City of Oshkosh

Shoreline Buffer Zone Recommendations

University of Wisconsin Oshkosh

Environmental Studies Senior Seminar

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Executive Summary

Pollution within Lake Winnebago and the Fox River has been a major concern for decades. Contaminated and polluted water can affect the health of a community and surrounding ecosystems. The water in Oshkosh provides sustenance for humans and animals, and it helps the economy through tourism and recreation. This is why it is important to protect the city's water resources. Clean waterways not only provide a sustainable and flourishing lifestyle for residents within a city, they also attract people from elsewhere. The use of buffer zones along shorelines is one possible solution to alleviate contaminants within our waterways.

Buffer zones utilize native vegetation by filtering out pollutants which makes for a cleaner, more sustainable, and economically viable option to combating pollution while simultaneously creating a flourishing ecosystem. Currently, fresh water algal blooms create issues to human health and the health of the water by disrupting bacteria, aquatic life, and vegetation. Stormwater runoff is another issue within the city because of the one pipe system Oshkosh currently has for filtering runoff. The storm drains currently enter directly into the water which increases the amount of pollution, especially from larger items such as plastic bottles.

The following proposal is a recommendation to initiate a suitable shoreline buffer zone length of 35 feet for public land. This recommendation is needed to ensure contaminants are properly filtered from the waterways. We propose a 25 foot buffer zone for private land properties. This recommendation is to better suit the shoreline landowners and what they demonstrated through interviews to be viable for private land. Identification of the problem, stakeholder identification, case studies, costs, barriers, and how this addition to the city will help Oshkosh become more sustainable will all be discussed.

Problem Identification

Waterfront land dominated by turf grass without buffer zones creates an unhealthy shoreline that leads to major issues for society and the environment. Turf grass is what you typically see on lawns and is a group of grass species that has narrow leaves forming resilient ground cover (Landschoot, 2018). Their root system is generally thinner and more fragile compared to native grasses (Landschoot, 2018). Common issues with turf grass include lower water quality and overall ecological functioning. Without a native buffer zone water quality will be jeopardized by sediment and contaminated runoff that flows into water bodies instead of being filtered in the buffer zone. The danger continues as the shoreline will not be able to provide a stable habitat for aquatic and terrestrial beings because of erosion which is essential in order for ecosystems to thrive. Without buffer zones the water will not be as clear and aesthetically pleasing to the eye which leads to decreased property value and undesirable land (Bernthal, 1997). As of right now, the shorelines at Menominee Park here in the City of Oshkosh are an example of unhealthy shorelines. The runoff from the parking lots, roads, and other impervious materials contribute to the erosion of the shoreline and pollution of the lake.

From our observations, the City of Oshkosh municipal codes currently do not mention shoreline buffer zones in either Chapter 14 Stormwater Management (2014) or Chapter 30 Zoning: Article IX Landscaping (2018). The City of Oshkosh has an abundance of shorelines with many surrounding rivers and lakes, and nearly all of these

shorelines do not have native buffer zones. Our team's recommendation on buffer zones will help the City of Oshkosh become more sustainable through three pillars: society, environment, and economics which is elaborated on near the end of the report.

The City of Oshkosh may not have any written regulations to support buffer zones, but the Parks Department has been involved with shoreline restoration projects in Miller's Bay and South Park (Maurer, pers. comm., 2018). These initiatives are just the beginning for shoreline restoration projects in Oshkosh. The Parks Department has made a goal to incorporate buffer zones when possible (Maurer, pers. comm., 2018). The use of buffer zones are not required in the City of Oshkosh, however, the Parks Department is a leader and supporter of green infrastructure practices. They are currently in need of funding and policy change to support their efforts.

Recommended Ordinance

Through our research, we have concluded that a 35-foot buffer zone provides the most benefits for water quality without a large intrusion on residential and public properties. Winnebago County has a minimum standard for buffer zones that requires all buffer zones to be at a 35-foot depth (WDNR, 2000). We recommend that Oshkosh meets this countywide standard on all public city land that is either in the process of being developed or is undeveloped. We recognize that the 35-foot depth buffer zone may not be achievable on private land because residential lots are typically one acre or less. This means a 35-foot shoreline buffer would ultimately take up a large portion of

their land. As a result, we would like to add an additional recommendation for private property new builds and redevelopments to meet a minimum 25-foot depth buffer.

