Community Action for Lake Michigan (CALM)

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Mission Statement:

CALM's mission is to ensure that the Root-Pike watershed meets water quality standards to a level that is safe for human use, while working towards restoring the watersheds coasts, preventing further digression, and preserving important ecosystems by 2035.

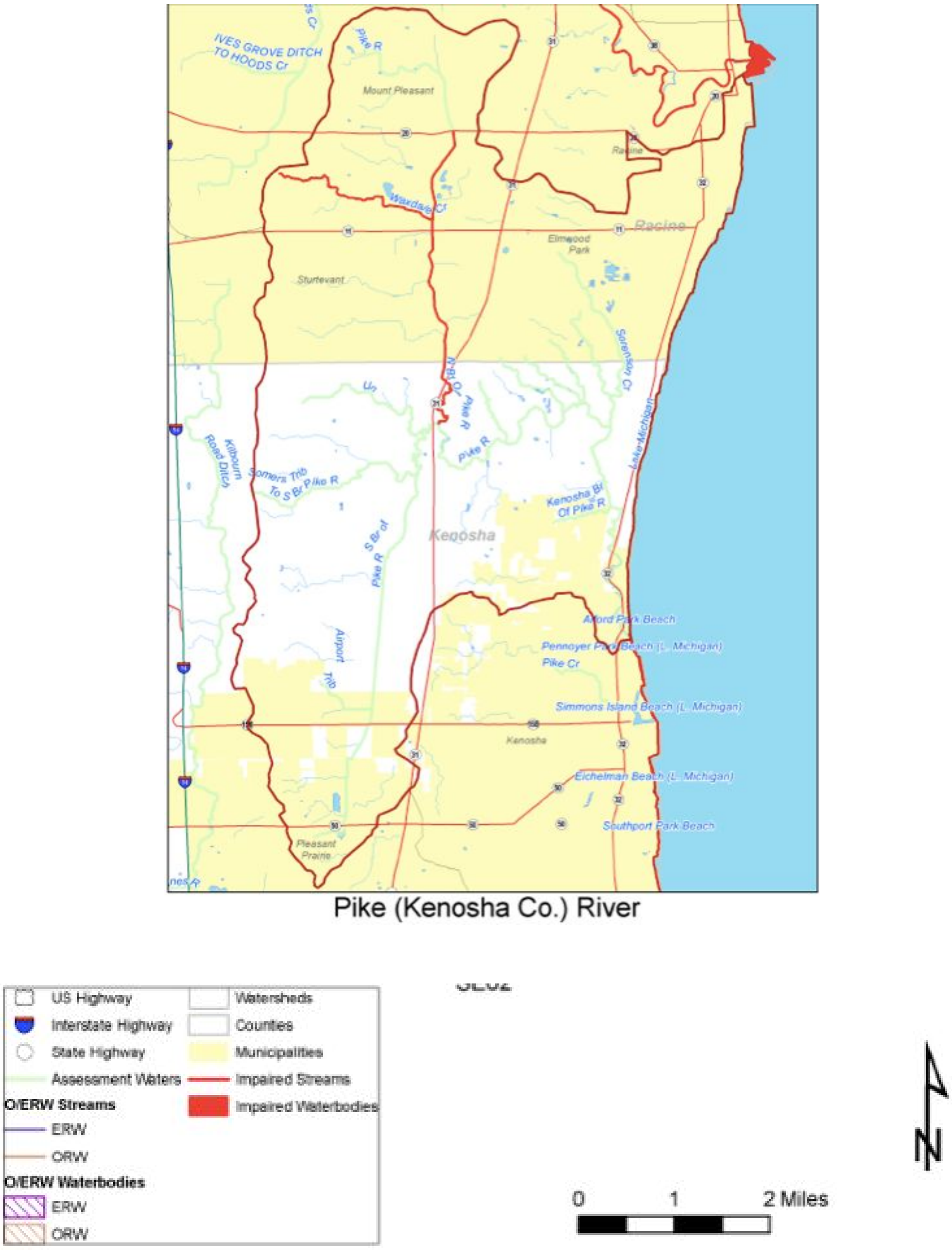
Background:

The Root-Pike Water Basin is a sub-watershed of the Lake Michigan Water Basin. Root-Pike covers over 410 square miles, with 113 miles of shoreline along Lake Michigan and is located in four counties. The basin is composed of five smaller watersheds (State of the Basin). Wetlands make up 4% of the watershed or 8,500 acres. There are five lakes and over 300 miles of intermittent streams (State of the Basin). The watershed feeds into Lake Michigan, the second largest great lake. Half of the watershed is used agriculturally, and 30% of land use is urbanized. These uses of land have led to a somewhat degraded water quality.

