas and water bodies." These organisms are not subject to the same checks and balances as native species, and therefore, they tend to overwhelm natural systems and alter them in unwanted ways (Wisconsin Department of Natural Resources). Lake Montesian is home to a number of invasive plants, all of which have documented negative impacts on the health of the ecosystems where they become established.

Threat to fish communities:

Invasive species crowd out natives that provide valuable habitat and spawning areas for fish, and the known invasive aquatics at the site, Purple loosestrife (*Lythrum salicaria*) and Curly-leaf pondweed (*Potamogeton crispus),* have well-documented and deleterious effects on the health of native fish communities. Purple loosestrife rapidly degrades habitat essential to fish spawning, and curly-leaf pondweed forms dense mats on the surface of the water that subsequently decompose, depleting oxygen levels in the water and causing fish kills (Minnesota Sea Grant)**.**

The scope of this threat to the fish community was *Medium*, as we saw very few invasive plants in the course of our site visit, but the severity and irreversibility of this threat we rated as *High*, because the numerous negative impacts of invasive plants on native fish communities and the documented difficulties removing them once they have become established at a site (Minnesota Sea Grant; Wisconsin Sea Grant). The overall rating for this threat-target combination was therefore *Medium*.

Threat to submerged plant communities:

There are already a number of invasive species present in the submerged plant community at the lake, including curly-leaf pondweed and Eurasian watermilfoil (*Myriophyllum spicatum*). Susan Graham conducted a standard rake pull of the lake in 2011 and estimated that, of the submerged vegetation in the lake, 90% was Eurasian watermilfoil and 10% native coontail (Personal communication with Susan Graham, March 8, 2017)**.** Eurasian watermilfoil has the capacity to grow rapidly and outcompete native vegetation, which means that the threat it poses to the lake's submerged plant communities is significant (Minnesota Aquatic Invasive Species Research Center; Michigan Sea Grant). Curly-leaf pondweed significantly compromises the integrity of the ecosystems where it establishes itself, and its dense, matted growth is suspected of shading out native plants, in addition to providing inadequate shelter for native animals (Minnesota Department of Natural Resources; Minnesota Sea Grant).

The scope of this threat received a rating of *Very High*, as at the last estimation, up to 90% of Lake Montesian's submerged vegetation was composed of Eurasian watermilfoil. The severity of the threat, given the potential for serious degradation of this ecosystem, was also *Very High*. We judged irreversibility to be *High*, because, while the Department of Natural Resources has a number of established invasive plant removal techniques, even they admit that these techniques are not always effective in the face of a flourishing invasive plant infestation (Minnesota Department of Natural Resources;

Wisconsin Department of Natural Resources). The overall threat rating for this target is *Very High*.

Overfishing. Overfishing is a threat that bears further investigation. The general lack of data on the number of fish in the lake makes any estimation of population impossible without using equipment and techniques beyond our current ability to acquire. However, the posting of size limits for fish suggests that numbers may be a problem that the village is seeking to address. Due to our current lack of data, we made conservative estimates of the scope, severity, and irreversibility of this threat – *Medium, Medium*, and *Low*, respectively, with a summary threat rating that was likewise Low.

Mowing. Mowing is exactly what it sounds like – an intensive vegetation management regime on the shores of Lake Montesian that has resulted in a riparian buffer consisting of close-cropped native and invasive littoral zone species.

The heavy management of the lake banks is fortunately easy to reverse–changing the mowing regime from approximately 85% of the lakeshore to 25-30% alone would be enough for the riparian buffer to reassert itself. However, its consequences are severe for the native plant communities, preventing them from reaching their full potential–and performing any of the ecosystem services associated with riparian buffers–during the growing season (Iowa State Extension and Outreach, 2002).

The scope of the threat was rated as *Very High* and the severity was *High*, seeing as all but a fraction of the riparian buffer has been eliminated and this has fairly detrimental effects on the littoral zone and its native plant communities. However, because the buffer can be regenerated by simply reducing the area of the shoreline that is mowed, the irreversibility of this threat was rated as being *Low*, and the target-threat summary rating was *Medium*.

6.3 Threat Summary by Target

Lake. Current and projected threats of greatest concern to the integrity of the communities that depend on the water column of the lake are 1) nutrient loading and 2) climate change. Climate projections for southern Wisconsin suggest that we will be seeing more frequent and intense rainfall events (Groisman et. al., 2004; Kunkel et. al., 1999; Karl and Knight, 1998).. This, and the corresponding increase in flooding (Schuster et al., 2012), increase the amount of nutrient-loaded stormwater that discharges into the lake, raising the level of phosphorus in its waters, decreasing dissolved oxygen, and causing unwanted algal blooms that threaten the integrity of the entire ecosystem (Carpenter et al., 1998; Selbig, 2016). Our overall threat rating to this biodiversity target was *High*.

Fish communities. No data exists on the current number of fish in Lake Montesian. The DNR website states that there are three species in the lake: common panfish, largemouth bass, and northern pike (Wisconsin DNR)**.** However, during our onsite visit we also saw a catfish, and nobody we spoke to could tell us the exact number or nature of the species in the lake as of 2018. Therefore, our assessment of the threats to the fish community is necessarily a tentative and preliminary estimate based on available knowledge. As a result of our lack of data on this aspect of the Montesian ecosystem, we listed a number of potential threats: 1) climate change, 2) nutrient loading, 3) overfishing, and 4) the introduction of invasive species. Our overall threat rating to this target was *High* due to the considerations listed below.