In order to encourage private landowners to implement these buffer zone requirements, we will provide incentives to community members. We plan to add to the already existing point system outlined by Zoning Ordinance Chapter 30, Article 9: Landscaping Requirements (2018). This landscaping ordinance states the requirements for all new developments. These requirements explain limitations and corresponding point values with several green practices including rain gardens and bioswales, however, shoreline buffer zones are not clearly outlined in this ordinance. We would like to add a section to this ordinance that specifically outlines the infrastructure practices involving shoreline buffer zones in addition to a point system. This point system, under the Landscaping Requirement ordinance, will state that for every 10 square feet of buffer implemented on new developments they will receive 50 points. Builders will continue to receive points from other green infrastructure practices such as rain gardens and bioswales in addition to these added points for the implementation for buffer zones. This landscaping requirement ordinance only pertains to new builds in the City of Oshkosh, however landowners can still implement these green practices to receive credit.

For those private landowners who do not want to provide 25 feet for a buffer zone, we have come up with several alternatives that will improve water quality and the surrounding ecosystem in Oshkosh. One suggestion is the requirement to implement

rain gardens, bioswales, or similar green infrastructure practices that may prevent runoff and restore water quality in Oshkosh. Another suggestion is the addition of permeable pavements for private landowners in exchange for a width deduction on the shoreline buffer zone requirements. In relation to parking lots within the city, permeable pavements on or near shorelines in Oshkosh will require a small 10-foot buffer zone be implemented. This 10-foot vegetative buffer will act as a safety net to the parking lot to account for excess runoff.

Stakeholder Identification

City Officials

John Ferris

John Ferris is the City of Oshkosh Civil Engineering Supervisor and is a primary and key stakeholder for shoreline buffer zones. He is an active supporter of green infrastructure and its implementation in the Oshkosh area (Ferris, pers. comm., 2018). Recognition of the problems we face with stormwater management is important and he is willing to take the necessary steps to correct these issues. Several problems were mentioned in the interview including pollution from city events and erosion. However, Mr. Ferris' main concern with implementing shoreline buffer zones is new development. Oshkosh currently has no specific mention of green infrastructure practices, including buffer zone implementation, in the stormwater ordinance. Many developers are not looking for the most environmentally conscious structure when building a new

development. They typically express interest in projects that are time and cost effective (Ferris, pers. comm., 2018).

During the interview, Mr. Ferris expressed concern over developers who are not willing to implement green practices if there is no personal gain associated with the implementation (Ferris, pers. comm., 2018). The Landscaping Requirement which we outlined above is rewarding credits to new builds, however, Mr. Ferris still sees room for improvement with this ordinance. He suggested that if the city had more accessible programs that were more inclusive of other types of green infrastructure there would be less of a fight against sustainability.

Raymond Maurer

Raymond Maurer is the Parks Director for the City of Oshkosh. His work in relation to development of watershed restoration includes Miller's Bay and South Park (Maurer, pers. comm., 2018). Previously, South Park had issues with erosion, which is why vegetation was needed along the shorelines. With Miller's Bay, shoreline buffers were installed, but were too tall for the taste of the landowners living there. He stated that the transition to new native plantings will continue to be a slow transition due to continual controversy with landowners not wanting plants to obstruct their view of the water and shoreline (Maurer, pers. comm., 2018).

In relation to community acceptance, there are numerous groups within Oshkosh and surrounding cities where green infrastructure has been implemented and continues to flourish that were mentioned by Mr. Maurer. Some of them include Audubon Nature

Preserve, Wild Ones, Master Gardeners, UW Extension, UWO, South West Rotary, and Oshkosh North High School. He discussed that these groups would be on board with shoreline buffer zones and would be a great help when it comes to implementation.