The Lake Michigan Watershed has changed massively in a very short amount of time. Before the first settlements developed, approximately 170 years ago, the terrain consisted of lush upland forests and was rich with water and wetlands. Lake Michigan, along with the rivers and forests surrounding it, sparked the first attempts of development and settlement in the Lake Michigan Watershed (2010 Water Quality). Before the first European villages settled in 1834, Native American villages sprouted in and adjacent to the watershed. This area appealed to settlers due to the proximity of water and lush forest land. The first European Settlement in the Pike-River Watershed, named The Village of Pike River, was developed in 1835 near the mouth of the river. The Pike River was one of the first rivers in the Lake Michigan Watershed to be dammed and ditched for the purpose of drainage and supplying water for irrigation. It's closeness to multiple European Settlements made the river ideal. Historic stream and shoreline modification can be seen throughout the rivers of the watershed, due to the once common practice of clearing the land to the very edge of the banks to provide lumber and cropland (2010 Water Quality).

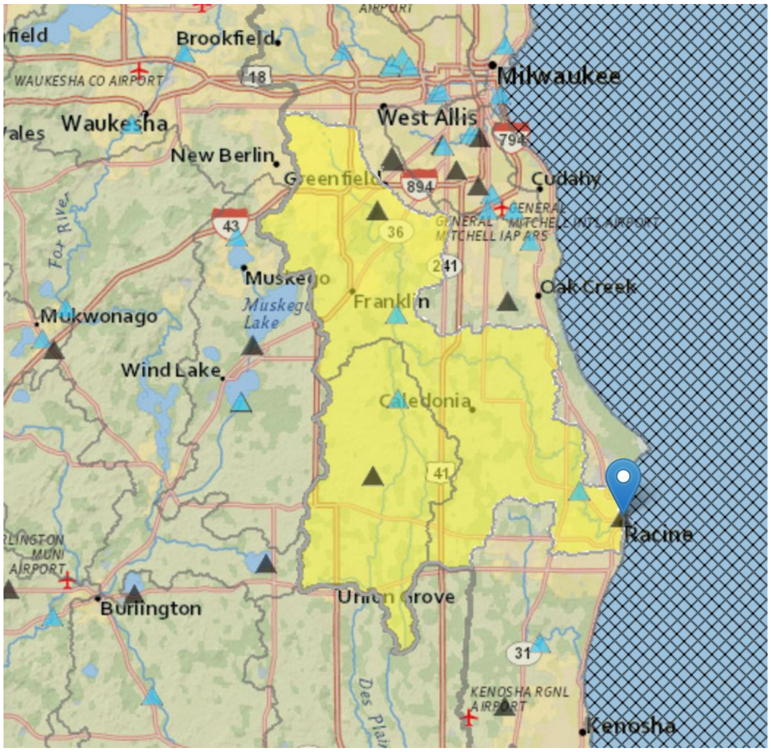
Governance and Policies In Place:

Under the Great Lakes Water Quality Agreement, the US and Canada agree to cowork to identify water quality issues and collaborate to find solutions. The Lake Michigan Lakewide Action Management Plans, which are plans of actions to restore and protect the Great Lakes System, have focused greatly on increasing the quality of water within the lakes. Smaller scale watershed groups are in place in Pike Root as well, including the Root-Pike Watershed Initiative Network (Root-Pike WIN), which was created more than two decades ago by a cooperative effort with the Wisconsin Department of Natural Resources and, in 2001, became a 401c3 non-profit. In their existence, Root-Pike WIN has completed over half a million dollars in river restoration, educational programs, and monitoring projects (Watershed Restoration). Their Pike-River, EPA-approved Plan is a nine key plan which highlights multiple issues including, phosphorus and nitrogen from farming, E. Coli and pathogens from agriculture and storm water run-off, chlorides from road salts, and invasive and non-native species (Watershed Restoration). Other small initiatives include 1000 Friends of Wisconsin, Midwest Center for Environmental Science and Public Policy, Sustainable Racine, The Waukegan Harbor Citizens Advisory Group, and Lake Michigan Watershed Ecosystem Partnership.