Climate change is a given; rising air and water temperatures, as well as the potential increase in nutrient loading due to more intense precipitation events, are all potential stresses for fish species adapted to a different climatic paradigm. Nutrient loading, as we noted above, creates eutrophic, low-oxygen conditions that are documented as being detrimental to freshwater fish communities. Overfishing we had less data on, but there was some indication that fish populations had been reduced by unsustainable fishing practices, including a sign posted on one dock specifying bag limits. The introduction of invasive plants degrades habitat vital to the life cycles of many native fish, including areas they require for successful spawning (Minnesota Sea Grant)**.** The overall threat rating for this target was *High*.

Littoral zones. We identified two threats to the littoral zone of the lake: 1) climate change, and 2) mowing. Climate change expands the range of potential invasive species, which outcompete native vegetation in the littoral zone (Hellman. et. al., 2008). Mowing, in turn, disrupts the growth of native and invasive vegetation alike, reducing its overall cover on the shoreline. The overall threat rating to this biodiversity target was *Medium.*

Submerged plant communities. We identified two threats to the submerged plant communities: 1) climate change, and 2) the introduction of invasive species. As with the littoral zone, warmer temperatures are expected to increase the range of many submergent invasive species (Hellman. et. al., 2008), many of which are difficult to eradicate once established. The second threat, then, is magnified by the first, as invasive species such as Eurasian watermilfoil have already gained a significant foothold at Lake Montesian. The overall threat rating to this biodiversity target was *High.*

7. Situation Analysis

7.1 Diagram

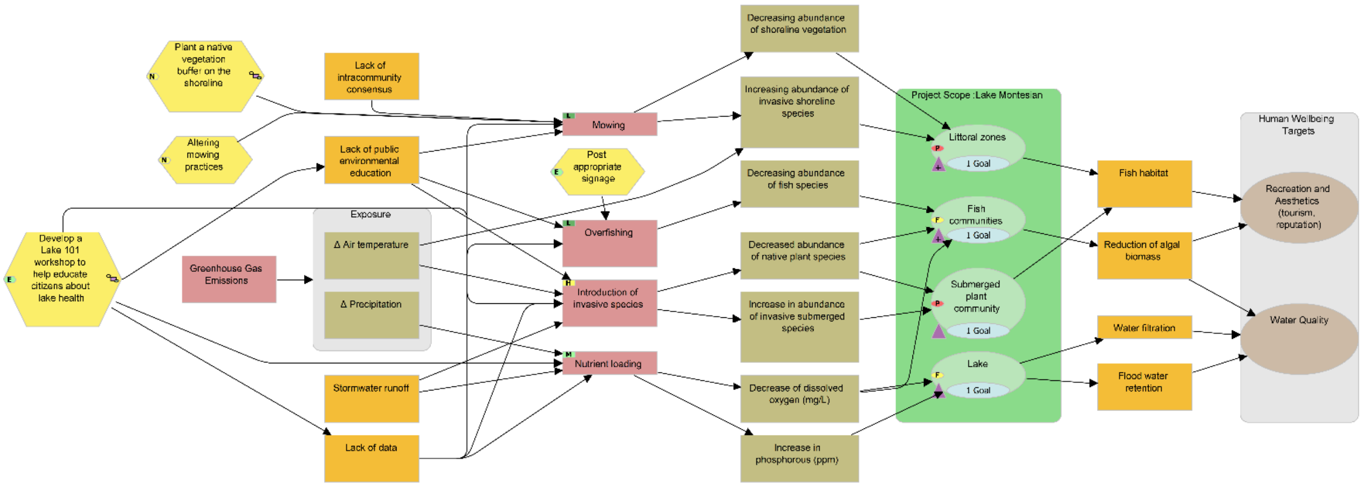


Figure 10. Lake Montesian conceptual model. Key: strategies (yellow), indirect threats and ecosystem services (orange), direct threats (pink), stresses (brown boxes), biodiversity targets (green), human wellbeing targets (brown ovals).

7.2. Narrative

Lake Montesian is the heart of the Monticello community, and so perhaps it is unsurprising that the threats it faces are intimately connected to the social and environmental context in which it was created. The vegetation regime, the overfishing, the introduction of invasive species, and the nutrient loading can all be tied back to human decisions made in good faith that, for one reason or another, had unintended consequences.

A major indirect threat that we identified in our meetings was a general lack of intracommunity consensus. A number of people we spoke to alluded to internal disagreements that stymied lake improvement projects, usually because the parties involved had different views of what Montesian should become. Everyone in Monticello cares deeply about the lake, which is the site of weddings, firework displays, and long afternoons of fishing. However, it appears that there is no commonly agreed-upon vision for the lake and its surrounding greenspace. Thus, attempts to change anything about the nature of Montesian itself have been met with resistance that our project partner Kevin Komprood has had to contend with in the past.

This resistance may be due in part to a lack of knowledge about the potential benefits of conservation techniques. The native plant buffer, our DNR contacts noted, is a very easy and attractive solution to excess nutrient inputs. In April 2017, Susan Graham replied to Mike Davis's inquiry on such an initiative, pointing out that, "you and I would see healthy habitat for things like honey bees, natural goose deterrent, and butterflies, but others may see ‘messy’ weeds, tick habitat, and places for mosquitoes to hide” (Personal communication with Susan Graham, April 14, 2017). The potential problem of overfishing can also be tied back to a simple lack of knowledge about how many fish can be sustainably taken from the lake. A potential solution to both these issues and the lack of community consensus may be simply to get everyone on the same page. Native vegetation is aesthetically appealing and environmentally friendly, and it would attract charismatic and typically Midwestern species such as Monarch butterflies and bumblebees that would enhance Montesian’s image as a family-friendly place for events and recreation.

Our team identified stormwater runoff as a major driver of the nutrient loading and subsequent introduction of invasive species. The lack of buffer or mitigating structure between the runoff–which often contains nitrogen and phosphorus pollutants from fertilizers, pet and yard waste–and the lake itself is a key reason for Montesian’s currently eutrophic, oxygen-starved state. This, too, ties into the need for broader public awareness of the threats associated with pumping stormwater directly into the lake.