Michelle Muetzel

Michelle Muetzel is a member of the Sustainability Advisory Board (SAB) in Oshkosh. As a member of SAB, Ms. Muetzel is familiar with environmental issues we face in Oshkosh, specifically erosion (Muetzel, pers. comm., 2018). Oshkosh is in need of regulations pertaining to erosion, which is where SAB steps in. Unfortunately, we were unable to meet with this stakeholder face to face, however, we were able to communicate through email.

Community acceptance will be the biggest barrier when it comes to any green infrastructure proposal, especially buffer zone implementation (Muetzel, pers. comm., 2018). She stated that people do not see beauty in native plants, especially if they grow taller than 3-feet and interfere with the view of the lake from their home. Our culture tends to correlate tall growth with weeds and lack of maintenance (Muetzel, pers. comm., 2018). In addition to trying to resolve this barrier, Ms. Muetzel and SAB would like to see a major push toward education on these issues. There are several groups in the Oshkosh area that can help with the education of community members including neighborhood associations, parks and forestry departments, schools (UW extension and UW Oshkosh), and varying environmental groups (Audubon Society, Wild Ones, etc.).

Bill Sturm

Bill Sturm works under Ray Maurer as the Landscape Operations Manager and City Forester for the City of Oshkosh. The city does not have an official horticulturalist, which is why Mr. Sturm has taken over vegetation in parks throughout Oshkosh (Sturm, pers. comm., 2018). Mr. Sturm is a key stakeholder for shoreline buffers because he is the person in charge of implementing restoration programs on city owned parks, which cover a large portion of the shorelines in Oshkosh. The issue of unhealthy shorelines has given Mr. Sturm the opportunity to implement more native plants in restoration projects, including trees. The creation of healthy buffer zones would require Mr. Sturm to use these species because of their strong root system which keeps soil in place. The plants will help with park water quality by keeping maintenance at a minimum which would benefit Mr. Sturm and the parks department over time (Sturm, pers. comm., 2018).

A continual challenge faced throughout implementation of green infrastructure practices in the City of Oshkosh are neighboring shoreline landowners who are against the restoration projects (Sturm, pers. comm., 2018). Mr. Sturm feels the only way these projects will get support from the neighboring landowners is through education. An educational sign was established in a pilot restoration project to explain the importance of the native plants to the health of the shoreline (Sturm, pers. comm., 2018). There have been less complaints since the placement of the sign, and he believes more education to the public through social media, classes, and signage will aid in efforts to decrease public outcry. Mr. Sturm's support for education is a method to change the

minds of resisting landowners, which is a large barrier that stands in the way of shoreline restoration projects (Sturm, pers. comm., 2018).

Steven Wiley

Steven Wiley is the assistant planner at Oshkosh City Hall. The interview was primarily focused on laws already implemented, barriers we will face, and permeable pavements (Wiley, pers. comm., 2018). One important code he discussed was subordinate structures. Currently in the Oshkosh ordinance, boathouses can be no closer than 3-feet to the side lot line, and the house must be set back at least 50-feet from the high water mark. These pieces of information are important to know in order to help demonstrate barriers with implementing a natural vegetated buffer.

An important topic to emphasize is the aesthetic value of natural vegetation (Wiley, pers. comm., 2018). Natural vegetative buffers will attract butterflies and create a healthy ecosystem for aquatic, transitional, and terrestrial life. An issue with many landowners, Mr. Wiley discussed, is the illusion of a decrease in aesthetic and economic value of private landowners properties (Wiley, pers. comm., 2018). In actuality, native vegetation increases land value because water and land is naturally cleaner. Native vegetation also requires less maintenance which is something commonly misunderstood by the general public (Wiley, pers. comm., 2018).

The idea of adding buffer zones to the point system in Oshkosh for green infrastructure was also discussed. This addition will be incredibly helpful with implementation because it can increase security and happiness of landowners knowing

they have options when it comes to their land, and that they are not restricted to exact policies (Wiley, pers. comm., 2018). Our recommendation is to allow 5 to 10-feet for compensation in order to reduce setbacks with private landowners.