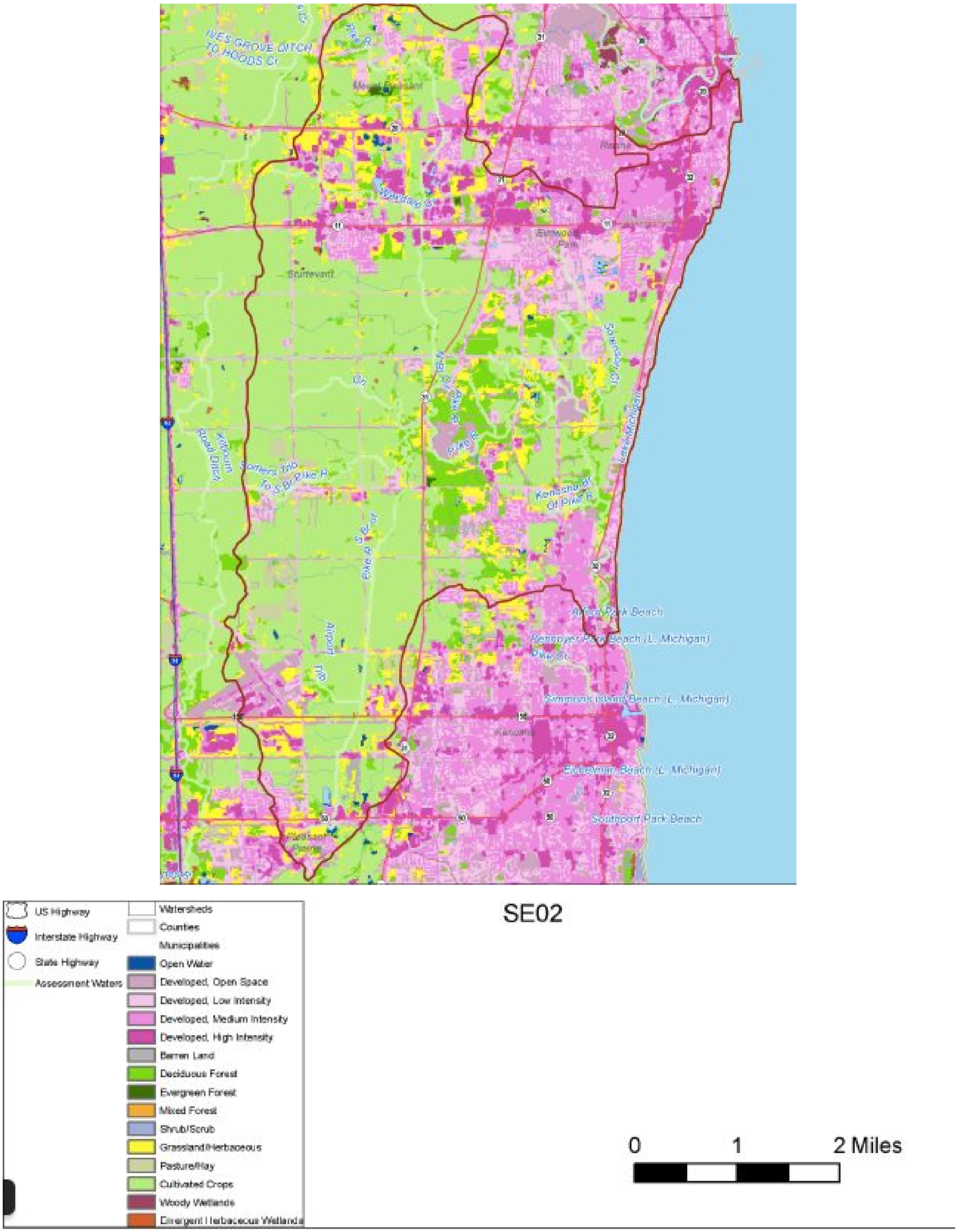


Watershed Overview

Photo By: US EPA



USGS Delineated Watershed



Land Use and Land Cover

Photo by: US EPA

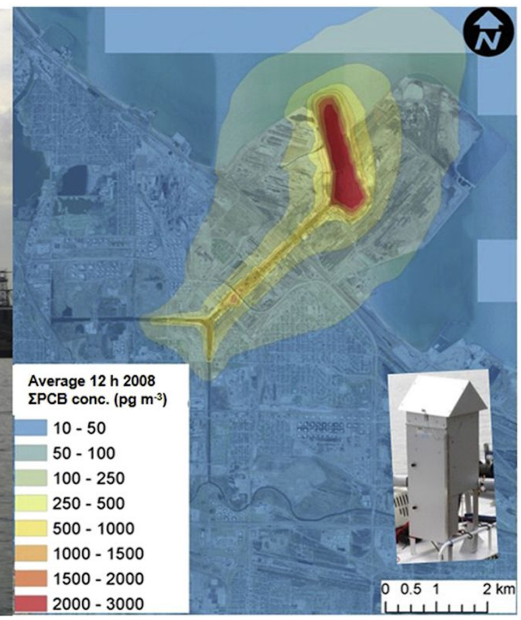
Root-Pike Watershed Initiative Network:

Their initiatives have been adopted by the municipalities of the Root-Pike watershed. An example is the adoption of wetland restoration and ravine restoration project of Racine County Board of Supervisors in Cooperation with the Root-Pike WIN in 2017. This restored 2,450 feet of tributaries leading to Lake Michigan to reduce pollutant loading. It provided funds to ensure community involvement with tours of the site and obtaining professional oversight. Phosphorous, Nitrogen, and