Another serious problem is the lack of data, which impedes any and all attempts at improvement. When we were formulating our threat ratings, we were frequently forced to seek information from outside sources, taken from lakes not our own. While this is a valid and common strategy for conservation practitioners to engage in, it nevertheless left us feeling rather troubled by the lack of available information on Montesian itself. Each site is unique, and Montesian, being an artificial lake, is perhaps more unique than most. Without data on the site, it is difficult to determine which threats present the most danger to the lake, which in turn contributes to a lack of consensus at the community level. The implementation of a structured and thorough citizen science program for the lake would not only be a potential avenue for youth education and a way for Monticello’s citizens to get closer to the lake–it would also allow them to more effectively protect it from potential threats.

The most long-term and irreversible threat to Lake Montesian is climate change. The increase in precipitation and warming average air temperatures contribute to greater frequency of intense flooding events and to the expansion of harmful invasive species into ranges that they were hitherto excluded from. Unfortunately, there is very little that Monticello can do to reverse this trend. However, they can strengthen the adaptive capacity of Montesian’s natural systems by enacting the aforementioned changes and continuing to learn about the best practices for protecting their lake.

Our human wellbeing targets also have the potential to be strongly impacted by the threats listed above. Lake Montesian is more than just a body of water–it is the cultural heart of Monticello. Each threat to our biodiversity targets is, by extension, a threat to the enjoyment that Monticello’s citizens derive from its presence in their town. Recreation, tourism, and water quality are all at risk if the current state of affairs continues, as eutrophic, invasive-choked waters are generally unattractive to sports fishers and casual tourists alike.

This analysis may, at first glance, seem rather grim. After all, community disagreements, eutrophication, invasive species, and climate change are all serious threats to lake health the world over and will continue to be so well into the future. However, Monticello has the advantage of caring deeply about its lake, and with caring comes initiative. We have no doubt that many of Montesian's problems have solutions that the Village can come together to implement.

8. Action Plan

8.1. Conservation Goals (4).

When setting goals for biodiversity targets there are certain criteria that you must be sure your goals meet for them to be achievable. A good goal typically has five main criteria that must be met for it to be viable: (FOS, 2014)

1. **Linked to targets:** Directly associated with one or more of the conservation targets
2. **Impact oriented:** Represents the desired future status of the conservation target over the long-term
3. **Measurable:** Definable in relation to some standard scale (numbers, percentage, fractions)
4. **Time limited:** Achievable within a specific period of time, generally 10 or more years
5. **Specific:** Clearly defined so that all people involved in the project have the same understanding of what the goal means

Keeping the criteria in mind, we created goals that we believe meet all those expectations. Our goals specify the desired state of our conservation targets over the next ten years. We've considered the current status of a target as well as the future, desired status that could realistically be achieved in the next ten years. With hard work and dedication to the plan, we believe that all the goals could be achieved.

Goal 1 - Littoral Zone: Increase the percent of native vegetation along the shoreline to 50% by 2028.

Goal 2 - Fish Communities: By 2028, there will be ≥5 fish species that are reproductively mature so to sustain a viable population.

Goal 3 - Submergent Plant Community: There will be 25-50% increase in native plant cover in the lake by 2028.

Goal 4 - Water Column: Reduce phosphorous levels to 1-3 ppm by 2028. Increase dissolved oxygen levels to 6-10 mg/L by 2028.

These goals were created understanding the situation of Lake Montesian and what we believed to be the main concerns for the lake, communicated to us by Kevin. During our conversations, it was clear that water quality and reducing the amount of algae in the lake was one of the main issues. All of the goals we constructed either directly or indirectly help improve the water quality of Lake Montesian. Creating realistic goals are necessary for a conservation plan to be feasible.

8.2 Threat Reduction Objectives

Our action plan provides the framework for achieving our vision for Lake Montesian. It integrates all the information gathered and formulates specific goals, objectives, strategies, and monitoring actions needed to assess the conservation progress. The plan was developed by our project team evaluating the direct threats that have the most potential to cause harm to Lake Montesian.

Our action plan includes:

- Strategies: a group of actions with a common focus that work together to reduce threats, capitalize on opportunities, and/or restore natural systems
- Objectives: formal statements that detail a desired outcome of a project, such as reducing a critical threat.
- Activities: a specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives
- Goals: Formal statements detailing a desired impact of a project such as the desired future status of a conservation target(s).

Using this framework, our team was able to come up with four different strategies which would help us reach the goals for the biodiversity targets. We added the strategies into our action plan and will explain them more thoroughly in the following sections.

Our action plan includes four strategies:

1. Develop a ‘Lake 101’ workshop to help educate citizens about lake health
2. Plant native vegetation buffer on shoreline
3. Alter mowing practices
4. Post appropriate signage on fish bag limits

These strategies were developed by the project team. We identified what we considered to be the most pressing direct threats to the biodiversity targets of Lake Montesian and developed strategies to help each of mitigate them. Each of the strategies have activities and related objectives that will help work towards achieving the biodiversity goals. Each strategy has four threat reduction objectives that are listed with their corresponding strategies below.

Strategy 1: Develop a Lake 101 workshop

- Objective 01. A 50% increase in native vegetation cover by 2028.
- Objective 02. A 50% decrease in invasive vegetation cover on the shoreline by 2028.
- Objective 03. Phosphorus levels are within 1-3 ppm by 2028.
- Objective 04. Dissolved oxygen levels have increased to 6-10 mg/L by 2028. related to the direct threat of the decrease in nutrient loading.