In relation to commercial properties, there was mention about reducing the risk of medical occurances (workmans compensation) due to the implementation of permeable surfaces and vegetative buffer zones (Wiley, pers. comm., 2018). Native plantings reduce flooding and issues associated, and they decrease the likelihood of someone slipping on private property or in a public parking lot. It is important to mention that retrofitting parking lots, for commercial property owners, is a recommendation because it increases water quality and drinking water for the community (Wiley, pers. comm., 2018).

Private Landowners

Anonymous Landowner

The anonymous landowner we interviewed was a previous lakefront property owner in Oshkosh. One issue continuously noticed by this stakeholder was the amount of fertilizers neighbors used to fertilize their lawns (Anonymous Landowner, pers. comm., 2018). It was a major concern because it was known that they flooded into the waterways and there were no guidelines or regulations within the city that mention fertilizers and the importance of trapping their pollutants. We recommend implementing vegetative buffer zones to combat that issue, especially with agricultural fields.

The interviewee was hesitant in the implementation of vegetative buffer zones for numerous reasons (Anonymous Landowner, pers. comm., 2018). Neighbors preferred the cookie-cutter turf grass, which is well maintained and trimmed land. This stakeholder, among many others, did not want their view of the water to be obstructed due to vegetation on the shorelines. When the stakeholder was asked if there was value in replacing turf grass with a native vegetative buffer, the response was “No, because it has the potential to raise taxes. That would deter many landowners from wanting to plant them, especially themselves. It could inhibit a nice view of the lake and get in the way of the aesthetic and economic value associated with it. Maintenance of the plants would be incredibly hard, especially for the elderly and those who may not be home as much” (Anonymous Landowner, pers. comm., 2018).

No interest was expressed in personally planting native vegetation or the option of city workers planting them. However, there was interest in receiving education through the city on green infrastructure and environmental issues within the community. What plants to use for natural vegetative buffer zones and where those plants can be found are pieces of information that the city should have readily available for citizens in order to ensure proper implementation of green infrastructure practices.

Mindie Boynton

Mindie Boynton is a private landowner who is currently building a new property on Lake Winnebago. Due to scheduling conflicts, we were unable to meet face to face, however, we communicated with this stakeholder over email (Boynton, pers. comm.,

2018). The inability to meet face to face could have impacted how we interpreted our conversation during the interview, therefore we recommend that city officials reach out and try to speak with Mrs. Boynton on their own.

Mrs. Boynton provided insight as to why there should be importance placed on community education (Boynton, pers. comm., 2018). As someone who is currently building on shoreline property, she did not have a lot of prior knowledge on the ordinances dealing with shoreline buffer zones or water quality related standards. This lack of knowledge is concerning because while she is building a new property, she should consider her affect on the environmental component of the property.

She discussed different educational programs, parks, and organizations people can visit to get a simple view of nature and educate themselves on the importance of green infrastructure and native plants (Boynton, pers. comm., 2018). We believe that stakeholders, like Mrs. Boynton, would benefit greatly from organizations and educational programs that highlight the importance of shoreline restoration in Oshkosh.

Kevin Crawford

Kevin Crawford is an analytical chemist professor at the University of Wisconsin Oshkosh. He is a primary stakeholder and owns property along a channel which connects to Lake Winnebago (Crawford, pers. comm., 2018). One thing mentioned immediately during the interview was that 35-feet for shoreland buffer zoning is too much. This answer is based on what he feels property owners think, considering most have limited space within their backyards. Implementing a buffer zone of that length could deter people from building patios which would create problems between the city

and landowners (Crawford, pers. comm., 2018). He does agree that 35-feet is sufficient for trapping pollutants and cleaning the waterways. From his knowledge, most private landowners prefer turf grass for their properties. It will be a continual challenge getting landowners on board with natural vegetation implementation in place of turf grass.

The abundance of weeds within the channels and Lake Winnebago are an issue for many landowners. Many of the weeds people see are an invasive species named Eurasian watermilfoil (Crawford, pers. comm., 2018). Not only are these weeds everywhere, but they get trapped within boat engines and clog their systems disrupting the natural aquatic and shoreline ecosystem, and lessening the aesthetic and economic value of the area. This issue is something he believes should be addressed. Legal push for the implementation of shoreline buffer zones, discussed in our interview, will be incredibly difficult and time consuming (Crawford, pers. comm., 2018).