total suspended solids would be reduced with this restoration. It would reduce cliff and ravine erosion by the use of bio diversifying habitats and implementing buffers along farm, fallow, and cliffsides. These all contribute to solving the problems that the CALM initiative has identified. The problems with this project are expansive, including the small mention in the legislation that relieves the County of any responsibility to fund the projects. All funds must be raised by the Root-Pike WIN. The project can only move forward if the WIN is awarded grants enough to fund the project.

Problems and Possible Solutions

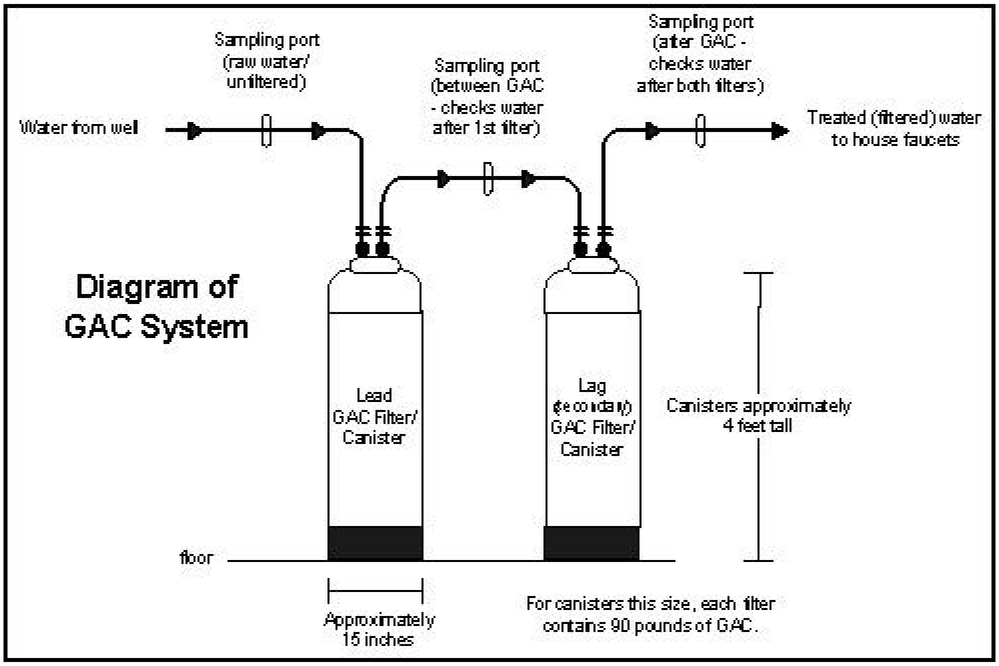
Problem 1 and Solution:

Lake Michigan has a history of issues regarding pollution, including a subset of persistent organic pollutants (POPS). One POP in particular is polychlorinated biphenyls (PCBs) which are a class of chlorinated aromatics. PCBs are a significant source of pollution in Lake Michigan. In 2006 alone, there were 52 cases of PCB impairment in the Lake Michigan Watershed. Although they were banned decades ago, PCBs remain in the environment. Most PCBs found in the environment are remnants from their heavy industrial usage before 1979, when they were banned domestically in the United States. The manufacture of PCBs was discontinued because exposure to PCBs could cause neurological disorder, reproductive toxicity, endocrine disruption, cancer, and deformity (Learn about Polychlorinated Biphenyls). This happens once the PCBs accumulate in the lipid rich tissues of any organism. PCBs are difficult to manage in the environment because of their chemical properties. PCBs are bioaccumulative, able to form strong bonds with soil and sediment, highly transportable, and resistant to biodegradation (Clough). There have been various attempts to reduce PCBs in the watershed. Much of the PCBs in Lake Michigan can be found in the soil/sediment since it has such a high sorption for the sediment matrix. Therefore, it is important to remove contaminated sediments from the watershed. For instance, over one million pounds of PCB has been dredged from the Waukegan River, a source that feeds into the Pike Root Watershed (Pike-Root Watershed). Additionally there is an ongoing 30 year dredging project located at the Indiana Harbor and Ship Canal. This busy port is a major source of PCBs to the Lake Michigan Watershed. Contaminated sediments are stored in a confined disposal facility (Martinez).



(Sediment Dredging and Indiana Harbor and Ship Canal PCB concentrations)

Removing PCBs from Lake Michigan should be a high priority because of the potential it has to spread to surrounding communities. The Lake Michigan Watershed is a considerable source of airborne PCBs as the molecules transition from the sediment, to the water, and eventually to the air, where they can contaminate nearby populated areas. Removing PCBs from the watershed is crucial to protecting the health of nearby and far away residents, as PCBs can travel far once airborne (Meng). Water and air contamination is not the only cause for concern in regards to potential exposure. Since PCBs are bioaccumulative, many of the fish in the lake are contaminated with unsafe levels of PCBs. Recreational and commercials fishing on the lake is threatened by the presence of contaminated fish. Reducing PCB levels in the water, would naturally lead to lower levels in the fish. The contaminated fish and water have a direct impact on the economy, creating another reason to invest in infrastructure to lower PCB levels (Rasmussen). Issues in the Lake Michigan Watershed concerning PCB levels can be remedied with an increased efforts to dredge current high concentration areas. Another method to reduce PCB levels in the watershed would be to build GAC filtration systems, which is often used to lower PCB concentrations in water supplies (Polychlorinated biphenyls PCBs and drinking water).



Another water quality issue at the Lake Michigan Watershed is E coli contamination. E coli enters the water through fecal contamination, runoff from groundwater, and overburdened sewage systems. E coli can cause severe abdominal illness, especially in young or elderly people. E coli contamination in itself has been an issue for a number of years, which raises concern for overall pathogen contamination in the water ("Drinking Water Contaminants - Escherichia Coli, E. Coli."). Numerous beaches in the watershed had summer warnings of high bacteria levels, the beaches were closed entirely on some occasions as well. There were 51 cases of E coli counted in 2006. The maximum amount of E coli for swimmable conditions is 130 counts per mL water, and levels were recorded at five times this allowable amount. Fortunately, E coli levels in the Lake Michigan Watershed have been decreasing. A 15 year study on E coli levels in Lake Michigan has shown that there is a decrease in the total e coli population in the watershed. Interestingly enough, one of the reasons for the decrease in E coli levels, happens to be another problem in the watershed, invasive species of mussels. These mussels directly remove bacteria from the water column. The mussels may make the water cleaner, but bring their own problems that are not necessarily good for the health of the watershed and its ecosystem. As the invasive species of mussels are dealt with, it should be noted that removing them, will likely lead to an increase in e coli. Another contributing factor that leads to lowering levels of E coli in the watershed is a reduced amount of untreated sewage pouring into the watershed. Improvements to the large scale wastewater and stormwater infrastructure have been shown to decrease E coli concentrations. Nearby highly populated areas need to properly manage their sewage, as they are a major contributor to E coli concentrations at the watershed. E coli contaminated beaches are a major concern for recreational water uses, and are remedied through sand grooming and gull reduction. These solution help to lower E coli levels temporarily at a particular recreational beach but have no been shown to decrease larger regions of E coli contamination. However since, much of the concerns from E coli are from recreational beach goers, this solutions is very helpful in reducing health risks (Weiskerger).