The first threat reduction objective is related to the direct threat of mowing. This objective aims to improve the quality of biodiversity targets: fish community and the littoral zone. Objective two is related to the direct threat of control of invasive species. This objective aims to improve the quality of biodiversity targets: fish community, and the submerged plant community. Objective three is related to the direct threat of the decrease in nutrient loading. This objective aims to improve the quality of biodiversity targets: fish communities, the lake, and the submerged plant community. Objective four is related to the direct threat of the decrease in nutrient loading. This objective aims to improve the quality of biodiversity targets: fish communities, the lake, and the submerged plant community.

Strategy 2: Plant a native vegetation buffer on the shoreline

- Objective 01. A 50% increase is unmown shoreline vegetation cover from 2018 levels by 2028.
- Objective 02. A 50% decrease in area regularly mowed within 25 feet of the shoreline by 2028.

- Objective 03. A 50% reduction in shoreline erosion rates from 2018 baseline levels by 2028.
- Objective 04. By 2028, there will be a 50% increase in native vegetation from 2018 baseline levels.

All four threat reduction objectives are related to the direct threat of mowing. These objectives aim to improve the lake the and littoral zones.

8.3. Management Strategies to Achieve Goals and Threat Reduction Objectives

8.3.1. Strategy Summary

Once we identified our goals, we next brainstormed possible strategies for meeting these goals. According to the Open Standards, a strategy is "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" (conservationmeasures.org.) Based on our selected goals for our four biodiversity targets, we determined four strategies: develop a lake workshop, plant a native vegetation buffer, alter mowing practices, and post appropriate signage. We rated the potential impact and feasibility of our strategies as low, medium, high, or very high. Miradi then used these two ratings to calculate the potential overall effectiveness of each strategy. Miradi defines very high potential impact as being "very likely to meaningfully contribute to one or more project goals and/or objectives and can be implemented at scale with only implementation monitoring." Miradi defines a very high feasibility as being "ethically, technically, and financially feasible." See appendix B for information on all the definitions of Miradi strategy ratings. The table below lists our four strategies and their potential impact, feasibility, and summary ratings.

Strategy	Potential Impact	Feasibility	Summary Rating
Lake 101 Workshop	High	Very High	Effective
Signage	High	Very High	Effective
Altered Mowing Practices	Very High	Medium	More Information Needed
Native Buffer	Very High	Medium	More Information Needed

Figure 11: A table of strategies, potential impacts, feasibilities, and summary ratings.

8.3.2. Strategies and Intermediate Objectives

8.3.2.1. Strategy 1: Lake 101 Workshop

8.3.2.1.1. Description of Strategy

The first strategy which our team chose to focus on is the development of a "Lake 101" workshop. These courses are led by a Wisconsin DNR employee at no cost to the community. Their purpose is to educate local citizens about the lake ecosystem and its maintenance. Educating the citizens of Monticello about lake health would have impacts in every target our team defined.

8.3.2.1.2. Biodiversity targets

These targets were the littoral zones, fish communities, the submerged plant community, and the lake itself (i.e. water and pollution).

8.3.2.1.3. Direct threats

The lake 101 workshop strategy will also affect all of the direct threats for these targets. These threats are mowing, overfishing, nutrient loading, and the introduction of invasive species.

8.3.2.1.4. Results chain for Lake 101 Workshop

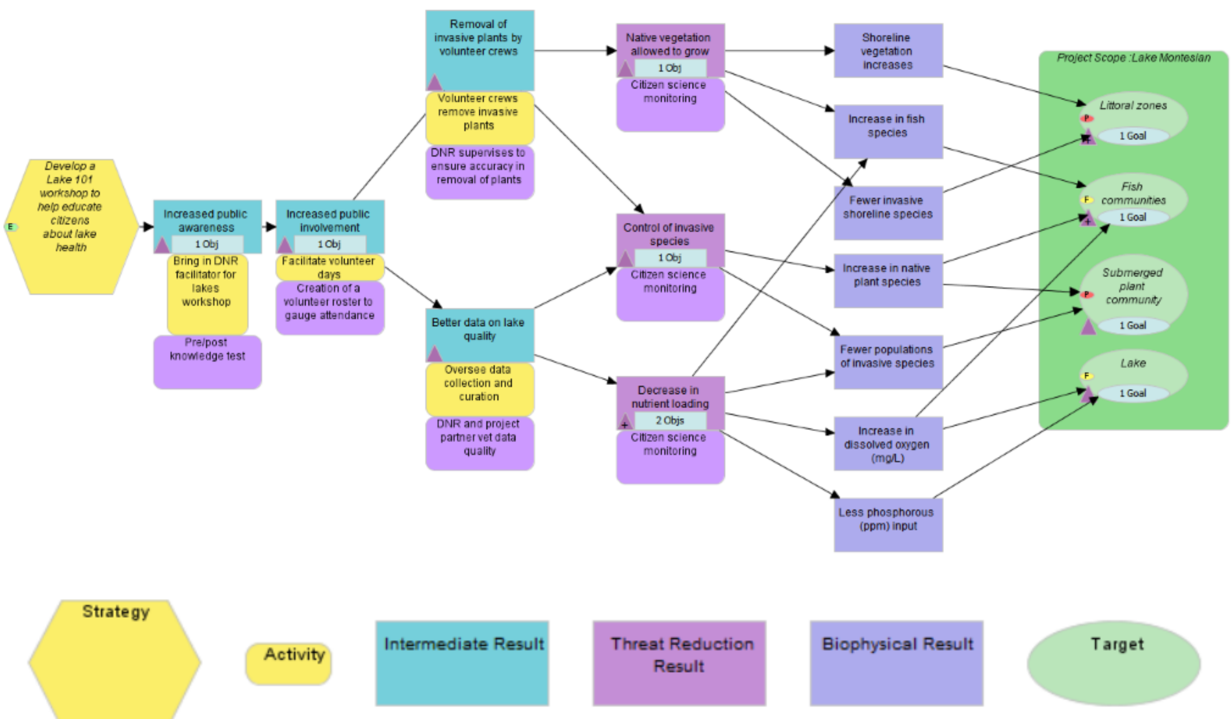


Figure 12. Results chain for the Lake 101 workshop strategy.