Case Studies

Currently, numerous cities within Wisconsin and the United States have regulations on buffer zones. The implementation of adequate buffer zones establishes a secure base for native vegetation to properly reduce the amount of agricultural and chemical pollutants entering the waterways. An article written by Hickey and Doran (2004) assessed numerous case studies on buffer zones and shoreline restoration. The first focus was on the importance of buffer zones along shorelines, which deals with protection of water quality, especially for drinking water purposes.

Agricultural runoff is a major issue in numerous areas of the country, notably in Wisconsin. Nitrogen, through numerous studies, has been shown to to be removed through native shoreline vegetation. This is partly due to the long root system of native plants. Plants also have a mechanism that slows the movement of water which in turn increases sedimentation rates (Hickey and Doran, 2004). Phosphorous is also a chemical of major concern. Just like nitrogen, it is absorbed and can be removed by placing native, deep rooted vegetation on shorelines, in surface water and shallow groundwaters (Hickey and Doran, 2004). Since nitrogen and phosphorus can stimulate the growth of invasive species, it is important to ensure plants are native and deep rooted.

Another effect buffer zones can have on the water deals with temperature. Temperature increases have been associated with the removal of natural vegetative shoreline ecosystems. Average temperatures along shorelines were found to have increased by 4.4° Celsius when natural zones were removed (Hickey and Doran, 2004). This can have serious effects for aquatic life that rely on certain water temperatures for survival.

Through analysis of various articles and case studies on vegetative buffer zones, these authors concluded that wide buffer strips between 30 to 100 meters are shown to provide the best pollutant protection. We are aware that 30 to 100 meters is unrealistic within the City of Oshkosh due to land restrictions. That is why doing a cost-benefit analysis before implementation of vegetative buffer zones is important to determine

what width is best for the land area, as well as what is most economically feasible for the community (Hickey and Doran, 2004).

Northern Highland Lake District, Northern Wisconsin, U.S.A.

The Northern Highland Lake District contains the third largest density of freshwater glacial lake deposits in the entire world, which makes this a good case study to help illustrate the importance of clean freshwater for both ecosystem quality and aesthetic values (Elias and Meyer, 2003). Their discussion begins on the importance of buffer zones for wildlife habitats, aesthetic appeals, and basic transition zones between aquatic ecosystems and upland systems. Shorelines are affected through a variety of environmental changes which include erosion, sedimentation, and pollution runoff. Another area the study observed was the likelihood of fauna residing on shorelines between developed and undeveloped lands (Elias and Meyer, 2003).

The study area included both Vilas and Oneida counties in Northern Wisconsin, and included 12 pairs of lakes ranging in size from 11 hectares to 162 hectares (Elias and Meyer, 2003). Surface area, shoreline length, depth, water source, and quality were all measured. The sites were chosen during 1997 and included 182 sites for surveyed vegetation on a total of 28 lakes. Data concluded a few recommendations: 1) vegetative cover is important in managing temperature of shorelands and water, 2) an increased amount of trees is important as well as woody debris in the terrestrial area of the buffer zone, and 3) the conversion of mowed lawn into native plant species helps restore the land area back to its original biological functioning (Elias and Meyer, 2003).

Embarras River, Central Illinois, U.S.A.

Vegetated Buffer Strips (VBS) were studied for their use in stream water quality in the Embarras River in Illinois (Osborne and Kovacic, 1993). In this study, an assimilation strategy is suggested because it includes natural, biological, and physical strategies in order to store, convert, and reduce pollutants within vegetated landscapes before they enter an aquatic system. This, as well as a stable, rational management policy, has incredible potential to stabilize natural ecosystems (Osborne and Kovacic, 1993).