Problem 2 and Solution:

Another issue threatening this watershed is that of erosion along due in part to water levels rising and anthropogenic sources like development and agriculture along waterways. The waters of Lake Michigan have been rising and are at the highest in 20 years, swallowing valuable wetlands with it (Briscoe). Rising waters have depleted the shoreline of not only its wetlands but has eroded away the sediment preserving the structure of the ecosystem around it. The stream banks running into Lake Michigan are eroding, and with that contribute to sediment displacement (Rootpikewin). High bank erosion is prominent in the Pike-Root watershed and contributes high masses of sediment, sometimes more than the waterway can handle (Field Geological Services). The Pike-Root watershed has erosion throughout its urban, agricultural Sediment deposits harm aquatic environments, reduce water quality, create impediments in the watershed and harms the shorelines, coasts, and harbors alongside Lake Michigan (Rootpikewin). Soil can settle on the bottom of waterways, coating gravel and rocky areas that are home to invertebrate and fish, making them no long habitable (State of the Basin). Active construction sites in the urban areas of the watersheds provide about 15 tons of sediment deposits per acre per year and are not governed appropriately. If permitting was enforced in areas, erosion and sediment could be reduced by 80% (State of the Basin).

Evidence of extreme bank erosion along the shores of Pike River

Sediment deposits accumulate in Southern Milwaukee

(Photo from Rootpikewin)

Bank erosion can be restored using bio-engineering stabilization, which will integrate plates and plant material into the ecosystem that will hold together banks (Rootpikewin). Bioengineering is necessary; anthropogenic sources are a root of this erosion due to increased impervious cover around the areas, and human intervention is necessary to restore and maintain the stream and tributary banks leading into Lake Michigan. This includes banks on 117 miles of rivers and streams draining into the Root River Watershed. The Root River Watershed drains almost two thirds of the entire Root-Pike River Basin and has the most extreme erosion (Pike River Watershed). An example of bioengineering is to introduce logs in waterways to deflect water against an eroding bank (Field Geological Services 1). You can also introduce large rocks with filter fabric for bank stabilization (riprap). Revetments can also be created, either impervious or pervious in order to prevent adjacent water movement at high velocities, which a source of erosion.

A very successful form of bioengineering is the implementation of buffer strips. Buffer strips offer a solution to impacts of rising waters, flooding, and shoreline erosion. According to Minnesota requirements, buffers are permanent vegetation, riparian strips, that span 50 feet on either side of proposed body of water (Vegetation Buffer Strips 1). Funding for buffer strips is available in many states to reduce the individual burden of restoring and conserving stream and river banks. Buffer strips improve water quality by removing pollutants before reaching waterways from developed land or agriculture. They can remove up to 50% or more nutrients and pesticides, 60% or more of pathogens, and 75% or more of sediment. This will improve water quality while reducing sediment deposits and bank erosion (Vegetation Buffer Strips). They also offer stream protection by decreasing impervious cover and provide shaded areas that can control temperature. They also help improve habitats with more food sources, shelter, and places to nest (Vegetation Buffer Strips). Introducing different plants with longer roots hold together banks more than traditional grass like the Kentucky bluegrass (Vegetation Buffer Strips 2). Replacing these with non-invasive grasses or shrubbery with longer roots can improve the resistance to flooding and erosion.

A final solution is restoration of the watershed. Restoration can include sediment management to reduce the sediment input into the waterway. This works best on small tributaries, but can be expensive and long term (Field Geology Services 1). Sediment management can include reintroducing gravel back to habitats that have lost large amounts (Good Practice Sediment Management). It can also be dredging and removal of sediment deposits, coordinate and monitor sediment practices in order to maintain good sediment management, and ensuring agricultural best practice techniques in order to manage sediment at the source (Good Practice Sediment Management). Waterways in urban areas of the Root-Pike watershed like Milwaukee have been altered by humans, this contributes to erosion as the waterway tries to return to a meandering pattern. Natural restoration can occur if straightened pathways can return to a meandering channel instead of hard bends (Field Geology Services 1).