8.3.2.1.5. Theory of Change

Our team believes that if we developed a Lake 101 workshop with a DNR facilitator, then there will be increased public awareness of issues affecting the lake. If there is increased awareness, there will be increased public involvement. If there is increased public involvement and our team facilitates work days, then the public will work to remove invasive plants, and to collect data on lake quality. If invasive plants are removed, then more natives will prosper, and invasives will be better controlled. If better data is gathered, then choices can be better made about methods to decrease nutrient loading.

If native vegetation is allowed to grow, then there will be an increase in shoreline vegetation cover, fewer invasives along the shoreline, and an increase in fish due to more habitat. If there is an increase in shoreline vegetation cover as well as fewer invasives, the littoral zone will benefit. If fish increase, then the fish community will benefit.

If invasives are better controlled, then there will be an increase in the number of submerged native species as well as fewer invasives. If natives increase and invasives decrease, there will be benefits to fish and submerged plant communities.

If there is a decrease in nutrient loading, there will be the potential for an increase in fish species, fewer invasive submerged plants, an increase in dissolved oxygen in the water, and a decrease of phosphorous. As stated earlier, if fish species increase it will benefit fish communities. If there are fewer submerged invasives, the submerged plant community will benefit. If there is an increase in dissolved oxygen, then fish communities as well as the lake water will benefit. Finally, if there is less phosphorous in the water, lake quality will improve.

8.3.2.1.6. Intermediate Objectives

The intermediate objectives for this strategy are an increase in shoreline vegetation, fish species, native plant species, and dissolved oxygen in the water; as well as a decrease in invasive shoreline plants, invasive submerged plants, and dissolved phosphorous.

8.3.2.1.7. Activities

Activities for this strategy will be bringing in a DNR facilitator to run the workshop, facilitating volunteer days with workshop gradates, the removal of invasive plants, and the collection and curation of data about the lake.

8.3.2.2. Strategy 2: Native Vegetation Buffer

8.3.2.2.1. Description of Strategy

The second strategy we intend to focus on is the planting of a 25-foot wide native vegetation buffer along the shoreline. This is something that has been discussed with relation to Lake Montesian before, and it has the potential to have a highly positive impact on both the state of the littoral zone and the lake. As we discussed in our Threat Assessment (Section 6), riparian buffers are essential to good water quality. Plantings of native flowers and grasses on the shoreline would be effective filters for goose- and yard-related runoff, a potential protection against further erosion of the shoreline, and provide an aesthetically appealing backdrop for the area's frequent social events. After discussing it with our project partner, we concluded that Applied Ecological Services, which operates out of Brodhead, Wisconsin, and has worked with Monticello before, would be the best choice to carry out the native plantings for the village.

8.3.2.2.2. Biodiversity targets

The two biodiversity targets impacted by this strategy are the littoral zone and the lake itself.

8.3.2.2.3. Direct threats

The direct threats that the strategy will address are mowing and nutrient loading.