This study analyzed different ways in which riparian zones are known to improve ecosystem health and functioning (Osborne and Kovacic, 1993). One way was how forested VBS can minimize temperatures along the shoreline and the water. Another element was sediment retention through vegetation density, particle size, and soil characteristics. Nutrient reduction was also analyzed as well as those released through agricultural runoff (Osborne and Kovacic, 1993). They were measured by absorption rates of both organic and inorganic particles. For forested vegetated buffer strip, a buffer zone of 30 to 50 meters in width was found to reduce nitrates by 79-98%, while their counterparts, grass buffers, were shown to eliminate 54-84% (4.6-27 meters width) (Osborne and Kovacic, 1993). After data collection was finalized, it was concluded that forested VBS created lower or more moderate temperatures on both shoreline vegetation and water was able to effectively reduce agricultural runoff chemicals from entering the waterway (Osborne and Kovacic, 1993). Wider width buffer zones will

inevitably cost more which means government supported incentive programs will be required in order to implement policies.

Shihmen Reservoir, Taiwan

The Shihmen Reservoir in Taiwan is incredibly important to the surrounding areas because it supplies fresh water to millions, prevents flooding of surrounding cities, is an irrigation central for agricultural diversions, provides hydroelectric power, and is popular among tourists (Chang et al., 2011). An analysis was conducted on the stormwater management systems and the effectiveness of buffer zones in trapping pollutants along the shorelines of the reservoir. More specifically, they did a cost-benefit analysis on vegetative buffer strip efficiency based on location and design.

The study was focused on numerous areas such as irrigated and unirrigated farmlands and forests to help build a diverse background. This was completed through the Soil and Assessment Tool (SWAT) method which looked at buffer strip slope and width (Chang et al., 2011). Overall, they concluded that the most effective buffer strips were placed in shallow areas around the shoreline, were uniform with another, and slowly filtered pollution. Through this analysis, they were also able to determine 30 meters to be the most economically feasible and sufficient in trapping pollutants for the Shihmen Reservoir (Chang et al., 2011). Their suggestion for future studies is to first apply a cost-benefit analysis to determine pollutant reduction and economic effectiveness (Chang et al., 2011).

Not only do these examples provide sufficient evidence on the quality of native vegetation buffer zones, but they also illustrate effective mechanisms to combat pollution of waterways and economic concerns of implementation and policies. These detailed accounts can provide guidance to the City of Oshkosh when discussions occur on the economic feasibility of such measures and for a reference for current and future landowners who are looking to make a sustainable difference within their community.

Costs

The Maryland Cooperative Extension priced shoreline buffer zones anywhere "between $218-$729 per acre to plant and maintain" (Lynch and Tjaden, p.3, n.d.). This price is variable because it depends on many factors including but not limited to: the type of plants chosen, the total amount planted, the total land area, the accessibility of the shoreline, and whether someone is independently doing the work or hiring someone to plant the vegetation (Lynch and Tjaden, n.d.).

In Oshkosh, the shoreline of Miller's Bay near Menominee Park recently installed buffer zones. Miller's Bay is located along approximately one mile of shoreline with the total cost of buffer zone implementation being approximately $6,000 (Sturm, pers. comm., May 2018). To compare this total to the estimates given by the Maryland Cooperative Extension, calculations demonstrate that roughly $240 was spent per acre in Miller's Bay, which is on the lower end of the approximated cost range.

In terms of who is responsible for the financial costs, it will be dependent on the landowner. Oshkosh should have funding available to help private landowners if

applicable. The Wisconsin Department of Natural Resources (2018) has grants available that Oshkosh could apply to for money for implementing buffer zones along the shorelines. Grants available are the Targeted Runoff Management Grant, the Urban Nonpoint Source & Stormwater Management Grant, and the River Protection Planning & River Protection Management Grant (Surface Water Grant). All of these grants focus in part on the protection of waterways and the prevention of pollution such as stormwater runoff. The grants range in value from $10,000 all the way up to $1,000,000 for very large projects. This money could go towards the city's own land that requires buffers (i.e. parks) and some of it could be set aside for private landowner assistance. A large benefit of these DNR stormwater grants is that they can be used not only for shoreline buffer zones, but for other green infrastructure projects throughout the city as well.