Problem 3 and Solution:

The watershed is also being negatively affected through ecological issues. Loss of native species on land and in the water, coupled with the addition of invasive species has caused a degradation of the natural ecosystems in this watershed. Ecosystems are filled with a variety of species, each with its specific niche. When invasive species encroach and overtake an ecosystem, it is not as adept in performing its natural services to maintain a healthy ecosystem (Redlinski). Negative consequences are observed when this delicate balance is disrupted. At least twenty-five invasive species of fish have entered the great lakes since the 1800s, along with many invasive plant species ('Invasive Species'). Zebra and quagga mussels are two of the most dominant invasive species for the Pike-Root watershed. Zebra and quagga mussels multiply rapidly and have the ability to cling to a variety of surfaces. They adhere to native species of mussels, and also out-compete them, which reduces the populations of the natives species greatly. In addition to harming native mussels, they harm many other native species as well. They consume needed nutrients, and impede the lifestyles of many food sources for fish, leading to a decline in overall fish health. These mussels also have a unique way of filter feeding, in which they accumulate bio organic pollutants by up to 300,000 times more than the water (Hoddle). This accumulation of contaminants works up the food chain, killing predators that consume these mussels, even reaching humans at the top of the food chain as well ('Lake Michigan Lakewide Management Plan'). The presence of these mussels also leads to growth of cladophora algae and type E botulism. These bacteria types can lead to great nutrient enrichment and eutrophication, and also avid avian death. The lists go on and on about the chain of negative effects caused by these

invasive species. In addition to ecological issues, they are a real nuisance to humans as well. Their disruption of the food web greatly affects fish populations, which in turn affects the fishing industry in regards to quantity of fish available and quality of fish that are consumable. They also multiple and grow within man-made structures like pipes, boat motors, docks, and more. If they progress into water intake pipes it cloggs them and leads to higher need for maintenance uptake. Electric barriers exist at the entrances of the great lakes to address water related issues detected traces of asian carp, yet another aquatic invasive species. The asian carp out compete native species for limited resources, yet again negatively impacting the food web. Asian carp are yet another notorious invasive species in the US. The Chicago Area Waterway System connects the Mississippi to the Great Lakes and poses the highest threat of introducing asian carp into this watershed. Often, they feed on native mussels, which are already greatly threatened from the zebra and quagga mussels. Their eating/ lifestyle patterns also are notorious for disrupting natural ecosystems. The carps are not yet as great of an intrusion in the watershed, but preventing this intrusion is key. Invasive plant species also have the same over-competitiveness in respect to native species. Native plants are also an integral part of a watershed, as they play a role in shoreline maintenance, wetland structure, and overall water quality. Native plants also help give ecosystems a reasonable buffering capacity against stresses in the environment. Native plants play a big part in water quality and nutrient retention, and invasive plants hurt this process. The common reed and reed canary grass are two examples of invasive plant species harming ecosystems in this watershed. These plants can grow quite large and dense with extensive rooting, and are difficult to eradicate. They out-compete native species, reducing biodiversity, which leads to altered natural wetlands and coast-lines. They are hard to deal with and make mitigation efforts for wetlands and coasts hard to combat. A slew of other invasive species threaten this watershed, but these in particular have had significant detrimental effects on the watershed. The issues relating to the species of a watershed seem to pertain to the other issues we've examined in this plan in some way. Preventing further intrusion and attempting to restore native species will have a cascade of effects that will also lend help to other watershed issues.

Boosting native species, and working to fight invasive species will have a cascade of positive effects for the watershed. Prevention is a big component of protecting watersheds, and advising the public is of the utmost importance. Invasive species are most likely not going to be entirely eradicated, but this inevitability should not deter community members from working to prevent further encroachment and doing their best to fight these species. While they most likely cannot be entirely erased from an ecosystem, invasive species must be maintained as to protect the watershed as best as possible, and that is what CALM suggests. Zebra and quagga mussels are extremely hard to combat once they've entered an ecosystem, which adds to the reasoning they're some of the most invasive. It is estimated that the US spends $500 million a year managing zebra and quagga mussels (Hoddle). We suggest watershed management strategies implement the use of EPA approved pesticides that target these mussels. EPA has approved molluscicide and Zequanox, both have been tested and show a significant impact on the population of mussels. The chemicals are safe for most other aquatic species as well, so we recommend implementation of these chemicals where scientists feel the threat is most severe. Since the use of these chemicals is still new, we suggest using in a trial and error basis, as opposed to fully distributing throughout the watershed as to minimize potential risk. We suggest any pipe structures in contact with great populations of these mussels must also be regularly checked in case further actions must be taken to remove and replace. In addition, we suggest the watershed governance employees work along with the Coast Guard which is currently investigating more effective ways to dump ballast water. Proper disposal of ballast water is an important component of preventing carrying non-native species to new ecosystems (‘Invasive Species’).