8.3.2.2.4. Results chain for native vegetation planting

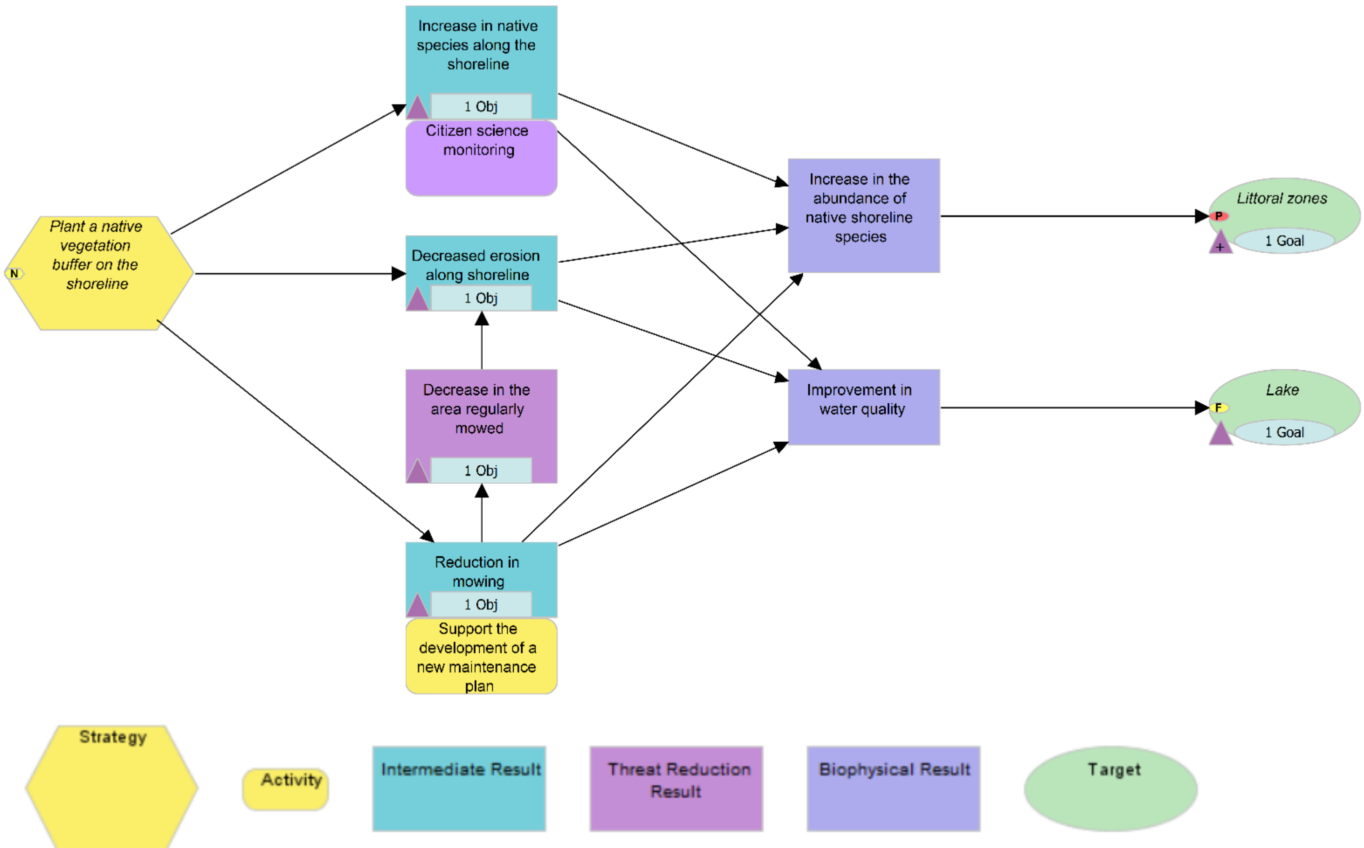


Figure 13. Results chain for the native riparian buffer strategy.

8.3.2.2.5. Theory of Change

This strategy relies on a number of assumptions, and will therefore be subject to adjustment as we learn more about conditions at the lake. Based on the data that we currently have, we believe that planting native vegetation at the south end of the lake will provide a riparian buffer against runoff and sedimentation, discourage geese from settling on the banks, and, by reducing mowing, prevent further erosion of the shoreline.

If we plant the native vegetation buffer, that will cut down on the area of the lakeshore that is regularly mowed, which was one of the direct threats to that biodiversity target. The deep roots typical of native littoral zone vegetation will hold soil more effectively than turf grass, which will decrease overall erosion along the shoreline, and lead to an improvement in water quality, as the water will no longer be receiving regular inputs of nutrient-loaded soil. This, in turn, will positively impact dissolved oxygen and phosphorus levels in the lake.

8.3.2.2.6. Intermediate objectives and indicators

Intermediate Results	Objectives	Indicators
Reduction in mowing	A 50% increase in unmown shoreline vegetation cover from 2018 levels by 2028	% increase in unmown shoreline cover
Decrease in area regularly mowed	A 50% decrease in area regularly mowed within 25 feet of the shoreline by 2028	% decrease in area regularly mowed
Decreased erosion along shoreline	A 50% reduction in shoreline erosion rates from 2018 baseline levels by 2028	% decrease in erosion rate
Increase in native species along shoreline	By 2028, there will be a 50% increase in native vegetation from 2018 baseline levels	% increase in native shoreline species

Figure 14: A table of the plan's intermediate goals, objectives, and indicators.

In selecting our intermediate objectives and their indicators, our team decided to express them in terms of percentages, as we do not yet have access to long-term data on conditions at Lake Montesian. It is possible that, in future versions of this conservation plan, the objectives and indicators will change as Kevin and his team acquire more information on the state of the lake.

8.3.2.2.7. Activities and monitoring actions

Activities and Monitoring Actions	Details
Support the development of a new maintenance plan	Kevin and his team will develop a new lakeshore maintenance plan, using the recommendations for mowing and native plantings that he developed with us.
Citizen science monitoring	Citizen scientists trained by the Lake 101 course will conduct surveys five times a year between April and September of the shoreline to determine % cover of native vegetation

Figure 15: A table with the details about the activities and monitoring actions.

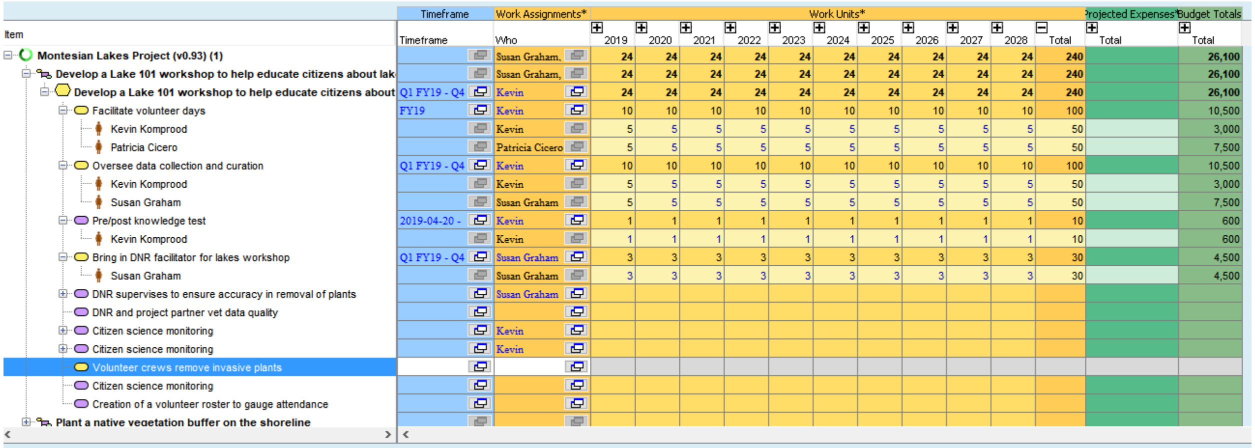
8.3.3. Strategy Timeline and Budget

Strategy 1 - Lake 101 Workshop: The total budget for the plan is $26,100. $25,500 of the budget is going towards the monitoring activities required for implementing our first strategy. That is 97.7% of our total budget.