Grants and other monetary incentives can be effective tools for making sustainable change in a community, or even a whole state. This can be seen in Minnesota and the success of their statewide buffer law. Between 2015 and 2017, a majority of the counties in the state had over a 95% compliance rate for shoreline buffer implementation (State of Minnesota, 2018). On Minnesota's state website, they offer a list of available opportunities for financial assistance to help landowners pay for installation and maintenance of buffer zones on their land (State of Minnesota, 2018). The website broke financial assistance down into local, state, and federal assistance which makes it easy for state citizens to find the loans and grants they need. If the City of Oshkosh had grants and loans easily laid out on their website for shoreline buffer

zones, or stormwater management in general, it would help the public in implementing these aspects of green infrastructure.

Barriers

The largest barrier for implementing shoreline buffer zones will be public acceptance from neighboring landowners. Our team has identified a group of citizens in Oshkosh that either were or are currently shoreline landowners, or landowners with a view of the water. These citizens have been vocal and strongly oppose the implementation of native vegetation to shorelines. After conversations with one of the landowners who wishes to stay anonymous, and individuals from the City of Oshkosh Parks Department, we found a few different reasons why these landowners oppose native plantings.These reasons include a change in their view of the water, potential tax raises, and maintenance of the buffer zones (Anonymous, pers. comm., 2018).

The anonymous landowner was a shoreline homeowner for many years before moving out of the city. During their time in Oshkosh the project at Miller's Bay was completed. The landowner was upset because the waterfront view they cherished was now obstructed by the tall native plants. They preferred the ability to plant want they wanted and had a great dislike for native plantings on the shore that blocked their view of the water (Anonymous, pers.comm. March, 2018). This seemed like a trend for some landowners according to the Parks Department. The pushback from landowners over this issue called for the shore to be redone. The plants that were planted were moved to

a different location, and replaced with shorter species that did not block the view of the water (Maurer, pers. comm., 2018).

The interview with the anonymous landowner also showed concern over the potential raise in taxes. The landowner could not disclose where they had heard that raising taxes could be a possibility if shoreline buffers were implemented. Any funds for these projects would be sourced through the Stormwater Utility Fee that every resident already pays, and there is no intention on raising the fee because of shoreline restoration projects.

Another idea held by the landowner would be the increase in maintenance labor and cost for buffer zones. The Wisconsin DNR and UW- Extension have published many shoreline property guides to educate citizens on how to maintain their land, and in one of these guides short and long term maintenance of the bufferzone is explained (Wisconsin DNR and UW Extension, 2002). The guide outlines how the implementation of native buffer species saves time and money. The native plantings do not need to be mowed, sprayed, or replanted every year. The majority of the maintenance is in the beginning stages to ensure the plants have successful establishment. After the plants are established, the maintenance drops significantly to almost nothing (Wisconsin DNR and UW Extension, 2002).

Significance for Sustainability

Sustainability contains three pillars: Environment, Economy, and Society. In order for a practice to be sustainable, each pillar must be represented. Shoreline buffer zones

address each of the three pillars, which in turn would make Oshkosh a more progressive city. A sustainable city provides for a thriving economy, ecosystem, and community. These are very attractive qualities for a city to have, which is why Oshkosh should strive to implement sustainable practices such as buffer zones along its shorelines.

All of the following examples of sustainability demonstrate how buffer zones are a great investment. The benefits outway the costs in many ways. One of the greatest benefits is the improvement of water quality, which is important to the City of Oshkosh. Installing vegetative buffer zones is also preventative and cost saving when it comes to pollution. Preventing pollutants from entering water means pollution clean up is not a cost needed down the road.

Environment

Buffer zones along the shore can greatly improve water quality. Buffer zones have been known to reduce certain pollutants like nitrogen and phosphorus, among others, from entering water bodies (Gillespie, 2005). The Minnesota Pollution Control Agency conducted a study to test water quality of buffered and non-buffered waterways to determine if vegetation along the shoreline really helps (MPCA, n.d.). Fish and other aquatic species are great indicators of water quality, and the study found that these species were healthiest in places with buffer zones and health was poor in places without them. This not only shows how buffers can improve water quality, but also demonstrates how they can improve ecosystem health. Aquatic species benefit from

cleaner water, but buffers also provide food and habitat for a variety of wildlife (Gillespie, 2005).