Preventing asian carp invasion is a significant goal as well for CALM, so as to prevent any further watershed quality depletion by invasive species. We strongly advise avid upkeep for the existing electrical barrier fences that exist in the Chicago Sanitary and Ship Canal (‘CHICAGO DISTRICT’). Since some carp have already been able to pass through these barriers, we encourage continued observation and maintenance on these structures in order to maximize their efficiency. USGS is working to develop Asian carp targeted pesticides, and we would suggest policy-makers for this watershed support and follow up with the developments of this chemical. In a case of possible encroachment by the carp, a swift action through hunting or poisoning could prevent a serious invasion. There have also been efforts made to reintroduce native species, and we strongly suggest the continued efforts made by ecologist to restore what they can of natural ecosystems. The native sturgeon has been successfully reintroduced, and we suggest continued reimplementation of those feasible species that have been out-competed by past native species. “The challenge is to protect water quality and habitat to turn these isolated successes into a basin trend” was stated in the 2010 Lake Michigan Lakewide Management Plan, and we hope by 2035 at least one more native species is boosted population-wise in the watershed (‘Lake Michigan Lakewide Management Plan’).

Many invasive plants must be managed in steps. Often they are chemically treated and then physically managed after the initial treatment. Burning is also a control method for larger concentrations of plants, and smaller spot areas are treated with herbicide and mowing. This is done typically on public land by trained professionals, in order to minimize harming any native species. Watershed community members outside of the lake or wetlands also have the ability to obtain permits in order to combat these pests on their own property. Many community members are unaware of invasive species on their property, so we recommend that on top of educating the public about these plants, the community leaders provide an incentive for citizens to manage the species as well. Incentivizing the public is already a strategy, as much of the monitoring of aquatic invasive species is done on a volunteer basis. The easier it is for the public to obtain information, permits, and adequate materials, the more colonies of invasive species can be managed. Technology and methods are always changing, and while at the moment the eradication of invasive species seems impossible, we stress that better treatment methods may someday be plausible and to continue to invest in research.

Education and community action is overall very important in protecting watersheds from further invasion. We suggest that boaters are advised to frequently check for any unwanted passengers in or attached to their vessels. It must be stressed to the public the importance of actively cleaning their water recreation tools so as to prevent transporting a species into a new environment where it could invade. In the coming years, CALM has the goal that any local marinas/docks provide this information to its users. It is also important that community members are informed of what species are a threat to their watershed, and how to fight them. We recommend that upcoming water quality reports include specific information about invasive species and how to adequately deal with them. While invasive species require long-term maintenance, each individual can perform short-term actions in order to better their watershed. CALM's main goal dealing with invasive species is to ensure their population and encroachment do not grow any larger. The species in a watershed have a great impact on the overall quality, and CALM emphasizes the active work towards managing these species in order to better manage the watershed as a whole.

Example of advisory warning for invasive species

Goals and Possible Solutions

There are many possible solutions to these issues threatening the Root-Pike Watershed.

Issue	Possible Solution 1	Possible Solution 2	Possible Solution 3
Water quality	Investment in water infrastructure	Dredging Sediments	Community efforts
Shoreline Erosion	Bioengineering	Reconstruction	Buffer Strips
Invasive species	Implementation of chemical and physical combative methods	Community efforts, education, and incentives	Reintroduction and support of native species

Conclusions

The introduction of invasive species in the Root Pike Watershed has negatively affected the overall health of the watershed. Overcompetitvity coupled with the altering of natural ecosystem tendencies has reduced water quality, biodiversity, and aquatic specie health. Maintaining current preventative measures like the electric barrier, utilizing new chemicals and management techniques, and regular monitoring can help to ensure the invasion of non-native species does not escalate any further. Encouraging and incentivizing community members to participate in the ongoing battle against non-native species is also a goal of CALM as well. Another goal of CALM is to reduce the problem of erosion by restoring and maintaining healthy bank conditions, which require decreasing erosion of streambanks, streambeds, riverbanks, and shorelines. This can be done through bioengineering of plants and plant matter to bolster bank strength and make more durable to anthropogenic influences and flooding. Another goal is to reconstruct areas affected by flooding and erosion with buffer strips where appropriate and financially logical in order to reduce effects of flooding and prevent further erosion. E coli and PCBs create significant water pollution problems in the Lake Michigan Watershed. To combat these issues CALM should invest in water filtration infrastructure, contaminated sediment disposal, as well as efforts in the greater community to reduce pollution into the watershed.

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