The team members of the Lake Monteisan project worked together to determine which strategies were feasible given our financial and technical resources. Our team estimated staff requirements, staff salary costs, and other costs associated with the implementation of our Lake 101 Workshop strategy. We estimated cost in terms of days and divided them up by our implementation and monitoring activities. Kevin's team will oversee the execution of the plan over the next ten years in partnership with the DNR. The hours on our work plan represent the amount of time in days spent on each activity by each member of the team and volunteers. Our DNR partners, Susan Graham and Patricia Cicero, will be paid by the DNR and are not an official part of our budget. However, we included their salaries on our work plan in recognition of the time they are spending on this project.

The DNR workshop will be on three consecutive weekends in March. Kevin and a representative from the DNR will facilitate these meetings and ensure they run smoothly. Since the DNR representative is going to be paid by the DNR, a significant portion of the budget presented here is for hand-outs, refreshments, and publicity required to bring residents to the workshop. This workshop will be held annually for the duration of the plan.

The pre/post test will be administered by Kevin. We expect it to take a total of one hour per year for him to prepare and grade in order to gage the efficacy of the Lake 101 Workshop and teaching the citizens about lake health and monitoring. Facilitating volunteer days will take happen between April and September of every day, averaging one day a month. This activity will be overseen by our team manager Kevin and a DNR official. Data collection and curation will generally happen the following day after a volunteer day has been concluded. Kevin and a DNR official will ensure the data is of good quality and can be used by the Lake Montesian management team.



Item	Timeframe	Who	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	Work Units* Total	Projected Expenses* Total	Budget Totals Total
Montesian Lakes Project (v0.93) (1)		Susan Graham,	24	24	24	24	24	24	24	24	24	24	240		26,100
Develop a Lake 101 workshop to help educate citizens about lak		Susan Graham,	24	24	24	24	24	24	24	24	24	24	240		26,100
Develop a Lake 101 workshop to help educate citizens about	Q1 FY19 - Q4	Kevin	24	24	24	24	24	24	24	24	24	24	240		26,100
Facilitate volunteer days	FY19	Kevin	10	10	10	10	10	10	10	10	10	10	100		10,500
Kevin Komprood		Kevin	5	5	5	5	5	5	5	5	5	5	50		3,000
Patricia Cicero		Patricia Cicero	5	5	5	5	5	5	5	5	5	5	50		7,500
Oversee data collection and curation	Q1 FY19 - Q4	Kevin	10	10	10	10	10	10	10	10	10	10	100		10,500
Kevin Komprood		Kevin	5	5	5	5	5	5	5	5	5	5	50		3,000
Susan Graham		Susan Graham	5	5	5	5	5	5	5	5	5	5	50		7,500
Pre/post knowledge test	2019-04-20 -	Kevin	1	1	1	1	1	1	1	1	1	1	10		600
Kevin Komprood		Kevin	1	1	1	1	1	1	1	1	1	1	10		600
Bring in DNR facilitator for lakes workshop	Q1 FY19 - Q4	Susan Graham	3	3	3	3	3	3	3	3	3	3	30		4,500
Susan Graham		Susan Graham	3	3	3	3	3	3	3	3	3	3	30		4,500
DNR supervises to ensure accuracy in removal of plants		Susan Graham													
DNR and project partner vet data quality															
Citizen science monitoring		Kevin													
Citizen science monitoring		Kevin													
Volunteer crews remove invasive plants															
Citizen science monitoring															
Creation of a volunteer roster to gauge attendance															
Plant a native veaetation buffer on the shoreline															

Figure 16: The work plan developed for Lake Montesian.

9. Monitoring Plan

We have created a monitoring plan in order to "evaluate the assumptions in [our] results chains and to track progress in achieving stated goals and objectives" (conservationmeasures.org.) The plan will allow us to make sure the project is progressing effectively by identifying measurable indicators. In this paper we have provided the three following tables to illustrate how the Lake 101 Workshop strategy can be monitored.

9.1. Goals

What: Existence of Lake 101 workshop	How:	When:	Who:	Where:	Comments
Goal: By 2028, 10% of the population in Monticello will have taken a lake workshop and the citizens will have a score of 50% or better on the post test					
Monitoring Approach: time series					
% of citizens who attended the workshop and have attained a score of 50% or better on the post test	Pre/post knowledge test	One week after having taken the Lake 101 workshop	The village of Monticello	Will be mailed to their residency.	People who attend the conference will be asked to provide a residential and email address for workshop facilitators to send them a final evaluation.

9.2. Threat Reduction Objectives

What: Decreased nutrient loading	How:	When:	Who:	Where:	Comments
Goal: Decreased phosphorus levels to 1-3 ppm and increased dissolved oxygen levels to 6-10 mg/L by 2028.					
Monitoring Approach: time series					
Phosphorous and oxygen levels	Water quality tests; which include measuring dissolved oxygen and phosphorous among other things (i.e. temp, water clarity, turbidity)	Two times every month during the growing season (April-September).	A citizen lake monitoring group within Monticello.	Lake Montesian	

9.3. Intermediate Objectives

What: Increased public education	How:	When:	Who:	Where:	Comments
Goal: By 2028, the operations of the program will be handed over to citizens of the village who have graduated from the 'Lakes 101 Workshop'.					
Monitoring Approach: time series					
Citizens begin facilitating the lake workshop by themselves without guidance from outside sources.	Tracking active participation through volunteer rosters.	Annually through 2028.	Project facilitators and officials from the DNR.	Village of Monticello	

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

All good plans are meant to change. Over the course of the next ten years at Lake Montesian, the team in Monticello will learn more about the lake and its surrounding environment, and this information will then inform how planning is carried out. Below are a number of recommendations for how to effectively incorporate new knowledge into future versions of the plan, with the understanding that even these suggestions may change as the Monticello team learns more.