A major problem in many rivers, lakes, and other waterways is the growing amount of invasive species. Eurasian watermilfoil is an invasive species found in the Oshkosh area. One reason that invasives can be so prevalent in waterways is because they are more tolerant of pollutants than native species are (Pichler, 2013). In a study conducted by Pichler (2013), water quality and invasive species were compared in various lakes in Wisconsin. The results showed that lakes with deep rooted buffers had less invasive species than lakes that had no buffer. A reason for this is that buffer zones filter out nutrients such as phosphorus and nitrogen, as mentioned above, that can cause rapid population growth of invasives (Pichler, 2013). Without invasive species present in water ways, native plants and animals are given a better opportunity to thrive.

Shoreline buffer zones also provide stabilization to the shore and prevent erosion (Bernthal, 1997). Root systems are what helps hold soil in place, and the popular option of turf grass has a root system that cannot support a shoreline against the movement of water (Bernthal, 1997). Deep rooted native grasses help hold everything together on the other hand. It saves a shoreline landowner time and money to plant native vegetation one time instead of having to rebuild their shore year after year due to erosion.

Economy

A booklet published by the Wisconsin Department of Natural Resources and the University of Wisconsin Extension described ways in which one can protect their shoreline home investment (Markham and Demorest, 2005). The booklet mentions that greater water quality leads to greater property values for the homes and businesses located along the shore. To keep property values high, or to even increase them, it is the responsibility of the shoreline landowners to assist in protecting the quality of the water they live on. One of the ways to do this is to implement shoreline buffers, which when well grown, can also provide privacy on the property which is another factor that can help raise a property value (Markham and Demorest, 2005). In some cases, raising property values can be seen as negative because it can push people of lower income out of an area, but shoreline residents typically pay more for their property to begin with so this would not likely be an issue.

Society

A study by Gaffield et al. (2003) discussed that drinking water contamination can usually blame runoff as the reason for making people sick. They mentioned that standing stormwater is a breeding ground for bacteria and when water makes its way to lakes and streams, major health problems can occur. Unfortunately, wastewater treatment plants are not capable of removing every type of harmful bacteria from the lake and river water, which means people can become ill from drinking water (Gaffield et al., 2003). The study concluded that vegetated buffers are great options when in regards to protecting water resources. The health of members in a community is high

priority, and by filtering out harmful pollutants, shoreline buffers would improve the overall health of the Oshkosh community.

Another benefit of shoreline buffer zones to society is the fact that they provide beauty to the landscape. The misconception that buffer zones are unattractive and full of weeds is often discussed, but buffer zones can actually be full of native flowers and other aesthetically pleasing plant varieties. Nature itself can bring about many health benefits which is another positive impact buffer zones can have on society. Viewing nature, particularly a thriving ecosystem such as a buffer zone, can alleviate stress and help with mental health and even cardiovascular health issues (Maller et al., 2006).

Conclusion

After discussing shoreline buffer zones with various stakeholders, the general consensus was that shoreline buffer zones are an important part of wastewater management and protecting the city's water from pollution. Even when stakeholders were against buffer zones, there was still a willingness to learn more about them. Community acceptance seems to be the greatest barrier, and there is hope that with more education on shoreline buffer zones offered to the community, a greater acceptance for them will follow.

The case studies mentioned in this report demonstrate how shoreline buffer zones can be effective additions to communities. Minnesota's incentive program had major success and Oshkosh can utilize their methods to implement better green infrastructure practices. Wisconsin DNR grants were found that could be effective tools

to use, following Minnesota's lead. These grants could be used to pay not only for shoreline buffer zones, but also other green infrastructure practices to help mitigate stormwater pollution throughout the city.

Shoreline buffer zones have also proven to be very sustainable in all three pillars: environment, economy, and society. By implementing sustainable practices throughout the city, an increase in the overall health and wellbeing of our waterways, ecosystems, and the Oshkosh community can occur. It is because of all of these reasons that we recommend the City of Oshkosh follow the countywide buffer requirement of 35-foot buffer zones for city land, and that the city requires a 25-foot buffer for all private land new builds along the shoreline. We also recommend that the city implements an incentive program to encourage current shoreline landowners to install buffer zones. These recommendations would be investments to enhance Oshkosh to become a more sustainable community.

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