1.) Further develop the strategies of altering mowing practices and posting appropriate signage on bag limits. The former strategy ties in closely with the planting of native vegetation, but it will need to be developed further to be fully effective, and more research will be needed on the current status of Montesian's fish communities to determine bag limits.

2.) At the end of 2019, reevaluate the success of the Lake 101 workshop by calling a meeting with the citizen science volunteers for that year and discussing what they felt was and was not successful.

3.) In the same spirit as the above, arrange a public meeting for Monticello's citizens more generally to discuss any progress made at Lake Montesian and to hear comments and concerns from the public. This can inform decision-making going forward, and it ensures that relevant stakeholders remain an active part of the planning process.

4.) In 2020, evaluate the success of native plantings on the shoreline by going over applicable data on native vs invasive plant densities and lake water quality. Determine if there are documentable linkages between the existence of a native plant buffer and an improvement in water quality. If there are, then that part of the plan is working. If there are not, then that means that it is time to make adjustments to the plan.

5.) In 2020, revisit the indicators for goals and objectives and determine whether they should be adjusted to account for data gathered during the past two work seasons. Indicators based on percentage increase or decrease in a given lake feature might work initially, but it could be helpful to make them more specific as we learn more about the lake.

6.) In 2023, at the 5-year mark for the project, conduct another assessment using steps 1 through 4, and incorporate any new information learned from stakeholders or citizen scientists into a revised version of the plan.

7.) At the end of the 10-year period, go through steps 1 to 6 again, with an eye to determining the overall success of the plan in all of its iterations. Take a survey of the plants in the vegetation buffer, analyze data on dissolved oxygen and phosphorus in the water, determine the state of submerged vegetation in the lake itself, and enlist the assistance of the Wisconsin DNR in taking stock of the fish community. All of this will inform any plans going forward.

Appendix A: Threat Rating Definitions

Scope: proportion of the target expected to be affected by the threat within 10 years.

- **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: level of damage to the target expected if current trends continue.

- **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.

Irreversibility: degree to which target can be restored if threat removed.

- **Very High:** Effects of the threat cannot be reversed and it is very unlikely the target can be restored, and/or would take >100 years to achieve.
- **High:** 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.
- **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.
- **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.

Appendix B: Strategy Rating Definitions

Potential Impact: Level of confidence of the evidence that the strategy will achieve its desired goals and/or objectives.

- **Very High:** The strategy is very likely to meaningfully contribute to one or more project goals and/or objectives and can be implemented at scale with only implementation monitoring.
- **High:** The strategy is likely to meaningfully contribute to project goals and/or objectives but would need effectiveness monitoring to ensure it is effective under this project's conditions.
- **Medium:** The strategy could meaningfully contribute to project goats and/or objectives, but would need pilot-testing to ensure it is effective under this project's condition.
- **Low:** The strategy is unlikely to meaningfully contribute to project goals and/or objectives.

Feasibility: Extent to which the project team will be able to implement the strategy within likely time, financial, staffing, ethical, and other constraints.

- **Very High:** The strategy is ethically, technically, and financially feasible.
- **High:** The strategy is ethically and technically feasible, but may require some additional financially resources.
- **Medium:** The strategy is ethically feasible, but either technically or financially difficult.
- **Low:** The strategy is not ethically, technically, or financially feasible.

Glossary of Terms

- **Activity**: a specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives.

- **Adaptive Management:** 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.

- **Biodiversity target:** A synonym for conservation target.
- **Conservation Target:** An element of biodiversity at a project site, which can be a species, ecological community, or habitat/ecological system on which a project has chosen to focus.
- **Direct Threat:** A human action that immediately degrades one or more conservation targets (e.g., logging, fishing, and urban development).
- **Factor:** A generic term for an element of a conceptual model including direct and indirect threats, opportunities, and associated stakeholders. It is often advantageous to use this generic term since many factors-for example tourism-could be both a threat and an opportunity.
- **Goal**: A formal statement detailing a desired impact of a project such as the desired future status of a conservation target.
- **Indirect Threat:** A factor identified in an analysis of the project situation that is a driver of direct threats. Often an entry point for conservation actions.
- **Irreversibility:** degree to which the effects of a threat can be reversed and the target affected by the threat restored, if the threat no longer existed.
- **Key ecological attribute (KEA):** an aspect of a conservation target's biology or ecology that, if present, defines a healthy conservation target but, if missing or altered, would lead to the outright loss of extreme degradation of that conservation target over time. Examples include population size, reproductive success, community composition or structure, habitat connectivity, hydrological regime, sediment dynamics, and fire regime.
- **Objective**: a formal statement that details a desired outcome of a project, such as reducing a critical threat.
- **Project Team:** A specific core group of practitioners who are responsible for designing, implementing, and monitoring a project. This group can include managers, stakeholders, researchers, operations staff and other key implementers.
- **Scope:** Definition of the broad parameters or rough boundaries (geographic or thematic) for where or on what a project will focus.

- **Strategies**: a group of actions with a common focus that work together to reduce threats, capitalize on opportunities, and/or restore natural systems

- **Severity:** within the scope, the level of damage with the continuation of current circumstances and trends.

- **Stress:** Attributes of a conservation target's ecology that are impaired directly or indirectly by human activities (e.g., reduced population size or fragmentation or forest habitat).

- **Threat:** A human activity that directly or indirectly degrades one or more targets. Typically tied to one or more stakeholders.

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About UniverCity Year

UniverCity Year is a three-phase partnership between UW-Madison and one community in Wisconsin. The concept is simple. The community partner identifies projects that would benefit from UW-Madison expertise. Faculty from across the university incorporate these projects into their courses, and UniverCity Year staff provide administrative support to ensure the collaboration's success. The results are powerful. Partners receive big ideas and feasible recommendations that spark momentum towards a more sustainable, livable, and resilient future. Join us as we create better places together.

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